Report of the Physics Team 'BICEP2'
by
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Material:
BICEP2 paper "Detection of *B*-Mode Polarization at Degree Angular Scales by BICEP2"
(Phys. Rev. Lett. **112**, 241101)
Planck paper: "Intermediate results. XXX. The angular power spectrum of polarized dust emission at intermediate and high Galactic latitudes"
(arXiv:1409.5738)
further information:

- Caltech Observational Cosmology Group (http://bicep.caltech.edu/public/)
- Talk by J.Fillippini 5.16.2014 (https://www.youtube.com/watch?v=Q2gNZeoTlsQ)
- Talk by Chao-Lin Kuo (https://www.youtube.com/watch?v=AEffvW281bc)

In the physics team meetings, we discussed the theoretical backgrounds, the detector and the final results of the BICEP2 experiment. One of the main points of the discussions was how gravitational waves are produced during inflation, how they generate B modes in the CMB and what the differences are compared to E modes. Furthermore, the experimental setup was discussed, with a main focus on the focal plane, where the signal is measured and how it is converted into a temperature via **T**ransition **E**dge **S**ensors. One of the final results the BICEP2 collaboration presented in their paper, is the observation of an excess in the BB spectrum which corresponds to a 5.2σ excursion from the base lensed-ΛCMD model. With this excess they find a tensor-to-scalar ratio of $r=0.2$ to fit their data best, and reject $r=0$ with 7.0σ significance. In other words, they strongly reject the null-hypothesis in which no gravitational waves are existent. If confirmed to be correct, these results would have huge implications such as: it would show evidence that inflation happened, that gravity would be quantized and that some string theory models could be ruled out.

However, latest results from the Planck collaboration present a measurement of the polarized thermal emission from galactic dust. They took the measurement at a different frequency than the BICEP2 measurement, but they were able to extrapolate their results to the BICEP2 region. These results strongly suggest that the region of the sky BICEP2 was looking at is unfortunately a region with high dust contributions. In addition they could show, that a dust-only-assumption could explain an excess in the BB spectrum, similar to the excess which was observed by BICEP2. One of the methods to estimate the dust foreground of BICEP2 was to use a measurement of the dust distribution by Planck, but since they were rejected when asking for the data, they took a distribution shown at a public conference and re-digitized it.
There are plans to publish a joint paper of Planck and BICEP2 on this topic.

We found this topic highly interesting, since this it addresses some of the most fundamental questions and gained a huge public interest. If the results of the BICEP2 experiments would be confirmed in the future, these be the oldest signals ever measured and studied by human kind. Furthermore it connects a variety of different fields of physics, such as cosmology, thermodynamics, plasma physics and electrodynamics, just to name a few.
For further physics teams it would be interesting to follow up on the joint paper, or to study future experiments such as BICEP3, KECK or T-REX which might be able to contribute more and independent data to this topic.