South Pole Infrastructure, Integration, & Commissioning

Amy Bender, Erik Nichols

2021-03-11

South Pole Scope

- Power & networking infrastructure; data transfer off-site
- Ice pads (foundations) for all new facilities
- SAT towers & control rooms
- Lab buildings for SATs
- SPLAT High bay
- On-site assembly & install of all on-site equipment & facilities
  - Includes SPLAT, SATs, DM, DAQ/OCS
- On-site integration and commissioning
- Logistics for on-site activities (in coordination with Antarctic Support Contract/ASC)
  - Cargo from Port Hueneme to the South Pole
  - Personnel deploying to South Pole
  - Vehicles at South Pole
  - Safety!

Driving Requirements

Design:

- Environmental: temperatures, snow accumulation, wind
- Ground pickup prevention
- Radio-quiet environment
- Spaces: for assembly and integration of receivers, maintenance throughout operations, data management system, office/work space
- Power for SPLAT/SATs/DM systems
- On-site networking between buildings & DM system, connection to satellite upload

Logistics:

- Austral summer access
- Cargo pallet size
- Shipping deadlines

Infrastructure Considerations

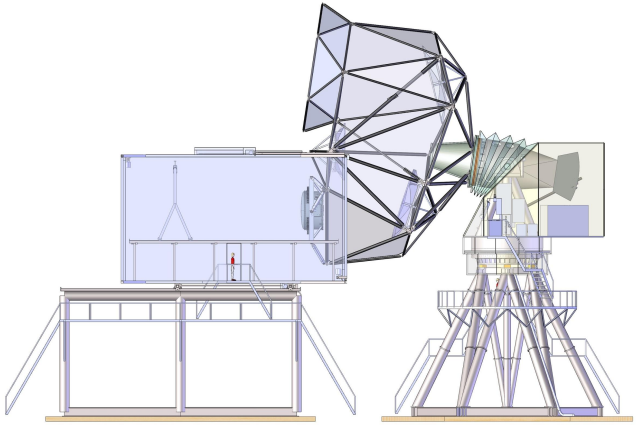
- Provide power & network connections to SPLAT, SATs
- Connect on-site network to off-site transfer system
- Inputs are mostly taken from other subsystems
  - Need to check values and links in Jama, and add backup documentation
- Other items
  - High-purity helium and nitrogen bottles
  - Liquid nitrogen for DR cold traps

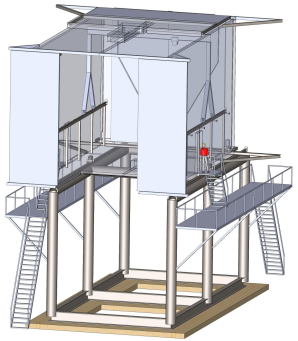
	Average power	
Equipment	Chile Total [kW]	SP Total [kW]
LATs (including receiver and readout but not DAQ)	210	105
SATs (including receiver and readout but not DAQ)	0	264
Cooling system	30	14
DAQ, compute, and office	44	34
Data management	10	50
Site power	30	20
Total	304	487

	LAT	SAT x 6	Total
Full Data Rate [Gbps]	1.62	0.5	-
Compressed Data Rate [Gbps]	0.57	0.17	-
Compressed Data Rate [TBytes/Day]	6.11	1.88	8

Preliminary Design: SPLAT High Bay

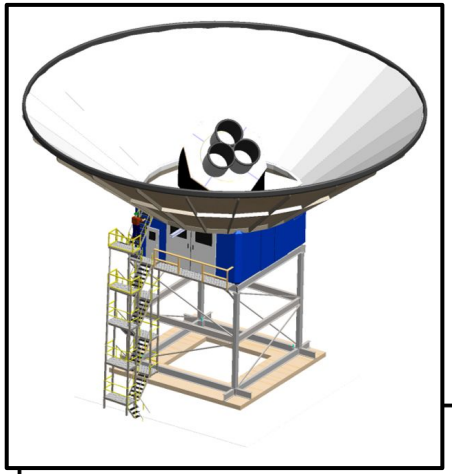
- Designed for LATCR & LATR assembly and installation on the telescope
- Three modes:
  - Rear door open for receipt of cargo
  - Front door open and building docked with telescope for receiver install/maintenance
  - Both doors closed and building moved away to allow clearance for telescope motion
- 8 m x 8 m x 14.3.m
- Includes glycol cooling loop for compressors
- Designed in parallel with SPLAT on MSIP award
- Going forward: Add requirements details from CMB-S4 to Jama and refine design



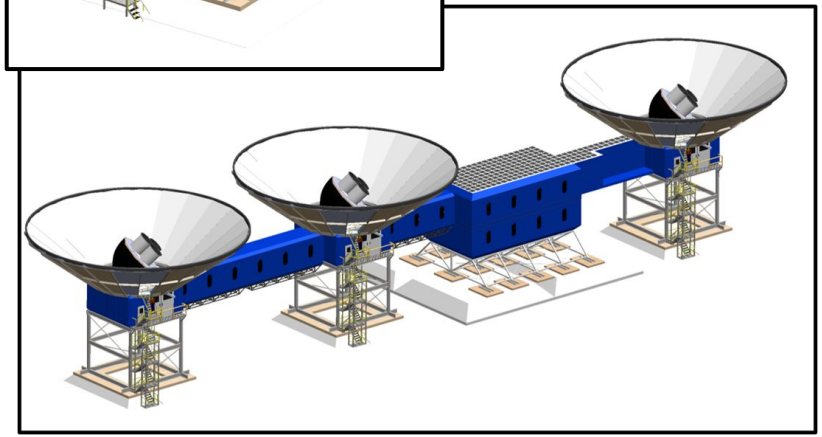


Preliminary Design: SAT Facility

- SAT tower & control room
  - Mount and ground shield installed on top
  - Tower compensates for snow accumulation and minimizes ground pickup from nearby structures
  - Compressors & electronics housed in control room (includes glycol cooling loop)
  - Proposed design: BART tower & control room
- Laboratory buildings
  - Space for receiver assembly & maintenance
  - 3 SATs per support building
  - Use existing MAPO building
  - Second building will essentially duplicate MAPO



Credit: B. Schmidt

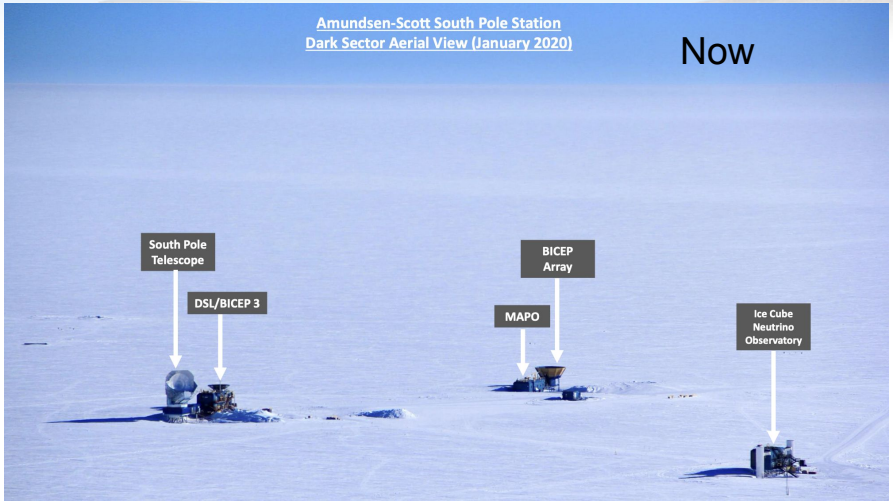


Site Layout

- Telescopes will be located in the ‘dark sector’
- Re-use MAPO & upcoming BART, add 2 more SATs
- SPLAT location dictated by ground pickup requirements
- Additional restrictions from IceCube strings & station operation zones
- Proximity to main station

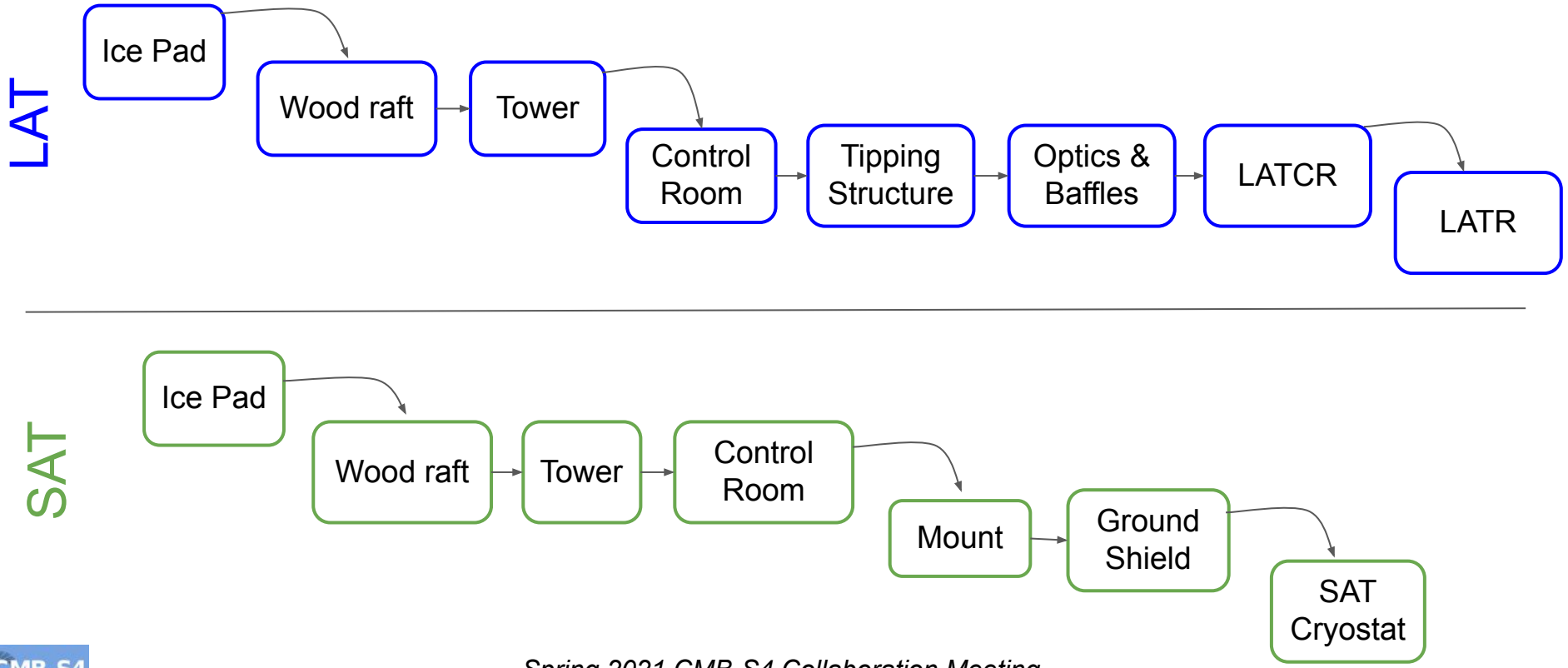
Once locations are refined, can plan for fiber & power distribution

DM system currently planned for main station lab/work space.



Credit: B. Schmidt

On-site Assembly



Commissioning

Commissioning: Tasks that need to happen prior to acceptance of integrated telescope+receiver etc and transition to operations. Verifies functionality of experiment.

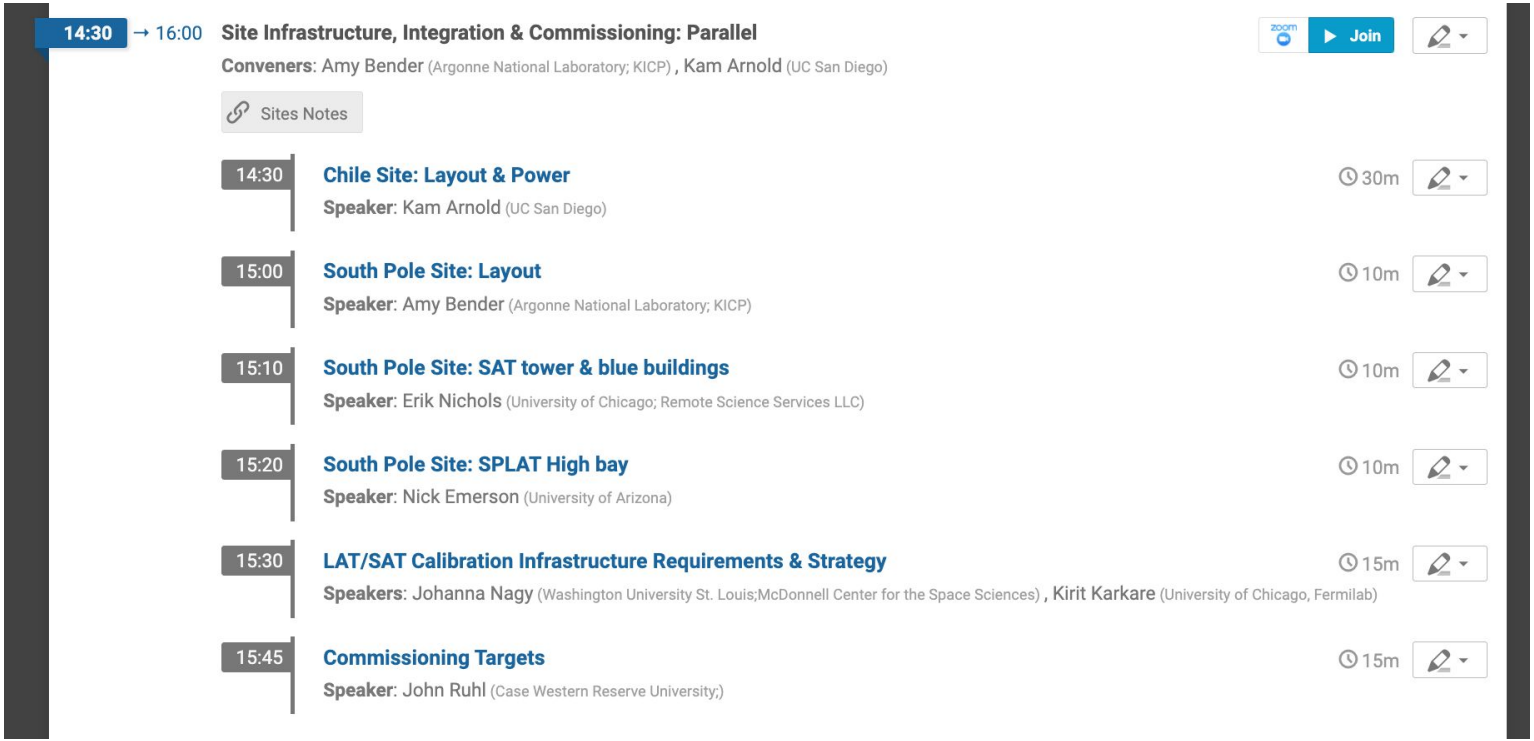
Calibration: Tasks that can happen before or after transition to operations. Measurements that are needed for analysis.

<u>Commissioning</u>
Holography
Pointing check & models
Detector & readout operation
NET verification (detector response & system noise)
Initial beam checks (main beam shape & side lobes)
Magnetic & RFI sensitivity
DM/DAQ integrated checks

<u>Calibration</u>
Bandpass
High S/N beam measurements
Polarization calibration
Temperature calibration

Need to start working with LAT & SAT to link up the targeted levels of precision and acceptance for each of these tasks to refine schedule.

Parallel Session



14:30 → 16:00 **Site Infrastructure, Integration & Commissioning: Parallel**

Join

Conveners: Amy Bender (Argonne National Laboratory; KICP) , Kam Arnold (UC San Diego)

Sites Notes

14:30	**Chile Site: Layout & Power** **Speaker**: Kam Arnold (UC San Diego)	30m
15:00	**South Pole Site: Layout** **Speaker**: Amy Bender (Argonne National Laboratory; KICP)	10m
15:10	**South Pole Site: SAT tower & blue buildings** **Speaker**: Erik Nichols (University of Chicago; Remote Science Services LLC)	10m
15:20	**South Pole Site: SPLAT High bay** **Speaker**: Nick Emerson (University of Arizona)	10m
15:30	**LAT/SAT Calibration Infrastructure Requirements & Strategy** **Speakers**: Johanna Nagy (Washington University St. Louis;McDonnell Center for the Space Sciences) , Kirit Karkare (University of Chicago, Fermilab)	15m
15:45	**Commissioning Targets** **Speaker**: John Ruhl (Case Western Reserve University;)	15m

Summary

- Continue focus on defining requirements & their values/ranges and interfaces in next few months
- Refine site layout
- Work with other subsystems to define the commissioning requirements
  - Check infrastructure locations for calibration equipment (holography tower, calibration masts)
- Further in the future, refine designs for High Bay and updated buildings
- Lots of project related documentation in preparation for NSF status review & PDR/CD-1
  - Schedule, cost backups, safety

Backup

Site Power Backup

LAT Component	Average Power kW	Max Power kW
PT420 backed DR (LD400)	15	16.5
PT420 #2	13	14.5
PT420 #3	13	14.5
TDM readout	5.2	-
Misc. Electronics	2	-
DAQ system	1	2
Telescope drives	20	60
Glycol cooling loop	2	2
Building power large equipment		20
Building power small equipment		10
LAT total	101.2	146.7

SAT Component	Average Power kW	Max Power kW
PT410 backed DR	9.2	11
PT 60	3.3	-
PT420	13	14.5
TDM readout	1.7	-
Misc. Electronics	2	2
DAQ system	1	2
Telescope drives/mount	10	10
Glycol cooling loop	2	2
SAT Total	42.2	46
Lab Building	-	30
SAT x 6 + 2 Lab Buildings	313	337