CMB-S4 2021 Spring Collaboration Meeting
LAT Report Back - Parallel

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SPLAT and CHLAT

General updates on status of SPLAT design

Question:

● How many segments for monolithic mirrors?
  ○ 2 or 6 depending on material suppliers

CHLAT Updates and many photos of actual hardware

Questions:

● Will CHLAT design need to be changed for larger instrument?
  ○ Nominally fits with 4m diameter space, but this needs to continue to be tracked and studied.
  ○ Action for LAT group to incorporate CHLAT instrument space around LATR design, with estimates for rotator
  ○ Current S4 weight is ~4500 kg, CHLAT design is for 6000 kg

CHLAT Instrument space => still space for instrument rotator
CHLAT Survey Strategy and Sidelobes

● Preliminary baseline plan requires $f_{\text{sky}} \sim 68\%$:

From PBDR:

MR2.0: CMB-S4 shall measure $I$, $Q$, and $U$ over 68% of the sky at frequencies of 27, 39, 93, 145, 225, and 278 GHz, with angular resolution of 7.4, 5.1, 2.2, 1.4, 1.0, and 0.9 arcminutes, respectively, with $I$-map noise levels $\leq$ 21.8, 12.4, 2.0, 2.0, 6.9, and 16.7 $\mu$K-arcmin, respectively, and $Q/U$-map noise levels of $\leq$ 30.8, 17.6, 16.7 $\mu$K-arcmin.

○ After discussions in parallel and by email, it is not clear whether this is possible at 40 deg elevation or requires observing at 35 deg elevation.

○ While either 35 deg or 40 deg elevation could work, observing at 35 deg is likely to introduce additional systematics (ground pickup) and will reduce mapping speed.

  ▪ ACT observations are 40 deg elevation or higher.

● Additional studies are underway to:

  ○ Assess whether adjustments to survey strategy can enable covering 68% of sky at 40 deg elevation (Keskitalo)

  ○ Assess whether $N_{\text{eff}}$ constraints meet science requirements with updated nominal observing strategies at both 35 deg and 40 deg elevation (Flauger and Meyers)
Simons Observatory LAT Receiver

Update by Ningfeng Zhu on great progress being made with SO LAT Receiver

- Lessons learned on challenges with installation and handling of LATR, special fixturing, cable management
  - We will need to be very mindful not just of installed space, but also of installation routes/procedures
- Will need revised corotator design for S4 LATR

Question:
- What is driving 24 Hz resonant frequency on 100mK stage?
  - Believed to be coming from cold fingers coming out the back of the optics tubes
S4 LATR Updates

- Lots of work on LATR optics tube optimizations, candidate groupings to minimize complexity
- Great progress on 85-tube LATR cryostat design, optics tube mechanical layout, and concept-level interface structure from LATR to SPLAT
- Cryogenic design advancing, with concept for fast cool down to reduce time from ~30 days to ~12 days.
  - Concern re: wrinkling of filters during rapid temp change. Only metal mesh filters are at low pass filters at 4K, no longer metal mesh IR blocking filters so should be fine.
- Some recommendations on requirements documents, need to be updated in particular the LATR-LAT ICD.
- Some questions on stability of Pulse Tubes off-of-vertical
  (See poster by Tran Tsan on pulse tube performance at different angles)
- Also discussion on magnetic shielding in optics tube
  - Concept is for 1K A4K shield going back from L1, and Nb spitoon around. Need specs from flowdown
LAT Commissioning Receiver

- **Overview of LATCR**
  - Key driver that CMB-S4 must work immediately after commissioning, this requires testing before receiver is deployed
  - LATCRs will be critical for testing integrated software and control systems
  - Optics tubes must be validated in North America first
  - Design heritage from SO LATR tester and Modcam (CCAT-p)

Action to develop schedule and LATCR requirements in more detail
LAT Calibration Hardware and Baffling

LAT Calibration Hardware

- Scope is hardware for optics tube testing (NA), NA Test build, On-site validation (commissioning), and On-site calibration (observing)
- Discussion on viability of Holography at SP vs. Laser Tracker for mirror alignment and HWFE validation
  - Holography generally more accurate, but with 3-mirror system very challenging to deconvolve each mirror (Lots of effort to do just 2 mirrors for CCAT-p/FYST)
- Requirements not well defined for on-site full system validation and calibration (Band properties, Pol angle, Pol efficiency, Time constants)

Baffling

- Pressing of aluminum sheets into 3d-printed random noise patterns looks very promising for randomizing sidelobes across sky
- This would be applied over most of the baffles of the TMA tipping structure, requires mass production