BICEP3 and Keck Array performances from 2016 -2018

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BICEP/Keck Array telescopes:

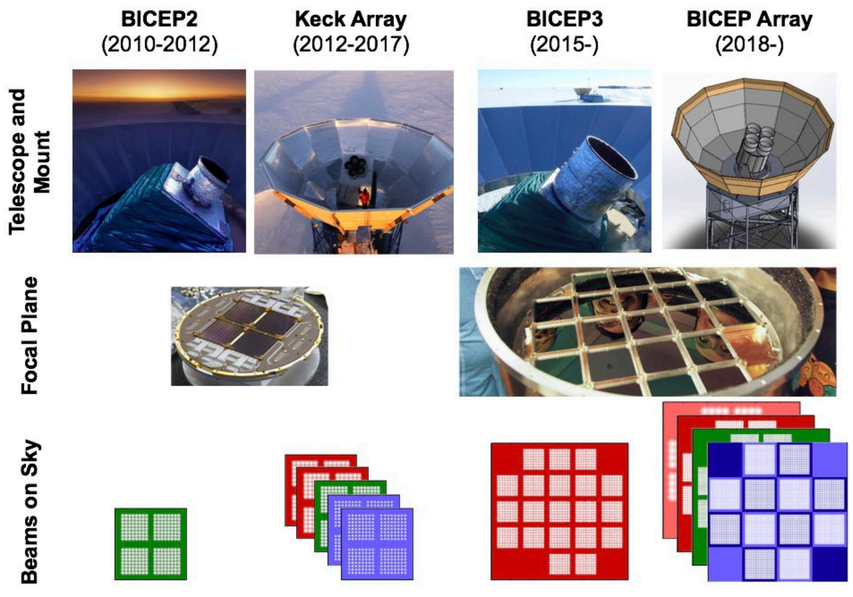
The BICEP/Keck Array telescopes are small aperture, polarization sensitive, on-axis refractors designed for study of the degree-scale microwave sky. They observe between ~400 (Keck Array) to ~600 (BICEP3) square degree patch from Aumndsen-Scott South Pole Station and are optimized for detecting cosmological B-modes within the Cosmic Microwave Background (CMB).

The strong constraints on primordial gravitational waves to date comes from the analysis result of the BICEP/Keck Array data up to the 2015 observing season, which find $r < 0.07$ at 95% confidence with $\sigma(r) = 0.020$. Since then new data are added at 95, 150, 220 and 270GHz. Here we present an overview of the analysis pipeline for the real and simulated data. While the full systematic tests for 2016 to 18 dataset are still being analyzed, we show the distributions of jackknife PTE values for the 2016 Keck Array 220GHz and BICEP3 95GHz data over the tests and spectra. Finally the preliminary Keck Array and BICEP3 T/Q/U maps with data up to 2017 (220GHz) and 2018 (95, 150GHz) and the estimated sensitivity are calculated in these maps.

Observing strategy:

We observe a small, low-foreground patch from the geographic South Pole where the high, dry Antarctic plateau and long night provide excellent observing conditions. The small, compact refractor design permits cryogenically cooled optics, and external ground shields and absorptive, co-moving forebaffles mitigate sources of systematic contaminations. Both the Keck Array and BICEP3 are installed in a 3-axis mount, with freedom of motion in elevation, azimuth, and rotation about the boresight of the telescope.

The modularity design of the receiver enable us to observe multiple frequencies throughout the years.



Receiver	2012	2013	2014	2015	2016	2017	2018	2019
Keck 0	150GHz	150GHz	95GHz	95GHz	220GHz	220GHz	220GHz	220GHz
Keck 1	150GHz	150GHz	150GHz	220GHz	220GHz	220GHz	220GHz	----
Keck 2	150GHz	150GHz	95GHz	95GHz	220GHz	220GHz	220GHz	220GHz
Keck 3	150GHz	150GHz	150GHz	220GHz	220GHz	220GHz	220GHz	220GHz
Keck 4	150GHz	150GHz	150GHz	150GHz	150GHz	270GHz	270GHz	270GHz
BICEP3	----	----	----	----	95GHz	95GHz	95GHz	95GHz

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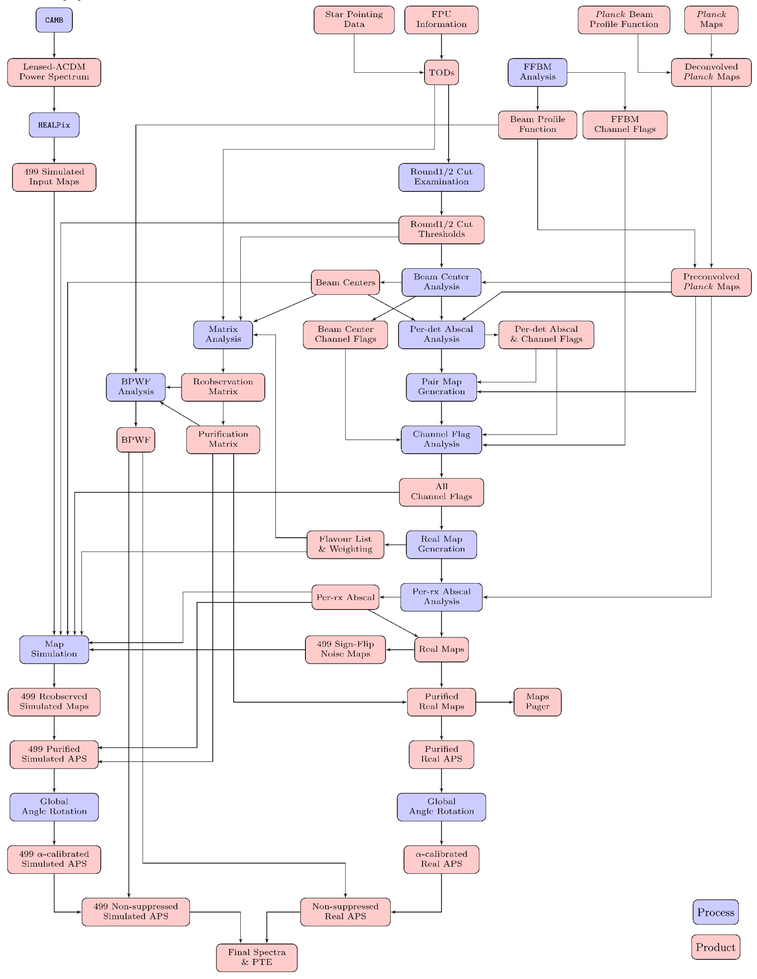
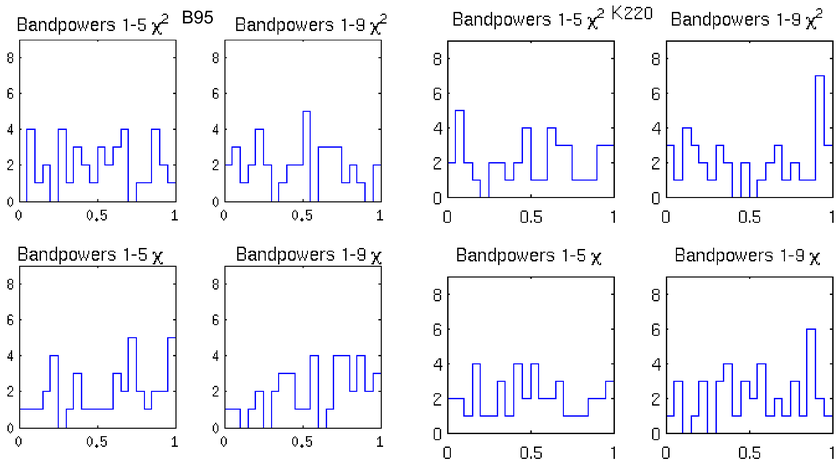
Analysis Pipeline:

The goal of the experiment is to measure the tensor-to-scalar ratio r from the degree scale polarization of the CMB. Overall, this pipeline process the time stream (TOD) data collected over detectors, transforming it to the polarization maps of the sky, and to angular power spectra which allow us to measure the tensor-to-scalar ratio r or its upper limit.



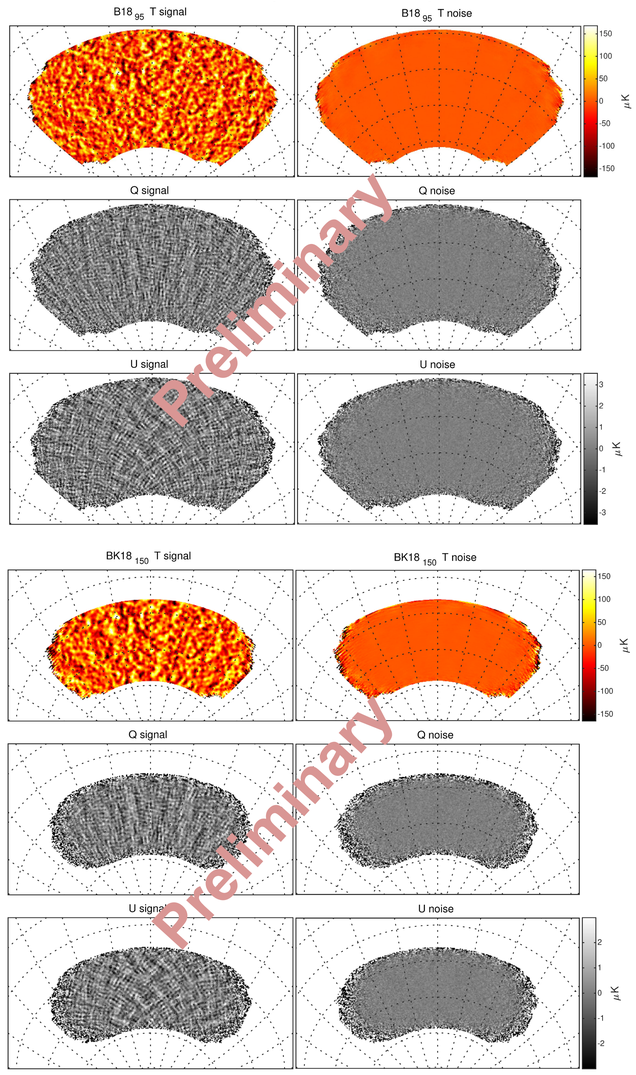
Jackknife Tests:

Each data set must pass a complement of 14 jackknife tests. A jackknife map splits the data in two halves and differences the resulting pair of maps, cancelling signal and potentially enhancing systematics. χ and χ^2 statistics are calculated versus the null hypothesis. The probability to exceed (PTE) of the real data versus the ensemble of simulations is summarized below for the BICEP3 95GHz and Keck 220GHz data sets in 2016 and is found to be consistent with uniform.



Preliminary T/Q/U maps:

Here we present the preliminary maps from BICEP3 and Keck Array. The 95 and 150 GHz maps use data up to 2018, and 220 GHz maps use data up to 2017.



Frequency	Map depth	Effective Area	Total Sensitivity
B18 95GHz	2.8 μK-arcmin	598 deg^2	1.3nK
K18 95GHz	5.2 μK-arcmin	387 deg^2	3.1nK
K18 150GHz	2.8 μK-arcmin	387 deg^2	1.7nK
K17 220GHz	10.3 μK-arcmin	394 deg^2	6.1nK
K17 270GHz	127.7 μK-arcmin	378 deg^2	77.4nK