Title : **Diffuse astrophysical plasmas**

Acronym : A1

EU Coordinator : Patrick HENNEBELLE (CEA Saclay)

Teaching staff : Patrick HENNEBELLE

Pre-requisites : First year of MSc in Physics or Engineering Schools.

Credits : 3 ECTS

Language : French/English

Keywords : Space plasmas & Astrophysics. Gravity, thermal balance, instability. Ideal and non-ideal Magneto-hydrodynamics. Conservation and transport of angular momentum.

The lecture goes deeper into astrophysical plasmas as the interstellar medium. Some of the classic processes and equations are derived and further discussed. Particular importance is given to the processes important in the context of structure formation. A particular emphasis is put on the dissipative and transport processes.

General introduction : the Universe, the galaxies, the stars and planets.
Complexity of baryonic matter.
Conservative form of the ideal MHD equations, the interstellar medium, qualitative discussion on the interstellar turbulence and numerical simulations.
Hydrodynamical and MHD shocks.
Cooling processes and thermal instability.
Bi-fluid approach, propagation of Alfven waves in the presence of neutrals.
Non-ideal correction of MHD.
Jeans length and Jeans mass.
Viriel theorem, isothermal clouds and influence of the magnetic field.
Equilibrium and gravitational collapse.
Accretion disks: importance of angular momentum transport, centrifugal barrier. Magnetic braking. Magneto-rotational instability (MRI), Toomre criteria.

Protostar forms through gravitational collapse. Magnetic field is playing a fundamental role through magnetic braking and by launching an outflow. A protoplanetary disc forms.