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Broad-band polarimetry: technique, calibration and standards (12+3)

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Polarization is an important property of light. It has been regularly detected in scattered light and it could be emitted from the sources with a strong magnetic field (e.g. magnetic cataclysmic binary systems, neutron stars, etc.) and its properties are linked to the internal geometry of a source of radiation and scattering environment. As a consequence, polarimetry complements photometric and spectroscopic studies of sources of radiation and has made possible many astrophysical discoveries.

We processed the large data set obtained using single-channel aperture photometer-polarimeter installed on the 2.6-m Shajn mirror telescope (SMT) at the Crimean astrophysical observatory (Ukraine). It contains high time resolution measurements of various polarimetric standards, magnetic cataclysmic binaries, comets, moons and asteroids obtained in 2002-2017. The polarimeter was equipped with a fast rotating quarter wave plate, and this construction allows us to measure all four Stokes parameters simultaneously. Contrary to classic algorithm used earlier, based on determination of Stokes parameters from linear combinations of intensities obtained on different wave plate angles, we implemented least squares approach. This way we got some benefits including better accuracy of results.

Due to fast rotation of the phase plate, we can exclude influence of majority of atmospheric phenomena, but the correct elimination of the sky background is still necessary.

Polarimetry requires precisely measured high polarization standards and zero-polarization stars. Measurements of zero-polarization stars are used to compute the instrumental polarization. Contrary to classic approach, when instrumental polarization is measured during each night, we found it possible to use continuous functions that describe behavior of instrumental polarimetric system of the instrument during large time intervals.

We obtained Stokes parameters for hundred of polarization standards in this research. Generally, data are consistent with the published catalogs. Dozen stars show non-consistent values, that may argue for the presence of variable sources of radiation or interstellar medium with variable properties thus these objects must not be used as polarimetric standards and sometimes require further investigation.

Using described approach, we processed large data set obtained during observations of cataclysmic binaries and solar system objects.

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