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

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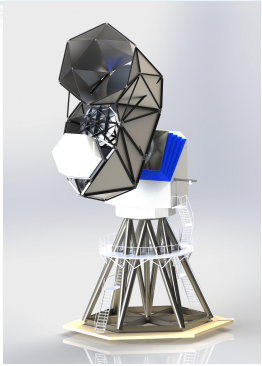
CMB-S4

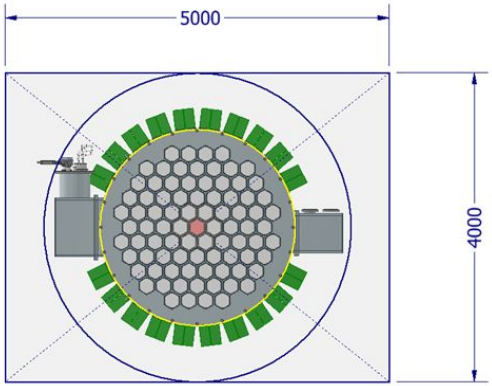
SPLAT and CHLAT

General updates on status of SPLAT design

Question:

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

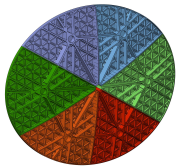


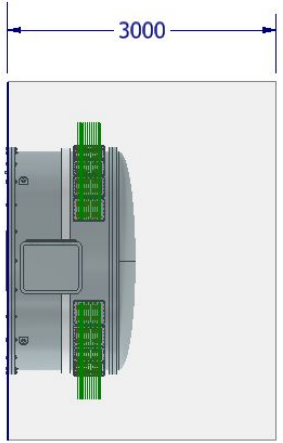


CHLAT Updates and many photos of actual hardware

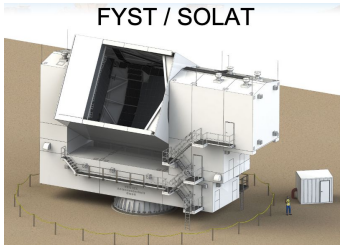
Questions:

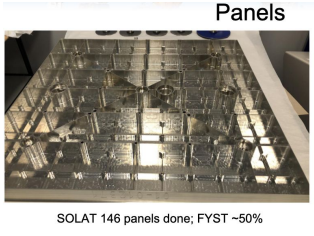
- Will CHLAT design need to be changed for larger instrument?
  - Nominally fits with 4m diameter space, but this needs to continue to be tracked and studied.
  - Action for LAT group to incorporate CHLAT instrument space around LATR design, with estimates for rotator
  - Current S4 weight is ~4500 kg,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

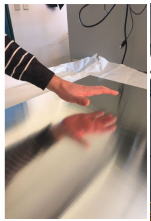




CHLAT Instrument space
=> still space for instrument rotator







CMB-S4

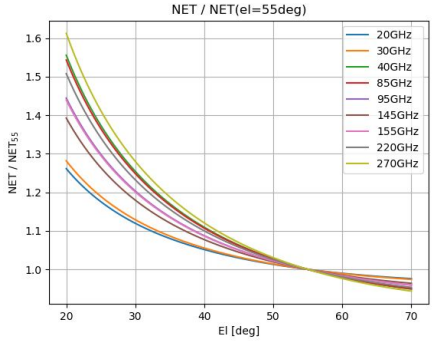
CHLAT Survey Strategy and Sidelobes

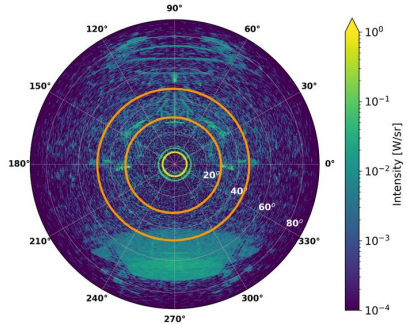
- Preliminary baseline plan requires f_{sky} ~ 68%:

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 μK-arcmin, respectively, and Q/U-map noise levels of $\leq$ 30.8, 17.6,

  - 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_{eff} constraints meet science requirements with updated nominal observing strategies at both 35 deg and 40 deg elevation (Flauger and Meyers)





Plot from Gudmundson et al 21 10.1364/AO.411533

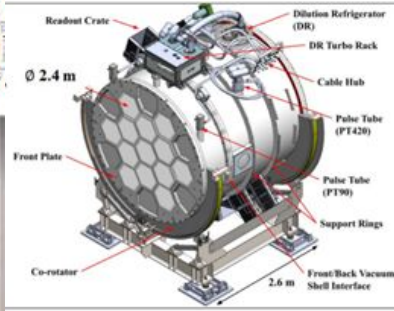
Simons Observatory LAT Receiver

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

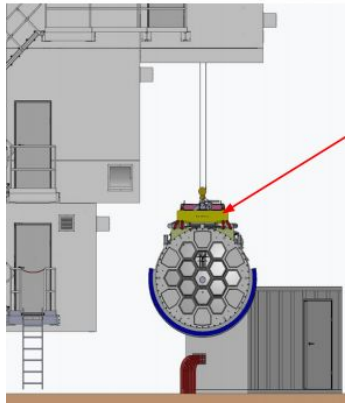
Question:

- 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



LATR paper on arXiv (https://arxiv.org/abs/2103.02747)

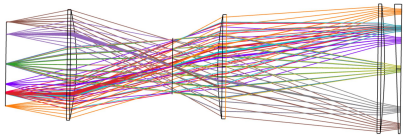
LATR interface - lifter

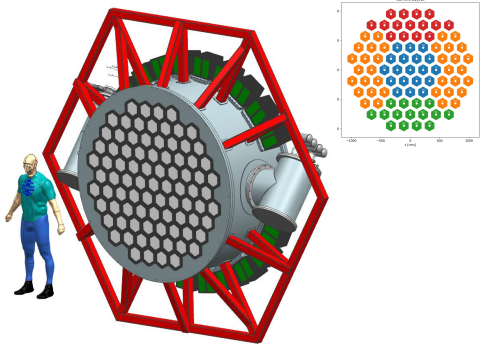


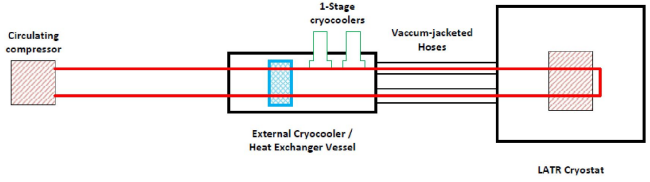
S4 LATR Updates

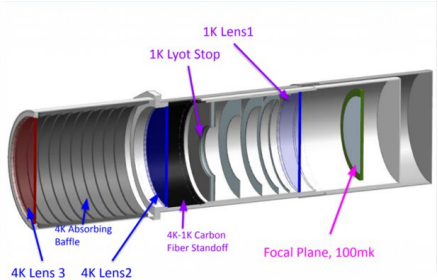
- Lots of work on LATR optics tube optimizations, candidate groupings to minimize complexity
- Great progress on 85-tube LATR cryostat design, optics tube mechanical layout, and concept-level interface structure from LATR to SPLAT
- Cryogenic design advancing, with concept for fast cool down to reduce 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

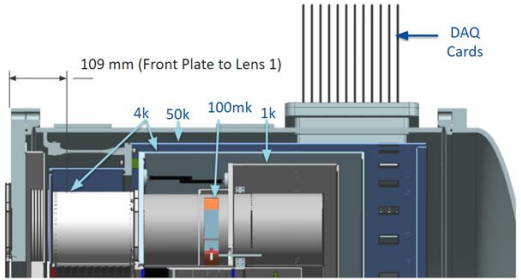
  (See poster by Tran Tsan on pulse tube performance at different angles)
- Also discussion on magnetic shielding in optics tube
    - Concept is for 1K A4K shield going back from L1, and Nb spitoon around. Need specs from flowdown











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

SO LATR tester (Chicago)

Modcam: CCAT commissioning camera (Cornell)

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