Features of chemical-element abundances in open star clusters of the Galaxy

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Abstract. On the basis of the compiled catalog containing spectroscopic abundances of 14 chemical elements for 90 open star clusters of the Galaxy, we show that in the young clusters not only barium but also three other studied elements of slow neutron-capture, Y, La, and Ce, reveal higher relative abundances than those in the field stars, with differences beyond the error limits. We also find that, at high metallicity ([Fe/H]> -0.1), the relative abundances of the r-process element Eu in the clusters with eccentric, high $Z_{\max}$ orbits are lower, and the relative abundances of primary α-elements O and Mg are higher, than the average values for the field giants. At the same time, at lower metallicity, the [Eu/Fe] ratios in the clusters are, on average, the same as in the field, but with a much larger dispersion, and the [O, Mg/Fe] ratios are lower than in the field giants. Taking into account that both α-elements and r-elements are ejected into the interstellar medium as a result of Type II supernova explosions, and that their yields are dependent on the pre-supernova mass, these properties naturally fit into the assumption that the clusters of different metallicity with eccentric, high $Z_{\max}$ orbits are formed by interaction of two types of high-velocity clouds with the interstellar medium of the Galactic disk. On the one hand, these are low-metallicity high-velocity clouds formed from the "primary" gas; on the other hand, there are more metal-rich intermediate-velocity clouds generated in the Galactic "fountain" process.

Key words: Galaxy: abundances – open clusters and associations: abundances

Determination of abundances of chemical elements in open star clusters of the Galaxy

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Abstract. Spectroscopic determinations of the relative abundances of chemical elements produced in different nuclear-synthesis processes, [el/Fe], are collected for 90 open star clusters of the Galaxy using data from 109 papers published between 1991 and 2015. Information is gathered on the abundances of α-elements (O, Mg, Si, Ca, and Ti), iron-peak element (Fe), slow neutron capture elements (Y, Ba, La, Ce, Nd, and Zr), rapid neutron capture element (Eu), and elements with an odd number of protons (Na, Al). The weighted averages are calculated for the clusters with more than one determination of the abundances of each studied chemical element. Estimates of metallicities are found for 346 clusters. A compiled catalog of the open cluster parameters contains metallicities, positions, ages, velocities, elements of Galactic orbits, and relative abundances of fourteen chemical elements.

Key words: Galaxy: open clusters and associations: general, abundances – catalogs

Periodic variations in the vertical velocities of galactic masers

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Abstract.   We compiled published data on Galactic masers with VLBI-measured trigonometric parallaxes and determined the residual tangential, ΔV_{circ}, and radial, ΔV_R, velocities for 120 masers. We used these data to re-determine the parameters of the Galactic spiral density wave using the method of spectral analysis. The most interesting result of this study is the detection of wavelike oscillations of vertical spatial velocities (W) versus distance R from the Galactic rotation axis. Spectral analysis allowed us to determine the perturbation wavelength and the amplitude of this wave, which we found to be equal to $\lambda_W = 3.4 \pm 0.7$ kpc and $f_W = 4.9 \pm 1.2$ km s^{-1}, respectively.

Key words: masers – Galaxy: stellar content – Galaxy: spiral arms – stars: formation

On the Astron UV space mission data

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Abstract. The Soviet UV space mission Astron, launched in 1983, had been operational for eight years as the largest ultraviolet space telescope during its lifetime. Astron provided a lot of observational material for various types of astrophysical objects, but unfortunately these data were not widely available and, as a result, unduly forgotten. Here we present some results of our comparison of the Astron data to the modern UV stellar data, such as the NGSL spectral library, discuss the precision and accuracy achieved with Astron, and make some conclusions on potential application areas of these data.

Key words: space missions: Astron – ultraviolet: stars – astronomical databases

A new revision of the HDEC (Henry Draper Extension Charts) catalog

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Abstract. A new version of the HDEC (Henry Draper Extension Charts) catalog is presented. The catalog includes 88,548 entries, more than 3500 of which (components of binary systems) were earlier corrupted by an algorithmic error (1579 multiple systems were revealed). Spectral classification of these objects has been corrected manually using the CDS data. We also corrected some mistakes of the catalog detected by the measurement model and cross-matching with other CDS catalogs, and, in some cases, by the authors of the catalog and through collaboration of the HDEC users.

Key words: catalogs – astrometry – stars: binaries: visual – stars: variables

Half a century after the outburst of the symbiotic nova V1016 Cyg

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Abstract. We present the results of our long-term $UBVJHKLM$ photometry and spectroscopic monitoring of the symbiotic nova V1016 Cyg. After its outburst in 1964, the star showed fading in the U, B, V bands at a rate of about 0.03 mag per year. The behavior of the $B - V$ and $U - B$ color indices reflects variations of the emission lines, fading of the erupted component, weakening and reddening of the cool giant. Also, monotonic color and brightness variations in the infrared (IR) were observed at a scale of several thousand days. After 2004, the yearly mean IR brightness showed a decline and IR colors, reddening, due to the increase of the optical depth of the dust. The parameters of the cool star and of the dust envelope were estimated. The pulsation period of the Mira-type variable was refined, $P = 465\pm5$ days. The Mira's photospheric temperature varied from 2100 to 2700 K in the pulsation cycle. The mass of the dust shell has grown twice during the recent decade, at a dust penetration rate of $\Delta M_{\mathrm{dust}} \sim 10^{-7} M_{\odot}/\mathrm{yr}$. Our spectroscopic monitoring of V1016 Cyg over 1995–2013 showed variations in the emission line strengths. The absolute fluxes of most lines decreased after 2000, whereas the relative intensities of [O III], [Ar III], [Fe VII], [Ca VII] lines with respect to Hβ are increasing after the possible minimum that could happen in the 1990s. An essential flux decline (approximately ten-fold between 1995 and 2013) in the Raman scattered O VI line at $\lambda6825$ shows the change of conditions in its formation zone, due to absorption of O VI 1032 Å quanta in the new dust shell of the cool component.

Key words: binaries: symbiotic – stars: variables: Miras – stars: individual (V1016 Cyg)

Analysis of interstellar extinction towards the hypergiant Cyg OB2 No. 12

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Abstract. The Cyg OB2 stellar association hosts an entire zoo of unique objects, and among them – an enigmatic star Cyg OB2 No. 12 (Schulte 12, MT 304). MT 304 is enigmatic not only due to its highest luminosity (according to various estimates, it is one of the brightest stars in the Galaxy), but also because its reddening is anomalously large, greater than the mean reddening in the association. To explain the nature of anomalous reddening ($A_V \simeq 10$ mag) of MT 304, we carried out spectrophotometric observations of 25 stars located in its vicinity. We mapped interstellar extinction within the 2.5 arcmin radius and found it to increase towards MT 304. According to our results, the two most reddened stars in the association after MT 304 are J203240.35+411420.1 and J203239.90+411436.2, both located about 15 arcsec from it. Interstellar extinction A_V towards these stars is about 9 mag. Our results favor the hypothesis of the circumstellar nature of reddening excess. In the second part of the paper we present the results of our modeling of MT 282 (B1 IV) and MT 343 (B1 V), which belong to the older population of the association and have ages greater than 10 Myr.

Key words: stars: early-type, atmospheres, fundamental parameters – Galaxy: open clusters and associations: individual: Cyg OB2 – stars: individual (MT 304, MT 343, MT 282)

Identification list of binaries

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Abstract. The Identification List of Binaries (ILB) is a star catalogue constructed to facilitate cross-referencing between different catalogues of binary stars. As of 2015, it comprises designations for approximately 120,000 double/multiple systems. ILB contains star coordinates and cross-references to the Bayer/Flemsteed, DM (BD/CD/CPD), HD, HIP, ADS, WDS, CCDM, TDSC, GCVS, SBC9, IGR (and some other X-ray catalogues), PSR designations, as well as identifications in the recently developed BSDB system. ILB eventually became a part of the BDB stellar database.

Key words: binaries: general – astronomical databases – catalogues

Stäckel-type dynamic model of the Galaxy based on maser kinematic data

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Abstract. A dynamic model of the Galaxy is constructed based on kinematic data for masers with trigonometric parallaxes. Maser data is used to compute the model potential in the Galactic plane. The potential is then generalized to three dimensions assuming the existence of a third quadratic integral of motion. The resulting Galactic model potential is of Stäckel's type. The corresponding space density function is determined from Poisson's equation.

Key words: methods: analytical – Galaxy: kinematics and dynamics

The outer ring of the Galaxy revealed by young open clusters

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Abstract. The distribution of young open clusters in the Galactic plane suggests the existence of the outer ring $R_1 R_2'$ in the Galaxy. The solar position angle θ_b providing the best agreement between the observed and model distribution is $\theta_b = 35 \pm 10°$. We compared the θ_b values derived from three different catalogues of open cluster and they appear to be consistent within the errors.

Key words: Galaxy: structure – Galaxy: kinematics and dynamics, open clusters and associations

Estimating stellar parameters and interstellar extinction from evolutionary tracks

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Abstract. Developing methods for analyzing and extracting information from modern sky surveys is a challenging task in astrophysical studies. We study possibilities of parameterizing stars and interstellar medium from multicolor photometry performed in three modern photometric surveys: GALEX, SDSS, and 2MASS. For this purpose, we have developed a method to estimate stellar radius from effective temperature and gravity with the help of evolutionary tracks and model stellar atmospheres. In accordance with the evolution rate at every point of the evolutionary track, star formation rate, and initial mass function, a weight is assigned to the resulting value of radius that allows us to estimate the radius more accurately. The method is verified for the most populated areas of the Hertzsprung-Russell diagram: main-sequence stars and red giants, and it was found to be rather precise (for main-sequence stars, the average relative error of radius and its standard deviation are 0.03% and 3.87%, respectively).

Key words: ISM: dust, extinction – stars: fundamental parameters

Astronomical surveys and big data

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Abstract. Recent all-sky and large-area astronomical surveys and their catalogued data over the whole range of electromagnetic spectrum, from γ-rays to radio waves, are reviewed, including such as Fermi-GLAST and INTEGRAL in γ-ray, ROSAT, XMM and Chandra in X-ray, GALEX in UV, SDSS and several POSS I and POSS II-based catalogues (APM, MAPS, USNO, GSC) in the optical range, 2MASS in NIR, WISE and AKARI IRC in MIR, IRAS and AKARI FIS in FIR, NVSS and FIRST in radio range, and many others, as well as the most important surveys giving optical images (DSS I and II, SDSS, etc.), proper motions (Tycho, USNO, Gaia), variability (GCVS, NSVS, ASAS, Catalina, Pan-STARRS), and spectroscopic data (FBS, SBS, Case, HQS, HES, SDSS, CALIFA, GAMA). An overall understanding of the coverage along the whole wavelength range and comparisons between various surveys are given: galaxy redshift surveys, QSO/AGN, radio, Galactic structure, and Dark Energy surveys. Astronomy has entered the Big Data era, with Astrophysical Virtual Observatories and Computational Astrophysics playing an important role in using and analyzing big data for new discoveries.

Key words: astronomical databases: miscellaneous – catalogs – surveys – virtual observatory tools

Results of 40-year studies of the X-ray binary Cyg X-1 = V1357 Cyg

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Abstract. This paper reviews the results of our 40-year studies of Cyg X-1 using various methods and observational data: mainly optical photometric, spectroscopic, and polarimetric ones, with X-ray data also considered. We show that, while performing model calculations approximating observational data, it is vital to take into account a diversity of factors, for example, the accretion structure variations that influence the shape of the orbital light curve. We emphasize the necessity of comprehensive studies, development and usage of all possible methods.

Key words: stars: atmospheres, abundances, accretion disks, individual (V1357 Cyg) – X-rays: binaries

Russian Virtual Observatory: data sources

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Abstract. The purpose of this review is to analyze main directions of creation and functioning of major data sources developed by Russian astronomers or with their participation and to compare them with the worldwide trends in these fields. We discuss astronomical space missions of the past, present, and future (Astron, INTEGRAL, WSO-UV, Spectrum Roentgen Gamma, Lyra-B), high-quality photometric atlases and catalogues, and spectroscopic data sources, primarily VALD and the global VAMDC framework for the maintenance and distribution of atomic and molecular data. We describe collection, analysis, and dissemination of astronomical data on minor bodies of the Solar System and on variable stars. Also described is the project joining data for all observational types of binary and multiple stars, Binary star DataBase (BDB).

Key words: astronomical databases: miscellaneous – catalogs – surveys – virtual observatory tools – e-science