Astrophysics

Modeling of stellar pulsations in eclipsing binaries
supervisor: doc. Mgr. Štefan Parimucha, PhD
study form: full time
Annotation: Pulsating variable stars belong to a wide group of physical variable stars, where change of brightness is caused by variations of stellar diameter and temperature. Analysis of pulsation periods and amplitudes can lead to the model of inner structure of the star. High precision observations from Kepler satellite show that pulsating stars are often components of the binary stars. In this case we can determine basic parameters of the both stars, like mass, temperature and luminosity, and, subsequently, we can more precisely model stellar structure.
In this thesis we will focus to the creating of the model of the eclipsing binary with one or the both pulsating components and application of this model to selected binaries from Kepler and/or ground observations.

Multi-frequency investigation of activity of the symbiotic binaries.
supervisor: doc. RNDr. Rudolf Gális, PhD.
study form: full time
Annotation: Symbiotic systems belong to a group of interacting binaries, in which the physical mechanisms related to the mass transfer and accretion are responsible for observable activity of these eruptive variable stars. Our previous investigation showed, that for better understanding of these physical processes is necessary a long-term monitoring of these objects during the whole cycle of their activity in a broad spectral range. The main goal of the PhD thesis is the study of behavior of accretion disks, impacts, jets and other phenomena related to the mass transfer in different phases of activity in selected interacting binaries using own photometric and spectroscopic observational data and modeling of their light curves and spectra.

Stability of the orbits in exoplanetary systems with more components
supervisor: Mgr. Martin Vaňko, PhD. – Astronomical Institute of Slovak Academy of Sciences
study form: full time
Annotation: Several exoplanetary systems with two and more planets was discovered in the past years. Transit times variations method was often used. Because TTVs can be caused by several effects (e.g centre of mass movement by another body(ies), orbital resonances, activity of host star, exo-moons...) it is necessary to study long-term orbital stability of bodies in the system. This analysis can confirm or disprove any of mentioned scenarios.
In this thesis we will focus to the precise determination of TTVs from satellite and ground-based observations of selected exoplanetary systems, determination of the parameters and numerical simulations of orbits and study of their stability.

Extrasolar planets and brown dwarfs
supervisor: RNDr. Ján Budaj, CSc. – Astronomical Institute of Slovak Academy of Sciences
study form: full time
Annotation: Brown dwarfs and extrasolar planets represent a modern field of research which is very dynamic. That is why the focus of the thesis may shift according the current situation as well as interest and activity of the student. Mainly the following areas will be considered and monitored:

- disintegrating exoplanets-"exo"bodies on close orbits around their parent stars,
- eclipsing stellar systems with dark dusty disks which may harbour planets (photometry and modeling of spectra and light curves)
- reflection effect and albedo in interacting binaries and exoplanets (photometry and modeling)
- transit timing variations and search for possible new exoplanets (photometry).

Rossiter-Mc Loughlin effect: tool to measure stellar obliquity.
supervisor: RNDr. Theodor Pribulla, CSc. – Astronomical Institute of Slovak Academy of Sciences
study form: full time
Annotation: Rossiter Mc Loughlin (RM) effect is an essential modeling tool to determine orbital plane-spin axis misalignment in double stars and exoplanetary systems. The effect changes the observed radial velocity of a star when it is eclipsed. In rapid rotators the orbital plane-spin axis misalignment can directly be inferred from the line-profile changes. The orbital plane-spin axis misalignment records evolutionary history and strongly affects the apsidal-motion rate of eccentric systems. The RM effect will be studied using medium and high-resolution échelle spectroscopy of selected eclipsing binaries during eclipses. The data will be obtained with 60 and 130cm telescopes of the Astronomical institute of the Slovak Academy of Sciences.