# On the multiphase structure of the neutral interstellar medium

**Antoine Marchal - Seminar IAS - 12/20/18**

Star formation in galaxies is strongly linked to the physical processes that govern the evolution of the interstellar medium. Stars form by gravitational collapse of dense and cold structures in molecular clouds but the process that leads to the formation of these over-densities is still unclear. One key element seems to be related to the efficiency of the formation of cold clouds of neutral hydrogen (HI) also called the Cold Neutral Medium (CNM).

Several studies have aimed at understanding the production of the CNM through the condensation of the Warm Neutral Medium (WNM) in a turbulent and thermally unstable flow using numerical simulations. In general, these studies indicate the presence of a significant fraction of the mass being in the thermally unstable regime, (i.e., with a temperature mid-way between the CNM and WNM stable states). However, the thermodynamical conditions of the gas remain largely unexplored from the observational point of view. One main hurdle in getting access to this information is the fact that our knowledge of the multi-phase nature of the HI relies on 21 cm absorption measurements that are limited to lines of sight crossing radio-sources. By nature, this way of observing prevent us from mapping the HI phases. To go further, and really compare with numerical simulation that are, for now, under-constrained by observation, it is mandatory to map the column density structure of each phase and study the spatial variations of their centroid velocity and velocity dispersion. This calls for methods that can extract the information of each HI phase from fully sampled 21 cm emission data only.

I will present ROHSA, an original Gaussian decomposition algorithm based on a multi-resolution process from coarse to fine grid using a regularised non-linear least-square criterion to take into account simultaneously the spatial coherence of the emission and the multiphase nature of the gas. This method allows us to infer a spatially coherent vision of the three-phase neutral ISM (see Marchal et al. 2018, submitted). Based on these results, I will discuss the new constraints that are obtained with an high-level of confidence on the thermodynamical properties of the neutral ISM.