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The main reasons for the nature of the variation in the brightness of magnetic stars

On the basis of the 10-color photometric system materials have been analyzed the light curves of more than 30 different (B0-F0) magnetic CP stars. In accordance with the variability of brightness, they can be divided into three groups.

a Variability of brightness is synchronous in all colors.

b Variability of brightness reach the minimum value in the depression area (λ 5200Å)

c Variability of brightness occurs in antiphase before and after depression at λ 5200Å.

The variability of brightness in the antiphase is explained by the intensification of depression in the region of λ5200 Å in the continuum, created mainly by rare earth elements, the excess of which reaches 4.5-6.0 dex in the region of spots on the surface of these CP stars.

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Magnetic field of δ Sct star 1 Monocerotis

We present the results of spectropolarimetric observations of δ Sct star type 1 Monocerotis. Observations were obtained during 5 nights in 2007 at 1.8-m telescope of Bohyunsan Optical Astronomy Observatory, Republic of Korea. We detected the weak magnetic field which changing from -22 +/- 10 Gs to +27 +/- 15 Gs.

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Short-time scale line profile variations in spectra of OB stars: case of rho Leo

The presented work continues the research by Kholtygin et al. (2017) of superfast line profile variations (LPV) in spectra of early-type stars. Multi-mode focal reducer SCORPIO at 6-meters telescope BTA was used to obtain 1271 spectra of rho Leo (B1Iab). The regular LPV for HI, HeI, FeII, NII, OII, and SiII lines with periods from 2 to ~90 minutes and amplitude of 1-2\% of the continuum level were detected. Nonregular LPVs were also detected at time intervals less then a minute. The frequencies LPVs with periods less than 10 minutes appeared to be variable. During of 128 minutes of observations the period can be changed by ~20%. The possible causes of discovered fast spectral variations are discussed. The presence of the short-term periodicity was not known earlier for B supergiants and its investigation is of a great importance for modeling the stellar evolution.

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The spin-powered strongly magnetized white dwarf AR Scorpii

AR Scorpii is a close low-mass binary system composed of a red dwarf and a strongly magnetized white dwarf which rotates with the period of 102 seconds and appears as a powerful spin-powered radio pulsar. Analysis of the system properties suggests that the white dwarf was spun-up to its current period in a previous epoch in which it passed through a phase of accretion from a keplerian disk. We show, however, that the spin-up scenario implies also a complicated evolution of the magnetic field of the white dwarf. Namely, the magnetic field was screened by the accreted material during the accretion epoch and reemerged after the intensive accretion had ceased. The magnetic field of the white dwarf during this phase has experienced a variation by more than two orders of magnitude.

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The magnetic field of the roAp star 33 Lib: a study in different spectral lines

The study of magnetic field inhomogeneities in the atmospheres of Ap-stars is important for modeling the topology of the magnetic field and for studying the inhomogeneous distribution of chemical elements in the atmospheres of these stars. 33 Lib (HD 137949) is the SrEuCr roAp-star with effective temperature 7350 K, log g = 4.4, Bs = 4.9 кГс, vsini < 8.0 км/с (Ryabchikova et al. 1999). The star is a possible very slow rotator whose axial rotation period exceeds 75 years. For this star we present the results of the longitudinal magnetic field measurement in individual spectral lines. We use spectropolarimetric observations from the open CADC database (http://www.cadc-ccda.hia-iha.nrc-cnrc.gc.ca), obtained for 4 nights (including 3 consecutive nights) in 2006 on the ESPADONS CFHT.

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About a magnetic field GY And (HD9996)

The regular monitoring of variability of a magnetic field is carried out long-period (P = 7962 days) a Ap-star GY And (HD9996) on the 1-m SAO RAS telescope. Monitoring showed that in areas of the maximal and minimum magnetic field possibly exists padding variability of a magnetic field. The found variability demands a padding research for its confirmation and clarification of the nature of this variability.

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About parameters of variability of magnetic fields of stars

Possibly all stars have global magnetic fields of various configurations and strengths. Observed variability of magnetic fields (MF) is studied by magnetic monitoring. At the majority of stars variability MF is explained by effects of a projection, i.e. MF is frozen in star substance also rotates together with a star. At some type of objects it is combined with physical variability - as at the flashing red dwarfs etc. Surely about parameters of a magnetic field it is possible to speak only when the behavior of MF is studied with the rotation period stars. Now the magnetic phase curves (MPC) are received for 310 stars. Types of objects for which are received by MPC are listed in tab. 1. Naturally, that it is the conditional classification. The most larger group of 196 studied objects are magnetic chemically peculiar stars (mCP). Some stars were simultaneously put into two different classes. For example, HD 96446 belongs to He-r and β Cep classes and HD 97048 belongs to TTS and Ae/Be Herbig types. Binary system DT Vir consists of two companions: UV+RS (Flare + RS CVn type stars). Therefore, the distribution of stars between classes had to be arbitrary or not unique in some cases. Fig. 1 shows the discrete distribution of star number vs. spectral class in our sample of magnetized stars with well known phase curves. Dominant fraction of those stars is located in the spectral range from early B to F type, i.e. in the spectral region containing mCP stars.

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Magnetic field and orientation orbit of planet in τ Boo (HD120136)

Among a set of the exoplanets found in stars there are such successfully located objects which observations give much information also allow not only to define physical and orbital parameters of planets but also to calculate orientation of the plane of an orbit of the planet rather equatorial plane of a star, and even direction the movements of the planet on an orbit concerning a star rotation sense. It turned out that there are planets which orbits are located under larger angles to the plane of the equator of a star. There are also such planets which orbit in the direction, opposite to the direction rotations of a star, so-called retrograde planets. It is apparent that the origin and evolution of retrograde planets passes absolutely not so, as in Solar system. For the unambiguous definition of a angle between plane of an orbit of the planet and equatorial plane of a star, angles λ, are necessary observations of passing of the planet on a star disk. In case τ Boo at which the plane of an orbit of the exoplanet is inclined so, that photometric transit is not observed. We suggest to estimate angle λ, using observations of a magnetic field of a star for definition period of rotation of a star. In this case it is the only way, which can specify the period of rotation of a star enough. Having defined the period, we can receive average the magnetic phase curve (MPC) and to make reasonable assumptions of structure of a global magnetic field of a star. And also for a case of the dipole field we can calculate a angle between an axis dipole and star spin axis, i.e. angle β. Magnetic fields at the stars having planets not only influence process formations and physical characteristics of planets, they give padding information on system. Angle between a spin axis of a star and a beam of vision, i_*, it is possible to calculate, involving spectroscopical observations. To calculate angle λ, one more angle, between the plane is necessary orbits of the planet and picture plane, angle of i_{pl}. Even in absence photometric observations of the planet it can be found if it was possible to receive curves of radial velocities for lines in a range and stars, and planets. Such object, suitable for researches, is also the star τ Boo with the planet (a hot jupiter).

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A preliminary orbit for μ Cet system from observations at the 6-m telescope

The construction of orbits with the subsequent measurement of the masses of components is one of the tasks of modern methods of high angular resolution. We present new observations of the speckle-interferometric system μ Cet carried out by speckle-interferometry and lunar occultations at the 6-m telescope. We derive a preliminary orbit and we find that our parameter estimates differ substantially from those of the SB9 catalog. Observational restrictions on the radius of μ Cet and on the total multiplicity of this system are discussed.

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Investigation of new mCV IPHAS J052832.69+283837.6

In the work, we present 5-year study of a new polar IPHAS J052832.69+283837.6. Including color photometry, polarimetry, spectroscopy. The object shows high orbital and long-term variability, change of color indexes. Circular polarimetry obtained on BTA with SCORPIO-2 reaches a maximum value of -9%, and switch sign during the orbital period. Thus we conclude that object has two pole accretion. Spectral data also varies for different epochs. We made Dopler maps to study accretion structure and line profiles variability. Radial velocity amplitude was used to estimate system parameters. Low-resolution wide range spectra were obtained to find cyclotron harmonics. The radiation region parameters will be present.

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Flare activity and confirmation of the type of variability of selected stars from the catalog GTSh10 according CRTS

The report presents information on the continuation of earlier studies on the search for flares in red dwarfs from the GTSh10 catalog at intervals of about 8,000 days and their activity based on the photometric observational database of the CRTS project. When reviewing the literature on the stars included in the GTSh10 catalog, it was found that for some of them there are no links to publications in the SIMBAD database. Further analysis showed that there is, at best, one article about the detection of flares activity in these objects, on the basis of which they were included in the catalogue of variable stars. To confirm the presence or absence of significant changes in gloss, studies were made of the light curves of selected objects from the data of the photometric survey of CRTS. The report presents a list of investigated objects, the number of flares detected and their amplitudes, and the graphs of the dependence of the brightness variations over time.

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Search for the cyclic activity of red dwarfs from photometric surveys data

A search for the cyclic activity of red dwarfs from photometric surveys. A brief overview of the search for the cyclic activity of red dwarfs from the moment of detecting their spottedness is presented. A list of the known periods in cycles of stellar brightness variations was compiled. The distribution of the known number of cycles is shown depending on their duration. Based on the data from photometric surveys, we show the possibility of detecting low-amplitude brightness variations on significant time intervals associated with the cyclic activity.

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Transmission spectrum of the planet WASP-32 b

The transmission spectrum of the exoplanet WASP-32 b, obtained from observations on the 10-m GTC telescope, is presented. Based on the results of spectrum analysis, evidence was found for the presence of Na and K chemical elements in the shell around the planet. It is also possible the presence of hydrogen HI. Analysis of the scale of the height of the exoplanet shows that the detected elements are significantly higher than its atmospheric layers.

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Observations of magnetic fields in Herbig Ae/Be stars

Models of magnetically driven accretion reproduce many observational properties of T Tauri stars. For the more massive Herbig Ae/Be stars, the corresponding picture has been questioned lately, in part driven by the fact that their magnetic fields are typically one order of magnitude weaker. Indeed, the search for magnetic fields in Herbig Ae/Be stars has been quite time consuming, with a detection rate of about 10%, also limited by the current potential to detect weak magnetic fields. Over the last two decades, magnetic fields were found in about twenty objects and for only two Herbig Ae/Be stars was the magnetic field geometry constrained. Also, several studies were undertaken to investigate the time dependence of spectroscopic tracers of magnetospheric accretion (MA). Overall, it seems that while there is proof that MA is present in some Herbig Ae stars, but there is less evidence for the Herbig Be stars.

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The extremely lengthiest magnetic period of a star of Przybylski's

It is very probable that the star of Przybylski's has the lengthiest of all known magnetic period, about 188 years. We used for definition of the period literary given and the estimates received by authors. Cooperative duration measurements makes 43 years (~ 23 % of the period). Period assessment very preliminary. We are discussed not only the extremely lengthiest period, but also some other unique features of this very interesting star.

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A method of estimation of the magnetic field in stellar wind of massive stars in High Mass X-ray Binaries

We consider High Mass X-ray Binaries (HMXBs) in which a magnetized neutron star is orbiting its massive early- type companion and appears as an accretion-powered X-ray pulsar. We show that such a system can be used as a native laboratory for testing parameters of the stellar wind ejected by the massive companion. The neutron star in the system plays a role of a probe, while its mass and radius are defined with a good accuracy by the equation of state. Parameters of X-rays emitted by the neutron star depend on the velocity and magnetic field of the stellar wind of its companion. Using HMXB OAO1657-415 as an example we demonstrate the method to estimate the velocity and magnetic field of stellar wind at the distance of orbital separation. We find that the magnetic field strength in the stellar wind of the massive component of OAO1657-415 at a distance of orbital separation lies in the range 20-70 mG.

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The unique chemically peculiar star HD 174 356

The B9pSi star HD 174 356 was found to display a peculiar light curve that does not agree with its classification as a CP2 star and can be interpreted as the sum of two independent strictly periodic signals with periods of 4.043615 and 2.11165 days. In all spectra, HD 174 356 appears to be single-lined, and no hint of orbitally-modulated radial velocity variations was found. We argue that the observed peculiar light variability is actually that of two independent objects that coincidentally share almost the same location in the sky: a bright rotationally-variable silicon CP2 star and a fainter unresolved short-period pulsating star, possibly a first-overtone Cepheid.

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New insights from magnetic studies of massive OB stars

Nearly 6-7% of massive OB stars possess a magnetic field. We review recent investigations of these fields. A special attention is given to studies of magnetic properties of high-mass X-ray binaries. The model involving the interaction of a magnetized stellar wind with the neutron star magnetosphere is considered to characterize the behavior of supergiant fast X-ray transients. The presence of magnetic fields in Be stars is also discussed. We argue that the observed fraction of magnetic stars is determined by physical conditions at the pre-main sequence stages of stellar evolution. We also consider the recent finding of the fast line profile variations on a time-scale of minutes and even a fraction of a minute in spectra of OBA stars. The existence of the compact regions with local magnetic fields on the surface of massive OB stars and their impact on fast line profile variations is also discussed.

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Statistical analysis of magnetic fields of HAEBE stars

Magnetic field measurements for Ae / Be Herbig stars are analyzed. The distribution of the rms values of magnetic fields B (in G) and magnetic fluxes F (in $G \cdot cm^2$) for 23 Herbig stars are evaluated. The distributions of B and F values can be fitted by a log-normal distribution with mean values <log B> = 2.2 and <log F> = 25.7 and widths sigma (log (B)) = 0.5 and sigma (log (F) = 0.5. The obtained values f the distribution widths appears to be almost the same as for the main sequence (MS) AB stars, while the mean values <log B> and <log F> seems to be significantly smaller than the corresponding values for the MS AB stars (2.5 and 26.4 respectively). The causes of these differences and possible scenarios of the evolution of the magnetic fields of intermediate-mass stars before MS are discussed.

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Magnetocavitation model of long-period oscillations of starspots

The long-period oscillations of the spots with the periods ranging from tens to hundreds minutes in the photospheres of the sun-like stars are investigated. The magnetocavitation model to explain these oscillations is suggested. According to this model, the starspots are considered as the homogeneous magnetized gas caverns, and the photospheric plasma is accepted an incompressible fluid. The interaction of the spots with the surrounding plasma of the photosphere can lead to the oscillations of the dimensions of the spots. The equation describing nonlinear changes of the characteristic size of the starspots is derived. The formula for the period of the linear oscillations of the spot sizes is obtained.

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Plasma ejections from the coronae of the red dwarfs

The process of the formation of the plasma ejections from the coronae of the flare red dwarf stars are studied. It is assumed that under certain conditions such process can be due to the plasmoid manifestation in the coronal plasma of these stars. The conditions contributing to this process can occur during the magnetic reconnection in the current sheets of the coronal plasma of the red dwarfs and lead to the formation of the plasmoids. Some plasmoids are ejected from the coronae, but others are destroyed because of to the resonant wave processes and shock waves in the stellar coronae. The process of the destruction of plasmoids can lead to the formation of the plasma ejections. The parameters of the ejections of the plasma are estimated.

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What can we learn about stellar magnetization by studying unique spin evolution of the X-ray pulsar OAO 1657-415

The persistent X-ray pulsar OAO 1657-415 is associated with a wind-fed High Mass X-ray Binary and shows a peculiar spin evolution. Its basic parameters are well studied including the magnetic field of the neutron star which is measured through observations of the cyclotron line. The pulsar is observed to experience a regular longterm spin-up superposed with chaotic spinup/spin-down events during which its period changes at a very high rate. According to our analysis such behavior can be expected if the stellar wind of the massive component is relatively slow and magnetized. Considering the neutron star as a probe we find that the velocity of the wind in the orbital plane at the distance of binary separation does not exceed 300 km/s and the magnetic field in the wind from which the neutron star captures material lies in the interval 20−70 mG. Finally, the observed spin evolution of the pulsar suggests that the stellar wind velocity may decrease as the massive star is approaching the final stage of its evolution.

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Index catalogue for the "Izvestiya CrAO". Stars with magnetic activity

The compilation of the Index Catalog for objects, information about which was published in the journal “Izvestiya KrAO”, allowed us to structure it according to the peculiarities of the conducted studies. The proposed report provides information on photometric, polarimetric and spectral observations of stars with magnetic activity. Observations were carried out at the Crimean Astrophysical Observatory and other observatories, and data on the studies were published in “Izvestiya KrAO”. The compilation of the list of objects and links to publications for them is described, as well as the catalog structure and the layout of its interaction with the main world astronomical databases.

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Statistical properties of magnetic fields and fluxes of young neutron stars

The young neutron stars (NS) of our Galaxy before the death line stage can be divided into normal pulsars and magnetars with magnetic fields <log (B)> = 11-13 and <log (B)> = 14-15, respectively. The average magnetic fluxes ($G \cdot cm^2$) of these groups of stars are <log(F)> = 23.9 for normal pulsars and <log(F)> = 26.8 for magnetars. The precursors of the NS are massive OB stars that also can be divided into two groups: magnetic stars with average magnetic fields from several hundreds of Gauss to tens of kilogauss and nonmagnetic or weakly magnetic stars whose magnetic fields can not yet be measured. The fraction of massive magnetic stars is 6-7%, and the average magnetic flux is <log(F)>=26.5. The average magnetic flux of weakly magnetic stars can be estimated using recent precision measurements of the magnetic fields of selected AB stars: Vega, Sirius A, rho_Leo, etc. For such stars a value <log(F)> = 23.8 which is close to the corresponding value for normal pulsars, whereas the average magnetic flux of magnetic OB stars is close to that for magnetars. For this reason we assume that normal pulsars are descendants of weakly magnetic stars, and magnetars are progenies of magnetic OB stars. The fraction of magnetars among the NS is only 1%. A small fraction of the magnetars can be explained by the short lifetime of the star at the magnetar stage.

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Evolution of the magnetic field of OBA stars at MS and beyond

Basing on the recent measurements we present evidences that the distribution of magnetic fields both for OB and for A stars can be approximated by a log-normal law with a mean log(B)=2.5. This conclusion contradicts to hypothesis on the magnetic desert proposed by Lignieres et al. (2014). We model the evolution of an ensemble of massive magnetic stars in the Galaxy with our new population synthesis code. The distributions of stellar radii, ages, masses, temperatures, effective magnetic fields and magnetic fluxes from the zero-age main sequence (ZAMS) up to the terminal age main sequence (TAMS) stages are evaluated. Basing on the comparison of real and model magnetic field distributions for OBA stars we conclude that the dissipation of the magnetic flux of early-type stars on the main sequence is very slow or even absent. It probably means that all changes of the magnetic field of massive stars are connected with the increasing of stellar radii during their evolution on the MS. Basing on this modeling we propose that the low observed fraction (6-7%) of magnetic stars among all early-type stars is connected with the physical conditions at the pre-main sequence stages of stellar evolution. We conclude that the shape of the magnetic field distribution for massive OB stars appears to be similar to that for neutron stars. This confirms the hypothesis that the magnetic field of a neutron star is mainly determined by the magnetic field of its predecessor, the massive OB star.

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An overview of the properties of a sample of newly-identified CP2 stars in the Kepler field

We present a comprehensive overview of the properties of several tens of Ap and Bp (CP2) stars that have been recently identified in the Kepler field and spectroscopically confirmed by our team (Hümmerich et al., A&A, 2018). Our targets populate the whole age range from zero-age to terminal-age main sequence in the mass interval from 1.5 to 4 Ms. A part of them exhibits a hitherto unobserved wealth of detail in their light curves indicative of complex surface structures that persist for decades. Monoperiodic variability and light curve stability were identified as cardinal criteria for selecting CP2 star candidates from among early-type stars in photometric surveys. Subsequent studies will be concerned with an exhaustive follow-on analysis of the new CP2 stars, which will lead to new insights on the physics of the CP star phenomenon.

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Towards comprehension of the variability of mCP star CU Virginis

The magnetic chemically peculiar (mCP) star CU Vir is one of the most enigmatic stars among upper main sequence stars. It is an unusually fast rotator showing strictly periodic light variations in all regions of the electromagnetic spectrum, as well as spectroscopic and spectropolarimetric changes. Exploiting information hidden in phase variations of all kinds we can well monitor the secular oscillation of the rotational period during the last 70 years. Applying own phenomenological approach, we treated 38 328 individual photometric and spectroscopic measurements from 73 data sources and improved the model O-C model considerably. All relevant observations indicate that the course of secular period variations can be well approximated by the 5-th degree polynomial. The outer surface fastened by the global magnetic field seems to be firm for decades what can be proven by the constancy of the mutual location of different phase tracers on the star surface.

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Fundamental parameters of CP-stars in Orion OB1 association

The report presents results of estimating the fundamental parameters for 61 CP-stars from the OrionOB1 association. The observational material is representing by more than 500 spectra of circularly-polarized radiation, which was obtained on the 6-m telescope (the Big Telescope Alt-azimuthal) of the Special Astrophysical Observatory of the Russian Academy of Sciences with the help of a Main Stellar Spectrograph (MSS) at the Nasmyth-2 focus in the period from 2010-2018. The average resolution of the spectra makes it possible to estimate the fundamental parameters of the stars with a sufficiently high accuracy. Also, we present a comparison of CP stars parameters with normal stars in association.

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Observations of stars with exoplanets at CrAO. Data base

The methods of keeping and access to the results of exoplanet observations, received since 2016 in CrAO RAS are stated. Keeping data must be publicly-accessible and must be used in general sources of International virtual observatory, particularly in Aladin software. A special Internet resource for data keeping with information about observational sets, light curves, comparison stars and a catalogue of objects in the field of observable object, is created. The catalogue is received by using nova.astrometry.net and SExtractor software. In the future, it is planned to provide on-line access to raw images of stellar fields.

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Statistical analysis of the UV Cet-type stars flares parameters on the results of monitoring with microsecond time resolution

In 2008-2015 at Special Astrophysical Observatory RAS the set of photonic observations of five flare UV Cet type stars with microsecond time resolution was held. Panoramic photometer-polarimeter of MANIA complex which set in primary focus of the BTA was used. During 72 hours of observation of CN Leo, EV Lac, UV Cet, V577 Mon, Wolf 434 stars about 160 flares were registered. The statistic analysis of 8 flares parameters: amplitude, brightness in the maximum, rise times, decay times, equivalent durations, total energies is given

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Search for exoplanets using spectroscopy

Когда астрономы предпринимают новый эксперимент, всегда присутствуют априорные соображения о предполагаемых результатах наблюдений. В задаче поиска планет, обращающихся вокруг звезд (экзопланет), преобладали представления о строении Солнечной системы. Поэтому ориентировались на создание методов, обеспечивающих возможность обнаружения юпитероподобной планеты в системе, аналогичной Солнечной. После того, как спектроскопическими методами были открыты планеты-гиганты, обращающиеся вокруг звезд за несколько земных суток, оказалось, что одно из главных астрономических открытий могло состояться на четверть века раньше.
Программы спектроскопического исследования экзопланет являются одним из аргументов как создания новых наземных и космических телескопов, так и внедрения новых технологий в спектроскопию звезд. Стабилизация характеристик современных астрономических спектрографов в значительной степени вызвана необходимостью проводить мониторинг экзопланет в течение продолжительного времени. Для расширения статистики доплеровских характеристик экзопланет разрабатываются многообъектные методы. Изучение тонких спектральных эффектов (на уровне 10-4 - 10-5 от регистрируемого сигнала) позволяет исследовать планетные атмосферы. Численное моделирование позволяет получать новые результаты и по архивным материалам. Сообщается об избранных разработках отечественной аппаратуры, ориентированной на спектроскопию и спектрополяриметрию звезд.

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Special Astrophysical Observatory

Technique of stellar spectroscopy. First quarter of XXI century

В начале XXI века состоялось несколько спектроскопических проектов, отражающих уже сложившиеся тенденции: увеличение диаметра коллимированного пучка, оптоволоконное сочетание с телескопом, снижение потерь на оптике спектрографа, увеличение квантовой эффективности приемника. Внимание уделяется стабилизации условий в объеме спектрографа.
Однако разработка новых телескопов большого диаметра и возрастающие требования к долговременной стабильности аппаратной функции спектрографа, ставят под сомнение перспективность классической схемы – эшелле спектрографа с оптоволоконным сочетанием. Современные твердотельные приемники достигли предельных значений квантовой эффективности и здесь резервы повышения возможностей классической схемы исчерпаны.

Представляют интерес новые разработки в области астрофотоники, интерференционной спектроскопии, адаптивной оптики в видимом диапазоне. Получают применение голографические решетки с объемным фазированием, интерферометры с внешней постдисперсией, фотонные «фонари», дифракционно ограниченные спектрографы, новые методы калибровки и цифровой обработки. Комбинирование новых технологий позволяет резко увеличить возможности спектроскопии высокого разрешения.
В обзоре приведены примеры развития классической схемы и рассматриваются принципиально новые технические решения.

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Analysis of spectropolarimetric observations: study of homogeneity and variability of polarized stellar spectra, individual lines selection for magnetic field calculation

There are two main approaches for measuring stellar magnetic fields using spectropolarimetric observations. Both of them based on Zeeman effect – splitting of spectral lines in the presence of a magnetic field. The first method, Least-Squares Deconvolution (LSD), involves calculating the weighted average Stokes V profile over all absorption lines (including blends) in the spectrum of the star. The second method, Single Line method (SL), allows to calculate the magnetic field by measuring the splitting of individual spectral lines. The LSD provides a high signal-to-noise ratio and allows to register very weak magnetic fields or complex magnetic fields that provide almost zero Zeeman splitting. But it does not take into account possible inhomogeneous distribution of physical conditions on the surface of the star. The LS method allows to calculate the magnetic field using all non-blended spectral lines as well as different arrays of spectral lines formed in the same physical conditions.

The distribution of spectral lines into arrays, depending on the physical conditions of their formation, requires the involvement of theoretical models of stellar atmospheres and the comparison of synthetic and observational spectra. In addition, an important step to automate the calculation of the magnetic field from individual spectral lines is to specify a "mask" that defines the wavelength boundaries and the upper restriction level of each spectral line.

In order to improve the efficiency of processing these large data sets, special software SpectroGraph was created. The program allows to visualize and compare observed spectra and synthetic spectra from Vienna Atomic Line Database, import synthetic spectra from third-party software, compare various spectra and different exposures. An automatic and interactive way of choosing the wavelength boundaries and top and bottom restriction levels of absorption lines is implemented, which allows measurement of magnetic field at different photospheric depths.

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Unusual spectroscopic behavior of the Herbig Ae/Be star HD37806

We present results of the spectroscopic study of the Herbig Ae/Br star HD 37806 carried out using high-resolution spectrographs at the Crimean astrophysical observatory, the OAN SPM in Mexico and the observatory of Ural Federal University. More than 100 spectra of the object obtained during 2012-2018 near Hα, Hβ, HeI 5876 and DNaI lines were analyzed. The following results have been obtained: 1. The Hα line can transform its profile type from P Cyg III to a double emission and back again on the time scale of months; 2. Narrow absorption components of the Hα and DNaI lines are observed, which change their velocities with a characteristic time of one day; 3. On some dates signatures of accretion onto the star in profiles of Hβ, HeI 5876 and DNaI lines appeared with the lifetime of order of several days. A possible interpretation of the observed phenomena is proposed. The Hα profile type transformation can be connected with variations of the external latitudinal boundary of the wind zone. The narrow absorption lines can result from rotation of local azimuthal inhomogeneities inside the wind zone, forming as a consequence of interaction of the disk with the stellar magnetosphere in the propeller regime. The assumption was made that the episodes of accretion cannot be connected with line modulation by the stellar rotation, but result from sudden short-term changes in the accretion rate. Additionally, short-term variations of the Hα and HeI 5876 lines during some nights showed that the wind outflows contained a stream-like structure and the signs of magnetospheric accretion are seen in the HeI 5876 profiles.

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Spectropolarimetric Observations of Magnetic White Dwarfs with the SAO 6-m Telescope

The results of spectropolarimetric observations of a number of magnetic white dwarfs obtained on the 6-m optical telescope of the Special Astrophysical Observatory are presented. The observations were carried out using the SCORPIO focal aperture-ratio reducer in a spectropolarimetric regime. Two characteristic dependences of the degree of polarization on the wavelength are observed. For one group of objects, the degree of linear polarization grows with wavelength, suggesting that the alignment of atoms and molecules in Rydberg states in the atmosphere of the white dwarf due to the action of its magnetic field influences scattering processes. The second group of objects displays an increase in the degrees of both linear and circular polarization with wavelength, providing evidence for the presence of protoplanetary disks around these magnetic white dwarfs, in which the alignment of circumstellar grains leads to the observed behavior.

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When polarisation is a measure of noise. The Terra Hunting Experiment

I will briefly present a new HARPS3 spectrometer planned to be installed on an upgraded robotic Isaac Newton Telescope. HARPS3 will be used for the Terra Hunting Experiment: a 10 year radial velocity measurement programme to discover Earth-like exoplanets in habitable zones around solar-type stars. Therefore, it will differ from other HARPS instruments in order to achieve the precision below 5 cm/s. At this level stellar activity becomes the main source of «noise» and thus the consortium behind the Terra Hunting Experiment is looking at reliable means for characterising stellar activity by systematic monitoring polarisation of spectral lines and traditional activity proxies like the cores of Ca H and K lines.

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The history of high-precision measurements of stellar magnetic fields at the Crimean Astrophysical Observatory from 1987 to the present

In the 80s of the 20th century, the appearance of CCD as a light detector revolutionized the accuracy of positional and energy measurements in astrophysics. This mainly concerns the area from UV to IR. At the Crimean Astrophysical Observatory of the USSR Academy of Sciences the first photoelectric measurements of stellar magnetic fields were performed in 1969 by A.B. Severny who used the modified Babcock's magnetometer. In 1985, the CCD camera of the University of Helsinki was incorporated installed in the coude focus in front of the long-slit spectrograph at the 2.6m Shajn reflector. After that the spectroscopic, and soon thereafter spectropolarimetric observations have been started.

Strong experience in long-term observations of global magnetic field of the Sun as a star and local magnetic fields of different solar patterns as well as rich experience with the solar and stellar magnetometers allowed to quickly switch to the use of a CCD as a light detector for measuring stellar magnetic fields. The Stokesmeter (polarization analyzer), whose design includes the rotating input quarter-wave plate, the light beam splitter, and the stationary output quarter-wave plate to compensate for the reflectivity of the beams with different linear polarization was designed. The techniques of spectropolarimetric observations and data processing were also developed.

First Stokesmeter for CrAO was made by I.D. Naidenov in SAO of the USSR Academy of Sciences. This Stokesmeter was using the quater-wave mica plates and was operating in the spectral region of 6200+/-200 A. The testing of joint use of the Stokesmeter and CCD, as well as the spectropolarimetric observational techniques were completed in 1986. Using the Stokesmeter together with the CCD has made it possible to achieve the magnetic field measurement precision better than 1 Gauss. Since 1987, the regular spectropolarimetric observations of stars of different spectral classes at different evolution stages have been performed at CrAO. I will briefly discuss the history of high-precision measurements of stellar magnetic fields at the Crimean Astrophysical Observatory.

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The behavior of magnetic fields with activity cycles in solar-like stars

The cycles of activity observed in the Sun and other cold stars are the result of the work of dynamo mechanisms that are triggered by the joint action of convection in the outer layers and the rotation of the star. For several decades chromospheric emission lines were the main indicators of magnetic activity. Modern methods of spectropolarimetry make it possible to measure magnetic fields in stars with convective shells with an accuracy of 1 G. Instead of disk-averaged chromospheric and photospheric flows, it has become possible to separate and study the global and local components of the magnetic field to track the long-term evolution of the topology of the magnetic fields of stars.

It is interesting to compare the time evolution of global and local magnetic fields and other parameters of photosphere and chromosphere activity. Measurement of different parameters associated with magnetic activity can provide complete information for numerical simulation of mechanisms of magnetic field generation in cold stars at different spatial scales. Knowledge of the parameters and range of the magnetic field variability of the parent star allow us to evaluate the possibility of the origin and evolution of life in its planetary system.

For most objects, the time base of spectropolarimetric observations is limited to a few years. But for several stars, time series of magnetic field measurements have already been obtained, completely overlapping the activity cycles. We present a brief review of the behavior of magnetic fields with activity cycles in selected solar-like stars

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Spectroscopic variability of the Herbig Be star HD259431

We analyze spectra of the Herbig Be star HD 259431 obtained in 2010-2018 at four observatories (Crimean AO, ESO in Chile, OAN SPN in Mexico and AO of Ural FU). The object demonstrates a very rich emission spectrum. Atmospheric lines are unusually shallow, and the majority of them are distorted by the circumstellar (CS) contribution. We have revealed that they are overlapped with an additional continuum emission. Using the observed ratio of the equivalent widths of two HeI 4009 and 4026 lines, we estimated the spectral class of the object as B5 V. We also constructed the spectral energy distribution using wide wings of the atmospheric Hβ – Hε lines free of the CS contribution. Balmer emission lines show very variable profiles looking as either of PCyg-type or a double-peaked emission line with a depression of the red wing. We found the period of this variability P = 2.840d and interpreted it as a sign of a rotating magnetosphere of the star with the magnetic axis inclined to the rotation axis. At different phases of rotation, the observer can see either an accretion flow at high latitudes or a wind zone at lower latitudes. We also estimated the inclination of the rotation axis $i = 43^{o} \pm 3^{o}$.

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Spectral and spectropolarimetric studies of the star FK Com

В работе представлен анализ спектрополяриметрических и спектральных наблюдений хромосферноактивной звезды FK Com. Спектропориметрические наблюдения получены на ОЗСП БТА САО РАН, спектральные данные высокого разрешения (R=45000) на УНУ «Телескоп Цейсс 2000» ЦКП «Терскольская обсерватория». Приводятся результаты спектропоряиметрических наблюдений проведенных в 2012, 2014, 2015 годах. Результаты анализа свидетельствуют в пользу предложенной интерпретации о поведения продольной компоненты магнитного поля <Bz>, что свидетельствует о более симметричном распределении магнитной области на поверхности FK Com. Возрастающая активность звезды за последние годы, зарегистрированная из фотометрических наблюдений, также согласуется с вероятным началом роста магнитного поля <Bz> начиная с 2014 года. Спектральные наблюдения получены в период с 2014 г. по 2017 г. Проанализированы линии Hα, H и K CaII. Изменение профилей линии свидетельствует о возрастающей активности звезды в последние годы.

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The variation of the Fe and Cr abundance stratification with the rotation phase in the atmosphere of Ap star 78 Vir.

We investigated vertical abundance distribution of Cr and Fe at different rotation phases of magnetic Ap star 78 Vir (HD 118022) using high-resolution high S/N spectra obtained with the NARVAL spectropolarimeter mounted at the 2 m telescope of the Pic du Midi observatory. The resolving power is R = 65000, the spectral range is 3700–10000 A. The spectra were analyzed at 6 phases of rotation: 0.095, 0.162, 0.371, 0.490, 0.623 and 0.927. For each phase, the chemical composition was derived and stratification analysis of Fe and Cr elements was performed. Comparison of the vertical element distributions at different phases showed that:

1. At all rotation phases Cr and Fe have sharp abundance gradients with abundance jumps at optical depth $\log\tau 5000 \sim -1.75$;
2. The element abundance in the deep atmospheric layers for all phases is nearly the same and varies within small limits ±0.1 dex;
3. The main changes are observed in the Cr and Fe abundances in the upper atmospheric layers, and, apparently, correlate with the magnetic field variations;
4. Position of abundance jump varies with rotation phase and correlates with magnetic field variations.

Our results suggest that the observed surface inhomogeneities of the Cr and Fe are most likely due to a move of abundance jump position towards the uppermost layers of the atmosphere: higher surface abundance corresponds to a transition region that occurs higher in the atmosphere and vice versa.

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Magnetic stars in Orion OB1 association

We studied magnetic field of chemically peculiar stars of the Orion OB1 association. More than 500 polarized spectra for 55 Cp stars were obtained with the 6m telescope. We found 10 new magnetic stars in addition to 20 previously known. The frequency of CP stars among normal A and B stars and the frequence of magnetic among all CP stars decrease with age in the Orion OB1 assocation. Detail study of group A of assotiatin is considered in detail.

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Formation of X-ray emission of OB-stars

Most of early-type stars are active X-ray sources. The main hypothesis of the origin of X-ray radiation of magnetic OB-stars is the Magnetically Confined Wind Shock model MCWS (Babel, Montmerle 1997). In this model, the matter of stellar wind moves along the magnetic field lines to the magnetic equator and forms a steady state shock there. A hot low-density gas is formed in the post-shock region. This area emits in X-ray. We propose three possible consequences from the MCWS model: the hardness of X-ray radiation of OB-stars should increase with extending of such stellar parameters as the magnetic field strength, the mass-loss rate and the terminal wind velocity. In 2007 A. Pollock put forward a new paradigm of the generation of x-ray emission of O-stars. His model is based on the analysis of X-ray observation of the O-type supergiant HD 37742. (Pollock 2007). According to his hypothesis the stellar X-rays forms in the collisionless shocks controlled by the magnetic field, the observed plasma is not in an equilibrium and the continuum of the braking radiation of electrons is weak, the plasma captured by the magnetic field in the double stars radiates in the X-ray and can be heated to higher temperatures than in single stars. We analyze archival observations of 32 O-and 26 B-stars obtained by the "XMM-Newton" space observatory in 2000-2015. We study the mentioned above consequences of the MCWS model and check the Pollock's paradigm for OB-stars. The result of our analysis shows that the consequences of the model MCWS are not confirmed. Also our statistical investigation revealed the failure of the Pollock's hypothesis for O and B stars. We propose that X-ray emission of OB stars is formed near the surface of the star in the region where the stellar wind forms the clumps which are geometrically thin and align.

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The analysis of X-ray emission of superflare stars.

Recent high-precision photometry from Kepler telescope made it possible to investigate the nature of ``superflares" on solar-type stars. The bolometric energy of superflares detected by Kepler ranges from 10^{33} erg to 10^{36} erg which is 10-10000 times larger than that released by a typical X10 class solar flare.

Apart, some G-type stars with super flares were detected in X-ray range. We analysed observations of 5 solar-type stars obtained by "XMM-Newton" satellite in 2011-2016. We have studied the variability and spectra of X-ray emission from solar-type stars. Short-time variability was not been found. Stellar spectra were modelled.

Based on the high precision photometric observations of the Kepler space telescope we investigated the properties of the active regions (cold spots) on the surface of these stars.

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Peculiarities of measuring the radial velocities of lines in the spectrum θ1Ori_C

Молодая (< 106 г.), близкая (» 414 пс) и очень массивная (Msum» 44$M_\odot$) двойная звезда θ1Ori_C является подходящим объектом для исследования формирования и эволюции двойных систем и для определения эволюционных параметров горячих массивных звезд. Впервые переменность со временем лучевых скоростей линий изучена для обоих компонентов, с использованием новых спектральных данных, полученных во время прохода системы периастра (декабрь 2012 до марта 2015). В течение пяти месяцев (октябрь 2013 - февраля 2014 гг.) на 1м телескопе САО были получены более 200 спектров (около 40 спектров в пределах 5-6 ночей ежемесячно) со спектральным разрешением R=35000 и отношением сигнал на шум 150≤S/N≤500. Также на 6м телескопе САО в течение 6 ночей (с 10.09 - 14.09.2013 г.) были получены спектры с R=60000 и N/S~800. Исследование лучевых скоростей линий показали, что в спектре первого компонента для изучения орбитального движения пригодны линии HeII. Для второго компонента - линии SiIII 4552, 4567 и 4574. Но во втором случае ошибки измерения могут дойти до ±10.0 км/с.

Впервые нами была построена 3D орбита системы, на основе интерферометрических данных и лучевых скоростей, полученных в течение 20 лет (ноябрь 1995 - март 2015 г.) для обоих компонентов. Уточнены параметры орбиты. Ошибка измерения суммарной массы около 9.7% и составляет 44.0 ± 4.3 $M_\odot$. Отношение масс компонентов, полученное по полуамплитудам лучевых скоростей, составляет (K1 = 15.0 ± 0.5, K2 = 44.1 ± 0.9 км/с) q=0.34±0.02. Соответственно M1=33.0±3.2 и M2=11.0±1.1 $M_\odot$.

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Software for NLTE spectrum fitting

We present software package for fine abundance analysis based on NLTE line profile fitting to the observed spectrum. The spectrum synthesis code SynthV is modified by loading the departure coefficients precalculated for any chemical element and chosen model atmosphere. For each element departure coefficients are calculated for a large set of energy levels, therefore NLTE synthesis is applied to any atomic transition between these levels by identifying them in input linelist extracted from VALD database in 'Long format' mode. SynthV NLTE is implemented to IDL visualization code BinMag6 (Kochukhov, 2018) which returns NLTE abundance for individual spectral line.

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RoAp star pulsation studies

The rapidly oscillating chemically peculiar A stars (roAp) are a subgroup of the chemically peculiar magnetic A stars. They are high-overtone, low-degree p-mode pulsators. They offer the opportunity to study the interaction of strong magnetic fields, rotation, and pulsation. Over the last decades, the studies of roAp stars have been altered drastically from the observational point of view through the usage of time-resolved, high-resolution spectra. Their unusual pulsation characteristics, caused by the interplay between short vertical lengths of pulsation waves and strong stratification of chemical elements, allow us to examine the upper roAp atmosphere in more detail than is possible for any star except the Sun. Here we review results of recent studies of the pulsations of roAp stars.

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Spots and activity of A-type stars

There is the problem of separating pulsating stars and stars with spots. We present a method of separating based on they the light curve period analysis and its Fourier parameters using the observations by the Kepler space telescope. Stability of Fourier parameters R_{21}, R_{31} indicates the pulsating nature of light curve variations. Contrariwise, instabilities of Fourier parameters indicate spots and their evolution marks during lifetime.

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Neutron star evolution in the Milky Way

The present work is devoted to the analysis of the evolution of young neutron stars (NSs) of the Milky Way to the death line. The population synthesis method has been used to study the distribution of young NSs by periods, period derivatives and their magnetic fields. The distributions of the initial periods and magnetic fields of the NS ensemble are assumed to be bimodal. Relatively slowly rotating NS with initial periods P0 ~ 1s becomes a magnetar, whereas NS with P0 ~ 300 ms turns into a normal pulsar. The model distributions of young NSs by rotation periods, period derivatives and magnetic fields arecompared with ones presented in the catalog ATNF. The location of the model ensemble of NS on the P-dot(P) diagram appears to be close to the position of the real ensemble of NS.

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Binary CP-stars in Orion OB1a association

Detailed spectroscopic survey of chemically peculiar (CP) stars in an association of Orion OB1 allowed us to extend the number of binary stars with CP-components. In the oldest part of the association, subgroup *a*, we have selected 11 CP-stars showing either variable radial velocity or signatures of composite spectra. Among these objects, we found several good candidates for further detailed study.

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Magnetic structure of ultracool stars inferred from quiescent and flaring radio emission

Ultracool stars reveal two components of the radiation at 5-10 GHz: a quiescent largely unpolarized component, and 100% circularly polarized flaring coherent emission [1]. We have shown that gyrosynchrotron emission from 30-50 magnetic loops with magnetic field of about 100 G which are quasi-uniformly distributed over the surface of star can be responsible for quiescent slowly varying radio emission from TVLM 513-46546. Gyrosynchrotron radiation generates by ~ 1 MeV electrons with the number density ~ 5×10^7 cm^{-3}. Soft X-ray data suggests that these magnetic loops contain hot (~ 10^7 K) and dense ($\geq 10^{10}$ cm^{-3}) plasma.

Flaring component with a high brightness temperature (10^{11} -10^{13} K) and a narrow radiation pattern arising from a source can be interpreted in terms of electron cyclotron maser (ECM) emission [2] or as the coherent plasma radiation [3]. ECM at 5-10 GHz requires quite high magnetic field in the coronal loops ~ 1.7–3.0 kG. Plasma mechanism suggests high plasma density~ 3×10^{10}–8×10^{11} cm^{-3} in the loops and medium magnetic field value, ~ 200-500 G. High plasma density forms due to the dissipation of electric currents in a thin ‘pressed-down’ atmosphere which lead to heating of the plasma and to the plasma evaporation into a loop. In addition, for the origin of energetic electrons, we suggest the acceleration mechanism in the electric field driven by electric current oscillations in a coronal loop, which can explain both long-lived quiescent and flaring radio emission from ultracool stars.

Thus the radio emission from ultracool stars assumes that the magnetic structure of the stars consists of a compact active region with several magnetic loops generating an intense completely polarized component of the radio emission, and from numerous loops quasi-uniformly distributed over the star surface - the sources of the quiescent component.

References

1. Hallinan G., Antonova A., Doyle J.G., et al., Astrophys. J . 684, 644 (2008).
2. Yu S., Hallinan G., Doyle J.G., et al., Astron. Astrophys. 525, A39 (2011)
3. Stepanov A., Zaitsev V., Kronshtadtov P. Astron. Soc. Pacific, 510, 284 (2017).

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Nebulae AFGL 2688: structure, kinematics, chemical composition

A new high resolution (R=60000) spectroscopic observations of proto-planetary nebulae AFGL2688 was carried out with NES spectrograph on the 6-meter telescope BTA. Although the object belong to high luminosity post-AGB stars we can observe only a small part of his dust scattered light, because of the central star a obscured by thick dust torus. A low surface brightness of nebulae lobes is due to a low density of matter that is in good agreement with an extremely high linear polarization (up to 70%). Thanks to our reconstruction of NES spectrograph [Panchuk V.E., Klochkova V.G., Yushkin M.V. // Astronomy Reports. 2017. T. 61. № 9. C. 820-831.] it became possible to obtain a high-resolution spectrum not only of the northern lobe of the nebula with a integral brightness V = 15.0m, but also of a weaker southern lobe with a integral brightness V = 16.5m.

Absorption photospheric lines are reliably identified in the spectra of the northern and southern. The redshift of photospheric lines relative to the velocity of the center of mass of the source is explained by the radiation scattering effect by dust particles of the expanding circumstellar shell. Precision measurements of the radial velocities of various spectral features make it possible to refine the geometry of the object. For the first time, the kinematic characteristics of the dust and gas component of the nebula are measured separately. Analysis of the complex profiles of the D1 and D2 lines of the resonant NaI doublet lines shows that the dust component of the nebula has a higher velocity in comparison with the gas. Perhaps we are seeing the effect of the acceleration of dust particles by radiation pressure.

By comparison of the chemical composition of the central star and the circumstellar envelope we suggest that the layers of the stellar envelope that have been processed in the CN cycle are uncovered as result of mass loss on the post-AGB stage. In conclusion we suggest about the high initial mass of the central star.