Thesis summary:

Giant stars in eclipsing binary systems as a great astrophysical laboratory

Ksenia Suchomska

Stars are the main baryonic building blocks of the galaxies and, so to say, the central engine of their evolution. Precise knowledge of their physical parameters such as mass, radius, luminosity or chemical composition helps us understand, not only their structure and evolution, but also the evolution of galaxies that they are located in.

In the context of studying the physical processes that take place inside stars, precise determination of their physical parameters has a crucial meaning. Double-lined eclipsing binary systems are great candidates to perform such determinations, since for such systems we are able to directly measure masses and radii of their components with high accuracy.

In my thesis I presented the analysis of five such systems that are located in galactic Bulge and disk and are composed of giant stars. I presented determined with a high accuracy (< 2%) physical and orbital parameters of the analysed systems and I discussed the influence of the obtained results on the other fields of astrophysics. I also established the reddening towards the investigated binaries and I measured the distances with the accuracy of around ~ 3%. To derive distances, I used surface brightness—(V-K) colour relation, well calibrated for Galactic late-type giant stars. That allowed me to estimate the angular diameter of a star. I compared the derived distances with the distances obtained from the parallax measurements provided by Gaia mission, which is a space observatory of the European Space Agency designed for astrometry. Using parallax measurements for distance determinations has its limitations connected with the increasing distance to a given star. According to ESA the accuracy of distance determinations basing on a data provided by Gaia can reach up to 20% for stars that are located close to the centre of Galaxy. Another problem can be the evaluation of potential systematic errors that affect the measurements. Therefore, the distance determinations presented in my thesis serve as an independent method of testing the quality of Gaia measurements.

The accuracy of establishing the physical parameters of a star has also a crucial meaning when it comes to testing the theory of their structure and evolution. Binary stars for which the physical parameters of the components where derived with a high accuracy (< 3%) can serve as a testbed for stellar evolutionary models. In my thesis I present such analysis for three of the investigated systems.

Derived physical parameters of stars, as well as their age and measured distances, give us the opportunity to explore a series of relations between them and study the structure of the Galaxy. In my thesis I presented the considerations regarding the relation between age and metallicity of stars, as well as the distance from the centre of Galaxy and metallicity.

In my thesis I showed the great potential of double-lined eclipsing binaries in the context of precise stellar parameters and distance determination. I also pointed out the necessity of increasing the sample of well characterised evolved stars. I presented the method of determining physical and orbital parameters of the components of binary systems, that allows to establish the stellar parameters with a high accuracy. My results nearly double the amount of well characterised giant stars in our Galaxy.

Keywords: binary systems; giant stars; galactic disk; galactic bulge; physical parameters; distances; evolutionary models

Ksenia Suchomska