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MEMORIAL SESSIONS

110-ЛЕТИЕ ПОЧЕТНОГО ГРАЖДАНИНА ГОРОДА-ГЕРОЯ ОДЕССЫ, ОСНОВОПОЛОЖНИКА ОТЕЧЕСТВЕННОГО РАКЕТНОГО ДВИГАТЕЛЕСТРОЕНИЯ, ДВАЖДЫ ГЕРОЯ СОЦИАЛИСТИЧЕСКОГО ТРУДА, АКАДЕМИКА ВАЛЕНТИНА ПЕТРОВИЧА ГЛУШКО

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«В Одессе есть какой-то фермент жизни. Помню, – рассказывал Глушко, – после какого-то из торжественных приемов в Кремле подошел ко мне Жора Добровольский и говорит: «Валентин Петрович, по паспорту мы – москвичи, но никогда не должны забывать, что сюда нас послала Одесса». Глушко вспомнились эти слова, когда Добровольский повторил в своем (кто мог тогда предположить, что последнем?) интервью, облетевшую весь мир фразу: «Одесса нас не забудет!».

Грустный юбилей.

Одесса встречает каждый год «День Космонавтики» без музея Космонавтики, без памятника С.П.Королеву, и перенесенным памятником с Приморского бульвара на проспект Глушко (Киевский район, Киевский овощно-фруктовый-хозяйственный рынок) почетного гражданина Одессы, дважды Героя, но с амбициозными планами.

Валентин Глушко – главный конструктор жидкостных ракетных двигателей – ЖРД.

В середине 1970-х г.г. Валентин Петрович Глушко написал: «Счастлив тот, кто нашел свое призвание, способное поглотить все его помыслы и стремления, заполнить всю его жизнь чувством гордости творческого труда. Дважды счастлив тот, кто нашел свое призвание еще в отроческие годы. Мне выпало это счастье. Жизненный путь, выбор решений на крутых поворотах, каждодневные поступки – все подчиняется одной мысли: приблизит ли это к заветной цели или отдалит?...»

Церковь Рождества Богородицы в одесском предместье Слобода – 14 сентября 1908 год – крестили Валентина.

Отец – Петр знакомится с Матроной Семеновной, ставшей законной женой и матерью троих детей – Галина (1907 г.рождения), 1908 г. сын Валентин (основоположник отечественного ракетного двигателестроения), 1915 Аркадий.

В 1917 году семья временно проживает в Киеве, в 1919 году семья возвращается в Одессу, поселяется в

квартиру № 15 дома 12 по Овчинникову переулку (ныне пер. Нечипоренко).

В автобиографии Валентин Глушко пишет: «... в Одессе я родился и провел половину детства, на Ольгиевской, 10. А в 1921 г. переехали в соседний дом № 10. Но и тогда трехкомнатная квартира с комнатой для прислуги не спасала. Места для семьи из пяти человек все равно было очень мало».

В 1919 году Валентин Глушко зачислен в реальное училище св.Павла, переименованное в IV Профтехшколу «Металл» им. Троцкого. В 1924 г. В.Глушко закончил училище.

Сергей Королев – основоположник практической космонавтики (Сергей Королев родился 12 января 1907 года) жил на Платоновском молу в порту, Валентин Глушко – на Ольгиевской улице. Вряд ли они встречались где-нибудь, во всяком случае, ни тот, ни другой не помнят такой встречи, а тут еще разница в возрасте: Валентин был на целых два года моложе, в детстве это огромная разница. Да и устремления у двух этих одесских мальчишек были разные: Сергей увлекался авиацией, Валентин – астрономией.

Работает в обсерватории в юношеском кружке при одесском отделении Русского общества любителей мироведения (РОЛМ), ведет наблюдения Марса, Венеры, Юпитера. С 1923 по 1930 годы состоял в переписке с К.Э.Циолковским.

Валентин Глушко поехал (1925 г.) в Ленинград, поступать в университет. В результате первый год ему пришлось прослушать в качестве вольнослушателя и, сдав все экзамены, быть зачисленным сразу на второй курс физического отделения физико-математического факультета.

Дипломная работа состояла из частей:

- проект межпланетного корабля «Гелиоракетоплан»,*
- электрические ракетные двигатели,*
- металл как взрывчатое вещество.*

15 мая 1929 года В.П.Глушко зачислен и рекомендован начальником отдела ГДЛ (газодинамическая лаборатория).

В 1934 году ГИРД (группа изучения реактивного движения) и ГДЛ были объединены в Реактивный научно-исследовательский институт (РНИИ).

Переезд в Москву (1934 г.). Перед В.П.Глушко встал очень серьезный выбор: чем ему заниматься в дальнейшем, ведь в ГДЛ он занимался не только разработкой ОРМ'ов (опытных ракетных моторов), но еще и ракетами РЛА-1, РЛА-2, РЛА-3, РЛА-100.

Писал: «...нужно было выбрать и я выбрал то, с чего начинается ракетная техника, то, что лежит в ее основе, определяет ее возможности и лицо – ракетное двигателестроение...». Продолжает работу по созданию более мощного ракетного двигателя, ОРМ-52, ОРМ-65. Работал над ОРМ-65 до 1937 г., был

представлен к правительственной награде – ордену Трудового Красного Знамени, получить который не смог из-за своего ареста.

В 1937 году во время массовых репрессий арестовали и расстреляли создателей и руководителей Реактивного научно-исследовательского института. В марте 1938 г. Глушко также подвергся аресту и получил срок восемь лет.

В тюрьмах создавались конструкторские бюро, которые назывались «шарашками». В одной из них продолжил свои исследования и Глушко.

Марта Семеновна (мать В.Глушко) предприняла несколько попыток освободить своего сына. Она ходила в НКВД и пыталась добиться его освобождения. Кроме того, ей было написано два письма в адрес И.В.Сталина с просьбой о пересмотре дела. В этой обстановке, в ожидании изменений в лучшую сторону, мать и отец пишут письма.

«...Вашему затруднительному положению сочувствуем и можем только посоветовать вооружиться терпением. Нам кажется, что Вашему терпению конец не далек. Валентин [Валентин Петрович Глушко – академик, основатель НПО Энергомаш] вот-вот должен быть дома, а с выходом его Ваше положение изменится, безусловно, в лучшую сторону. Хотя бы материально. Желаю всего хорошего. Привет от М.С. Целуйте от нас дочурку. П.Глушко. Ленинград «22» Пр. К.Либнехта № 79, кв. 23 Петр Львович Глушко»

«...еще раз повторяю, что рада за вас. Увидите Валу (но вряд ли, он в Казани), целуйте его и желаю вам всего хорошего совместного счастья. Не известно увидимся ли мы...»

«...Адрес: почтово-полевая станция № 791, 71 О.Б.С., А.П.Глушко. Адрес тети Кили Семеновны Косых вы ее знаете: Одесса, Ольгиевская ул., д. № 10, кв. 10 Целую крепко, Марта Семеновна Глушко». На письме стоит штамп: «Проверено военной цензурой».

«5/VII-44 г. «Дорогие дети! Тамарочка и Женечка, и Валя! Писали мне из Марьяновки, что Галю (сестра) угнали немцы и Тедика [Идентифицировать не удалось.] тоже. Из Одессы ответа нет. Наверное, погибли. Радовалась и строила планы, когда Валя придет и будет полное облегчение, а получается все задержка и волынка. Костилов [Андрей Григорьевич Костилов – лжеавтор «катюши», виновник арестов И.Т.Клейменова, Г.Э.Лангемака, В.П.Глушко и С.П.Королева.] один или и Пойда [Федор Николаевич Пойда – сотрудник НИИ-3.] несут должное наказание?! Пусть попробуют, но только та разница, что они заслужили...».

В тот день, когда следующее письмо было послано в Казань, Валентин Петрович был освобожден из заключения, но его близкие об этом еще не знали.

Позже Валентин Глушко охарактеризует А.Г.Костилова следующим образом: *«Костилов не был ни ученым, ни учеником или последователем Циолковского, а был порождением мрачной эпохи культа личности...»*

В 1946 г. И.В.Сталин вызвал В.П.Глушко к себе и предложил возглавить работы по созданию ракеты в целом, на что будущий академик ответил отказом, сказав, что хочет заниматься двигателями. Тогда генсек спросил у гордого одессита (как И.В.Сталин называл В.П.Глушко), есть ли у конструктора кандидатура на это место, и вчерашний зэк, не задумываясь, ответил: *«Есть такой человек... Его имя Сергей Королёв...»* Так С.П.Королёв был назначен на ту должность, на которой проявил себя во всем блеске своего организаторского таланта.

С.П.Королёва по просьбе В.П.Глушко уже вызволили из Колымы, и он с конца 1942 г. работает с ним в Казани

в качестве заместителя главного конструктора СпецКБ НКВД по летным испытаниям. Занимается установкой самолетного ускорителя РД-1 конструкции В.П.Глушко на самолет и его заводскими испытаниями.

8 апреля 1988 г. Валентин Петрович Глушко свалился с инсультом, отвез его в больницу, из которой он уже не вышел живым.

За полтора месяца до смерти стартовала «Энергия» с «Бураном». В репортаже об успешном старте и посадке назвали имена всех, кроме Генерального конструктора В.П.Глушко. Это стало самой последней каплей. В результате 10 января 1989 г. в 23 часа 35 минут его сердце останавливается после двух суток комы.

Все трое прошли через Одессу и это прошлое их сблизало. Г.Э.Лангемака с В.П.Глушко, В.П.Глушко с С.П.Королёвым. Пока В.П.Глушко и С.П.Королёв дружили, все летало и все было, но как только поссорились... новая ракета С.П.Королёва (Н-1) никуда не полетела...

А В.П.Глушко и С.П.Королёв на протяжении 33 лет были вместе, и никто не вправе разделять их после смерти!

NIKOLAY S. KOMAROV AND DEVELOPMENT OF SPECTROSCOPY AT ODESSA ASTRONOMICAL OBSERVATORY

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Nikolay Sergeyevich Komarov, being one of the founders of the School of Spectroscopy, formed the Department of Astronomical Spectroscopy at the Astronomical Observatory of Odessa State University. He defended his Candidate of Science (PhD) thesis on the kinematic and morphological properties of stars with enhanced metal lines in 1968, and his doctoral dissertation on the structure of the atmospheres of cool giants in 1989.

The main fields of research activities of Nikolay S. Komarov covered a wide range of issues, such as absolutised relative energy distributions in the spectra of late-type stars; spectral classification of giant stars; analysis of the coefficient of radiation blocking by atomic and molecular absorption lines; fundamental characteristics of stars (including effective temperature scale, absolute magnitudes, bolometric corrections and gravitational acceleration); structure of atmospheres of cool stars (including thermochemical equilibrium; methods of synthetic spectra calculation making allowance for the molecular absorption; elemental abundances); non-LTE spectra calculations; metallicity gradient of the Galactic disc; isotopic and neutron-capture element abundances; dust formation in the upper atmosphere of giants.

Apart from his scientific studies, Nikolay S. Komarov was engaged in the projects financed by extra-budgetary funds; in particular he headed projects on 52 research topics that allowed of the development of different areas of the observatory's activities. Nikolay S. Komarov was a co-organiser of the All-Union workshops "Stellar Atmospheres" and "Spectrophotometric Standards".

The research findings of Nikolay S. Komarov were reported in 160 scientific papers and three monographs. Among his students and mentees, there are 12 candidates and several doctors of physical and mathematical sciences.

PLENARY SPEAKERS

ADVANCED METHODS FOR TIME SERIES ANALYSIS OF IRREGULARLY SPACED DATA

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We review some algorithms and programs for the data analysis of signals with generally irregularly spaced arguments and some highlights of application to 2000+ variable stars of different types. Although there are many different methods for time series analysis the majority of applications are based on simplified formulae which are valid for restricted cases with some additional requirements. These are typically the regularly spaced arguments (i.e. data with a constant time resolution). This is important e.g. for the ACF analysis (including ARMA and related models) analytical expressions for orthogonal functions for the discrete Fourier transform (DFT) one needs an additional requirement that the length of the time series is s period multiplied by an integer. For the FFT one needs a specific number of data equal to 2^K (K is a positive integer) and, if not, the missing values are arbitrarily set to a sample mean value. This may cause aliases at the power spectrum. For this reason, we use a complete set of correct formulae for the (weighted) least squares (LS) instead of the simplified expressions, which are valid only under specific restrictions to the data arguments [1,2]. These formulae are realized in the software “Multi-Column View” (MCV) for multi-harmonic multi-period (up to 3 periods) fits with taking into account a possible (algebraic polynomial) trend. Taking into account a bias of the results of “prewhitening” in a general case of irregularly spaced data, we introduced a multi-harmonic periodogram analysis with simultaneous determination of a (polynomial) trend. The preliminary values of period(s) may be improved using “differential corrections” (DC). This is especially important for studying superhumps at descending branches of the light curve after outbursts, as well as for some semi-regular variables with slow variations. The error estimates of all parameters are computed, allowing checking statistical significance of model parameter [3]. In MCV, we also realized the method of “artificial comparison star” for improving the accuracy of the CCD photometry. This improves the methods of a “mean” comparison stars with equal weights (e.g. MaximDL) or “ensemble photometry”. Even a first application of the method was resulted in a discovery of a new variable star [4]. The improvement of the wavelet analysis [5] leads to significant noise reduction at the wavelet map and mean periodogram. This technique is based on the extension of LS for additional 2D weight function for arbitrary basic functions and introduction of the “scalegram analysis” for QPO of very low coherence using “Running Parabolae” (RP) [6]. For nearly-sinusoidal oscillations, the “Running Sine” (RS) is proposed, the applications of which were reviewed [7]. Recent complementary comparative studies of phenomenological modeling of symmetric and asymmetric extrema are presented in [8,9]. These studies are part of the “Inter-Longitude Astronomy” (ILA) [10] and “Astroinformatics” [11].

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VENTSPILS INTERNATIONAL RADIO ASTRONOMY CENTRE: VIEW FROM PAST TO THE FUTURE

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Ventspils International Radio Astronomy Centre (VIRAC) of Ventspils University College was established in 1994 with the aim to develop the research activities in radio astronomy and astrophysics. The most important instrumental base for the centre comprised two fully steerable parabolic antennas, RT-16 and RT-32 (i.e. with the mirror diameter of 16 m and 32 m). The intensive reconstruction and instrumental refurbishment carried out in 2014 – 2017 made it possible to use radio telescopes for the international scale fundamental and applied research in the field of radio astronomy. The most important aspect of this work is participation in the VLBI (Very Long Baseline Interferometry) international experiments. In last years radio telescopes were instrumented with new state-of-art broadband cryogenic receivers for frequency range of 4.5 – 8.8 GHz and a set of modern data recording and data processing equipment has already been assembled.

One of the main scientific objectives for the VIRAC Radio astronomical observatory is VLBI observations in centimeter and meter wavelengths in collaboration with the global VLBI networks, such as European VLBI network (EVN), RadioAstron, LOFAR, IVS and others. The new receiving and recording systems provides a high stability of the time frame, which is prerequisite for the VLBI observations. Since October 2015 VIRAC radio telescopes in regular way took part in international VLBI sessions.

In its fast evolution, the VIRAC does not stop only on radio astronomy and astrophysics, and today the institute also encapsulates strong scientific groups in remote sensing, satellite communication, satellite development and high performance computing. Main institute target is to become a global research service provider in the field of space technology research, thus speeding up the international growth of companies in the engineering industry in Latvia and Ventspils. VIRAC is carrying out this task by providing research and research services of high quality and client driven approach, in close cooperation with Ventspils University College and other RTD organizations and companies with similar aims.

GRAVITATIONAL LENSING AND BLACK HOLE SHADOW

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An overview of the developments in problems of the effects of gravitational lensing is given, including plasma influence. Deflection of light in the presence of gravity and plasma is determined by a complex combination of various physical phenomena: gravity, dispersion, refraction. In particular, the gravitational deflection itself, in a homogeneous plasma without refraction, differs from the vacuum one and depends on the frequency of the photon. In an inhomogeneous plasma, chromatic refraction also takes place. We describe chromatic effects in strong lens systems including a shift of angular position of image and a change in magnification.

The shadow is defined as the region of the observer's sky that is left dark if there are light sources distributed everywhere but not between the observer and the black hole. For constructing the shadow all past-oriented light rays are considered, that issue from a chosen observer position.

NEW IN X-RAY AND GAMMA-RAY ASTRONOMY

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In tightly related binary systems with a red giant and a neutron star in super strong magnetic fields the recombination X-ray radiation arises on H-like Si XIV produced 3.55 keV $L\alpha$ line. This process may realize on other H-like atoms during them recombination. They are: C VI, N VII, O VIII, Ne X, Mg XII, S XVI, Ca XX и Fe XXVI. On more high energies, than 3.55 keV, structures X-ray (4.5 keV) may arise. The same takes place on less energy than 3.55 keV (3.51 keV). Realization of a recombination X-ray laser on these atoms is discussed. Owing to these X-ray lines magnetic fields of neutron stars in binary systems may be tested on any distance of our Universe. 3.55 keV line has not reliable explanation till now. Besides, we shall shortly discuss Schwinger's magnetic world of the early Universe and probable messengers from this world in gamma range.

DARK ENERGY AND THE BASIC STRUCTURES OF THE LOCAL UNIVERSE

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The building blocks of the Cosmic Web are 3D groups and clusters of galaxies, 2D superclusters and 1D filaments. These systems are observed on both global and local spatial scales. All of them are embedded in the omnipresent dark energy background. We study the nearest 3D expansion flows around the groups (the Local Group and several similar groups) and the Coma and Virgo clusters; 2D Zeldovich Local Pancake; and 1D Sculptor Filament of galaxies. The HST recent accurate data on these systems are

provided by Karachentsev and his co-workers. A computer model is constructed for each of these systems, and the whole set of the models reveals their common feature: in all the systems, independently of the geometry dimensions, the dark energy anti-gravity is stronger than the self gravity of the galaxies. Because of this, the objects expand with acceleration tending asymptotically to the Hubble linear velocity-distance relation. Now it may be assumed that this feature is characteristic for all the systems that form the Cosmic Web on both local and also global spatial scales everywhere in the Universe.

POSITRON SPECTROSCOPY OF ACTIVE GALACTIC NUCLEI

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This paper focuses on the interpretation of radiation fluxes from active galactic nuclei. We have demonstrated the advantage of positron spectroscopy over other methods of spectral diagnostics of active galactic nuclei. We found a correlation between regular and random components in both bolometric and spectral composition of fluxes of quanta and particles generated in active central regions of galaxies. We have considered their diffuse component separately, and also have detected radiation responses after the passage of high-velocity cosmic rays and hard quanta through gas-and-dust aggregates surrounding massive black holes in active galactic nuclei. Relativistic positrons and electrons passing through such complex systems generate secondary emission throughout the volume of active galactic nuclei, which results in their visible fluorescence across all spectral bands. We obtained radiation and electron energy distribution functions depending on the spatial distribution of the investigated volume of matter in active galactic nuclei. Radiation responses typical for such media were divided into those of atoms, molecules and dust. We have plotted luminosity diagrams for gas-and-dust aggregates of a given volume with given reference chemical compositions which are essential for studying active galactic nuclei.

DEVELOPMENT OF THE METHOD OF APERTURE POLARIMETRY IN THE CRIMEAN SCHOOL: INSTRUMENTS, TECHNIQUES AND SOFTWARE

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The work presents and analyzes methods for measuring the polarization of radiation at different times used in the Crimean Astrophysical Observatory using the telescopes from 40 cm or more.

The advantages and disadvantages of one and two-beam method, and the conditions which led to the choice of a single-beam method with the rapid rotation of the analyzer.

A more effective method of measurement with medium-sized telescopes is proposed, which lacks the disadvantages of the above methods. Preliminary criteria for choosing a measurement method using modern optical and light-receiving equipment are proposed.

YOUNG OBJECTS OF THE GALAXY: LITHIUM AND BIMODAL CLASSICAL CEPHEIDS

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Tracking lithium in supergiants and Cepheids presents a great interest as it indicates either a young object or a specific evolutionary path. It is however a difficult task as until recently, Li was found in only a very small number of these stars, namely Milky Way supergiants and two Classical Cepheids. We report the discovery of two new super-Lithium rich Cepheids which have a Lithium abundance of $\log A(\text{Li}) \approx 3.3$ dex (ASAS 075842–2536.1 and ASAS 131714–6605.0). Also ASAS 131714–6605.0 is the first O2/O1 Super-Lithium rich Bimodal Cepheid.

We determine the metallicity and detailed chemical abundances (alpha-, iron-peak and neutron-capture elements) for the almost complete (19/24) sample of Galactic beat Cepheids Beat Cepheids are Cepheids that pulsate in two modes simultaneously. We calibrate a new relation between their metallicity and their period ratio $P1/P0$. This linear relation allows to determine the metallicity of bimodal Cepheids with an accuracy of 0.03 dex in the range of $[\text{Fe}/\text{H}]$ from +0.2 to –0.5 dex. By extrapolating the relation to Magellanic Clouds beat Cepheids, we provide their metallicity distribution function. Moreover, by using this relation, we also provide the first metallicity estimate for two double-mode F/IO Cepheids located in and beyond the Galactic bulge.

The period ratio of F/IO Cepheids allows for a reliable determination of the metallicity gradient in the Milky Way, and in turn, in other systems that would be difficult to reach via classical spectroscopic methods. Using the GAIA DR2 parallaxes for the F/IO Cepheids, we can derive the metallicity gradient in the Milky Way disk. We find a slope of -0.045 ± 0.007 dex/kpc. These result is in very agreement with previous determinations of the $[\text{Fe}/\text{H}]$ gradient in the disk based on classical Cepheids.

SEMI-REGULAR VARIABLE STARS

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The aim of the work is to provide an overview of information about the stars at the asymptotic giant branch (AGB) with a semi-regular (SR) type of variability. A

detailed description of their mean observational characteristics and features of some individual objects is given [1, 2, 3, 4]. We give a review of the most important works in the history of study of these stars concerning classification, evolutionary stage, photometry, multi-pulsating, maser emission, mass loss, statistic investigations, study of kinematic characteristics etc. [5].

Given that the class of semi-regular variable stars is highly heterogeneous in composition relative to age, mass, and stellar population, an attempt is made to order objects within the type of semi-regular variable stars [6].

The most interesting problems regarding semi-regular variable stars are specified. So, for example, the observations of variable supergiants (SRc) with the aim of identifying stars which are at different stages of transition to Mira-type stars, the pulse mode switching stage, etc. [6, 7]. The various methods of statistical research are considered, for example, the application of periodogram and wavelet analysis to the study of the multiperiodicity of semi-regular giants and supergiants based on the observations from the databases of the French Association of Variable Stars Observers (AFOEV) and Variable Stars Observers League of Japan (VSOLJ), American Association of Variable Star Observers (AAVSO) [8, 9].

Some attention is given to stars of the RV Tau type.

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SUPER-STRONG MAGNETIC FIELDS IN ACTIVE REGIONS ON THE SUN: HISTORICAL ASPECT AND NEW OBSERVATIONAL DATA

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In our report we focus on the existence of super-strong magnetic fields on the Sun, i.e., fields that exceed the well-known and the most often observed field intensities of 2-3 kG measured inside sunspots. Suggestions that very strong fields of order of 10^4 G might exist were repeatedly voiced in the past (e.g., Severny, 1957, Bruce, 1966, etc.), however these reports were related to sunspots and solar flares. These new observational effects allowed an alternative interpretation and called for new studies based on spectro-polarimetric data.

Direct evidence of super-strong fields in flares were obtained using observations in Fe I lines with very low

Lande factors of about 0.01 (Lozitsky, 1993, 1998, 2015). It was shown that during flares Stokes $I \pm V$ profiles of some of these lines, e.g., FeI 5123.723 and FeI 5434.527 Å, sometimes exhibit in their cores narrow and splitted emission peaks. If this splitting is to be interpreted as manifestation of the Zeeman effect, than the corresponding magnetic field strength should be about 20-90 kG. Spectral manifestations of about 8 kG fields were also found in the sunspot umbra (Lozitsky, 2016; 2017). The filling factor of these fields may reach 0.2–0.3 here, and the relative Doppler velocities may range from -1.7 to -3.1 km / s (plasma upflows).

If such extremely strong fields really exist, they should be very small-scale (likely, spatially unresolved in majority of cases) and should produce characteristic weak spectral manifestations in full vector of Stokes $\{I, Q, U, V\}$ parameters. In this respect, new observations using highest resolution instrumentation like the Goode Solar Telescope (GST) operating at the Big Bear Solar Observatory (BBSO) are needed.

Here we present a study of a solar active region (AR) made using the Near-Infrared Imaging Spectro-polarimeter (NIRIS) of GST. Observations were made in FeI 15648.54 Å line ($g_{\text{eff}} = 3.0$). As it was reported recently, very strong 5.5 kG transversal fields were found in this region (Wang et al., 2018). Our investigation is focused on very weak spectral effects located at distances 2.0-3.1 Å from the line center where spectral contributions of yet stronger fields could exist. Our preliminary results are as follows: (a) some locations in the AR exhibited polarization effects typical for the Zeeman effect corresponding to magnetic fields of about 8 kG of opposite magnetic polarity and plasma downflows with velocities of 2-4 km/s; (b) we also found noticeable depressions in the Stokes profile I , but with no polarization signal in the corresponding spectral features. At the moment we do not know what is the nature of these depressions: they can either be caused by spectral molecular blends, or correspond to some special cases of the Zeeman effect.

Such very strong fields cannot occur in the simplest case of an untwisted magnetic flux tube. Stronger fields should exist in the form of twisted force-free magnetic structures. It was shown that a theoretical interpretation of the super-strong magnetic field phenomenon can be possible within the framework of a linear force-free model (Soloviev and Lozitsky, 1986). This model is described by Bessel's functions J_0 and J_1 of zero and first orders and has a multipolar periphery and magnetic field up to $<10^4$ G with discrete values near the tube axis. For a field of 10^4 G, a large number of discrete layers with opposite magnetic polarity are needed inside one small-scale structure. The probable existence of such many-layered and very strong fields presents a very important problem for modern solar physics.

EXTREME SOLAR FLARES BY THE DATA ON "ANCIENT" PROTON EVENTS

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One of serious challenges to the problem of radiation hazard in space is a lack of a clear, unambiguous relation between the fluxes (fluences) of relativistic SCR and non-relativistic SEPs. Modern concept of Extreme Solar Event (ESE) is critically analyzed based on available direct and

proxy data on solar cosmic rays (SCR), or solar energetic particles (SEP). Special attention is paid to recent debate on validity, origin and properties of the events AD1859 (Carrington event, CE) by nitrate method and AD775, AD994 and 3372 BC by radionuclide data. We demonstrate that, in spite of existing uncertainties in proton fluences above 30 MeV, all of them are fitted well by a unique distribution function, at least, with present level of solar activity. Extremely large SEP fluxes are shown to obey a probabilistic distribution with a sharp break in the range of large fluences (or low probabilities). The studies of this kind may be extended for the periods with different levels of solar activity in the past and/or in the future. Considering the recent confirmation of super-flares on solar-type stars, this issue merits attention.

RELATIVE WAVELENGTHS INDEPENDENCE OF IR LAGS IN NGC 4151 DURING 2010-2015

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We investigate the correlation between infrared (JHKL) and optical (B) fluxes of the variable nucleus of the Seyfert galaxy NGC 4151 using our partially published data for 2010-2015. Here we are using the same data as in Oknyansky et al. (2014 a,b), but include also our new optical data and published optical and NIR photometric data from Schnuelle et al. (2015). We find that the lag of flux in HKL have the same 37 ± 3 days lags relative to optical variations. Variability in the J and HKL bands is not quite simultaneous, perhaps due to the differing contributions of the accretion disk radiation in these bands. The lag found for the K band compared with the B band is not significantly different from earlier values obtained for the period 2000-2009. However, finding approximately the same lags in HKL bands for 2010-2015 differs from previous results at some earlier epochs when the lag increased with increasing wavelength. About almost the same lags in different IR bands are found very common feature for active nuclei (Oknyansky et al., 2015). In the case of NGC 4151 it appears that the relative lags between the IR bands may be different in different years depending from variations of luminosity state. The available data allow us to investigate a possible change in the lags during the test interval. We don't confirm significant change of time lags for JHL in 2013-2014 which was found by Shenuelle et al., but we found that the AD component with the short time lag in J is became more significant during 2013-2015.

We discuss our results in the framework of the standard model where the variable infrared radiation is mainly due to thermal re-emission from the dusty clouds closest to the central source. There is also a contribution of some IR emission from the accretion disk, and this contribution increases with decreasing wavelength. The absence of the variations and wavelengths independence of the IR (HKL) lags can be explained by location of dust clouds farther than dust sublimation can be happen during 2010-2015. Another possibility to explain near simultaneity of the variability from the near-IR to the mid-IR is that the hot dust is in a hollow bi-conical outflow of which we only see the near side (Oknyansky et al., 2015).

SPATIAL-TEMPORAL PERTURBATION OF THE GEOMAGNETIC FIELD OF CERTAIN TERRITORIES IN THE NORTHERN AND SOUTHERN HEMISPHERES OF THE EARTH: ECOLOGICAL ASPECT

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The article considers the spatiotemporal perturbation of the geomagnetic field for regions of high and middle latitudes of the northern and southern hemispheres of the Earth. For this purpose, the module for induction of the geomagnetic field of Ukraine, Yamal (Russia) and near the Ukrainian Antarctic station "Academician Vernadsky" was analyzed for the period from 1950 to 2015. Essential spatial changes in the geomagnetic field are shown. So, for the 2010 epoch for the territory near the station "AB" the modulus of the induction vector B_{AB} is on average by 10 000 nT less than its value on the territory of Ukraine and 20 000 nT – of Yamal. That is why significant temporal changes of the geomagnetic field were revealed: its increase by 1,500 nT for Ukraine and Yamal and a decrease by 6,500 nT in the area of the station "AV". An ecological evaluation of the geomagnetic field was carried out.

DETAIL MORPHOLOGY OF THE GALAXY CLUSTERS

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The improved scheme of the morphology of galaxy clusters is present. The classical schemes base to one of several possible properties: viz shape, richness, luminosity, Hubble mix, dominant galaxy types, etc. However, the presence of substructures in the clusters was not examined exclude linear ones in Rood & Sastry approach.

Adapted morphological scheme bases on all galaxy clusters parameters and uses the numerical criteria. New approach allows to find different types of regular substructures besides linear ones, namely X-type (crossed bands) and Y-type (divaricated filaments) with corresponding positions and orientations of the bright cluster members; as well as curved strips and short chains without significant role of bright galaxies.

VARIABILITY OF SOLAR TOTAL IRRADIANCE AND OTHER INDICES OF SOLAR ACTIVITY AND THE EFFECTS OF THEIR MANIFESTATIONS IN THE SOLAR-TERRESTRIAL CONNECTIONS

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Analysis of the total solar irradiance (TSI) according to the satellite observations for the period from 1978 to 2017 was conducted using correlations and Wavelet analysis.

Systematization of solar activity indices was held out that represent physical characteristics based on data from cycles of discreteness and continuity, N-S asymmetry of wave and corpuscular manifestations. As such indices daily data was examined on total area groups of sunspots-Sp, Wolf numbers-W, "Spotless" index separately for the northern and southern hemispheres of the Sun.

Each of these indices shows properties of solar cycles that are not visible when you use their monthly and smoothed values for the full solar disk.

The properties of "visibility function" for indexes: Sp, W, total solar irradiance (TSI), and flux radio emission at 10.7 cm wave were considered. On this basis the substantiation of efficiency of their influence on the Earth was made.

Additionally we offer the records of Earth motion in orbit, when it turns out to be under the influence of activity of Northern, Southern hemispheres of the Sun or is in the plane of the equator. The result of the impact of solar activity on the Earth has a limited and selective character and can be determined according to the modified "geoeffectivity" indices.

SOLAR FACULAE: PHYSICAL CONDITIONS, LOCAL DYNAMO, ANISOTROPY OF MICROTURBULENCE

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Faculae are one of the types of characteristic magnetic formations in active regions on the solar disk in the visible range that affect the photospheric convection, the change of the brightness of the Sun and so on. In the paper we studied physical conditions and processes in atmosphere layers of a facula. According to the ground observations data of the center of the disk with high spatial resolution in the ionized barium line $\lambda 4554 \text{ \AA}$ and the line FeI $\lambda 1.56 \mu\text{m}$, a semiempirical 3D solar faculae model was constructed. It has been shown that magnetic field has significant influence on the photosphere convection: particularly, in the domains of strong magnetic field downstream flows of matter dominate, in regions with a moderate field the upstream flows prevail, the temperature inversion region is shifted into the upper layers, the correlation between the magnetic field (in the lower photosphere) and the temperature variations and radial velocities is practically absent (the results confirm the conclusions made earlier by R. Kostik).

In the photosphere layers of the facula, we detected an area in which the magnetic field is being amplified and internal and kinetic energy of the downstream flows transformed into magnetic field energy. And magnetic field energy is being transformed into the internal and kinetic energy for ascending flows. At the photosphere heights of the faculae there is significant field of unresolved velocities (microturbulence), and in the lower photosphere the microturbulence is isotropic, whereas in the upper photosphere layers and the layers of the lower chromosphere the microturbulence becomes anisotropic. The observed microturbulence is sensitive to the inclination of magnetic field lines. Anisotropy of microturbulence, in essence, serves as an alternative approach to existing methods for magnetic fields diagnostics using only I Stokes profiles.

BEHIND THE MILKY WAY AVOIDANCE ZONE: WHAT CAN WE RECOGNIZE BY DIRECT AND INDIRECT METHODS?

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The current notion of the Avoidance Zone of the Milky Way has changed significantly in the 1990s. If it was previously believed that this area closes an observer about 20% of the spatial distribution of galaxies in the optical range, which leads to an incomplete catalog of galaxies near the Galactic Plane, then this value is now about 10%. First of all, this was due to studies in the infrared and radio bands of the electromagnetic spectrum, since due to the decrease in the amount of light absorption with increasing wavelength, the avoidance zone becomes more transparent in these spectral ranges. In particular, in 1968, Maffei discovered two galaxies Maffei 1 and Maffei 2 in the avoidance zone using observations in the infrared range (see, Maffei, 2003). Now the IRAS and 2MASS surveys are actively used to solve these problems. Observations of the neutral hydrogen (21-cm) in frame of the DOGS project revealed the Dwingeloo 1 (Kraan-Korteweg et al., 1994) and Dwingeloo 2 (Burton et al., 1996) galaxies in this zone (see, for example, on the estimates of their kinematic and dynamic parameters, Huchtmeier et al., 1995; Buta et al., 1999; Karachentsev, 2005;). These discoveries were made by the so-called direct methods.

CMB measurements showed a 180 degree asymmetry known as dipole. It manifests itself in the heating of 0.1% of cosmic background radiation in comparison with the average in one direction and in the same cooling in the opposite direction. These measurements have been confirmed by the COBE (1989-1990) studies, which indicate that the Milky Way and its neighbors (the Local Group) are moving at a velocity of about 600 km/s towards the Hydra constellation. What is the reason for this movement, which manifests itself in a slight deviation from the homogeneous expansion of the Universe? The inhomogeneous distributed mass of matter in the Milky Way Avoidance Zone surrounding the Local Group may cause unbalanced gravity toward the Local Group in one direction. The expected velocity of the Local Group can be calculated by the sum of gravitational forces from all known LG galaxies (Karachentsev et al., 2013; Kashibadze et al., 2018). Despite the fact that the resulting vector lies within 20 degrees of the observed cosmic background dipole, the calculations remain highly ambiguous, partly because galaxies in the avoidance zone are not taken into account (Erdoğdu & Lahav, 2009). As is well known, this discrepancy between the direction on the dipole and the expected velocity vector made it necessary to introduce the concept of "attractors" (the Great Attractor at a distance of about 60 Mpc). The Local Group may be between the Great Attractor and located at the same distance above the Perseus-Fornax cluster (both of which are components of a long chain of galaxies known as the Supergalactic Plane).

Solving these tasks is possible through the use of indirect methods, including indirect estimates of averaged variables; methods of signal processing applied to obscured and incomplete data; methods of Voronoi mosaic, cluster and fractal analysis, machine learning (Kraan-Korteweg & Lahav., 2000; Vavilova, 2005; and others). In this way, the coordinates and masses of the clusters in the Puppis and in the Vela constellations were calculated, as well as the length of the Supergalactic Plane in the avoidance zone. The velocities of the galaxies near the two

edges of the avoidance zone are used to estimate the mass distribution in it, for example, the center of the Great Attractor was predicted to lie on a line joining the constellation Centaurus and the Pavo. These recovery methods, however, work only for large-scale structures in the avoidance zone; they are not sensitive to individual galaxies and small galaxy clusters; besides, extragalactic objects can be confused with the stars of the Milky Way.

Hence, till now the analysis of the spatial distribution of galaxies and their groups in the areas surrounding the Milky Way Avoidance Zone remains a complex and unresolved problem, as well as the estimation of the "invisible" content of the spatial galaxy distribution, which is obscured by this absorption zone. In the article, I will give a brief overview of works on solving this problem by direct and indirect methods, as well as I will consider possible methods for modeling the "invisible" spatial galaxy distribution behind the Avoidance Zone.

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HIERARCHICAL STRUCTURE OF THE UNIVERSE

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The modern understanding of the structure of the Universe is analyzed. The Solar system is considered as an ordinary planetary system. Further, neighborhood of the Sun is characterizes: from the nearest stars and their clusters to the structure of the Local Stellar System (Gould belt). Structure of the Galaxy, of the Our Stellar System, subgroup of the Andromeda Nebula analyzed as components of the Local Group of galaxies (LG). The special attention is paid to their astrophysical, kinematic and dynamic properties. Outside the Local Group of galaxies its nearest neighborhood and a large structure is analyzed – Local Supercluster (LS), in which it is included. Further seen gipercluster Laniakea, that includes the LS and its neighborhood. Characterized neighbors gipercluster Laniakea: gipercluster Perseus-Pisces and Local Void.

A map of the nearest superclusters to the LG, with located closer 1 Gyr. where has seen a network structure of the Universe is included. The part of the Universe, bounded by the Hubble radius, and its properties are discussed.

COSMOLOGY, GRAVITATION, HIGH ENERGY PHYSICS, ASTROPARTICLE PHYSICS

THE ANALYSIS OF IMAGES OF A CIRCULAR SOURCE IN N-POINT GRAVITATIONAL LENSES

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In this paper, we study images of a circular source in N-point gravitational lenses.

We defined the equation of the source boundary analytically and obtained an analytical description of the images in the form of a system of equations and inequalities.

In picture plane, we considered the relative positions of the circular source and its images. This allowed us to make the linear classification of images in 1-point lens.

We obtained in explicit form the formulas for calculating the area of the images. We plot the light curves for the image as a whole and for each connected component separately.

We proved:

Theorem 1. Let the circular source:

A) does not contain the origin, then the image is a two simply connected regions and the unit circle separates them;

B) contain the origin, then the image is one doubly-connected domain, the unit circle belongs to it and divides it into two doubly-connected domains;

C) has a boundary that contains the origin, then the image represents two circular alveolus, formed by two circles, one of which is a unit circle.

Theorem 2. The modulus of difference of area of the images inside and outside the unit circle is equal to the area of the circular source.

Theorem 3. The center of gravity of the images of the circular source coincides with the center of gravity of the source.

THE SOLUTION OF THE COSMOLOGICAL CONSTANT PROBLEM AND THE EVOLUTION OF THE UNIVERSE AND ITS STRUCTURE IN COSMOLOGICAL MODEL WITH SUPERCONDUCTIVITY

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The cosmological model with superconductivity (CMS), proposed by the author, gives a new possibility of solving the problem of the cosmological constant with obtaining its value close to that obtained by the PLANCK collaboration. In this case the possibility of the exponential expansion of the Universe is contained in the formulas of the CMS that describe the critical density of the Universe and the density of dark matter, so that there is no need to add special conditions for inflation. Consideration of the evolution of the

Universe within the CMS makes it possible to describe the process of the Big Bang and the expansion of the Universe as a result of the phase transition and the formation of phases of primary fermions.

ON THE NUMBER OF BARYONS IN THE OBSERVABLE UNIVERSE, THE MASS OF PROTON, AND THE POSSIBLE ORIGIN OF THE BARYON NUMBER IN THE COSMOLOGICAL MODEL WITH SUPERCONDUCTIVITY

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From the cosmological model with superconductivity (CMS) are obtained formulas of the baryons and neutrinos numbers in the Universe. The connection between the number of baryons and leptons with the holographic principle is discussed. Within the framework of the CMS it is shown the origin of the baryon number, or baryon charge of the Universe, and proton mass.

ON THE NATURE OF TIME

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It is a review of various theories and concepts of time - cosmological, geological, biological, and psychological. There are considered the possible physical causes of the irreversibility of the observed processes (time arrows).

THE THEORY AND SIMULATION OF THE NEUTRON MODERATION SPECTRUMS IN HOMOGENEOUS URANIUM-CARBON MEDIA FOR CONTROLLED NUCLEOSYNTHESIS

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In [1, 2] the analytic expression for the neutron slowing down spectrum for an isotropic neutron source in slowing down neutron-absorbing media was obtained.

Graphs are presented for the energy spectra of slowing down neutrons in hydrogen and uranium-carbon homogeneous media. The graphs are obtained by computer calculation using the theoretical expression from [1, 2] and using the GEANT4 code. A comparative analysis of the neutron spectra for uranium-carbon slowing down media presented in our work, demonstrates a good agreement between the spectra calculated according to the developed theory and the spectra calculated by the Monte Carlo method.

With the help of a change in the spectrum of slowing down neutrons, it is possible to regulate the yield of nuclides formed as a result of neutron-nuclear reactions.

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THE ROLE OF SIMULTANEITY IN THE RELATIVISTIC QUANTUM MECHANICAL MEASUREMENTS

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In the paper we analyze the definition of the Fock components of interacting relativistic particles for the case of the system. Attention is drawn to the problem of transition from one inertial reference frame to another [1]. In our opinion, the problem is that the simultaneous measurement of one inertial reference frame will be not simultaneous in another inertial reference frame. The physical theories in which explicitly or implicitly the multi-time probabilities amplitudes are considered, are analyzed. In the paper we present arguments that taking into account the influence of the measurement process on the state of the system it is impossible to consider the multi-time probability amplitudes for quantum theories. Even if the events corresponding to the particles observation at different points of space at different times, they are separated by spatially similar intervals. It is shown that due to the substantial non-localization of a quantum relativistic system interaction with a measuring device, these measurements can not be regarded as not related to each other. It is proposed to determine the Fock columns components as probability amplitudes, the squares modules of which determine the results of measurements which are simultaneous in relation to the reference frame in relation to which the state of the relativistic quantum system is considered. This leads to the fact that the arguments of the Fock column components in different reference systems can not be related to the Lorentz transformations, or in some other way.

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EINSTEIN-HAMILTON-JACOBI EQUATION SOLUTION IN THE T-REGION OF SPHERICALLY SYMMETRIC CONFIGURATION OF GRAVITATIONAL, ELECTROMAGNETIC AND SCALAR FIELDS

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The problem of constructing a T-solution of Einstein equations for spherically symmetric configuration of scalar, electromagnetic (EM) and gravitational fields and its research are considered. We note that such problem can be solved in two ways. In the first one, we would have to build space-time representation of spherically symmetric

field system evolution. It reduced to solving Einstein's equations and the laws of motion of EM and scalar fields together with boundary conditions.

The second method, which we used in this work, suggests investigating configuration space (minisuperspace) of spherically symmetric system of EM, gravitational and scalar fields. Especially, it prescribes to research how one field depends on another, instead of how fields depend on time. Using the Hamilton constraint, we exclude the lapse function from the Einstein-Hilbert action, which allows us to proceed to the minisuperspace for our configuration.

In this case, the Einstein equations are equivalent to the motion equations of some "effective" particle or to the geodesic equations in minisuperspace, taking into account reference frame fixing. We research minisuperspace geometry, calculate components of curvature tensor, Ricci tensor and scalar curvature. Described approach lets us to get configuration variables as functions of one of them. We concretize lapse function (frame of reference) and recover time dependency within classical geometrodynamics.

THE DENSITY OF MATTER: FROM MICRO-MECHANICAL (GRANULAR) TO MACRO-MECHANICAL (UNIVERSE) SYSTEMS

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We discuss some visible analogies of mapping of the density of matter field which has been observed in Universe [1] and in micro-mechanical in particular granular materials [2]. In both mentioned global classes of physical systems there are the same known initial problem exist: the local density field is insufficiently defined [1, 2].

Several structural characters which are in common in those, quite differently scaled systems (like specific clusterisation are outlined. Mentioned circumstances inspire the idea to apply the methods of parameterization of structural and physical properties of the granular materials [3] (like geometrical, structure invariants, statistical methods) also to study the relevant fragments of picture maps (plane cross-sections) of the Universe – filaments and voids.

The presented work has been done in the Department of General and Theoretical Physics in Odessa State Environmental University where regular international research program which focused on study of the Soft matter is carried on.

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ON THE CONFIGURATION SPACE OF A SPHERICALLY SYMMETRIC SYSTEM OF GRAVITATIONAL AND ELECTROMAGNETIC FIELDS

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We study some classical and quantum aspects of the minisuperspace for a spherically-symmetric system of gravitational and electromagnetic fields. Note that configurations, which are stationary respect to external observer, have regions of space-time (ST) with dynamic behavior. This means that in these regions there exists an evolution of the ST geometry in time, which is responsible for both classical and quantum mechanical properties of the model. From the standard action, we construct the reduced action and conserved total mass and charge. In view of a Hamiltonian constraint the non-dynamic degree of freedom from the action is excluded. This leads to the action in the minisuperspace. Therefore, the classical phase of the investigation of the Einstein equations solutions reduces to the study of solutions of the Einstein-Hamilton-Jacobi equation in the minisuperspace. The minisuperspace is flat therefore solutions of the Einstein equations correspond to a pencil of lines in the minisuperspace. Their intersections with the light cone correspond to the event horizons in the ST of BH. The consideration of the quantum aspects is formally reduced to the quantization of a particle in a three-dimensional pseudo-Euclidean space. Using the compatibility condition of the DeWitt and the eigenvalue equations for the operators of mass and charge the configuration wave function is constructed. Thus, we obtain a model of a charged BH with a continuous spectrum of masses and charge.

SUPERSPACE APPROACH TO THE QUANTIZATION OF CHARGED BLACK HOLES WITH ALLOWANCE FOR THE COSMOLOGICAL CONSTANT

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In the present paper, we study the geometry of a minisuperspace and its relation to the corresponding space-time geometry of a spherically symmetric configuration of electromagnetic and gravitational fields, taking into account the cosmological constant, and the construction of the wave function of a quantum system. By the generalized Birkhoff theorem, for this configuration we can introduce the R- and T-regions, which simplifies the description of the dynamical system. Proceeding from the standard classical Einstein-Hilbert action, a Lagrangian of the fields configuration is constructed for a spherically symmetric space-time. The Lagrangian of the system is degenerate and contains a non-dynamic degree of freedom, which leads to a constraint. After eliminating the constraints, we proceed to the description of the dynamic system in the configuration space (minisuperspace). We

consider additional conserved physical quantities: the total mass and the charge of the system. We note that the geometry of the minisuperspace turns out to be conformally flat. In addition to the standard horizons inherent in a charged black hole, space-time has an additional cosmological horizon. In the configuration space the simplest invariants of the curvature tensor: the scalar curvature, the square of the Ricci tensor, the Kretschmann invariant, are vanish, while the components of the Ricci tensor and the curvature tensor diverge on the minisuperspace analogue of the cosmological horizon.

Within the framework of canonical quantum gravity with material sources, physical states are found by solving the Hamiltonian constraint in the operator form for the wave function of the system defined on the minisuperspace, taking into account conserved additional quantities. Formal quantization in the R-region can be regarded as an analytic continuation of solutions from the T-region. In this approach, taking into account the mass and charge operators leads to a continuous spectra of mass and charge.

MORPHOLOGY OF GALAXY CLUSTERS IN SUPERCLUSTERS

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We present the results of study of the 2D distribution of galaxies in 112 galaxy clusters forming 19 superclusters with richness 5 and more. Our study bases on list of galaxies of Muenster Red Sky Survey (Ungruhe et al., 2003). The galaxy superclusters were detected using *Friend-of-Friend* method for cluster having 50 and more galaxy in the cluster field (based on Panko & Flin, 2006).

According the classification scheme (Panko, 2013) we attributed to clusters C, I or O type according to concentration to the center, as well as L or F types in the case statistically significant concentration to the line. We also took into account the role of bright cluster members (cD and BG types). In some cases we found a special peculiarities, such as X or Y-type substructures or curved strips.

The results are discussed.

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THE RESEARCH OF THE FIXED POINTS OF THE LENS MAPPING

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Let L be a lens mapping (from the plane of the source to the plane of the lens) that describes an N -point gravitational lens. Let L is defined by a complex function of the complex variable L . The fact that the function L is the difference of two functions: the identity function and W of the deflecting (from the source) function.

It can be shown that the function W :

- analytical;
- rational;
- its zeros are fixed points of L , the number of distinct zeros in the finite plane is from 1 to $N-1$;
- its poles are points whose coordinates are complex conjugate to the coordinates of point masses, all poles are prime, the residues at the poles are equal to the value of dimensionless point masses, the sum of the residues at the end points is equal to one.

The function W has a representation in the form of a ratio of two polynomials. Up to a constant factor, the numerator of the ratio is the derivative of the denominator. This allows the Gauss-Lucas theorem (on the distribution of the roots of the derivative of a polynomial) to apply to the function W .

We have proved:

Theorem. The fixed points of the mapping L belong to the polygon of the set of points that are complex conjugate to the points at which the point masses are located.

The polygon of a set of points is defined as the minimal convex polygon that contains this set.

AN ALTERNATIVE METHOD OF INTRODUCING THE ELECTROMAGNETIC INTERACTION INTO THE STANDARD MODEL

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In the Standard Model, the electromagnetic field is introduced as a linear combination of fields that transform according to the representations of different gauge groups. It leads to the fact that the electromagnetic field transformation law under local gauge transformations becomes complicated and does not resemble the transformation law in the "ordinary" electrodynamics. It drives to an issue with the construction of experimentally observable quantities - the strengths of electric and magnetic fields and "destroys" the known method of describing the electromagnetic field. The paper draws attention to the possibility of another method of introducing the electromagnetic interaction [1]. The method is based on the observation that the usual way of constructing the locally invariant Lagrangians ensures the invariance only for a certain choice of the gauge group generators representation [2]. The representation can be replaced by any equivalent representation and

it is natural to require the symmetry with respect to the replacement of the generators representation. The Standard Model Lagrangian contains the raising and lowering generators of the $SU(2)$ group. The commutation relations between generators of this group determine only the absolute values of the raising and lowering generators matrix elements. At the same time, the arguments of these matrix elements are uncertain. In the paper, the electromagnetic field is introduced as a compensating $U(1)$ -field, which ensures the Lagrangian invariance with respect to the various choices of arguments. It is shown that despite the fact that the W -bosons are charged particles, they should not interact with the electromagnetic field.

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THE ELECTROWEAK PHASE TRANSITION IN A SPONTANEOUSLY MAGNETIZED VACUUM

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We investigate the electroweak phase transition in the Standard Models with accounting for the spontaneous vacuum magnetization. As it is known, for mass of Higgs boson greater than 75 GeV, this phase transition is second order. But according to Sakharov's conditions for the formation of the baryon asymmetry of the Universe it has to be strong first order. The spontaneously generated (chromo) magnetic fields are temperature dependent. They influence the phase transition.

Color chromomagnetic fields B_3 and B_8 were created spontaneously in the gluon sector of QCD at temperature $T > T_d$ higher the deconfinement temperature T_d . Usual magnetic field H had also been spontaneously generated. For T close to T_{EW} the magnetic fields could change the kind of the phase transition.

The field strengths $B_3(T)$, $B_8(T)$ and $H(T)$ at relevant temperatures are also estimated.

DARK MATTER IN GALAXIES – ONE OF THE MOST INTRIGUING PUZZLES IN MODERN COSMOLOGY

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From long-term observations it follows:

- the speed of rotation of all types of galaxies can not be explained by the mass of luminous matter (stars),
- the mass of clusters of galaxies consists of dark matter by more than 80%,
- more, than 80% of all matter in the Universe is not associated with the primary plasma, that appeared as a result of the Big Bang.

Particles of dark matter:

- these are not the photons,

– these are not quarks or leptons (do not appeared in processes with strong, weak or electromagnetic interactions),

- are not associated with primary plasma,
- are not a hot dark matter.

Candidates for dark matter particles can be:

– thermal relic particles (which were in a state of thermal equilibrium with other particles immediately after the Big Bang): neutrinos (hot particles), sterile neutrinos, gravitino (warm particles), lightest supersymmetric particles (cold particles), lightest Kaluza-Klein particles (cold particles, from others dimensions);

– nonthermal relic particles (were not in thermal equilibrium in the early Universe): Bose-Einstein condensates, axions, axion clusters, solitons, supermassive WIMPs, etc.

Paolo Gondolo (2015): “That which does not kill us makes us stronger”.

HALOS IN DARK AGES: FORMATION AND CHEMISTRY

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Formation of halos in Dark Ages from initial spherical perturbations is analyzed in four component Universe (dark matter, dark energy, baryon matter and radiation) in the approximation of relativistic hydrodynamics. Evolution of density and velocity perturbations of each component is obtained by precise integration of system of nine differential equations from $z = 10^8$ up to virialization, which is described phenomenologically. It is shown that number density of collapsed or virialized dark matter halos with masses $M \sim 10^8 - 10^9 M_\odot$ is close to the number density of normal galaxies in the comoving coordinates. The dynamical dark energy of classical scalar field type does not influence practically on the evolution of other components, but dynamical dark energy with small value of effective sound speed can be important at the late stage of halo formation. Simultaneously, the system of kinetics equations describing the formation/dissociation of the first molecules have been integrated for each step of hydrodynamical part of problem. The results show that number densities of molecules H₂ and HD, which are important coolers in the processes of formation of first stars, are essentially higher in halos than on a uniformly expanding background. It is caused by increased density and rates of reactions at quasilinear and nonlinear evolution stages of density and velocity of baryon component of halos. For example, at the moment of virialization the mean number densities of molecules H₂ and HD are in $\sim 10^3$ and ~ 400 times larger than on cosmological background accordingly. At the end of Dark Ages ($z \sim 10$) the number density contrasts of these molecules are even greater. It is shown also that the temperature history of the halo is im-

portant for calculating the concentration of molecular ions with low binding energy. So, in a halo with virial temperature $\sim 10^5$ K the number density of the molecular ion HeH⁺ is approximately 100 times smaller than that on the cosmological background.

ON THE TETRAD APPROACH IN GENERAL RELATIVITY: AN ARBITRARY NONORTHOGONAL TETRAD, CONTINUITY EQUATIONS, AND SO ON

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A tetrad approach is well known for the description of any gravitational field in general relativity. If we pass from the metric tensor to the local non-orthogonal holonomic basis, the metric tensor is a bilinear combination of basis vectors with scalar functions as coefficients. Similarly, any tensor field of rank n may be represented as a corresponding n -polylinear combination of basis vectors with scalar coefficients.

Along with the holonomic basis we introduce the conjugate basis (cobasis), which vectors are connected with the vectors of the basis by the Kronecker symbols. We note that even for a diagonal metric, the cobasis vectors will contain both the gradient and the vortex parts. It can be shown that the curvature tensor, the Ricci tensor, and also the scalar curvature contain the vortex parts of the cobasis vectors only linearly. This representation allows us to consider any state of gravitational field in general relativity as a state of nonlinear scalar fields system and a state of linear vortex fields which define cobasis.

The description of the vortex parts of the cobasis vectors can be carried out in analogy with the electromagnetic field in Maxwell's theory: four antisymmetric II rank tensors for the gravitational field as well as the corresponding continuity equations are established. These tensors are omitted in the vacuum Lagrangian for gravitational field in general relativity. At the same time, their account is extremely important for the determination of dark matter in galaxies and of dark energy in cosmology.

DETAIL MORPHOLOGY OF THE RICH CONCENTRATED GALAXY CLUSTERS

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We present the results of study of the 2D distribution of galaxies in 30 rich galaxy clusters with significant concentration to the cluster center according to preliminary estimation. The input data were selected from “The Catalogue of Galaxy Clusters and Groups” (Panko & Flin, 2006) based Muenster Red Sky Survey galaxies (Ungruhe et al., 2003). Concentrated galaxy cluster (C-type, according to Panko, 2013

scheme) are evolved, virialized structures. It is confirmed by a big number of cD cluster in our data subset: 70%.

Substructures in C-type clusters must be weakly marked. For example, the clusters with the concentration to the narrow strip were not detected. Nevertheless we collected the subset of C-type rich clusters having the peculiarities.

FIRST RESULTS ON PRECISE DETERMINATION OF $Z-Z'$ MIXING WITH ATLAS AND CMS DIBOSON PRODUCTION DATA AT THE LHC AT 13 TeV AND PREDICTIONS FOR RUN 2

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New heavy neutral bosons Z' decaying to charged gauge boson pairs W^\pm are predicted by many scenarios of new physics, including models with extended gauge sector. The diboson production allows to place stringent constraints on the $Z-Z'$ mixing angle and Z' mass. We find that the bounds on the $Z-Z'$ mixing angle obtained with data comprised of $\sim 36/b^{-1}$ of pp collisions at LHC (13 TeV) and recorded by ATLAS and CMS detectors are quite competitive with those derived from the global analysis of the electroweak data. Further improvement on the constraining of this mixing can be achieved from the analysis of data which will be collected at higher luminosity at the LHC.

A NEW METHOD FOR MONTE-CARLO EVENT GENERATORS OF THE SCATTERING PROCESSES

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There is a well known problem of Monte-Carlo event generators for the inelastic scattering processes. This problem is connected with an enormous increasing of the phase-space dimension of such system as a result of the huge amount of the secondary particles in the final state of the scattering process at high energies. Accordingly, to generate the output events for the given initial state of the system we should generate the huge amount of the quantities with the accounting of the difficult dependence between them. Moreover the use of the non-phenomenological models leads to additional complexity connected with the accounting of the interference contributions to the scattering diagrams. So it was proposed the crucially new approach to the development of Monte-Carlo event generators which based on the Laplace method [1] for calculation of multidimensional integrals.

According to the Laplace method it is necessary to consider only the neighbourhood of the maximum point of the scattering amplitude rather than whole phase-space of the system. Furthermore this method makes it possible to generate independent quantities and then make a transition to the initial quantities which have too complicated dependency to be generated directly.

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THE LAPLACE METHOD FOR LOOPLESS DIAGRAMS IN THE MULTIPARTICLE FIELDS MODEL

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The paper considers the possibility of describing processes of inelastic scattering of protons by means of loopless Feynman diagrams that arise when applying the method of multiparticle fields to these processes. The amplitude of inelastic scattering of two protons with the formation of a certain number of charged and uncharged pions is the sum of all possible diagrams without loops. The paper proposes a recurrent method of taking into account all these diagrams. In the paper, it is analytically proved that the point of maximum of the module of each loop block corresponds to equal to the value of the pulses of all the particles joining this block. Partial, topological and inclusive cross sections for sufficiently small quantities of secondary particles are calculated by the Laplace method[1], taking into account all interference contributions. Comparison of the results of calculations with experimental data on inclusive cross sections for fastness is carried out. It is shown that with increasing collision energy, due to interference effects, the type of dependence of the inclusive cross section on the fastness should vary from one having one maximum to one having two symmetric maxima. It is precisely this change that is observed in known experiments in measuring inclusive cross-sections in rapidity at high energies of welded particles.

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DARK MATTER MODEL FAVOURED BY REIONIZATION DATA: 7-KEV STERILE NEUTRINO VS COLD DARK MATTER

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Recent reports about the detection of the faint narrow emission line at 3.5 keV can be interpreted in favour of dark matter made of 7 keV sterile neutrinos. Another signature of such sterile neutrino dark matter should be fewer ionising sources in the early Universe (compared to the standard 'cold dark matter' scenario) that should affect the process of reionization. By comparing the detailed model predictions of reionization made by 7 keV sterile neutrino dark matter and cold dark matter with the extended model-independent set of observations during the epoch of reionization, we found that 7 keV sterile neutrino dark matter is slightly better consistent with observations.

3D-FORM OF THE PERIODIC SYSTEM OF CHEMICAL ELEMENTS OF GAMOW AND ITS DEVELOPMENT

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In addition to fundamental theoretical works, Gamow's popularity was brought to him by his popular science works, in which the contemporary scientific ideas were discussed by live and accessible language. Gamow was not only a great scientist, but also an extraordinary man, which was repeatedly noted by his friends and contemporaries. The American mathematician Stanislaw Ulam wrote: "Nowadays, when more and more complex mathematics is used, perhaps too sophisticated, it was amazing to see how far he could go with intuitive pictures and analogies gathered from comparisons from the field of history or even art". In the official characteristic of Gamow, signed by the deputy director of the Radium Institute V. Khlopin, it is said about him: "... is a typical representative of the literary and artistic bohemia". Developed intuition and artistic taste did not allow the talented popularizer to use the conventional flat tables of the Periodic Table, which were not liked by the very first discoverer of the Periodic Law. The sequence and continuity principle was the main heuristic principle in the work of D.I. Mendeleev, which can be called also as the principle of integrity: "In essence, the entire distribution of elements represents continuity and corresponds, to some extent, to a spiral function". Mendeleev foresaw that "... the system requires a "bodily" form that allows rapprochement in all directions". For the first time, but not without shortcomings, the spatial spiral form was used by A.E. Shankurtua. But only in 1948 in the book "One, Two, Three ... Infinity", and then in 1961 in the book "Atoms and their nuclei" G.A. Gamow proposed exactly the truly Mendeleev periodic system in the form of a continuous tape of chemical elements arranged in order of proton number increasing, which forms a three-dimensional spiral. The periodic Gamow system is integral, self-consistent, naturally results from the main heuristic principle of D.I. Mendeleev and his idea of "corporeality" and includes the idea of spiral-like function of A.E. Shankurtua without its shortcomings.

Keywords: 3d-periodic system, Gamow, Mendeleev, Shankurtua.

CONDENSATION OF COLD NEUTRONS – IDEA OF G.A.GAMOW. ON THE POSSIBILITY OF OBTAINING A NEUTRON SUBSTANCE IN LABORATORY CONDITIONS.

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The formation of a neutron substance is considered, besides gravitational neutronization other mechanisms,

such as the condensation of ultracold neutrons (UCN) and neutronization due to the critical increase in the atomic number in the Periodic system (PS), are also taken into account. Condensation of cold neutrons was first talked by Gamow. Rarely mention this idea, which eventually found application in the theory of neutron stars. Gamow in 1937-38 showed that when a neutron gas is compressed, a new superdense state of matter appears. Gamow's key hypothesis: "we can assume that neutrons from this relatively cold cloud gradually merged into ever larger neutral complexes ..." The stability of the neutron substance is substantiated already at the microlevel due to Tamm-interaction, and not only at the macrolevel due to the gravitational interaction, as it is now believed in astrophysics. A neutron substance is a very concrete physical reality, urgently demanding its rightful place in the PS and studying not only physical, but also chemical, and possibly even in the near future, engineering and technical properties. We also consider the possibility of a "chemical" interaction of UCN with molecules of substances with an odd number of electrons. It is proposed to extend the PS beyond the limits of classical chemicals and cover a much wider range of matter in the Universe, based on the forgotten ideas of D.I. Mendeleev.

Moreover, the neutron and its isotopes (dineutron, tetra-neutron, etc.) begin, and the neutron stellar substance ends PS.

Keywords: neutronization, ultracold neutrons, periodic system, Gamow, Mendeleev, Tamm

RECENT RESULTS ON 3.5 KEV LINE SEARCHES

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The nature of the 3.5 keV line-like signal detected in the number of astrophysical objects at the beginning of 2014 still remains unknown. Apart from the purely astrophysical explanations (which still needs non-trivial assumptions), the line may be produced by the extra-week interactions of the Dark Matter particles with the Standard Model known ones. For example, such a signal can be produced by the decaying Dark Matter consisting of the sterile neutrinos of ~7 keV mass.

In this talk, we will review the ongoing work on the analysis of the X-ray data available so far, aimed at the determination of the line nature. We will also discuss the perspectives of the planned future observations dedicated to the study of this signal.

2-FIELD MODEL OF DARK ENERGY WITH CANONICAL AND NON-CANONICAL KINETIC TERMS

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The simplest and most common physical models for dark energy with the equation of state parameter crossing -

1 are either a K-essence field or 2-field models. In the latter case the quintom – 2 fields with canonical kinetic terms and a potential $U(\phi, \xi)$ – is generally considered. However, this is not the only possible choice of a 2-field Lagrangian. Here we reconstruct the potentials $U(\phi, \xi)$ of the 2-field model with canonical and tachyon kinetic terms for the dark energy equation of state parametrization of [Komatsu E., Dunkley J., Nolte M.R., Bennett C.L. et al., ApJS 180, 330 (2009)] and the classes of 2-field potentials from [Andrianov A.A., Cannata F., Kamenshchik A.Y., Regoli D., JCAP 02, 015 (2008)].

ON PLEBANSKI-DEMIANSKI-TYPE METRIC IN GR WITH FLOWS

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The properties of the Plebanski-Demianski [1] island where studied [2] using a non-orthogonal gradient tetrad. Plebanski-Demianski model is the eight-parameter solution of vacuum Einstein-Maxwell equations. This model as well as Schwarzschild model contains local singularity.

In present communication we study the island model with Plebanski-Demianski type metric in the framework of Riemannian geometry with curvature flows of vacuum space-time. The difference between the equations obtained in the framework of this model and equations obtained in the framework of Plebanski-Demianski model is discussed.

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THE DYNAMIC MECHANISM OF A SPONTANEOUS SYMMETRY BREAKING IN THE MULTI-PARTICLE FIELDS METHOD

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We propose an analysis of the known Higgs mechanism problems of the Standard Model. Namely, the «wrong» sign by a quadratic term in the Lagrangian of the Higgs field is introduced as a postulate, is considered. Besides, the «fi-four» interaction which is responsible for the spontaneous symmetry breaking does not reduce to any of the fundamental interactions. Such interaction is not related to the localization of some Lagrangian symmetry and it is not introduced by the transition to covariant derivatives. Also, the only particle involved in this interaction is the Higgs boson. In the paper we propose to consider the Higgs boson as a bound state of W-bosons due to their weak interaction [1]. The bound states description by the multi-particle fields method allows us to naturally get the «wrong» sign of a quadratic term in the Higgs field Lagrangian. That is, this sign is not introduced axiomatically, but it is obtained as a result of

the dynamic equations solution for the multi-particle fields. Unlike the Standard Model, the Higgs field self-action is considered not as an additional fundamental interaction but as a consequence of a self-action of the non-abelian gauge field which corresponds to the carriers of weak interaction.

[1] I.V. Sharph, et al. arXiv:1711.01914 [physics.gen-ph] (2017)

X-RAY EMISSIONS OF ICRF SOURCES

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ICRF (International Celestial Reference Frame) is current astrometric reference frame defined by the positions of distant extragalactic sources. The most of these sources are active galactic nuclei hence they should have some active processes with rapid motions. The aim of this work is to consider X-ray emission of ICRF sources and to look for features of their possible proper motions. We identified 54 X-ray ICRF sources and notices rapid variability of W Com and 2E 1802. To perform more complete analysis, we discussed evidences of their spectra possible proper motions. We concluded that some special attention should be paid to blazars when employing and developing ICRF.

Key words: reference systems, galaxies: active, X-rays, galaxies.

GEODESIC STRUCTURE OF SPACE-TIMES AROUND STATIC COMPACT OBJECTS WITH SCALAR FIELDS

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We consider static spherically symmetric compact objects with strong gravitational and scalar fields within the framework of the General Relativity. Main attention is paid to the distribution of stable circular orbits of test bodies around configurations with a scalar field (SF), which may contain a black hole (BH) or naked singularity (NS). Our results concern (a) the linear massive scalar field, (b) families of analytic solutions with a nonlinear (self-interacting) massless SF, (c) the same with a massive SF and (d) with a phantom SF. We found several examples of the scalar field potentials concerning (b,c,d) that allow for exact analytic solutions of the Einstein equations with scalar field; these potentials are not positively definite. Then we analyze the behavior of geodesics in the corresponding space-times. We found regions of parameters of the solutions for which the ring-shaped structures arise in the distribution of circular orbits. Our examples show that such annular structures arise both in the case of BH and in the case of NS.

GAUSSIAN FIELD MODEL FOR GALAXY DISTRIBUTION

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Current cosmological N-body and hydrodynamical simulations are performed with the usage of large resources. Ordinal modern simulation need thousands processor cores. Number of particles reach 8 trillions in some cases. New mathematical methods are included into cosmological codes such as Monte Carlo Markov chains, genetic algorithms and machine learning. Despite of increasing resolution and assortment of simulated physical values, there are no significant flow of new scientific results obtained from simulations. Some simulations becomes online virtual observatories with little usage.

We propose simple method to generate two dimensional galaxy distribution which can be considered as a model of sky distribution of real galaxies. We compared our random point distributions with positions of SDSS galaxies by fitting of two point angular correlation function. Resulting parameters of appropriate galaxy distributions could be used for the analysis of the large-scale structure of the Universe.

TWO-LAYER RELATIVISTIC CONFIGURATIONS WITH ANISOTROPY OF PRESSURE IN THE GENERAL THEORY OF RELATIVITY

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The assumption of local isotropy is one of the most common assumptions in the astrophysical study of super-massive stellar objects. Nevertheless, a significant change in the properties of the objects under consideration is possible, which occurs when operated with non-perfect liquid sources. The reason for this was theoretical development of realistic stellar models by Ruderman and Canuto, who showed, that matter in strong gravitational fields can be locally anisotropic. Herewith the radial pressure may not be equal to the tangential pressure.

In this paper we consider a method for obtaining the exact solutions of spherically symmetric Einstein equations with equation of state of an anisotropic liquid when there is a linear dependence of the radial and tangential pressure components. This method yields new exact anisotropic solutions. Analytical study of the solutions obtained give reason to believe that all new anisotropic solutions can be used to describe the shells of two-layer relativistic configurations or inner layers of multilayer relativistic configurations.

In the paper, isotropic solutions were used as nuclei and new anisotropic solutions were considered as external shells, external space-time is described by the Schwarzschild solution. In the models obtained it proved to be that all the configuration parameters are uniquely determined by specifying the energy density at the center of the

configuration. The ratio of the gravitational radius to the configuration radius indicates that such models can be satisfactory for describing the relativistic configurations.

DETAIL MORPHOLOGY OF THE RICH GALAXY CLUSTERS WITH INTERMEDIATE CONCENTRATION

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We present the results of study of the 2D distribution of galaxies in 170 rich galaxy clusters with intermediate concentration to the center according the previous estimation. The input data were selected from Panko & Flin (2006) based on Ungruhe et al., (2003).

Intermediate galaxy cluster (I-type, in Panko, 2013, scheme) correspond structures in the middle stage of evolution according to Rood & Sastry and latest ideas as well as modern numerical simulations.

We detect different kinds of statistically significant substructures in our data set. Regular ones, such as X and Y-type overdense regions, short strips or curved bands were are like to peculiarities detected in O-type clusters.

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NUMERICAL ESTIMATOR FOR LARGE-SCALE COSMIC STRUCTURES

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Components of large-scale structure of Universe includes galaxy clusters, walls, filaments, groups and field galaxies. The question of spatial organization of all these components remains open despite of a number of recently developed methods of LSS analysis. Here we introduce new continuous structural parameter of galaxy distribution. This parameter is based on comparison of radial distribution of galaxies around the certain point with the uniform one. New parameter was calculated for sky distribution of SDSS galaxies at distances from 50 to 150 Mpc. We come to conclusion that our structural parameter can be used for the division of LSS components and extragalactic filament detection.

ASTROPHYSICS

(stellar atmospheres, interacting binary systems, variable stars)

A STUDY OF HERBIG AE BE STAR HD 179218: VARIABILITY IN H α , H β AND OI

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Spectral observations of the star were performed at the Cassegrain focus of the 2 m Karl Zayss telescope of ShAO of Azerbaijan NAS by using an echelle spectrometer constructed on the base of the spectrograph UAGS (Ismailov et al., 2013). As a light detector we have used a CCD with 530x580 elements. Observations were performed in the range λ 4700-6700 Å. The spectral resolution is $R = 14000$. The mean signal to noise level in the region of the line H α is $S/N = 80-100$, and in the region of the line H β , is $S/N = 30-40$. Reduction and calibration of the spectrograms is performed in the DECH programs (Galazutdinov, 1992). The method of observations and material processing is described in more detail in the work of Ismailov et al. (2013).

Table 1 shows the log of observations, where in columns are respectively presented the names of the spectrum, the Gregorian and Julian dates, the signal accumulation time and the signal-to-noise ratio in the region of the line H α . Observations were conducted for the season May-September 2015. In total, 28 pairs of spectrograms were obtained for 28 nights of observations. For to control of instrument stability and position measurements the spectra of standard stars HR 7300 and HR 7734 for each night were obtained. The equivalent widths EW, the bisector radial velocities V_{bis} , the radial velocities at the peak of the line V_p , the half-widths FWHM (full width at half maximum), the central depths R_λ (intensities) of lines H α , H β , HeI λ 5876 Å, D1, D2 NaI, SiII λ 6347, 6371 Å, [OI] λ 6300, 6363 Å and diffuse interstellar bands DIB λ 5780 and 5797 Å were measured.

The average error in the intensity measurements as a function of the S/N level was 0.4-0.5% in the region of the H α line and up to 1% in the region of the H β line. Depending on the S/N level, errors in equivalent widths measurements, for example, were from 3% for H α , up to 30% for [OI] λ 6300, 6363 Å lines. The average error in measuring the radial velocities for individual spectral lines in the spectra of standard stars does not exceed $\pm 1.5-2.0$ km/s. The results of spectral observations of the Herbig Ae/Be type star HD 179218 are presented. Two wave-like cycles of variability in the parameters of hydrogen lines H α and H β with a characteristic time of ~ 40 days are revealed. The first wave of variations is deeper; the branches of decreasing and increasing the spectral parameters of the lines are more clearly expressed. At the time of the first minimum, in the profile of the emission line H α the appearance and disappearance of additional blue and red emission components are observed. At the same time, narrow absorption components were discovered in the H β line. Synchronously with

this, a significant variation in the lines of He I, Si II, D NaI, [OI] was observed. In addition, the parameters of many spectral lines shows variations with smaller amplitude and with a characteristic time of 10-20 days. Possible mechanisms of the observed variability of the star are discussed.

Table1. The log of observations of the star HD 179218.

Spektr	Date	JD 2450000+	t (sec)	S/N
ks 6096-97	31.05.2015	7174.3138	1800	94
ks 6103-04	02.06.2015	7176.3444	1800	89
ks 6113-14	04.06.2015	7178.3034	1800	103
ks 6150-51	08.06.20015	7182.3042	2100	90
ks 6154-55	16.06.2015	7190.2681	2100	93
ks 6204-05	17.06.2015	7191.3021	2000	89
ks 6220-21	18.06.2015	7192.2757	1800	99
ks 6233-34	20.06.2015	7194.3174	1800	91
ks 6275-76	21.06.2015	7195.2604	1800	97
ks 6286-87	24.06.2015	7198.2736	1800	91
ks 6328-29	27.06.2015	7201.3125	1500	96
ks 6343-44	29.06.2015	7203.2667	1800	98
ks 6369-70	30.06.2015	7204.3042	1500	87
ks 6387-88	09.07.2015	7213.3222	1500	98
ks 6424-25	10.07.2015	7214.3278	1500	99
ks 6437-38	11.07.2015	7215.2778	1500	98
ks 6448	11.07.2015	7215.2958	1500	90
ks 6449	12.07.2015	7216.2938	1500	87
ks 6460	23.07.2015	7227.3139	1500	86
ks 6491	26.07.2015	7230.2590	600	97
ks 6528-29	29.07.2015	7233.2625	1500	94
ks 6585-86	30.07.2015	7234.2882	1500	98
ks 6602-03	31.07.2015	7235.2681	1500	101
ks 6614-15	01.08.2015	7236.3104	1500	100
ks 6635-36	03.08.2015	7238.35	1500	102
ks 6716-17	09.08.2015	7244.2451	1800	99
ks 6815-16	16.08.2015	7251.2715	1500	109
ks 6831-32	18.08.2015	7253.2618	1800	108

MAVKA: STATISTICALLY OPTIMAL DETERMINATION OF EXTREMA

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Program MAVKA was elaborated for determination of characteristics of extrema using small nearby data intervals. Were realized different basic functions, some of them use whole interval near extremum (algebraic polynomial in general form, "Symmetrical" algebraic polynomial using only even degrees of time (phase) deviation from the position of symmetry argument, "Asymptotic Parabola", "New Algol Variable"), other split the interval into 3 parts ("Wall-Supported Parabola", "Wall-Supported Line", "Wall-Supported Asymptotic Parabola", "Parabolic Spline of defect 1"). The variety of methods allows to choose the "best" (statistically optimal) approximation for a given time series.

For all approximations, the “linear” parameters were determined by the Least Squares Method (LSM), and the “non-linear” parameters were determined using the method of differential corrections. For all parameters, the statistical errors are determined.

The methods were illustrated by applications to observations of some variable stars.

IMPROVED PARAMETERS OF NEWLY DISCOVERED SHORT-PERIOD BINARIES

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We present results of photometric observations of short-period variable stars discovered during recent decade in the field of view of intermediate polars (V2832 Cyg, V2833 Cyg, 2MASS J21334629+5112088, 2MASS J21323285+5107316, 2MASS J21330148+5101105, 2MASS J21341620+5107382, 2MASS J21342297+5115544, 2MASS J21344894+5112116, VSX J213351.1+510633, VSXJ212326.6+422115, VSXJ195753.6+322815, VSXJ195826.2+323717, VSXJ195810.3+323350). Most of variables belong to eclipsing binary systems. Data were obtained with different instruments in 2009-2017.

During analysis of (O-C) diagrams of some objects we found significant linear trends which indicate necessity of improvement of the orbital period values (that usually obtained using relatively short period of observations). Particularly, for the EW-type system V2833 Cyg the value of the orbital period is 0.37177351(19) days which is statistically different from published earlier value of 0.371782(12) days. For some objects we improved the value of the period and determined the parameters of the light curves. The previously period of the 2MASS J21330148+5101105 (3.672 days) contradicts the observed data, but we have not enough eclipsing minima to determine the correct value. Using time series of other objects we confirm previously published values of the period.

NEW RESULTS OF THE LONG-TERM MONITORING OF THE INTERMEDIATE POLAR V2306 CYGNI

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The pulsating X-ray source 1WG AJ1958.2+3232 was discovered by Israel et al. (1998). Negueruela et al. (2000) announced the system as the intermediate polar. Zharikov

et al. (2001) obtained time resolved spectroscopy and R-band photometry from which they determined an orbital period of 4h36m and confirmed the pulsation period of 733 s. Later on, Norton et al. (2002) obtained UBVR photometry and reported that the orbital period was 5.387 h, corresponding to the –1 day alias of the period found by Zharikov et al. (2001). Just after it, Zharikov et al. (2002) re-analyzed this system using own photometric and spectroscopic data along with the data by A. Norton and confirmed their previously found orbital period of 4h35m. The star was named as V2306 Cyg in 2003.

In 2009 we started our own photometric monitoring of this system. Using the data obtained between 2009 and 2014 and CCD time series from AAVSO database, we determined orbital minima timings and carried our an (O-C) analysis. The regular cycle miscount was detected, so we corrected cycle numbers and smoothed the (O-C) diagram with the linear fit. In this previous research we determined the new value of the orbital period of $0^d.181545 \pm 0^d.000003$ which is slightly different from the value of $0^d.181195 \pm 0^d.000339$ determined from radial velocities by Zharikov et al. (2002). Formally the accuracy estimate of our result is 113 times better (Breus et al., 2014).

The photometric monitoring continues and in 2016 we found the need to improve the previous results since there was still some linear trend at the (O-C). But at that time we had not enough data to do it. Now using CCD time series obtained during 2015-2018 using 60-cm Zeiss-Cassegrain telescope at the Observatory and Planetarium in Hlohovec, Slovakia and 50-cm Zeiss reflector at the Fort Skala observatory in Krakow, Poland we repeated similar calculations and we present the new value of the orbital period and some results on the spin variability.

“RUNNING SINE” ANALYSIS OF SYMBIOTIC, SEMI-REGULAR AND CATAclySMIC VARIABLES

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We present some highlights of the “Running Sine” (RS) method. This approximation is a powerful tool for analyzing characteristics of “nearly-sinusoidal” variations at a time scale, which is larger than the “basic” period [1]. This is related to the “least squares” wavelet (W) analysis [2], which is effective for slow changes of the period as well as multiple periods with large difference between periods (or quasi-periods = cycle lengths). However, the period is fixed, so the parameters – the “mean” (over the basic period), semi-amplitude and also the phase may be defined. The accuracy of all parameters (also predicted maximum, minimum and their phases) is estimated using statistically correct (complete, not abbreviated) formulae. For very long basic periods, which exceed the length of time series, such an approximation loses sense, and asymptotically converges to a “Running Parabola” (RP) method [3]. In other words, there is a sequence (RP, W, RS) of methods efficient for increasing ratio of the corre-

lation length (stability of oscillations) to basic period. The applications of this method are shown for variable stars of different types – symbiotic, semi-regular and cataclysmic. These studies are part of the “Inter-Longitude Astronomy” (ILA) [4,5] and “Astroinformatics” [6].

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OBSERVATIONS OF V1028 CYGNUS DURING ITS JULY 2018 SUPEROUTBURST

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We made observations of V1028 Cygni in B, R and I filters on two nights in 2018. We present results for analyses in I light for one night and R light on the other. Superhumps were detected on both nights of approximately the same value, 0.062 days. On the second night, the star was fainter and fading, but superhumps were still evident.

POSITRON SPECTROSCOPY OF YOUNG SUPERNOVA REMNANTS

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This paper discusses radiative and thermodynamic properties of cold rarefied aggregates containing non-uniformly distributed gas and dust, through which high fluxes of fast positrons with energies of 0.511, 1.2 MeV pass. The investigated gas is in the nebulous state with particle densities of $1-10^3$ and temperatures within the range of 30-100 K. We have estimated the input of energy into thermodynamic temperature of dust, which causes its additional heating and IR thermal emission. The structure of radiation field $S(E,r)$ and electron velocity distribution function $F(E,r)$ were determined depending on the energies of quanta and electrons, respectively. The ejecta of SN 1987A is reckoned as an ideal object of positron impact on the medium at the nebular phase. The interaction between positrons and solid particles, atoms and molecules has been considered separately. Passage of positrons through solid particles typically results in their enhanced amorphous state and heating. Consequently, a characteristic excessive fluorescence of particles, namely astronomical silicates and graphite, occurs. In fact, ionization loss of energy of fast positrons comprises consecutive creation of K-L-M shell vacancies, cascade transitions and transfer of the remaining energy to the atoms which make up solids rather than to the Auger electrons. In this case, quanta from cascade transitions in a solid particle can be only linked to the

lowest atomic levels or γ -quanta produced in the annihilation of positrons and K-L electrons. The energy used to heat a particle itself was estimated by the energy of N-M-K cascades. In this case, the accuracy of the calculated energy balance of dust in the ejecta markedly exceeds the estimates obtained using net radiation loss of particles in the matter. In the nebular atomic-molecular plasma of the supernova ejecta, the energy of the K-shell vacancy created by a positron is redistributed between cascade transitions and Auger electrons. It has been shown that in astrophysics the positron annihilation spectroscopy resulting in the typical radiative response of matter opens up new opportunities for studying young supernova remnants and active galactic nuclei.

DISTRIBUTION OF CARBON STARS IN THE GALAXY

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More than 5% carbon stars in Milky Way Galaxy were discovered in Baldone Observatory. Main photometric characteristics of these stars were obtained. New type of variability of late stars – DY Per with irregular dimming by 2-5 magnitudes was selected. “General Catalog of Galactic Carbon Stars” was prepared in 2001 and now is continued the catalog data updating.

A search for new faint carbon stars in the Polar region $\delta > 55^\circ$ has been accomplished by obtaining objective prism spectra in the visual-near infrared (5500 – 9000 Å) images of CCD camera. The positions of stars having color indices $J - K > 1.3$ mag in Two Micron All Sky Infrared Survey (2MASS) were selected to pick out suspicious carbon stars. Our survey is limited in brightness by $J < 10$ mag. 53 new carbon stars were found. The correlative relation between T_{eff} and spectral gradient [7570 – 6850] was confirmed. Such characteristics as T_{eff} , distance from the Sun, absolute M_k and bolometric M_{bol} magnitudes of carbon stars were obtained. Distribution of carbon stars on Hertzsprung-Russell Diagram are presented. Distribution of carbon stars in the Galaxy are obtained.

THE CHEMICAL COMPOSITION OF NEUTRON-CAPTURE ELEMENTS IN THE ATMOSPHERES OF BL138 AND BL148

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The chemical composition of neutron-capture elements in the atmospheres of BL138 and BL148 was investigated. We tried to find the absorption lines of several rare elements, like niobium, molybdenum, ruthenium, and rhodium, as well as lines of other heavy elements. The derived abundances are compared with solar system abundance pattern and the chemical enrichment of Fornax dwarf is discussed.

HAFNIUM ABUNDANCES IN GALACTIC DISC FGK DWARFS

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Hafnium (72) abundances in FGK dwarfs with metallicities ranging within $-1.0 < [\text{Fe}/\text{H}] < +0.3$ are presented. The investigated stars belong to the substructures of the Galactic disc. The observations were conducted using the 1.93 m telescope equipped with the echelle type spectrographs ELODIE and SOPHIE at Observatoire de Haute-Provence (OHP, France). The results were obtained from the analyses of spectra of typical signal-to-noise ratio (S/N ~ 100 -300) and resolution (R=42,000 for ELODIE and R=75,000 for SOPHIE). The hafnium abundances were determined by the LTE spectral synthesis of two Hf II lines ($\lambda 4080.437$ and $\lambda 4093.155$). Sources of the Hf enrichment in the Galactic disc have been discussed.

SOLUTION OF THE COAGULATION EQUATION WITH A COAGULATION COEFFICIENT

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A general theoretical treatment is developed for the solution of the time-dependent coagulation equation (with constant coagulation kernel) in the presence of a source term possessing arbitrary time dependence. It is shown how the relevant nonlinear first-order differential equation can be transformed into a linear second-order equation, which can then be used to obtain the general solution of the problem together with information about its asymptotic long-term behaviour. The technique is applied to a periodic source term where it is found that the long-term behaviour of the solution exhibits the same periodicity as the source. Detailed results are derived for particular source terms.

An approximate analytical solution of the discrete coagulation equation is obtained for an arbitrary initial distribution and a general form of the coagulation coefficient, that encompasses most of the forms used in practice. The classic Smoluchowski solution for monodisperse initial distribution and constant β_{ij} is thus extended. The approximate nature of the solution arises from the solution for the total number concentration $N_{\infty}(t)$, in which certain moments of the distribution must be assumed constant. In implementing the solution these moments can be updated as a function of time, so that the present solution can be viewed as an alternative to direct numerical solution of the coagulation equation.

An approximate analytical solution of the discrete coagulation equation is obtained for an arbitrary initial distribution and a general form of the coagulation coefficient

$$\beta_{ij} = c_0 + \sum q = 1Qc_0q_1q_2q_3,$$

that encompasses most of the forms used in practice. The classic Smoluchowski solution for monodisperse initial

distribution and constant β_{ij} is thus extended. The approximate nature of the solution arises from the solution for the total number concentration $N_{\infty}(t)$, in which certain moments of the distribution must be assumed constant. In implementing the solution these moments can be updated as a function of time, so that the present solution can be viewed as an alternative to direct numerical solution of the coagulation equation.

The most important characteristics of the swarm were the distributions of their masses and velocities. The velocities of the bodies were determined by their mutual perturbations and collisions and, consequently, depend on their masses. The mass distribution in turn depend on the velocities: at higher velocities smaller bodies were split up and the mass distribution changed. Therefore, in principle, it is necessary to consider jointly the evolution of these distributions in the process of accumulation of bodies.

CORRELATION OF THE 620.2 nm AND 661.4 nm DIFFUSE INTERSTELLAR BANDS IN CEPHEID SPECTRA

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An investigation of diffuse interstellar bands (DIBs) is one of the actual problems of modern astrophysics and astrochemistry. The interstellar absorption bands were discovered at the beginning of the last century, but scientists still have not identified their carriers. Some progress in this area is possible, when we will define "families" of known DIBs. By "families" we mean correlations of bands basic spectral characteristics.

In the research, we select two well-defined DIBs at wavelengths of 620.2 nm and 661.4 nm for an investigation their correlation. The spectra of selected stars received over a long period of time for several phases. This makes it possible to determine the shifts of the central wavelengths of the DIBs and to objectively analyze their profiles.

DEPENDENCE OF THE PRECESSION PERIOD OF EXOPLANETS IN BINARY STELLAR SYSTEMS ON INITIAL PARAMETERS

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We discuss the evolution of the osculating orbital elements of the zero-mass third body in a restricted problem of 3 bodies as the function of initial conditions. The computer program was elaborated, which allows computation of 2D and 3D trajectories of the third body, as well as an "osculating ellipse" for a trial point at the trajectory. Such trajectories may describe the motion either of exoplanets or asteroids around one of the components, or around an inner binary stellar system. A grid of numerical models

was calculated. The time series analysis of variations of orbital elements and related parameters was carried out. Results are compared to characteristics of positive and negative superhumps in cataclysmic variables (dwarf novae and nova-like systems), which are explained by a precession of the accretion disk.

ДИФФУЗНЫЕ МЕЖЗВЕЗДНЫЕ ПОЛОСЫ. КВАНТОВО-ХИМИЧЕСКИЕ РАСЧЕТЫ АДСОБЦИЙНОГО СПЕКТРА ФУЛЛЕРЕНОВ.

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Диффузные межзвездные полосы (DIBs) – это набор приблизительно 500 полос поглощения, которые наблюдаются в спектрах звезд разных спектральных классов. Первые DIBs были обнаружены в видимом спектре более века назад. В настоящее время DIBs наблюдаются от ближнего ультрафиолета до ближней инфракрасной области в спектрах звезд разных спектральных классов. За их появление ответственны различные участки межзвездной среды как в нашей, так и в других галактиках.

В некоторых случаях полосы DIBs (661.4 λ , 551.7 λ) имеют сложную структуру, подобную структуре молекулярных спектров многоатомных молекул, а именно имеет Q - P - R - ветви. Считается, что носители DIBs это сложные полициклические ароматические соединения (ПАН), которые имеют от 10-60 атомов углерода.

В нашей работе асчёт спектров молекул проводился в программном пакете Orca для расчётов методами квантовой химии. Полуэмпирическим методом ZINDO/S проведены предварительное оценочное квантово-химическое моделирование адсорбционного спектра фуллеренов C₆₀, C₆₀⁺ в видимой и в ближней инфракрасной областях спектра. С целью получения более точных результатов временно-зависимой теорией функционала электронной плотности(TDDFT) на кластере рассчитаны уточненные электронные характеристики. Результаты обсуждаются.

REFINEMENT OF STATUS OF METAL-POOR STAR HD 6268

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Using the spectral material obtained with echelle-spectrograph HRS fed by Southern African Large Telescope (SALT) we have determined stellar parameters and abundance of 30 chemical elements in the atmosphere of metal-poor star HD 6268. The obtained results were com-

pared with those of other authors, and also with the stellar and galactic evolution predictions.

MOLYBDENUM AND RUTHENIUM: PROBLEMS AND PROSPECTS FOR THEIR SOLVING

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We present a brief overview of the molybdenum and ruthenium abundance determinations in stars belonging to different substructures (populations) in the Galaxy. The present-day nucleosynthesis calculations, as well as main sources responsible for the production of molybdenum and ruthenium, have been discussed. Major advances in this area, as well as remaining problems, have been exemplified by recent studies of the Galactic halo and disc stars. Several ways to solve these problems have been proposed.

ON- AND OFF- STATE GENERATIONS IN THE CASE OF THE LOW MASS ACCRETION RATE ACCRETION DISK.

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In the given work we have calculated the donor's wind and the accretion disk model with the low mass accretion rate in disk (order of 10^{-10} Solar mass/year) on the base of microquasar, Cyg X-1 close binary system. The calculations show that in this case donor's wind dominates L₁-stream and ON and OFF states are generated in disk with some speciality. It means that the key parameters of ON- and OFF-states generation in disk show that firstly: the modulation of mass accretion rate in disk in time is very strong and ON-states in this case are very narrow, order of 0.2 – 0.3 of precession period (possibly such the result occurs because of that mass flux of the donor's wind flowing in disk is very wide geometrically and it produces the very narrow mass accretion rate modulations in ON-states); secondly: the difference between ON- and OFF-states for the central disk temperature is order of three times only and it is very low value for the generation of ON- and OFF-states (for comparison, in the case of high mass accretion rate in disk, order of 10^{-8} Solar mass/year, this difference was order of 100 – 200 times). Thus, the quantitative expressions of the mass accretion rate disk time behavior and the central disk temperature time behavior show that the generations of On and OFF states for the relatively low mass accretion rate in disk, order of 10^{-10} Solar mass/year for microquasar Cyg X-1 have two essential speciality: the very narrow in time ON-states and a small amplitude of the central disk temperature modulations (300 – 400 eV for OFF-states and 5 – 40 eV for ON-states). The last result may be occur because of the relatively low density in the disk center in ON-states. In principle, on the other hand, we think that to compute the full picture of ON- and OFF-state generations in the case of low mass accretion rate in disk the very long computational times are required, order of 100 – 200 precession periods at least.

THE PHOTOMETRICAL V-R-I SYSTEM OF THE TELESCOPE AZT-3 WITH CCD ICX 429ALL

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We present the results of study the photometrical system of the telescope AZT-3 (Mayaki observational station of the Astronomical Observatory, I. I. Mechnikov Odessa National University). The telescope AZT-3 ($D = 480$ mm, $F = 2025$ mm) equipped with radiation detector CCD SONY ICX 429ALL in Newtonian focus is used for photometrical study the variable stars.

We observed open NGC 188 cluster in V-R-I Johnson filters as photometrical standard. We determined constants for recalculation our data obtained in the instrumental photometrical system to standard V-R-I magnitudes.

THE PHOTOMETRICAL V-R-I SYSTEM OF THE TELESCOPE ZTS-702 + SBIG CCD ST-7

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We present the results of study the photometrical system of the telescope ZTS-702 (Kalinenkov Astronomical Observatory, of the V.O.Sukhomlinsky Nikolaev National University). The telescope ($D = 702$ mm, $F = 2806$ mm) equipped SBIG CCD ST-7 allows to study the variable stars and other celestial objects in the field $5' \times 8'$ with the scale 0.67 arcsec⁻¹.

We observed open NGC 188 cluster in standard V-R-I Johnson filter as photometrical standard. We showed the difference between instrumental ZTS-702 photometrical system with the standard one is small and determined constants for recalculation our data into V-R-I magnitudes.

THE OBSERVATION V724 AQL IN THE KALINENKOV ASTRONOMICAL OBSERVATORY IN 2015 AND 2018

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We present the results of observations CBS V724 Aql in the Kalinenkov Astronomical Observatory at the sea-

sons 2015 and 2018 in concordance with “Observational program for stars with varied periods” of the observatory. 34 minima times, were collected by Kreiner et al. [1] allow to assume apsidal motion as a reason for period varies. Our observations have been performed, using the 70-cm telescope at the Kalinenkov Astronomical Observatory of the Nikolaev State University, equipped with a SBIG ST-7 CCD camera in the instrumental photometric system close to the standard V-R-I. The light curve and O-C variations of V724 Aql are discussed.

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MOLYBDENUM ABUNDANCE IN SOME OPEN CLUSTERS

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The results of determining the molybdenum abundances in stars of NGC 2477 and NGC 2506 open clusters are presented. The abundance determination carried out by the synthetic spectrum method using the LTE approach. The high resolution spectra were obtained with a VLT telescope at the European part of Southern Observatory (Chile).

ORBITAL ELEMENTS OF THE THIRD COMPONENTS IN THE SHORT-PERIOD BINARIES ZZ CAS, BF VIR, AR LAC AND CC HER

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We investigated 4 eclipsing binary stars: ZZ Cas, BF Vir (both are β Lyrae type), AR Lac and CC Her (both are Algol type). These stellar systems drew our attention because of the specific shape of O-C curves. They were cyclic but with clear assymetry. To compile the minima timings and plot the O-C curves, we used the data from the international database BRNO and our determination of times of minima by using the AAVSO observations. We supposed that the cyclic shape is caused by the presence of the third component in the system and assymetry might be due to elliptical form of orbits. For all four systems, we estimated parameters of the third body’s orbit and calculated its minimal possible mass using least squares method with weights. For all cases, the masses of the third components were large enough to be stars.

In addition, for three systems (BF Vir, AR Lac and CC Her), the cyclic O-C changes were superimposed with parabolic trend which corresponds mass transfer between

components of the binary system. For these 3 stars, we computed the rates of the mass transfer.

Finally, we estimated the statistical errors of all parameters.

ON THE IRREGULAR VARIATIONS IN THE LIGHT CURVES OF RY VUL

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The star RY Vul according General Catalogue of Variable Star (GCVS) is RR Lyr variable, but period and initial epoch are unknown.

To determine these parameters the photometric observations during several seasons in 2011-2017 of the variable star RY Vul on the Astronomical station near Odessa have been carried out.

The 48-cm telescope reflector AZT-3 equipped with CCD photometer was used. The light curves in V and R band were obtained and analyzed.

It turned out that the light curves of the star is fully irregular. Therefore, the variable star RY Vul should be attribute to type "irregular variables".

SPECTROSCOPIC INVESTIGATIONS OF GALACTIC CLUSTERS WITH ASSOCIATED CEPHEID VARIABLES.

I. NGC 5662 AND V CEN.

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New spectroscopic observations of 14 stars and Cepheid V Cen obtained using 11m SALT are presented for open cluster NGC 5662. The resulting radial velocities, rotating velocities, atmosphere parameters and chemical composition are used for a detail cluster analysis. Due to recent parallax data obtained by GAIA we found out that two stars from the list (HD 127818 and CPD -55 6072) are not the cluster's members. Two K-giants (HD 127733 and HD 127753) are lithium-rich stars, whereas HD 127427 is an ordinary yellow giant. Other nine objects are the cluster's main-sequence stars, there HD 127866 is a "turn-off

point" star. Comparison of chemical composition between Cepheid V Cen, main-sequence stars and K-giants had been carried out. Using the radial velocities, parallaxes and proper motion values of these stars we were able to create the 3D- kinematic model of NGC 5662.

SPECTROSCOPIC INVESTIGATIONS OF GALACTIC CLUSTERS WITH ASSOCIATED CEPHEID VARIABLES.

II. POLARIS CLUSTER AND ALPHA UMI.

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New spectroscopic observations of 11 stars that can be members of nonnamed open cluster associated with Cepheid Polaris were obtained using 0.8m TCO telescope. The resulting intrinsic colours, effective temperatures, radial velocities are used for a detail cluster analysis. Due to radial velocities and recent parallax data obtained by GAIA we were able to check these stars to the cluster's membership. Using the radial velocities, parallaxes and proper motion values of these stars we were able to create the 3D- kinematic model of Polaris cluster.

THE ABUNDANCES OF HEAVY ELEMENTS IN LOCAL GROUP GALAXIES. CEPHEIDS IN LMC AND SMC.

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The identification of absorption lines of heavy lanthanides and other r- s-process elements were performed in the spectra of 31 cepheids of Large and Small Magellanic Clouds. We tried to identify the lines of elements which were not investigated in the atmospheres of these stars earlier. The derived abundances are used to investigate the history of chemical enrichment of interstellar medium in the Clouds.

KINEMATICS OF THE MILKY WAY FROM VELOCITIES OF YOUNG RED CLUMP GIANTS USING THE PMA AND TGAS DR2 DATA

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We selected ~22,000 young red clump giants from ~7.2 mln Gaia DR2 stars for which full information: coordinates, distances, proper motions, radial velocities, G-magnitudes, is known. To do it we used $M_{KS} - (J-K_S)_0$ diagram. Here M_{KS} is the absolute magnitude in 2MASS K_S passband, $(J-K_S)_0$ is the dereddened color equal to $(J-K_S)_{obs} - E(J-K_S)$. To correct the absolute magnitude and color for extinction and interstellar reddening the Gontcharov's 3D stellar reddening map (Gontcharov, 2017) was applied. From these data kinematic parameters using the 3D and 2D Ogorodnikov-Milne models (OMM) were derived. The results derived were compared with ones derived from the PMA catalog data.

We can conclude that there are some differences between values of parameters derived from 2D and 3D models. For instance, the deformation parameter M_{12}^+ is $3.10 \pm 0.08 \text{ mas yr}^{-1}$ in the 3D case versus $2.94 \pm 0.11 \text{ mas yr}^{-1}$ in the 2D case while the ω_3 remains unchanged and equal to $-2.91 \pm 0.08 \text{ mas yr}^{-1}$. This leads to differences between values of circular rotation velocity of the Galaxy at the solar distance which we accept to be $8.0 \pm 0.2 \text{ kpc}$ (Vallee, 2017): $V_{rot} = 228.0 \pm 0.5 \text{ km s}^{-1}$ vs. $221.7 \pm 0.6 \text{ km s}^{-1}$ for the 3D and 2D OMM models respectively. The ω_1 , ω_2 and M_{13}^+ parameters are significant in both cases and do not differ much. As for M_{23}^+ , it is not significant within 3σ . Also we note that the contraction-expansion parameter along the X galactic axis M_{11}^+ is significant and equal to $-1.70 \pm 0.11 \text{ mas yr}^{-1}$ while M_{22}^+ and M_{33}^+ are insignificant within 3σ .

In addition, the 2D OMM parameters were derived from the PMA proper motions. As a result, we have found that the value of V_{rot} derived from the PMA data is lower by 10 km s^{-1} compared to one derived from the Gaia DR2 data mainly due to differences between values of the M_{12}^+ OMM parameter ($M_{12}^{+(PMA)} = 2.64 \pm 0.12 \text{ mas yr}^{-1}$): $V_{rot}^{(PMA)} = 211.9 \pm 0.7 \text{ km s}^{-1}$.

SMALL-SCALE ACTIVITY OF THE FLARE STAR YZ CMi

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Photometric monitoring of the flare star YZ CMi ($U = 12.9$, $B = 12.7$, $V = 11.1$) was carried out on the Zeiss-2000 telescope at the Peak Terskol Observatory. We used a high-speed two-channel photometer with time resolution of 0.1 s in the U band. These observations confirmed the presence of small-scale high-frequency oscillations (HFO) during ordinary flare events. Here we examine small-scale flare events with amplitudes of about 0.1 mag and less, when the signal-to-noise ratio for such an events is close to unity. We used the Fourier reconstruction method to obtain significant harmonics in the signal spectrum, which theoretically allows to reconstructing the noisy light curve. Here we present a complete analysis of several YZ CMi small-scale flares detected during the monitoring in 2007 and 2012, analyzed to estimate their HFO properties,

and considered in the network of a time-dependent phenomenological model of flares.

GAIA DATA RELEASE 2: THE PROBLEMS OF THE SOLAR NEIGHBORHOOD

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The sample of objects with parallaxes more than 0.1 arcsec, which were included in the TGAS catalogue [1] (first version of Gaia space mission), were 25% larger than the number of stars that were known earlier and obtained from various ground-based observations [2]. The qualitative composition of this sample is not fundamentally different. Another situation has developed with the appearance of the results of the second version of the catalogue – Gaia DR2 [3]. Upon preliminary analysis of this version, the number of objects that belong to the region 10 closer to the PC from the Sun is 1722. This is more than three times higher than their expected value of the spatial density of stars [2]. Most objects in this sample (~80%) are stars about 20–21 stellar magnitudes in the G band [4].

In this paper, we discuss the reliability of all detected objects to the Solar neighborhood. Astrometric and photometric data from large modern catalogues created on ground observations such as PMA [5], Pan-STARRS (PS1) [6] and SDSS-DR12 [7] were used to solve this task.

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DURATION OF BURNING HELIUM IN STELLAR INTERIOR

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Using literature data [1–11], the approximation formulas that describe the relation "helium burning lifetimes – initial stellar mass" are derived on the content of heavy chemical elements Z (in the range from 0 to 0.1). The maxima of the obtained dependences correspond to the boundary values of the stellar mass (M_{deg}), in the case of bigger values helium burns in the stellar interior in which the electrons are in a nondegenerate state. Regularities revealed in the dependences constructed from the approximation formulas were obtained, on Z .

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SUBSECTION “ASTROINFORMATICS”

GAIA DR2 - FIRST RESULTS OF ASTROMETRIC ANALYSIS

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The new big catalogues of proper motion were created using of GaiaDR1 data. The names of these catalogues are HSOY, UCAC5, GPS1 and PMA. On April 25, the second Gaia Data Release was published. In this work we present the analysis of contents and properties of Gaia DR2 catalogue. The estimation of systematic and random errors of the stellar proper motions of the PMA, HSOY, GPS1, UCAC5 and Gaia DR2 catalogues in the faintest stellar magnitude range had been done via an analysis of formal proper motions of extragalactic objects are containing in these catalogues. From a comparison of Gaia DR2 data with same stars from the UCAC5, PMA, GPS1 and HSOY catalogues, the equatorial components of the mutual rotation vector of these coordinate systems were determined. The angular velocities of mutual rotation of the Gaia DR2 and UCAC5, PMA, GPS1, HSOY reference frames change within range from 0.2 to 2.0 mas/yr.

THE CATALOGUES ANALYSIS OF STARS EQUATORIAL COORDINATES AND B-MAGNITUDE OF THE FON PROJECT

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The comparison results of three catalogues (FON-Kiev, FON-Dushanbe and FON-Kitab) received as result work of the FON project, are presented in the paper. The data of zero zone (from -2 to 2 degrees of declination) from the mentioned catalogues was used during research.

The number of common objects after cross-match of catalogues with a circular search window equals to 1.5 arc seconds was more than 500 thousands. The estimation of random accuracy of stars positions from the mentioned catalogues was performed by the Wielen method. Final dispersions were calculated for every sub-range of magnitudes. The stars with individual differences of position and magnitude that exceed three standard deviations were rejected.

The data from catalogues PMA and Gaia DR2 was used for estimation of the systematic errors. It is obvious that the internal estimates of position accuracy of stars in the compared catalogues are low in one or all catalogues, and additional research is required. Analysis of the behaviour of the systematic differences and standard deviations of the stellar

magnitude of these catalogues have shown that there are a big values reaching 1 magnitude only in small sky regions. However, the internal accuracy that presented in catalogues is well matched with the systematic differences and standard deviations in the other sky regions.

MODERN STATISTICAL APPROACH TO ASTROMETRIC DATA TO DETECT OF VARIOUS INCREASING OF STELLAR DENSITY IN THE GAIA DR2 DATA

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Star catalog Gaia DR2 contains information only about dot objects. However, it is possible to obtain separate structural star objects using the wavelet analysis of catalog data. Among such: spherical and scattered clusters, nebulae and galaxies. In particular, analyzing globular clusters in the Milky Way galaxy, with the data of the entire complete and accurate astrometric catalog to date, it is possible to study qualitatively the kinematics of rotation of our galaxy at a new level.

With the help of the wavelet analysis of the GAIA DR2 catalog, we received information on the stellar sealing. For this purpose, we used the set of developed filters based on mathematical methods of data processing. Further, the separation of class objects from the background stars was made, which allowed to obtain high-precision proper astrometric parameters of stellar structures, as well as their preliminary classification. In this paper, special attention is given to globular star clusters.

ASTEROIDS EXPLORATION WITH BALDONE SCHMIDT TELESCOPE

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CCD observations of the asteroids are obtained with the (aperture/diameter/focal length =80/120/240 cm) Baldone Schmidt telescope of the Baldone observatory (code 069) of the Institute of Astronomy of University of Latvia. In the Minor Planet Circulars and the Minor Planet Electronic Circulars we published 5434 astrometric positions of 1488 asteroids. Among them, 76 asteroids were newly discovered at Baldone. The precise orbits were calculated with OpenOrb 4.2. The evolution of orbital elements of interesting asteroids, (428694) 2008 OS9 from the Apollo group and the Centaur (330836) Orius (2009 HW77), were calculated.

Schmidt telescopes are used to produce high-quality large field star images, which in many ways outweighs all other telescopes with similar aperture diameters. Now, these telescopes are no longer optimally used in the world, due to the technological transition to electronic sensors for the use of space imaging. Schmidt cameras have very strongly curved focal planes, thus requiring that detector be correspondingly curved, therefore in the past, the photographic astroplates on which the stellar images were captured were curved. Technologically going to a new type of image object acquisition, from photography to the use of video sensors, we encounter an unresolved problem – how to match the curved large-scale telescope’s focal surface with the surface of a flat-light imaging sensor.

The team of Institute of the Astronomy has succeeded in design and calculation of a small optical circuitry that would enable the Schmidt telescope optical system to be improved by inserting an additional optical system in the telescope, forming a flat telescope focal surface that coincides with the surface of the flat-beam receiver. This upgrade of optical system makes it possible to use the existing high-field flat-panel video sensors without loss of quality, at relatively low cost, without the expensive Schmidt telescope reconstruction. We have designed additional optical system integrated into Baldone Schmidt telescope and as a result we got a flat focal plane. Two large (4096 x 4096 pixels) CCD cameras which cover two square degrees of the sky with the resolution of 0,9 arc sec per pixel are installed on cassette holder of the Baldone Schmidt telescope.

BALDONE 1.2M TELESCOPE PLATE ARCHIVE - HIDDEN RESERVES OF THE FON PROJECT

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The plate archive of the 1.2 m Baldone telescope (Latvia) has approximately 780 and 4660 astronegatives exposed in 1967-1993 in the U (ZU21 + UG1 filter plates) and V (A600N + ZS17 filter films) closed to Johnson system U and V passbands. Digitization of astronegatives is carried out using the Epson Expression 10000XL scanner, the scanning mode is 1200 or 2400 dpi, each field covers 21 square degrees of sky. The astrometric and photometric reduction of digitized astronegatives is done in the Tycho-2 and U, V photoelectric system respectively. At this report, we present first results of reduction of more than 2000 astronegatives. Data of U and V magnitudes of stars and galaxies will be used as the photometric addition to the FON project, without, the long-term series of U, V observations have an independent value for studying the variability of stars. Also, many plates included open clusters and will be used for investigation of their population and photometric parallaxes.

THE PROJECT OF PROTOTYPE INTERACTIVE DATABASE FOR VARIABLE STARS WHICH WERE OBSERVED IN THE CRIMEAN ASTROPHYSICAL OBSERVATORY

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The exponential accumulation of astronomical research results, which is associated with the usage of up-to-date technologies for recording and processing observations, needs an innovative approach to the problem of data storage and analysis. This is primarily caused by the development of methods for working with large databases (BigData), which are becoming increasingly important for solving fundamental problems of modern astrophysics.

The significant observational material has been accumulated and is still being accumulated at the Crimean Astrophysical Observatory of RAS. It involves tens of thousands of photographic negatives and hundreds of thousands of images of astronomical objects obtained with electronic radiation receivers for more than a hundred-year history of observations. The authors of the Project have acquired experience in digitizing the observational material of the Observatory's glass library and papers published in the journal "Izvestia of Crimean Astrophysical Observatory". The first steps have been taken to organize a network access to information.

When implementing the project, it is expected to develop a technology for converting a variety of observational material into the interoperable formats supported by the International Virtual Observatory. Specific examples will demonstrate the possibility of analyzing the state of objects on time intervals from decades to days. The results of the Project will allow the astronomical community to access the rich heritage of our observatory and conduct researches compared to the newly obtained data.

THE SIMEIZ ASTROPLATE CATALOGUE OF THE ODESSA ASTRONOMICAL OBSERVATORY: DIGITIZATION AND PLACEMENT IN DATABASES

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We describe briefly the Simeiz Astronomical Plate Archive, which is now a part of the Odessa Astrophotonegative Collection. The archive contains of about 8000 plates obtained during the period 1909-1953 with the 2x120 mm astrograph. This 44-year observational archive is an important resource for research in positional astronomy, kinematics and dynamics of celestial bodies, astrophysics. The Simeiz Astroplate Archive contains mainly of observations of minor bodies of the Solar system (asteroids), planets and their satel-

lites. Several hundred plates contain of images of various another objects and phenomena: comets and variable stars, lunar eclipses, etc. The Ultimate Photographic magnitudes of direct plates are 12^m.5 - 16^m.9. In 2013 – 2015 a part of this archive was digitized using the flatbed scanner EPSON Perfection V700. Recently we started work to process the meta-data of these astroplates in the machine-readable catalogue compatible with the IVO-WFPDB standards. Information on the processed astroplates is keeping in the Joint Digitized plate Archive of the Ukrainian Virtual Observatory (UkrVO DBGPA V2.0, <http://ukr-vo.org>) and in the Wide-Field Plate Database (Sofia, IVO-WFPDB, <http://www.wfpdb.org>).

DEVELOPMENT AND IMPROVEMENTS OF COMPUTATIONAL METHODS IMPLEMENTED TO COLITEC SOFTWARE

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The CoLiTec software is a large complex of processing modules that implement computational methods for the different purposes: brightness equalization of CCD-frames; automated calibration of the frames by bias-, dark-frame and flat-field for reducing the dynamic range of brightness of the image background; frames track & stack; automated rejection of the anomaly pixels; automated excluding of the objects with anomaly errors; determining the equatorial coordinates of small Solar System objects; accurate parameters estimation of objects in frames; stars identification in the frames; plates solution; cross identification with astrometry catalogues; ensemble differential photometry using comparison stars; determining the instrumental brightness of stars in CCD-frames; automated light curve creation; detection of very slow and very fast objects in series of CCD-frames; immediate detection of objects with a near-zero apparent motion in series of CCD-frames.

The described methods work with the different forms of objects (point, long, stroke) and during the different observational conditions (with daily telescope guidance and without it). These methods lead to increasing of the astrometry and photometry accuracy indicators as well as the quality indicators for detection of the small Solar System objects in series of CCD-frames.

The CoLiTec software is widely used in the different observatories. In total, it was used for about 700 000 observations and discovery of more than 1560 asteroids, including 5 NEO, four comets (C/2011 X1 (Elenin), P/2011 NO1 (Elenin), C/2012 S1 (ISON) and P/2013 V3 (Nevski)), 21 Trojan asteroids of Jupiter and 1 Centaur.

We are working on the improvements of computational methods and algorithms for automated detection of small Solar System objects in series of CCD-frames to increase the accuracy of astrometry and photometry reduction.

PROCESSING'S RESULTS OF SELECTED WDS MULTIPLE STAR SYSTEMS

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The results of selected multiple star systems CCD observations, which were carried out at the KT-50 telescope of the Research Institute "Mykolaiv Astronomical Observatory" during the 2016-2018 years are presented. The Washington catalog of double stars (WDS) was used for observational list. Astrometric reductions of the CCD frames with multiple system components at the current epoch were performed. The combination of the CCD received data with other Strasbourg base catalogs allowed to determine the new values of stars proper motions. Parameters of mutual component configuration (position angle and separation) were also measured for the components of the multiple star systems using REDUC software. The measures standard errors were 0.05" for separations and 0.2° for position angles.

HIGH-PRECISION FOLLOW-UP OBSERVATIONS OF NEAR-EARTH OBJECTS

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We present the latest results of ongoing high-precision astrometric follow-up observations of Near-Earth Objects (NEOs) using the telescope KT-50 of RI "MAO" Mobitel Complex. The combination of classical and modified observational mode allows us to recover targets having $V < 17$ with high astrometric precision. The comparative statistics of Mykolaiv observations of NEOs for the period 2015-2018 are presented. The results of the study of the effect of new observational data on the residual differences (O-C) with respect to modern ephemerides are shown.

PROGRESS IN THE REALIZATION OF THE PROJECT "FON-DUSHANBE CATALOGUE"

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Since May 2018 the process of the scanning and processing of photographic plates from the archive of the Institute of Astrophysics Academy of Sciences of Tajikistan has begun. It is a matter of approximately 1560 photographic plates in the sky zones from -8 to +90 degrees that were exposed for the FON project in the Hissar observatory (HissAO) during 1985-1992. The plates are digitized by using of the scanner Microtek ScanMaker 1000XL Plus with the resolution of 1200 dpi. The size of the photographic plates is 8°x8° or 30x30 cm, the size of the digitized images is 13000 x 13000 px. So far the first results of the processing of the 71 plates of zero zone and the 58 plates of 64, 68 and 72 zones were obtained. The errors in the definition of

equatorial coordinates and B-magnitudes for the stars in the range of 5^m – 17^m are the following: $\sigma_{\alpha\delta} = \pm 0.33''$ and $\sigma_B = \pm 0.12^m$. The differences between the calculated positions and B-magnitudes and the reference one from the Tycho2 catalogue are $\sigma_{\alpha\delta} = \pm 0.12''$ and $\sigma_{BT} = \pm 0.19^m$ respectively.

The difference between the calculated and the photoelectric B-magnitudes equals $\sigma_B = \pm 0.15^m$. In the realization of the “FON-Dushanbe catalogue” project five astronomical institutions are involved: Institute of Astrophysics of AS of Republic of Tajikistan; Walter Hohmann Observatory, Essen, Germany; Ulugh Beg Astronomical Institute UAS, Uzbekistan; Research Institute “Mykolaiv Astronomical Observatory”, Ukraine and Main Astronomical Observatory NASU, Ukraine.

ANALYSIS OF MASS CCD OBSERVATIONS TO IMPROVE THE ACCURACY OF ASTROMETRIC PROCESSING

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In RI MAO regularly observation of fields with open clusters are carried out on the KT50 telescope (D = 500 mm, F = 3000 mm) with an Alta U9000 CCD camera (3k × 3k, FOV 42.6' × 42.6') in drift scan mode. For this observation mode, we investigated the dependence of the (O-C) of reference stars on X (direction perpendicular to the direction of charge transfer) in the CCD coordinate system. The data of observations of open clusters obtained in the RI MAO in 2013-2017 were used for the study. The data array used to obtain the distribution (O-C) for Ra and Dec, depending on X, contains 62 million single observations of stars. The processing of the original data was carried out using the Astrometrica program with the reference catalog UCAC4. The distribution of the (O-C) value as a function of X according to Ra and Dec was obtained by the method of least squares. For the solution is a 10th-degree polynomial of X and a third degree from the integral intensity of the object in the image was used. The study showed the presence of significant (0.01-0.02)'' systematic errors in the field of the matrix for bright stars (10-12)^m. For faint stars, the amplitude of the constant part decreases significantly while maintaining the periodic component. Similar studies have also been carried out for a lot of CCD frames obtained from astronomical databases for other instruments. The results will be used to improve the accuracy of astrometric catalogs obtained with the KT50 telescope and to improve the accuracy of the proper motions of stars in the vicinity of open clusters.

CATALOGUE OF STARS PROPER MOTIONS IN +65° – +90° ZONE BY USING IMAGES FROM UKRVO PLATE ARCHIVE

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UkrVO plate archives contain information obtained at different years and in different observatories for the same regions of the sky. It allows us to carry out their joint processing and to receive new results for interesting ob-

jects. To obtain proper motions of stars in circumpolar areas we used two epoch from RI MAO archive (observed epoch 1929-1931 and 1972-1975) and GAIA catalogue.

We scanned 202 plates for first epoch and 242 plates for second epoch from RI MAO archive. Scanning was carried out by using 6 scans with a resolution of 1600 dpi. The raw image processing was carried out by using the MIDAS/ROMAFOT package to obtain (X, Y) coordinates. Star identification and astrometric reduction in the Tycho-2 system was carried out by using own software. We processed all plates and two catalogues in declination zone of 65° to 90° was compiled. First catalogue contains near 2 million objects up to 15^m at 1930.4 mean epoch. Standard deviations of equatorial positions are $\sigma_\alpha = 0.12''$ and $\sigma_\delta = 0.17''$. Second catalogue contains more than 2 million objects up to 15^m at 1973.7 mean epoch. Standard deviations of equatorial positions are $\sigma_\alpha = 0.13''$ and $\sigma_\delta = 0.19''$. Compile catalogue contains star proper motions for common stars with GAIA catalogue. A comparison of catalogue with several astrometric catalogues was conducted.

RESULTS OF PROCESSING OF CCD OBSERVATIONS OF SELECTED OPEN CLUSTERS ON MAIDANAK

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Observations of 20 open clusters at the Maidanak Observatory were performed using the Zeiss-1000 telescope in the winter of 2018. As the light receiver, a CCD camera Apogee Alta U9000 (3K x 3K, FOV 19.5'x19.5') was used. All observations were performed using BVRI light filters. The exposure time, depending on the filter was from 60 to 150 seconds. Due to the instability of the telescope, images of the stars are slightly elongated. For each observation night, calibration images were obtained. Astrometric processing was carried out after filtering the hot pixels. For testing purposes, we used two methods of reduction: by the Astrometrica program and the author's set of programs with primary processing in the MIDAS environment. The reduction of 280 frames was performed using a polynomial of the third degree. As reference stars in different processing options, the Tycho2, UCAC4 and GAIA catalogs were used. Due to the small field and the small number of reference stars, the processing in Tycho2 showed the worst result. The results obtained by author programs with reference catalogs UCAC4 and GAIA, showed good convergence. Integrated catalog of 18 thousand stars upto 18.5m was obtained. The accuracy of the catalog is $\sigma_{RA} = 0.011''$ and $\sigma_{Dec} = 0.013''$, the accuracy of single observation on RA (0.030 - 0.032)'' and DEC (0.035 - 0.037)''". At the same time, the accuracy of intra-frame processing with the GAIA reference catalog turned out to be 2-3 times better than the analogous one with the UCAC4 catalog. The accuracy of processing elongated

star images by the Astrometrica program is on the average 3-4 times worse than by the author's programs. Also a systematic dependence of the pixel scale on the using filter was found. Based on the results of the test photometric processing of NGC869 cluster a photometric estimate of the accuracy of the observations was obtained. The internal errors of one measurement of the stellar magnitude in the instrumental system bvr have the values $\sigma_{bvr} = \pm 0.03-0.05^m$. After the reduction of instrumental stellar magnitudes to the Johnson BVR system, the errors of one measurement are $\sigma_{BVR} = \pm 0.05-0.08^m$. The processing of observations showed the possibility of carrying out differential observations on the telescope Zeiss-1000 with an accuracy of one observation, not worse than $0.04''$, and near $0.02''$ after improved telescope management.

ASTERIODS SEARCH RESULTS IN DIGITIZED OBSERVATIONS OF THE KITAB PART OF THE NORTHERN SKY SURVEY PROJECT

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About 2,000 photographic plates from 0° to -18° of Kitab part of the Northern Sky Survey (FON) project were made using Double Wide Angle Astrograph at the Kitab observatory, Uzbekistan during 1981-1989. Using that digitized observations the catalogue of equatorial coordinates and stellar magnitudes for 13 413 268 stars and galaxies up $B \leq 17.5^m$ was composed. At present, we analyzed the processing results for the search for asteroids and compilation of the catalogue of its equatorial coordinates and stellar magnitudes.

As a result more than 3,000 asteroids with visual magnitude from $9^m.8$ to $17^m.4$ were identified now. All positions of asteroids were compared with ephemeris. A comparative analysis of O-C differences was carried out.

New and interesting is that the moments of discovery of several identified asteroids much later than their moments of observation. In addition a few observations of asteroids of the Kitab part of the FON project are the earliest known observations in the world of these asteroids.

GENERAL CATALOG OF STARS WITH SOLAR TYPE ACTIVITY

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A new Catalog of stars with solar-type activity is presented in the report. A brief history of the compilation of the Catalog is described. The new Catalog includes data obtained through the implementation of GAIA, SDSS, Kepler, Pan-STARRS, Catalina, HATNet projects and information from the SIMBAD, VSX, MORX databases. The catalog contains information from publications about

the activity of red dwarfs from the SAO/NASA ADS database. The report is illustrated by statistical data on various types of activity of stars included in Catalog.

NEW APPROACH FOR ANALYSIS OF THE X-RAY DATA IN CORES OF GALAXY CLUSTER

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We discuss methods, which are used for analysis of the X-ray observational data to obtain a distribution of the main physical parameters of cores of galaxy clusters. Usually, it is the binning on the concentration rings around the central parts to calculate the integrated amount of pixels which contain the information on temperature and other parameters of hot diffuse gas, cooling flows etc. as well as allow us to determine the central engine of galaxy cluster (see, for example, our papers by Babyk et al., where methods of the X-ray data processing available through Xspec and other standard programming software were applied). The another approach was developed by Sanders with co-authors (2000-2006), the so-called "contour binning algorithm" (<https://www.xray.ast.cam.ac.uk/papers/contbin/>). Their approach allows us to select contours on an adaptively smoothed map in such a manner that "the generated bins closely follow the surface brightness, and are ideal where the surface brightness distribution is not smooth, or the spectral properties are expected to follow surface brightness". In this paper we discuss another architecture for such a platform, namely, to use a wavelet analysis likely the "Mexican Hat" (Flin, Vavilova, 1997), which allows to determine not only the regions of cores in clusters but also regions occupied by galaxies while processing their X-ray contour binning.

ANALYSIS OF ACCURACY OF ASTEROID COORDINATES FROM DIGITIZED OBSERVATIONS OF THE PROJECT FON-KIEV, FON-KITAB, FON-DUSHANBE

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Photographic observations of XX century is an important source of information on small bodies of the Solar system. The observations of chronologically earlier oppositions, photometric evaluation of brightness for long periods of time allow refining the orbits of asteroids and identifying various non-stationaries. Unfortunately international databases were contained a very little observable

data for accurate estimates of geometric and kinematic parameters of asteroids. Modern approach to processing of photographic observations using new digital technologies provides a sufficiently high accuracy of coordinates and magnitudes for all objects including asteroids.

For a global search for small bodies of the Solar system we analysed the results of digital processing of photographic plates of Northern Sky Survey (FON) project. The Kyiv part of the project includes a strip of sky from -2° to $+90^\circ$. The second Kitab and third Dushanbe parts of the project include a strip of sky from $+2.5^\circ$ to -20° . Asteroid search with Kyiv part of the project is finished. This work with Kitab and Dushanbe parts continues. Therefore now it became possible to compare the positions of asteroids obtained from digitized observations of the FON project at three observatories.

Positions of selected asteroids were compared with ephemeris. We analysed O-C differences for different samples of asteroids and each observatories. The preliminary results of re-processing with GAIA catalogue as a reference was discussed too.

**THE FIRST RESULTS OF PROCESSING
PHOTOGRAPHIC OBSERVATIONS OF SS
BODIES BASED ON THE MATERIALS OF THE
GLASS COLLECTION OF THE ULUGH BEG
ASTRONOMICAL INSTITUTE OF THE UZBEK
ACADEMY OF SCIENCES USING THE NEW
TECHNIQUE**

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The archive of the glass collection of the Ulugh Beg Astronomical Institute (UBAI) of the Uzbek Academy of Sciences contains about 15 thousand of photographic plates. Astronegatives were obtained on the Tashkent Normal Astrograph TNA (Marsden's 192, D/F=330/3438) and the Zeiss Double Astrograph (Kitab, Marsden's 186, D/F=400/3000) in 1985-2004.

At the moment, work is in progress to organize the archive and create a database in a single format. It is expected that the number of observations of the major planets on two telescopes will be more than 300 photographic plates, and observations of asteroids - more than 500. Joint work has begun on processing these photographic observations using the method of reduction of digitized images. This technique was developed and proposed in the MAO NAS of Ukraine. Currently, an insignificant part of the observations of the major planets (23 plates) has been processed in a wide range of brightness of these objects (8^m to 14^m). In total, more than 50 topocentric positions of Neptune, Pluto, Uranus and satellites of Saturn have been obtained. The accuracy of reduction in both coordinates when using the reference system of the TYCHO2 catalog lies in the range 0.08 ... 0.13 arcseconds.

**FIRST RESULTS OF THE SEARCHING OF
ASTEROIDS BASED ON THE DATA OF FON-
DUSHANBE PROCESSED PLATES**

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Dushanbe (Gissar observatory) observational part of FON project consists of about 1550 photographic plates obtained in 1988-1993 on Zeiss-400 astrograph (Marsden's 190, D/F=400/2000mm). Plates dimensions are 30x30 cm, an area covered with plates is from -8 to 90 degrees of northern declination. Recently, plate digitizing and processing have been started using Microtek ScanMaker 1000XL Plus commercial scanner. The resolution of plate images is 1200 dpi. Image processing is conducted using the software proposed and developed in MAO NAS of Ukraine. The result of the processing is the list of astrometric positions of all objects fixed on the plates in the uniform reference system of Tycho-2 stellar catalog. The main purposes of the research are the searching of comets and asteroids that hit the plate during observations and the creation of a catalog of their positions. At the moment, 117 topocentric positions of 104 asteroids and 1 comet are obtained. The searching of objects is carried out using ephemeris of internet service <https://ssd.jpl.nasa.gov/sbfind>.

RADIOASTRONOMY

LOW-VELOCITY PART OF MOLECULAR OUTFLOW IN 17233-3606

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Mapping of the molecular outflow in IRAS 17233-3606 has been performed in the J = 2-1 line of 13CO and C18O molecules using the APEX radio telescope (Chile). A pronounced bipolar structure for this object is shown. This structure was interpreted as a low-velocity part of the molecular bipolar outflow. Estimations of the outflow characteristics were carried out by method for calculation of parameters of the low velocity components of bipolar outflow in molecular clouds. This method excludes the influence of the surrounding stationary cloud on the calculations of outflow parameters. The correction for the effect of optical thickness was using. The outflow parameters for different ranges of velocities were calculated. Distribution of mass per unit velocity interval as a function of velocity for the IRAS 17233-3606 bipolar outflow has been obtained.

RADIO TELESCOPE URAN-4 AND THE PROBLEM OF RADIO INTERFERENCE

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When conducting radio astronomical observations in the decameter wave band, the observational material quality is depends to a large extent on the level and nature of the radio interference. Unfortunately, the interference situation in this frequency range continues to deteriorate, which is confirmed by the results of long-term observations at RT URAN-4. The radio interference can be divided into two groups: remote and local. Remote sources of interference include broadcast radios, communication systems and radar, ionospheric stations. In this case, there is an ionospheric propagation of radio interference. Ways of struggle: carrying out observations at night, when the maximum applicable frequency for possible ionospheric traces is lower than the working frequency of the radio telescope, the use of narrowly directed antennas with small sidelobes, frequency and temporal filtering of interference. The allocation of protected frequencies for the radio astronomy did not solve the problem of remote interference in the decameter wavelength range. Another type of interference is industrial radio interference, which, in general, is of a local nature. The sources of such interference include switching power supplies and special technological equipment, corona dis-

charges on high-voltage power lines and transformer substations, powerful fluorescent lighting devices. Most local sources have a broadband spectrum, which makes it very difficult to suppress them. Therefore, the main method of suppressing local radio interference is their identification and solution of the problem by organizational and administrative methods. To realize this approach, the principal task is to establish a radio telescope guard zone. The presentation discusses some problems associated with the formation of guard zones of radio telescopes and presents the development of a device for localizing interference.

ON THE PROGRAM FOR OBSERVING VARIATIONS IN THE CAS A FLUX IN THE INTERVAL FROM MILLIMETERS TO DECAMETER WAVELENGTHS

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At present, there is ordinary observational material of the secular variation of the Cas A flux in millimeter, centimeter, decimeter, meter and decameter wavelengths conducted separately and independently.

The presence of systematic trends of flux variation at centimeters (0.5% per year) and millimeter (0.47% per year) waves are noted.

At decimeter (0.62-0.71% per year) meter (0.65-0.79% per year) and decameter (0.6-0.89% per year), a noticeable contribution of the influence of the interstellar medium and ionosphere with seasonal daily effects as well as solar and geomagnetic activity. The nature of the influence of these factors increases with increasing wavelength.

Probably the presence of quasi-periodic processes in the radio stream is associated with the evolution of the supernova remnant and the presence of a sharpened x-ray source at the center of the remainder.

At the same time, observations of the evolution of the Cas A flux are usually episodic and do not allow us to trace the nature of the variations in the flux and its dependence on the frequency with simultaneous observations.

The program of conducting quasi-simultaneous observations using radio telescopes of the International Ventspils Radio Astronomy Center (RT-32 RT-16 centimeter range), RT-22 and BSA PRAO (millimeter and meter ranges), and RT URAN-4, UTR-2, GURT (decameter range) RI NANU.

SURVEY OF THE NORTHERN SKY IN ORDER TO FIND SPORADIC RADIO EMISSION SOURCES IN DECAMETER WAVE RANGE. RESULTS

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The world's largest decameter radio telescope UTR-2 has recently accomplished a full survey of the Northern sky in order to find sporadic radio emission sources. As a result, about 100 TB of observational data was obtained and completely processed. A special test was carried out that showed the inability to generate pulses, such as those found, by ionospheric scintillations. For the avoidance of a large number of interference among the candidates, a threshold level of SNR (8 RMS) was introduced which significantly exceeds the level of all signals that we consider to be interference and ionospheric scintillations. There were 380 signals of cosmic origin. Distributions of these signals' dispersion measures, galactic latitudes, SNRs and times of appearance were built. Times' of appearance distribution (during the observational session) is quite uniform. DMs' distribution is similar to the simulated DMs' distribution of known pulsars, which will be observable by the SKA radio telescope in future. SNRs' distribution looks like distribution of the anomalously intense pulses of known pulsars by energies. And, finally, distribution by galactic latitude has much in common with the one of close known pulsars ($DM < 30 \text{ pc/cm}^3$ and $P > 0.2 \text{ s}$).

In present work we estimate the number of potentially available for the low frequency observation sources of sporadic radio emission and compare their number with the obtained results.

Thus, analysis of the detected signals, of the signals' parameters distributions and their comparison with similar distributions for known sources show that the signals found have a cosmic origin and are generated, most likely, by different types of neutron stars.

FEATURES OF APPLICATION OF SDR RECEIVERS WITH USB INTERFACE FOR RADIO ASTRONOMICAL OBSERVATION

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Modern SDR receivers, which are used in decameter radio astronomy, are direct-gain digital receivers with tens MHz bandwidth. These special receivers are capable of operating in a coherent mode with high accuracy of synchronization of output and registered signals. Such receivers have unique characteristics and are not serial products, so they are quite expensive. There are tasks that can be solved using of mass low cost SDR receivers. The disadvantage of such receivers is the need to adapt them to using in radio astronomy. The amount of work on adaptation depends on the tasks for which the receivers are intended. Such receivers can be useful in non-professional radio astronomy (amateurs of radio astronomy, schools and

colleges students). The simplest task is the use of such receivers in radiometric measurements. On the radio telescope URAN-4, the serial inexpensive SDR receiver was successfully tested as an element of the switching radiometer. Unfortunately, these receivers have not synchronization tools for working in a group. We used RTL-SDR receiver for study of synchronization methods of SDR receivers with a USB interface. The synchronization task is solved by appending of the synchronosignal to the receiver input. The results of experiments on the selection of the characteristics of the synchronizing signal are considered.

ON THE USE OF GALAXY NOISE FOR THE CALIBRATION OF RADIOTELESCOPES OF THE DECAMETER WAVELENGTH RANGE

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To measure the characteristics of the radiation of cosmic radio sources, it is necessary to calibrate the radio telescope. Calibration in the decameter wave band involves a number of difficulties. Calibration methods that are employed in higher frequency ranges are based on the use of calibration sources. Stable discrete space sources are used as such sources. Sometimes specially designed artificial sources with a given radiated power are used, which are located in the far zone of the antenna of the radio telescope. The use of calibration sources allows you to monitor the entire radio path, including the antenna, receiving and recording devices. For radio telescopes of the decameter wave band, the use of an artificial calibration source is not possible, and discrete space sources are not sufficiently stable due to the strong influence of the ionosphere on the radio waves passing through this range. Therefore, in the decameter wave band, it is necessary to use highly stable noise generators. With their help, the part of the radio path that does not include the antenna is calibrated. The characteristics of the antennas can vary due to the change in the underlying surface. All these circumstances lead to errors in the measurement of the radiation characteristics of cosmic radio sources, in particular, in the study of long-term changes in the flux density. The possibility of using the galactic background as a calibration source is considered. This makes it possible to exclude the effect of ionospheric absorption and changes in antenna characteristics on the results of measurements.

BRAKE RADIO EMISSION OF HETEROGENEOUS PLASMA FORMATIONS IN THE ATMOSPHERE OF EARTH AND SPACE AND PHYSICAL GROUNDS OF HIS USE FOR TELEDIAGNOSTICS OF RADIATING PLASMA OBJECTS

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Brake radio emission of heterogeneous plasma formations (ППО) within the range of lengths $\lambda \in [10^{-3}, 10^0] \text{ m}$ of the waves in "coded" type bears in itself information of local dynamics of electron-ion processes [1] and can serve by ef-

fective tool of studying of physical processes in volume of the HPF generating radio signal. The window of transparency of ground atmosphere for radio frequency range (RF-range) lies in the area from millimeter long to HF волн, which are fixed directly in "on shore conditions by" modern astrophysical equipment. Development of adequate model physical approach to description of generation of brake HPF radio emission (in the plan of definition of his capacity and spectral composition depending on the conditions of local thermodynamic equilibrium (LTE) and HPF microstructure) - is urgent and up to the end by unsolved problem of the astrophysics, and her detailing, in the plan of identification of parameters of plasma formations, is the subject of heightened interest as a whole a series of applied problems connected with identification of aircrafts with reaction engines on solid propellant.

The main moment of given work is development of model approach of generation of brake combustion products plasma radiation formed at work of reaction engines on firm metallic fuel. With use of statistical ячеечной model of ionisation of heterogeneous combustion products plasma and the principle of local thermodynamic balance (LTE) Kubo, are analysed local processes (in disturbed HP quasineutrality cells, indignation of which are formed at the expense of displacement of macroparticles or электронов regarding electric centre of statistically averaged electroneutrality cell. Process of the relaxation of the cell to LTE-balance has character of relaxation process and is followed by brake radio emission. In wave zone integrated rate of the HPF (the flame of jet engine) is defined in approach of random phases. Statistical distributions of local displacement of charges in individual electroneutrality cell is defined in the model based on the appropriate distribution of disturbed cells on correlation energies. Model computer experiment is conducted for the products plasma of combustion of first stage of motors "Space Shuttle". Comparison of data of computer simulation and full-scale model experiments for plasma of aluminium powder combustion products in atmospheric air testifies about adequacy of developed approach.

Results of work can be used for development of new methods of telediagnosics of plasma formations containing the subsystem of particles of condensed dispersed phase (CDPh) which are sources and drains for electronic subsystem of gas электронов plasma.

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ESTIMATES OF BLACK HOLE MASSES FOR SOURCES WITH STEEP RADIO SPECTRA

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We have identified the sample of steep-spectrum radio sources in UTR-2 catalogue (decametre band) with counterparts at centimetre, near-infrared, optical, X-ray bands. The

calculated monochromatic luminosities at these bands allow determination the total luminosities of identifiable galaxies and quasars with steep radio spectra. We suppose that obtained total luminosity of source is near to the value of Eddington luminosity of its active nucleus. Thus, one can estimate the mass of black hole located in the source. The derived estimates of black hole masses have values from 10^7 to 10^9 mass of the Sun. The relationships of determined black hole masses and luminosities of radio lobes, accretion disk, torus of steep-spectrum sources are examined.

SPATIAL MULTIPLICATIVE PROCESSING OF MULTI-FREQUENCY SIGNALS

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A method for multiplicative shaping of the antenna array directivity pattern (DP) is proposed. The method allows to significantly reduce the width of the main peak and the level of the side lobes due to the application of algorithms for signal processing in the frequency domain. The system under investigation consists of two sublattices. Signals from the sublattice outputs pass through narrow-band filters of receiving devices tuned to different frequencies. In each frequency channel, correlation processing of the sublattice signals is carried out, then the signals from the outputs of the frequency channels are summed with the weight coefficients. It is shown that when 9 odd frequencies and equal weighting factors are used, the level of maximum side lobes of DP is reduced by 6.6 dB. Further lowering of the level of the side lobes is accomplished by weighing the signals from the outputs of the frequency channels. Optimization was carried out in the following formulation of the problem: determine the weight coefficients that ensure the minimum root mean square level of the side lobes in a given zone of suppression of DP. The use of optimal weighting reduced the level of the maximum side lobe by 21 dB. In general, the choice of the frequency grid and the weights of the frequency channels provides a predetermined width DP of the antenna with limited antenna aperture dimensions, an increase in the signal-to-noise ratio, a decrease in the side lobe level, and interference effects.

PECULIARITIES IN THE IONOSPHERE SCINTILLATION SPECTRUM SLOPE BEHAVIOR ON THE OBSERVATIONS OF THE COSMIC RADIO SOURCES AT THE DECAMETER WAVE RANGE

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Index, period and spectrum slope can to characterize the effects of the scintillations on the ionosphere irregularities. Early the behavior of the scintillation index was considered for different time intervals. Meanly scintillation period associated with index by inversely proportional dependence. Spectrum slope is especially interesting because its behavior reflects the changes of the ionosphere plasma structure. The values of the ionosphere scintillation spectrum slope

obtained on the power cosmic radio sources observations at the decameter waves during 1998-2007 were analyzed. As compared with ionosphere scintillation index it should be noted the dependence of this parameter from the height on which radio source observed and also more clearly seasonal-daily dependence. Comparison with solar and geomagnetic indices was carried out.

RENOVATION OF CONTROL SYSTEM OF THE URAN-1 RADIO TELESCOPE

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The URAN network of decameter wavelength interferometers has been successfully used in investigating the structure of space radio sources for over 30 years. Since then, both their facility and software package and techniques used have been repeatedly subjected to improvements. Thus, new receivers with extended up to 250 kHz bandwidth and software rejection of interferences have been designed. Recorders of broadband signals, following the world progress trends and development of computer engineering, have grown from analog multichannel tape recorders to digital storage devices on magnetic hard disk drives of a computer. In this report we consider a new control system designed for URAN-1 radio telescope. The equipment allows to increase the reliability of the radio telescope and to automate almost all stages of observations with the possibility of remote control via a local network and the Internet.

DEVELOPMENT OF DATA PROCESSING TECHNIQUES FOR DAILY SURVEY AT 110 MHZ BY BSA LPI USING HIGH-PERFORMANCE COMPUTING METHODS

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The BSA (Big Scanning Antenna) LPI radio telescope has a multi-beam diagram and is capable of recording daily in the frequency range 109-111.5 MHz in 96 beams in the declination range from -8 to +42 degrees, daily logs 87.5 GB of data (32 TB per year). The number of frequency bands is 32 and 6 for a time constant of 0.1 s and 0.0125 s, respectively. The processing of this amount of data for a number of scientific tasks requires the use of

high-performance computing. The paper discusses two methods of processing data-using GPUs (CPU + GPU, C / C ++ programming using OpenCL) and cluster calculations (using MPI on multiprocessor nodes).

INTERFEROMETRIC OBSERVATIONS OF THE QUIET SUN RADIOEMISSION IN THE FREQUENCY RANGE OF 8 - 32 MHZ

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Interferometric observations of solar radio emission at decameter wavelengths were carried out for the purpose of measurements of an angular diameter of the quiet Sun. For the observations we used two pairs of interferometers with different baselines, oriented along a parallel and meridian. These interferometers were composed from sections of north-south and east-west arms of the UTR-2 radio telescope. The broadband DSPZ receivers that we used allowed carrying out the measurements in the frequency range of 8-32 MHz. In this report we describe hardware equipment, a method of the observation and data reduction. Preliminary results of the observations are also presented.

PECULIARITIES OF THE FLUXES VARIATION OF POWERFUL COSMIC RADIO SOURCES BY OBSERVATIONS AT RT "URAN-4" UNDER VARIOUS SPACE WEATHER CONDITIONS

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The radio telescope "URAN-4" of radio-astronomical institute of NAN of Ukraine is the VLBI element of the URAN system located in the territory of Ukraine with the maximal removal of elements in 1 thousand km. From the moment of its commissioning in 1987 on a radio telescope "URAN-4" monitoring of fluxes of high-power galactic and extragalactic radio sources is carried out.

Changes of fluxes of radiation sources on decameter waves are defined by a condition of an ionosphere as a result of changes of space weather. The program of monitoring includes radio galaxies: 3C274, 3C405 and supernova Remnant: 3C144, 3C461. Monitoring of radiation sources are made by separate sessions, in limits ± 2 hours before and after the culmination of sources. Common time of daily monitoring exceeds 13 hours.

Changes in the fluxes of radio sources in calm and extreme conditions of space weather are considered. Long-term changes in the streams of radio sources are examined in the 23rd cycle of solar activity. The model of multiple correlative dependence of fluxes of radio sources on the factors forming space weather for the periods of its extreme condition is considered. Values of a multiple coeffi-

cient of correlation in the range of 0.86-0.99 were received. Sounding of the ionosphere radiation powerful cosmic radio sources makes it possible to estimate the integral effect on solar and geomagnetic activity.

SHORT-PERIODIC GEOMAGNETIC VARIATIONS IN REGION OF THE ODESSA MAGNETIC ANOMALY AND THEIR CONNECTION WITH GEOMAGNETIC STORMS

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The Odessa city and surrounding area is a large regional magnetic anomaly. In connection with location the radio telescope URAN-4 (decameter range 10-30 MHz) in this region and significant effect of the ionosphere state on observations of cosmic radio sources, special attention is devoted to investigation of short-periodic and long-term variations of the geomagnetic field, reflecting the ionosphere state. Since November 2017, close to center of the magnetic anomaly, on territory of the Astronomical Observatory of Odessa National I.I. Mechnikov University, systematic observations began on a precision flux-gate magnetometer LEMI-008. Short-periodic variations of the geomagnetic field in June 2018 are analyzed. Various appearance of quasiharmonic and irregular geomagnetic variations are selected in the days of magnetic storms, a slightly disturbed and quiet field, in a period range 5–40 minutes. Also, the results are compared with a data of short-periodic variations at the "Kiev" magnetic station located in region with normal geomagnetic field, and with a data of the "Odessa" magnetic station located on edge of the Odessa magnetic anomaly.

THE MOST LOW-FREQUENCY SPECTRAL LINES DETECTED IN THE INTERSTELLAR MEDIUM BY RADIO ASTRONOMICAL METHODS

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Extension of the range of radio recombination lines (RRLs) studies toward increasingly low frequencies is an important astrophysical goal associated with the investigation of processes in the cold, partially ionized interstellar medium. In this report the results of the lowest-frequency RRLs studies performed at UTR-2 radio telescope in 2017 are discussed. Giant radio telescope UTR-2 surpasses its closest competitors both in terms of effective area and sensitivity, as well as other technical parameters. Observations have been carried out for the medium in the direction of the Cassiopeia A supernova remnant using wide-band, high-dynamic-range digital receivers (DSP-Z). A special observational methodology and software for data processing have been developed for full frequency band studies at

the radio telescope. New method of radio frequency interferences mitigation was also used. Carbon recombination line C854 α has been detected near frequency 10.5 MHz, which is the lowest-frequency spectral line detected in the interstellar medium. Obtained results open up the new tasks for further theoretical and experimental research.

PRELIMINARY RESULTS OF STUDY INTRA-DAY VARIABILITY OF EXTRAGALACTIC RADIO SOURCES ON RADIO TELESCOPES OF THE VENTSPILS RADIO ASTRONOMY CENTER, LATVIA

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On the radio telescopes of the Ventspils Radio Astronomy Center in Latvia, since April 2017, a long-term monitoring of intra-day and interdiurnal variability of selected extragalactic radio sources has been carried out. This paper presents preliminary results for radio sources 3C 295, OJ 287 and BL Lac at frequencies 5 and 6.7 GHz, during observation sessions from February to May 2018, the technique and features of conducting flux density measurements are described. An analysis of the obtained data showed that studied radio sources have variations in flux density on time scales from several hours to several days, which are detected both from the initial data and from the smoothed data. This results are compared with a works of other authors on study of intra-day variability of lacertides and radio galaxies.

INVESTIGATION RELATIONSHIP AND VARIABILITY PROPERTIES IN OPTICAL AND RADIO RANGES FOR LACERTIDES OJ 287 AND BL LAC

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The lacertides OJ 287 and BL Lac are some of most popular extragalactic objects for study in a wide range of wavelengths, from radio to X-ray and gamma ranges. The reason for this is rapid and high-amplitude variability of these objects, which is quasi-harmonic in the radio and optical bands. In this paper, a study was made of long-term and rapid variability of lacertides OJ 287 and BL Lac on basis of long-term monitoring in radio range performed at UMRAO (1965 - 2011) (4.8, 8, 14.5 GHz) and OVRO (2008-2018) (15 GHz) observatories versus optical variability according to data from AAVSO (American Association of Variable Star Observers) catalog. To study variability properties of lacertides, Fourier analysis methods for non-uniform time series and wavelet analysis with preliminary interpolation by a cubic spline, were used jointly. As a result, information was obtained on the main periods of variability at different radio frequencies and optical bands B and V, their appearance and decay times in the studied data,

the characteristics of time-frequency spectra, similarities and differences in quasiharmonic oscillations, comparison with a results of other authors. The obtained results can be applied in theoretical models of physics lacertides wide-range variability, taking into account possible presence of double black holes, as an alternative variant of observed varability effects in OJ 287 and BL Lac.

ON THE INFLUENCE OF MHD TURBULENCE ON THE STRUCTURE OF THE RADIOGALAXY LOBES

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The evolution of the shape in the lobes of the FRI and FR II type radialaxies is traced in the model of the MHD wave transformation accompanying the jet under the influence of the interaction of waves with the fluxes of proton and electron cosmic rays (CRs). It is shown that Alfvén turbulence contributes to the collimation of jets in FRII radio galaxies, and to the pumping of a quasiregular magnetic field that holding the jet. In the head of jet Alfvén turbulence is transformed into magnetosonic, after which the energy flux of the jet from the CRs is directed normally to the lines of the mean magnetic field into the lobe, and in the leading bow shock front (in the form of ion-sound waves). In FRI-radio galaxies, the kpc-jet is controlled by the propagation of sound and MS waves that matched with the p-CR flux. The collimation of FRI-jets on pc scales is supported by the galactic wind. The conditions for the decollimation of the FRI jet and the formation of a FRI-bubble at the kpc-scales are analyzed. There are looking for the variations in the radio-emissivity of low-energy e-CRs (with allowance for their possible re-acceleration) within the different regions of FRI/FR II- radialaxies.

POLARIZATION OF FINE STRUCTURE OF PULSAR RADIO EMISSION AT LOW FREQUENCIES

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Determination of the polarization parameters for the fine structure of pulsar radio emission at meter and decimeter wavelengths gives us an opportunity to probe the upper layers of the pulsar magnetosphere. Methods of such researches at low frequency band are different from similar methods are used at higher frequencies (decimeter and shorter wavelengths). It happens because at low frequencies a big horizontal phased antenna arrays are usually used as a radio telescopes. In this case it is necessary to take in account three projections of electrical field strength vector at the reference frame of observer. There is

no such a problem at higher frequencies, where the full-rotating paraboloids or optical telescopes are used.

Moreover, the very formulation of the problem to probe the upper magnetosphere of a pulsar supposes the registration of rapid changes, both the polarization and time parameters of the fine structure. The possibilities of accumulation realization, for example, the Stokes parameters are very limited in the time and the frequency domain. In the time domain the interval of accumulation can't exceed the scattering time constant at the observation frequency (in the decimeter range this interval is of the order of one ms). In the frequency domain the constraint is the reciprocal of the given time interval (i.e. the accumulation band is about 1 kHz in frequency domain). That's why the polarization parameters are best to explore for giant and/or anomalously intense pulses.

The scattering of radio waves on the space inhomogeneities of electron concentration in the interstellar plasma is the base factor that limits the researches of the fine structure of the pulsar radio emission at meter and decimeter wavelengths. Therefore we choose the nearest pulsars to the Earth for exploring the polarization parameters of their radio emission at low frequency band.

The report will give the studying results of the polarization parameters of the fine structure of radio emission for three nearest to the Earth pulsars J0242+6256, J0814+7429 и J0953+0755 in the decimeter wavelength range.

THE RT-32 CREATING PROJECT ON THE BASE OF MARK-4B ANTENNA SYSTEM

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The MARK-4B telecommunication antenna system (in Zolochiv, Lviv's region) was constructed by Japanese firm NEC in 1987. In a series of similar systems, it was designed to receive and transmit information streams with a capacity of 128Mb/sec in the ascending and descending direction to a geostationary satellite. Currently the antenna system is the property of the State Space Agency of Ukraine (SSAU) and is under reconstruction in the radio telescope RT-32. A distinctive feature of this type of antenna system is the Cassegrain system (diameters reflector/subreflector 32/2.7 m) conjugated with a beam waveguide (BWG) with diameter 2.3 m and a corrugated conic feed-horn. The roughness of the reflector, the subreflector, and the BWG system determine the upper frequency of the operating range of such antennas. The level of diffraction losses on the subreflector and in the BWG

system itself determines the low operating frequency for such antennas. The conducted estimations showed that the BWG MARK-4B antenna system can provide the parameters required for radio astronomy in the frequency range 2.3-25 GHz. The presence of a corrugated conical flare horn makes it impossible to use the entire band for receivers. Therefore, at the first stage of testing, we will determine the subbands of the operating frequencies of this horn in which the overall level of system noise in the C range will be less than 35 °K in the zenith direction in clear and dry weather conditions, and in the K band will be less than 60 °K. It is assumed that after the first stage of modernization, the future RT-32 radio telescope will be able to operate simultaneously in the both orthogonal polarizations in the C and K bands. At the second stage of modernization, the possibility of changing back end facility of the feed-horn system and simultaneous identical to previous operation of this radio telescope in the S and X ranges will be realized. In addition, the guidance system will be modernized.

We envisage that after completing of the modernization, this radio telescope will be able to solve the following radio astronomical tasks:

- 1) Broadband observations of pulsars;
- 2) Monitoring of solar activity;
- 3) VLBI (*Very Long Baseline Interferometry*) observations;
- 4) Spectral observations of the neutral hydrogen and hydroxyl masers lines;
- 5) Observations of molecular clouds;
- 6) Observation of cosmological objects.

CALIBRATION OF LARGE PHASED ANTENNA ARRAYS

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We consider the calibration principles of large phased antenna arrays (LPAA) on the example of UTR-2 radio telescope. There are three different ways to calibrate LPAA. The first method involves the use of the point

cosmic radio emission sources as calibrators. Only a small number of such sources are available in decameter wave range on the sky (up to 5). The use of these sources is complicated by the effect of diffraction scintillation of its radio emission on the spatial inhomogeneities of the electron concentration of the interplanetary medium and the ionosphere of the Earth.

The second method involves the use an extended radiation source as a calibrator, for example, a galactic background emission. However, this incoherent source of radiation and its use needs a priori information about the radiation antenna pattern. The third method involves the use a reference noise generator as a calibrator. The third method will be discussed here.

A feature of LPAA implies that some of its electrical circuits cannot be covered by the calibration with signal of the reference noise generator. Therefore, in order to calibrate the entire radio telescope, periodic measurements of the circuits parameters throughout the operating frequency range of the radio telescope are required. Another complexity of LPAA, which is based on the analog (discrete) phasing principle, is that the calibration mode of such LPAA works correctly only for directions close to the zenith. Therefore, in order to correctly calibrate LPAA in other directions, it is necessary to use the mathematical model of the LPAA itself and its individual components. Since the sections composing the LPAA can work in different modes (additive, correlation, sum-difference), the mathematical models of LPAA must correspond to the chosen operation mode.

The report will be devoted to discussion of all the features of LPAA calibration as well as the development of its mathematical models for different operating modes.

SOLAR ACTIVITY, SOLAR-TERRESTRIAL RELATIONS, ASTROBIOLOGY

AXION MECHANISM OF SOLAR LUMINOSITY VARIATIONS

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It is shown that the hypothesis of the axion mechanism for solar luminosity variations suggesting that the solar axion particles are born in the core of the Sun and may be efficiently converted back into γ -quanta in the magnetic field of the solar overshoot tachocline is physically relevant. As a result, it is also shown that the intensity variations of the γ -quanta of axion origin, induced by the magnetic field variations in the tachocline via the thermomagnetic Ettingshausen-Nernst effect, directly cause the Sun luminosity variations and eventually characterize the active and quiet states of the Sun. Within the framework of this mechanism estimations of the strength of the axion coupling to a photon ($g_{a\gamma} = 4.4 \cdot 10^{-11} \text{ GeV}^{-1}$) and the hadronic axion particle mass ($m_a \sim 3.2 \cdot 10^{-2} \text{ eV}$) have been obtained. It is also shown that the claimed axion parameters do not contradict any known experimental and theoretical model-independent limitations.

Keywords: solar luminosity, tachocline, variations, Ettingshausen-Nernst effect

LONG-TERM AND SHORT-TERM OSCILLATIONS OF AREAS OF GROUPS OF SUNSPOTS IN 12-24 CYCLES OF ACTIVITY

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The Greenwicz catalog and its extension of the NOAA-USEF area of the group of spots for the years 1879-2016 are analyzed in terms of the availability of a number of long-term and short-term fluctuations in data. We analyze the Greenwich catalog data on areas of sunspot groups of last thirteen solar cycles. Various parameters of sunspots are considered, namely: average monthly smoothed areas, maximum area for each year and equivalent diameters of groups of sunspots. The first parameter shows an exceptional power of the 19th cycle of solar activity, which appears here more contrastively than in the numbers of spots (that is, in Wolf's numbers). It was found that in the maximum areas of sunspot groups for a year there is a unique phenomenon: a short and high jump in the 18th cycle (in 1946-1947) that has no analogues in other cycles.

Long-term fluctuations. Previously, we found [1-3] that the integral distribution index for equivalent diameters of active regions, determined on a section of 50-90 Mm, varies within a fairly wide range from 3.5 to 10. We

studied the integral distributions for equivalent diameters and found the following: (a) the average value of the index of power-law approximation is 5.4 for the last 13 cycles and (b) there is reliable evidence of Hale's double cycle (about 44 years). In particular, the minimum values of the index were detected three consecutive times in the cycles Nos. 14, 18, and 22. Since this indicator reflects the dispersion of sunspot group diameters, the results obtained show that the convective zone of the Sun generates embryos of active regions in different statistical regimes which change with a cycle of about 44 years.

Short-term fluctuations. For the analysis of short-period oscillations of the groups of spatial areas, a fast Fourier transform of smoothed monthly values for each solar cycle was performed. It was found that there are two groups of oscillations of 8-10 months (cycles 13, 16, 17, 18, 20, 22, 23) and 14-16 months (cycles 12, 14, 15, 19, 21).

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THE RELATIONSHIP OF THE SCR WITH PARAMETERS OF RADIO BURSTS AND CME

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The relationship between the intensity of the proton flux I_p ($E_p > 30 \text{ MeV}$) and the parameters of the continuum bursts of the IV type and the velocity of coronal mass ejections (CME), as well as the parameters of type II radio bursts, is investigated. Comparative analysis showed that for the vast majority of proton events, a strong relationship between the intensity of the proton flux I_p and the integrated flux of microwave bursts and the V_{CME} velocity is observed, where the correlation coefficient r between the investigated values is 0.80 and 0.72, respectively. At the same time, the relationship between the intensity of the proton flux I_p and the drift velocity of the type II bursts does not exceed 0.40.

NEW APPROXIMATION OF THE ENERGY SPECTRUM OF PROTON SCR

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In this paper, we consider a new approximation of the energy spectrum of protons of solar cosmic rays (SCR) in the range $E_p > 1-100$ MeV. The sample under study contains 342 proton events for the period from 03-02-1986 to 23-07-2016. Comparative analysis showed that all events can be conditionally divided into 5 types according to the form of the energy spectrum of protons. It is known that for most proton events, the energy spectrum of SCR protons is described quite accurately by two power-law models. However, there remains a large number of events for which the energy spectrum of protons can not be approximated accurately by two power-law models. In connection with this, another dependence was used in this work, which allows us to approximate the energy spectrum of the protons for all events quite accurately.

ANALYSIS OF SPATIO-TEMPORAL DYNAMICS OF TWO POPULATIONS OF SUNSPOTS IN THE 22-YEAR MAGNETIC CYCLE OF SOLAR ACTIVITY

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An analysis of dynamics of the fine structure in the 22-year cycle of solar activity (1964-1986) was carried out.

The complete homogeneous data series for sunspot data – Wolf numbers, squares of groups and individual spots, their coordinates, polarity and magnetic fluxes in them (the electronic data base of Daily Solar Data) were used for the corresponding years.

We determined the peculiarities of distribution dynamics of two sunspots populations by area, lifetime, magnitude of magnetic fluxes. The following results are obtained:

1. By the logarithm of the maximal areas of the spots groups, we divided them into two populations – the large and small ones (Nagovitsyn, Pevtsov's hypothesis et. al.). They intersect in the domain $\log S = 1.8-1.9$, where $S=60-90$ m.f.h. In the same region the separation of two populations of spots groups by the average lifetime takes place: less than 3-4 days – for small and more than 4-5 days – for large groups of spots.

2. Two sunspots populations differ in the dynamics of the magnetic field distribution: a weak field strength (about 1600 Gs) is localized in small spots and a powerful flow – in large groups of spots, where magnetic field reaches 3000 Gs.

3. The analysis of the fine structure of the 22-year cycle confirmed the existence of the so-called points of the Waldmeier's fracture on the growth branches, after which the growth of spot manufacturing significantly slows down before the phase of the maximal activity.

4. Separate consideration of spots groups in the northern and southern hemispheres of the Sun shows the advantage of spotting on the branches of growth in the northern hemisphere. So, a positive asymmetry dominates there, and, conversely, on the recession branches the negative asymmetry of the southern hemisphere starts to dominate.

5. The same features are shown by the asymmetry of the sunspots magnetic field in two hemispheres. The indexes of the magnetic asymmetry are maximal on the branches of growth till the maxima of magnetic activity cycle – during periods of the sunspots magnetic field re-polarization.

FORECAST OF THE PERTURBATIONS OF THE EARTH'S MAGNETIC FIELD DUE TO THE SOLAR ACTIVITY

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A methods for short-term forecast of magnetic perturbations of the Earth as a response to changes of solar activity during 11-year cycle is developed. The basis of the mathematical model is the equation of linear multiple regression of the random process.

We used time series of data obtained from the database of NOAA SWPC in the running 24th cycle of solar activity. We considered the solar fluxes of radiation, the flows of the corpuscles and the indices of geomagnetic disturbances as responses to them in the Earth's magnetosphere. The flows of solar wind (proton fluence with energy $E_p > 1$ MeV and electron fluence with energy $E_e > 0.8$ MeV) enhanced by X-ray streams from solar flares turned out to be the most geoeffective predictors.

Identification procedures for the prognostic model were carried out. The input data were passed through appropriate low-frequency Lancos filters that suppressed high-frequency noise. We found that the use of filters improves quality of the prediction. We established criteria by which the quantitative characteristics of the quality and effectiveness of the results were calculated. The correlation coefficient between observed and predicted planetary geomagnetic indices is greater than 0.9 (using of filters for the prediction with lead time 1 day increases the correlation coefficient by 10-12%). Efficiency of prediction with lead time 1-3 days is greater than 0.8. It indicates the validity of the developed forecast method.

FLUCTUATIONS IN PLASMA DENSITY NEAR TEMPERATURE MINIMUM OF SOLAR ATMOSPHERE

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Partially ionized plasmas are found in many different astrophysical environments. They are an essential ingredient of the solar atmosphere, molecular clouds, planetary ionospheres and protoplanetary disks, among other envi-

ronments, and display a richness of physical effects. In the present report we consider weakly ionized collisional plasma near the temperature minimum of solar atmosphere. Using non-ideal MHD equations for the case of fully developed turbulence of atmospheric gas in the presence of ambient magnetic field and the mean electron-density gradient, generation of fluctuations in plasma density of turbulent flows at this level of the solar atmosphere was described. The spatio-temporal spectrum of plasma fluctuations was derived. Then from this formula, expressions for the 1D spectrum and the rms fluctuation level were obtained. The obtained expressions were used to estimate features of plasma fluctuations near the temperature minimum in regions with different values of magnetic field strength. It was shown that the spectral slope decreases while the fluctuation level increases with increasing magnetic field. The present results can be helpful for better understanding of evolution of solar active regions near temperature minimum. It is known that the active regions are the source of many energetic and geo-effective events. Understanding how these complex source regions evolve is of fundamental importance, not only to solar physics, but also to the demands of space weather forecasting.

CHARACTERISTICS OF SUNSPOTS GROUPS PRODUCING PROTON FLARES

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A statistical analysis of the observed parameters of sunspot groups was carried out, in which 176 proton flares occurred in 21st – 24th cycles of solar activity according to the NOAA catalog. The study of the average areas of groups and the maximum magnetic field strengths of the spots on the day the flare occurred, made it possible to estimate the magnetic energy that could be realized in proton events at the level of $10^{31} - 4 \cdot 10^{32}$ erg. The decrease in the area of the group after the flares correlates with the proton flux for only 70 events that occurred in the largest groups with an area of 1000-4000 millionth parts of hemisphere. It remains to be assumed that proton events associated with smaller groups of spots take energy from the complex of active regions.

МАГНИТНЫЕ И РАДОНОВЫЕ АНОМАЛИИ ТЕРРИТОРИИ УКРАИНЫ И Г. КИЕВА

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Геомагнитные и радоновые аномальные поля являются существенными геофизическими факторами

окружающей среды, которые в значительной степени определяют ее экологическое состояние. В настоящее время разработаны предельно допустимые нормы интенсивности магнитного поля и радиационного излучения, которые не должны превышать в местах проживания и работы людей. Существенная часть радиационного облучения обусловлена радоном. Следовательно, выявление на территории Украины и в г. Киеве геомагнитных и радоновых аномальных зон является актуальной задачей при изучении геоэкологической обстановки территории и оценке ее экологической безопасности. Согласно исследованиям, радоновые аномалии генерируются радиоактивными элементами ураном и торием, которые концентрируются в породах, грунтах и подземных водах.

По результатам анализа для территории Украинского щита выявлена корреляция радоновых и урановых аномалий с отрицательными магнитными аномалиями регионального и локального классов и с разломами и зонами трещиноватости, по которым радон поступает на земную поверхность. Предложено физико-минералогическое и тектоническое обоснование такой связи. Выполнен анализ природных и техногенных магнитных и радоновых аномалий на территории Киева, а также в различных сооружениях, помещениях и метрополитене. По результатам исследования выявлены места с превышением допустимых норм магнитного поля и радиационного излучения. Рассмотрены некоторые аспекты возможной взаимосвязи динамики магнитных и радоновых аномалий с геофизическими факторами ближнего космоса.

EXPLORATION OF ION-AEROSOL PLASMA BY AIR-BORN INSTRUMENTATIONS IN THE LOWER IONOSPHERE

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The first-order recombination of stratospheric ions is established by balloon measurements by Gerdien condensers of their high-altitude profiles in all latitudinal zones including the TERLS station (Thumba Equatorial (geomagnetic) Rocket Launching Station), South India. It's important the GCR cut-off threshold for the geomagnetic equator as the reference latitude does not depend on solar activity, unlike other latitudes.

To register potential high-energy aerosols or clusters, a flow reactor-through with a photometer with protection from external light sources was installed at the head of the rocket. In flight, cold air passes through a heated in-flight reactor, the photometer measures light pulses of different amplitudes, which we interpret as recombination with photon emission when "frozen" plasma consisting of a mixture of ice and hydrated ionic clusters "thaws".. Such aerosols were observed at Molodezhnaya station during the spring ozone Antarctic anomaly in 1987 and three months later at TERLS. These experiments made it possible to explain the differences in the concentrations of atmospheric aerosols measured by impactor and photoelectric aerosol counters and the reason for the discrepancies

between the results of measurements of ozone concentration by various electrochemical cells: ECC-1 and MAST.

The existence of layers in the lower ionosphere with a reserve of chemical energy was confirmed by rocket measurements with the help miniature thermometric bodies with catalytic coatings.

"Frozen" plasma was considered (L. Shulman, 1987) as a possible source of energy for spontaneous explosions of cometary nuclei.

Such a plasma can be an important link in the energy transfer chain from the Sun to the Earth, including the mechanisms of solar activity, gravitational tides, giant ionospheric electrical discharges, optical transients observed from the orbits of small satellites – “Tatiana”, “Lomonosov”, and others.

PUBLIUS VIRGIL MARON AND ALEKSANDER LEONIDOVICH CHIZHEVSKIY

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The protean creativity of the outstanding scientist, biophysicist and founder of heliobiology and cosmic medicine Aleksander Chizhevskiy (1897-1964) was a concentrated expression of incredibly rich spiritual experience, it included equally his scientific genius, his inventing talent, his marvelous poetic and art abilities.

Virgil (70-19 BC) is recognized as one of the greatest poets of Rome and a major figure in world poetry, his works are full of deep scientific and philosophical thoughts and significant artistic merit. Creativity of Virgil undoubtedly renders (and, we want to be optimists, will have) influence on the humanitarian and natural sciences of a rapidly developing civilization

Virgil, like Chizhevskiy understood the influence of the Sun on the military and political activities of the peoples of the ancient world (Punic Wars, the assassination of Caesar, the replacement of dynasties of pharaohs in Egypt).

“..... Who would dare the sun

Lie to call? About deaf insurrections, about the intrigues of the invisible

• It warns about the secret swelling wars

At the hour when Caesar was extinguished, the sun also felt sorry for Rome...”

The rich experience of the farmer and the attentive observer of Virgil used to write the poem "Georgiki" a breeze of doubt that has not lost its meaning even in our time.

For example:

“...Happy is the seventeenth day for planting the vine grape...” Or:

“..To know we could in advance on the signs true -, whether it be the heat, or the rain, or the winds carrying the cold, He Himself commanded us the Father to trust the moon with predictions...”

SYNCHRONIZATION IN THE EARTH-LUNA-SUN SYSTEM

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The analysis of large in number statistical data confirmed the N. Sidorenkov's discovery of the quantum nature of meteorological processes and their synchronization with lunar-solar gravitational tides. Discrete periods (0.5, 1.0, 2...9 days or more) of variability weather, the formation of tropical depressions and typhoons, monsoon precipitation, etc.

The periodic forcing of astronomical and geodynamic oscillators leads to corresponding resonances in the geospheres, the biosphere, and in various human systems.

No less important and obvious results follow from the correlation (coincidence) of the dates of the extremes of the Earth's rotation rate (EERR) with the dates of emergencies in the technosphere (accidents on all types of transport, nuclear power plants, in industry) and with the already mentioned medical indicators of human health, including cases of exacerbation of chronic and sudden cases of human disease as well as its immunity, consciousness and psyche.

The histograms of coincidences of the dates of extrema of lunar-solar gravitational tides (EERR) with the dates of geomagnetic storms ($Kp > 5$), coronal mass ejections (CME), of solar flares (X class), dates of the increase in Wolf numbers during different periods of solar activity are presented and discussed. Statistically significant synchronization of EERR and events of solar and geomagnetic activity is established. These unexpected and intriguing results require further testing, exploration and explanation of physical mechanisms in the universal fundamental synchronization phenomenon discovered by Christian Huygens in 1665 in a famous experiment with pendulum clocks. However, it is absolutely clear in what directions it is necessary to move in the problem of predicting the variability of the environment and society in order to reach the so-called sustainable (regulated) development.

THE ADVANTAGES OF THE ASTROPHYSICAL MODEL OF THE SUN WITH A CENTRAL BLACK HOLE

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The suggested astrophysical model of the Sun is based on the hypothesis of the existence of a black hole with a similar mass at the center of stars, with the assumption that such black holes, being gravitational and thermodynamically isolated systems, do not absorb and radiate. They are only able to absorb and re-radiate the ordinary matter and radiation through gravitation.

The suggested model of the Sun and stars enables us to approach the resolution of the following issues anew:

1. The problems of star formation.
2. The problems of the formation of the magnetic dipole of the Sun.
3. The issues of the Sun activity.
4. The problem of the Sun's corona.

NUMERICAL MODELLING OF INSTRUMENTAL CONTOUR WITH RESPECT TO IRREVERSIBLE PROCESSES

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One of the problems of modern astrospectroscopy is constantly changing instrumental contour, that shows the impact of a spectral device on the data received. Since the contour itself evolves in time because of external conditions, it is usually measured before each spectral survey as it is redundantly described in [1]. In the present study an approach to a problem of estimating an instrumental contour of a spectroscopy is suggested, that is based on statistical information about the contour past measurements. The experimental data was obtained at Main Astronomical Observatory, The Department for Solar Physics, solar telescope ACU-5 and spectrometer ASP-20 [2].

Given a set of 35 contour profiles measured during the 2015 year at different ambient temperature values, an approximal method of reduction an instrumental contour to a simple parametrised curve is proposed. Each curve is shown to be easily transformed into the corresponding instrumental contour with the same convolution function. As a result, the time of measuring an instrumental contour of any spectral device is shortened because part of the contour can be excluded with informational loss within the margin of error. The approach allows to save measurement time of an instrumental contour getting the desired accuracy by means of a big enough sample set. Prospectively it can be used for preventive diagnostics of the internal state of a spectral device, particularly for astrospectroscopic purposes.

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SOLAR SYSTEM

EXTERNAL COMPARISON SATELLITE POSITIONS OBTAINED BY THE NETWORK OF PASSIVE CORRELATION RANGING OF GEOSTATIONARY TELECOMMUNICATION SATELLITES

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Network of passive correlation ranging contains of five stations located in Ukraine and Latvia. It has been created at the initiative of the RI "Mykolaiv Astronomical Observatory" to have independent means to track the future Ukrainian geostationary satellite "Lybid". Regular observations of the geostationary telecommunication satellite "Eutelsat-13B" has being carried out by the network since February 2015. A catalog of daily orbital elements of the tracked satellite has been created using the network observations. The analytical model SGP4/SDP4 of satellite motion and a numerical model of integration of equations of satellite motion are used to determine the orbital elements. The numerical model takes into account the gravitational attraction of the Sun and Moon, and non-spherical Earth. Software of the orbital elements determinations has been developed by the RI "Astronomical Observatory" of the Mechnikov Odesa National University.

Satellite positions calculated using orbital elements from the catalog were compared with ones obtained using the NORAD space-track.org site and optical observations performed by the Ukrainian Network of Optical Stations. The satellite position comparisons were carried out only for time intervals of unperturbed motion of the satellite. The free motion time intervals were determined using the algorithm that had been tested using satellite owner data about the moments of satellite maneuvers. Herewith they were compared: a) values of time difference of arrival of satellite TV signals to the stations, b) values of right ascension and declination, c) Cartesian coordinates of the satellite in the ITRF. Regular (mean) and random (standard deviation) values of the residuals are given in the report.

DOPPLER STATION FOR ORBITAL TRACKING OF LOW-ORBIT SPACECRAFTS BY THEIR RADIO BEACON SIGNALS

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A ground station of orbital tracking of low-orbit spacecrafts has been developed and tested in the RI "Mykolaiv Astronomical Observatory". The station uses the Doppler shift of frequencies of signals radiated by spacecraft radio beacons for their orbital tracking. The station consists of: 1) 10-section antenna with a circular directional diagram and the operating frequency band 400-450 MHz, 2) electronic unit of connection of the antenna sections to a receiver, 3) the SDR-receiver used USB receiver of terrestrial digital TV and radio ("DVB-T+DAB+FM"), 4) personal computer. Software of the station includes the free program HDSDR for SDR-receiver control, as well as an antenna direction control program, a program for determining a frequency of a signal, emitted by satellite radio beacon and received by the station, and a program for clarifying elements of satellite's orbit using the measured values of the frequency.

The NORAD ID of a satellite and a frequency of the signal emitted by its radio beacon should be set to clarify the satellite orbit. The antenna direction control program download current TLE (Two-Line Element) orbital elements of the satellite from the space-track.org site using the satellite's ID. These elements are used by the program to calculate, as functions of time, the values of range, azimuth and elevation angle of the satellite relative to the station. The program determines then the moments of the connections of the necessary antenna sections to the receiver, and performs these connections in the automatic mode, which provides continuous tracking of the satellite during its passage in the zone of direct radio visibility of the station. Simultaneous recording of the received radio signal is performed by the HDSDR program in wav-files. The program of determining a frequency of satellite radio beacon signal analyzes the records and automatically detects the radio beacon signal and determines its frequency. The initial orbital elements obtained from the space-track site are clarified according to the measured values of the frequency using the program developed by Yamnitsky V.A.

The report presents the results of the station test, which include an estimation of internal errors of the orbital elements determining of tracked satellites.

A network of stations similar to the one considered in the report could be used to orbital tracking of low-orbit spacecrafts equipped with radio beacons.

INTERPETATION OF COMET JET STRUCTURE

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Comets often show activity in the form of jets. Jets are associated with active sites on the nucleus. The shape of the jets depends on the parameters of the rotation of the nucleus, the location of the active site on the surface of the nucleus, the geometry and rate of emission of matter, the relative position of the Sun, the Earth and the comet. The distribution of particles in size, the acceleration of particles under the influence of solar radiation and other factors need to be taken into account with rise distances from the nucleus comets. It is proposed to use a simple geometric model that takes into account the orientation of the axis of rotation, the period of rotation of the nucleus, the angular radius and the precession period to interpret the structure of comet jets. It is also assumed that the emission of matter occurs perpendicular to the surface of the nucleus at a constant rate. This approximation works near the cometary nucleus. It can be considered as the first approximation for calculations using more sophisticated models. The calculated jets are projected on the sky plane. Then they are overlaid on the appropriate scale with the actual image of the comet for comparison. The graph of changing the positional angle of the jet in the picture plane, as well as the form of the comet nucleus from the position of the observer and from the side of the sun, are also calculated for apparent and correct interpretation. The proposed approach was used for interpretation of the jets in comets 2P/Encke and 67P/Churyumov-Gerasimenko.

PERIODS OF EXTREME DRAG OF ARTIFICIAL SATELLITES IN CONDITIONS OF HIGH SOLAR AND GEOMAGNETIC ACTIVITY IN 23-24 SOLAR CYCLES

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To show the effects of atmospheric drag on the artificial satellite's motion in the upper layers of atmosphere the B-star drag term is used. This index is used in atmospheric models of SGP and characterizes the state of the Earth's atmosphere during periods of increased solar and geomagnetic activity.

13 years (2005–2017) of observations of 25 satellites with different orbital inclination were taken for analysis. This data includes: end of 23-rd, current 24-th solar cycles and minimum phase between them.

12 events, with the highest amplitude for the B-star index, of extreme drag were analyzed. All selected periods differ in duration. From the beginning of the extreme period of drag to its maximum can pass from 3 days to 17 days, and in the most active periods of solar and geomagnetic activity up to a month or two. These long periods include shorter periods of the disturbed state of the atmosphere. These periods have approximately the same date of the beginning and maximum of extreme drag for all selected satellites, which indicates the collective effect of the manifestation of solar and geomagnetic activity.

THE EXISTENCE OF THE GROUPS OF METEORITE-PRODUCING BOLIDES AND METEORITES IN COMETARY ORBITS

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Meteorite-producing sporadic fireballs are produced by large meteoroids which are capable, under the suitable geometric and physical conditions, of producing meteorites. The meteorites can help us to understand the solar system genesis and the processes that occurred after the formation of small bodies of solar system. Meteorite and fireball instrumentally observations provide useful data for a study a link between meteoroids, meteorites and their parent bodies. The entry even of relatively small (of some decametres in diameter) meteoroids can cause substantial danger for a peoples and environment. We present here the result of the analysis of the possibility of existence of groups of linked slow moving sporadic fireballs and known ordinary chondrites meteorites, the atmospheric passage which was recorded instrumentally. According to provided data of instrumentally observations the orbits of investigated meteorites and fireballs are cometary and followed a JFC orbits. The main argument for the existence of groups of meteorite-producing fireballs is the existence of fireballs with mutually similar orbits and radiant as well as meteorites with correlated days-of-fall.

The selection of potentially meteorite-producing fireballs in the IAU MDC database was based on the statistical criterion: pre-atmospheric velocity $V_{\infty} < 25$ km/s, the terminal height $H_e \leq 35$ km, terminal velocity $V_e \leq 10$ km/s, and terminal mass m_e over several tens of grams. On the base of this criterion in the time of 1.5-2 monthly periods of appearance of six known ordinary chondrite meteorites the potentially meteorite-producing fireballs were selected. The well-known D_{SH} – criterion of Southworth & Hawkins, D_{Dr} – criterion of Drummond and D_N – criterion have been used to compare the similarity of each specified meteorite and fireball orbits. The threshold value $D_c = 0.2$ for D_{SH} , D_N – similarity functions and the threshold value $D_c = 0.105$ for D_{Dr} – similarity function was selected, which should reduce the number of chance coincidences from the compiled set of fireballs. On the basis of selected orbits, a mean orbit of group of meteorite-producing meteoroids and known meteorite was calculated. A group of meteorite-producing meteoroids is a group of meteoroids and of each specified meteorite which contributed to the final mean orbit. In result six identified groups of 95 meteorite-producing meteoroids associated with six ordinary chondrites were found.

In result the several tens of meteorite-producing sporadic fireballs, orbits of which are currently similar to orbits of studied six meteorites as possible members of groups were found and the possible source regions have been considered. The geocentric radiant and orbital elements of meteoroids confirmed sporadic nature and orbits of Jupiter family comets ($T_j \leq 3.1$) of these events. The calculated value of the aerodynamic pressure at the height of maximal brightness and terminal flare used to estimate the bulk density of the meteoroids. In result a value of bulk densities of meteoroids in these six groups about 1070-1250 kg m⁻³ were obtained and suggested the chondrite composition of meteoroids in these groups. In solar system especially the bodies of the small sizes (50–100 m)

on the Earth-crossing orbits on a time scale of a human civilization represent the natural hazard because of the greatest probability of risk of collision with the Earth. The identified six groups of meteorite-producing meteoroids and known ordinary chondrites may still contain large meteorite-producing bodies. In practical terms, this can serve as an incentive for purposeful monitoring of the indicated groups of the meteorite-producing fireballs in the identified periods of increased fireballs and meteorites activity by means of both of land fireball network and space tools established on orbital satellites that is important for the prevention of danger for the Earth.

MONITORING OF SPACE DEBRIS ROTATION BASED ON PHOTOMETRY

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In recent years we have seen a growing interest in the observation of large space debris, motivated in part by space situational awareness, but also with the goal to forced removing these debris objects from orbit. In particular, the large inoperative European environmental satellite Envisat has been widely studied as a primary target for Active Debris Removal (ADR) project, which involves capturing and deorbiting dangerous large spacecrafts from densely-populated orbits. The European Space Agency (ESA) is currently planning to launch its de-orbit mission, in 2023, with the goal of removing Envisat. Understanding the rotational dynamics of the target, however, is necessary for the success of such a mission. Non-active defunct spacecraft, which are not attitude controlled any longer, tend to start to spin or tumble under influence of the external and internal forces and torques. Note that knowledge of the spin motion of a defunct spacecraft is of interest for several applications. It can help to study specific perturbations and torques affecting the attitude of the spacecraft and it can be used for future attitude model development and improving. An important application is the above-mentioned active debris removal, where the spin rate and axis of a target object has to be evaluated before a pursuit-spacecraft comes into its proximity. In this case, accurately knowing the current spin motion is necessary to perform the maneuver to capture the target. Variations in the rotation of several large satellites in orbit have been studied in this paper, primarily long-standing inactive spacecraft. The results are based on long-term photometric observations of these space objects.

RESULTS OF TESTING MULTI-INSTRUMENTAL AUTOMATED MOBILE COMPLEX FOR OBSERVATIONS OF ANOMALOUS METEORS

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The results of testing multi-instrumental automated mobile complex for meteor observations developed in Astro-

nomical Observatory of Taras Shevchenko National University of Kyiv have been presented. The basis of the complex is a system consisting of minimum two high sensitive video cameras, installed onto transportable platform: one of which is provided for obtaining panoramic images of meteor evolution on the sky background; the second one, equipped with a diffraction grate, is for detection of meteor spectra. It is automatically supposed that there is another basic panoramic video camera for providing support of calculation of all kinematic parameters of meteors registered with the help of the given observational complex.

In order to provide correct physical results from observations we carried out a range of tests of given video cameras with both natural sources of light like stars and laboratory ones. Photometry calibration, accompanied with estimation of linearity of matrix response onto input signal, was made by focal and unfocal star images. For spectral calibration we got images of Vega. For imitation of meteor motion we made a range of video records of stars of different star magnitudes by mean of camera rotation with different angular velocities.

As components of the observational complex we used video cameras Watek WAT-902H2 Ultimate (NTSC, 30 fps) and WAT-910HX (PAL/SECAM, 25 fps) with sensitivity 0.0001 lk; diffraction grate 500 d/mm; GPS-receivers. For detection of automatic detection and grabbing of video sequences we used the hybrid budget video-registrator Dahua DH-HCVR4104C-S3, additionally equipped with terabyte hard disk for accumulating and storing video information. Entirely given video registrator allows a full format input rate for 4 analogue video cameras of format PAL/SECAM and NTSC, and one digital camera up to 5 Mp. At this the video registration occurs completely in automatic mode, with administration and video data transfer through Internet. Different photographic lenses were used during testing. In perspective we plan to enhance the given complex with ultraviolet video cameras, and with short and midi wavelength infrared detectors.

STATE IDENTIFICATION OF CUBESAT-TYPE SATELLITES BY OPTICAL OBSERVATIONS (ON THE EXAMPLE OF ARKYD 6A SPACECRAFT)

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Today, there is a tendency for a sharp increase in the number of small spacecraft (SC) launched and planned to be launched into LEO.

By 2026, the global orbital constellation is expected to increase to 9,000 or more SC with majority of small SC, in particular the CubeSat standard with various formfactors (from 1U to 12U) and weight from 1 to 100 kg.

Such SC are small in size, but possess high functionality, which allows replacing most of their larger "colleagues". In

addition, this technology allows relatively cheap creation of multi-satellite orbital constellations to ensure unprecedented speed of information retrieval. For example, 170 CubeSat-type SC of Planet Company, starting from 2017, provide the imaging of the entire Earth surface once a day.

However, in view of the small size of such SC, there is a problem of monitoring their state in the event of loss of communication with them or the occurrence of other abnormal situations. Especially relevant is the task for experimental SC – technology demonstrators.

In the framework of this study, an experiment was carried out to monitor the state of the ARKYD 6A SC (International Designator – 18004V, CubeSat 6U standard) using comparatively small optical instruments equipped with modern light-sensitive equipment.

The report presents the results of observations of the ARKYD 6A, which were performed in May 2018 using a 30-cm telescope of Sazhen-S quantum-optical station (QOS) of the Center for Special Information Reception and Processing and Navigation Field Control of the National Space Facilities Control and Test Center.

Processing of the results of photometric and positional data carried out at the Space Research Laboratory of Uzhgorod National University showed that during observations the longitudinal axis of this SC made one revolution around the vertical axis (zenith-nadir) with a period of about 145 seconds at an angle to the last $\alpha > 35^\circ$. This may indicate the inoperability of its stabilization system and, possibly, the SC as a whole.

Another important result can be considered in the proven possibility of monitoring the state of small SCs of CubeSat-type using small high-aperture optical instruments.

Keywords: CubeSat satellites, LEO satellites, photometric observations.

RADIANTS AND ORBITAL DATA DISTRIBUTION OF METEORS OBSERVED IN MYKOLAIV

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Double station meteor observation using TV CCD un-intensified techniques was started in 2013 in Nikolaev astronomical observatory (RI NAO). Catalog containing 1055 meteoroid orbits has been obtained. Registered meteoroid masses are between 10^{-7} and 10^{-2} kg. Distribution of radiants, velocities and orbital elements for different ranges of masses are analyzed in the work. Comparison with data from meteoroid orbit catalogs SonotaCo, EDMOND and CAMS networks is also given.

INVESTIGATION OF DUST ENVIRONMENT OF DISTANT COMET C/2014 A4 (SONEAR)

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The results of imaging photometric, polarimetric, and long-slit spectroscopic observations of comet C/2014 A4 (SONEAR) in 2015 are presented. Possible explanation of the unusual polarimetric properties of the dust in this comet is provided.

STUDY OF THE STRATOSPHERIC AEROSOL OF THE EARTH USING ULTRAVIOLET POLARIMETRY

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For the study of stratospheric aerosol, projects of polarimetric experiments in the ultraviolet (UV) region of the spectrum were proposed (Ugolnikov & Maslov, 2009). In (Dollfus, 1974; Morozhenko et al., 2000), another method of obtaining information on the physical properties of aerosol in the stratospheres of planets was considered (Dlugach et al., 1983; Klimentenko et al., 1980; Morozhenko et al., 2017; Ovsak et al., 2015; Vidmachenko, 1989). It is supposed to be obtained from the results of polarimetric measurements of the twilight sky (Morozhenko et al., 2013; Morozhenko et al., 2013; Nevodovsky et al., 2015). For more complete information, it is also necessary to carry out photometric measurements of the corresponding objects (Vidmachenko, 2015; Vidmachenko, 2016). The experimental dependence of the degree of polarization P on the height h of the scattering layer indicates the absence of its systematic changes. A slight decrease in P may be a consequence of the depolarizing effect of the background of the clear sky. There is also an increase in P with increasing wavelength. It was noted that the effect of a significant amount of aerosol in the troposphere increases significantly at wavelengths greater than 760 nm. As a modification of the process of polarimetric observations of the cloudless sky, it was proposed in (Morozhenko 2010) to place the telescope not in the zenith, but on the coordinate of the declination of the Sun. In this case, due to the change in the hour angle of the telescope, it is possible to considerably widen the interval of the observed phase angles. In addition, it is also possible to plan in advance the acquisition of the necessary information in the Earth's atmosphere at a selected altitude, above which scattering is recorded at these observations. The telescope was planned to direct on a site in the sky with a declination of the Sun and a small hour angle to the central meridian. Further, the results of po-

larimetric observations can be compared with the calculations of the polarization phase curves given in (Morozhenko 2010). This will allow us to obtain the physical parameters of the stratospheric aerosol.

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LUMINESCENT COMETARY CONTINUUM AND OTHER PHYSICAL PARAMETERS OF GAS AND DUST COMETARY ATMOSPHERES

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We estimated the gas and dust productivity of the comets in 2008-2017 years. The comae of the eleven comets (8P/Tuttle, 22P/Kopff, 46P/Wirtanen, 81P/Wild 2, 103P/Hartley 2, C/2006 W3 (Christensen), C/2007 N3 (Lulin), C/2009 K5 (McNaught), C/2009 P1 (Garrad), C/2013 US10 (Catalina), C/2014 Q2 (Lovejoy)) were studied. The research on the basis of the optical spectra with an average resolution ($\lambda/\Delta\lambda \approx 1300$ and $\lambda/\Delta\lambda \approx 14000$) has been performed. The spectra were obtained at the mountain observatory «Peak Terskol» IC AMER NAS of Ukraine and observation station «Lisnyky» AO TSNU of Kyiv with the help of the telescopes Zeiss-2000 ($D = 2.0$ m; $F_2 = 16$ m) and AZT-14 ($D = 0.48$ m; $F_2 = 7.7$ m) respectively.

The distributions of general and reflected energy in spectra of the comets and along the slit of the spectrograph have been built. Also, the identification of the spectral emission bands and lines on the basis of obtained spectral material has been performed. Based on the Haser model some physical parameters of neutral gaseous cometary atmosphere (fluxes, the number of molecules, gas productivity) for bands of molecules CN, C₂, C₃, NH₂ were calculated. Observed dust continuum and relative dust productivity (A/f_p) were obtained for all comets. Luminescent cometary continuum in the spectra of the four investigated comets (81P, 103P, C/2007 N3, C/2009 K5) was detected. The sources of the luminescent continuum and the mechanism of its formation on the basis of known laboratory spectra of organic phosphor substances have been proposed.

ANALYSIS OF OPTICAL MONITORING OF FIVE ACTIVE GALACTIC NUCLEI

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We present the results of systematical monitoring of selected objects from the CTA optical follow up list, started in January 2018. Observations are carried out with the AZT-8 ($D = 70$ cm, $F = 2.8$ m) telescope of the observation station Lisnyky of Taras Shevchenko National University of Kyiv. This telescope equipped with the PL4710-1-BB-E2V CCD and broadband Bessel UBVR filters. The AZT-8 was included in the list of supporting instruments in the CTA consortium.

Light curves were plotted, variability of color indexes with time were investigated for the next four objects: IES 1011+496, PKS 1222+216, IES 1426+428, PKS 1510-089, Mrk 501. In addition, we determined the variability amplitude and tested all these objects for Intraday Variations (IDV), Short (STV) and Long term variability (LTV) where it was possible. The results and methods were analysed and compared with the data of other authors.

ORBIT ESTIMATION OF GEOSTATIONARY SATELLITES AND ANALYSIS OF RANDOM AND SYSTEMATIC MEASUREMENT ERRORS OF THE UMOS OBSERVATION STATION USING ASTRODYNAMICS LIBRARY KORBESTLIB

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The Kotlin Orbit Estimation Library (KorbestLib) is space dynamic library. It is developed in the Astronomical observatory of Odessa Mechnikov National University. This library is based on the open-source low level space dynamics library Orekit (www.orekit.org). KorbestLib introduces the alternative models of measurements in comparison with Orekit and own optimization algorithms of model parameters of satellite propagators in near earth space and measurement models. In addition, KorbestLib provide the access to observation data and model propagations of satellite positions in widespread Ukrainian and international formats. It has facilitations for plot and visual analysis data, and can save output results in excel formats for next analysis.

The Ukrainian Optical Facilities for Near-Earth Space Surveillance Network (UMOS) observe the artificial satellites in near-Earth space regularly. The cooperative observations of several geostationary satellites and other etalon satellites were obtained in June 2018 within the UMOS. Korbest library was used for orbit estimation of these objects and error analysis of the obtained observations.

In the work we present analysis of random and systematic errors for observations that obtained in Mayaky (Odesa), Mykolaiv, Lesnyky (Kyiv), Derenivka

(Uzhhorod) and Bryukhovychi (Lviv). The analysis was performed for residuals (O-C) between observations and fitted orbit for UMOS observations and between observations and daily propagations that are provided International Laser Range Service (ILRS). We reduced systematic errors of measures for all observation stations and calculated a sequence of propagations of positions for several geostationary satellites using all observations. The propagation results are accessible in the consolidate prediction format (CPF) that used by ILRS. We present quantitative comparison of the approximation quality for serial position propagations of the satellites for fitted intervals and forecast ones. We present quantitative comparison of the approximation quality for series of the satellite position propagations for fitted intervals and forecast ones.

THE 206-DAY LUNAR CYCLE AND SPRING TIDES IN THE ATMOSPHERE

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A vivid manifestation of 206-day lunar cycles in air temperature and weather anomalies over European Russia in 2016–2017 is described. It is shown that air temperature anomalies in Moscow, Samara, Krasnodar are highly correlated with variations in the lunar perigee distance. The nature of 206-day lunar cycles and their manifestation in spring tides of the sea level and atmospheric pressure are described.

POSSIBLE REASONS OF DIFFERENCES IN PROPERTIES OF JUPITER TROJANS IN L4 AND L5 SWARMS

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From the beginning of the study of Jupiter Trojans, there is a well-known asymmetry in populations of L4 and L5 groups. For a long time, this difference was thought to be due to observational selection. However, as the number of discovered Trojans increased, L4 Trojans the difference became even more noticeable. However, thanks to modern all-sky surveys (SDSS, WISE) we can surely say that the number of bodies in L4 and L5 swarm is different. At present, according to Minor Planet Center data base, total of 7,031 Jupiter Trojans have been found as of May 30, 2018. Number of objects at the L4 point is 4595 and number of objects at the L5 point – 2436. We decided to examine distributions of albedos, diameters, amplitudes and rotational frequencies of bodies in two swarms as far as their orbital elements, inclinations and eccentricities, to find other differences between the swarms. Most of them, except diameters and inclinations, turned to be mostly similar. L4 asteroids dominate over L5 on inclinations up to 10° before the exponential decrease, while distribution in L5 swarm represents wide plateau between 4° and 30°. We analyzed drastic asymmetry in inclination distributions and found that particularly the groups of asteroids with diameters less than 20 km contribute to the asymmetry in distributions of inclinations. Also on distributions of sinus of proper inclinations

for asteroids smaller than 20 km we found that asteroids of Eurybates family, the only robust family among Jupiter Trojans, whose peak value of $\sin(I_{prop})$ coincides with peak of distribution, are the reason for the most apparent asymmetry between distributions in L4 and L5 swarms of this particular type.

SPACE INVASION. AS IS.

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Two cases of space invasions into the atmosphere of the Earth are considered. Both cases are considered as anomalous events. The first event demonstrates a complicated flight trajectory of the "corkscrew" type. The second event is short-lived one with a lifetime of about two seconds. Both events left inversion traces in the earth's troposphere. The effect of the "wobbling" of traces of meteors is considered, which occurs when a gas flows around the rotating body (the Magnus effect). It is shown that a meteoric body can be considered an air turbine, which converts the energy of the air flow into rotational energy. The speed of rotation of the meteor can reach several kilohertz. The movement of the meteor in the frame of the compressed gas dynamics is considered. It is shown that the gas motion in the meteor trace is accompanied by a non-stationary rarefaction wave. In this case, the trajectory of the meteor may appear for a short time as an inversion trace. The process of formation of an inversion trace is considered. It is shown that under favorable conditions the inversion trace is formed almost instantaneously, for thousandths of a second. The above estimates make it possible to draw an important conclusion. Almost all space invasions, whether they are meteors or fragments of space debris, are accompanied in the troposphere by the appearance of a short-term inversion trace (Küchemann, 1938; Zhilyaev & Totochava, 1996). Depending on the speed of the invasion, the meteoroid mass and atmospheric conditions, inversion (and partly dust) tracks can be seen from fractions of a second and up to two hours (Churyumov et al, 2014; Vid'Machenko, 1995).

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EFFECT YARKOVSKY-SCHACH IN ASTEROID SYSTEMS

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The Yarkovsky-Schach effect is a small perturbation affecting of the orbit of satellites. It was first discovered in the study of the dynamics of the satellites LAGEOS I and LAGEOS II. Also, it was used to describe the dynamics of the rings of the giant planets.

With the orbital motion of satellites around the central body, the satellite periodically enters and leaves the shadow, while cooling and heating again - this effect is called Yarkovsky-Schach. In this report, we will show the long-term effect of the Yarkovsky-Schach on the dynamics of satellite asteroids under different illumination conditions and at different distances from the Sun.

PHOTOMETRY OF SELECTED ASTEROIDS ON THE OMT-800 TELESCOPE

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Over the past years, the OMT-800 telescope are held photometric observations asteroids. Most of these small bodies are Near-Earth asteroids.

Asteroids (2102) Tantalus [NEO, PHA, Apollo], (3361) Orpheus [NEO, PHA, Apollo], (4197) Morpheus [NEO, Apollo], (6053) 1993 BW3 [NEO, Apollo], (20460) Robwhiteley [NEO, Amor] were observed to refine the spin periods and diameters.

Triple asteroid (3749) Balam [Main-belt] and binary asteroid (66391) 1999 KW4 [NEO, PHA, Aten] were observed to refine the physical and orbital parameters of the components of these systems.

Asteroids (357024) 1999 YR14 [NEO, PHA, Apollo], (370307) 2002 RH52 [NEO, Apollo], (496018) 2008 NU [NEO, Amor], 2014 YC15 [NEO, Apollo], 2017 MB1 [NEO, PHA, Apollo] were observed to refine spin periods, search for diameters, and possible satellites.

For some of the small bodies observed, spin periods and their diameters are unknown. Observing (153415) 2001 QP153 [NEO, Aten], 2017 MC4 [NEO, Apollo], 2017 TE5 [NEO, Apollo], 2017 XS [NEO, Aten] we first get these parameters.

Also carried out observations of the asteroid 2012 TC4 [NEO, Apollo], an interesting very small spin period (0.204155h) and the presence of the YORP effect.

All the photometric light curves obtained are loaded into the «Asteroid Lightcurve Photometry Database». As well, all new results are being published in «THE MINOR PLANET BULLETIN».

V-TYPE ASTEROIDS

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The main aim of the project is to carry out an observational campaign designed at verifying the predictions of the numerical model of planetesimal formation and evolution. In particular we plan to:

- Derive physical (spectral parameters, spins, shapes and masses) and dynamical characteristics of V-type asteroids outside the dynamical Vesta family,

- Compare the derived characteristics with those of typical Vestoids and with the dynamical evolution model of the Vesta family, test the hypothetical presence of non-Vestoids in the inner Main Belt,
- Determine and compare the spatial distribution of non-Vestoids in the Main Belt with the predicted distribution, determine formation location of differentiated planetesimals and total mass of non-Vestoids.

Planetesimals were the first large, solid bodies that formed in the Solar System four billion years ago. Current Solar System evolution theories and abundant meteoritic evidence suggest that there once existed from 30 to 150 different differentiated (into geologically distinct layers: iron core, silicate mantle and crust) planetesimals. They were then collisionally disrupted during later stages of Solar System evolution. The disrupted fragments of those bodies can be found in the current Main Asteroid Belt and in the meteorite collections today. In particular V-type asteroids and HED meteorites are identified as parts of crusts and mantles of those thermally evolved planetesimals. Several of the HED meteorites show oxygen isotope ratios suggesting that they must have originated in at least five distinct bodies. Iron meteorites (parts of cores of differentiated planetesimals) show even greater diversity indicating even up to 150 distinct bodies. On the other hand observationally only one large (4 Vesta and its collisional family) and a few small V-type asteroids in the mid and outer Main Belt (1459 Magnya, 21238 Panarea, 40521 1999 RL95, 10537 1991RY16) have been identified as traces of differentiated planetesimals, not summing up to 30-150 differentiated parent bodies and thus the "missing mantle" problem.

In this project we plan to verify this theoretical presence of fragments of differentiated planetesimals (particularly V-type asteroids other than Vestoids) in the inner Main Belt. Due to the fact that inner Main Belt is dominated by Vesta family, interwoven with dynamical resonances and overlapping asteroid families only combined detailed photometric and spectroscopic survey with numerical studies of the the V-types outside the dynamical Vesta family can address this issue

PHOTOMETRY OF COMET C/2009 P1 (GARRADD) BEFORE AND AFTER PERIHELION

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During the period from September 2011 to February 2012, photometric observations of comet C/2009 P1 (Garradd) were performed on the 0.6-m telescope IC AMER at the peak of Terskol (North-Caucasus).

The paper presents an analysis of photometric observations of Comet C/2009 P1 (Garradd) obtained for heliocentric distances of 2.0-2.1 au before and 1.7-1.8 au after perihelion passage. The measurements of the comet were performed using a CCD camera SiTe003AB with narrow-band comet filters BC ($\lambda 4450 / 67 \text{ \AA}$), GC ($\lambda 5260 / 56 \text{ \AA}$), RC ($\lambda 7128 / 58 \text{ \AA}$) and C2 ($\lambda 5141 / 118 \text{ \AA}$), CN ($\lambda 3870 / 62 \text{ \AA}$) HB-set [1]. Observation data were obtained during 11 nights.

According to the results of observations, the dust production $A_{\beta\rho}$ [2] of comet, the gas production of comet for

molecules C₂, CN using the Hazer model [2], dust-to-gas ratio and color were calculated.

The obtained results showed that the physical parameters of the comet are close to the average characteristics typical for dynamically new dust-rich comets.

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JUPITER'S NORTHERN TROPICAL ZONE BECAME DARKEN AFTER THE PASSING OF APHELION IN 2016

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The proposed brightness ratio of the northern and southern tropical and temperate regions of Jupiter A_J is a good factor in the photometric activity of processes in its atmosphere (Vid'Machenko, 1985; 1997; Vidmachenko, 1985; Vidmachenko et al., 1984a; 1984b). From the analysis of observational data for the period 1962–2018, we registered a cyclicity in the change in A_J with a period of ~ 11.87 years. This practically coincides with the time of revolution of the planet around the Sun, and speaks about the presence of seasonal reconstruction in the atmosphere of Jupiter (Vidmachenko, 1994a; 1994b; 1999; 2015; Vidmachenko et al., 1979). Such an increase in activity in different hemispheres of the planet may indicate that in the atmosphere there is a periodic global restructuring of its circulation system, of the structure of clouds and haze above the clouds (Vid'Machenko, 1991; Wagener & Caldwell, 1988). The value of the eccentricity of the orbit ($e = 0.04845$) and the fact that at a time close to the summer solstice for the northern hemisphere, Jupiter is at perihelion, northern part of the atmosphere receives 21% more solar energy than the southern one.

Comparison of the time dependence of the factor A_J in the visible spectral range with the change in the R index of solar activity shows that in 1962–1995 these parameters changed practically synchronously, with the delay of the reaction in the visible cloud layer, on the regime of irradiation of the atmosphere by the Sun on ~ 6 years. Such a value coincides with the time of radiative relaxation of the hydrogen-helium atmosphere in the Jovian conditions (Gierasch & Goody, 1969; Trafton & Stone, 1974; Vid'machenko, 2002).

To analyze the seasonal changes in the reflective characteristics of the cloud layer of Jupiter, we used the results of observations from (Vidmachenko, 2016a; 2016b), supplementing them with the results of processing the images of Jupiter, digitized by us, obtained in 1990–2018. Note that the last moment of passage of Jupiter through the perihelion of the orbit at a distance of about 4.96 AU from the Sun, was close to the time of the summer solstice for the northern hemisphere of the planet in 2010.6 at a minimum of solar activity. Almost at the same time, the averaged dependence curve $A_J(T)$ passed through a minimum of its values. In 2015 Jupiter passed through the aphelion of its orbit at the maximum of solar activity, and light tropical and temperate latitude zones (NTrZ, NTZ) were brighter in the northern hemisphere compared to similar southern latitudes.

And then the ratio of brightness A_J was maximal. The width and brightness of the bright equatorial zone EZ remained unchanged from August 2012 to middle of 2018; all this time it was bright and unchanged in width; the

southern tropical zone all this time was also of the same width and very bright. In 2012–2017 the equatorial belts of NEB and SEB were rather dark. From January 2015 to April 2016 external form of bright northern and southern tropical zones (NTrZ and STrZ), and the dark northern and southern equatorial bands (NEZ and SEZ) – remained practically unchanged. But from June 2016 to middle 2018 – NTrZ and the nearby Jovian regions have changed significantly. So in 2016 NTrZ began to fill with a dark substance, first in the middle, and gradually spreading across the entire width; this continued almost until the beginning of 2018, when over the dark cloudy layers began to appear high light cloud structures; in May 2018 its edges again began to lighten a little. Such a change in the brightness of the morphological details of the disk of Jupiter led to the fact that the activity factor A_J in 2013–2016 was more than 1; and from June 2016 to the end of 2017 – the situation changed to the opposite. Note that solar activity globally affects the entire planet, and seasonal variations alternately contribute to the change in the optical properties of the northern and southern hemispheres of the planet. From 1995 to 2012 there was a noticeable violation of the periodicity in the change in the relations A_J . It was from the middle of the 1990s to the year 2012 that the maximum was the discrepancy between the moments of Jupiter's passage through perihelion and aphelion of the orbit, and through the moments of minima and maxima of solar activity. At the same time, the decrease in the influx of solar energy to the winter northern hemisphere in aphelion was substantially compensated by the energy input from the Sun due to the growth of solar activity. And the heating of the atmosphere due to the approach of the planet to the Sun at perihelion, was compensated by a common "cooling" effect due to the fact that at the same time, solar activity was minimal. The joint effect on the atmosphere of Jupiter of these two factors - and led to a discrepancy in the periodicity of changes in the brightness of the northern and southern hemispheres of the planet. On the rise of solar activity after the autumnal equinox for the northern hemisphere in 2012–2013, of the course of the time dependence of $A_J(T)$, of the solar activity index $R(T)$ and of the irradiation regime of Jupiter by the Sun due to its orbital motion, - again become aligned. Starting in 2015, Jupiter began to approach perihelion at a decreasing in the solar activity index. Taking into account the value of the radiation time constant for the hydrogen-helium atmosphere ($\Delta R \sim 6$ years), the joint effect of variations in the solar irradiation of the planet due to the impact of solar activity and selective irradiation of different hemispheres of the planet by sunlight during the passage of perihelion and aphelion of the orbit - gives the observed picture in the visible light alternating quasi-periodic changes in the brightness of tropical and temperate latitudinal belts. That is, it shows the existence of a seasonal reconstruction in the atmosphere of Jupiter.

At the same altitudes in the atmosphere, bright zones - are rising areas with greater temperature and increased cloudiness; and dark, colder regions - are descending air masses with relatively low cloudiness at the same pressure levels. Analysis of the dependence of the reflective characteristics of the Jupiter hemispheres on the results of observations in visible light in 1962–1995 and 2013–2018 - shows a well-defined delay of ≈ 6 years, as a reaction to the 21% change in the irradiation of different hemispheres during the motion of the planet in orbit. Such a value coincides well with the time of radiative relaxation for the atmosphere from hydrogen and helium. Variations in the atmospheric activity factor associated with the influence of solar activity are caused by a significant change in the ultraviolet radiation of the sun. And this can affect at first

only on the energy of the upper part of Jupiter's atmosphere. Then such changes will be transmitted down to the troposphere. For example, on this indicate images, that are obtained almost simultaneously in visible light and at wavelengths typical for absorption bands of methane at 725 and 890 nm (Klimenko et al., 1980; Morozhenko et al., 2016; Ovsak et al., 2015; West, 1979).

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POLARIMETRIC MEASUREMENTS OF THE SKY IN ULTRAVIOLET SPECTRAL REGION

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To carry out polarization observations of the cloudless sky, we used a modification of the active prototype of the onboard ultraviolet polarimeter (UVP) created by us (Nevodovsky et al., 2013; Nevodovskiy et al., 2015). First, we carefully checked this layout on a specially designed and manufactured stand. The stand was designed so that we had the opportunity to conduct research, both as the entire device and for its individual units. To fulfill these conditions, the entire stand was divided into separate interchangeable parts, nodes and blocks. This design allows us to change the research tasks without much effort and constantly improve this stand. The research carried out at this stand allowed the determination of the technical parameters and performance characteristics of the UVP device (Sorochnynskiy et al., 2016). Then this model of ultraviolet polarimeter was installed on the telescope AZT-2. The role of the input lens in the device was performed by the telescope mirrors, and instead of the processing and information transferring unit, a special M8784 matching board of the firm "HAMAMATSU" was used (Vid'machenko & Nevodovskii, 2000). This board also allows you to perform primary data processing. The po-

larization modulator is Glan's prism, which rotates by a specially designed piezoelectric motor for this purpose.

09/26/2017 at the AZT-2 telescope in the Main Astronomical Observatory of the National Academy of Sciences of Ukraine with an improved model of the ultraviolet polarimeter, we carried out polarimetric observations. The whole day of observation and the next night were cloudless. The telescope was aimed at a site in the sky with the Sun's declination $\delta \approx 0^\circ$ at a hourly angle of -1^h to the central meridian. The work began at 14:00 on Kiev time, and observations were conducted until 20:00. A filter with $\lambda = 362$ nm at the boundary of the visible and ultraviolet part of the spectrum was used for observations; A diaphragm with a size of ≈ 0.5 mm marked a patch in the sky. The piezoelectric motor rotates the modulator with the phase plate on constant angle of 45° ; so the modulator carried out one turn of 360° in 8 steps; exposure of 2 seconds was selected; the useful signal was about 300,000 pulses/second with a dark flux of 10-20 pulses/second. The calculations gave a polarization value of 12 to 32%. In (Morozhenko, 2010), the results of calculations of the polarization phase curves are given of spherical particles with a normal-logarithmic distribution law on their dimensions, with a dispersion of sizes 0.1 for the mean of geometric particle sizes r_0 and the real part of the refractive index n_r (Yanovitskij & Dumanskij, 1972). Comparison of our observational data with the results of calculations shows that our observational data are closest to the calculations with particle sizes $r_0 = 0.16 \mu\text{m}$ and the real part of the refractive index $n_r = 1.33$.

In the future, it is planned to select the diaphragm sizes and filters that cover the more fully visible spectral range (Morozhenko et al., 2013; Morozhenko et al., 2014) necessary for this type of observations. In the future, for more unambiguous interpretation in estimating the imaginary part of the refractive index, polarization observations are planned to be supplemented with definitions of the reflectivity (Klimenko et al., 1980; Morozhenko et al., 2016; Vidmachenko 1989, 2015) of the twilight sky.

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PHYSICAL AND ASTRONOMICAL EDUCATION IN FRAMES OF MINOR ACADEMY OF SCIENCES IN UKRAINE

ПЕРШИЙ ДОСВІД КЕРУВАННЯ ГРУПОЮ НА ВСЕУКРАЇНСЬКІЙ АСТРОНОМІЧНІЙ ОЛІМПІАДІ ТА КОНСУЛЬТУВАННЯ ЮНИХ АСТРОНОМІВ НА ЛІТНІЙ ШКОЛІ МАН

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На олімпіаді, як і при підготовці, в дітей виникає купа питань як щодо завдань, так і що краще прочитати, на яких сайтах знайти інформацію. Дуже ефективними виявляються ресурси з «науково-популярними» лекціями (наприклад сайт Пост-наука), додатки від NASA, освітні сторінки, в тому числі, у Фейсбукці, що дозволяють подивитись як саме рухаються об'єкти Сонячної системи, та інші схожі засоби.

СЕКЦІЯ АСТРОНОМІЇ ОДЕСЬКОГО ВІДДІЛЕННЯ МАЛОЇ АКАДЕМІЇ НАУК: ПОПУЛЯРИЗАЦІЯ ТА ПРОФОРІЄНТАЦІЯ

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Проведено огляд діяльності секції астрономії МАН у популяризації астрономії та профорієнтації у тісній співпраці з іншими освітніми заходами.

Позашкільна робота з астрономії у Одесі має довгі та традиції. Екскурсії у астрономічну обсерваторію (АО) Одеського національного університету ім. І.І.Мечникова (ОНУ), консультації активним школярам та аматорам астрономії та залучення найбільш активних з них до реальних спостережень та виконання наукових робіт, які потім представляють на конференції МАН та публікують у «дорослих» фахових журналах. На жаль, припинилася публікація збірок «Перші кроки», у яких публікувалися обрані тези.

У Одесі понад 15 років (з 1978) працювала «Заочна астрономічна школа» (без фінансування) для школярів та аматорів усієї країни, зокрема, членів МАН.

Крім офіційного конкурсу МАН, щорічно (у вересні та березні) проводяться дві додаткові конференції спільно по фізиці та астрономії на базі кафедри теоретичної фізики та астрономії (ТФА) факультету математики, фізики та інформаційних технологій (МФІТ) ОНУ із публікацією тез. Проводяться щорічні конкурси «Мирний Космос», на яких

часто виступають учасники МАН, враховуючи зауваження на «основній» конференції.

Переважає частина переможців та призерів конкурсів МАН та астрономічних олімпіад (в тому числі, міжнародних) є членами астрономічного гуртка, яким керує доцент В.І.Марсакова. В 2018 році блискуче виступали К.О.Козицька (10 кл., гімна. №5), С.В.Савастру (11 кл., Ришельєвський лицей (РЛ)) які зайняли відповідно перше та друге місця на всеукраїнському МАН, М.Коваленко-Кіпер (11 кл., РЛ), Л. Тартаковський (7 кл., РЛ), В.Чабанюк (11 кл., гімна. №5) – одеська команда нагороджена 3 дипломами другого та 2 – третього ступеню на Всеукраїнській астрономічній олімпіаді. Нещодавні члени гуртка (К.Д. Андріч, Д.С. Твардовський, Р. Солецький) навчаються в ОНУ і вже мають дипломи міжнародного рівня. А.А.Хмарська (8кл., Морський лицей) перемогла у Всеукраїнському інтерактивному конкурсі "Ман-Юніор-Дослідник" у номінації "Астроном-Юніор".

Активні члени гуртка регулярно беруть участь у міжнародних літніх школах із спостережень змінних зір.

У останні роки, найкращі роботи учасники МАН доповідають також на міжнародних конференціях у Одесі, Києві, Польщі, Словаччині, Бельгії, США.

У майбутньому, призери стають студентами – не лише астрономами, а й фізиками, математиками, програмістами та ін. Десять призерів МАН стали кандидатами наук вже в новому тисячолітті.

ЕКСКУРСІЯ НА ВЕЛИКИЙ АДРОННИЙ КОЛАЙДЕР У ЖЕНЕВІ ПРИЗЕРІВ ВСЕУКРАЇНСЬКОГО КОНКУРСУ МАН З АСТРОНОМІЇ ТА ФІЗИКИ

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Цьогоріч переможці Всеукраїнського етапу конкурсу-захисту науково-дослідницьких робіт учнів-членів МАН мали можливість відвідати ЦЕРН – центр ядерних досліджень у Женеві, Швейцарія. Серед переможців, що посіли перші та другі місця у чотирьох секціях відділення фізики та астрономії, був проведений іспит з англійської. За його результатами були відібрані 10 учнів, що матимуть змогу вирушити до Швейцарії.

Серед них було двоє одеситів, вихованців гуртка астрономії ООГЦПОВ, що посіли перше та друге абсолютне місце у секціях «Аерофізика та космічні дослідження» та «Астрономія та астрофізика» відповідно. Наша подорож тривала 5 днів, у Женеві ми перебували з 20 по 24 червня. Кожен день ми проводили у ЦЕРНі, на Великому адронному колайдері, де вивчали його будову, принципи дії, напрямки робіт, досліджень, що тут проводяться. Мали змогу не лише

бути звичайними туристами, а поглянути на грандіозний винахід зсередини, поспілкуватися з фахівцями, що там працюють і ставлять власні досліди, та навіть поекспериментувати власноруч і дослідити знімки з детектора, що ми відвідували. Лише ввечері ми мали змогу побачити місто, що також справило чудове враження. Також ми відвідали зали засідань ООН.

Беззаперечно, подорож справила неймовірне враження на усіх нас та надихнула на подальше самовдосконалення.

КОМП'ЮТЕРНІ ПРОГРАМИ У ВИКЛАДАННІ КУРСІВ «ЗАГАЛЬНА АСТРОНОМІЯ» ТА «МОРЕХІДНА АСТРОНОМІЯ»

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Представлений огляд деяких астрономічних програм і віртуальних планетаріїв, які можуть бути використані в курсі загальної і морехідної астрономії. Головна мета використання комп'ютерних програм віртуального зоряного неба – навчити студентів впізнавати сузір'я та окремі яскраві зорі, які використовують для навігації, а також світила (планети). Сформувані вірне уявлення явищ природи, пов'язаних з рухом Землі у космосі. Навчити вірно вимірювати час за допомогою небесних світил. Запровадження поняття небесної сфери, хоч воно і не має фізичного сенсу, надає очевидну перевагу, оскільки воно дозволяє легко зрозуміти причину добових і річних змін у положенні небесних світил, і, що ще більш важливо – передбачити положення небесного світила у будь-який момент часу [1].

Вивчення дисципліни «морехідна астрономія» ґрунтується на знаннях загальних законів будови Всесвіту, закономірностях руху небесних орієнтирів та обертання Землі, визначення географічних координат місця за світилами, для чого використовується допоміжна побудова "небесна сфера" та рішення паралактичних трикутників. [2]. Краще всього порозуміти цю тему можна за допомогою віртуального планетарію.

Starcalc – швидка астрономічна програма-планетарій, яка дозволяє отримувати зображення зоряного неба у будь-який момент часу та у будь-який точці земної кулі. Зображення можна збільшувати, зменшувати, повертати, роздруковувати. Програма має багато функцій для розрахунку положень небесних тіл. Потребує багато плагінів: зоряні каталоги, об'єкти сонячної системи, координатні сітки та ін. [3].

Stellarium – це програма, що вільно розповсюджується, яка формує реалістичне зображення неба в реальному часі, використовуючи Open Graphics Library. Stellarium дозволить вам побачити те, що можна побачити на небі неозброєним оком, за допомогою бінокля або невеликого телескопа. Доступні понад 120 000 зорь з каталогу Hipparcos та 210 мільйонів зорь з використанням додаткових каталогів. Крім того, доступні зображення планет, супутників, об'єктів каталогу Мес'є, вибір ландшафту, візуалізація атмосферної рефракції та ін. [4].

Celestia – вільна тривимірна астрономічна програма, яка заснована на каталозі Hipparcos. Дозволяє користувачеві розглядати об'єкти розмірами від ШСЗ до галактик у трьох вимірах, використовуючи Open Graphics Library. Користувач може вільно мандрувати Всесвітом. Програма містить якісні реалістичні тексти космічних об'єктів, сценарії, які наочно демонструють ті чи інші події і явища, додаткові інформаційні тексти та інші інструменти. [5].

SkyMap – напівпрофесійний зоряний планетарій. Користується великою популярністю серед аматорів астрономії завдяки точності позиціонування і широким можливостям по налаштуванню інтерфейсу. [6].

SkyGlobe – зручний глобус зоряного неба. Багато налаштувань, можна використовувати для лабораторних робіт з астрономії. [7].

EZCosmos – схожий на SkyGlobe, але є можливість більш точних географічних координат місця спостереження. Також є можливість зберігати обрану конфігурацію. Це є програма-симулятор планетарію. Ви можете ввести дату, від 2000 р. до н.е. до 4000 р. н.е. і місце розташування на землі, і програма покаже ділянки неба з планетами, зірками аж до 8 зоряної величини, і космічні об'єкти. Також є можливість друку зоряних карт, анімацій, перегляду сонячних затемнень, місячних і сонячних транзитів і багато іншого. [8].

SightMaster – багатофункціональна астрономічна програма на англійській мові для розрахунків по зорям, сонцю, планетам і Місяцю. Включає в себе всі дані, записані для навігації: курс, швидкість, остання позиція, висота ока, шляхові точки, маршрути, дати. Вбудований альманах з точністю до 1 секунди дуги з 1900 по 2100 рік. Містить 59 зір і світила. Програма дає прогноз координат для будь-якого тіла, графічне небо, астроплан, навігаційні сутінки, фази Місяця і т. д. [9].

Ubuntu Astronomy – операційна система на базі Linux/Ubuntu, яка містить понад 40 додаткових астрономічних програм («віртуальні планетарії», «управління», «аналіз»), що не потребує їх установки. [10].

1. Андрієвський С.М., Климишин І.А. Курс загальної астрономії: Навч. посібник. – Одеса: Астропринт, 2007. – 480 с.
2. Верюжський М.О. Морехідна астрономія: Навч.-метод. посібник. – М.: ПКонсульт, 2006. – 164 с.
3. <http://www.softportal.com/software-11389-starcalc.html>
4. <http://www.stellarium.org/ru/>
5. <http://www.celestiaproject.ru/>
6. <http://www.sky-map.org/>
7. <http://www.adamhome.com/skyglobe.htm>
8. <http://www.ecuadors.net/astronomy/astroprog.htm>
9. <http://seaworm.narod.ru/3/3.htm>
10. <https://sourceforge.net/projects/ubuntu-astronomy-16-04/>

**УЧЕБНО-ВОСПИТАТЕЛЬНЫЙ ЦЕНТР
«ПЛАНЕТАРИЙ» – СРЕДСТВО
АСТРОНОМИЧЕСКОГО ОБРАЗОВАНИЯ
МОЛОДЕЖИ**

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В условиях всевозрастающих требований к учебно-воспитательному процессу по астрономии, решение концептуальных задач становится благодаря функционированию учебно-воспитательного центра (УВЦ) «Планетарий» астрономического образования молодежи. В созданном нами учебно-воспитательном центре «Планетарий» достаточно полно воспроизведены педагогические организационно-методические условия для комплексного изучения астрономии, что дает возможность обеспечить активность и самостоятельность студентов (учащихся) для получения астрономических знаний, применить комплексный подход к изучению отдельных тем из разделов школьной и общей астрономии, визуализировать смоделированную специально-предметную информацию.

УВЦ «Планетарий», по нашему мнению, является моделью учебно-воспитательной астрономической среды. Наличие соответствующей материально-имитационной модели создает дополнительные условия для гибкого моделирования и отображения учебно-воспитательных ситуаций, учебных объектов и процессов. Такая лаборатория предоставляет широчайшие технико-технологические и дидактические возможности применения современных инновационных технологий обучения. Возникает все больше потребность в создании и реализации системы различных форм учебной работы и соответствующих им программно-аппаратных средств, которые на основе дидактических принципов обеспечивали бы целенаправленное управление учебно-познавательной деятельностью учащихся и студентов. При таких условиях будет постоянно увеличиваться эвристическая составляющая учебного процесса по астрономии за счет применения интерактивных форм занятий, в том числе приобретение студентами опыта в организации и проведении научно-популярных экскурсий с подрастающей молодежью, проведении уроков, воспитательных мероприятий, научных диспутов и тому подобное. Стоит отметить, что в период с 2004 по 2018 годы в УВЦ «Планетарий» побывало более 20 000 посетителей. Зрительская аудитория представлена учениками начального звена образования (в том числе детьми 5-6 летнего возраста), основной и старшей школы, студентами различных вузов Украины, ближнего и дальнего зарубежья, известными специалистами в области естественнонаучного направления, а также педагогами, психологами, методологами высшего образования и просто любителями астрономии.

**ДОСЛІДЖЕННЯ ВПЛИВУ СЛАБКИХ ПОЛІВ
НА РОСЛИНИ У РОБОТАХ МАН**

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Вивчення впливу слабких фізичних полів на біологічні об'єкти є важливим завданням в умовах електромагнітного забруднення. Більшість існуючих публікацій є емпіричними. Математичні моделі майже не описані в літературі. Незважаючи на складність процесів, що відбуваються в біологічному об'єкті, емпіричне дослідження може проводитися навіть школярами, які мають якісь мінімальні знання в галузі проведення експерименту. Отже такий експеримент може контролюватися шкільним вчителем та за допомогою зовнішнього фахівця (або навіть без нього).

У якості експериментальних рослин рекомендовані стандартні модельні організми, такі як *Arabidopsis thaliana* (L.) Heunh. (магніторецепція [1]), *Pisum sativum*, *Vicia faba*, *Allium cepa* (тест *Allium* [2]). Важливо, щоб мінімальна допустима кількість насіння в кожній групі становила 300-400. Для випробування *Allium* можна використовувати набагато меншу кількість рослин, але цитологічне обстеження має бути зроблено.

Фізичне поле, доступне для дослідження, може мати побутовий характер (випромінювання від смартфона, маршрутизатора, індукційної печі тощо) або бути спеціалізованим (з використанням неодимових магнітів або соленоїдів – для дослідження впливу магнітних полів). Головне, що необхідно вивчити школяру, який бере участь у таких експериментах, є правила проведення експерименту та обробки його результатів. Вчитель або консультант повинен ознайомити його з такими елементами дослідження, як культура експерименту, поняття «сліпе дослідження», контрольна група, принцип «*ceteris paribus*» та ін. Також необхідно ознайомитись з основними методами обробки експерименту, мати представлення про найпростіші статистичні розподіли та їх параметри, а також про однопараметричний кореляційний аналіз.

[1] Paul Galland, Alexander Pazur, "Magnetoreception in plant", Journal of Plant Research, **118(6)**:371-89 (2006). DOI: 10.1007/s10265-005-0246-y

[2] Fiskesjo G. "The *Allium* Test as a standard in environmental monitoring", Hereditas, **102**, P. 99-112, (1985).

**VARIABLE STARS OBSERVING AS AN
EFFECTIVE METHOD OF GENERAL TRAINING
FOR YOUNG ASTRONOMERS**

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There are several main ways of astronomical education in our astronomical circle (such as theoretical astronomy lectures, astronomical Olympiad training, observations and practical tasks). The observations of variable stars are very effective methods of gaining the experience in orientation on the night sky and in practical work with astro-

nomical data. We discuss some results of observations in the station of ONU in Mayaki and several international Astrocamps “Variable”.

ФОРМАТ ОСВІТНЬОЇ ГРИ У ЛІТНІЙ ШКОЛІ МАН: ДОСЯГНЕННЯ ТА ПЕРСПЕКТИВИ

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З 11 по 15 червня 2018 року на фізичному відділенні факультету МФІТ Одеського національного університету імені І.І.Мечникова проводилася Літня школа МАН з фізики та астрономії для учнів 8-10-х класів «Світ навколо нас та закони фізики». Крім традиційних лекцій, практичних занять, виконання лабораторних робіт фізичного практикуму більше третини програми школи була присвячена проведенню освітньої гри «Космічні перельоти – колонізація Сонячної системи». 8 команд повинні були обґрунтувати мету польоту, прокласти маршрут та розрахувати все необхідне (паливо, повітря, вода, продукти харчування, обладнання тощо) для польоту з Землі до наступних об'єктів Сонячної системи: планети Венера, Марс, супутники Юпітера Ганімед, Європа, Іо, Каллісто, супутник Сатурна Титан та астероїд Веста. Протягом чотирьох днів члени команд консультувалися, проводили розрахунки, готували презентації, а в останній день роботи Літньої школи доповідали розроблені проекти.

Найважливіші досягнення: учасники команд з першого дня з ентузіазмом включилися в гру, використовуючи для отримання необхідної інформації інтернет, консультації викладачів ОНУ, своїх вчителів, друзів, знайомих, а також членів інших команд; кількість інформації, проробленої кожним школярем за чотири дні майже дорівнювала тому обсягу інформації, який школяр зазвичай набуває протягом семестру при підготовці наукової роботи МАН; учасники гри активно вчилися не тільки знаходити інформацію, а й переробляти її для досягнення поставлених цілей.

Перспективи використання формату освітніх ігор: мабуть, це найбільш ефективний метод активного вивчення проблем, що лежать на стику точних наук та технічних застосувань. Даний формат дозволяє молодим людям глибше підійти до вибору своїх власних пріоритетів та вибору професії.

КОНКУРС «МАН – ЮНІОР ДОСЛІДНИК 2018» ТА ДОСЛІДЖЕННЯ СОНЯЧНО-ЗЕМНИХ ЗВ'ЯЗКІВ

Хмарська Анна Андріївна, учениця 8-В класу Одеського навчально-виховного комплексу «Морський ліцей – ЗОШ №24 І-ІІІ ступенів» Одеської міської ради Одеської області

Цього року вже дев'ятий раз в Україні проводиться конкурс «МАН – Юніор Дослідник». Конкурс проводить національний центр «Мала академія наук України» у квітні – травні 2018 р. Змагання відбуваються в два етапи. На I етапі роботи розміщуються на сайті і

оцінюються компетентним журі. Але не тільки, в оцінюванні можуть взяти участь ще й учні та наукові керівники. Такий підхід розширює знання учнів, вимагає від учнів відповідальності та відчуття справедливості. II етап проходить у форматі онлайн-захисту. Така організація дозволяє брати участь в конкурсі всім бажаючим незалежно від місця проживання.

Конкурс відбувається в чотирьох номінаціях «Історія», «Екологія», «Техніка» та «Астрономія». Під керівництвом наукового керівника Рябова Михайло Івановича (старший науковий співробітник Одеської обсерваторії радіоастрономічного інституту НАУ) та вчителя фізики і астрономії Даньо Людмили Павлівни, я прийняла участь у номінації «Астрономія». Мною була представлена робота «Аналіз прояву погоди в м. Одесі та можливі зв'язки з космічною погодою». В наданій роботі розглядається наукова проблема, що пов'язана з впливом сонячної і геомагнітної активності на Землю, стан нижньої атмосфери та погоду Землі, вчасності на погоду в м. Одесі з регулярним аномальним магнітним полем. Я досліджую та аналізую результати зіставлень змін погоди в Одесі з індексами сонячної і геомагнітної активності. Отримані результати підтвердили залежність погоди від проявів сонячної і геомагнітної активності в Одесі та узгоджуються з даними описаними в науковій літературі щодо наявності сонячно-земних зв'язків та впливу сонячної активності на атмосферу Землі та її погодні явища.

На конкурсі моя робота отримала високу оцінку як від членів журі, так і від наукових керівників та учнів. Я нагороджена дипломом переможця Всеукраїнського інтерактивного конкурсу «МАН – Юніор Дослідник» у номінації «Астроном – Юніор».

ДЕЯКІ НАПРЯМИ РОБОТИ НАВЧАЛЬНО-ЛАБОРАТОРНОГО КОМПЛЕКСУ «МАНЛАБ» НЦ «МАНУ»

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Школи на базі Міжнародного центру дитячої наукової творчості MANLAB.CAMP. Їх слухачами є учні закладів загальної середньої освіти та позашкільних навчальних закладів. Лекції, практикуми і проблемні задачі об'єднують загальні теми з фізики або астрономії. Експериментальні дослідження відбуваються як в лабораторіях так і на відкритому полігоні MANLAB.CAMP за допомогою сучасного освітнього лабораторного обладнання із застосуванням цифрових вимірювальних комплексів. Астрономічні спостереження відбуваються як вночі так і вдень. До лекційної роботи та практикумів із розв'язування задач залучаються науковці Київського Національного університету імені Тараса Шевченка, Київського Академічного університету, Київського політехнічного інституту імені Ігоря Сікорського та інші.

Тренінги для вчителів природничих дисциплін в рамках Всеукраїнського проекту «Впровадження інноваційних освітніх технологій в системі МАН».

Вчителі мають змогу познайомитись із сучасним освітнім лабораторним обладнанням та найновішими програмами за напрямками STEM-освіти. До спілкування залучаються науковці провідних вишів України, НАНУ, НАПН.

Експедиції в рамках науково-дослідного проекту «Моя аксіома нескінчености» за керівництвом Чернецького І. С. Залучення учнів та викладачів до реального наукового пошуку відбувається шляхом надання фахових консультацій та можливості використання сучасного освітнього лабораторного обладнання на місцевості, що стала об'єктом дослідження учнів закладів освіти.

Всеукраїнський проект «Віртуальний STEM-центр». STEM-лабораторія МАНЛаб – центр реальних і віртуальних навчальних досліджень, спрямований на підтримку та розвиток STEM-освіти в Україні.

1. Лабораторія МАНЛаб: <http://manlab.inhost.com.ua>
2. Віртуальний STEM-центр Малої академії наук України: <http://stemua.science>

ЕФЕКТ «СПОВІЛЬНЕНОЇ ЗЙОМКИ» ЯК ІНСТРУМЕНТ ДОСЛІДЖЕННЯ В РОБОТАХ МАН

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Навчання дітей проведенню фундаментальних досліджень і спостережень в рамках підготовки наукових робіт МАН часто передбачає вивчення звичайних фізичних явищ і процесів з незвичних точок зору.

Серед перешкод для таких досліджень можна виділити наступні:

– звичайні фізичні явища, які ми бачимо щодня, часто бувають занадто швидкими, щоб наші очі дозволяли спостерігати в деталях, а в деяких випадках, щоб ми правильно розуміли, що насправді відбувається (зіткнення, розриви, розпади частинок, вибухи, поява фронтів горіння і т. д.);

– багато явищ та процесів пов'язане з деякими важливими для їх розуміння змінними, які важко виміряти, особливо з використанням шкільного обладнання (швидкість і координати рухомого снаряда, траєкторії бризок, абсолютна деформація твердих тіл під час зіткнення та ін.). У багатьох випадках точне вимірювання коротких часових інтервалів має велике значення.

Останні розробки в області персональних електронних пристроїв, таких як смартфони і фотокамери, дозволяють молодим вченим використовувати сповільнений відеозапис як інструмент дослідження. Багато сучасних мобільних телефонів можуть знімати відео з частотою кадрів від 240 до 960 кадрів в секунду (з роздільною здатністю 1080 пікселів).

Високі частоти кадрів дозволяють вивчати швидкі процеси і забезпечувати більш точні вимірювання часу (абсолютна похибка обернено пропорційна кількості кадрів в секунду і становить близько 1 мс для 960 кадрів в секунду). Роздільна здатність відео вкрай важлива, коли потрібно знайти координати об'єкта або відносні позиції декількох об'єктів. Для деяких вимірювань, таких, наприклад, як вимірювання швидкості, однаково важливими виявляються як частота кадрів, так і роздільність відеосигналу.

IN DISCUSSION

FUNDAMENTAL CONNECTION BETWEEN THE PLANCK AND HUBBLE CONSTANTS

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In this article it is stated that there is a fundamental connection between the basic constant of the quantum theory - the Planck constant h and the basic constant of cosmology - the Hubble constant H , which states the dynamic material-energy unity of our world.

To date, it is believed that "dark matter" and "dark energy" are outside the real baryonic material world and accordingly outside the orthodox physical science. The standard model explains our world only within baryonic matter. Our research, outlined in this article, speaks of the need to "legalize" dark matter and dark energy and the corresponding expansion of physics beyond the Standard Model, for this is the only way to explain and combine the motion of matter in the microcosm and the macrocosm, describing it theoretically as the movement of energy, as a deterministic energy process, determined by the energy characteristics of a single Cosmos.

"From the above considerations it follows that in the present state of our knowledge the difference between the density of matter and zero should not theoretically be related to spatial curvature," not "with the expansion of space" [A.Einstein], but should communicate with material and energy dynamics of the structure of space-time.

In this article, taking into account the new fundamental components of the "cosmological structure of space" - "dark matter" and "dark energy", "in the present state of our knowledge", finding the total energy density of the universe, and putting forward the drain-source hypothesis (convergence-divergence) matter, the fundamental connection between the Hubble cosmological constant H and the quantum theory constant Planck constant h , equal to $h = 32H^2/c$, is determined.

LOCAL STRUCTURE OF GRAVITY, GRAVITATIONAL-THERMODYNAMIC CORRELATIONS, ANTHROPIC PRINCIPLE AND FUNDAMENTAL CONSTANTS

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We consider the possibility of gravitational-thermodynamic adaptation of elementary particles in the gravitational background in the vicinity of the Earth and the influence of human vision parameters on the perception of the environment.

Possible connections between the parameters of view and gravity at the level of fundamental constants and gravity, as well as consequences in cosmological theory and in the theory of elementary particles are considered.

It is possible to conduct an experiment on the simultaneous registration of "elementary particles" and the current gravity situation in the vicinity of the Earth.

POSSIBLE VARIANTS OF GENETIC STRUCTURES AND LIFE ON OTHER PLANETS

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Astrobiology with the discovery of exoplanets posed questions of the differences between life, elements and genkoda of them and the Earth. Synthesis and selection of these elements determine the "beginning of Gamow" (the G-start.) Its rhombic and triangular code resembles the transcription controllers of DNA "grooves," and the combination is independent of order and explains the "magic number" of $20 = 4 \times 5$ triplets of type 4 ($H_3 + 3H_2H * + HH * H **$). Genetic information and functions are transferred consisting of three or two + 4 nitrogen and binding bases and acid chains. DNA and RNA, termed by sugar, deoxy ribose, can be replaced by binding TNK – with triosa-tetrozo, PNA-peptide backbone, and change both nucleotides and elements themselves. In addition to No. 1 (HG-start) and 6-8 (CNO), nucleic acids include phosphorus, and sulfur proteins, No. 15-16. Changes in its degree of oxidation, from -2 to +6, give greater possibilities in comparison with phosphorus (+5) and oxygen (from -2 to 0, in the ROS). Its current role and OV reactions of cysteine, glutathione, co-enzymes such as CoA-SN and other sulfur-containing compounds can reflect primary, "sulfuric world" and "first five" elements. Genkod further reflects the general and separation of the functions of the elements prior to the RNA of the world (marked by Nobel for its discovery, Cech and Altman studied at the University of Colorado Gamow). Acidic, higher oxidation states are replaced by carbon S-P, sulfate and phosphate, according to Van't Hoff (carboxy groups of amino acids, like K + amino groups, basic amino acids Lys + Arg). According to Pauling, selecting phosphorus for enzymes, according to the hydration energy of hydroxy acids between the 4th and 6th groups of Mendeleev. The latter, unlike IUPAC, include sulfur analogues, molybdenum and others, like iodine (№ 34, 42 and 53), the most difficult and rare of the "magical twenty" bioelements. To explain their functions and bioconcentration, we propose radioisotopes.

Keywords: Astrobiology, exoplanets, DNA, RNA, TNK, PNA, OV reactions.