LST-1 Commissioning

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(with material by Daniel Mazin)

1st VHEGAM Meeting
2024-01-15

Remarks

- I will focus on LST-1, of course :)
- I will focus on the recent advance in LST-1 commissioning and open points
  - for the first commissioning years, I will mention the main milestones
  - I will try to highlight possible tasks that require the involvement of new people, if not too technical
- I will also mix in details about operations

Commissioning

- In a few words, commissioning is needed to check that the telescope works as expected
  - in the LST-1 specific case, we have also requirements from CTA that we need to fulfill since they need to accept the telescope

- Initial phase of the commissioning needed a high involvement of experts on site, dedicated to their corresponding subsystem

- This was followed by a phase where the experts involvement onsite reduced gradually, and data taking with the help of shifters (operators) increased

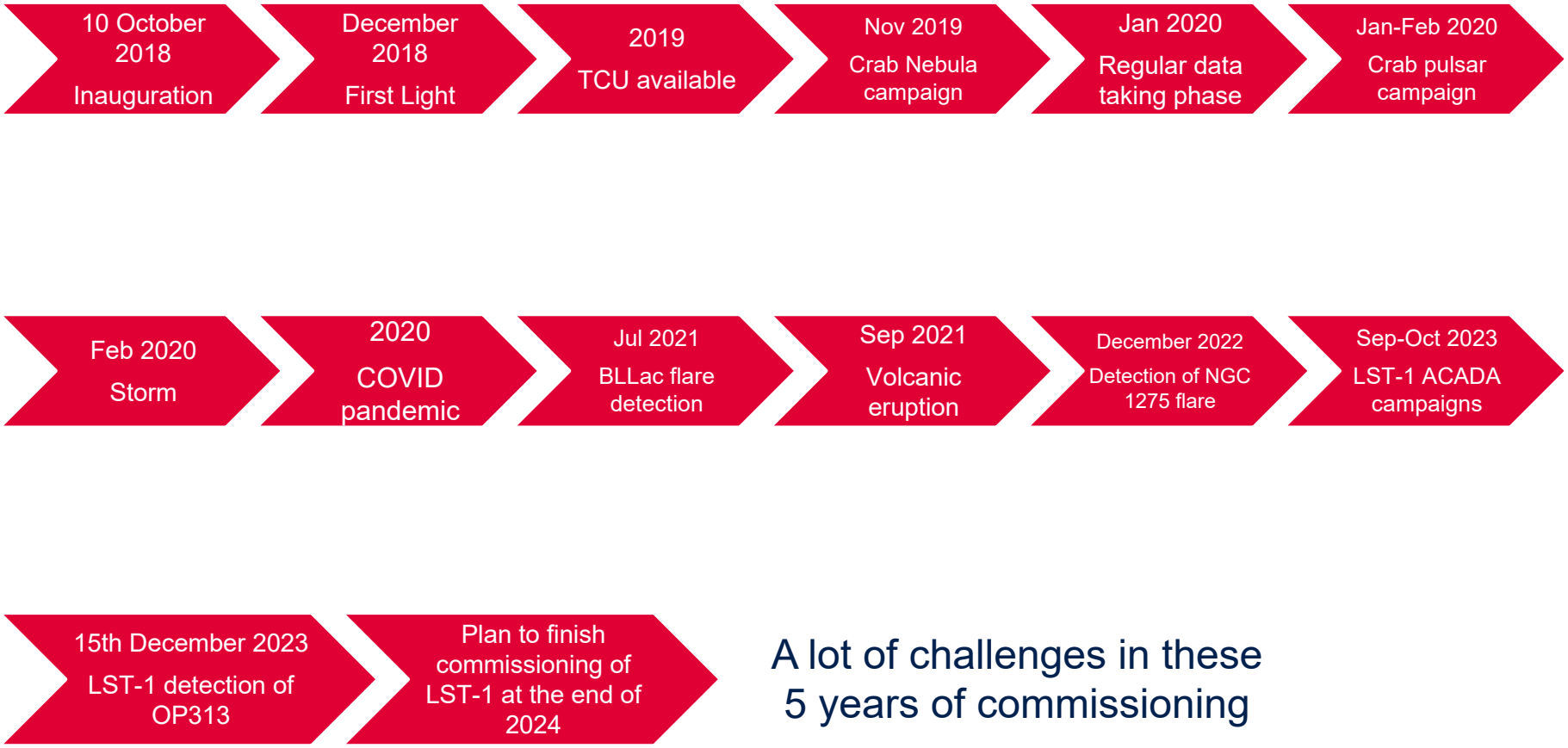
- Finally, in the last phase the data taking is regular (i.e. monthly data taking shifts are organized) and experts are on call during the night
  - we are in this phase
  - involvement of experts during the night should decrease with time as issues are understood and solved

Commissioning

- The commissioning also helps to find critical points and may trigger a redesign of some components in order to e.g. increase safety, or to meet a requirement
  - it provides “lessons learned” which are then also applied to the other LSTs

- It is also connected to the maintenance of the telescope: through commissioning one can e.g. fine tune the maintenance plan for a given component/subsystem

Timeline (not complete)



A lot of challenges in these 5 years of commissioning

Missing items to end the commissioning

- We have several open items, with different levels of priority, which we must close to end the commissioning. Discussed at the last LST Meeting in November 2023
- A board was created (Technical Coordination Board, TCB) to follow the progress on such items, and help/ping experts if needed for their finalization
  - Alice Donini (chair), Daniel Mazin, Alessio Berti
- Different types of items
  - software
  - hardware
  - maintenance
  - safety
  - compliance with CTA requirements to have the telescope accepted
- List started in August 2023, 10 items were already closed, 10 show good progress.
- In total ~90 items. Seems a lot, but the effort required is different, and some items are connected between each other

Missing items to end the commissioning

Items with signif cant progress or closed

cherenkov telescope array

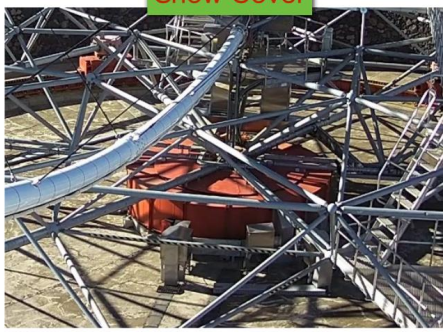
- LST1 Foundation Repair ✓
- Weather Station ✓
- Emergency Parking System ✓
- Event Builder Version 6 ✓
- Calibration Box Trigger Signal and Crashes of Calibration Box Software ?
- Snow Cover around the Central Pin ✓

Repair of foundation is in progress

Weather Station

Emergency Parking

Snow Cover



LST-1 Commissioning status

- Good progress in the last months, but slow

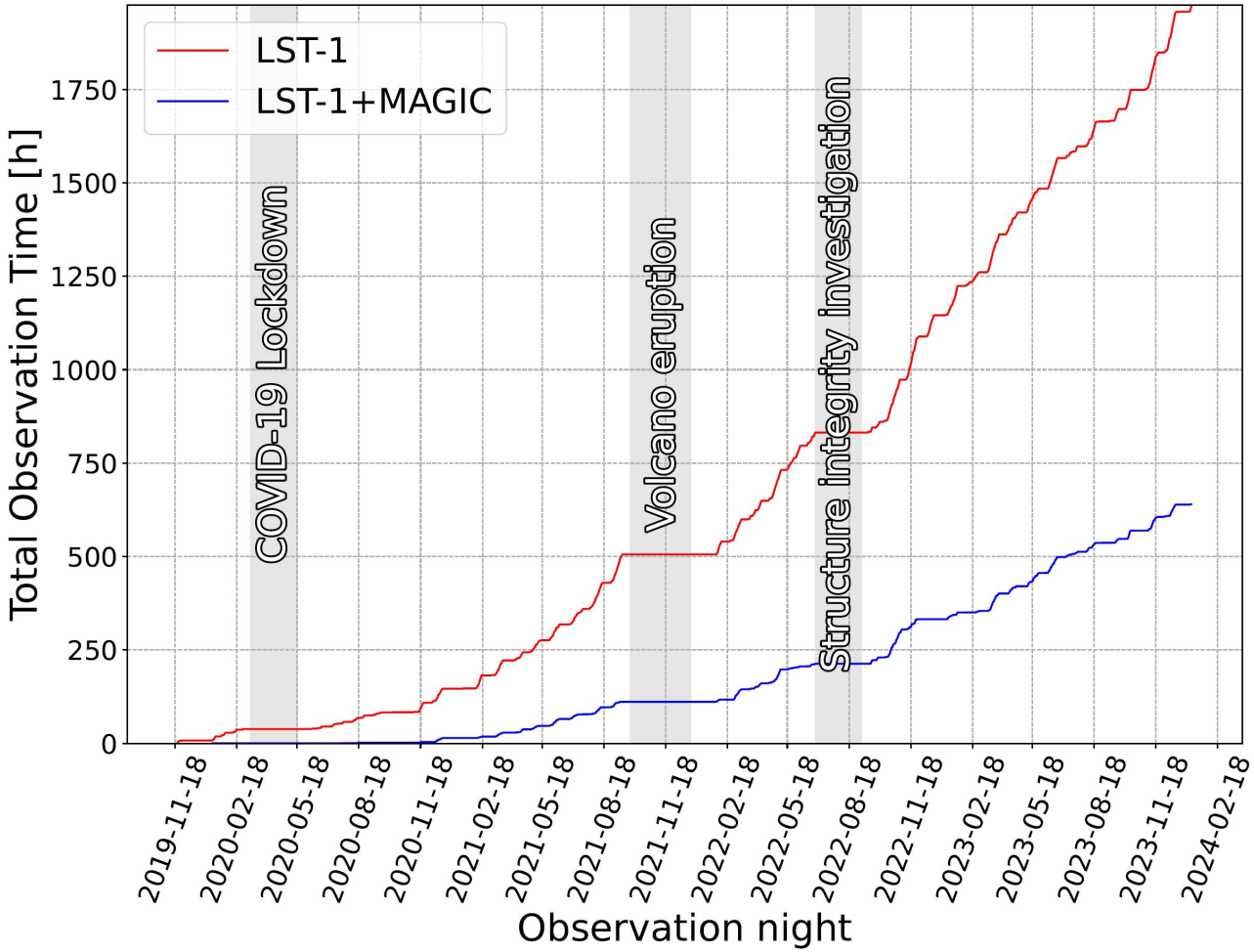
- The progress is slow because:
  - there are several unfinished items
  - the team is small
  - partially, the same team is involved in both operation of LST-1 and in construction of LST2-4
  - experts who have constraints in traveling to La Palma
  - availability of different teams to be onsite for the same task (e.g. fast movement which require both drive and mechanics team)

- Despite this, a huge effort by experts and shifters to improve the stability of operations and at the same time progress with the commissioning
  - tests are prioritized wrt data taking if related to commissioning
  - feedback by shifters extremely important to spot issues and report to experts
  - on the other side, many experts are available during the night to solve problems on the fly

Data taking

- Three major periods with no operations
- Almost 2000h of data taken with LST-1 (alone or with MAGIC)
- Around 650h joint with MAGIC i.e. 1/3 of the time we observe with MAGIC
- Around 240h in Cycle I

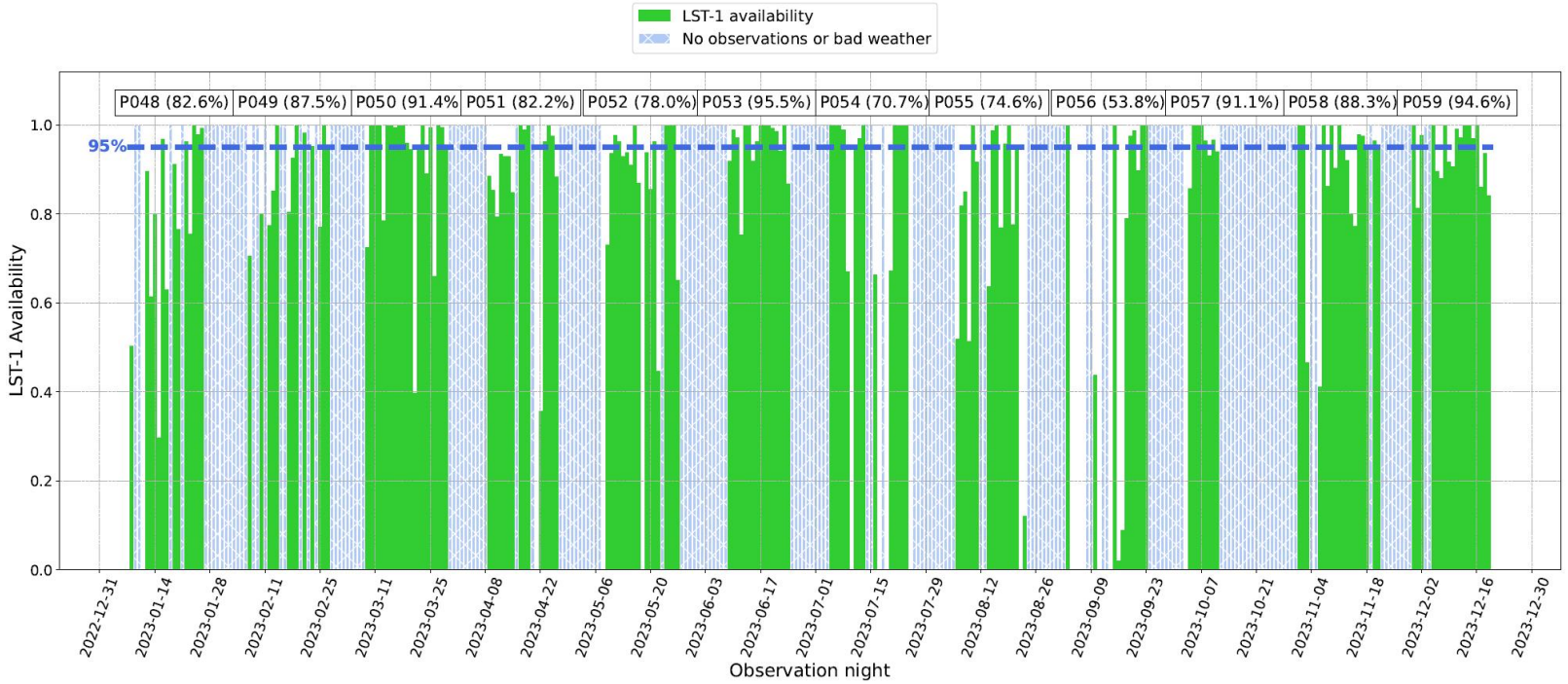
NB: taken != usable, no quality cuts applied



Telescope availability

- The aim here is to have at least 95% availability
  - troubles at the end of summer (e.g. power cuts in P056)
  - it reflects the stability of the subsystems and telescope control

- For 2023 on average 82.5%
  - still work to do on stability of operations
  - last months of 2023 look promising



Commissioning “schedule”/coordination

- Regular data taking shift, plus experts coming for tests, maintenance, commissioning, LST2-4 etc. + companies

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Period	Week	Date	Daniel	Patricia	Alice	Antonio	Shifters		Drive	Camera	Optics	Aux	Control	Other		Remarks
273			27. Sep 2023														Julien)
274		39	28. Sep 2023														
275			29. Sep 2023														ACADA integration tests Control/Monitoring test (LST1-ACADA Release 1a)
276			30. Sep 2023														
277			1. Oct 2023														
278			2. Oct 2023														
279			3. Oct 2023														
280			4. Oct 2023														
281		40	5. Oct 2023														
282			6. Oct 2023														
283			7. Oct 2023					P057									
284			8. Oct 2023					Ryuji Takeishi (SL; ICRR)			CaliBox intervention (Mau, Fabio)						
285	P057		9. Oct 2023														
286			10. Oct 2023					Yukiho Kobayashi (DSL; ICRR)									
287			11. Oct 2023														
288		41	12. Oct 2023					Victor Moya (Op; UCM-GAE)									
289			13. Oct 2023														ACADA integration tests End to End test (LST1-ACADA Release 1b)
290			14. Oct 2023														
291			15. Oct 2023														
292			16. Oct 2023													PMT Afterpulse measurements (Tokonatsu, Mitsunari, Takuto, Ryuji, Yukiho)	
293			17. Oct 2023														
294			18. Oct 2023														
295		42	19. Oct 2023														
296			20. Oct 2023														
297			21. Oct 2023							Emergency parking system installation (LAPP team)							
298			22. Oct 2023														
299			23. Oct 2023												LST2-4 Rail Installation Visit		
300			24. Oct 2023														
301			25. Oct 2023														
302		43	26. Oct 2023														
303			27. Oct 2023														
304			28. Oct 2023														

LST-1 Commissioning and duties

- Coordinating the commissioning is not easy
  - many tasks, involving both operations and maintenance
  - it can also involve external companies

- Day to day activities (day or night) coordinated by Telescope Managers, Operation Coordinators, Schedulers
  - external companies for works or maintenance
  - institute teams onsite for commissioning, or again maintenance

- Experts should focus on finishing commissioning
  - some task they currently have can be covered by non-experts (of course after a proper introduction supervised by the experts, if needed)

- For this reason, duties will be introduced (see also Martin's slides)
  - list under discussion, detailed definition of each duty ongoing

People power issue

	significantly contributing	involved in some aspects	consultants (e.g. SE)
Camera	7	15	5
Optics	2	7	5
Auxiliary	2	5	3
Central Control Software	3	3	3
IT	1	4	2
	Total=O(10)		

discrepancy

LST statistics			
	Members	Scientists + Students	Authors
Bulgaria	2	2	2
Brazil	3	2	2
Spain	90	56	56
France	42	21	25
Croatia	10	10	9
Czechia	16	16	10
Germany	47	40	38
Switzerland	15	12	11
Italy	109	92	68
Japan	82	78	63
Poland	3	3	4
Total	419	332	288

- ~300 authors, but the number people coordinating and contributing in commissioning of different aspects of the telescope is low

Examples of duties which can help for commissioning

- Daily checks
  - check data quality and spot issues in data, report them to the experts
- Software maintenance
  - different subsystems
- IT
  - Sys admin help for ICRR for onsite IT
  - IT network maintenance
  - IT in Commissioning Container
- Structure monitoring
- Call for a new scheduler will be out soon (I wanted to do it before but could not)
  - Needless to say, the schedulers are vital to schedule data taking, but also nightly tests requested by experts
- Possibly, also a call for deputy operations coordinator

Shifts and commissioning

- Shifters operate LST-1 in 21 days shifts (3/4 people per shift)
  - they take scientific data that can be used in publications (technical or scientific)
  - they help debugging the telescope operation
  - ultimately, they help in the commissioning

- From this year, going to shift will grant a duty (2024 shift call is already complete)

- Discussion to start about “day shifters”, which can help in day tests/maintenance and at the same time gaining experience in operations

Period	Start date (evening)	Stop date (morning)	Dark time	SL	DSL	Op
P060	2024-01-08 (Mon)	2024-01-22	101.00h	1	1	2
P061	2024-01-29 (Mon)	2024-02-19	139.23h	1	1	2
P062	2024-02-27 (Tue)	2024-03-19	129.32h	1	1	2
P063	2024-03-28 (Thu)	2024-04-18	116.51h	1	1	1
P064	2024-04-26 (Fri)	2024-05-17	106.97h	1	1	1
P065	2024-05-27 (Mon)	2024-06-17	103.60h	1	1	1
P066	2024-06-25 (Tue)	2024-07-16	106.86h	1	1	1
P067	2024-07-26 (Fri)	2024-08-16	118.64h	1	1	1
P068	2024-08-26 (Mon)	2024-09-16	127.85h	1	1	2
P069	2024-09-23 (Mon)	2024-10-14	144.54h	1	1	2
P070	2024-10-21 (Mon)	2024-11-11	153.81h	1	1	2
P071	2024-11-19 (Tue)	2024-12-10	158.28h	1	1	2

Summary

- If you want to be involved in commissioning-related tasks, let us know via the Technical Coordination Board (lst-tcb@cta-observatory.org)
  - we can point you to suitable tasks
  - we can put you in contact with the relevant experts

- If you are already in LST, we have weekly LST-1 commissioning meetings where we discuss the issues in operations and the progress for the different subsystems. If you are interested, join them!

- Joining the commissioning effort benefits everyone
  - improves operation stability --> smoother data taking, better data quality and coverage
  - sharing of tasks --> if more people are involved, the load on everyone decreases
    - experts focus on commissioning, coordinators coordinate
  - more people gain experience and knowledge about the telescope (the “bus factor” increases)

- The aim is to have (almost) a Swiss clock, working at the best of its possibilities

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