Studying the epoch of reionisation with star formation history and 21cm intensity mapping

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Abstract

In this talk, I will investigate two complementary ways of studying the Epoch of Reionisation (EoR): one will tell us about the global reionisation history and the other about the topology of the process.
The commonly accepted storyline for reionisation depicts star forming galaxies progressively ionising the neutral Hydrogen in the IGM until quasars take over for the second ionisation of Helium. However, the galaxies observed today are not enough to lead the reionisation process to its end and galaxy luminosity functions (LF) beyond observations, i.e. at high redshift or low magnitudes, are poorly known and require extrapolation. In the first part of this talk, based on Gorce et al. (2018, A&A), I will describe how the uncertainties on the LF faint-end can impact our knowledge of the reionisation process, along with other parameters such as the escape fraction of ionising photons from their host galaxy into the IGM.
Another essential way of learning about reionisation is the intensity mapping of neutral Hydrogen through the 21cm signal, with SKA expected to map HI regions in the sky up to redshift 20. To make the most of these upcoming observations, there is a strong need for robust statistical tools and most works are focused on power spectrum information. In contrast with these works, I will introduce in the second part of this talk a new statistical tool called the triangle correlation function, which makes use of the information we can extract from the Fourier phases of the ionisation field and described in detail in Gorce & Pritchard (2019, submitted). Derived from the 3-point correlation function, it is designed to probe the characteristic scale of ionised regions and can be applied directly to Fourier data, which makes it more suitable for interferometric measurements. I will show that this statistical estimator performs very well not only on toy models but also on more elaborate simulations such as 21CMFAST. It is also robust to observational effects such as instrument noise and angular resolution (LOFAR, SKA1-Low).

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