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ASTRONOMIJAS SEKCIJA

Tēžu krājums

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LATVIJAS UNIVERSITĀTE

Astronomijas sekcija

Programma/Programme

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Jānis Šteinbergs, ***K. Veitners, M. Iacobelli***	**Statistical properties of the Galactic magnetised, warm and ionised medium.**
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V.Bezrukovs, M. Ryabov, A. Sukharev, S. Udovichenko, I. Kudzei, P. Dubovsky, A. Orbidans, I. Eglitis, O. Ulyanov, V. Zakharenko, A. Konovalenko, V. Ozhinskyi, V. Vlasenko, D. Bakun

Variability properties of the Seyfert radio galaxy Perseus A in the radio and optical bands - first results of Latvian-Ukrainian joint research project.

With the participation of radio telescopes RT-32 and RT-16 of the Ventspils International Radio Astronomy Center (Latvia), RT-32 (Zolochev, Ukraine) and optical telescopes AZT-3 (Mayaki Observatory, Ukraine), 1-m VNT (Vigorlatskaya Observatory, Slovakia), the 1.2-m Schmidt Telescope (Baldone Observatory, Latvia) an unusually powerful lenticular Seyfert galaxy Perseus A (3C 84, type SyII) with a complex jet structure is investigating. In addition to its high-amplitude long-term radio variability (detected from the data of long-term monitoring at the UMRAO observatory, USA at frequencies of 4.8, 8, and 14.5 GHz), this object, presumably, also possesses jet precession, which ensures the wavelike behaviour of long-term variability. These are rather unusual and rare properties for SyII type galaxies. In addition, this galaxy may have a double core, where a second black hole is assumed as a companion. It is also important that this galaxy is the centre of a cluster of galaxies, and it actively interacts with its immediate environment. At present, this object, in terms of ideas about the understanding of its radio and optical variability, is still rather poorly studied. Of particular interest are the properties of its fast radio-optical variability (with characteristic time intervals from several hours to several weeks), which reflects short-term processes in the "accretion disk-jet" system under conditions of the possible presence of a binary black hole system at its centre and the presence of dynamic interaction with other members of the cluster. Radio and optical telescopes are located at close longitudes, which ensures quasi-simultaneous studies of the short-period variability of active galactic nuclei. From November 2020 to February 2021, the first observations were carried out in the radio and optical range, among which on December 19–20, 2020 there were simultaneous observations, which made it possible to work out the method of obtaining data and analysing observations. The first results showed the presence of irregular day-to-day variations in the flux density, and on some days close to cyclical intraday variations are observed. The data on the characteristic times of these variations will be refined in subsequent observations. Cross-correlations between quasi-simultaneous observations from two antennas separated by approximately 1000 km showed the presence of correlations in the range of 0.6 - 0.8 in a band of periods of 3 - 6 hours, but this requires clarification based on longer series of simultaneous observations. The appearance of optical (BVRI) light curves and statistical tests show the presence of significant changes in magnitude during October - December 2020, as well as linear trends in brightness changes for individual nights of observations, but these data require additional analysis.

J. Šteinbergs, K. Veitners, M. Iacobelli

Statistical properties of the Galactic magnetised, warm and ionised medium

Radio pulsars (PSRs) data can allow three-dimensional (3D) mapping of the Galactic magnetized, warm and ionized interstellar medium (WIM), based on the synthesis of star Rotation Measure (RM), Dispersion Measure (DM) and distance measurements. 3D maps of the Galactic magnetized WIM are very useful tools for several purposes, including for the spatial distribution of the Galactic magnetic fields and turbulence in the interstellar plasmas. However a very large O(10**5) sample of observational RM and DM radio data for PSRs with robust distance measurements is required for constructing 3D maps. In the next decade, the Square Kilometre Array (SKA) will significantly increase the sample of radio PSRs, enabling the mapping of the local magnetized WIM. In this talk we introduce the ongoing research project and present preliminary results on the turbulent component of the magnetic field, based on the largest to date sample of radio PSRs and an phenomenological model of the B||-dDM correlation.

D. Haritonova, A. Zarins

Reconfigurable space object optical tracking system of GGI – implementation stage

In 2014 the Institute of Geodesy and Geoinformatics (GGI) of the University of Latvia (UL) in cooperation with the Institute of Physics (UL) were engaged in a joint project. It was focused on the development of an experimental instrument of optical tracking system intended for both positional and laser ranging observations of near-Earth objects. The system has not been fully completed due to lack of funding. Now, within the grant of post-doctoral research “Reconfigurable space object optical tracking system of GGI – implementation stage”, GGI is intending to bring it to working condition, allowing semi-automatic operation and remote control. The project objective is to install and configure the optical tracking system of GGI and start its exploitation using for positional astrometric observations. The design of the optical tracking system will be complemented. The device will be placed into new computer-controlled dome, which is located on the roof of new building of UL (House of Science in the Academic centre), next to the premises of the GGI. The tracking system has original optical scheme with three optical channels: transmitter equipped with laser collimator and two receiving optical tube assemblies (OTAs). The laser collimator has manual / computer control capability. One of the twin optical systems is fitted with a CCD camera and within the project will be used for astrometric and positioning purposes: orientation of the instrument in star-defined coordinate system and observations of natural or artificial space objects. Each OTA has Advanced Coma-Free (ACF) 16″ optic with high transparency coating. The focal length is 4 meters. The drive of Alt-Alt type system has stepper motors with worm-wheel reductors and incremental encoders (resolution up to 0.36 arcsec); it is controlled by FPGA under computer control. In future, following configurations of the optical tracking system seem to be most prospective: - one or both OTAs equipped with CCD – for positional observations; - one OTA with analog signal receiver (PMT) – for registration of SLR retropulse, another OTA with digital receiver (CCD) – for visual guiding of space objects; - both OTAs with analog signal receivers – for registration of SLR retropulse in coincidence or parallel arrangement. Project No: 1.1.1.2/VIAA/4/20/619.

K. Veitners, J. Kalvāns

From interstellar medium to star forming molecular cloud cores. Updating collapsing molecular cloud core thermal structure model

A galaxy typically consists of a few things, stars, stellar remnants, and a diffuse interstellar medium (ISM). Since stars originate in dense molecular cloud cores, to start understanding star formation, an understanding of molecular cloud formation and evolution is required. A molecular cloud is a dense nebula, which is shielded from interstellar medium and permits the formation of molecular hydrogen. Molecular clouds are hierarchial structures, together with ISM, they represent fractal nature, smaller

and denser structures are found at every level. One such structure is filaments, observed by the Hershchel satellite. One of Hershel main purposes is to study the formation and evolution of stars and galaxies. Hershel observed that molecular clouds have a highly filamentary structure, with widths of 0.1pc being the most popular. These filaments are further classified as supercritical/trasnscritical/subcritical filaments, with prestellar cores being found within transcritical or supercritical filaments. Our attempt at contributing to the field of study of star formation and the occouring processes, is updating a multicomponent model for computing the thermal structure of collapsing protostellar clouds, (Ya. N. Pavlyuchenkov, A. G. Zhilkin, 2013). We modify the existing model by changing the hydrostatic core input data to dynamic data fit to model. This allows us to take different observed or theorised, protostellar or prestellar molecular cloud core data, fit it to model and run the evolution simulation. This gives us the density distribution with mass coordinates, velocity distribution and thermal distribution, which consists of separate dust and gas temperatures. The simulation runs up until the initial protostar formation, and some time after, giving a detailed physical molecular cloud core description at different times in cloud evolution. The future aims are 1. further analyse different cloud cores using the updated model; 2. use the resulting data in astrochemical simulations.

I.Pundure

On astronomy at the University of Latvia since 1997

In 1997, the Institute of Astronomy of the University of Latvia was established by including the Radio-Astrophysical Observatory (RO) of the Latvian Academy of Sciences (LAS) in the University of Latvia (LU) and merging it with the LU Astronomical Observatory (AO). Both observatories have different scientific research directions: the LAS RO was mainly committed to fundamental research in astrophysics, while the LU AO focused more on applied research in astrometry and the development of astronomical instruments and apparatus. In 2005, the Kārlis Kaufmanis Memorial Scholarship was established (by 2021, a total of 12 astronomy scholarship holders). After 2017, new LU astronomical institutions appeared: the LU Institute of Astronomy (also: Astronomical Institute of University of Latvia) was founded by merging Astronomical Observatory of University of Latvia and Baldone's Astrophysics Observatory of Latvian Academy of Sciences and the LU Baldone observatory. Since the Autumn of 2018, the popular science seasonal edition Zvaigžņotā Debess (The Starry Sky) of the LAS and the LU Institute of Astronomy ceased to exist. By the University of Latvia Rector's Order of August 1, 2018, LU established a mass media journal Zvaigžņotā Debess – a popular science publication on astronomy. This report provides a brief overview of the changes in research and popularization of astronomy. Everything is decided by specialists. 17 References.

I. Eglītis, I. Vilks

The results of Online Observatory project

ERASMUS+ project "Online Observatory" (KA201-2018-008, 2018-2020) started at the autumn of 2018. The Online Observatory was founded by five European observatories (Baldone Observatory; Brorfelde Observatory, Denmark; Harestua Solar observatory, Norway; Helsinki observatory, Finland; Faulkes telescope project, UK) in 2018, all of which with special interest in communicating astronomy and where visitors get hands-on experiences on how to be an astronomer. Their combined efforts resulted in the Online Observatory, where activities developed at each observatory are made accessible for schools and others for educational purposes (https://onlineobservatory.eu/). The outcomes contain 71 resources for educational purposes in astronomy beginning from Virtual tours at the five observatories, about the sky observation, Moon, Planets and exoplanets, Sun and stars, and concluding with the Universe. Thirteen of them have been prepared by the staff of the Institute of Astronomy (Baldone Astrophysics Observatory).

D. Draviņš

'Ab initio' simulations of stellar spectra

It has become possible to numerically simulate complex physical processes, starting from initial conditions and then only applying basic laws of physics, without fitting to any empirical data. Results can be somewhat unexpected, revealing phenomena that were neither known nor predicted but which, in hindsight, may be interpreted and also identified in observations. For example, such simulations are used for the growth of large-scale structure in the Universe. The great amounts of data produced by these numerical experiments have a character similar to observations, which need to be categorized, analyzed, and interpreted. For stars, such “ab initio” simulations have previously been made for the three-dimensional, hydrodynamic, and time-dependent structure of stellar atmospheres. Recently, it has become possible to extend such modeling to complete stellar spectra. Using the 3-D atmospheric structures, and introducing laboratory data for some half a million spectral lines, synthetic spectra are obtained for solar-type stars of different temperatures. Such modeling achieves “hyper-high” spectral resolutions (above 1 million), for several center-to-limb locations across stellar disks, and for numerous timesteps during the simulation sequences. Each spectrum comprises some 3 million data points from the ultraviolet to the infrared. Precise spectral line shapes depend on an interplay between opacities in atmospheric inhomogeneities, in neighboring absorption lines, and in different wavelength regions. Such synthetic spectra are surveyed for Fe lines with different strength, excitation potential, and ionization level, displaying signatures of changing strength, asymmetry, and convective wavelength shift across stellar disks. Corresponding observations may verify those models, from which fluctuations in spectral-line parameters can be computed, including the jittering in wavelength. Such fluctuations in apparent stellar radial velocity (rather than instrumental precision) is a critical limitation for the discovery of small exoplanets. To segregate the small radial-velocity signal induced by an orbiting exoplanet from stellar microvariability requires a calibration, which could be obtained from simulated spectra. An adequate calibration should provide proxies for the radial-velocity jitter, enabling to precisely deduce the true stellar motion, as needed in searches for low-mass and Earth-like exoplanets. References: D.Dravins, H.-G.Ludwig, B.Freytag: Spatially resolved spectroscopy across stellar surfaces. IV. F, G, & K-stars: Synthetic 3-D spectra at hyper-high resolution, Astron.Astrophys. (2021); arXiv:2103.03880, D.Dravins, H.-G.Ludwig, B.Freytag: Spatially resolved spectroscopy across stellar surfaces. V. Observational prospects: Toward Earth-like exoplanet detection, Astron.Astrophys. (2021); arXiv:2103.04996.

J. Kauliņš

Observations of noctilucent clouds in Latvia in 1957-1983

After a certain loss of interest in the second half of the 1980s, there has been a clear increase in interest in observing mesospheric clouds (MM; known as a noctilucent clouds) over the last decades. MM were observed in places where they had not been seen before; there is also evidence of an association between the emergence of MM and the effects of climate change. The study of the state and dynamics of the mesosphere and the analysis of long-term processes have therefore become a topical scientific task, which, given the nature of the phenomenon and the environment under study, can only be effectively carried out in international cooperation. Long-term visual and photographic observations of the MM were performed at the Latvian branch of the All-Union Society of Astronomy and Geodesy; now Latvian Astronomical Society (LAS). They began during the International Geophysical Year in 1957 and lasted until 1983, 26 years. Observation materials were accumulated in the archives of the LAS. The archive contains observation journals from that period and more than 2,000 large-format (180x130 mm) photonegatives. The observations were mostly made according to a unified, internationally recognized methodology, which has allowed to obtain a series of observations unique in duration. The process of digitizing observation logs is under process; it is also intended to

scan photographs. In order to facilitate further processing of this material, the digitized material is intended to be placed in publicly available sources, such as the UL Repository. The article evaluates and compares the observation methodology used with modern standards, summarizes the information about the observation points and the photographic equipment used in them, as well as an overview of the materials obtained in the observations and their content. There is a justified need to continue the work and perform in-depth data processing.

J.Freimanis, R.Peženkovs

Polarized radiative transfer: Comparison of three independent codes

Polarized radiative transfer test calculations have been done, comparing two Monte Carlo codes and the direct solution of Fredholm integral equations for polarized source functions. Monte Carlo code Ventspils RTMC and the software for the solution of integral equations were created recently by ourselves. The other Monte Carlo code was the well-known RADMC3D created by C.Dullemond et al. The aim was to compare these codes, in order to check their reliability and suitability for interpretation of real astrophysical objects. Test calculations were done with the model of homogeneous Rayleigh scattering sphere and concentric star inside it, varying the single scattering albedo and optical radius of the sphere. We compared the images of the scattering sphere on the virtual CCD matrix. It was shown that all three codes give basically similar results for single scattering albedo values between 0.4664 and 1.0, and the optical thickness of the scattering matter being from 0.1 up to 10. Some differences between the statistical noise of both Monte Carlo codes and some trends in intensity ratios were found. The polarization degree was essentially the same for all three codes. We conclude that all three codes give reliable results in the parameter space tested. As expected, the solution of integral equations for this physically simple model was much faster than calculations using any of the Monte Carlo methods. Besides, it was found that RADMC3D is much faster than Ventspils RTMC.

B.I. Ryabov, A. Vrublevskis, D. Bezrukovs

On opprtunity to measure magnetic fields in open structures of Solar corona

Radio polarimetric observations of quasi-transverse (QT-) propagation can produce measurements of coronal magnetic fields. Since open-field coronal structures by definition are primarily expected along magnetic field lines with a dominant radial component, it is not clear whether the QT-propagation of radio waves might realize within them. To determine the propagation conditions the magnetic structure of a narrow coronal corridor was calculated using the Potential Field Source Surface model. Resulting QT-regions, where radio waves intersect field lines at a right angle, partially cover the emitting regions of narrow coronal corridors. Thus, we expect an opportunity to measure field intensities of 2.5 – 6 gauss at heights z = (0.013 – 0.02) Rsun in the decimeter wavelength range and of 0.12 – 0.2 gauss at z = (0.2 – 0.58) Rsun in the meter range.

D. Bezrukovs

Microwave Observations of the Quiet Sun with VIRAC RT-32 Radio Telescope During the Solar Activity Minimum

Microwave spectral polarimetric observations of the solar emission remains one of the main trends in the contemporary solar radio astronomy and a significant part of Ventspils International Radio Astronomy (VIRAC) scientific activity. A series of observations of the Sun for 6.3-9.3 GHz frequency

range with VIRAC RT-32 radio telescope were performed on the very beginning of the 25th solar activity circle in 2019-2020. Because of a minimal number of solar active regions and its rare appearance these observations could be expected as ones of the quiet Sun. Observations at the solar activity minimum offer the rare possibility to study the emission of the quiet Sun without an influence of active regions as a background one for many of solar physics models and tasks. A 2D shape and size of the solar disk and brightness temperatures of the quiet Sun in some microwaves were obtained after the analysis of solar observations performed. On the other hand a set of quiet Sun data was used as a calibration source to study some features of RT-32 antenna after its reconstruction in 2015. The presentation concerns on analysis and results of the quiet Sun microwave emission and a comparison with another known observations. Some methodological issues of an observational data processing and some newly revealed features of the RT-32 antenna are discussed also.

A. Aberfelds, I. Šmelds, J. Šteinbergs

Four years of methanol maser monitoring with Irbene radio telescopes

This spring an ongoing 6.7 GHz methanol maser program has been going for four full years. During this period a substantial amount of 45 selected source spectral data were collected. Typical observation cadence was 3 to 5 days between observations and daily observations for particularly interesting sources in the active phase. Typically the program has a 1500 h time requirement for one of the Irbene radio telescopes. An active collaboration with the world wide maser astronomer community Maser Monitoring Organization is ongoing, with active data exchange and by opportunity with focus on interesting events. More than 70 % of sources were found to be variable but often only one or two spectral features are varying significantly. Several different kinds of variability were found in our sample: non-variable, periodic, quasi-periodic, irregular, synchronized and anti-correlated variations between spectral features.

J. Šteinbergs, A. Aberfelds, G. Jamonts, K. Šķirmante, V. Bezrukovs

VLBI developments in VIRAC

In recent years VLBI techniques have been several improvements, space VLIB, wide instantaneous bandwidth, wide-field imaging, remote clocks etc. VIRAC VLBI team is not only participating in these developments as users but also creating improvements that are useful to VLBI society. VIRAC VLBI team has been involved in many activities: 1) Developing single baseline interferometer to measure continuum flux towards Ultra-Compact HII (UCHII) zones associated with massive protostars with active methanol 6.7 GHz masers. Sensitivity results close to the theoretical system noise level was achieved (6 mJy for a 120 s) with calibrator flux measurements being close to the literature given values. 2) SFXC correlator, installed on the VIRAC HPC, was used for correlation of PRECISE experiment data with 7 participating antennas. Tests show the possibility to involve VIRAC HPC in correlation tasks for EVN like antenna arrays. 3) For the first time, a science group led by VIRAC members successfully applied time request for regular EVN observation. The observation was carried out on 31.10.2019. Selected targets were 3 methanol masers associated with massive star-forming regions. The since goal for this observation is to study maser proper motion and evolution of long-surviving cloudlets. 4) Radar VLBI research using forward scatter radar method, with the since goal to detect asteroids, comets and space debris. All these activities are carried out with close international collaboration with these institutions: JIVE, Yamaguchi University, North-West University, Institute of Astronomy, Nicholas Copernicus University and Ural Federal University.

I. Eglitis, A. Sokolova

CCD sky survey in the selected zones at the Baldone Observatory

Infrared 2MASS J - K (Cutri R.M. et al. http://cdsbib.u-strasbg.fr/cgi-bin/cdsbib?2003yCat.2246....0C) colour distribution for C and M-stars differs. Late carbon stars are redder than late M star. It give possibility to complete list of potential late carbon star candidates by infrared photometric colours (J-K). The potential list of carbon stars contains more than 20000 objects, therefore the program of observation was planned to cover five-degree delta slices, in each season of observation, beginning from the pole gradually descend to the celestial equator. Observations were made with a 1.2 m Schmidt system telescope of Baldone Astrophysical observatory with a four degrees objective prism and CCD ST - 10XME from 2006 till early 2017, and CCD STX-16803 from late 2017 till 2019. 49 new carbon stars have been discovered in the constellations Casiopeia, Perseus, Auriga, Cygnus, Cepheus and Pegasus. Without spectral images of potential C-stars, positions of 347 spectral CCD images of bright standard C-star fields were exposed to study their spectral characteristics. The distance in kpc can be calculated from the equation Mk - mk + 5lgr + Ak + 10 = 0, where Ak is interstellar absorption, Mk absolute magnitude in K passband, mk observed K magnitude. Mauron (2008) showed that the absolute K magnitude of late carbon stars varies in a small range of magnitude from -8.1 to -7.4 depending on (J - K)0 colour indices. The interstellar absorption Ak and (J - K)0 can be calculated from interstellar reddening. Ak = 0.302E(B–V) and (J - K)0 = (J - K) – 0.405E(B –V), where E(B – V) is taken from infrared full-sky dust maps obtained by Schlafly and Finkbeiner (2011). Comparison of Gaia satellite and Baldone Observatory obtained distances are made. The distances of Gaia satellite and distances obtained at Baldone Observatory correlate within ±0.9 kpc; r(B) = 1.07r(G) - 0.41. Carbon star concentrations at distances 2, 4, 6-7 kpc from the Sun are observed. According to distances they are located near Orion, Perseus, and Outer arms, however, in general, carbon stars poorly tied to the galaxy's branches. Acknowledgements This publication makes use of data products from the Two Micron All Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation. This work use results from the European Space Agency (ESA) space mission Gaia. Gaia data are being processed by the Gaia Data Processing and Analysis Consortium (DPAC). Funding for the DPAC is provided by national institutions, in particular the institutions participating in the Gaia Multi-Lateral Agreement (MLA). The Gaia mission website is https://www.cosmos.esa.int/gaia. The Gaia Archive website is http://archives.esac.esa.int/gaia.

Observations of asteroids using the Baldone Schmidt telescope

I.Eglitis, A.Bule, A.Sokolova

In 221 observation nights were obtained 5544 CCD images, which covered 648 square degrees of sky. More than 6000 astrometric positions for 1122 asteroids were published and 49 new asteroids were discovered. Of them 3412 CCD images devoted to studying photometric characteristics of 25 NEO-type asteroids. For asteroids Nr.11508 (Stolte), 6178 (1986 DA), 2014 LJ21, 850 (Altona), 2583 (Fatyanov), 345705 (2006 VB14) and 26724 (2001 HU8) rotation periods were obtained. Photometric data reductions for the images of five Near-Earth Objects were done using the MPO Canopus and MaxIM DL programs. Through experimentation with different rotation periods used Fourier fitting to determine the best size of periods. The G(RP) photometric magnitudes for reference stars were taken from Gaia DR2 release (Brown et al., 2018, A&Aph, 616,1-22). Photometric data reductions are continuing.

This work use results from the European Space Agency (ESA) space mission Gaia. Gaia data are being processed by the Gaia Data Processing and Analysis Consortium (DPAC). Funding for the DPAC is provided by national institutions, in particular the institutions participating in the Gaia Multi-Lateral Agreement (MLA). The Gaia mission website is https://www.cosmos.esa.int/gaia. The Gaia Archive website is http://archives.esac.esa.int/gaia.

This research is funded by the Latvian Council of Science, project Complex investigations of Solar System small bodies, project No. lzp-2018/1-0401.

N.Jekabsons

Observations of OH masersof comets in 1.6 GHz frequency band using the Irbene RT-32 radio telescope and comets

Short reports and poster session

J. del Pino, K. Salmins

Continuous Sky Clarity Monitoring at SLR 1884 Riga, results and perspectives

The Aurora Cloud Sensor III sky clarity detector was installed and put into operation at the SLR 1884 Riga during the spring of 2017. After developing the additional methodology/software and testing it during the 2017, the permanent bilateral clarity monitoring together with the Finnish Metsähovi SLR was started in January 2018. We present the results up to now and the development ideas for the next years.

K. Nagainis, I. Eglītis

Asteroid detection on digitized scans of Baldone Observatory (code 069) Schmidt telescope archive

Many years of data of sky objects are stored in astronomical photo plate archives. That large archive was saved at the Baldone Astrophysical observatory. The archive contains more than 24000 wide-field direct and spectral images of the North sky. Archive data can be used to solve many astrophysical problems. One of them is finding observed asteroids from the archive. Manually it means to go through the observations of tens of thousands of objects to find what you're looking for. To save time, energy and to get more information about the asteroids, a program was needed. The goal of the program was for it to be easy to use and help new users to work with it. Now the program can do the following – give clear instructions how to use the NASA webpage(used to get the coordinates for archive asteroids) and give information to copy in there, autocorrects the values from NASA page, displays the info of archive file and finds the needed asteroid, finds similar objects and after that can show the location of all them graphically either in decimal degrees or hexagonal degrees. The result is a program which can be used by any employee in the Institute of Astronomy of the University of Latvia to find specific asteroids or to try and find new ones. The next steps are to find as many asteroids as possible and search the similar properties of them, and to automatize the input and output of the webpage. In conclusion, the program grants the possibility to gather data of the old and unused archives and to find asteroids that have not been approved yet. The goal of the program is reached, although it can be only used for Baldone Schmidt telescope archive digitized data for now.

This research is funded by the Latvian Council of Science, project Complex investigations of Solar System small bodies, project No. lzp-2018/1-0401.

D. Draviņš

Zvaigžņu spektroskopija un citplanētu meklēšana

Starp astronomijas izaicinošākajiem projektiem ir atrast tādas planētas ap citām zvaigznēm, kas ir ļoti līdzīgas mūsu Zemei, t.i., ar tai līdzīgu masu un kuras aptuveni gada laikā riņķo ap kādu Saulei līdzīgu zvaigzni. Plašsaziņas medijos dažreiz tiek ziņots, ka ir atrasta kāda "Zemei līdzīga" planēta. Tomēr tādas ziņas ir nedaudz maldinošas, jo attiecas tikai uz kādu atsevišķu īpašību kas atgādina, iespējams, Zemes temperatūru vai izmērus. Zemei reāli līdzīgas planētas vēl nav atrastas, un ar pašreizējām metodēm tās arī nav iespējams atklāt. Ierobežojumi neizriet no teleskopu vai instrumentu veiktspējām, bet gan no tā, ka planētas zvaigznes fiziskās svārstības daudzkārt pārsniedz niecīgo signālu, caur kuru varētu atklāt kādu nelielu Zemei līdzīgu planētu. Zvaigznes spožuma un spektrālo līniju izmaiņas rodas no konvekcijas gāzes kustībām zvaigznes atmosfērā, no globālām svārstībām akustisku viļņu ietekmē un no magnētiskiem reģioniem uz zvaigznes virsmas. Tie dažādos veidos ietekmē spektrālo līniju precīzos profilus un to viļņu garumu nobīdes, piemēram, atkarībā no tā, cik dziļi atmosfērā līnija veidojas, jeb vai tā ir jutīga pret magnētiskajiem laukiem. Šis projekts apvieno novērojumus ar augstas izšķirtspējas spektrometriem (R = 100.000) pie lieliem teleskopiem Eiropas Dienvidu Observatorijā (ESO) ar sintētiskiem hiper-augstas izšķirtspējas spektriem (R=1.000.000), kas aprēķināti no hidrodinamiskiem atmosfēru modeļiem. Sintētiskie spektri tiek analizēti ar nolūku atrast spektrālu līniju grupas, kurās svārstības var attiecināt uz zvaigznes atmosfēras izmaiņām (atšķirīgi efekti dažāda tipa spektrālajās līnijās), lai atšķirtu no tā signāla, kuru izraisa planētas orbītā ap zvaigzni (līdzīgs efekts visās spektrālajās līnijās), ar mērķi galu galā atrast kādus mūsu Zemei īstenus “dvīņus”.

A.Bule, I. Eglītis

A program for processing spectrum records

A new stellar spectrum processing program was developed due to the incompatibility of the previous version of the program with Windows 10 and more new Windows environments. The spectra are obtained using a Baldone Schmidt telescope 80x120x240 cm with ST-10XME 6.8x6.8 microns charge-coupled arrays, which were replaced with KAF-16803 9x9 micron arrays. A new optical system has also installed at the telescope so that the previous version of the program no longer made the correct calculations. During spectrum processing, background correction, rationing, cropping, wavelength pixel mapping, and graph processing are performed. The previous program consisted of 3 small Fortran programs running on a 32-bit operating system. Now all the calculations are done in a single Python-based program running on a 64-bit operating system. Wavelength mapping to pixels was performed using a polynomial approximation of the spectral class A star spectral lines. The new program offers the possibility of displaying a star spectrum graph - the number of photons per wavelength, or the same once in tabular form with a CSV file.

D. Bezrukovs, B. Ryabov, A. Vrublevskis

Microwave observations of “dark coronal corridors”

The interest into specific narrow coronal hole-like structures (“dark coronal corridors”, "coronal partings", "narrow coronal holes", "S-web") as an eventual source of the slow solar wind is growing up

nowadays. This kind of structures have an evident association with local open magnetic field areas. A reduced plasma density due to the plasma outflow along open magnetic field lines to the outer space permits to these structures. As a result some depression of the emission should be observed at wide range of wavelengths. Reliable microwave spectral polarimetric observations offers the possibility for direct estimations of the magnetic field induction and parameters of atmosphere at different heights in “dark coronal corridors”. The presentation concerns to studies of the structure of the “dark coronal corridor” between active regions NOAA 12089, 12090, 12091 and the evaluation of plasma densities in it based on a set of accessible microwave observations with Irbene RT-32 radio telescope and Nobeyama Radio Heliograph.

I.Eglitis, N.Jekabsons

Half period research results of project Nr. lzp-2018/1-0401

WP1 In 55 observation nights were obtained 1891 CCD images, which covered 575 square degrees of sky. 3676 astrometric positions for 1049 asteroids were published and 11 new asteroids were discovered. WP2 Photometric data reductions for the images of five Near-Earth Objects were done using the MPO Canopus and MaxIM DL programs. Through experimentation with different rotation periods used Fourier fitting to determine the best size of periods. WP3 Comets C/2018 W2 (Africano), 38PStephan-Oterma and 2019 Q4 (Borisov) were observed in R passband with Baldone Schmidt telescope. Comets C/2018 W2 (Africano), C/2017 T2 (PANSTARRS), 260P/McNaught were observed with Ventspils radio telescope RT 32m in passband L. WP4 Eight presentations were given at five international conferences, published seven papers and two articles are prepared for publications. Results reflected at
https://www.baldonesobservatorija.lu.lv/httpwwwlulvqesbaldonesobservatorijalulv/ and many public events. This research is funded by the Latvian Council of Science, project Complex investigations of Solar System small bodies, project No. lzp-2018/1-0401.

A.I. Vasyunin, M. Kiskin

Formation and Evolution of Organic Molecules in Protoplanetary Disks

We present the results of research of the chemical composition of the protoplanetary disk around a T Tauri star with mass of ~1 Msolar using the physical and chemical modeling. The physical model of the protoplanetary disk contains 4400 points and is based on the 1+1D -model. The chemical model includes 670 reactants and 6015 gas-phase and surface reactions. Radiation fields from the central star and interstellar radiation are taken into account. The chemical composition at each grid point of the physical model of the protoplanetary disk was calculated. Two-dimensional distributions of molecular fractional abundances with respect to hydrogen nuclei number density in the disk and total column densities were obtained. Impact of hydrogen abstraction reactions on abundances of methanol and related species is studied.

V. Sokolova, A. Vasyunin

Potential importance of experimentally evaluated changes in methanol formation chemistry

Diverse molecular composition is one of the main characteristics of interstellar objects: it can include both simple and complex (more than 6 atoms) molecules. Complex organic molecules (COMs, molecules containing more than 6 atoms, including C and H) are species of special interest, because they are actively involved in prebiotic chemistry and, possibly are associated with the origin of life. According to laboratory studies, methanol (CH3OH) is especially important molecule for the formation of more complex organic compounds. According to modern studies, methanol in interstellar medium forms on the surface of dust particles by hydrogenation of a carbon monoxide (CO) molecule, and then desorbs into the gaseous medium as a result of thermal and non-thermal processes. New experiments of [Minissale et al.(2016)], connected with H-exposure of carbon monoxide, formaldehyde, and methanol thin films deposited on cold surfaces, revealed an unexpected desorption phenomenon which complete relevant scheme for the CO-H chemistry. It was shown that new H2-abstraction reactions for HCO and H2CO need to be included into relevant chemical scheme of methanol formation. In this work we investigate an impact of new reactions HCO + H = CO + H2 and H2CO + H = HCO + H2, described in the work of [Minissale et al.(2016)], on the methanol formation pathways both on the grain surfaces in in the gas. For this purpose we model chemical evolution in properties of the cold dark cloud and the collapse of the translucent cloud into the dark cloud, with using different chemical networks. Analysis shows that new reactions are more effective and have a huge impact on abundances of almost all molecules, participating in the formation of CH3OH. Besides, in the models with reverse reactions abundances of gaseous CH3OH and on the grain surfaces decreases on more than 3-4 orders of magnitude. Moreover, importance of using chemical networks with both CH2OH and CH3O radicals is investigated.

N. Satonkin, A. Vasyunin

Development of the numerical code for the off-lattice three-dimensional modeling of the evolution of icy mantles of interstellar dust grains

In order to study the physical and chemical processes on the surface of interstellar dust grain, we started the development of numerical code for off-lattice Monte Carlo simulations of the evolution of a dust grain mantle. Current version of the code includes treatment of the van-der-Waals interaction between the atoms comprising the grain and atoms accreted to grain surface from interstellar gas. The code simulates processes of accretion of atoms from the gas phase, as well as desorption and diffusion in the icy mantle due to quantum tunneling through the barriers of surface potential. This is a necessary basis for further development of microscopic modeling of physical and chemical processes occurring on the surface of dust grain. More details will be presented on the poster.