

SUBSECTION “ASTROINFORMATICS”

ON THE COMMUNICATION OF PHOTOMETRIC SYSTEMS FOR REDUCTION OF STAR MEASUREMENTS WITH PHOTOGRAPHIC PLATES

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For the purpose of photometric calibration of astronegatives, work has been done that made it possible to establish a relationship between the photovoltaic magnitudes of the BVR Johnson system and the magnitudes BV Tycho2 and bgr GAIA DR2. For a sample of more than 11 thousand common stars, the rms errors of the reduction of the solar indices of the B-V Tycho2 and b-r catalog of the GAIA DR2 catalog to the Johnson BVR system do not exceed 0.1 magnitude.

RE-REDUCTION OF THE OLD PHOTOGRAPHIC OBSERVATIONS OF INTERAMNIA (704) BASED ON GAIA DR2 REFERENCE CATALOG

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A new astrometric reduction of old photographic plates, benefiting from modern technologies such as high precision digitizing machines associated with a reduction using high precision Gaia DR2 catalog could be useful to study the orbital motion of Solar system minor bodies. Based on the newly released Gaia DR2 star catalog, the scans of the photographic plates containing images of Interamnia (704) taken by the Zonal Astrograph of Mykolaiv Astronomical Observatory (MAO) in 1974-1985 were re-reduced. For our investigation we used 29 plates from UkrVO archive digitized by commercial EPSON scanner with 1600 dpi resolutions. Besides for 2 of them were digitized by high precision digitizing machine of Shanghai Astronomical Observatory (ShAO, PRC) with 2540 dpi resolution. Almost all plates have 3 exposures with small shift. Each of 29 plates was scanned 6 times by EPSON scanner in 0° direction. Digitizing machine scanned 2 plates also 6 times but 3 times in 0° direction and 3 times in 90° direction. A total of 85 asteroid positions taken from 29 plates were derived using various reduction options. Only 5 asteroid positions were calculated from ShAO scans. The full identification was conducted and coordinates of all objects were obtained with usage of different options of astrometric reductions. The mean inner accuracy of obtained asteroid positions is 0.03" in RA and 0.14" in DEC for EPSON scanner and 0.014" in RA and 0.013" in DEC for digitizing machine in 0° direction and 0.010" in RA and 0.011" in DEC in 90° direction. The comparison of the new topocentric asteroid positions with Horizons ephemeris was made for calculation (O-C)

residuals and their RMS. The mean residual differences between the scan obtained positions and JPL calculated positions were $(0.09 \pm 0.16)''$ in RA and $(-0.09 \pm 0.25)''$ in DEC for MAO digitized plates, for ShAO scans the calculated differences are close to zero. Comparison of the results obtained with previous reductions of these observations with Tycho2 and UCAC4 reference catalogs showed that the use of the Gaia DR2 reference catalog does not lead to a significant improvement in the random and systematic component of the residual differences (O-C) for scans with EPSON scanner from the UkrVO archive. The results, obtained by processing images from ShAO digitizing machine, suggest that in this case, Re-reduction of the all photographic observations based on Gaia DR2 could improve the accuracy of old photographic observations to the level of modern ground-based CCD observations.

SOFTWARE FOR SEARCH AND MEASURING OF WDS CATALOG DOUBLE AND MULTIPLE STARS FROM DATABASE OF RESULTS OF CCD OBSERVATION

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Double and multiple star systems are source of unique information for determining the parameters of star formation models and for testing stellar models evolution. Therefore observations and measuring of their mutual configuration parameters is still important. Observations of double and multiple star systems at the RI MAO were performed using different telescopes since 2013. In addition, we also have an observational database and proceeding results of the fields in open clusters vicinity, which were performed using the KT-50 telescope (D=500mm, F=3000mm) in 2011- 2020. All astrometric processing was carried out by the Astrometrica software using UCAC4 or GAIA DR2 as reference catalogs. The catalogs of stars positions in the vicinity of open clusters were created as results of these observations.. There are a lot of double and multiple stars in the fields with open clusters. Software for search and measuring of mutual configuration parameters of the double and multiple stars from Washington Double Star Catalog (WDS) are presented. Observational array over 71 nights of 2019 were checked. 9679 CCD images were reduced and in 7170 of them 27157 WDS pairs were found. Total numbers of unique pairs are 1475 in 1088 systems with average number of pair observations near 18. The standard errors of measurements were 0.15" for separations and 0.5° for position angles. The epoch difference between our observations and the last observation in the database is in the range from 2 to 28 years. The comparison with WDS data was shown that residual differences and their standard errors were $(-0.03 \pm 0.24)''$ in separations and (-

0.07±0.88) ° in position angles for close observation periods.

ASTEROID POSITIONS BASED ON DIGITIZED OBSERVATIONS OF THE NORTHERN SKY SURVEY PROJECT IN DUSHANBE

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We continued to identify asteroids images and create catalogs of their positions based on digitized photographic observations of previous years.

The Dushanbe part of the Northern Sky Survey (FON project) is represented by about 1570 photographic plates obtained in 1985-1992 on the Zeiss-400 astrograph at the Hissar Astronomical Observatory of the Institute of Astrophysics of the Academy of Sciences of Tajikistan. At present, their digitization and further scan processing continue until the final product is obtained in the form of a catalog of equatorial coordinates and stellar magnitudes for all registered objects on the plates. The equatorial coordinates α , δ of all objects on the plates were obtained in the Tycho-2 reference system at the epoch of exposure of each plate. Photometry of stars for the plates was carried out on the basis of the principles implemented in the processing the plates of the FON project using photoelectric measurements of stars to construct the characteristic curves of the plates. Photographic B-magnitudes of objects were calibrated to photoelectric standards.

In parallel with solving the main task of the project to create a catalog of stars and galaxies, we analyzed the results of processing the plates in order to search for images of asteroids and comets and create a catalog of their coordinates and values.

In total, about 325 positions of asteroids and comets were obtained with visual magnitudes from 7 to 16.5. All positions of the asteroids were compared with the ephemeris. A preliminary analysis of the O-C differences was performed and their comparison with similar results obtained from the digitized observations of the Kyiv and Kitab parts of the FON project.

"VANISHING & APPEARING SOURCES DURING A CENTURY OF OBSERVATIONS" (VASCO) PROJECT

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The "Vanishing & Appearing Sources during a Century of Observations" (VASCO) project uses existing survey data to find examples of exceptional/unknown astrophysical transients (see Villarroel et al. 2020). Among the broad set of astrophysical goals related to long-term variability of astrophysical objects, are the goals to look for signatures of extra-terrestrial intelligence, which includes signs of vanishing stars, Dyson spheres and photometric signatures of red lasers. In Villarroel et al. (2020) we presented the results of the first VASCO search where ~100 red transients were found. Possible natural explanations are strong M dwarf flares or optical counterparts or high-redshift supernovae. In this presentation, I update the community on the ongoing analysis of the ~100 transients. I also present the currently launched VASCO citizen science project, that has been developed in a cross-disciplinary collaboration between astronomers, image analysis- and machine learning scientists.

THE SPECTRAL OBSERVATION ARCHIVE OF THE MAO NAS OF UKRAINE AS A PART OF THE UKRAINIAN VIRTUAL OBSERVATORY

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The overview of the content of an Archive of the spectral observation data obtained at the MAO NAS of Ukraine since 1965 is presented. This archive covers a time period about 20 years and contains of 50,000 spectra of variable stars.

This spectral photographic material (glass astroplates) was obtained mostly by the 70-cm reflector AZT-2 (Kyiv) as well as in addition to the 60-cm Zeiss telescope at Mount Terskol, North Caucasus, Russia and 1-m telescope at Mount Sanglok (Institute of Astrophysics, Tajikistan), equipped with spectrographs UAGS with a set of gratings to obtain dispersions in the range of 29 Å/mm to 167 Å/mm in the range of wavelength 3500 - 6800 Å. There is also data related to the experience of using DSA refractor (Double Short Astrograph) with a pre-objective prism to monitor Nova Cygni 1975 in the initial stage of outburst. Almost all the spectra are calibrated with the 9-step attenuator and a comparison spectra for the wavelength scale.

We discuss observational programs (aims, instruments, results), in frame of which this archive was accumulated, as well as key principles for digitizing spectra and their processing by modern tools of virtual observatory software.