cherenkov telescope array

SWISS CTA Day 2020

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STATUS of the Cherenkov Telescope Array Observatory

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What is CTA ?

- CTA, the Cherenkov Telescope Array, is the next generation ground-based instrument for gamma-ray astronomy at very high energies, from some tens of Gev to about 300 Tev
- It will have up to 118 telescopes on two sites in the North and South
  - Baseline configuration: 19 in the North, 99 in the South
  - Largest existing instrument has 5 telescopes
- It is designed and built in a large international collaboration
- It will be the first open gamma-ray observatory
  - Previous and existing instruments run as experiments
- Cherenkov radiation is electromagnetic radiation emitted when a charged particle passes through a dielectric medium at a speed greater than the phase velocity of light in that medium
  - Discovered 1934 by Pavel Cherenkov (1904-1990)

The CTA Consortium (CTAC)

The CTA Observatory (CTAO)

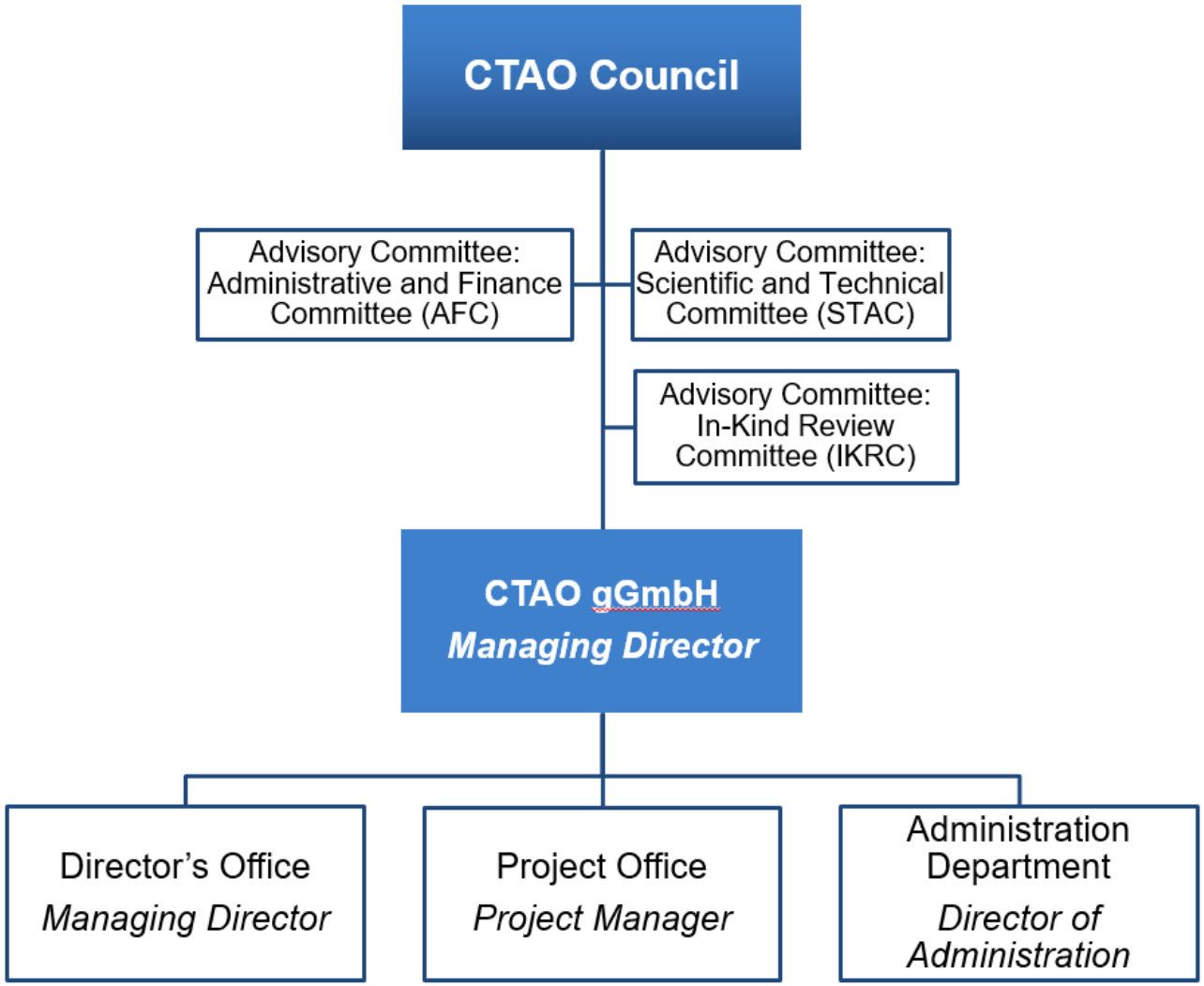
- In 2014, the CTA Observatory gGmbH was founded as interim legal entity, under German law
  - To prepare the CTA implementation (select and prepare two array sites + Science Data Management Centre)
- The final legal entity for full construction and then operation, a *European Research Infrastructure Consortium* (ERIC), is being set up under European Union law
- During 2017 the CTA Project Office moved to Bologna (Italy)
- The *Science Data Management Centre* (SDMC) hosted by DESY in Zeuthen (Germany)

CTA sites: arrays, headquarter, data center

CTAO GmbH membership status

Country	Shareholder	Associate Member	MoU signature	Observer
Australia	X		X	
Austria	X			
Brazil/Sao Paolo State				X
Czech Republic	X		X	
ESO	X			
France	X			
Germany	X		X	
Italy	X		X	
Japan	X		X	
Poland			X	X
Slovenia	X			
South Africa		X		
Spain	X		X	
Switzerland	X		X	
The Netherlands		X		
United Kingdom of Great Britain and Northern Ireland	X			
Kingdom of Thailand			X	X
NSF/United States of America				X

CTAO Governance



CTAO gGmbH Membership

- 12 Shareholders
- 6 Associates/Observers

CTAO ERIC

First Step Application
29 March 2019

Final Application
March 2021

CTAO

Australia, Austria, Brazil, Czech Republic, ESO, France, Germany, Italy, Japan, Netherlands, Poland, Slovenia, South Africa, Spain, Switzerland, United Kingdom, Thailand, USA

CTAC

Armenia, Australia, Austria, Brazil, Bulgaria, Canada, Chile, Croatia, Czech Republic, Finland, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, Namibia, Netherlands, Norway, Poland, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Ucraine, UK, USA

Status from the managerial point of view

Hosting Agreements signed for all sites

Structure of the Organisation in place

Cost Book of the project – in the Construction Configuration – approved by Council

Project Management Plan: released

Construction can start only after CTAO-ERIC in place, as from AoA

But Pathfinder strategy: LIDAR, FRAM, 5 MST on CTA-N

ERIC process lead by Board of Governmental Representatives (BGR)

- Statutes
- Construction Cost (BGR/Council WG)
- Rules and Regulation (Transition Working Group)
- Operation costs sharing

Cost Book – Review Results and Funding

- Approved Cost Book shows construction cost for threshold configuration:

Telescope design	Northern Site	Southern Site
Large-Sized Telescope	4	
Medium-sized Telescope	5	15
Small-sized Telescope		50
Total	**9**	**65**

- Total cost of threshold configuration is 365 M€
  - Not including VAT, contingency, inflation
  - Not including research, prototyping and design activities prior to the reference date (except LST-1 and CTA-N infrastructure)
- Overall foreseen IKC contributions: 64%
- Overall needed cash contribution: 36%
- 88% of the overall cost is in four (out of 11) cost area

BGR: commitments 280M€

Distribution of Threshold Costs

88% of total cost

Cost Area	% of total	Foreseen as IKC	Remark
Telescopes	48.8%	98.6%	
CTA-S Infra & On-Site	18.2%	0.0%	For 65 telescopes
Computing	16.2%	61.0%	
CTA-N Infra & On-Site	4.7%	53.2%	For 9 telescopes
Array Common Elements	2.7%	70.1%	
Science & SciOps Prep	2.5%	37.8%	
Administration	2.1%	0.0%	
Site/Infra Design	1.6%	40.0%	
Systems Engineering & Integration	1.2%	0.0%	
Director’s Office	1.0%	0.0%	
Project Management	0.9%	0.0%	

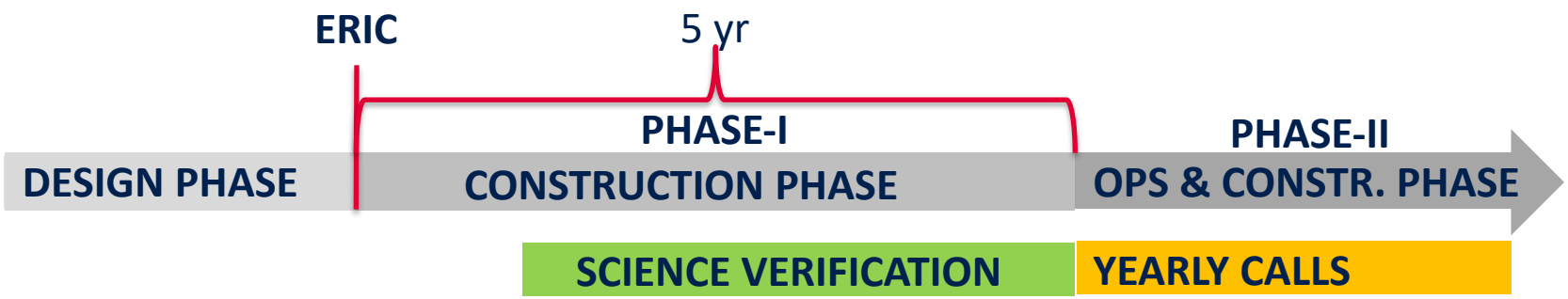
CTA Construction Staffing

- CTA construction needs ~320 FTE/yr for five years (Cost Book)
  - IKC staff ~202 FTE/yr (for all IKCs)
  - CTAO staff ~117 FTE/yr (for observatory design & construction tasks)
- To prepare and carry out CTA construction, CTAO needs more staff
  - Either directly hired (needs budget) or seconded from institutes
- Given the expertise and expert staff in CTAC institutes and the limited CTAO funding, secondments will be welcome. Idea:
  - CTAO specifies needs and announces it widely
  - Seconded staff remains employed and paid by home institution
  - Seconded staff would be part of the CTAO organization with a defined position
  - Co-location for certain functions needed, no co-location for others
  - Recognition as IKC with the aim to “pay” in observing time (TBD by ERIC)

Some good news …

- Although ERIC does not yet exist, some pre-funding for CTA construction activities will become available in 2021
  - Will allow to build the CTA-S access road to the site
- Technical and project work moving ahead
  - LST, MST, SST, CTA-N infra, ...
  - System engineering, ACADA, CTA-S infra, …
  - Important reviews passed and upcoming (LST, NectarCAM, …)

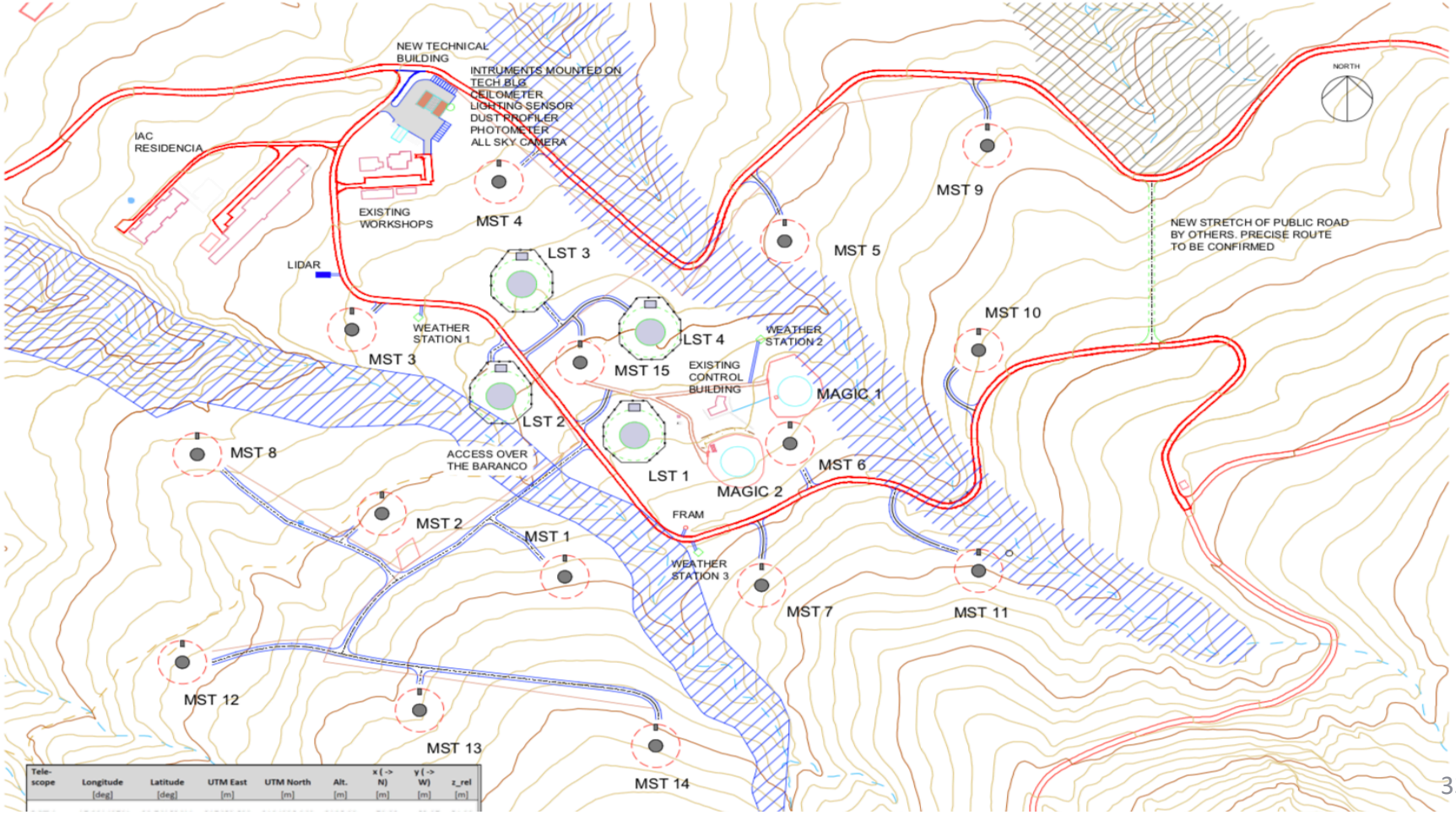
Project Status



- **Phase-I: construction of the threshold configuration**
  - **a significant performance improvement wrt the currently running facilities**
    - high-impact science covering most of the science cases
    - a significant increase of the discovery space
- **Phase-II: regular operations of the threshold configuration + construction towards the final full-scope one**

CTA-North site

- **4 LSTs + 15 MSTs (full-scope configuration)**
  - **Focus on sub-TeV and TeV energy range**



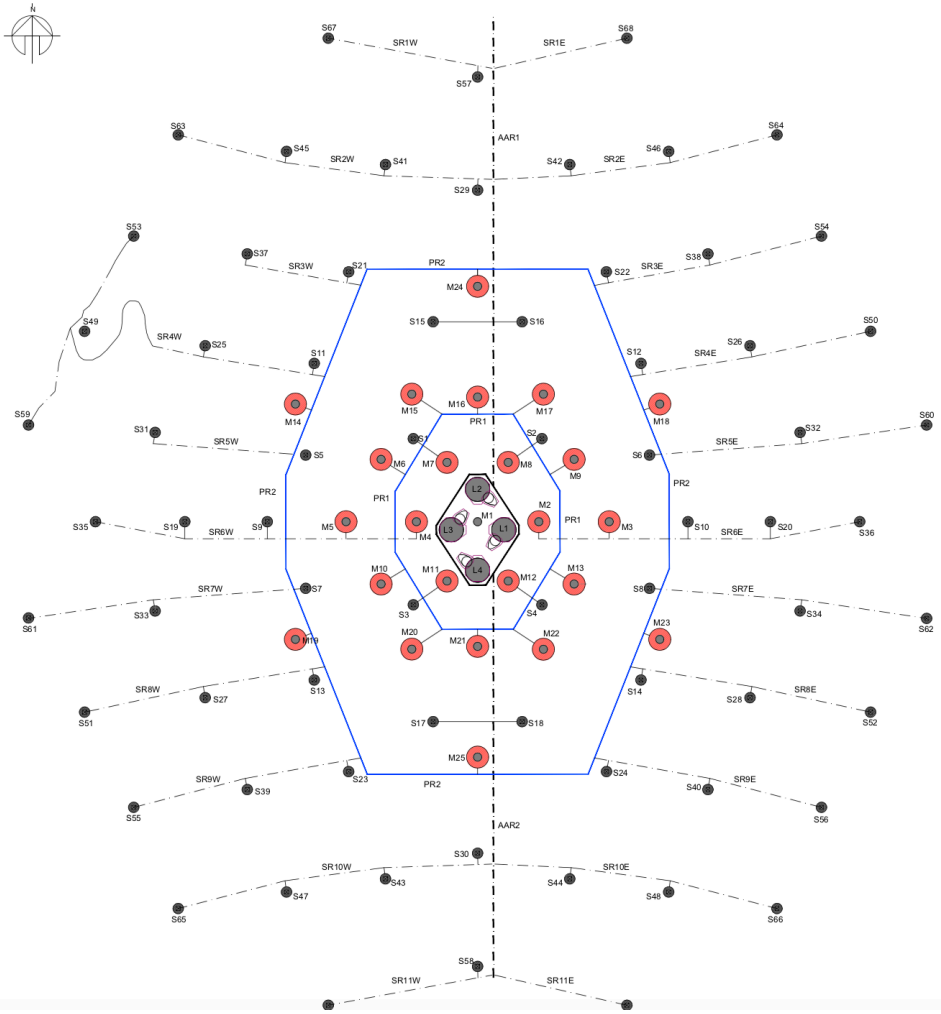
Tele-scope	Longitude [deg]	Latitude [deg]	UTM East [m]	UTM North [m]	Alt. [m]	x (-> N) [m]	y (-> W) [m]	z_rel [m]

CTA-North Status

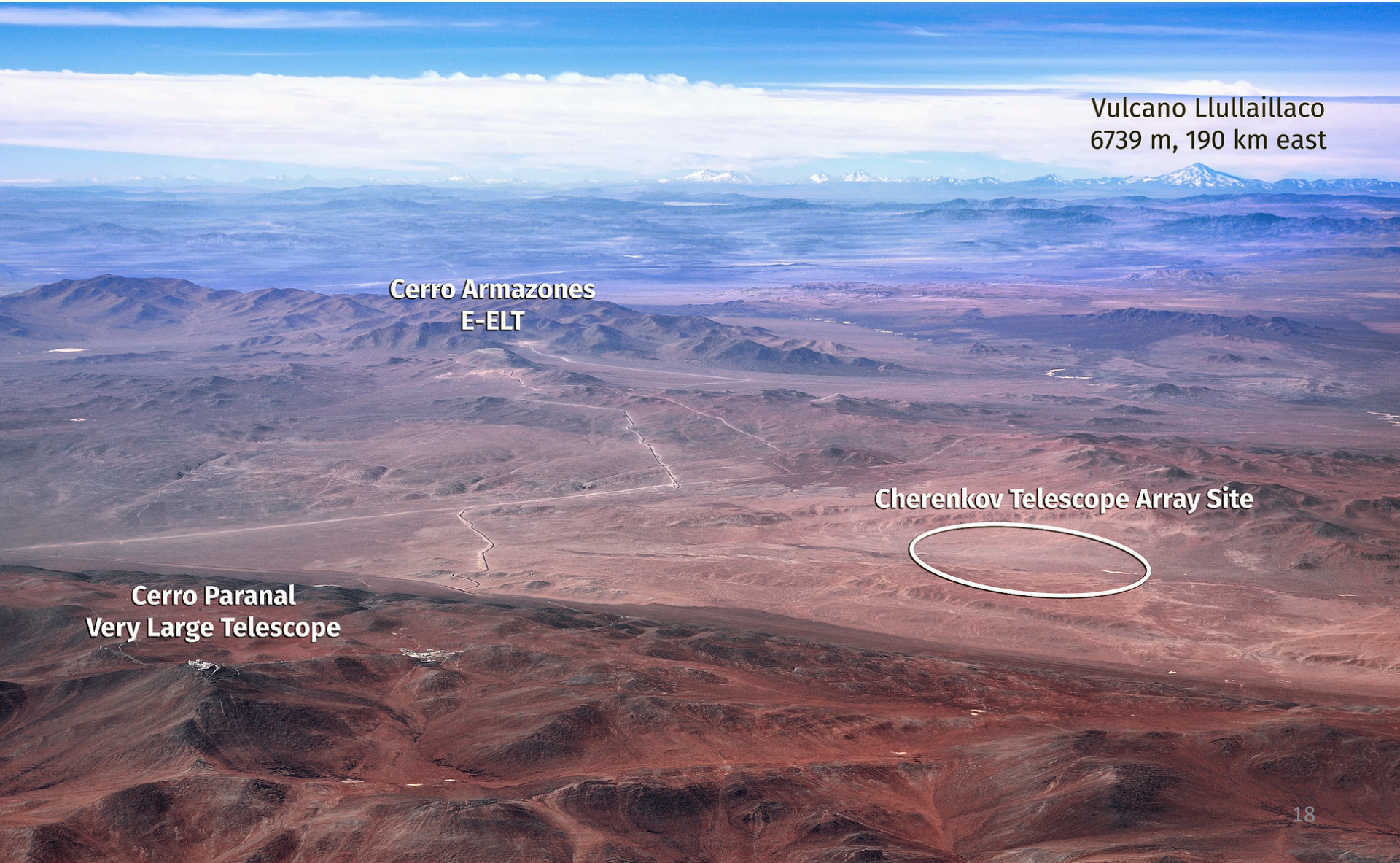
- LST-1 being commissioned by LST consortium
- Infrastructure construction (phase 1) initiated
  - Three more LST foundations, one MST foundation
  - Roads, data and power network
  - Tendered by *Instituto de Astrofisica de Canarias* (IAC) in collaboration with CTAO
  - Operation building
- CTAO building up its organization on La Palma
  - North Site Manager in place since 1 Jan 2019
  - Setting up CTAO Low Elevation Office (LEO)
- CTAO Systems Engineering very busy with detailed system design
  - Addressing all system level details
  - Up to 70% of the CTA-North definition applicable to CTA-South

CTA-South site

- **4 LSTs + 25 MSTs + 70 SSTs (full-scope configuration)**



CTA-South Site – ESO (Chile)



CTA-South Status

- Hosting agreements between Republic of Chile, ESO, CTAO and CONICYT were signed in Dec 2018
- CTA-South Site Manager appointed (starting 1 July 2019)
- Seismic investigation for the specific site underway
  - CTAO can reuse some of ESO-ELT site related data
  - CTA-South specific seismic investigation to complement available data
- CTAO wants to construct CTA-South infrastructure as soon as possible
  - Foundations, roads, power and data network
  - Depends on available funding

Science Data Management Centre (SDMC)

- In 2016, the CTAO Council, selected DESY in Berlin-Zeuthen (Germany) to host the SDMC, in 2020 signed Hosting Agreement
- The SDMC will be responsible for CTA science operations and make the science products available to the worldwide community
  - With an estimated 20 staff in a new building
  - Expect ~5 PB of data per year

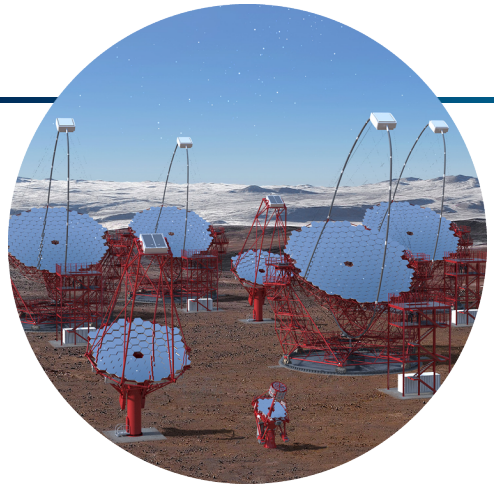
Credit: Heinle Wischer und Partner Freie Architekten GbR, Berlin, with Ulrich Krüger Landschaftsarchitekten, Dresden

Conclusions

From various points of view:

- Politics: ERIC process progressing, thanks to the support of various Nations – Switzerland is providing very valuable contribution
- Finances: Cost Book well defined, need to aligne the construction plan to available funding
- Governance/organisation: CTAO is now structured for the future
- PM & SE: advancing well – Construction on sites prepared
- Instrumentation: Telescopes Consortia in place and continuous connection with CTAO
- Computing: complex organisation, need for strong participation of Institutes
- Science: see Werner's talk

What better time to increase the participation of the Swiss scientific community to CTA?



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telescope
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Thank
You