

Physics Team Report “Planck”

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Material:

“A Joint Analysis of BICEP2/Keck Array and Planck Data” (arXiv:1502.00612v2)

<https://www.youtube.com/watch?v=EnnLA2JYwJo>

http://webcast.in2p3.fr/events-primordial_universe_after_planck

Course:

In the physics team meetings we discussed the Planck Experiment in a broad and complete way, ranging from its purpose and predecessor experiments to its experimental design, the recorded data and finally the implications of a joint analysis of BICEP2/Keck Array and Planck data.

Regarding Planck's purpose we learned a lot about open questions concerning the cosmic microwave background that Planck seeks to answer as well as further astronomical questions concerning e.g. galaxy clusters, quasars or the interstellar medium. We put the main emphasize on the theory of the creation of B-Modes in the cosmic microwave background due to primordial gravitational waves from cosmic inflation.

Planck's predecessor experiments on the matter were also interesting to us to get an idea of the technological advances that have been made. So we had brief looks into the history of the COBE and WMAP experiments.

Of particular interest to us was the experimental design of the Planck satellite, especially its detection capabilities. Here we studied the technical specifications of the satellite, such as the functionality and resolution of the high and low frequency instruments which give a major advantage over competing detectors like the BICEP2 detector. We familiarized ourselves with the measurement and studied the results. These included CMB skymaps, powerspectra and their fits according to the LCDM model and their implications for modern cosmology.

The results were particularly interesting in a joint analysis of BICEP2/Keck Array and Planck data regarding B-Mode polarization in the cosmic microwave background. To classify these results we studied how apparent B-Modes can arise from dust contamination and how dust is modelled by Planck exploiting different frequency bands. Also the methods to subtract the galactic foreground and dust contributions via cross-correlations were studied leaving us with the conclusion that the remaining signal is not significant and only dust and lensing were detected at 5 and 7 sigma.

Review:

It was well possible to divide the topic into different areas for each team member to work on his or her own and then to share the knowledge. Meetings were at times difficult to arrange due to spatial separation of the members. The topic was highly interesting since it covered so many different aspects such as cosmology, general relativity, thermodynamics, electrodynamics, detectors, data analysis, space flight and ethics of preliminary publications.