Astrophysics
and
Solid State Theory

Module No.: N-P-SP-Astro, MN-P-PN-Astro, MN-P-SP-ThSol, MN-P-PN-ThSol, MN-P-WaMa

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Course: Hydrodynamics - from water droplets to Supernovae

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Category	Type	Language	Teaching Hours	CP	Semester
Specialized Course	Lecture	English	2+2	6	SuSe 2016 and later
Specialized Course	Lecture	English	2+1	4.5	SuSe 2014
Specialized Course	Lecture	English	2	3	SuSe

Requirements for participation:

Good bachelor level knowledge of theoretical physics and astrophysics

Type of module examinations:

One oral examination at the end of the module

Duration of the course:

1 semester

Aims of the course:

Understanding of fundamental concepts of gas hydrodynamics and basic computational implementations to simulate fluid flows.

Contents of the course:

The lecture introduces the basic aspects of Hydrodynamics:
Equations of ideal fluids, sound and potential waves, viscous fluids, hydrodynamical instabilities (e.g. Kelvin-Helmholtz-instability), convection, turbulence.
Basic numerical methods used in fluid hydrodynamics will be discussed, e.g. Riemann solvers.
The selected examples and exercises will mostly be related to astrophysical problems, like Supernova explosions, or turbulence in the interstellar medium.

Recommended literature:

Greiner & Stock – Theoretische Physik 2 – Hydrodynamik (Europa Lehrmittel Verlag, 1991)
Landau & Lifschitz – Band 6 – Hydrodynamik (Deutsch, 2007)
L.D. Landau & E.M. Lifshitz: Fluid mechanics (Pergamon Press, 2nd edition, 1987)
A.R. Choudhuri: The physics of fluids and plasmas (Cambridge University Press, 1998)
Bodenheimer, Laughlin, Rozyczka, Yorke – Numerical methods in astrophysics (Taylor & Francis, 2006)