Cosmology with clusters of galaxies and their SZ signal

As the last step of the hierarchical structure formation process, clusters of galaxies represent the largest gravitationally bound objects that we can observe in our Universe. Since they formed all along the cosmic history, they contain plenty of information about the evolution of our Universe, and can then provide a strong tool for cosmological investigation, complementary to CMB.

Clusters are dominated by dark matter (85% of their total masses), while most of their baryons are present as a diffuse gas, the Intra-Cluster Medium (ICM), which is hot (10^6– 10^8 K) and completely ionized due to the incredibly high masses characterizing this kind of structures (10^{13} – 10^{15} M_{Sun}). At these temperatures the ICM electrons Compton inverse interact with CMB photons producing the thermal Sunyaev-Zel'dovich (SZ) effect (a distortion of the CMB spectrum at the cluster position). Even if it is a faint, challenging signal to detect ($\Delta T_{CMB}/T_{CMB} \sim 10^{-4}$), the SZ signal is not affected by the cosmological dimming, potentially pushing cluster detection at higher redshift. In the last years SZ survey dedicated instrument (Planck, ACT, SPT) have finally been able to produce SZ selected catalogues containing several hundreds of clusters. And in fact clusters and their SZ signal are becoming increasingly used to derive cosmological constraints. However, cluster derived cosmology is limited by our ability to translate cluster observables into mass estimates and tracers of the matter distribution. A thorough study of the scatter that the details of cluster morphology and astrophysics might introduce around the average behaviours is then mandatory. In particular we need to investigate how this scatter is related to cluster morphology and if there is any redshift evolution.

As a member of both the Planck and the NIKA collaborations, I will present the recent SZ results that both instruments have produced. In particular, I will discuss how their complementarity, especially in terms of angular resolution, can be used to address the systematics that currently limit cluster(SZ)-derived cosmology.