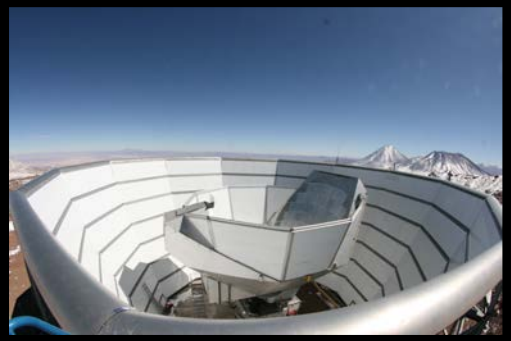
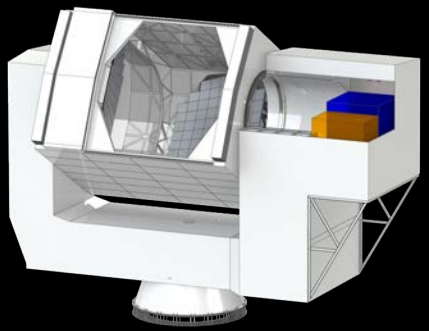
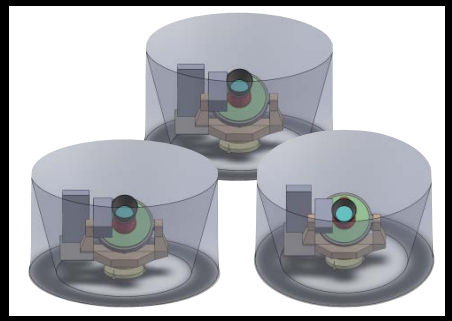
CCAT-prime Synergies: Simons Observatory, CMB-S4, and the Atacama Cosmology Telescope

ACT



Simons Observatory





CMB-S4

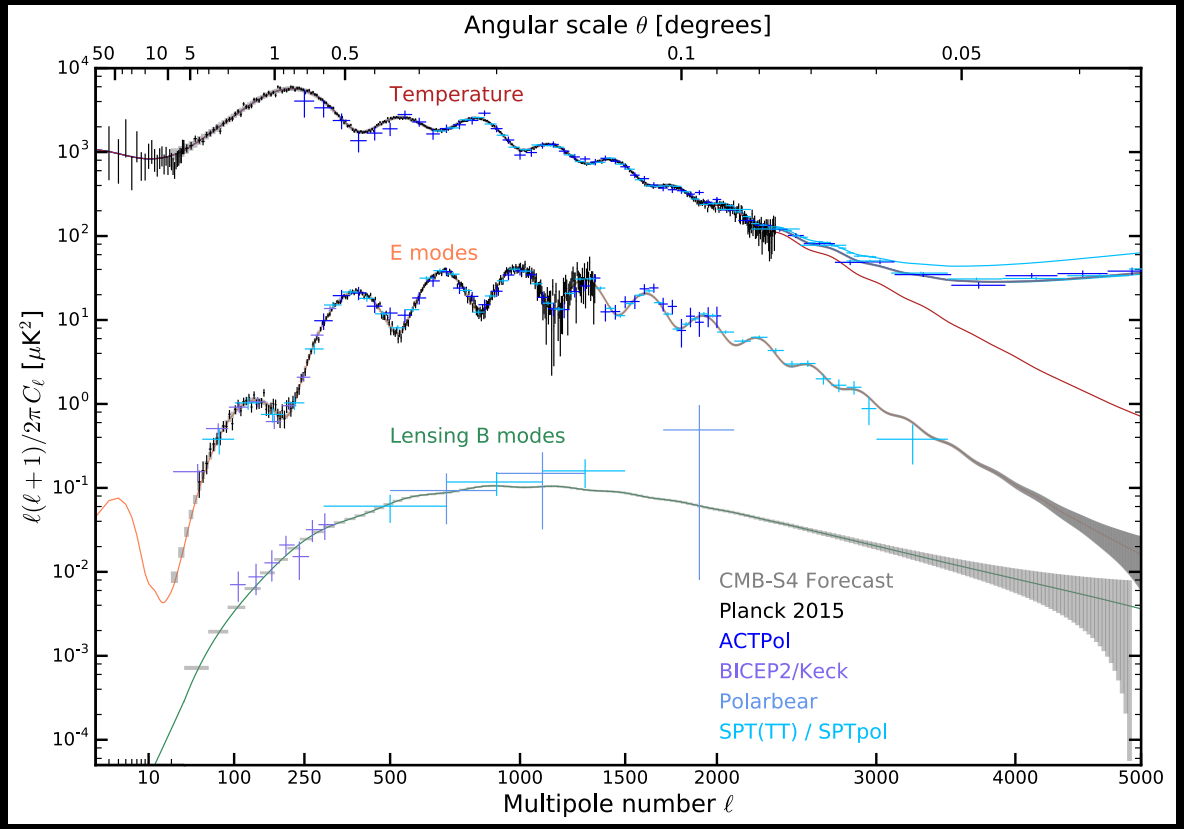
Mike Niemack, Cornell

ACT Guiding Board, SO Technical Board, CMB-S4 Large Aperture Telescope Co-leader

Current CMB Survey Research

Longer wavelength complement to CCAT-prime

Temperature & Polarization Power Spectra



Improving sensitivity of temperature & polarization 1 – 10 mm (30 – 300 GHz)

Goals:
Cosmology, clusters, high-z galaxies, transients, galactic science, …

Atacama:

ACT – 6m

SA – 2.5m

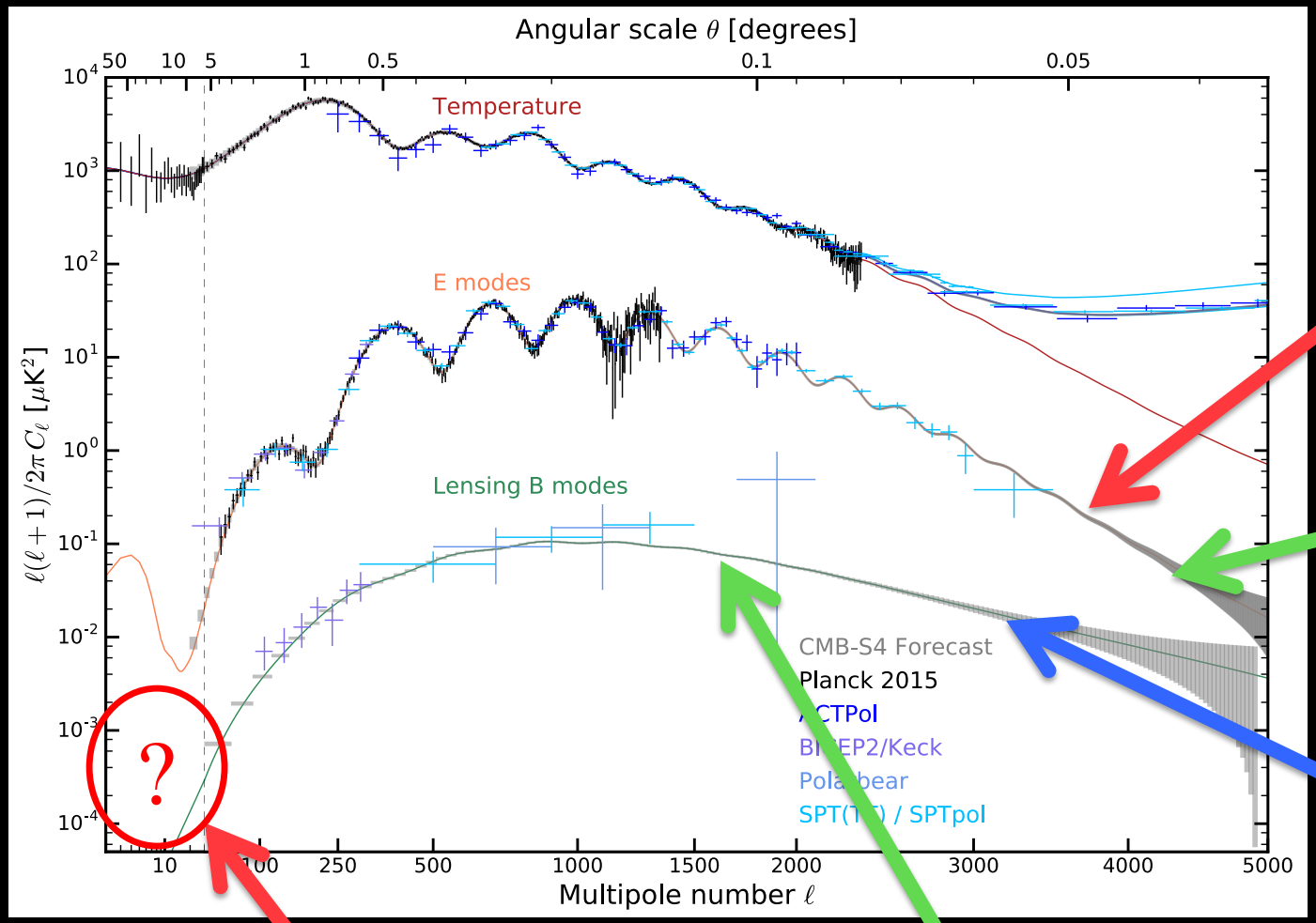
CLASS – 0.6m

South Pole:

Keck – 0.5m

SPT – 10m

Current & Future CMB Survey Research



Hubble constant
H_0

Light relics (ν, DM),
N_{eff}

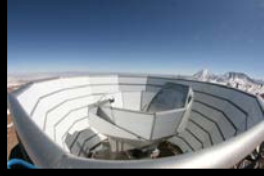
Early
Dark Energy

Smoking gun of inflation?
r

Cosmic Structure

(CMB-S4 Science Book, arXiv:1610.02743)

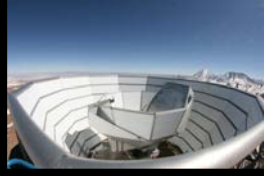
Atacama Cosmology Telescope (ACT)



PI: Suzanne Staggs, Princeton

Director Debra Kellner
Footage Nina Bernfeld and Yvan Neault
Editor Jean Paul Husson

ACT Survey Strategies

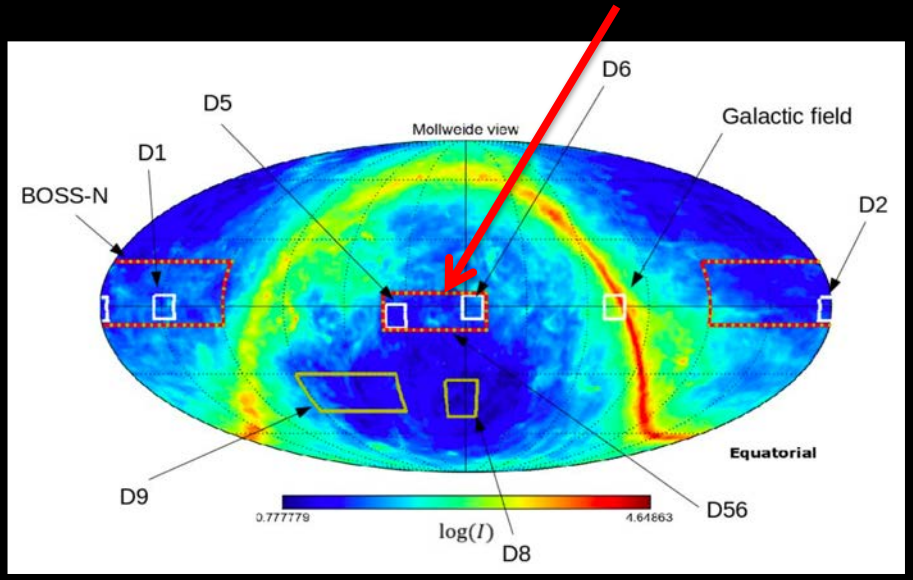


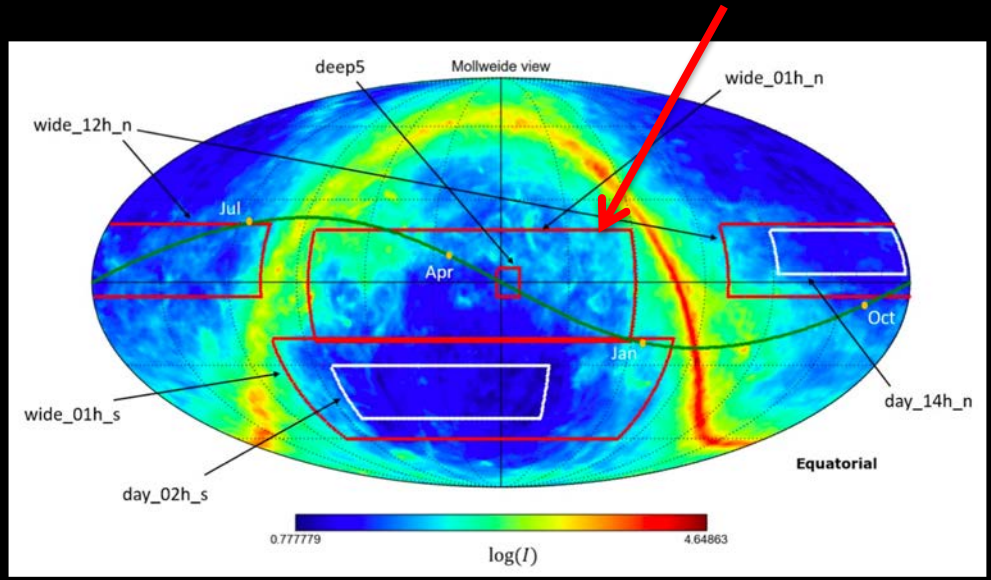
ACTPol - Deep (Stripe 82)

- Observations 2013-15
- 2 frequencies (90/150 GHz)
- Red patches ~3000 deg^2
- Most papers on ~1/4 survey

Advanced ACTPol - Wide

- Observations 2016-present
- 5 freqs (30/40/90/150/220 GHz)
- 4 new detector arrays
- 15,000 deg^2 survey





(De Bernardis, Stevens et al. SPIE 2016)

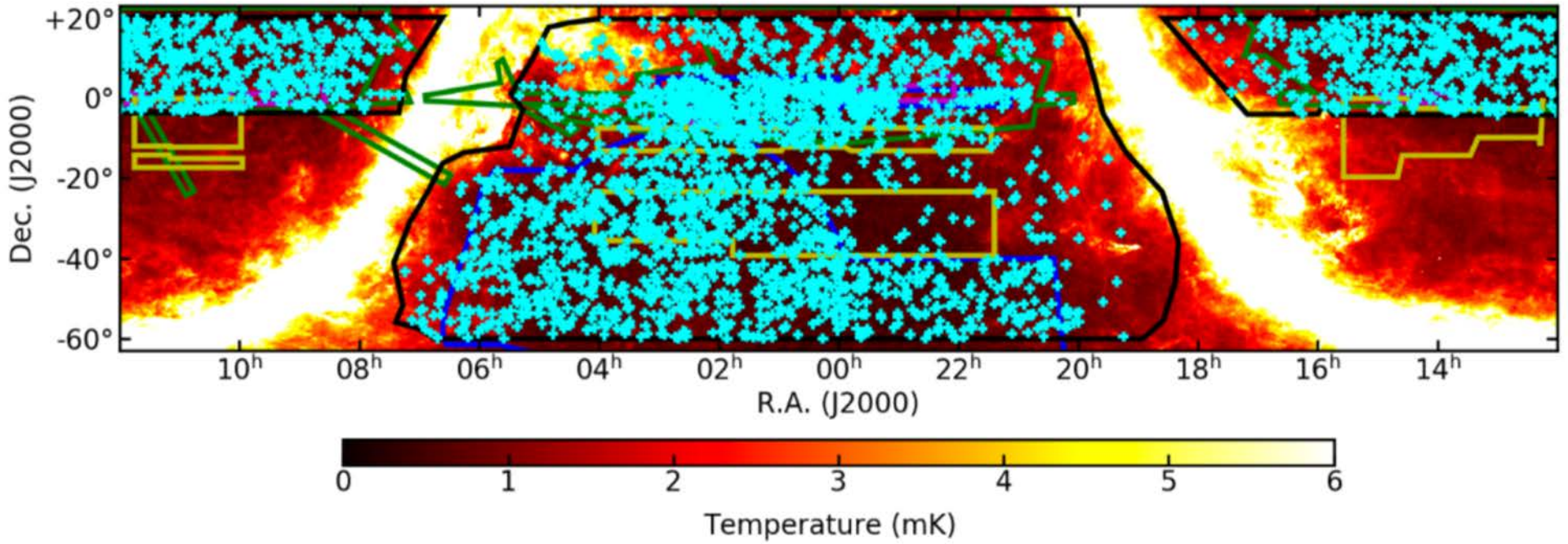
AdvACT data are excellent and *will be public* for joint analysis with CCAT

Advanced ACT cluster search

- Night time only data to **S18** (90, 150 GHz):
  2874 confirmed clusters with redshifts to date

Slide from Matt Hilton
Papers and data release imminent

PRELIMINARY



Black = cluster search area; Pink = HSC (s18a); Blue = DES; Green = SDSS; Yellow = ESO/VST

Simons Observatory (and CCAT-prime)

Director Debra Kellner
Footage Nina Bernfeld and Yvan Neault
Editor Jean Paul Husson

Simons Observatory

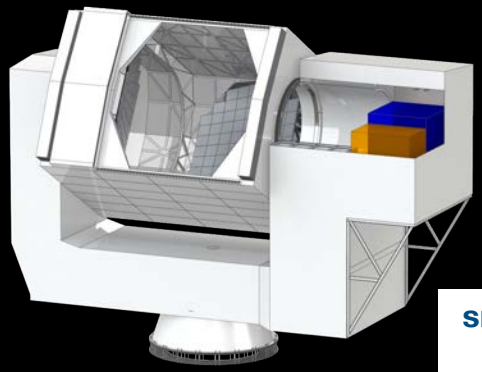
Director: Brian Keating, UCSD

Next stage of ACT + Polarbear teams

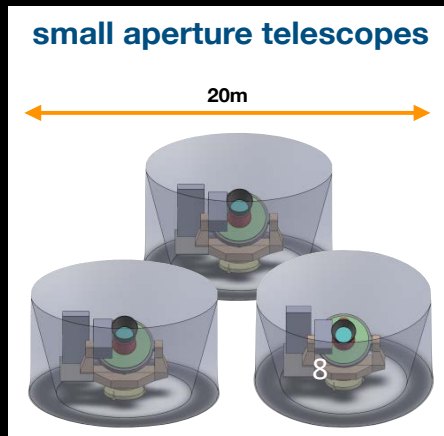
- Building a copy of CCAT-prime
  (only for 1 – 10 mm wavelengths)
- Small 0.5m aperture telescopes/cameras to constrain inflation
  $\sigma(r) = 0.002 – 0.003$
- Funded by Simons Foundation

(SO Science Forecasts, arXiv:1808.07445)

SIMONS FOUNDATION



Large aperture telescope



Simons Observatory

Director: Brian Keating, UCSD

Construction is underway!

The largest CMB camera yet

Will be ideal for joint analysis with CCAT-prime after data supercedes AdvACT

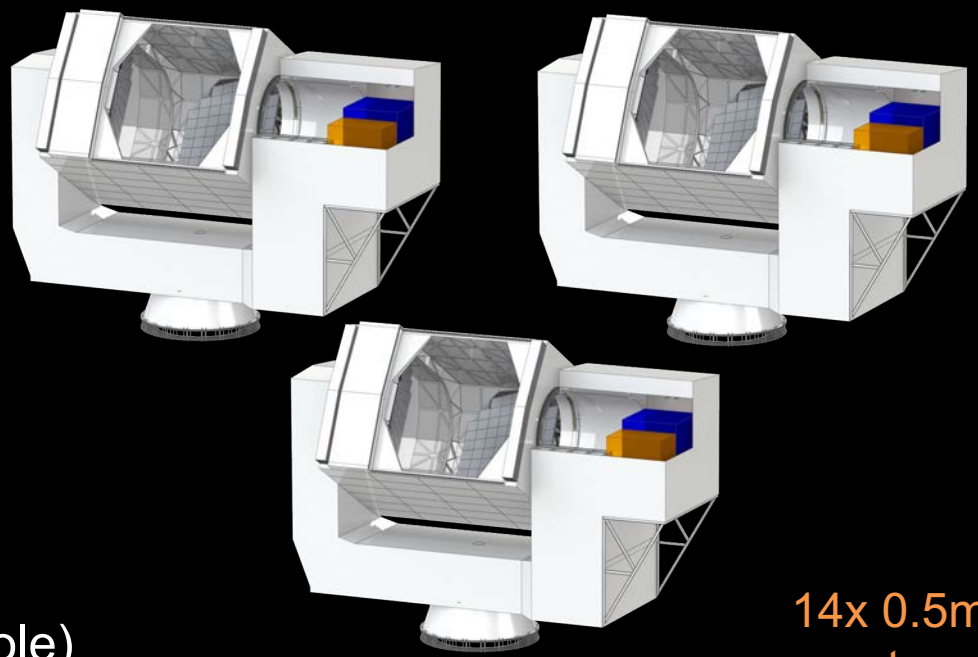
CMB-S4

Collaboration formed 2018

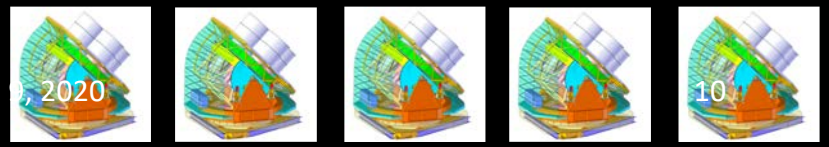
Primarily: ACT + Polarbear + BICEP/Keck + SPT

- Science: Inflationary Gravity Waves, Light Relics, Large Scale Structure
- Reference design:
  - Wavelengths: 1 – 10 mm
- *Baseline design defined this year*
- Survey outline:
  - ~50% sky survey for N_{eff}
  - ~5% sky survey for r
  - Roughly 4×10^5 detectors!
  - Multiple sites (Chile & South Pole)
  - Multiple high throughput telescopes

3x 6m apertures (2 in Chile, 1 at South Pole)



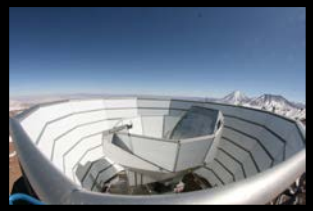
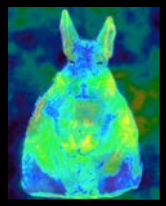
14x 0.5m apertures



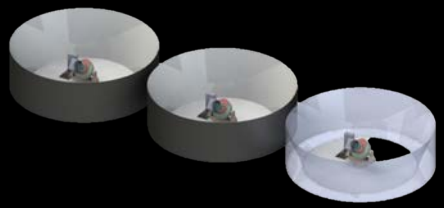
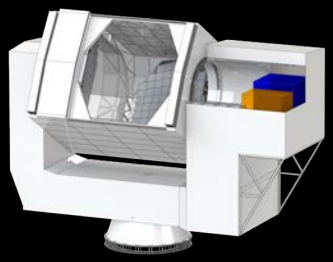
(CMB-S4 Science Book, arXiv:1610.02743)

Status of Projects & Synergies

- Advanced ACTPol observing now => ~10x more data to analyze!
  - *Data will be public and well-matched for early joint CCAT-prime analyses*

- Simons Observatory observing starts in 2021
  - MOU in place for instrumentation. Further MOUs will be pursued as needed


- CMB-S4 passed CD-0 at DOE + small NSF funding, observing 2027?
  - CCAT-prime and SO are pathfinders (and possibly telescopes) for S4!
  - Letters of interest in collaborating exchanged between CCAT-prime and CMB-S4