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An Improved Measurement of the Cosmic Microwave Background B-mode Polarization Power Spectrum at Sub-Degree Scales with the POLARBEAR Experiment

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POLARBEAR is a ground-based experiment which is designed to measure the Cosmic Microwave Background (CMB) B-mode polarization at arcminute resolution in the Atacama Desert of Northern Chile. We started our science observations in early 2012 at 150 GHz with an array of 1,274 polarization sensitive antenna-coupled Transition Edge Sensor (TES) bolometers. The CMB B-mode polarization on degree angular scales is a unique signature of primordial gravitational waves from cosmic inflation, and B-modes on sub-degree scales are induced through gravitational lensing by cosmological large-scale structure.

Recently we released a new paper reporting an improved measurement of the B-mode polarization power spectrum. By adding new data from a second observing season (2013-2014), and re-analyzing the combined data set, we have reduced the band-power uncertainties by two-fold compared to our first-season only results. We reject the null hypothesis of no B-mode polarization at a confidence of 3.1σ including both statistical and systematic uncertainties and test the consistency of the measured B-modes with the Lambda Cold Dark Matter (LCDM) framework. In our first-season results, we implemented a blind analysis method, and we have adopted the same procedure. We performed extensive suite of null tests in which 12 divisions of data were used to finalize the data analysis and an estimate of systematic errors from 9 sources of instrumental contamination using a detailed instrument model.

I will present details of this data analysis as well as the new result, and summarize the current status of POLARBEAR. I will also present the development of Simons Array, which consists of three new receivers that will observe at 95, 150, 220, and 270 GHz and have the sensitivity to reach inflationary tensor-to-scalar ratio σ(r)=0.006 and the sum of the neutrino masses σ(Mν)=40 meV.

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