Study programme: Astronomy and Astrophysics - PhD studies

Course name: Stellar Atmospheres

Lecturers: Olga Atanacković

Status: Optional

ECTS: 9

Attendance prerequisites: None

Course aims: Acquiring advanced knowledge of the theory of stellar atmospheres

Course outcome: At the end of the course, student has enough skills to start a research concerning the theory of stellar spectra and stellar atmospheres modeling

Course content:

Basics of radiative transfer. Local thermodynamic equilibrium (LTE). Radiative transfer equation. The condition of radiative equilibrium. The grey atmosphere.
Line and continuum opacity. The line absorption coefficient. Spectral line broadening. Continuum absorption cross-sections. Hydrogen. The negative hydrogen ion. Helium and heavier elements. Continuum scattering cross sections (Thomson and Rayleigh scattering).
Spectral line formation. Non-LTE line transfer. The two-level atomic model. The effects of an overlapping continuum. Line formation in the presence of a chromosphere. Solution of the multi-level non-LTE line transfer problem. Solution of the transfer equation in multiplets. Line formation with partial frequency redistribution. Line formation in moving atmospheres.
Model atmospheres. LTE radiative equilibrium model atmospheres. Temperature correction procedures. Non-LTE radiative equilibrium models. Model atmospheres for early-type stars. The complete linearization method. Line effects. Convection and models for late-type stars. Solar atmosphere models. Extended atmospheres. Solution of the transfer equation in spherical geometry. Expanding stellar atmospheres.

Literature:

1.Mihalas, D.: 1978, *Stellar atmospheres*, 2nd ed., San Francisco: W.H.Freeman & Comp.
2. Gray, D.: 2005, *The observation and analysis of stellar photospheres*, Cambridge Univ. Press
3. Rutten, R.J.: 2003, *Radiative Transfer in Stellar Atmospheres*, Utrecht University lecture notes, 8th edition. (https://robrutten.nl/rrweb/rjr-pubs/2003rtsa.book.....R.pdf)
4. Crivellari, L., Hubeny, I., Hummer, D.G.: 1991, *Stellar atmospheres: Beyond classical models*, NATO ASI Series.
5. Hubeny, I., Mihalas, D.: 2015, *Theory of Stellar Atmospheres: An Introduction to Astrophysical Non-equilibrium Quantitative Spectroscopic Analysis*, Princeton University Press

Number of hours: 10	**Lectures**: 4	**Tutorials**: 6 (exercises+project)

Teaching and learning methods:
Ex cathedra, group work, online

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	-	Written exam	-
Exercises / Tutorials	20	Oral exam	60
Colloquia	-		
Essay / Project	20		