

CTAO.

Der Beitrag von DESY zum neuen
Gammastrahlen-Detektor

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26.06.2025

HELMHOLTZ



CTAO in a nutshell

2

Standorte/ Locations

Chile und La Palma

3

Teleskoptypen/ telescope types

Large-Sized Telescopes

Medium-Sized Telescopes

Small-Sized Telescopes

60

Teleskope/ telescopes

North: 4 LSTs, 9 MSTs

South: 4 LSTs, 14 MSTs, 37 SSTs

ca. **1500**

Mitglieder/ members

Aus mehr als 150 Instituten

From 150 institutes

ca. **3500**

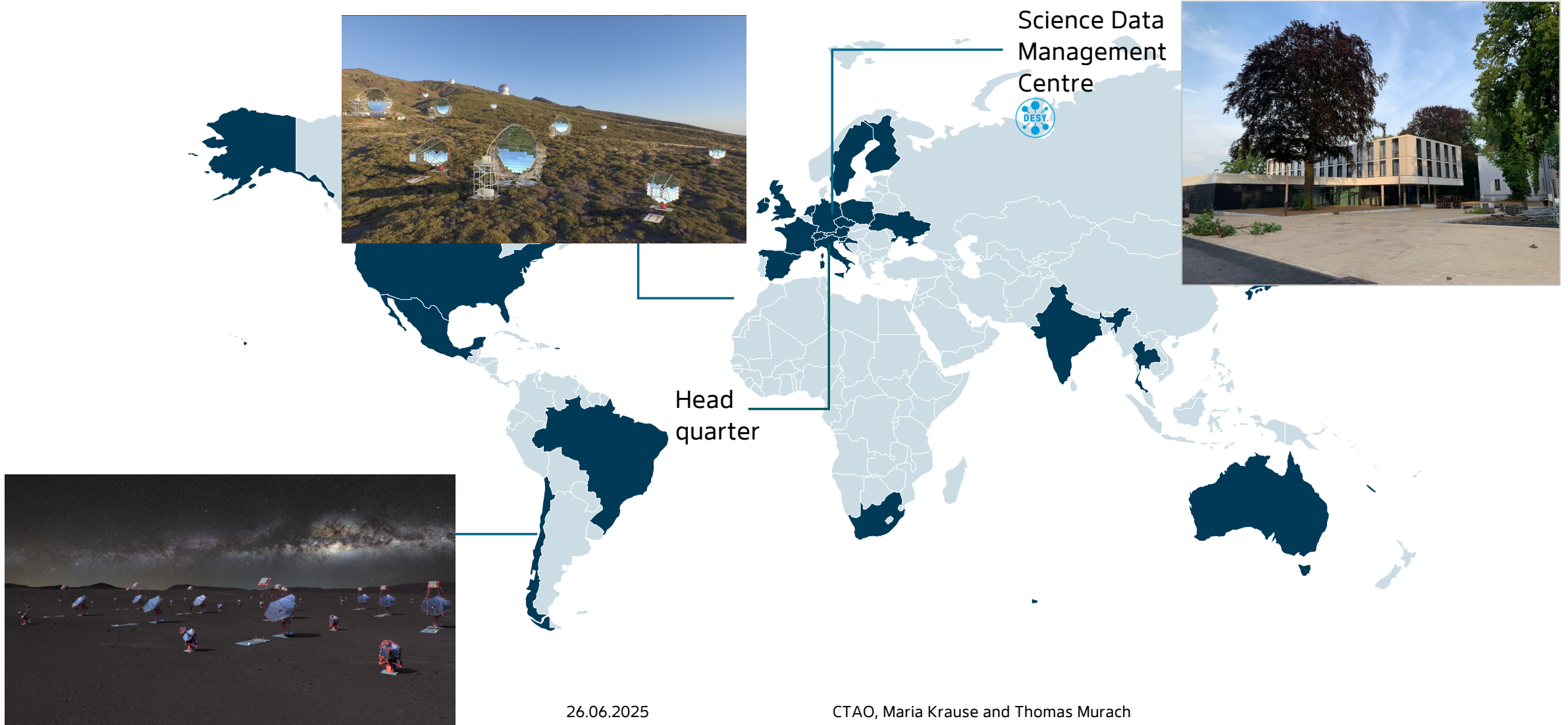
Spiegelemente/ number of mirror facets

ca. **125.000**

Ultraschnelle Kamerasensoren/ number of ultra-fast camera light sensors

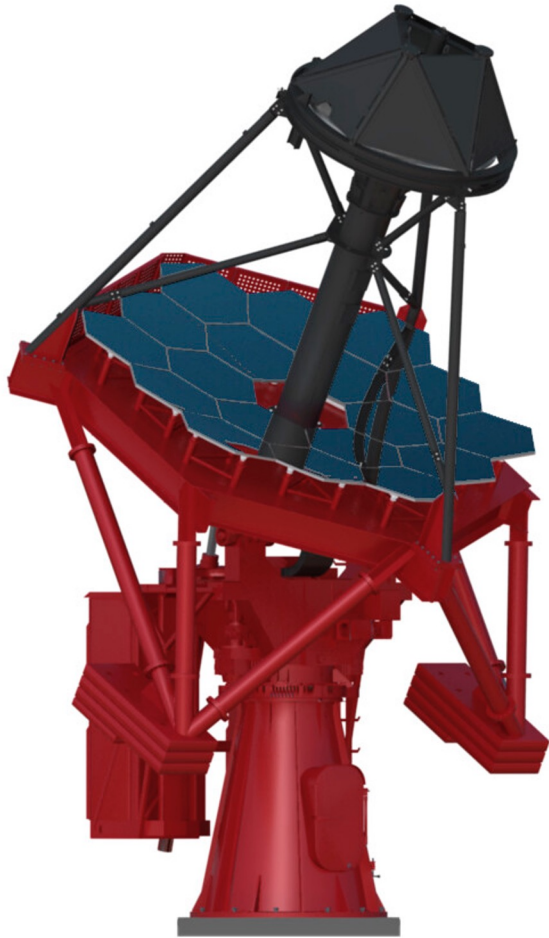
CTAO – Cherenkov Telescope Array Observatory

A European priority research infrastructure and global open observatory

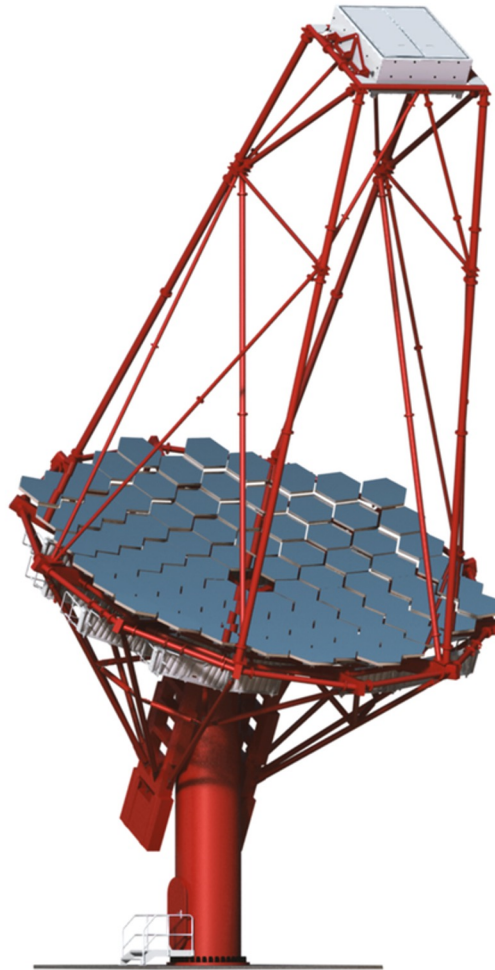


Telescope types

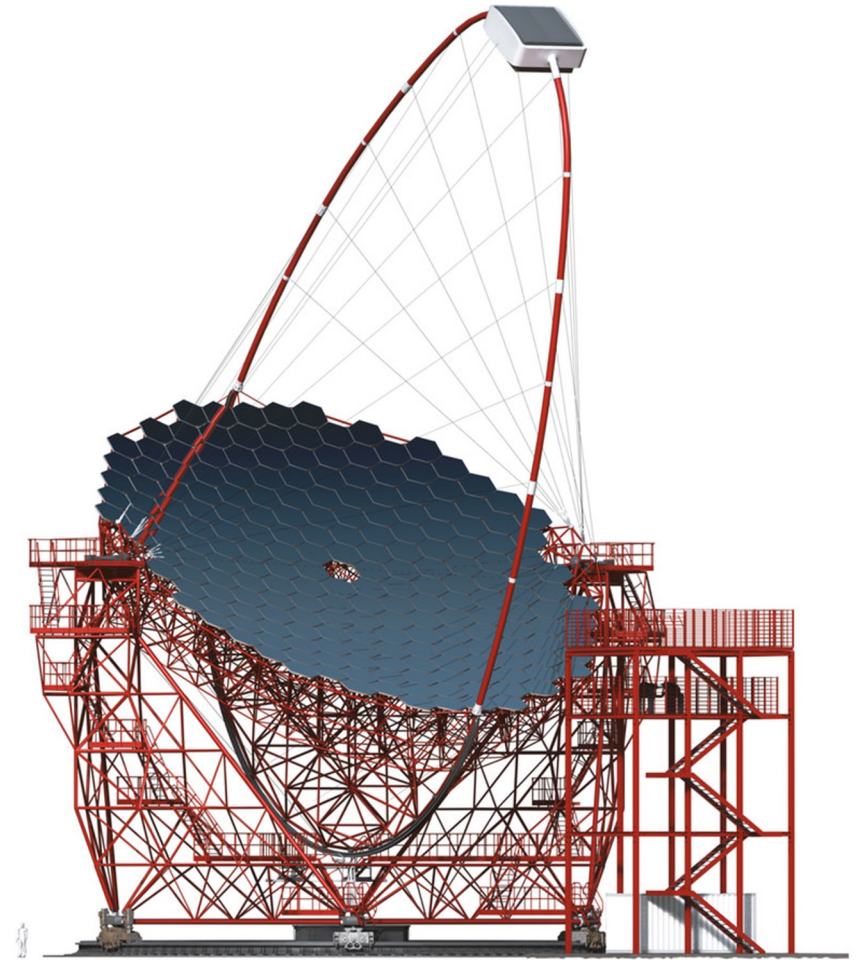
From small to middle and large



Small-Sized Telescope (SST)

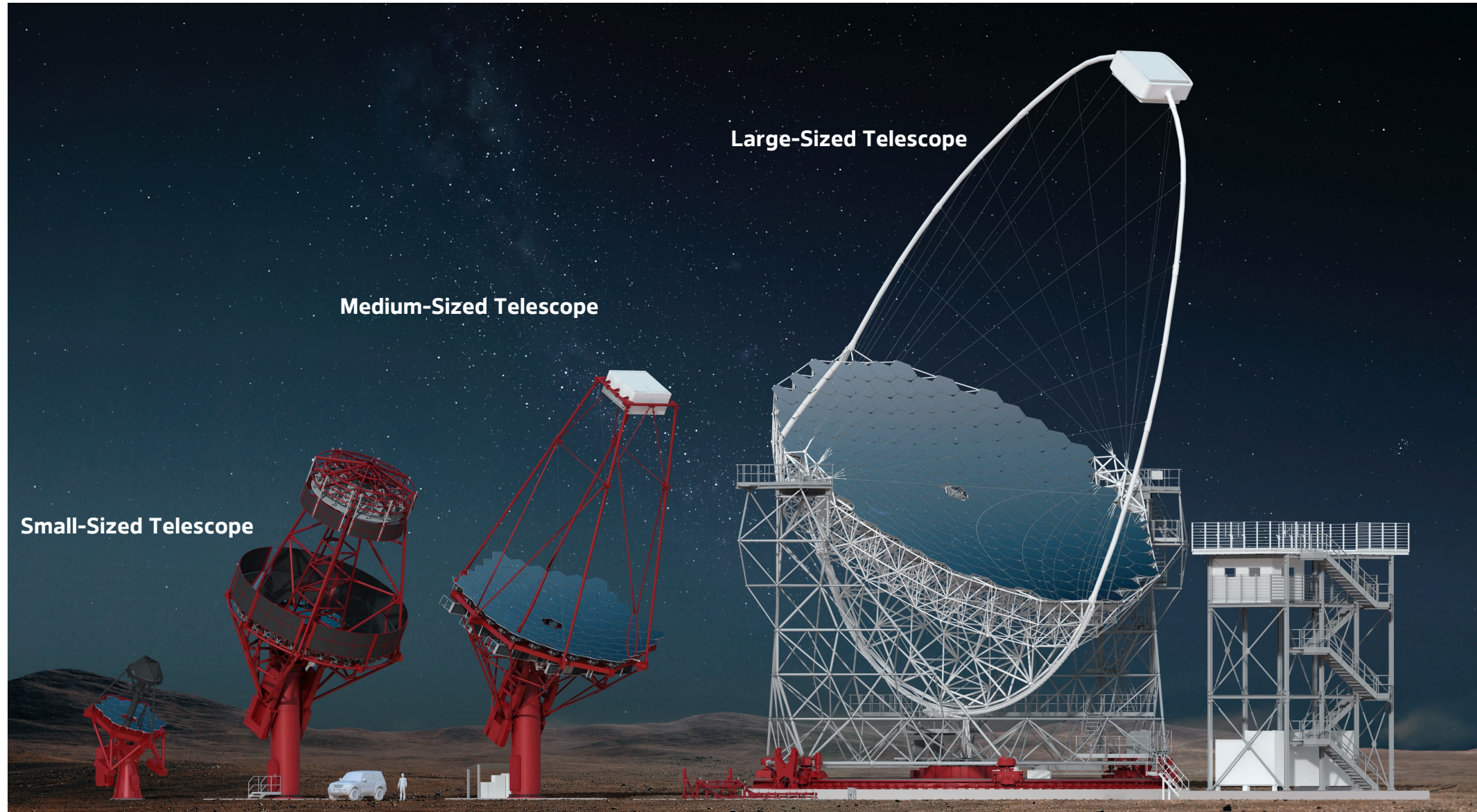


Medium-Sized Telescope (MST)

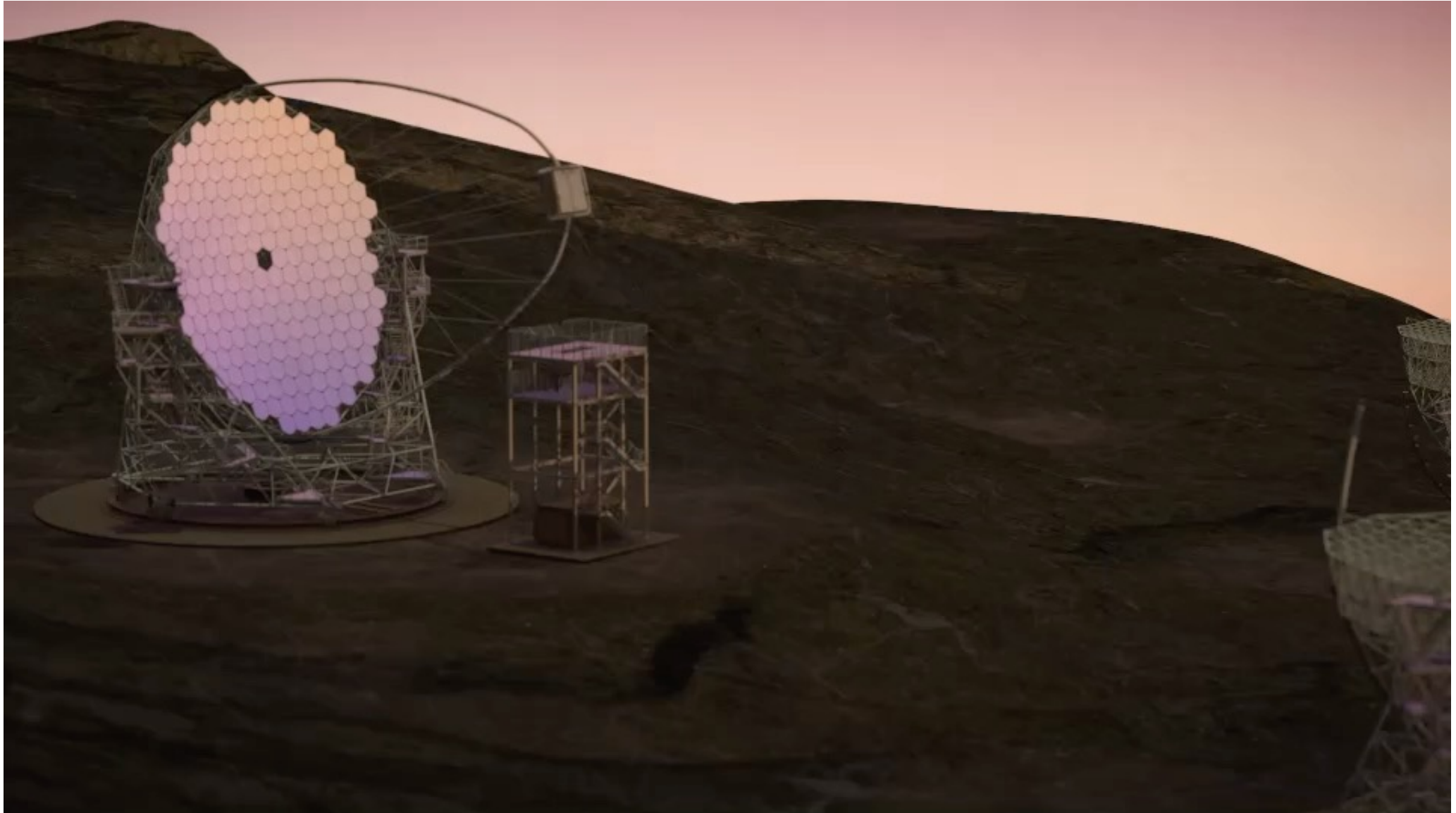


Large-Sized Telescope (LST)

Telescope types

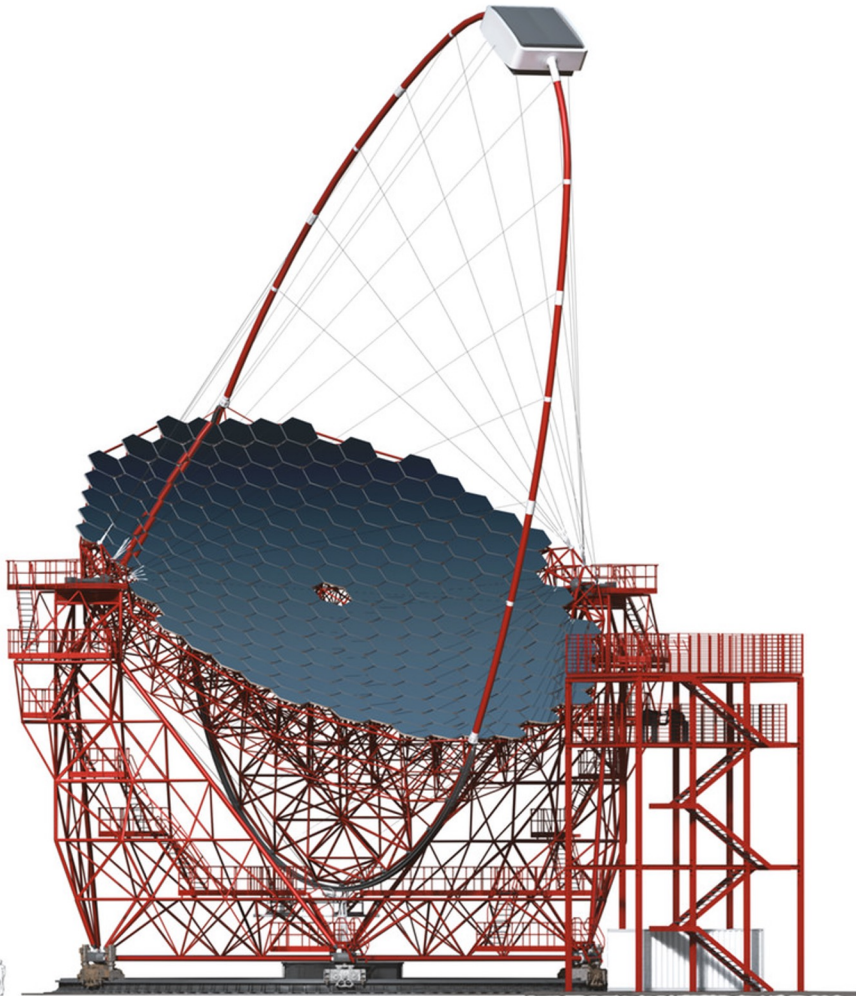


Telescope blow-up



Telescope types

Large-Sized Telescopes



20 to 150
GeV

**Gammastrahlen
produzieren wenig
Cherenkovlicht**

Gamma rays produce
little Cherenkov light

Kamera-Pixel / *Camera pixels*: Photomultiplier tubes (PMTs)

Optimiert für schnelle Neuausrichtung: 30s um sich zu einer beliebigen Stelle
am Himmel auszurichten

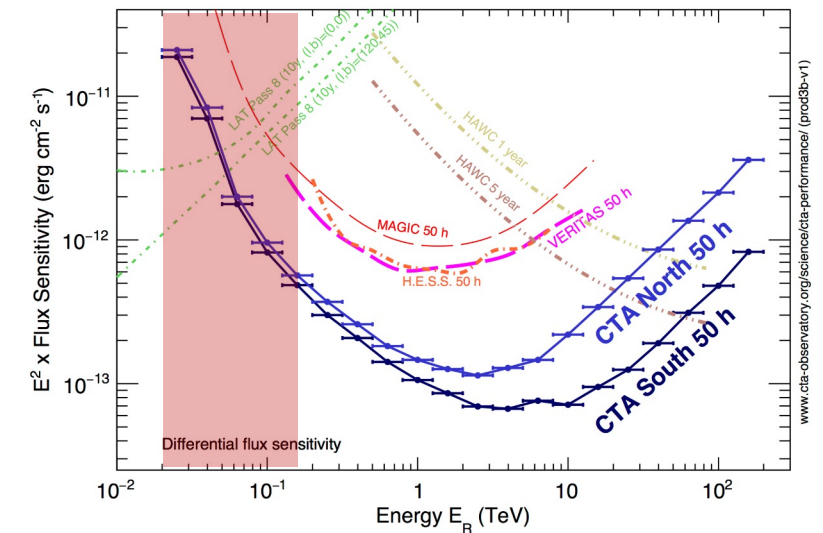
Fast repositioning speed: 30s slewing time to any point in the sky

23

Spiegeldurchmesser
Reflector diameter

100

Tonnen Gewicht
Tons of total weight



The Medium-Sized Telescope in a nutshell

Das Arbeitspferd von CTAO/ The workhorse of CTAO

12

Spiegeldurchmesser

Reflector diameter

25

Teleskope/ telescopes

14 im Süden (South)

9 im Norden (North)

Baseline: 25/15 (South/North)

86

Spiegelemente

Mirror facets

88

Quadratmeter Reflektorebene

Square metres reflector surface

7.7

Grad an Gesichtsfeld der Kameras

Degrees of field of view of the cameras

2

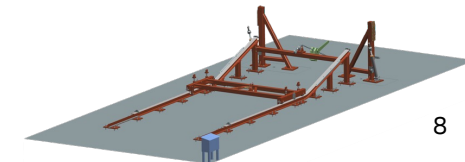
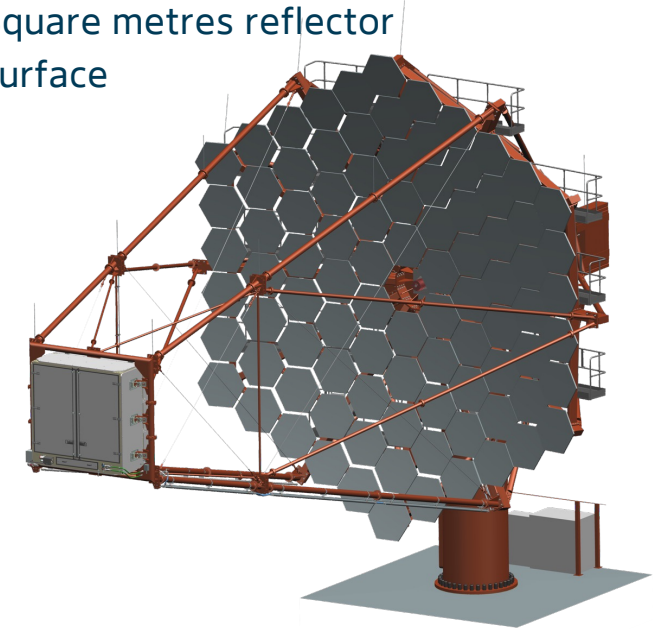
Kameratypen

Types of cameras
(FlashCam, NectarCAM)

89

Tonnen Gewicht

Tons of total weight



The Medium-Sized Telescope in a nutshell

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**Grad an Gesichtsfeld der
Kameras**

Degrees of field of view of the
cameras

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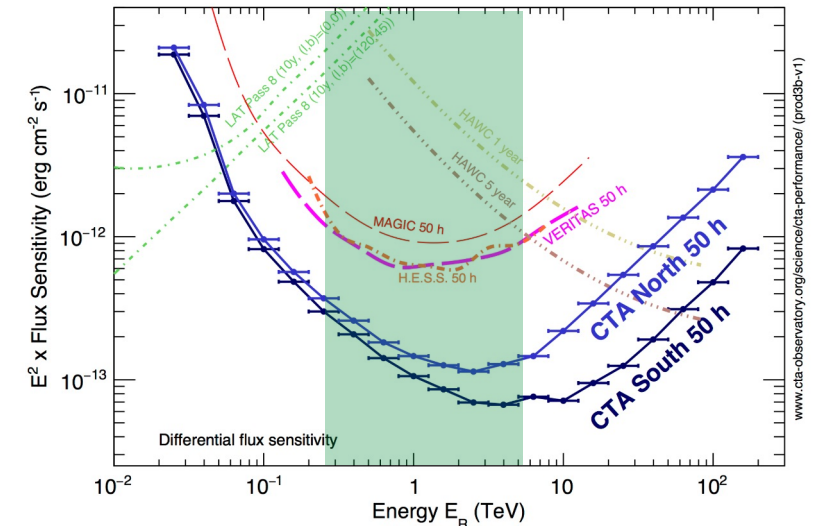
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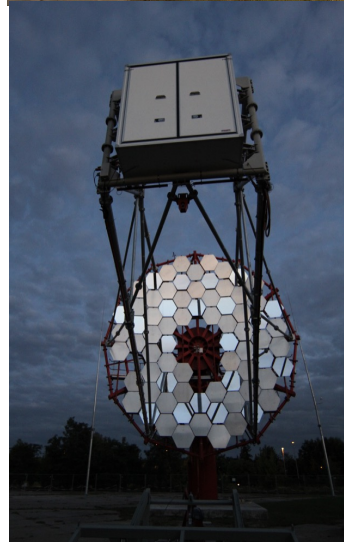
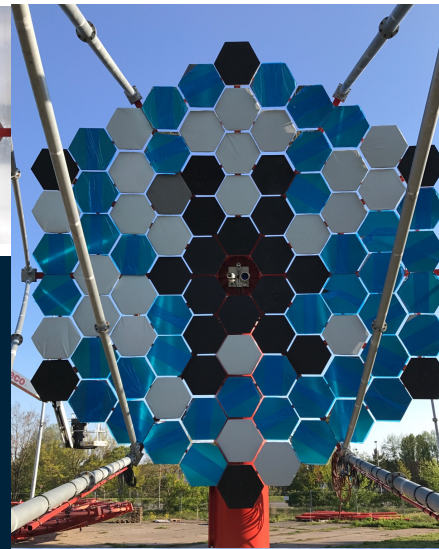
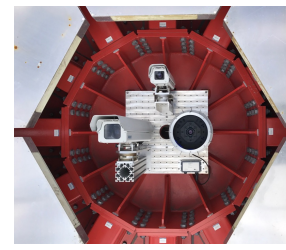
Tons of total weight



Prototype in Adlershof

2012-2020

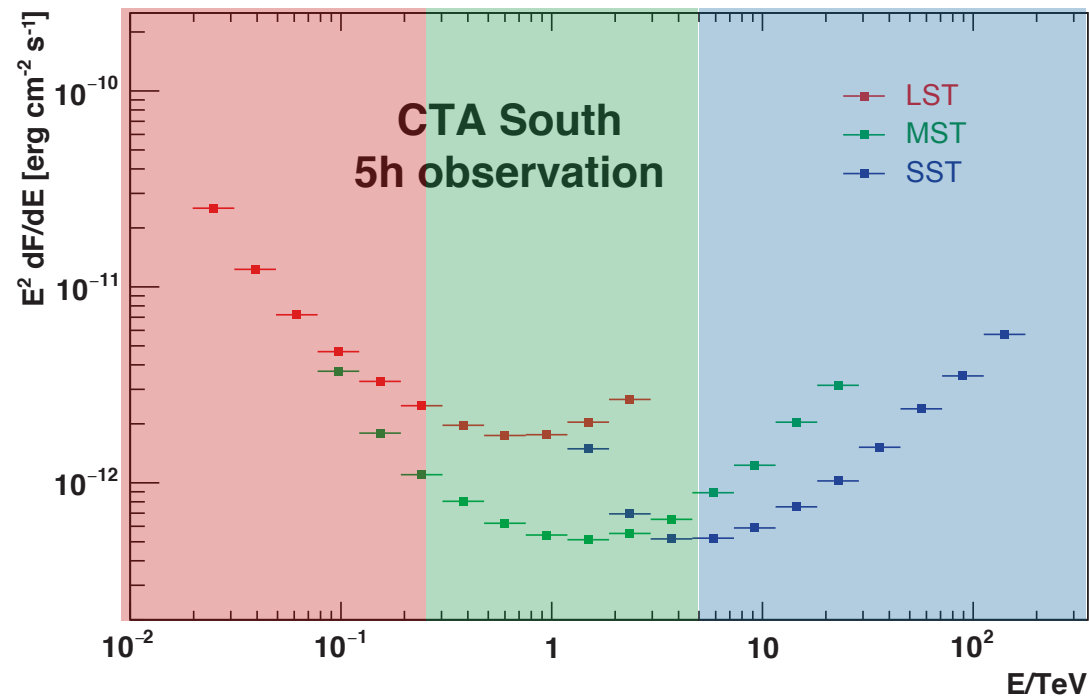
2012: Beginn des Aufbaus
2013: Teleskopeinweihung
2014: 1. Austausch der Camera Support
Struktur
2015: 1. Test mit FlashCam
2017: Austausch des Dishes
2017: 2. Test mit FlashCam
2018: 2. Austausch der Camera Support
Struktur
2019: Test mit NectarCAM
2020: Abbau des Prototypen in Adlershof



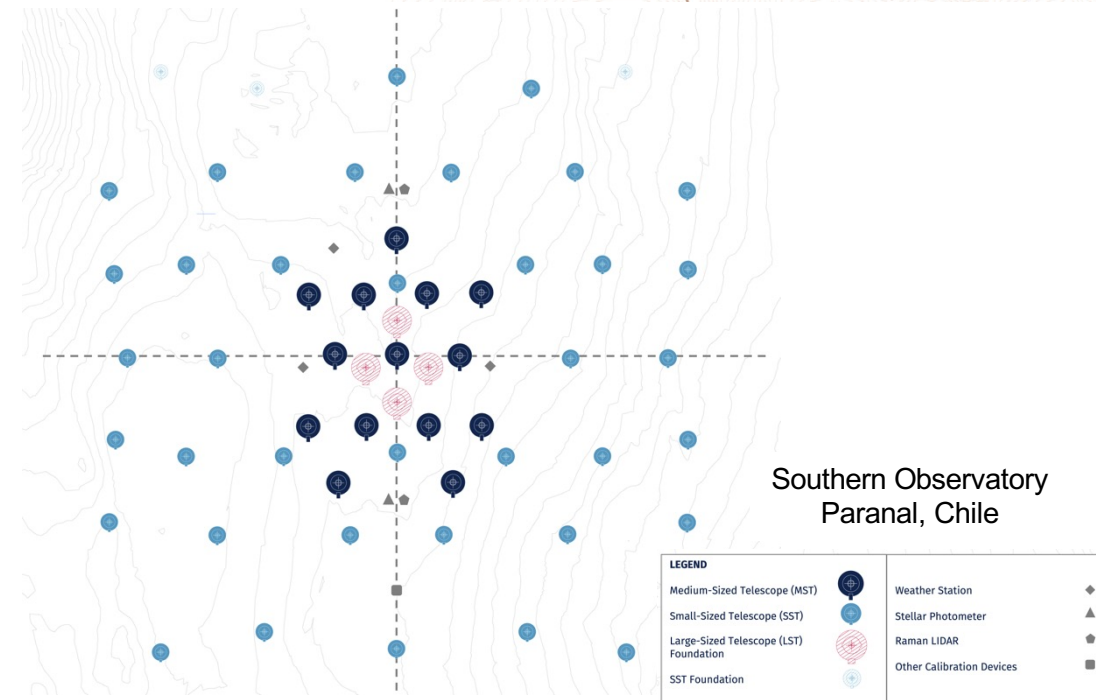
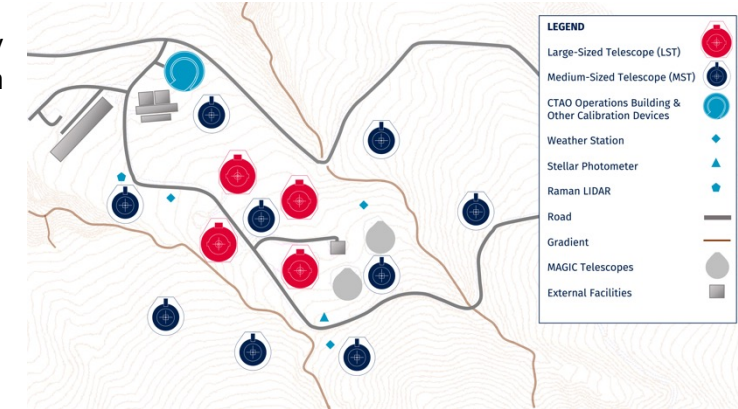
The array of Medium-Sized Telescopes

Das Arbeitspferd von CTAO/ The work horse of CTAO

Core energy range: 150 GeV – 5 TeV

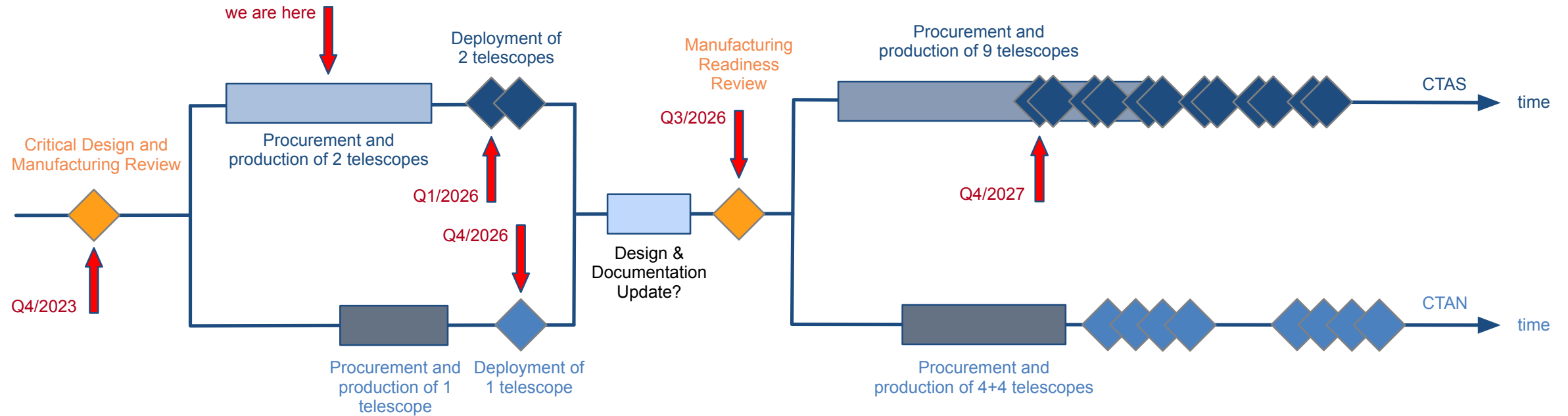


Northern Observatory
La Palma, Spain



Projektplanung

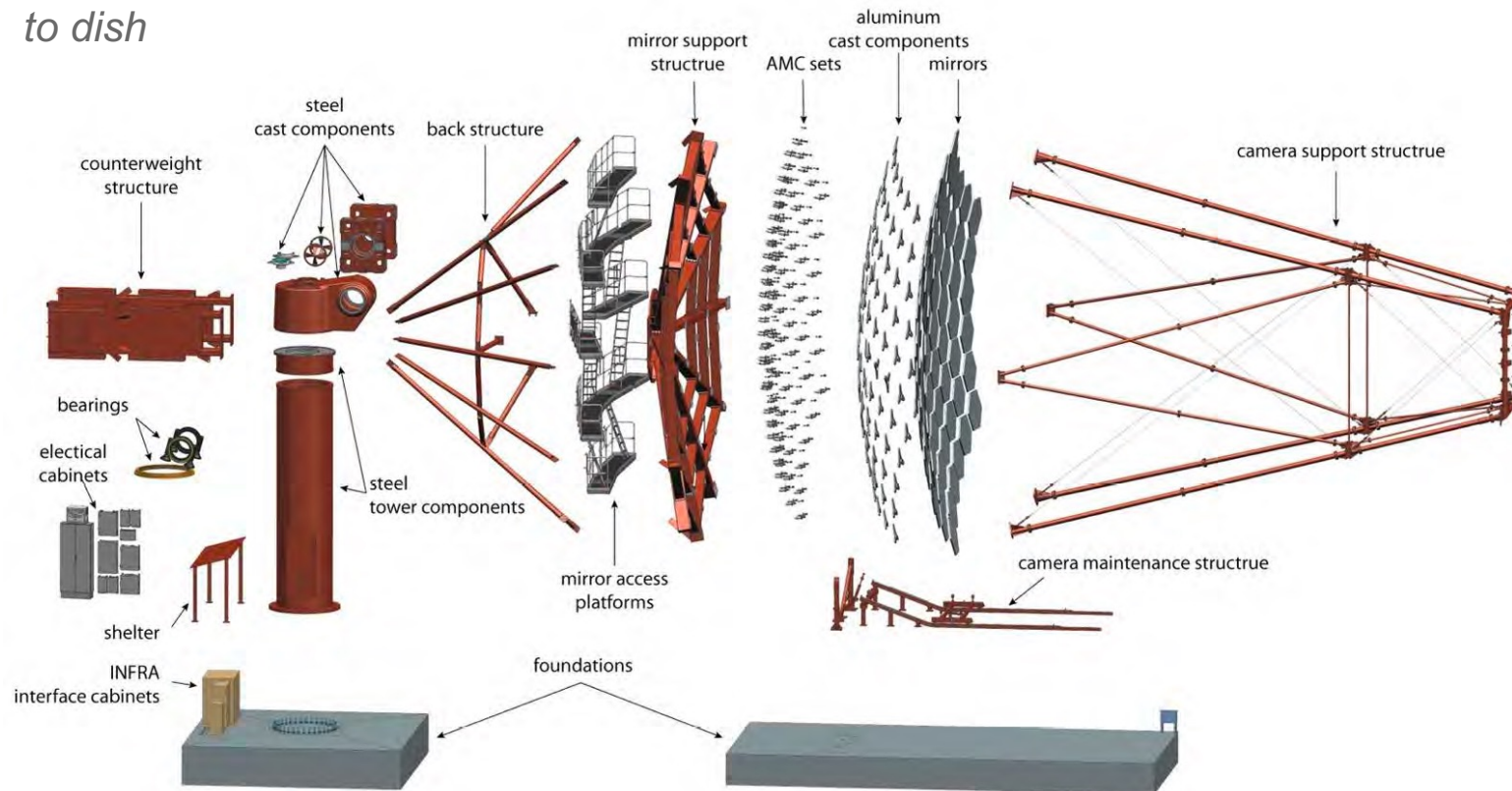
Project timeline



MST-STR current procurement scheme

Entwurf, Entwicklung und Produktion unter der Federführung von DESY; vom Kabel bis zum Spiegelträger

Design, development and production under the leadership of DESY; from cables to dish



Mechanics tenders

Cast components

→ Steel cast components

→ Aluminium cast components

Tower

Optical Support Structure

→ Dish structure

→ Counter Weight Structure

→ Backbone structure

Camera Maintenance Structure

Camera Support Structure (Brazil)

Mirror Access Platforms

Electrical tenders

Drive and safety cabinet (CB13)

Electrical cabinets

Cables

Active Mirror Control Sets (US)

Direct purchases

Mirrors (Poland/Spain/Italy)

Telescope infrastructure (CTAO/IAC)

Vom Rohmaterial zum fertigen Produkt – der Turm

From raw material to final product - Positioner



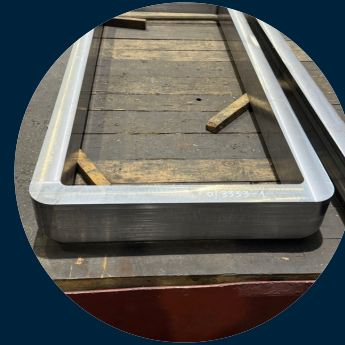
Raw material positioner



Raw material azimuth ring



Door position



Door frame



Tower welded



Tower welded with door



Complete welded tower



Tower sandblasted



Tower first coat

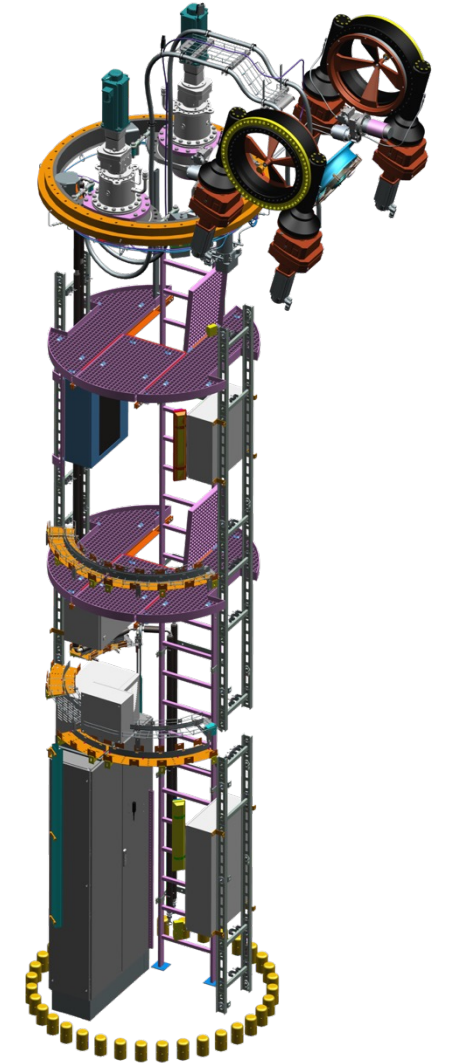
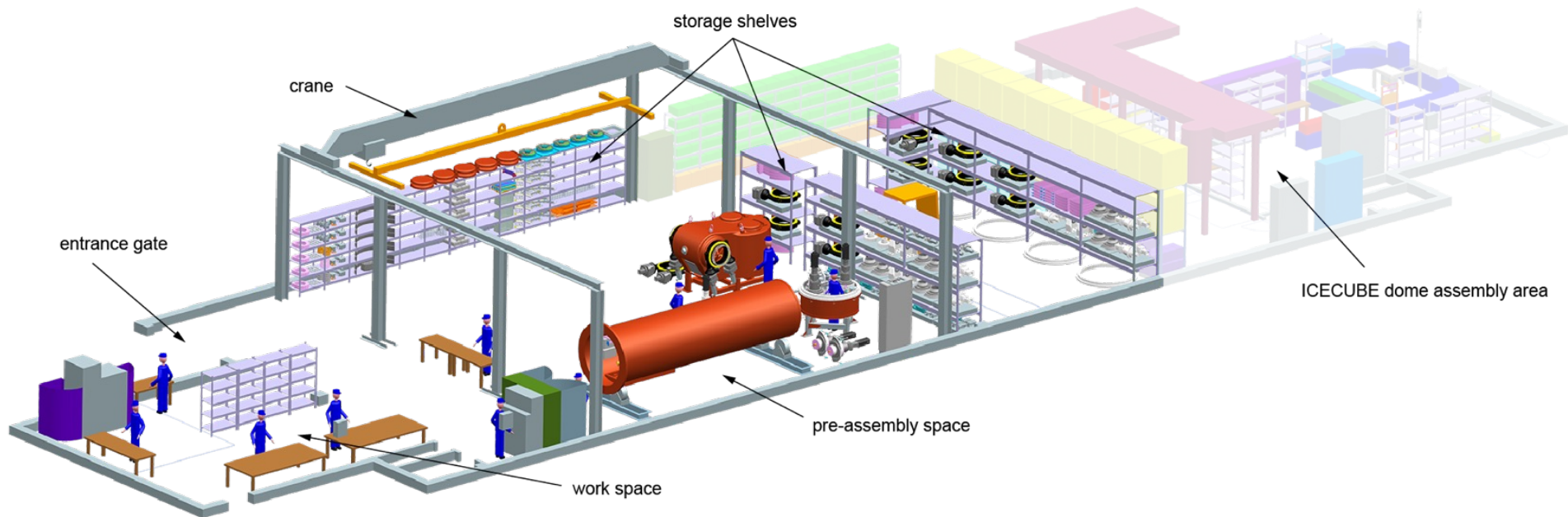


Final tower

Vormontage in der SEGRO-Halle in Bohnsdorf

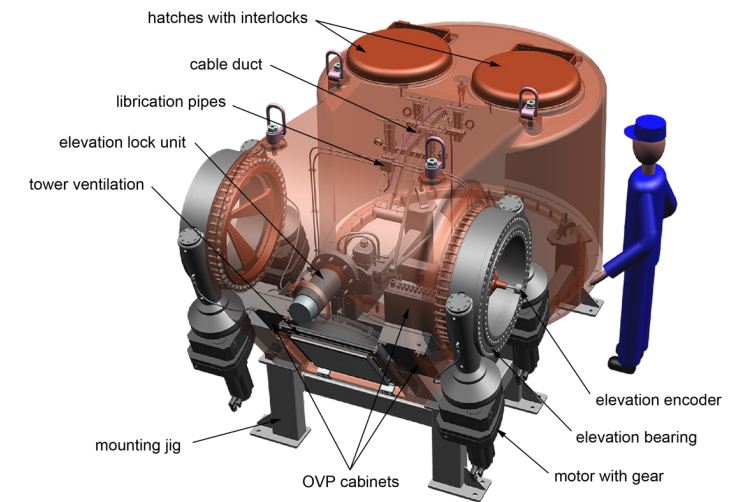
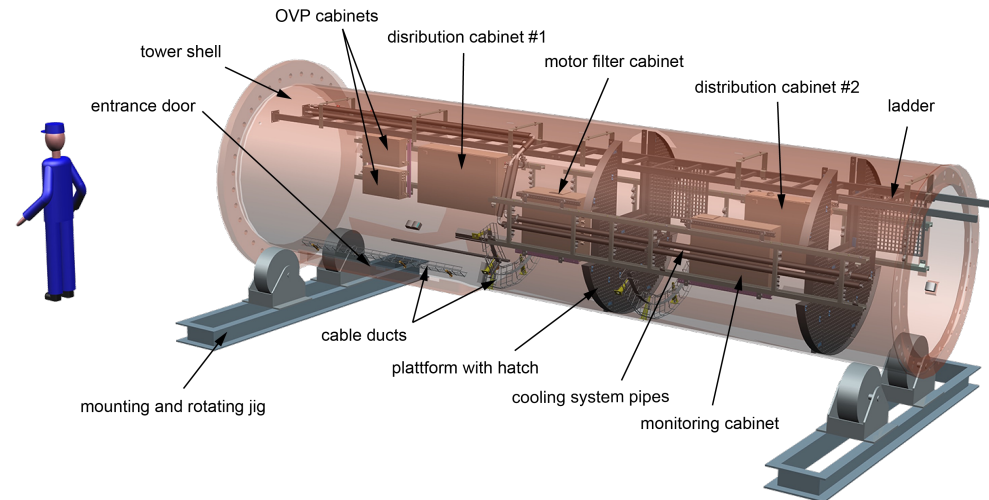
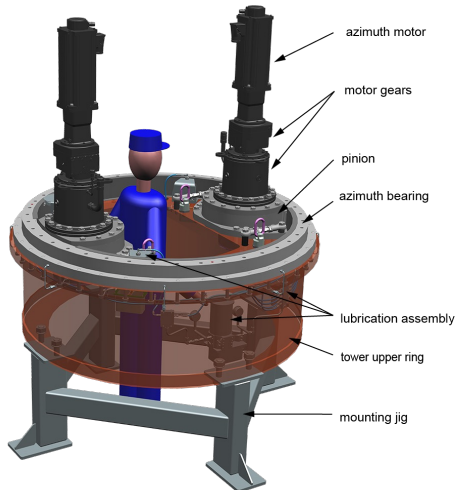
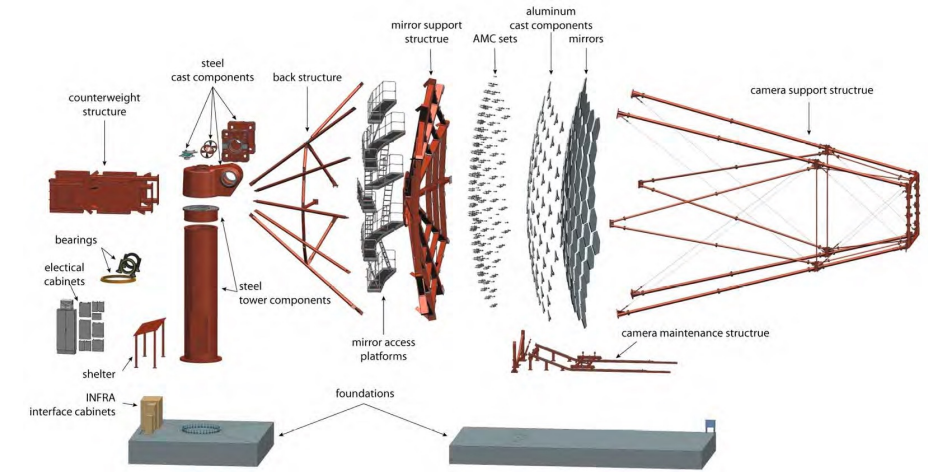
Pre-assembly facility in Bohnsdorf

- Miete einer Halle in der Nähe des BER (gemeinsam mit IceCube)
Rental of a hall near BER (shared with IceCube)
- Ausstattung der Halle mit Kran, Gabelstapler, Lagerregalen, Vorrichtungen für die Montage
Equipment of the hall with crane, forklift, shelves, mounting jigs ready for first integration



Mechanische Komponenten

Mechanical components



Elektronik – vom Schaltschrank zum Kabel

Electronics – from electric cabinets to cable

21 Schaltschränke pro Teleskop

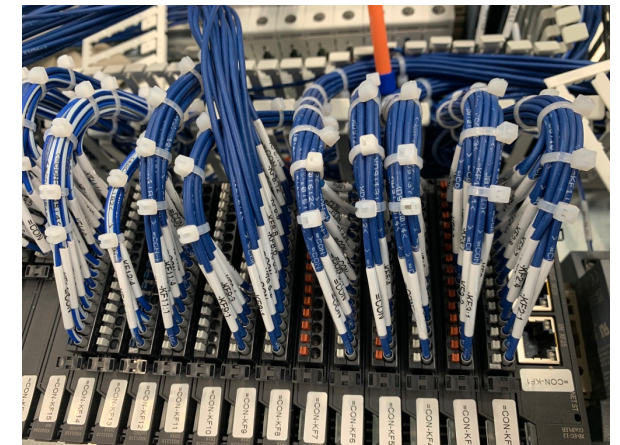
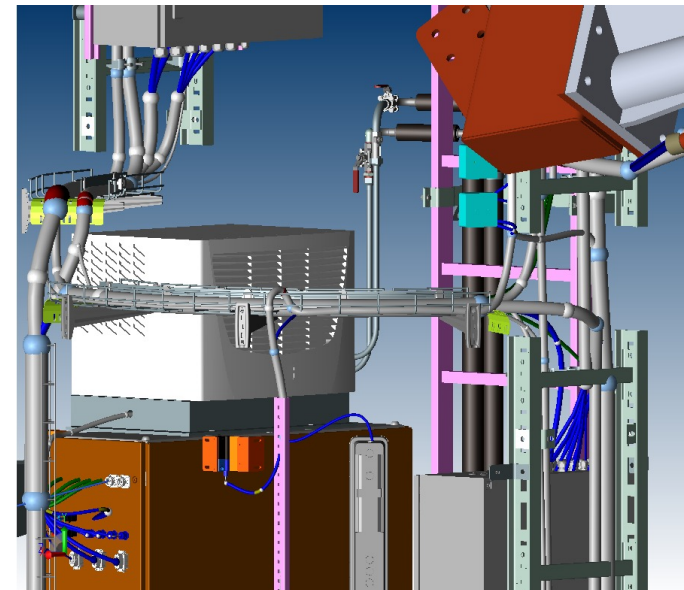
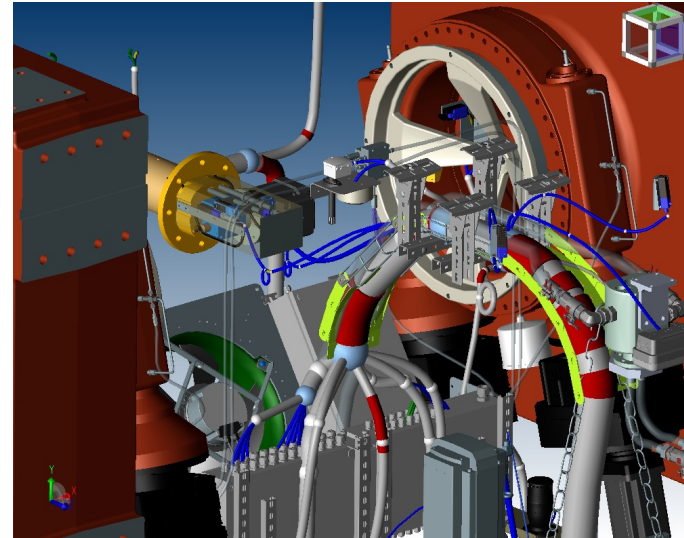
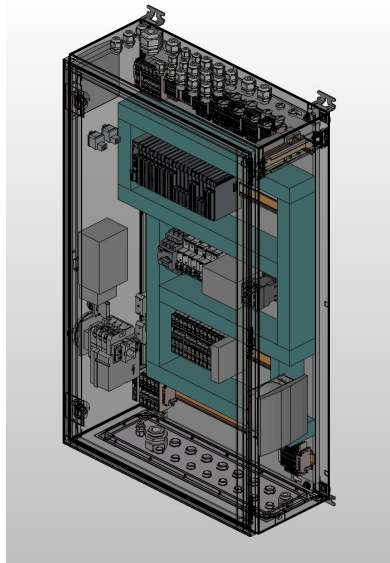
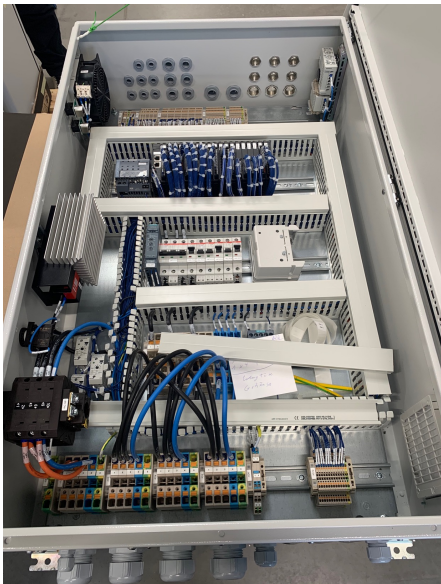
21 electrical cabinets per telescope inside the positioner

Entwicklung mit ePLAN inhouse, Fertigung extern

Design using ePLAN inhouse, external production

Verkabelung mit ePLAN

Cable routing via ePLAN



Spiegelsteuerung

Active mirror control

Entwurf und Entwicklung der aktiven Spiegelsteuerung sowohl für die MSTs als auch für die LSTs

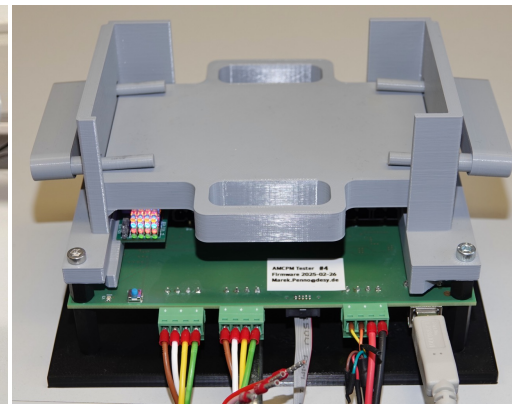
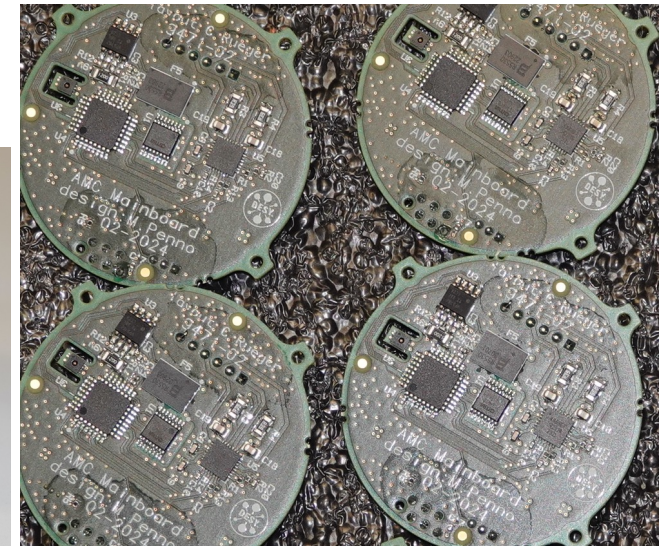
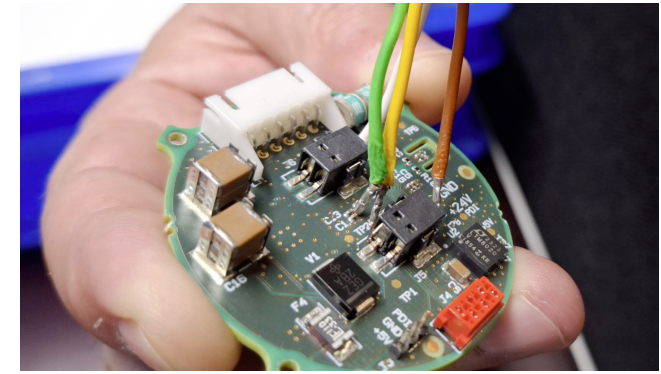
Design and development of the active mirror control units for both MSTs and LSTs

Insgesamt 2500 AMC Mainboards (davon 1680 produziert) und 2500 Hall Sensor boards (bereits komplett) - zusammen mit DESY HH

In total 2500 AMC Mainboards (1680 already produced) and 2500 Hall Sensor Boards (already finished) - together with DESY HH

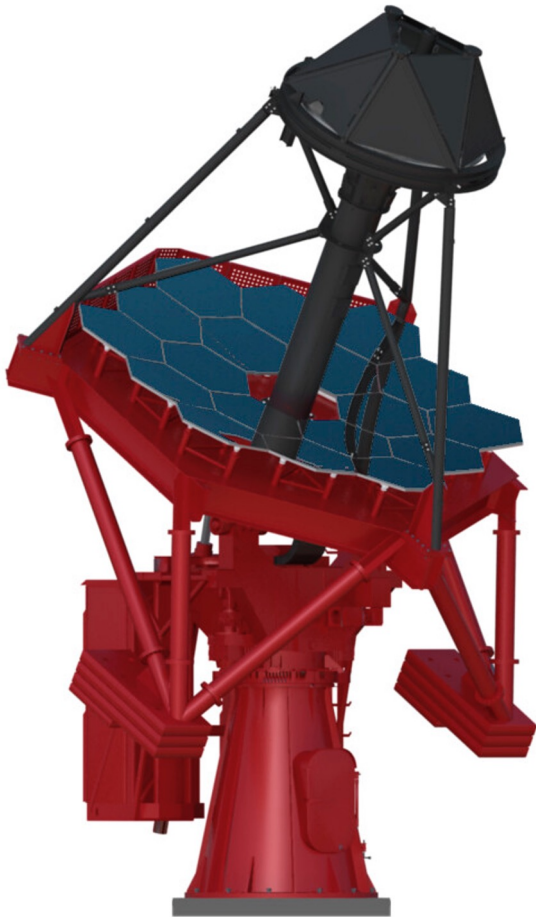
120 AMCPM Boards (gefertigt in der ZEW Zeuthen)

120 AMCPM Boards (manufactured in ZEW Zeuthen)



Small-Sized Telescopes

Klein, aber oho! Small but mighty



5 to 300
TeV

**Seltene aber
energiereiche
Gammastrahlen**

Rare but high-energy
gamma rays

Kamera-Pixel / *Camera pixels*: SiPM-based, 2048 pixels

Optimiert für schnelle Neuausrichtung: 30s um sich zu einer beliebigen Stelle
am Himmel auszurichten

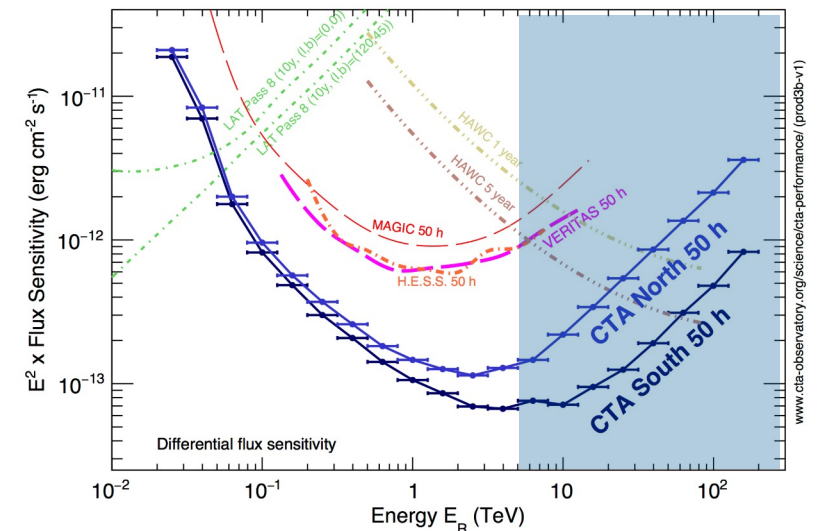
Fast repositioning speed: 30s slewing time to any point in the sky

4

Spiegeldurchmesser
Reflector diameter

18

Tonnen Gewicht
Tons of total weight



The SST camera

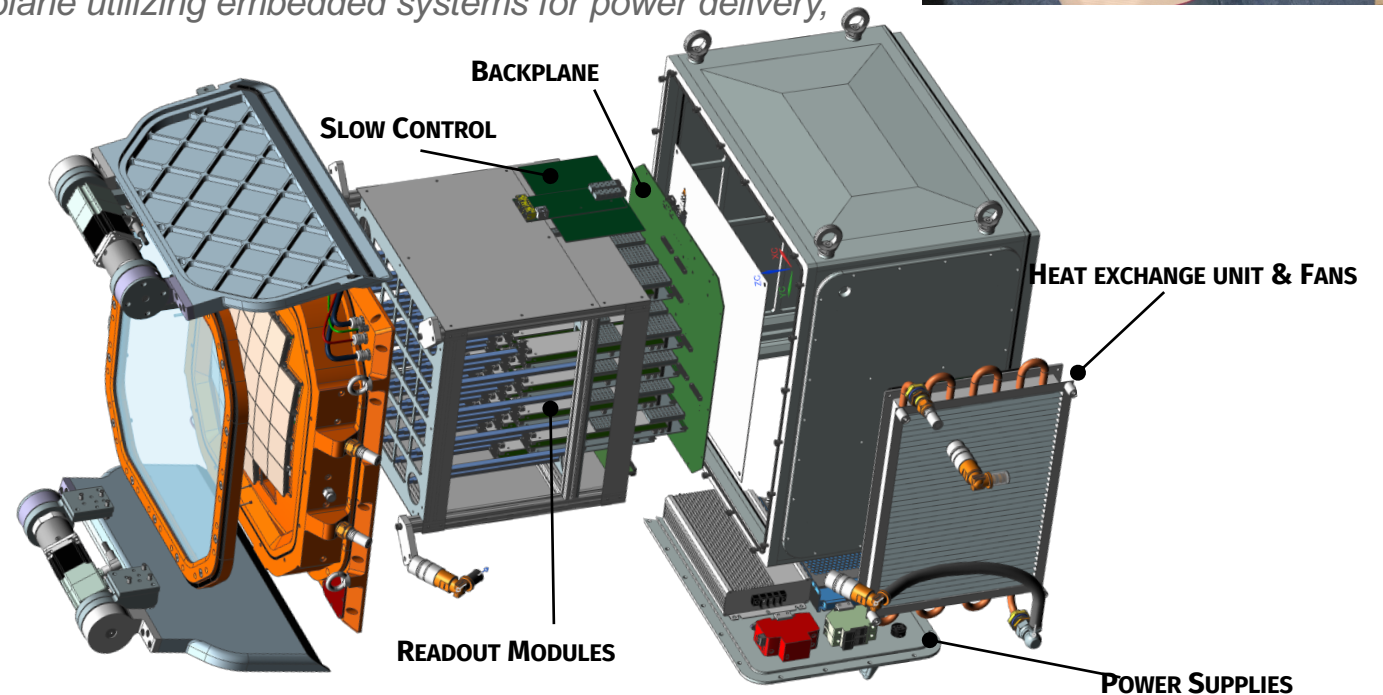
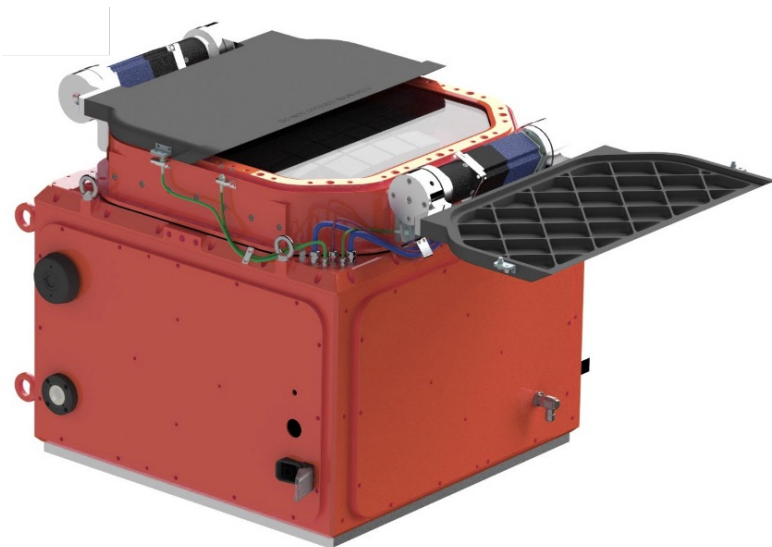
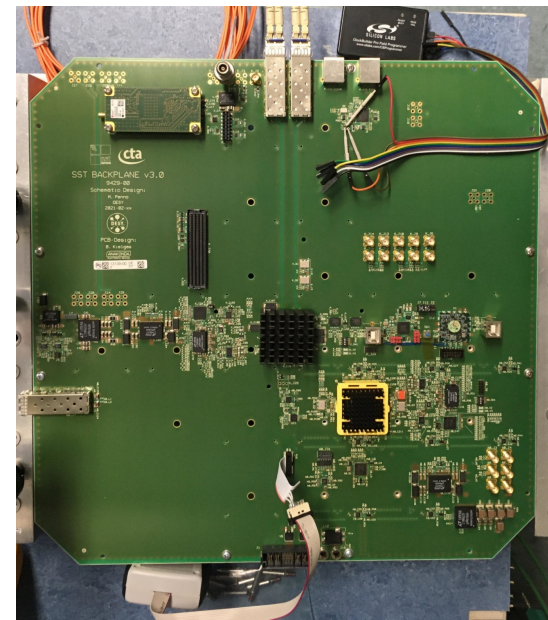
DESY's main contribution to SST

- Leitung der Arbeitspakete der Kontrollsoftware sowie des Systems Engineering

Leading the control software and systems engineering work package

- Verantwortlich für die Entwicklung und Produktion der Kamera bestehend aus der Stromversorgung, Auslösung, Zeitnahme und Datenverarbeitung

Responsible for developing and producing the camera backplane utilizing embedded systems for power delivery, triggering, clocking and data routing



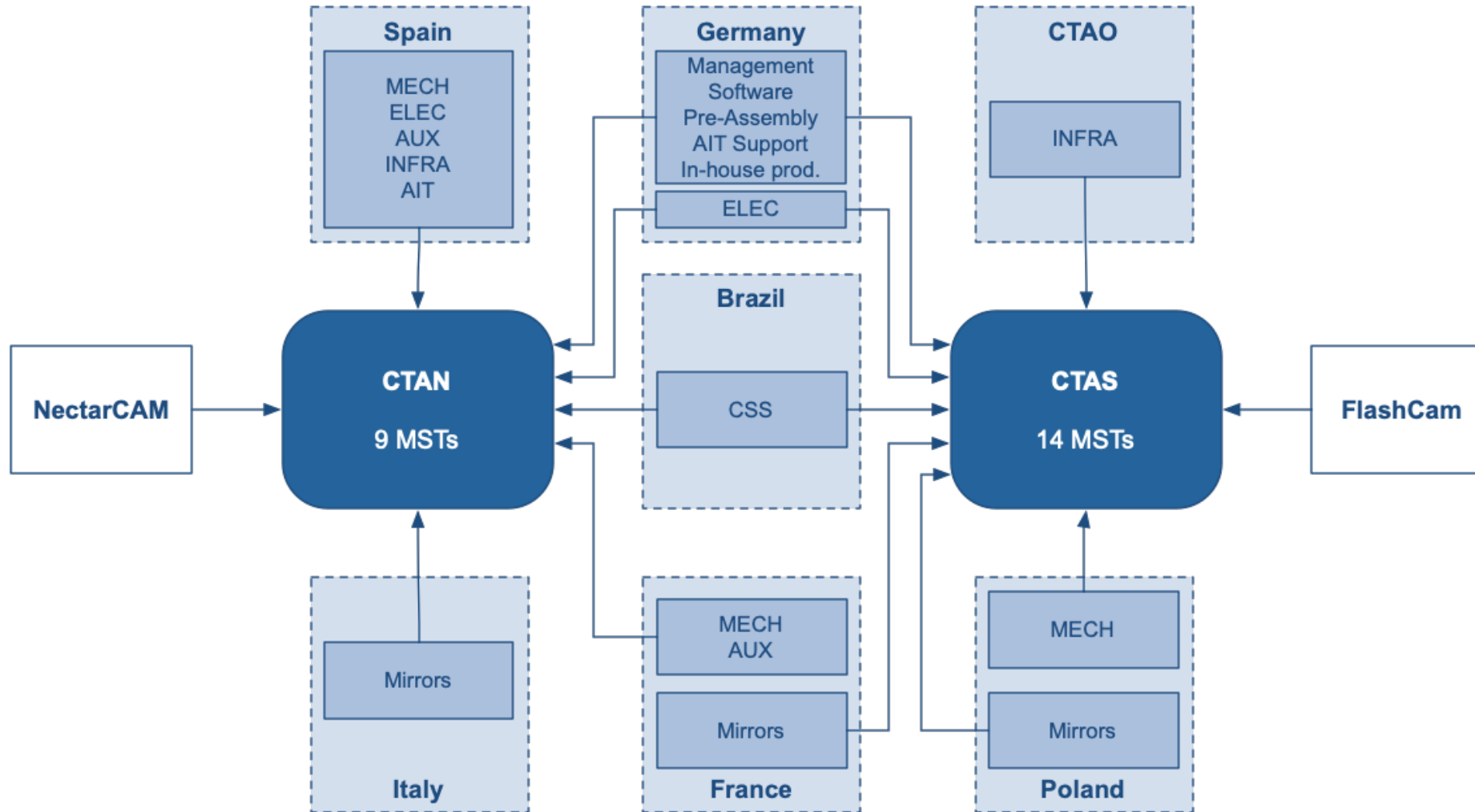
It's official

THE CTAO ERIC IS ESTABLISHED

CTAO

Project baseline

Projektstruktur



Logistics plan

Pre-assembly at DESY a central part of the process

