

ASTROPHYSICAL FLUID DYNAMICS

Master in Astrophysics and Cosmology

First year: second semester

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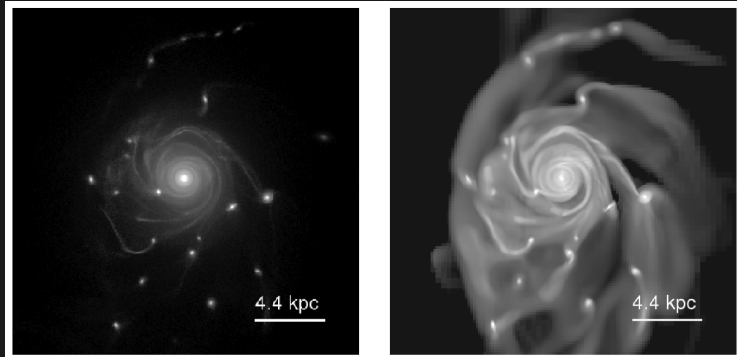
Fluids in astrophysics

- ▶ Highly compressible gases
- ▶ Gaseous planets
- ▶ Stars
- ▶ Galaxies: interstellar medium & gaseous halos
- ▶ Active galactic nuclei: accretion discs
- ▶ Intergalactic medium
- ▶ Clusters of galaxies: intracluster medium
- ▶ Star formation
- ▶ Cosmology & galaxy formation

Astrophysical fluid dynamics: the course

- ▶ Theoretical approach
- ▶ Analytic calculations
- ▶ Equilibrium solutions
- ▶ Stability/instability
- ▶ Non-equilibrium dynamics

Gravitational instability in rotating fluids



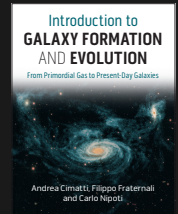
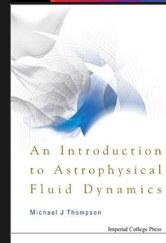
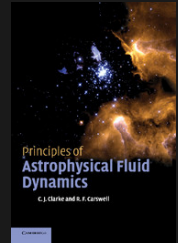
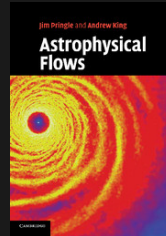
Simulated disc galaxy at $z=2.7$ (left: stars; right: gas; Agertz et al. 2009)

Astrophysical fluid dynamics: syllabus

- ▶ Fundamentals of fluid dynamics
- ▶ Unmagnetized fluids: hydrodynamic equations
- ▶ Static and rotating gas in gravitational potentials
- ▶ Perturbations, waves and hydrodynamic instabilities
- ▶ Astrophysical gas flows: inflows, outflows and shocks
- ▶ Magnetohydrodynamics: waves, rotation and instabilities

Astrophysical fluid dynamics: reference textbooks

- ▶ **Pringle & King**
“Astrophysical flows”,
2014, Cambridge University Press
- ▶ **Clarke & Carswell**
“Principles of Astrophysical
Fluid Dynamics”,
2014, Cambridge University Press
- ▶ **Thompson**
“An introduction to astrophysical
fluid dynamics”
2006, Imperial College Press
- ▶ **Cimatti, Fraternali & Nipoti**
“Introduction to galaxy formation
and evolution”, 2019, Cambridge
University Press



Astrophysical fluid dynamics

- ▶ Teacher: Carlo Nipoti (carlo.nipoti@unibo.it)
- ▶ 48 hours (6 credits). Oral exam.
- ▶ Teaching material: suggested textbooks + lecture notes
- ▶ Web: <http://www.unibo.it/docenti/carlo.nipoti> (teaching, astrphysical fluid dynamics)