CAPSEN Exit Report

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One of the targets of the precision cosmology era is be able to pin down the total mass of the Standard Model neutrinos using cosmological observables from many current and upcoming surveys, like the DES, HSC, WFIRST, EUCLID, and LSST. To achieve this target, a thorough understanding of structure formation in massive neutrino cosmologies is essential. It has been established that neutrino produce a characteristic damping of the matter power spectrum on small scales, compared to cosmologies without massive neutrinos. However, the presence of massive neutrinos also produce more subtle signatures, such as making the bias of Dark Matter halos scale-dependent on linear scales. In Standard ΛCDM cosmology, the halo bias is expected to be independent of scale on linear scales. Further the shape of the scale dependence is unique, and set by the transfer function of the neutrinos, which for the SM neutrinos, depends only on their mass.

Together with Francisco, and other collaborators, we have explored how this effect can be enhanced by making use of the halo environment. We have found that the signature is clearest when making use of both the CDM and the total matter environment around halos. During the CASPEN visit, Francisco and I worked on finishing the paper detailing our study, and will be ready for submission in the upcoming week.

It has been shown that signatures of massive neutrinos become more pronounced in the underdense regions of the universe, voids. Voids have also been identified as the best testbeds for theories of modified gravity. During my visit, together with Elena Massara, we worked on a plan to build various emulators of the void-statistics which can be used to make full use of the constraining power of voids on various cosmological parameters. These emulators are going to be built off data from Aemulus simulations already run by the Stanford group.

During my time at the CCA, I also gave a talk at the weekly CCA-NYU (New York University) weekly cosmology meeting. At the meeting, I presented my work on using stacked weak lensing measurements and satellite counts around clusters to constrain self-interactions in Dark Matter. Our work shows that the possible constraints on SIDM from these measurements are already quite competitive with those coming from merging cluster systems like the Bullet Cluster. In a few years, as lensing measurements go to higher signal to noise due to more clusters being observed, this method will provide one of the tightest constraints on SIDM.

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