# Compulsory Astrophysics I - astro810

| ***Module No.*** | **astro810** |
|---|---|
| *Category* | Required |
| *Credit Points (CP)* | 12 |
| *Semester* | 7. |

**Module: Compulsory Astrophysics I**

*Module Elements:*

| Nr | Course | Course No. | CP | Type | Teaching hours | Semester |
|---|---|---|---|---|---|---|
| 1 | Stars and Stellar Evolution or specific: Stellar Structure and Evolution | astro811 | 6 | Lect. + ex. | 3+1 | WT |
| 2 | Cosmology | astro812 | 6 | Lect. + ex. | 3+1 | WT |

**Requirements:**

**Preparation:**

**Content:** The module represents the fundamentals of the phases of stars and stellar evolution and the knowledge about our cosmological model

**Aims/Skills:**

The student shall acquire deeper understanding of the workings of stars and their evolution, in particular of important transitory phases of evolution, and shall be able to understand the origin of stars related with the location of their parameters in the HRD.

The student shall acquire deep understanding of the foundation of our world models and of their consequences, with special emphasis on the formation of structures in the universe and its physical and observational consequences

**Form of Testing and Examination:** Requirements for the submodule examination (written or oral examination): successful work with the exercises

**Length of Module:** 1 semester

**Maximum Number of Participants:** ca. 100

**Registration Procedure:** s. https://basis.uni-bonn.de u. http://bamawww.physik.uni-bonn.de

**Note:**

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## Stars and Stellar Evolution or specific: Stellar Structure and Evolution - astro811

| *Course* | **Stars and Stellar Evolution or specific: Stellar Structure and Evolution** |
|---|---|
| *Course No.* | astro811 |

| Category | Type | Language | Teaching hours | CP | Semester |
|---|---|---|---|---|---|
| Required | Lecture with exercises | English | 3+1 | 6 | WT |

**Requirements:**

**Preparation:**

**Form of Testing and Examination:** Requirements for the examination (written or oral): successful work with the exercises

**Length of Course:** 1 semester

**Aims of the Course:** Students will acquire sufficient knowledge to understand stars and their evolution. Study of radiation transport, energy production, nucleosynthesis and the various end phases of stellar evolution shall lead to appreciation for the effects these processes have on the structure and evolution of galaxies and of the universe

**Contents of the Course:** Historical introduction, measuring quantities, the HRD. Continuum and line radiation (emission and absorption) and effects on the stellar spectral energy distribution. Basic equations of stellar structure. Nuclear fusion. Making stellar models. Star formation and protostars. Brown Dwarfs. Evolution from the main-sequence state to the red giant phase. Evolution of lower mass stars: the RG, AGB, HB, OH/IR, pAGB, WD phases. Stellar pulsation. Evolution of higher mass stars: supergiants, mass loss, Wolf-Rayet stars, P-Cyg stars. Degenerate stars: White Dwarfs, Neutron Stars, Black Holes. Supernovae and their mechanisms. Binary stars and their diverse evolution (massive X-ray binaries, low-mass X-ray binaries, Cataclysmic variables, etc.). Luminosity and mass functions, isochrones. Stars and their influence on evolution in the universe

**Recommended Literature:** Lecture notes on “Stars and Stellar Evolution” (de Boer & Seggewiss)

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## Cosmology - astro812

| ***Course*** | **Cosmology** |
|---|---|
| *Course No.* | astro812 |

| Category | Type | Language | Teaching hours | CP | Semester |
|---|---|---|---|---|---|
| Required | Lecture with exercises | English | 3+1 | 6 | WT |

**Requirements:**

**Preparation:** Introductory astronomy

**Form of Testing and Examination:** Requirements for the examination (written or oral): successful work with the exercises

**Length of Course:** 1 semester

**Aims of the Course:** The student shall acquire deep understanding of the foundation of our world models and of their consequences, with special emphasis on the formation of structures in the universe and its physical and observational consequences. The lecture shall enable the student to read and understand original literature in astrophysical cosmology, but also to see the direct connection between the fundamental problems in cosmology and particle physics, such as the nature of dark matter and dark energy

**Contents of the Course:** Kinematics and dynamics of cosmic expansion, introduction to General relativity, Friedmann equations and classification of world models, flatness and horizon problem; thermal history of the big bang, decoupling, WIMPS, nucleosynthesis, recombination and the CMB; gravitational light deflection, principles and applications of strong and weak gravitational lensing; structure formation in the Universe, perturbation theory, structure growth and transfer function, power spectrum of cosmic fluctuations, spherical collapse model, Press-Schechter theory and generalizations, cosmological simulations, cosmic velocity fields; principles of inflation; lensing by the large-scale structure, cosmic shear; anisotropies of the CMB, determination of cosmological parameters

**Recommended Literature:**

J. A. Peacock; Cosmological Physics (Cambridge University Press 1998)

P. J. E. Peebles; Principles of Physical Cosmology (Princeton University Press 1993)

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