CASPEN Exchange Report
September 7th - September 17th
Host institution: CCA/Flatiron Institute, NY
Host: Fransisco Villaescusa-Navarro

For my CASPEN travel I visited Fransisco Villaescusa-Navarro at the Flatiron Institute. Our overlapping research interests are the inference of primordial non-Gaussianity in large-scale structure cosmology. Initially, we had a couple of research ideas to explore, e.g. applying machine learning techniques to constrain the local primordial non-Gaussianity parameter, f_{nl}, in dark matter halo simulations. This could either be achieved directly, or to investigate the scale-dependent bias model first. In the end, we decided to test the field-level inference method that I had developed earlier, by applying it to halo simulations, namely the Quijote-PNG simulations. For this project, Will Coulton and Benjamin Wandelt showed interest to partake as well, and they have also been assisting me during my stay at the Flatiron Institute.

With the project statement in mind, I got to work on setting up the necessary runs, and, with the help of Will, getting access to the data. Although I had some initial issues with the project, I was able to successfully apply the method to the data within the 1.5 weeks exchange (see Figure 1). This result demonstrates the first full field inference of PNG applied to a dark matter halo simulation, and showcases the possibility of constraining cosmological and inflationary parameters using such an approach. The project is not yet complete, however, but will instead focus on how to optimize the method to maximally extract the available information on f_{nl}. I expect to have the project finished before January

Not only for the development of the project was the exchange a success, but I was also able to interact with a number of researchers at the CCA. Primarily, Fransisco and Will arranged for settings things up for me, and reaching out to other people at the institute. I had the opportunity to talk to Shirley Ho, Fiona McCarthy, David Spergel, Alba Kalaja, Natali de Santi, Adri Duivenvoorden, and Oliver Philcox. Moreover, I was able to give a talk on my work and participate in the group meetings. There was also the Learning the Universe conference going on at the same time, which I was able to partake in as well.

In summary, this CASPEN-funded exchange was a success in many ways I would like to thank Fransisco and Ben for hosting me, and Will for making sure I had everything I needed while on-site. I also would like to thank CASPEN for funding this visit. The exchange has been very productive for me and has put me in a good spot for quickly wrapping up this project.
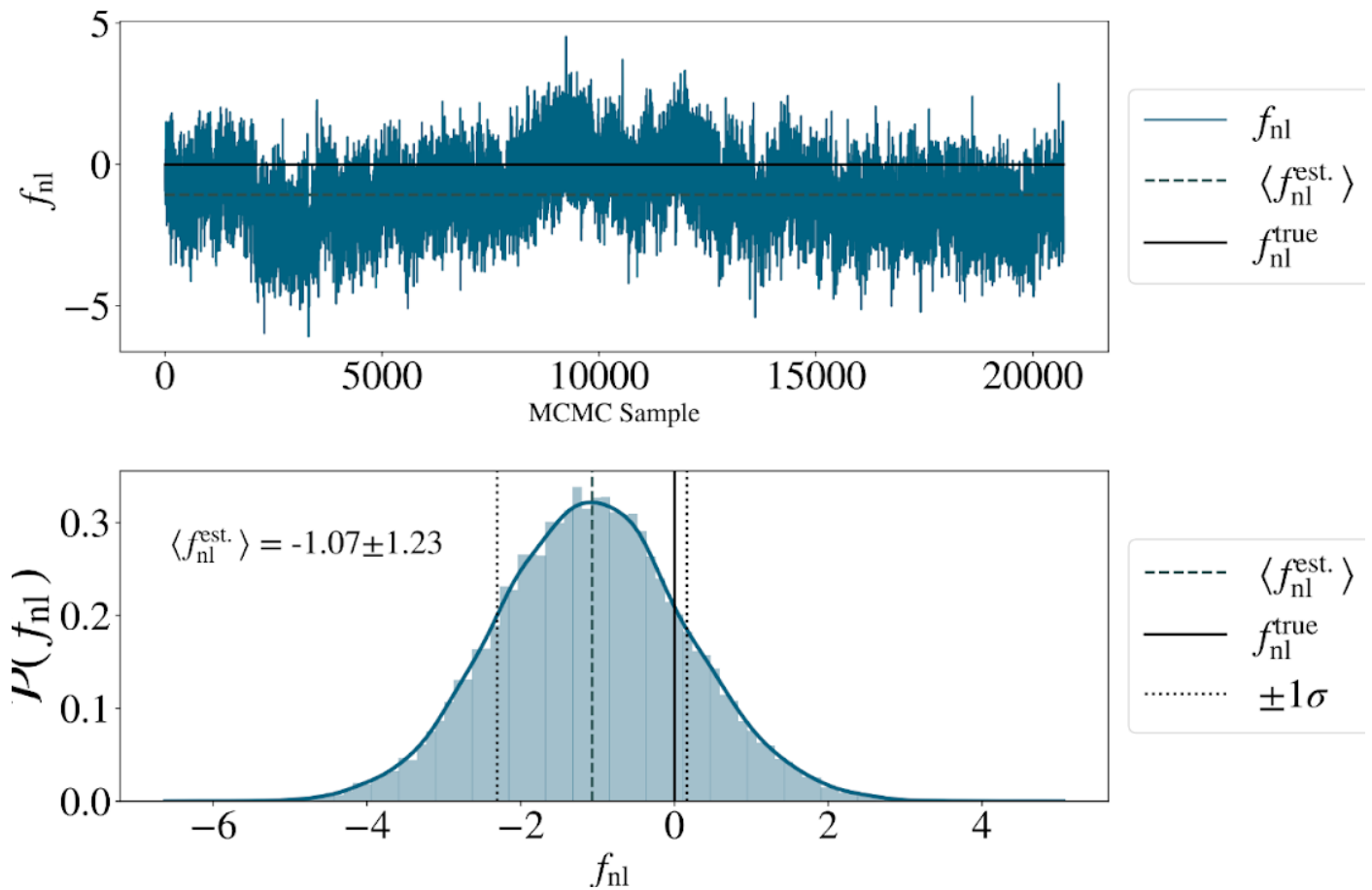
Adam Andrews

Figure 1: The first successful run of the analysis. In the top panel, the trace plot of the sampled f_nl values is plotted, showing how the chain explores plausible f_nl values to match to the data. In the bottom panel, the corresponding posterior distribution, spanned by the sampled values, as informed by the data. These results demonstrate a key milestone, namely that full field inference can effectively analyse dark matter halo simulations to constrain primordial non-Gaussianity