

Introduction to Hydro- and Magnetohydrodynamics - astro8401

Degree - M.Sc. in Astrophysics (PO von 2014)

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| Module | Elective Advanced Lectures: Observational Astronomy |
| <i>Module No.</i> | astro840 |

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| Course | Introduction to Hydro- and Magnetohydrodynamics |
| <i>Course No.</i> | astro8401 |

| Category | Type | Teaching | | | Semester |
|----------|---------|----------|-------|----|----------|
| | | Language | hours | CP | |
| Elective | Lecture | English | 2 | 3 | ST |

Requirements for Participation:

Preparation: Revision of vectors and vector calculus, electromagnetism, basic thermodynamics

Form of Testing and Examination: Written or oral examination

Length of Course: 1 semester

Aims of the Course:

The students will become familiar with the basic laws of hydrodynamics and magnetohydrodynamics and will understand their universal applicability and importance in many varied contexts. As well as

learning about the basic phenomena such as waves and compressible flow, several particular contexts (mainly in astrophysics and atmospheric physics) will be examined in detail using analytical tools which the students will then learn to apply in other, new situations and contexts. By doing this the students will develop abilities to tackle and interpret any hydrodynamical phenomenon they encounter.

Contents of the Course: The fluid approximation, Euler equations, ideal fluids, viscous fluids, diffusion of heat, sound waves, hydrostatics, flow around an object, the Bernoulli equation, the Reynolds number and other dimensionless parameters used to describe a flow, compressible and incompressible flow, supersonic and subsonic flow, shock waves (with example: supernovae), surface gravity waves, internal gravity waves, waves in a rotating body of fluid (example: earth's atmosphere), stability analysis (examples: convection, salt fingers in ocean), the magnetohydrodynamics equations, Alfvén waves, flux conservation, flux freezing, magnetic pressure and tension, force-free fields, reconnection (with example: solar corona), angular momentum transport and the magneto-rotational instability (example: astrophysical discs).

Recommended Literature:

E.Landau & E.Lifshitz, Fluid mechanics (Pergamon Press 1987)

S.Shore; Astrophysical hydrodynamics: an introduction (Wiley-VCH, 2007)

Lecture notes at <http://www.astro.uni-bonn.de/~jonathan/misc/astroMHDnotes.pdf>