Simons Array

2020. 02. 17, Cosmic Acceleration Symposium Masaya Hasegawa (KEK)

(B01) SA members:

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Simons Array Collaboration (8 countries, ~100 researchers)

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SIMONS FOUNDATION

學城 8

SA F2F Meeting 2019 @ UC Berkeley

CARDIFF UNIVERSITY PRIFYSGOL CAERDYD

Observation Site



- Atacama desert, Chile (5,200m)
- Dry, thin and stable atmosphere
- Year-round access (~45min. drive from SP) Excellent site for CMB observations

Observation Site



Торіс	Journal
Cross correlation of lensing deflection with Cosmic Infrared Background	PRL 112, 131302 (2014) (Editor's suggestion)
Lensing deflection power spectrum	PRL 113. 021301 (2014) (Editor's suggestion)
CMB B-mode auto power spectrum (1st year)	ApJ 794, 2 (2014)
Modeling of atmospheric emission	ApJ 809, 63 (2015)
Cosmic Birefringence and Primordial Magnetic Field	PRD 92, 123509 (2015) (Editor's suggestion)
Map-making algorithm	A&A 600, A60 (2017)
Performance of continuously HWP	JCAP 05 008 (2017)
B-mode auto power spectrum (1st+2nd year)	ApJ 848, 2 (2017)
Ice cloud	ApJ 870, 2 (2019)
POLARBEAR x Herschel-ATLAS	ApJ 886, 38 (2019)
POLARBEAR x HSC	ApJ 882, 62 (2019)
FTS Calibrator	RSI 90, 115115 (2019)
Delensing	arXiv: 1909.13832
Degree Scale CMB B-mode spectrum	arXiv: 1910.02608

Continue timely publications of high profile results

The Simons Array

Expanding POLARBEAR to three multi-chroic telescopes



- Three 2.5m off-axis Gregorian telescope
- 7588 TES bolometers per receiver
 - 90/150GHz for 1st & 2nd receiver, 220/270GHz for 3rd receiver.
- Continuously-rotating half-wave plate for pol. modulation

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Simons Array (projected) sensitivity



Simons Array will contribute to cosmology and particle physics significantly.

The SA Receiver

- SA uses superconducting detectors (TES bolometer)
 - PB-1 : 1274 bolos
 - SA : 22,764 bolos (= 7588 x 3)

More sensitivity requires more detectors

- Technical Challenges
 - Detector fabrication
 - Detector readout
 - Cryogenics
 - Large optical elements





- Employ the advanced materials (Al₂O₃)
 - for large cold optics (~50cm aperture) Applied Optics 53, 1727 (2014), Applied Optics 55, 22 (2016)

(1st) SA Receiver assembly at KEK



2018: PB-2a receiver was integrated and tested

at "Advanced Instrumentation Lab." at KEK.



Full scale (~7588) PB2a TES bolometer array is successfully operated and readout.

2018-2019 Deployment

1st receiver for Simons Array was shipped to the Atacama desert from KEK on Oct. 1&2, 2018.





First light !



Achieved First light for PB2/SA !



Run20000065 FP_average_150GHz LR

0.90

0.75

0.45

0.15 0.00

Site crew at 1st light





- "(Planet) First light" in January
- We took date for only ~ 1 month in (relatively) good condition
 - Bad weather
 - Unstable on the site infrastructure (Generator etc..)
 - → We focused on Calibration and Characterization
 - Yield, Beam, Noise, Stability, calibrator & DAQ commissioning, monitoring etc...

(see ref: D. Kaneko et. al, appeared in J. Low Temp. Phys)

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 Stable data transfer, and Telescope / Receiver status can be checked in realtime (Live PB2A).

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Progressing steadily towards science observation

PB2b and PB2c Status



- PB-2b : Shipping to Chile, Deployment starts in Mar.
- PB-2c : Integration at UCB. Deployment in 2020.

Simons "Array" will start in 2020-2021.



- Successful deployment of 1st SA receiver in 2018-2019
 - Hardware development, integrateion and verification was done in Japan
 - Focused on calibration/characterization in 1st year (many progresses).
 - 2nd and 3rd receiver should be deployed soon.
- Interesting physics opportunities for inflation, neutrinos and more (1st result in 2022-2023 ?)
- Pathfinder instrument for next-generation CMB experiment : Simons Observatory, LiteBIRD etc..