Abstract: Investigating Cosmology with angular power spectra from small to large scales

Among the most promising topic in Cosmological investigation we can certainly consider the polarization of the Cosmic Microwave Background (CMB) and the multi-wavelenght analysis of extragalactic emissions. On one side, CMB polarization allows to better constrain the cosmological parameters and to test the standard model. On the other side, the study of millimeter and submillimeter data opens the door for investigation of the matter distribution on large scales in order to understand the formation and evolution of the Large Scale Structure.

In the first project described in this thesis we present an assessment of the large-scale CMB anomalies in polarisation using the two-point correlation function as a test case. We employ the state of the art of large scale polarisation datasets: the first based on a *Planck* 2018 HFI 100 and 143 GHz cross-spectrum analysis, relying on `SRoll2` processing, and the second from a map-based approach derived through a joint treatment of *Planck* 2018 LFI and WMAP-9yr. We consider the well-known $S_{1/2}$ estimator, which measures the distance of the two-point correlation function from zero at angular scales larger than 60°, and rely on realistic simulations for both datasets to assess confidence intervals. We find that both datasets exhibit a lack-of-correlation anomaly in local $E-$modes, similar to the one observed in temperature, which is better constrained by the less noisy *Planck* HFI 100×143 data, where its significance lies at about 99.5%. The analysis has been carried out with the best datasets currently available at large angular scales, which are however limited by the still significant amount of noise in polarisation observations. This issue will be hopefully overcome by the advent of new data, such as those from LiteBIRD, which are expected to be cosmic variance limited at all scales.

In the second project presented in this thesis we developed a tool for data analysis designed for the millimeter and sub-millimeter wavelenght datasets. We fit with a unique model data from the South Pole Telescope and the Hershel/SPIRE experiment. Our formalism describes the emission of radio galaxies, the thermal Sunyaev Zeldovich (tSZ) effect, the kinetic Sunyaev Zeldovich (kSZ) effect and the Cosmic Infrared Background (CIB) clustered and Poisson contribution. We use a halo model approach to describe the clustering of dark matter together with a halo occupation distribution model to parametrize the galaxy power spectrum. We fit for the so-called clustering parameters, i.e. minimum mass of the hosting halo and the index regulating the accretion of galaxies in the halo outskirts. We consider two population of galaxies: early and late-type population. The key parameter in modelling the tSZ is the hydrostatic mass bias, which strongly depends on cosmology and contains all the uncertainties we have in the determination of the SZ clusters mass. With our analysis we improve the constraints on the clustering parameters of the late-type population, finding that it is hosted in less massive structures with respect to the early-type one. We obtain a minimum mass of $10^{12.5}[M_\odot h^{-1}]$ and $10^{11.4}[M_\odot h^{-1}]$ for the early and late-type population respectively, when fitting for SPIRE data. For both datasets we find values of the hydrostatic mass bias, $b = 0.57 \pm 0.16$, higher than those found by Planck, although the amplitude of the tSZ power spectrum obtained with this value of b is in line with the foundings of previous SPT analysis. We also derive a more severe constraint on the amplitude of the kSZ with respect to previous literature, i.e. $D_{3000}^{kSZ} < 3.7$ at 99% C.L., and investigate its degeneracy with the tSZ-CIB correlation. These results are obtained using the state of the art data available but our tool will be of great utility in the analysis of future datasets, such as the Simons Observatory, CMB-Stage 4 and CONCERTO.