Deployment of POLARBEAR-2A

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CMB anisotropy and physics

The polarization fluctuations of the Cosmic Microwave Background have the potential to provide new information about physics and cosmology.

![Power spectrum of CMB](image)

- Low-ℓ region: Primordial Gravitational Wave by inflation in early universe
- High-ℓ region: Gravitational Lensing by large scale structure (neutrino mass)

**Design of POLARBEAR-2A receiver**

- Transition Edge Sensor (TES) bolometers which operate at 0.3 K cooled by He sorption cooler
- 2 spectral bands (90 and 150 GHz) in each detector
- ~40 cm detector plane, 7588 sensors mounted (~6 times more than PB-1)
- 40 channels are multiplexed in 1 readout channel of SQUID.

**Expected performance by Simons Array**

Sensitivity after 3 years observation with 3 telescopes of expected performance

- Inflation, tensor to scalar ratio: $r \approx 0.1 \pm 0.006$
- Sum of the neutrino masses $\sum m_\nu \approx 40$ meV combined with DESI BAO results

**PB-2A site installation 2018**

- Time:
  - Packages arrived at Atacama site.
  - Assembly work in high-bay.
  - Receiver assembly completed.
  - Transport to the telescope.
  - Hoisting work by hand.
  - Receiver attached.
  - Ready to start scan!

**Calibrator tests**

- Stimulator:
  - Stimulator is an artificial reference source which uses radiation from ceramic heater which put behind secondary mirror. It is used for good channel selection, relative gain adjustment and time constant measurement. Currently stimulator is in test operation.

- Wire-grid calibrator:
  - Polarization angle is needed to be calibrated in order to control fake B-mode signal made by contamination of E-mode.
  - Wire-grid is one of polarization angle calibrators, and a trial run was performed.
  - Calibration with improved instrument and half-wave plate is planned.

**Planet observations**

- Beam shape can be checked by the data from planet scan, since planets are well smaller than expected beam size.

- Circular Venus images were seen in many channels, although this is a preliminary result. The beam shape will be improved after optical alignment.

- We have achieved the first light