

Large Aperture Telescopes

Note Takers: Nick Emerson and Mike Niemack

Slides:

https://drive.google.com/drive/folders/1Da-KD0cPNqQ_pV-mMH-p7m0c3kl8IOCr?ths=true

Plenary (Mike Niemack):

- Q: Will the S4 LATR co-rotate with the chlat? A: Yes, that is the baseline, will need to be redesigned from the SO rotator
- Q: What is unique about SP environment that requires the TMA design vs CD design? A: Driven by reducing systematics associated by panel gaps, scattering, which are factors limiting measurement at lo-ell. Boresight rotation also
- Q: question on magnetic shielding for optics tube. A: will discuss in parallel session, but will be incorporated into each optics tube
- Q: Can you quantify the statement about a preference for a higher elevation scan? For example, if the effect of lower elevations is increased effective noise on large angular scales, that might be a worthwhile trade-off? A: Reijo quantified this, will be discussed this afternoon, raw sensitivity between 35deg and 45deg will decrease by 10%(?) , direct sensitivity hit going lower in elevation. Additionally, have seen evidence on ACT additional pickup at 35deg, decreasing going higher, looking ok at 40deg. Most telescopes in Chile don't observe lower than 40deg based on most recent experience.
- JB: ACT has different science drivers. MN: if we observe 65% vs. 68% of sky, is that ok, vs. hit at 35deg
- Joel: Increasing sky area generally better even with hit?
- John K: Reijo put link about hybrid strategy about observing at 2 different elevations. A: Concerns about this
- Reijo: observing at 2 elevations: "We considered two observing elevations here: https://cmb-s4.uchicago.edu/wiki/index.php/High_cadence_LAT_from_Chile"
- Discussion about optimizing for Neff
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Parallels:

SPLAT Update (Nick Emerson)

- How many segments are mirrors being assembled from: either 2 or 6 segments depending on vendor

CHLAT Update (Steve Parshley)

- Question: will CHLAT design need to be changed for larger instrument?
 - Nominally fits with 4 m diameter space, but this needs to continue to be tracked and studied further
 - Current weight is 4500 kg. CHLAT design is for 6000 kg max

- ACTION ITEM: Include current LATR design in CHLAT instrument space as well as estimate for co-rotator size and readout electronics in case changes are needed to fit.

CHLAT Survey Strategy and Sidelobes (Patricio Gallardo)

- Joel recently reported that current forecasts may actually be based on 40 deg elevation instead of 35 deg.

Simons Observatory LAT Receiver Update (Zhu Ninfeng)

- SO LATR is ~5000 kg fully loaded.
- What is driving 24 Hz resonant frequency on 100 mK stage? They think it is due to the cold fingers coming out of the back of the optics tubes and are exploring making them thicker and more rigid to increase frequency.

S4 LAT Receiver (LATR) Updates (Brad Benson)

- Need to include magnetic shielding in optics tubes, possibly A4K on 4K stage and Niobium at 1K.
- Modal analysis will be a priority after remaining aspects of cryogenics are included.
- SPLAT does not use an instrument rotator, so telescope boresight rotation goes +/- 45 deg.
- ACTION ITEM: Check how much PTC cooling numbers degrade with +/- 45 deg boresight positions.
 - Current plan is for PTCs to be vertical at 40 deg or 45 deg elevation
 - Most important boresight rotation is to be able to rotate from Q to U, which only requires boresight rotations of +/- 22.5 deg
- Currently looking at < 2 weeks for cooldown of LATR to base temp.
- Do we need to worry about wrinkling of filters due to rapid cooldowns? Only metal mesh filters are low pass filters at 4K and there are no longer metal mesh IR blocking filters.
- Additional thermal simulations are needed.
- SO LATR sees ~20-30 mK gradients across FOV currently and expresses that it will be challenging to achieve with many more optics tubes. Matt suggests that thermal links could be optimized differently for different tube positions.
- If rapid cooldown fails, other cooling systems will still work fine, but cooling down would take a lot longer maybe ~ 30 days.
- ACTION ITEM: Develop thermal modeling further
- Mattheaus encourages working on advancing LATR requirements documentation and interface documentation. JeffZ notes that documents exist from Vic Guarino, but need more attention, especially interface documentation.
- Bobby notes that Requirements and interfaces need review and updating project wide.
- See poster from UCSD grad student Tran Tsan on pulse tube performance at different angles.
- ACTION ITEM: Determine diameter of LATR plus electronics crates as well as diameter including cryogenics

- What are temperature stability requirements? Will rotations or changes in elevation cause problems? Sense is that these will primarily cause long time scale drifts that are likely to be sub-dominant to atmosphere drifts. However, these might also require rebiasing detectors on shorter time scales.

LAT Commissioning Receiver (Jeff McMahon)

- What if telescopes have already been used for observing? Are LATCRs still required?
 - Baseline is that all 3 telescopes will be new and will need to be commissioned. Plan might be adapted if we are reusing old telescopes, although,
 - It's also critical to test integrated system software and hardware interfaces before LATRs are deployed.
- ACTION ITEM: Develop schedule and LATCR requirements in more detail.

LAT Calibration Hardware and Baffling finishes (Johanna Nagy)

- Hydraulic pressing of aluminum sheets into random noise patterns looks appealing for randomizing sidelobes across sky.
- Where would these sheets go? All over the cabin walls of TMA and CD telescopes.
- Are both holography and laser trackers required? It's not clear. One may be sufficient for S4 specs, although, both are being planned for CCAT-prime/FYST since it is targeting a system RMS < 11 μ m.
- SteveP notes that doing holography with TMA will be even more challenging due to having 3 mirrors.

General Discussion

May 6 is scheduled date for Chile LAT/ South Pole LAT Conceptual Design Review.

Plenary chat messages:

11:45:59 From NINGFENG ZHU to Everyone : Will S4 LATR co-rotate with the CHLAT?

11:52:50 From Neelima Sehgal to Everyone : What is unique about the South Pole environment that requires the TMA design versus the CD design?

11:54:52 From Joel Meyers to Everyone : Can you quantify the statement about a preference for a higher elevation scan? For example, if the effect of lower elevations is increased effective noise on large angular scales, that might be a worthwhile trade-off

11:55:13 From Neelima Sehgal to Everyone : Thanks

11:56:33 From J. Ruhl to Everyone : Joel, fwiw, lower elevation also has higher white noise, due to larger photon noise.

11:58:25 From Bradford Benson (he/him) to Everyone : Yeah, I think a 20-cm diameter 1K A4K magnetic shield from the Lyot stop to behind the detector module, with a Nb spittoon around the detector module would be physically possible, and I suspect should be sufficient. However, we also need some guidance from flowdown group, about requirements, and joint magnetic shielding sims with what the readout group should be done.

11:59:10 From Joel Meyers to Everyone : Thank you!

12:00:04 From Simon Dicker to Everyone : Two different elevations?
12:00:52 From Lorenzo Monceli to Everyone : thanks Mike and Brad for the answers. Jeff F and I have attempted to collect info on requirements, but it's definitely not well spelled out yet. We can share what we have with interested parties.
12:01:20 From Reijo Keskitalo to Everyone : We considered two observing elevations here: https://cmb-s4.uchicago.edu/wiki/index.php/High_cadence_LAT_from_Chile
12:04:16 From Keith Thompson to Everyone : Is lowest EL just a survey question, or does it have instrument design implications?
12:05:46 From Joel Meyers to Everyone : Here is the link to the wiki post Reijo mentioned, with N_eff forecasts for a few different scan strategies, including multiple elevation scans: https://cmb-s4.uchicago.edu/wiki/index.php/WAFTT_results_part_3
12:07:07 From J. Ruhl to Everyone : Keith: the target el feeds into detector saturation power target, and of course into concerns about sidelobe pickup/baffling.

Parallel Chat messages:

Jeff McMahon to Everyone (3:48 PM)
How much does the receiver weigh? Is that an issue?
M Hollister to Everyone (3:49 PM)
~4500 kg
John Carlstrom (he/him) to Everyone (4:01 PM)
hi Ningfeng — move your camera up a bit...
Bradford Benson (he/him) to Everyone (4:03 PM)
I've seen that lifting issue before, i.e., not having as much vertical height as you thought, definitely scary
Nick Emerson to Everyone (4:04 PM)
Yes, I've been there and done that as well
Amy Bender to Everyone (4:06 PM)
Is co-rotation a requirement for the deep-wide survey?
Bradford Benson (he/him) to Everyone (4:08 PM)
I can ask my question at the end
Simon Dicker to Everyone (4:08 PM)
The fov of the LAT telescopes is not symmetric so if the cryostat does not rotate with the telescope then the beams at 270 will change will elevation.'
Me to Everyone (4:08 PM)
Amy, it's part of the baseline because additional simulations would be required to not include it
Amy Bender to Everyone (4:08 PM)
Is it potentially a cost driver?
Me to Everyone (4:11 PM)
Amy, my recollection of the cost is a few hundred k\$, so I do not think it's a cost driver.
Amy Bender to Everyone (4:11 PM)
Ok.
John Carlstrom (he/him) to Everyone (4:17 PM)
Will the TDB readout crates on the exterior fit in the CCAT rx cabin?

thinking about the floor clearance

TBD == TDM

Matthaeus Leitner to Everyone (4:18 PM)

I also wonder about the space needs of the LATR compared with what's available in the telescope structure. There's also the rotating mechanism which has to be considered.

NINGFENG ZHU to Everyone (4:19 PM)

Just want to add one more point to John's question: having the readout crates clear the co-rotation structure took us a long time.

John Carlstrom (he/him) to Everyone (4:20 PM)

The SO umux crates are probably smaller and there are definitely fewer than in the CMB-S4 TDM crates

Stephen Parshley to Everyone (4:21 PM)

There are 2 meters between the telescope floor and the EL axis. Co-rotator takes its share... not sure how much. I know SO thought they had lots of space ~3 years ago, but I get the impression it has been eaten up.

Antony Stark to Everyone (4:21 PM)

Lenses should be numbered from the sky to the detector.

John Carlstrom (he/him) to Everyone (4:23 PM)

Don M — what is the diameter of the cryostat plus crates

Bradford Benson (he/him) to Everyone (4:23 PM)

The google slides animate, I'll include the link the google drive directory when I'm done

Simon Dicker to Everyone (4:23 PM)

Does the SPLAT have a rotator for the cryostat?

Bradford Benson (he/him) to Everyone (4:24 PM)

No

The telescope rotates though

Simon Dicker to Everyone (4:24 PM)

That would put the pulse tubes upsidedown

Nick Emerson to Everyone (4:24 PM)

The cryostat rotates together with the optics about the telescope boresight axis

Bradford Benson (he/him) to Everyone (4:24 PM)

Yeah, we could only rotate +/-45 d along boresight

Nicholas Galitzki to Everyone (4:30 PM)

a UCSD grad student Tran Tsan has a poster on PT-420 capacity versus angle just as a quick plug!

Bradford Benson (he/him) to Everyone (4:30 PM)

That was a great poster and great measurements!

Tyler Natoli to Everyone (4:30 PM)

Oh, thanks Nicholas.

Bobby Besuner (he/him) to Everyone (4:40 PM)

Requirements and interfaces need review project-wide and updating

Jeff Zivick to Everyone (4:41 PM)

Make sure you put May 6th on your Calendars to attend the scheduled Chile LAT/South Pole Lat Conceptual Design Review.

Eve Vavagiakis to Everyone (4:46 PM)

Mod-Cam details in 2012.10411

Bobby Besuner (he/him) to Everyone (4:48 PM)

My question will be if a goal is to sample a lot of the field with the LATCR (meaning distributing optics tubes spatially)

Bradford Benson (he/him) to Everyone (4:51 PM)

The "LATCRs" both serve as optics tube testers (to test the tube concept/design) early on in project, and do on-sky commissioning of the telescope in the field later in the project. So there are two different functions and timescales involved.

Tyler Natoli to Everyone (4:52 PM)

The software test is a good answer I was not considering. Thanks.

Bobby Besuner (he/him) to Everyone (4:52 PM)

I am certain LATCR will save commissioning time.

Katie Harrington to Everyone (4:53 PM)

The software test case at Chicago has been SUPER useful for DAQ/Readout things.

John Carlstrom (he/him) to Everyone (5:00 PM)

Sorry, I have to leave on the hour. Thanks to everyone for the great presentations and questions.

Bradford Benson (he/him) to Everyone (5:10 PM)

Detector session is still pretty active