

Status of the Large-Sized Telescopes



1st VHEGAM, Bologna, January 2024



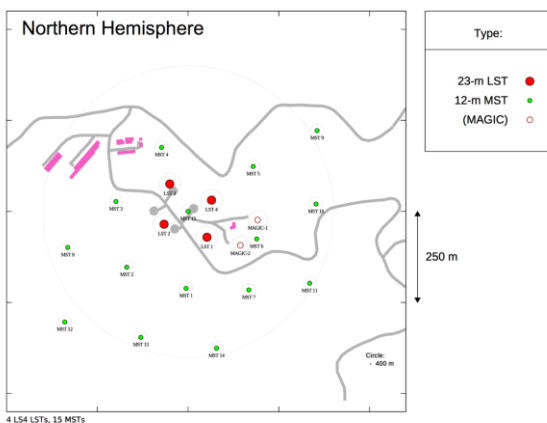
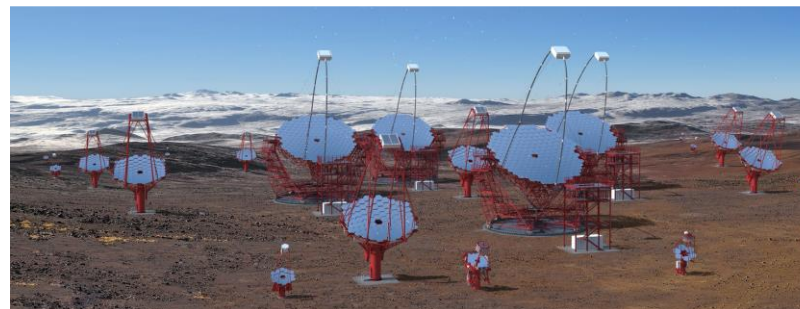
MAX-PLANCK-INSTITUT
FÜR PHYSIK



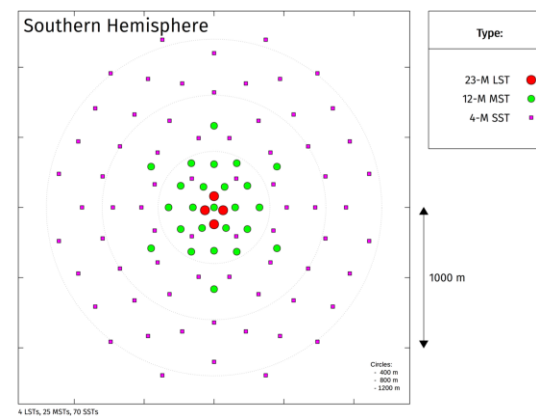
Martin Will for the CTA LST Project
Max-Planck-Institut für Physik

This work was conducted in the
context of the CTA-LST Project

Cherenkov Telescope Array

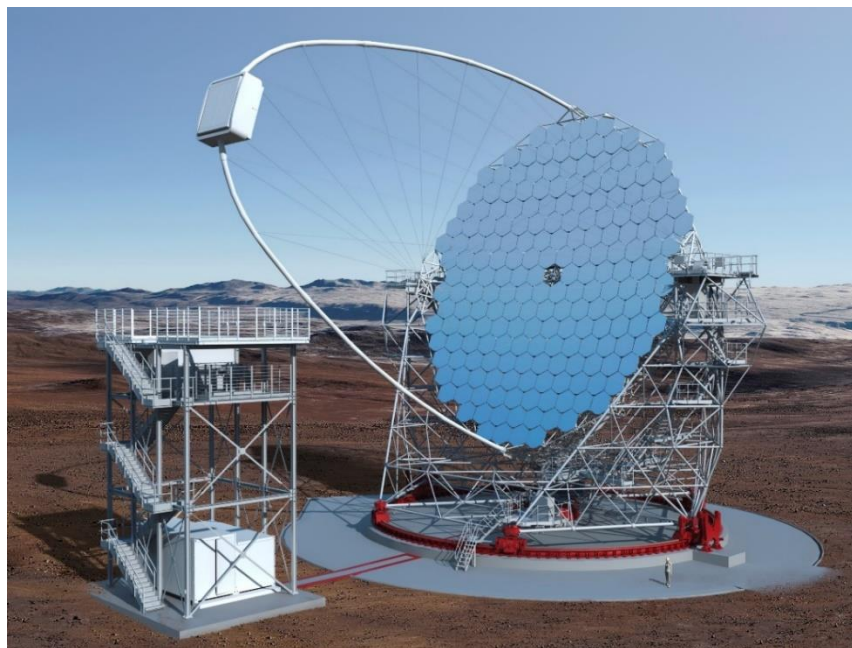


- Northern site (baseline)
 - ▶ ORM, La Palma
 - ▶ 20 GeV to 20 TeV
 - ▶ **4 LST**, 15 MST



- Southern site (baseline)
 - ▶ Paranal, Chile
 - ▶ 20 GeV to 300 TeV
 - ▶ **4 LST**, 25 MST, 70 SST

Large-Sized Telescope (LST)

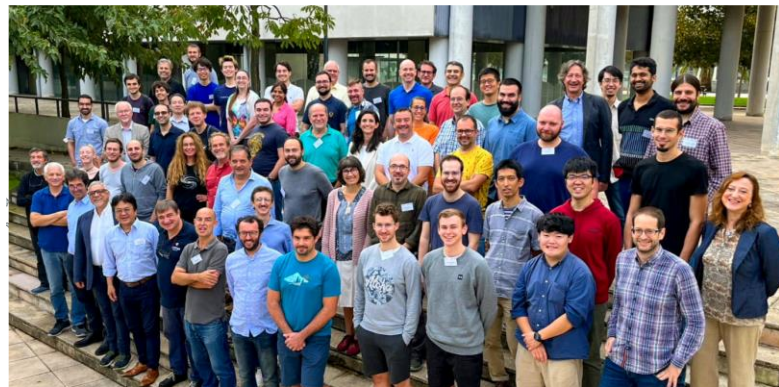


- Energy range: 20–150 GeV (3 TeV)
- Camera: 1855 PMTs, FoV $\sim 4.3^\circ$
- Focal length 28 m
- Parabolic mirror: 23 m, 400 m²
- Pointing precision: < 14 arcsec

- Carbon fiber reinforced polymer (CFRP) / steel structure
 - ▶ Total moving weight: ~ 100 tons
 - ▶ Repositioning speed: 10 deg/s
 - ▶ Repositioning time: < 30 s



LST Collaboration

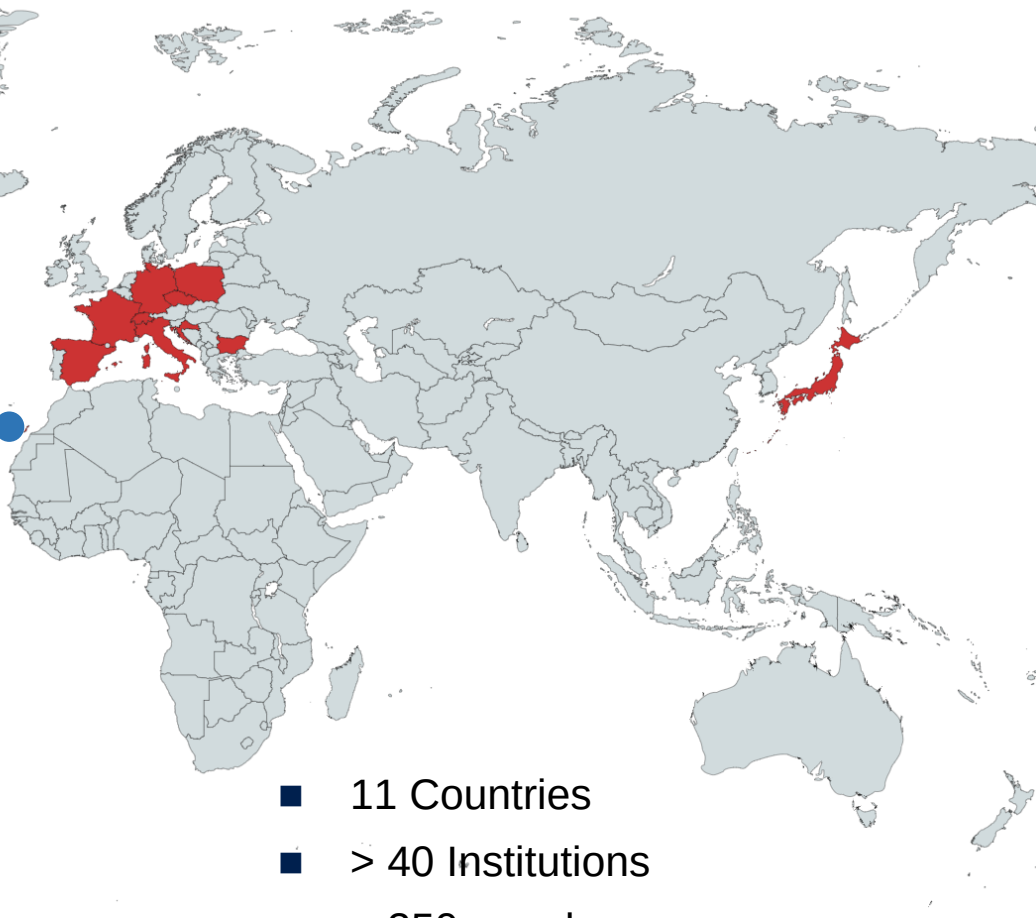


CTA North
La Palma
4 LSTs

LST Collaboration

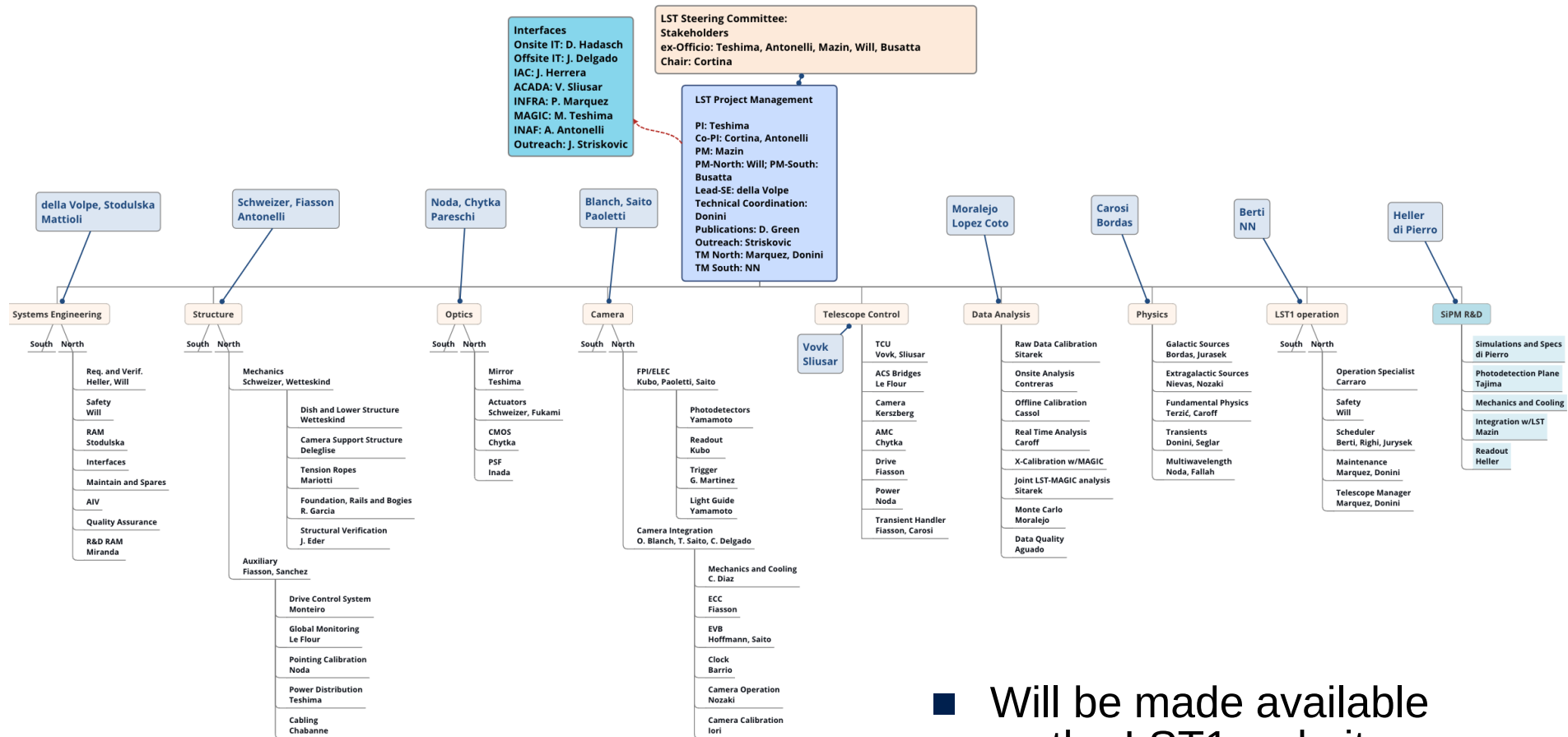
Brazil
Bulgaria
Croatia
Czech Rep.
France
Germany
Italy
Japan
Poland
Spain
Switzerland

CTA South
Chile
4 LSTs



- 11 Countries
- > 40 Institutions
- ~ 350 members
(scientists, engineers,
technicians, ...)

Organigram



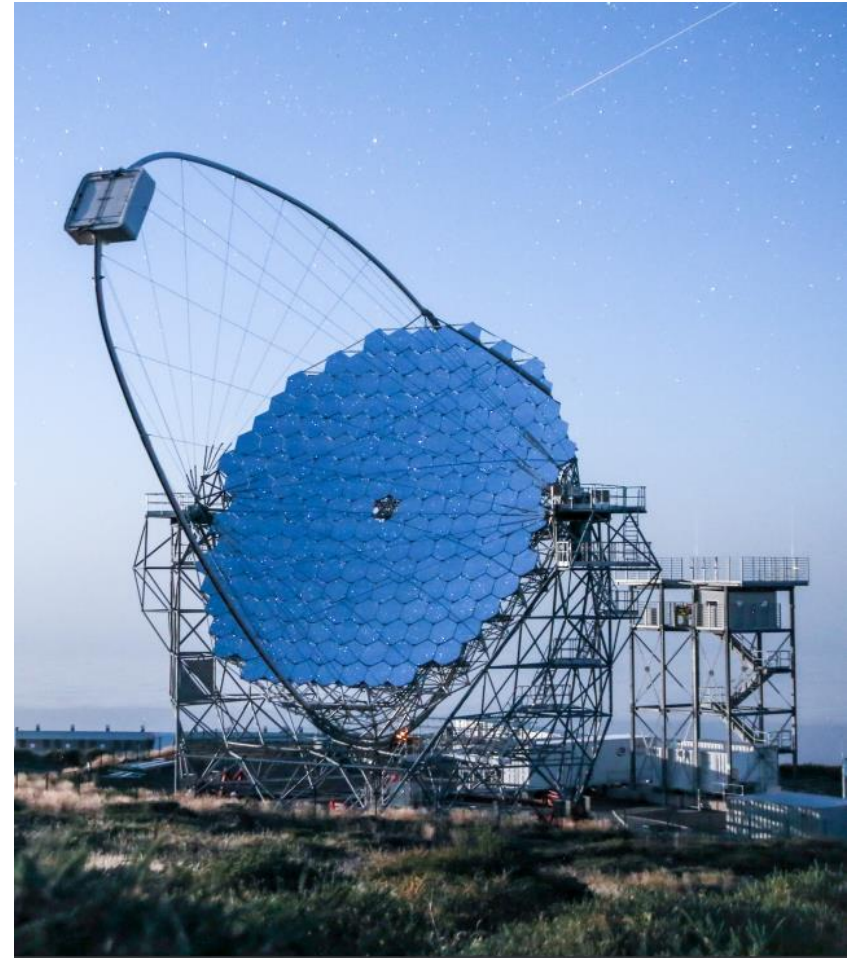
■ Will be made available on the LST1 website soon

- Several ATels
 - ▶ Latest on detection of OP313
 - ▶ Various flaring sources
- Already published several papers
 - ▶ LST Performance
 - ▶ LHAASO J2108 MWL
 - ▶ Star Tracking for Pointing
 - ▶ SiPM Test Cluster
- Many papers in the pipeline
 - ▶ Image Correction, PMT Modules, Atmosphere Correction, ...
 - ▶ RS Oph, BL Lac, GRBs, ...

#160: Observations of the Crab Nebula and Pulsar with the Large-Sized Telescope prototype of the Cherenkov Telescope Array Crab_Nebula_and_Pulsar_observations_of_the_Large_Sized_Telescope_prototype_of_the_Cherenkov_Telescope_Arra Abelardo Moralejo Olaizola Accepted Your content review is pending	Published in ApJ
#161: Development of a SiPM Pixel Prototype for the Large Size Telescope of the Cherenkov Telescope Array SiPM_PixelLST_Paper_v0.4b_CTAIR.pdf Davide Depaoli Accepted Your content review is pending	Published in NIM
#162: The optical calibration system for the Large Sized Telescope camera Calibox_Paper_v3.pdf Maurizio Iori To be corrected Your content review is pending	
#164: Star tracking for pointing determination of Imaging Atmospheric Cherenkov Telescopes. Application to the Large-Sized Telescope of the Cherenkov Telescope Array Star_tracking_paper-final-draft-with-lst-and-SAPO-comments-v2.pdf Mykhailo Dalchenko Submitted for reviewing Your content review is pending	Published in A&A
#165: Performance of the joint LST-1 and MAGIC observations evaluated with Crab Nebula observations diff_v3.4_to_v3.5.pdf Julian Sitarek Accepted Your content review is pending	Published in A&A

LST-1 Mono Proposals

- LST-1 Cycle II Mono Proposals
 - ▶ Internal only to LST members
 - ▶ 500 hours (dark time) dedicated to LST Mono observations
 - ▶ Observations must be achievable with LST-1 alone, MAGIC+LST requests go through MAGIC
- Timeline
 - ▶ Need to be discussed first within respective WGs
 - ▶ Deadline February 2, 2024
 - ▶ Cycle II begins March 27, 2024
- Email with relevant information was sent last November



- Steering Committee approved introduction of duties (similar as MAGIC)
 - ▶ Everybody wants to do physics, but we have a telescope to finish and commission and 4-5 more on the way.
 - ▶ We run the telescope with about 5 FTE, compare to 20 FTE CTAO is planning to have for CTA North.
 - ▶ Need to strengthen onsite team with technical stays for commissioning
 - ▶ Close to 100 open duties identified in addition to shifts.

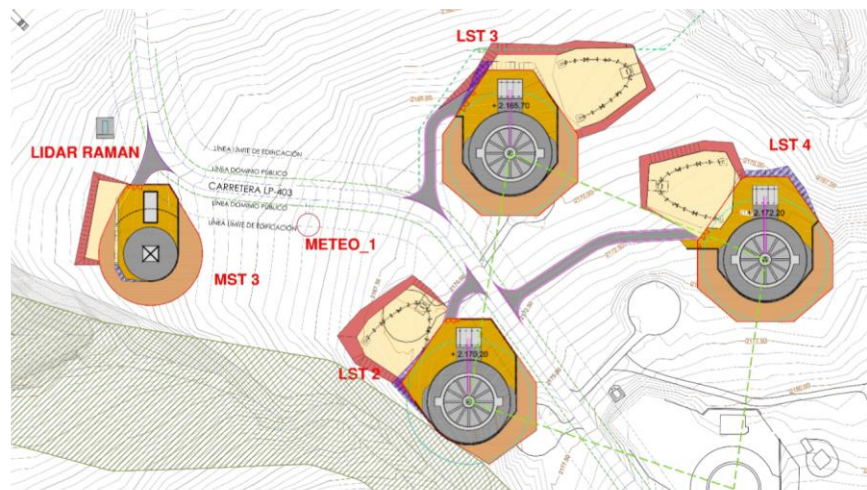
- Duties for new people
 - ▶ Daily Checks, Burst Advocates
 - ▶ Software Maintenance and Development
 - ▶ Hardware Projects

- Duties for experienced people
 - ▶ Deputies for several coordinators
 - ▶ Schedulers
 - ▶ Shift leaders

2024

PBS	Level 1	Max number of Duties	Number of covered Duties	Number of Vacant duties
1	Boards	123	117	6
2	Operation	102	61	41
3	Maintenance Hardware	58	30	28
4	Maintenance Software	66	39	25
5	R&D	0	0	0
6	LST2-4 construction	0	0	0
7	LST South	0	0	0
	Summary	349	247	100

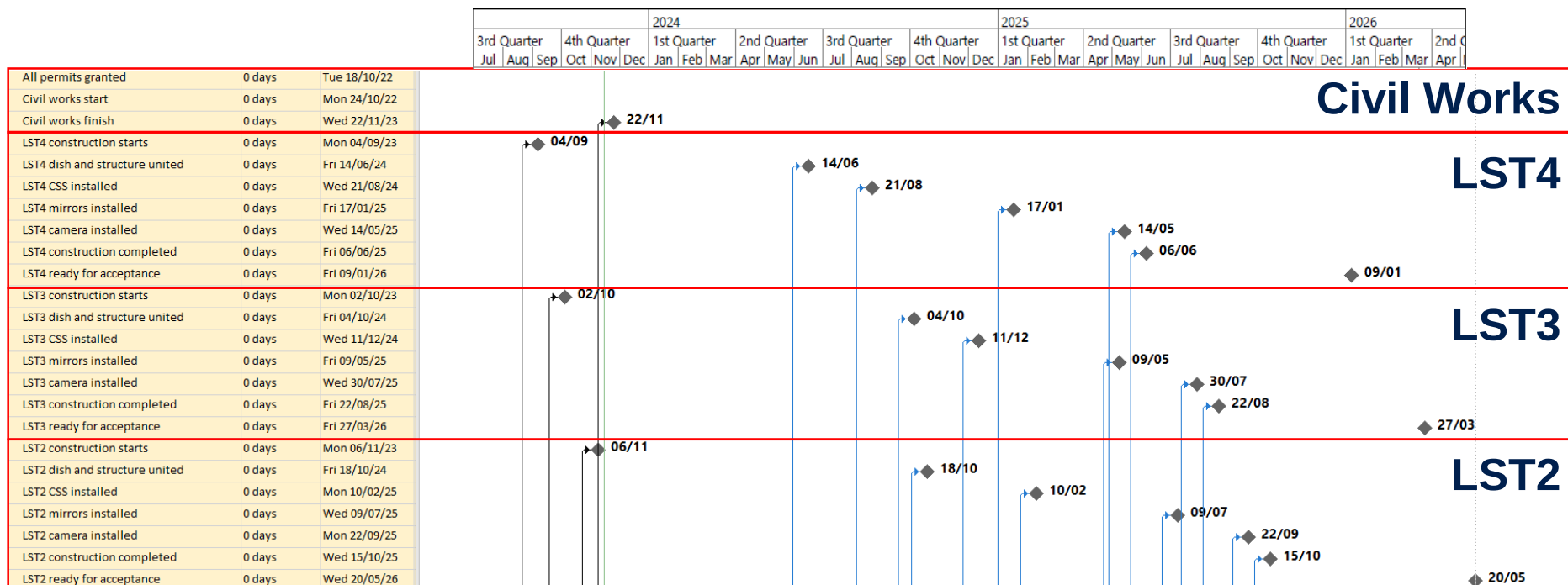
Status of CTA North Site



- 2018: LST1 inaugurated
- 2019: LST1 first light, commissioning
- 2020: Permit process for LST2-4 started, delayed in local administration
- 2021: Project re-submitted but volcano starts to impact everything in La Palma
- 2022: Permit issued, deployment power lines and civil works start
- 2023: Start of installation of LST2-4

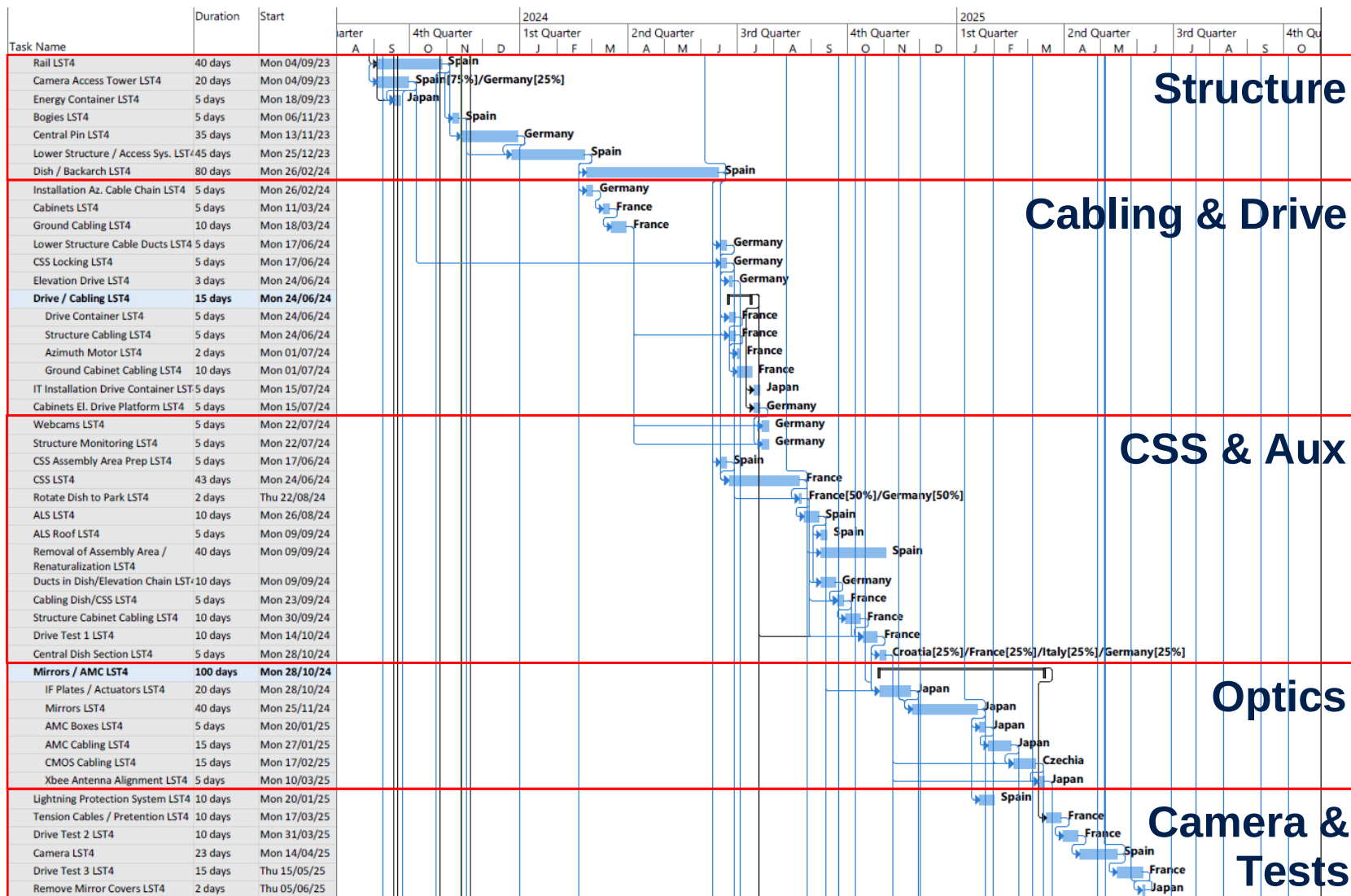


Schedule LST 2-4

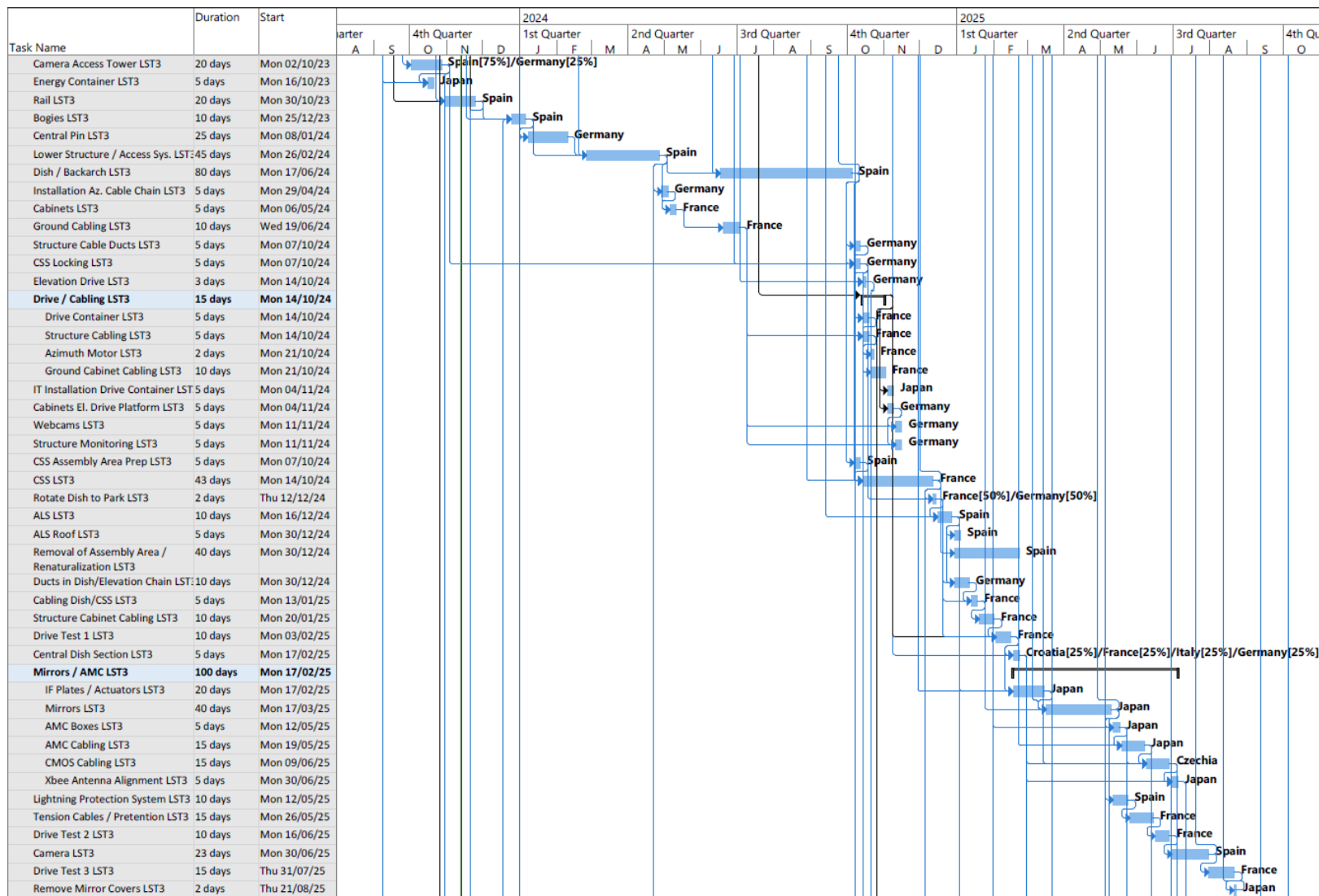


- Changed order: LST4, LST3, LST2
- Civil works started in December 2022, should finish end of January 2024 (delays due to missing work force)
- Some more delays in rail, central pin installation
- End of installation in 2025

LST4 Installation Schedule



LST3 Installation Schedule











Foundation

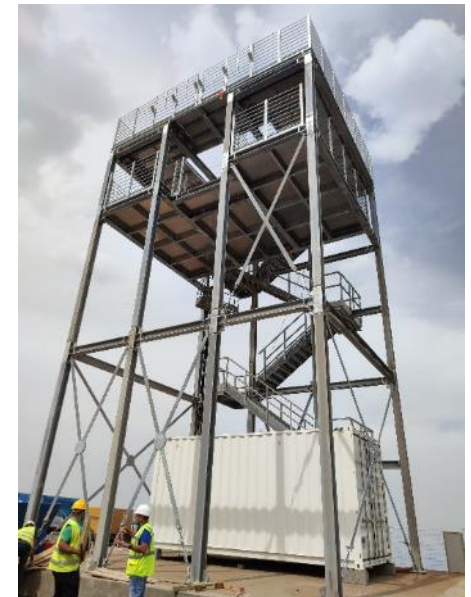


Foundation



- All 3 finished

Camera Tower



- All 3 finished

Energy Storage Container



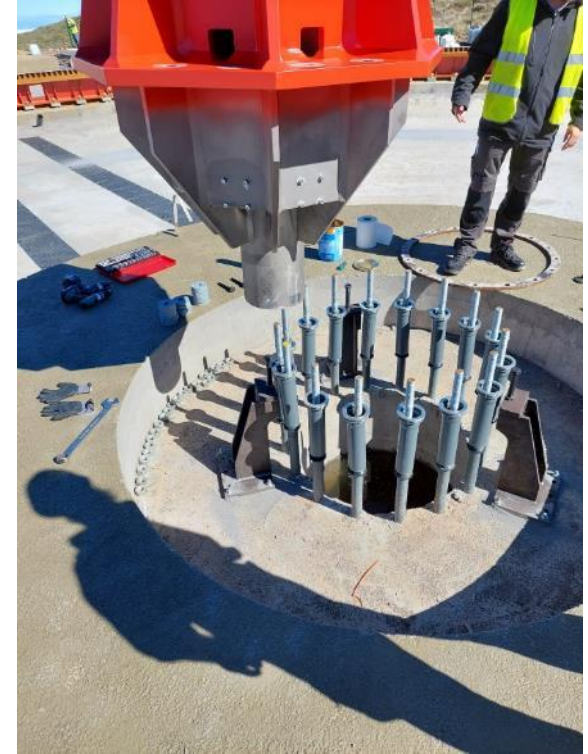
- All 3 UCs moved from LST1 site before top platform of camera tower was installed
- Electrically connected and running, monitored from remote
- Maintenance in coming months during construction through subcontractors





- Height of concrete under rail too high, company tried to flatten it as much as possible
- Flatness of rail in LST4 and LST3 fine adjusted, latest measurements still pending

Central Pin



- All Central Pins installed, some issues with rail height solved
- Next steps: armoring, mortar, apply pretension, final fixation
- No further issues expected

Bogies



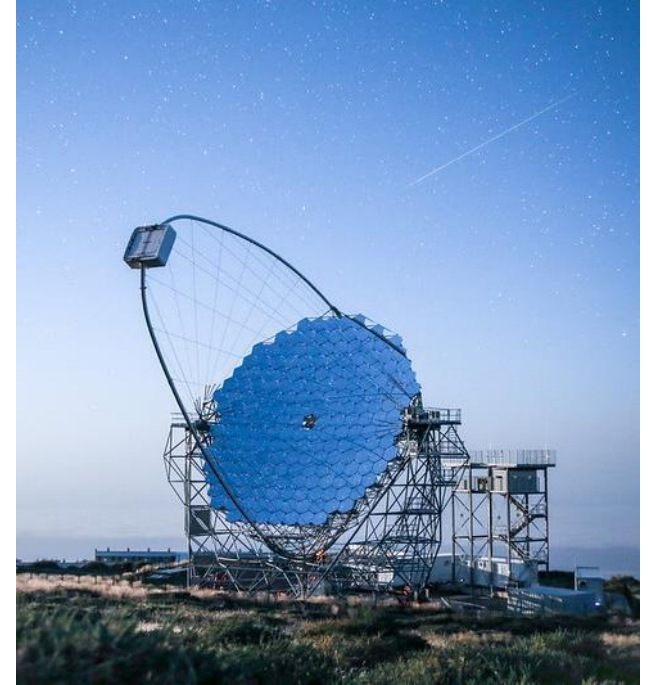
- Some rust found on rack, was removed and greased to allow fine adjustment of rack and pinion

Lower Structure



- Height of rail was barely ok to install central pin, just enough length in threaded bars to apply pretension after installation
- Next steps: armoring, mortar, apply pretension, final fixation
- No issues with LST3, LST2 expected, cage installed slightly higher

Lower Structure



coming soon...

- LST4 structure ongoing, LST3 and LST2 can start right after

- LST2-4
 - ▶ Production of most parts finished, ready for installation
 - ▶ Cameras passing QC and verification in Tenerife
 - ▶ Civil works almost finished, good progress in installation
- Road to CTA North
 - ▶ LST2–4 construction phase includes first MST, atmospheric monitoring
 - ▶ Prepare for acceptance review by CTAO in 2024
 - ▶ Operations Building permits soon
 - ▶ Training of CTAO Staff
- LSTs in the South becoming reality
- Performance, Technical, and Physics papers on the way

