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
Version: 29.01.2014 PS

Course: Hydrodynamics - from water droplets to Supernovae

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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)
A.R. Choudhuri: The physics of fluids and plasmas (Cambridge University Press, 1998)
Bodenheimer, Laughlin, Rozyczka, Yorke – Numerical methods in astrophysics (Taylor & Francis, 2006)