CTA infrastructures: Telescopes and Sites

An overview of the various telescope structures and sites infrastructures needed to operate the Cherenkov Telescope Array

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The future in VHE gamma ray astronomy:

10 fold sensitivity of current instruments

10 fold energy range

improved angular resolution

O(100) telescopes in mixed arrays

distributed in two sites (North / South)

operated as observatory

Estimated cost ~200 M€

cta
cherenkov telescope array

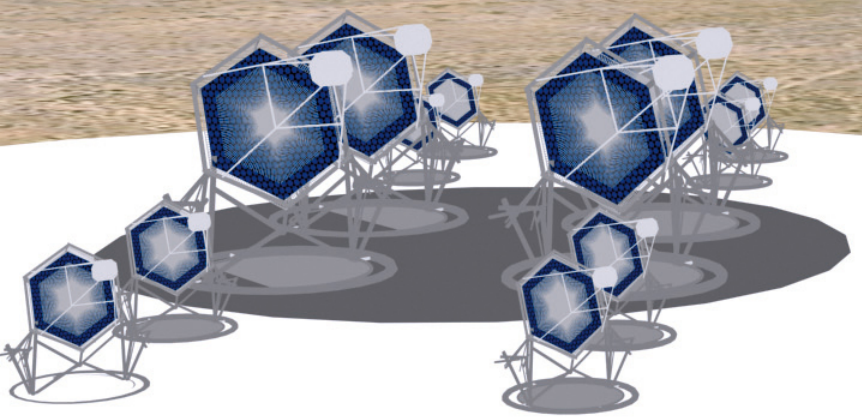
World-wide cooperation

27 countries

80 parties

348 FTEs

1127 scientists



The zoo – part 1

Low-energy section:

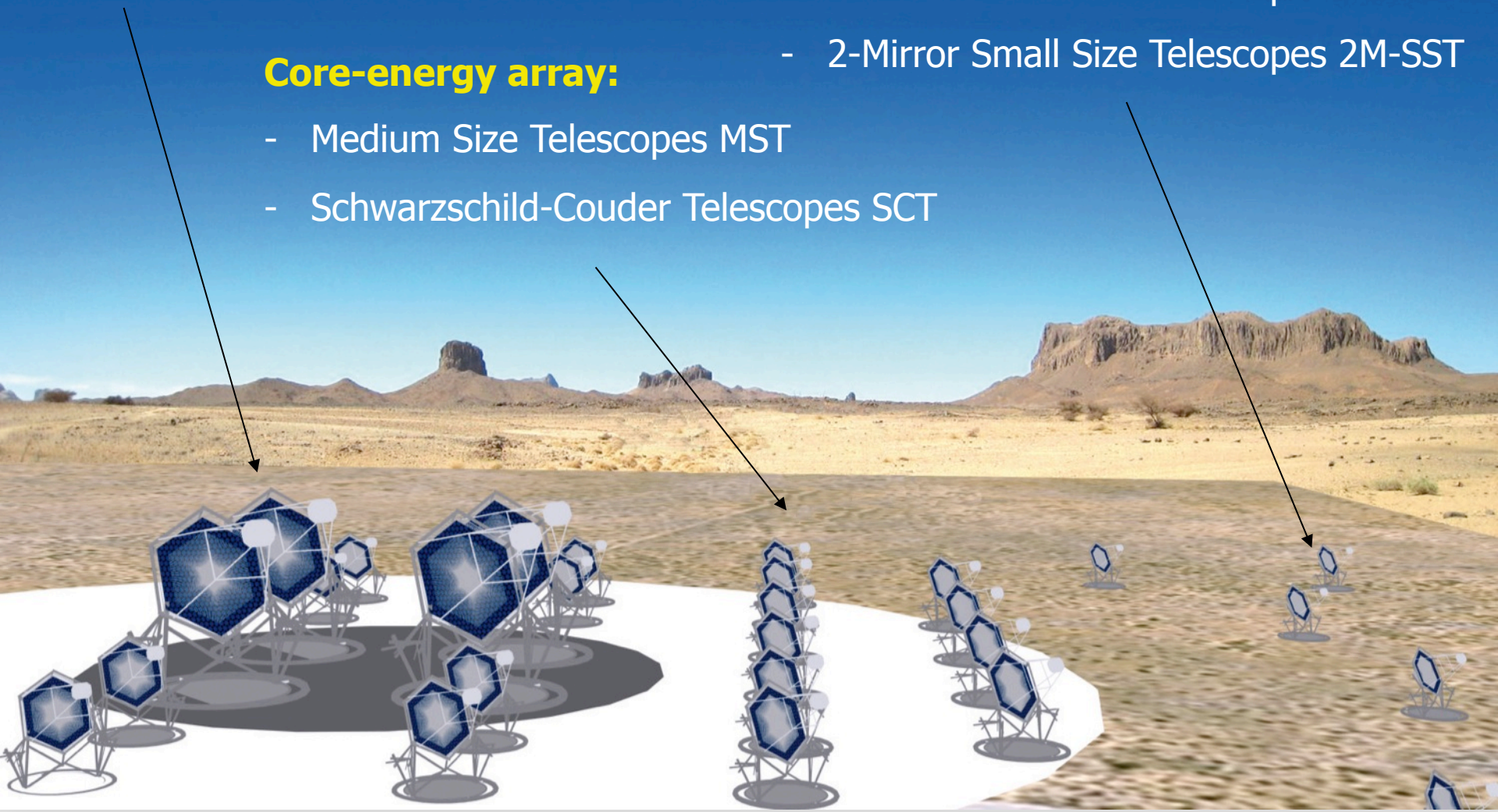
- Large Size Telescopes LST

Core-energy array:

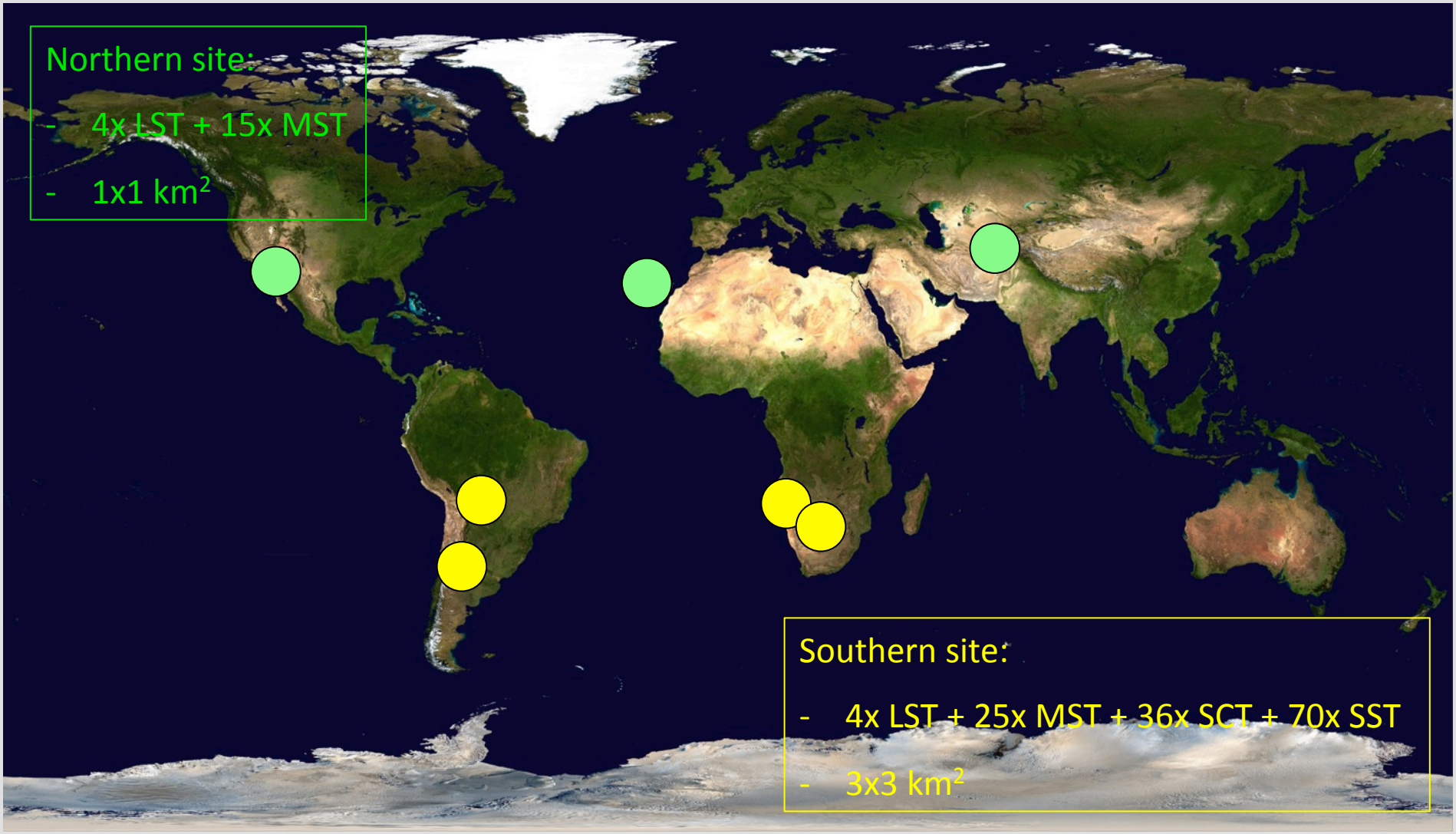
- Medium Size Telescopes MST
- Schwarzschild-Couder Telescopes SCT

High-energy section:

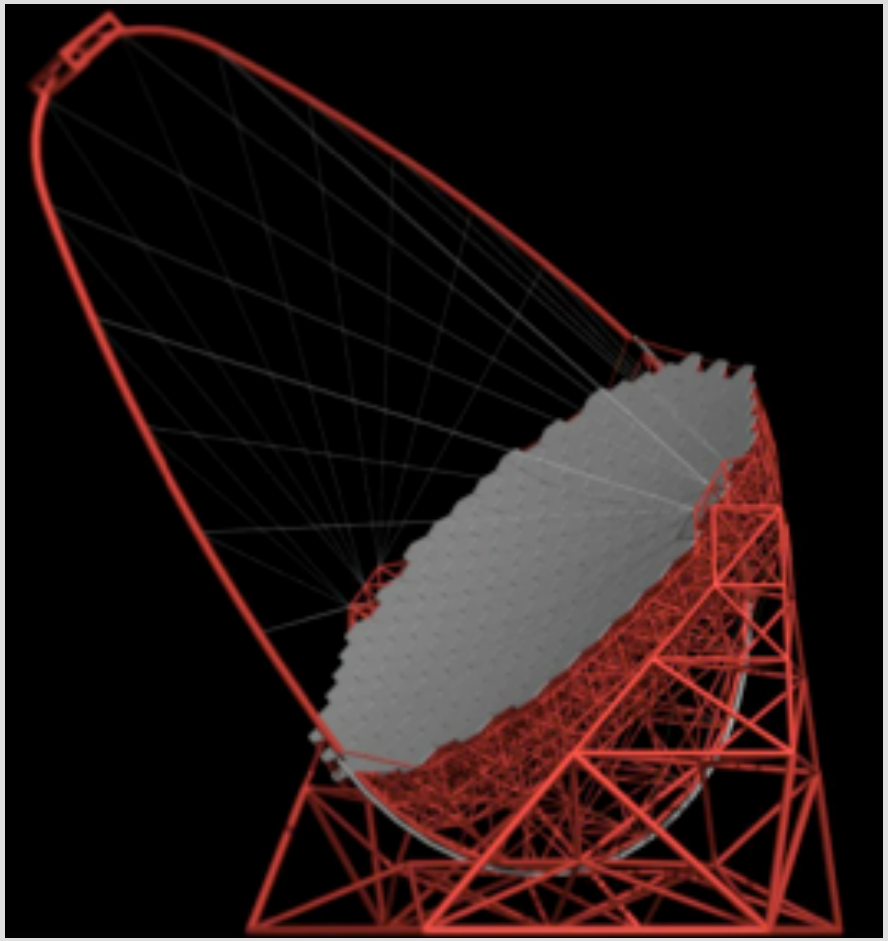
- 1-Mirror Small Size Telescopes 1M-SST
- 2-Mirror Small Size Telescopes 2M-SST



The zoo – part 2



The Large Size Telescope



CFRP space frame structure with special end-pieces (T-Igel)

Steel tubes at the very bottom

HOT NUMBERS

Diameter: 23m; f/D = 1.2; f=28m

Collecting area: 389 m^2

Dish profile: Parabolic

Deformation of mirror dish: < 10mm

Active mirror Control

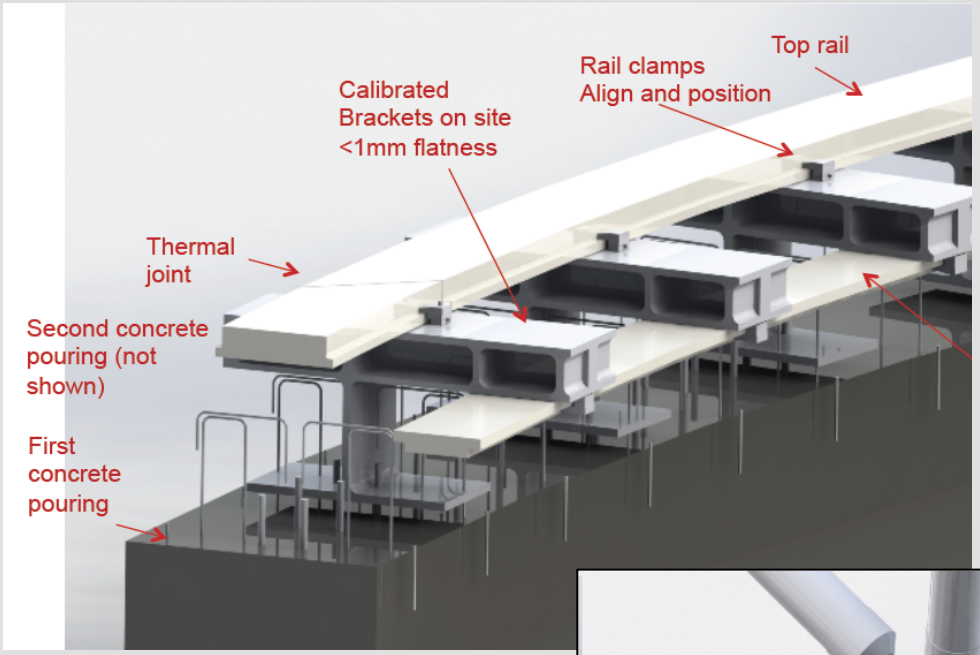
Fast rotation: 360° / 40sec

Tracking accuracy: 20 arcsec

Total weight: 70 tons

Grand total of 4 (+4) telescopes needed

The Large Size Telescope



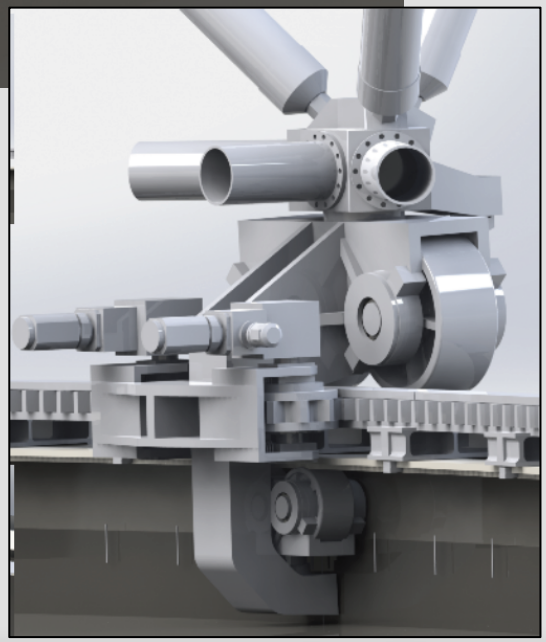
The telescope is studied by a consortium of German-Spanish-French Institutes and Universities.

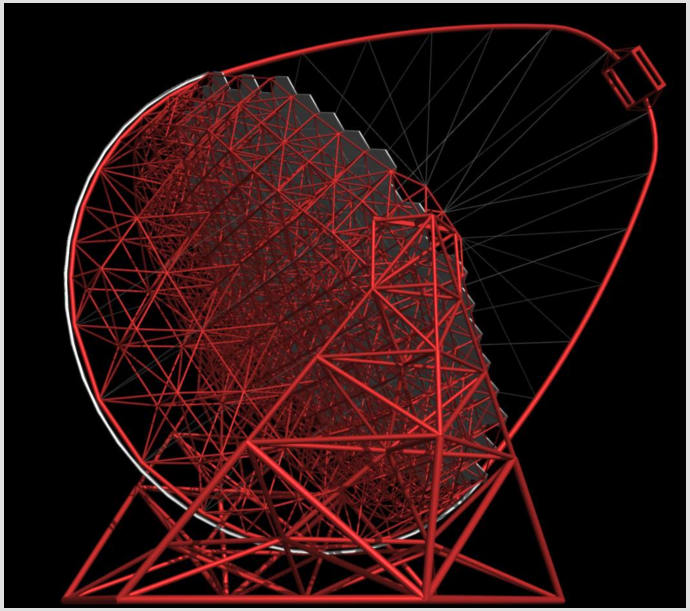
<u>Prototyping activities planned/ongoing</u>

PI: Prof. Masahiro Teshima – MPG

masahiro.teshima@mppmu.mpg.de

Complex dual-rail and bogie system to move the telescope and to hold it against wind storm





The Medium Size Telescope

HOT NUMBERS

Diameter: 12m; f/D = 1.3; f=16m

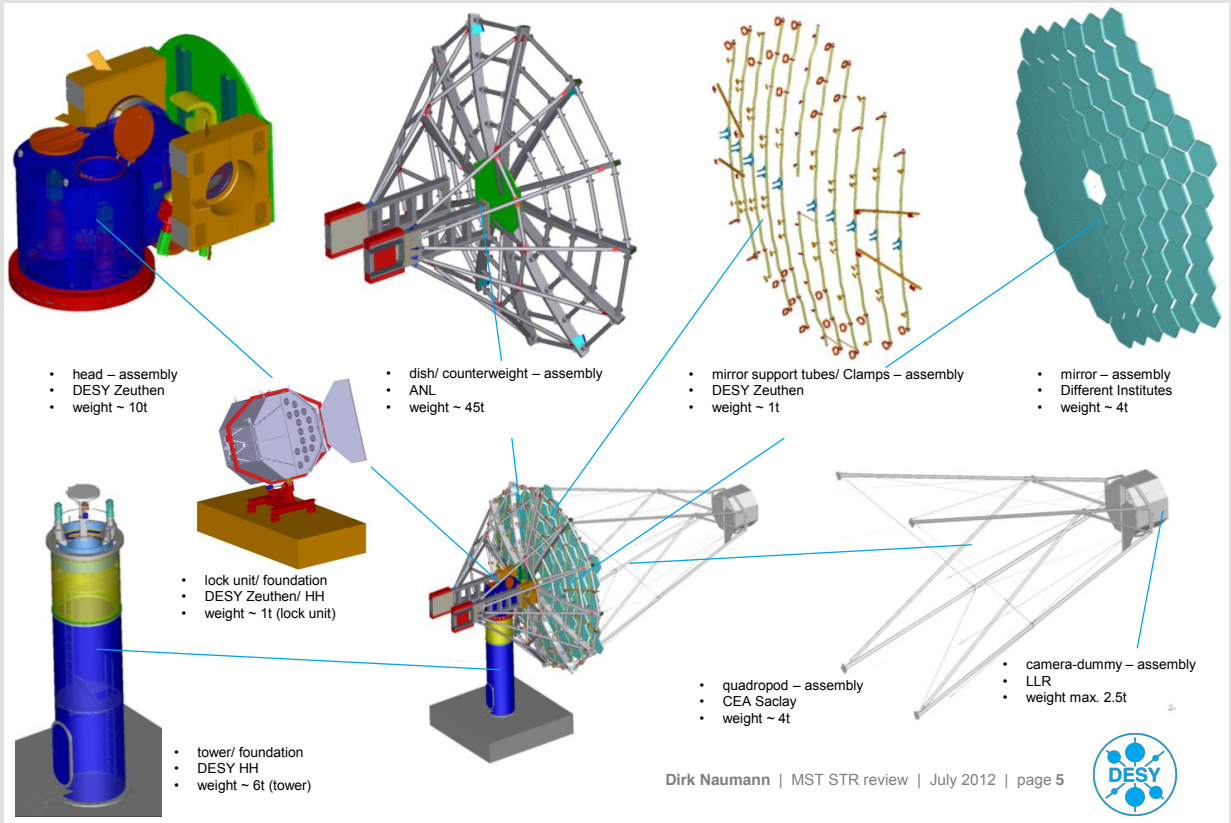
Active Mirror Control

Fast rotation: 360° / 78sec

Collecting area: 100 m^2

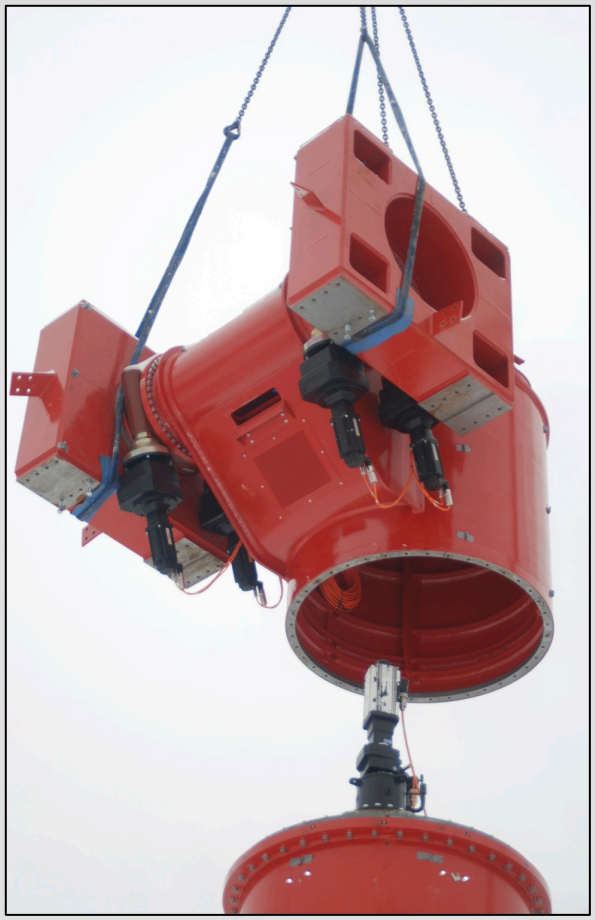
Camera weight: 2.5 ton

Total weight: 75 tons



Grand total of 25 (+15) telescopes needed

The Medium Size Telescope



Steel structure made by assembled tubes (bolted joints)

The column hosts the azimuth drives and electric cabinets

The telescope is studied by a consortium of German-French-US Institutes and Universities

<u>Prototyping activities planned/ongoing</u>

PI: Prof. Stefan Schlenstedt – MPG

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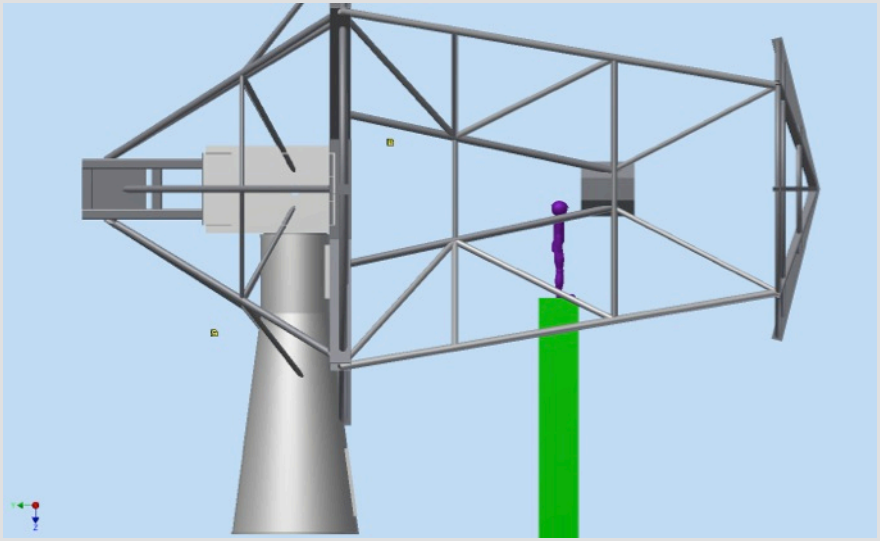
The Schwarzschild-Couder Telescope



Truss structure made by assembled steel tubes (Open Joist Trusses)

Use the same column and driving system as MST

HOT NUMBERS

Dual-Mirror design with:

- M1 diameter: 9.66 m
- M2 diameter: 5.42 m
- f/D = 0.58
- Collecting area: 50 m^2

Camera weight: 0.7 ton

Active Mirror Control (M1 and M2)

Total weight: 40 tons

Grand total of 36 telescopes needed

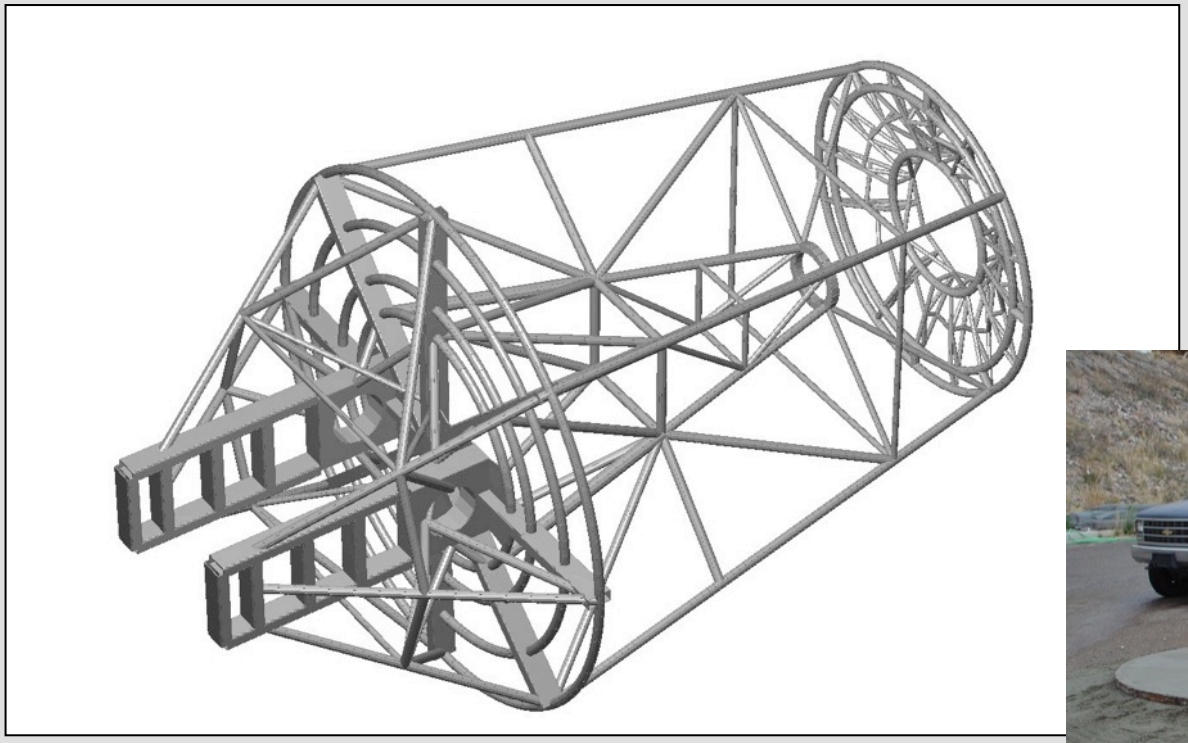
The Schwarzschild-Couder Telescope

The telescope is studied by a consortium of US Institutes and Universities

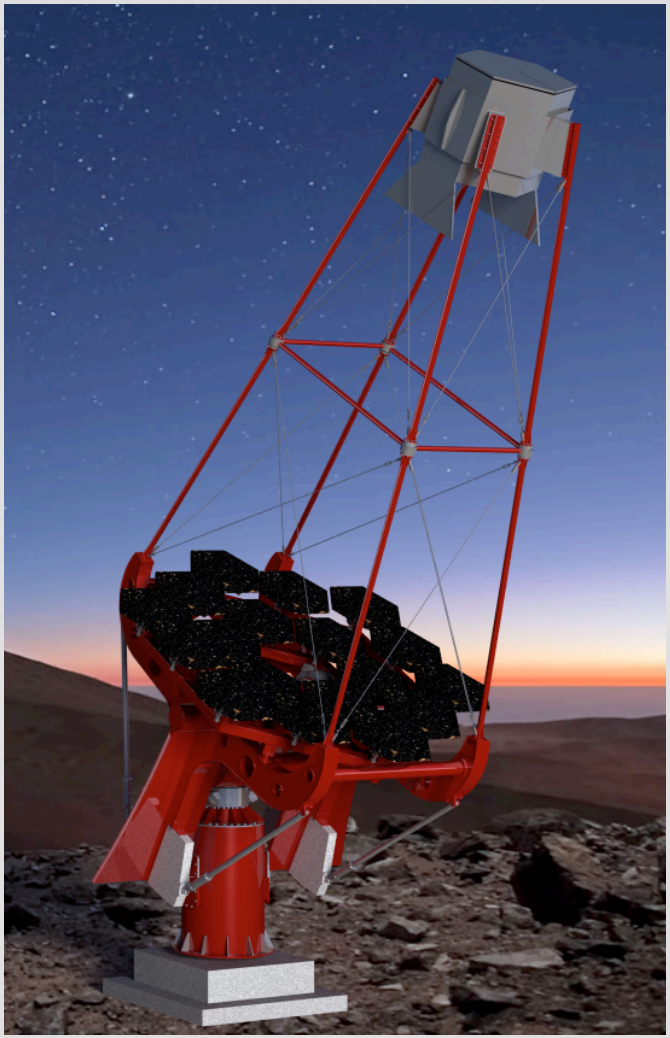
<u>Prototyping activities planned/ongoing</u>

PI: Prof. Vladimir Vassilliev – UCLA

vvv@astro.ucla.edu



The 1-Mirror Small Size Telescope



HOT NUMBERS

Diameter: 4m; f/D = 1.4; f=5.6m

Collecting area: 10 m^2

Active mirror Control

Camera weight: 0.3 ton

Total weight: 10 tons

Grand total of 70 telescopes needed

This design is similar to a scaled-down MST and uses the same driving system

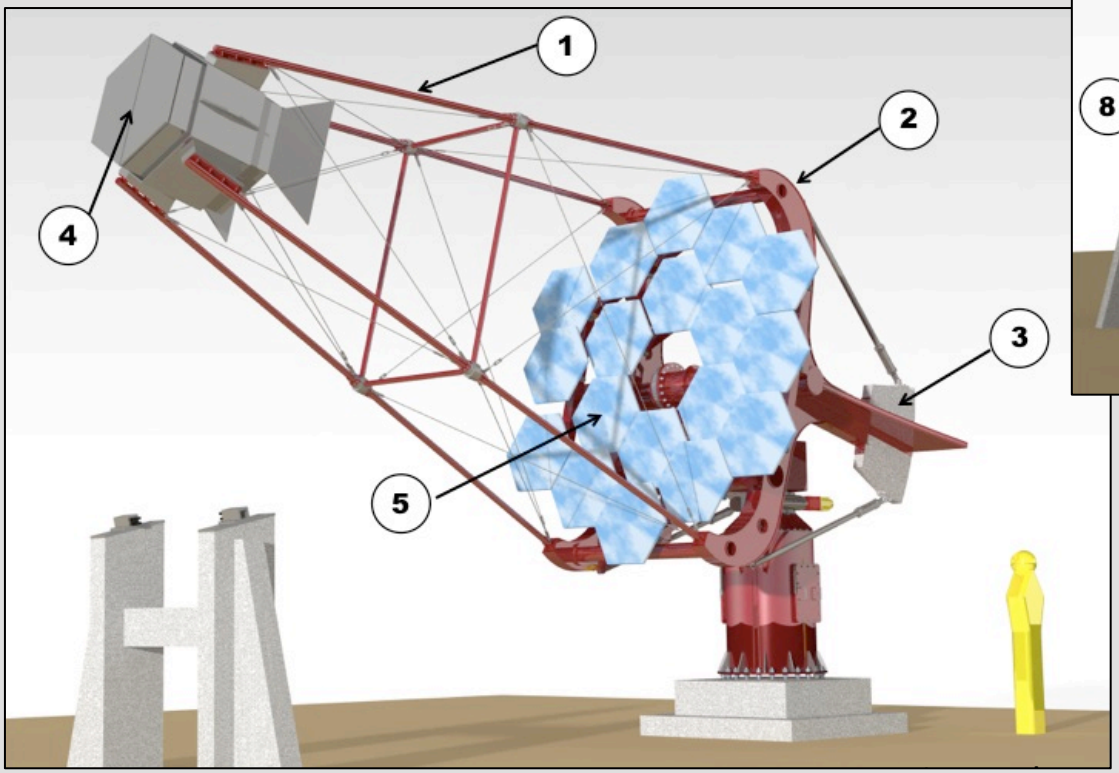
The 1-Mirror Small Size Telescope

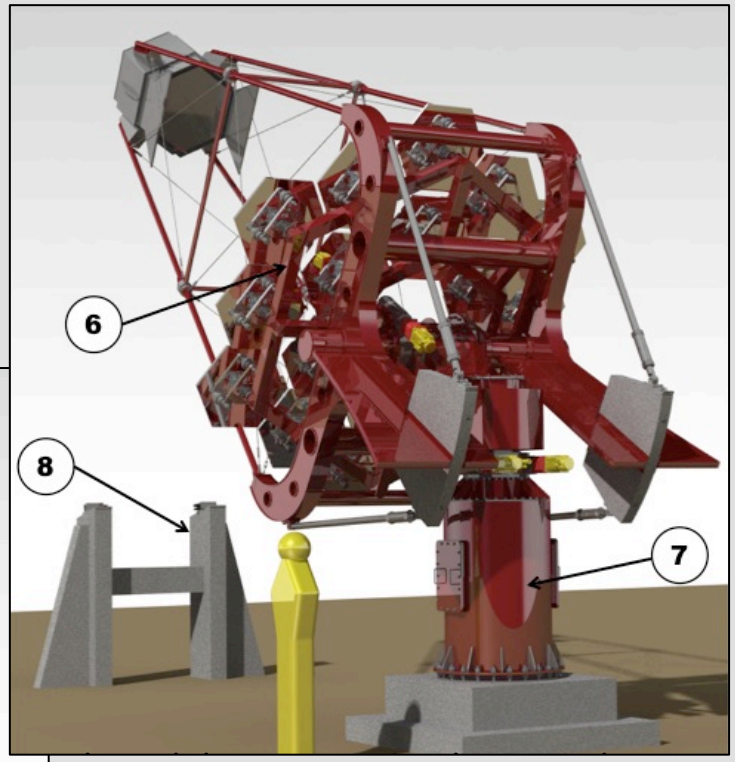
The telescope is studied by a consortium of Swiss and Poland institutes.

<u>Prototyping activities planned/ongoing</u>

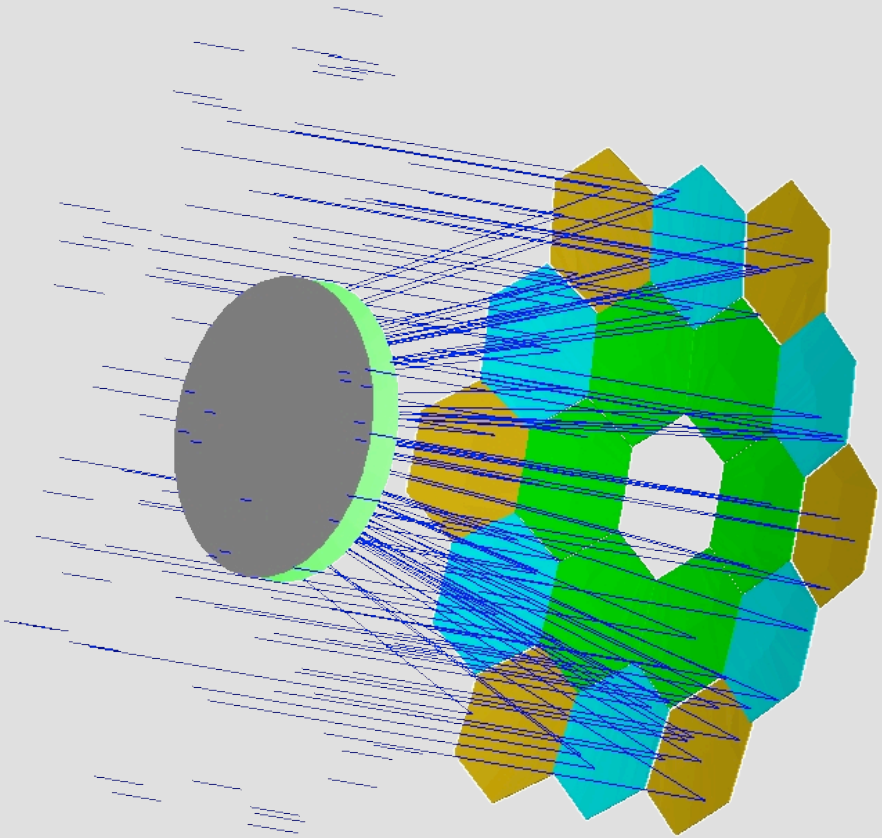
PI: Prof. Teresa Montaruli – Uni Geneve

teresa.montaruli@unige.ch





The 2-Mirror Small Size Telescope



It uses the same optical layout of the SCT, but pushing on the field of view instead of the angular resolution

HOT NUMBERS

Dual-Mirror design with:

- M1 diameter: 4 m
- M2 diameter: 2 m
- f/D = 0.5
- Collecting area: 10 m^2

Active Mirror Control (M1 and M2)

Total weight: 20 tons

Grand total of 70 telescopes needed

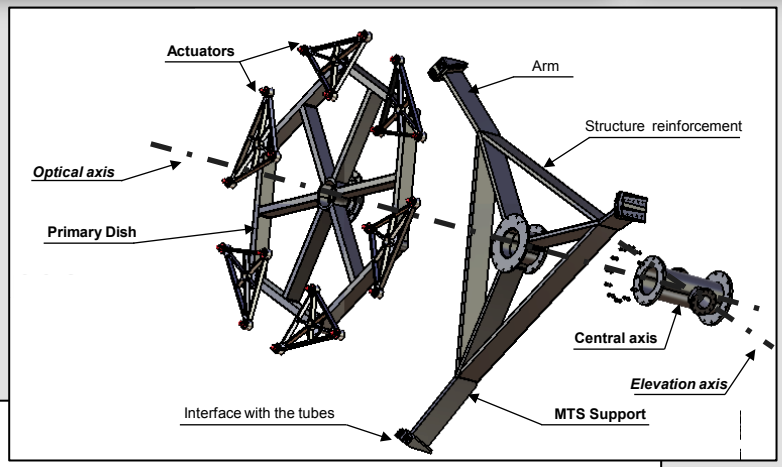
The 2-Mirror Small Size Telescope

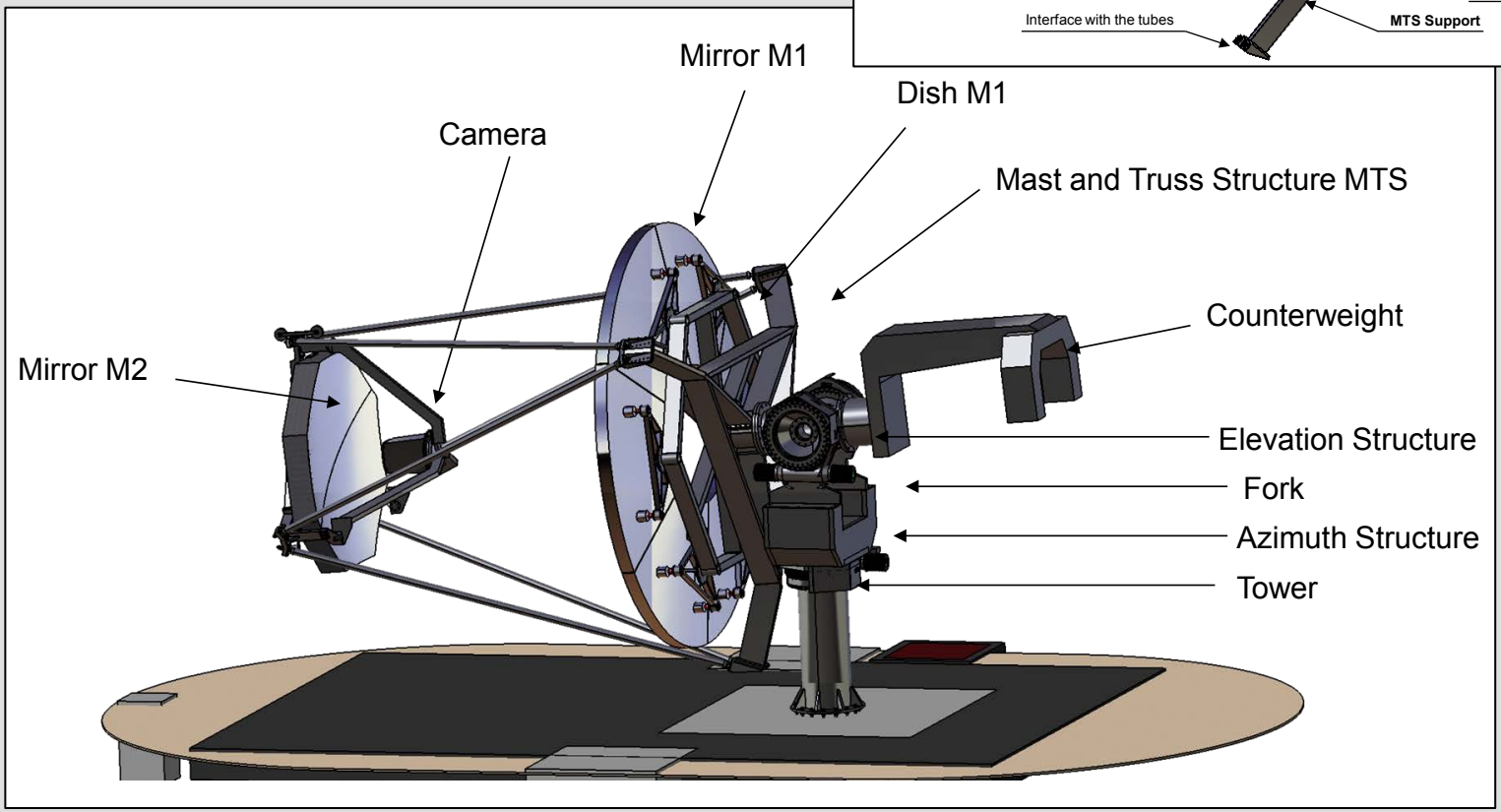
The telescope is studied by the Paris Observatory

<u>Prototyping activities planned/ongoing</u>

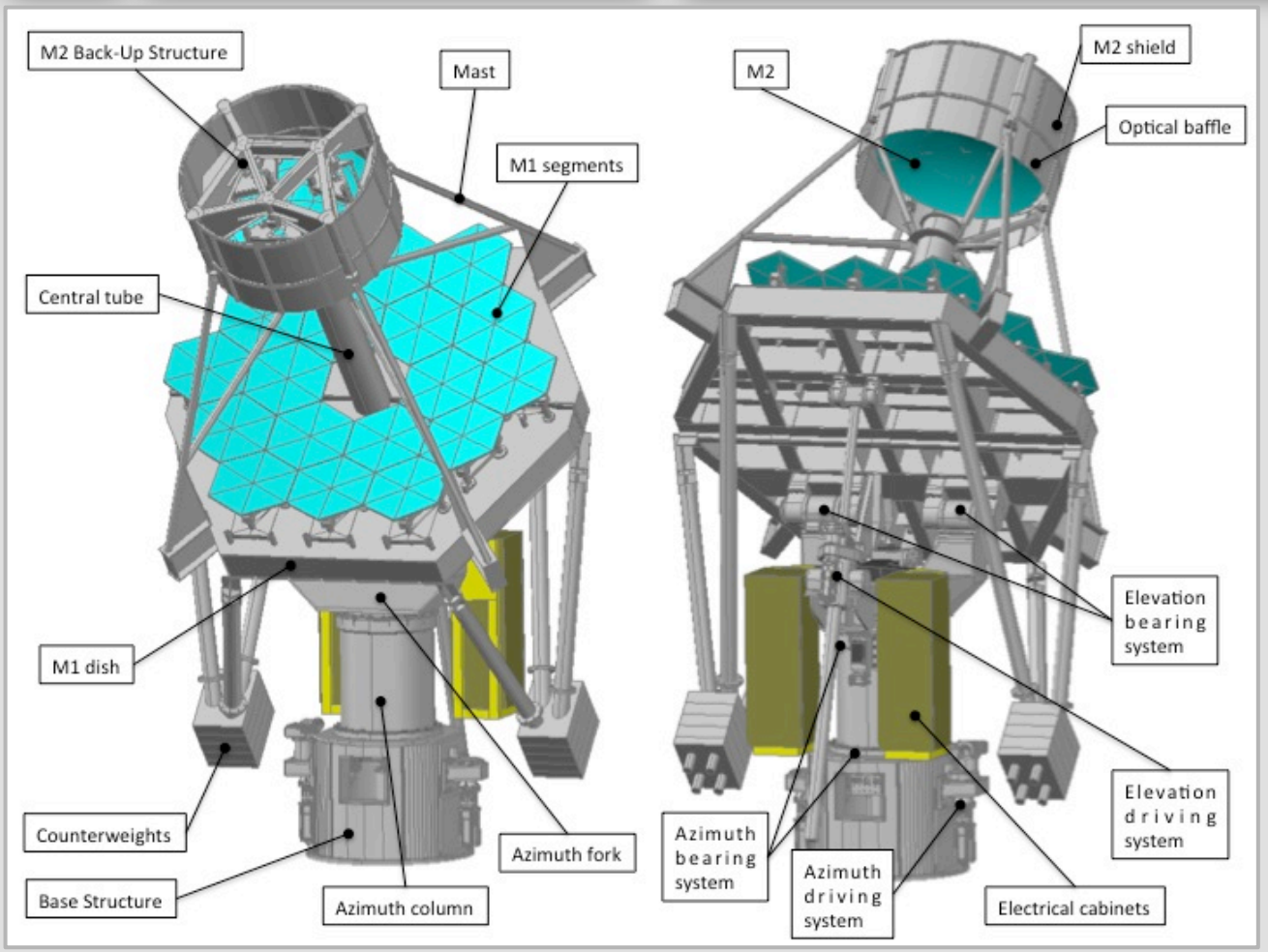
PI: Prof. Helene Sol – OBS Paris-Meudon

Helene.Sol@obspm.fr





The 2-Mirror Small Size Telescope



The telescope is studied by **INAF** in the contest of **ASTRI**, a **flagship project of MIUR**

<u>Prototyping activities planned/ongoing</u>

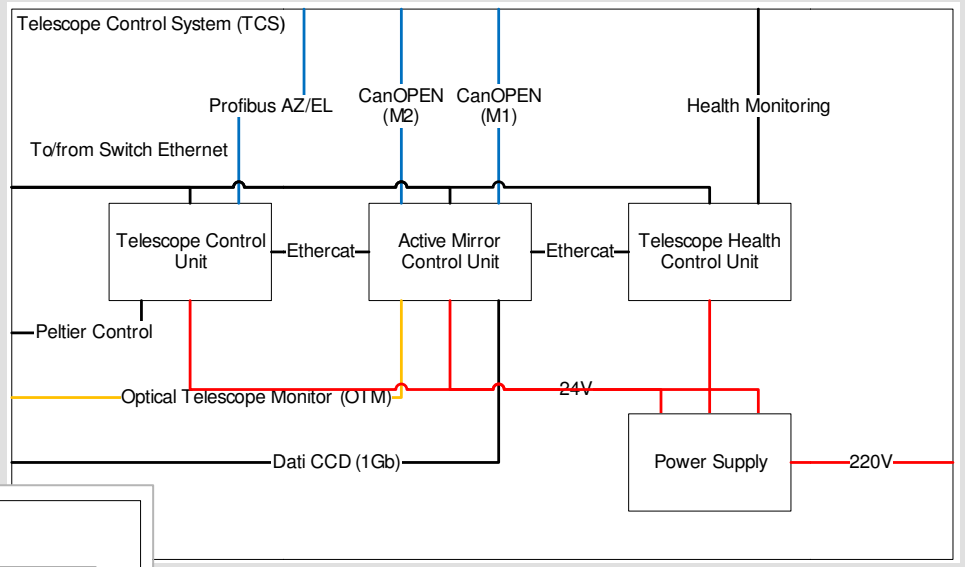
PI: Prof. Giovanni Pareschi – OA Brera

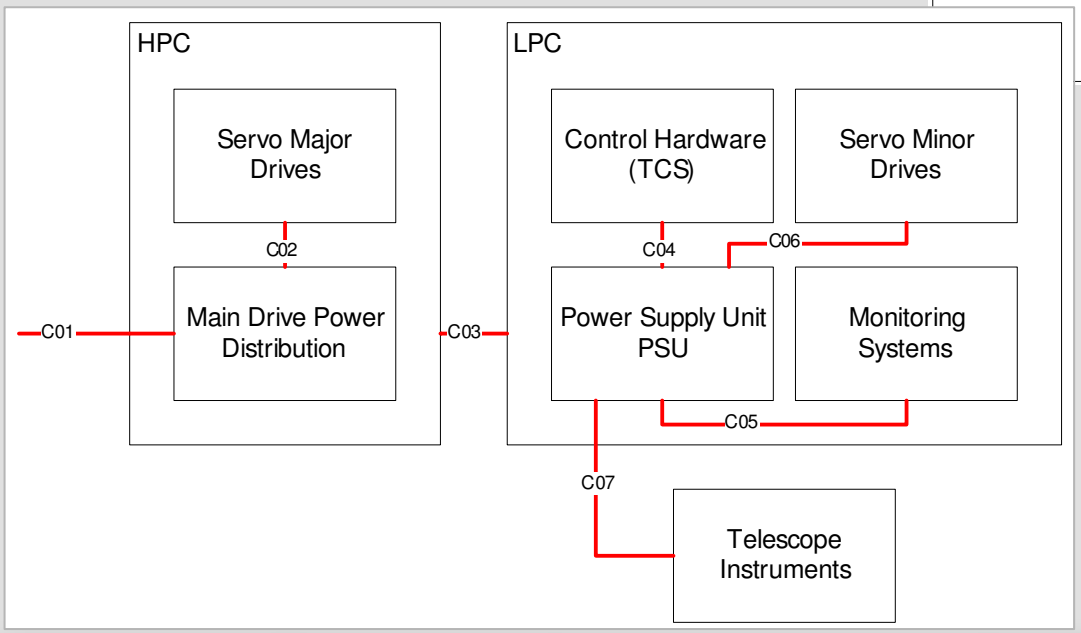
giovanni.pareschi@brera.inaf.it

Electrical equipment

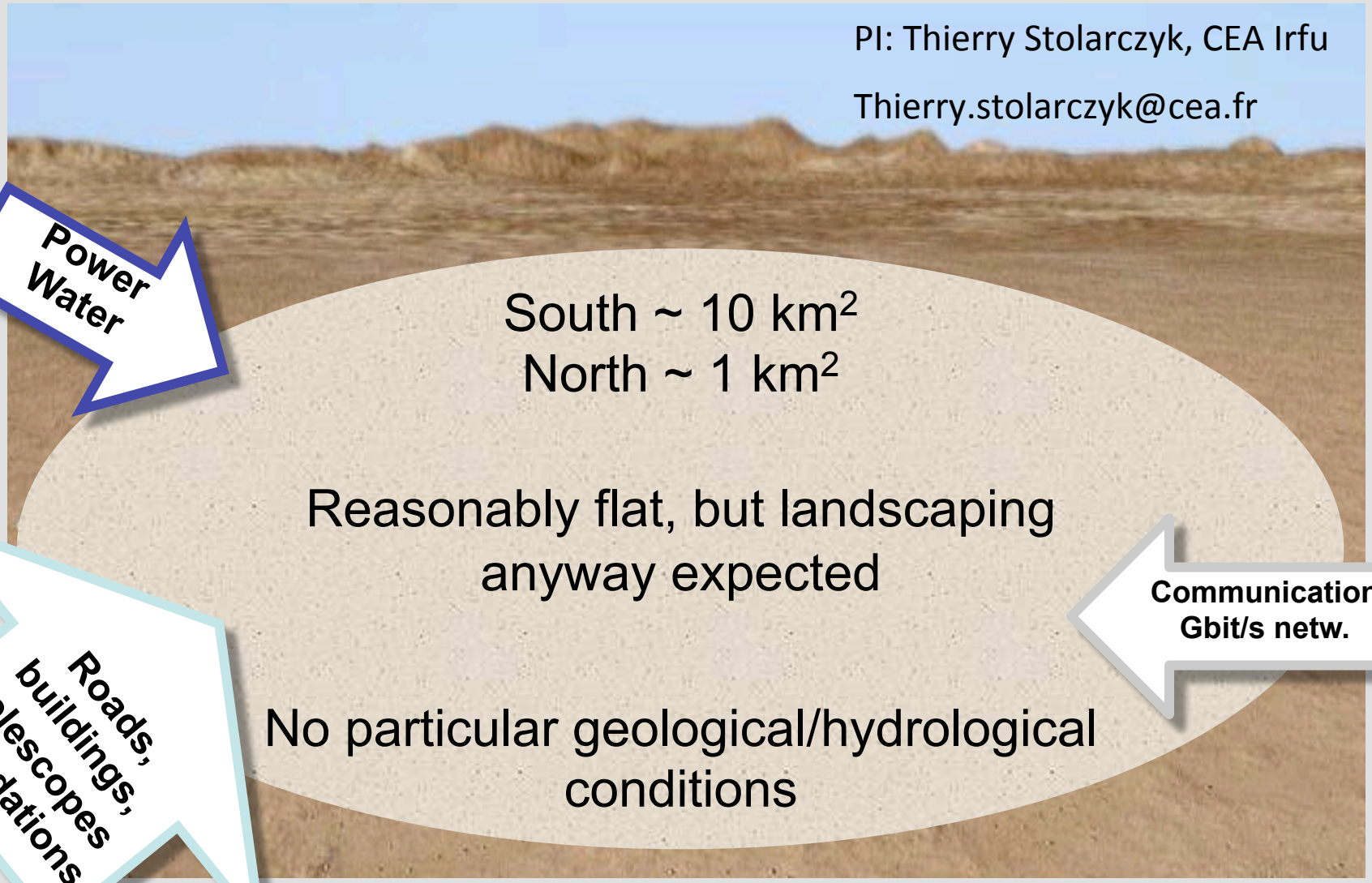
The telescope control hardware include at least:

- safety and health monitoring;
- active mirror control;
- drive systems;
- electrical cabinets and cabling
- more and more other…



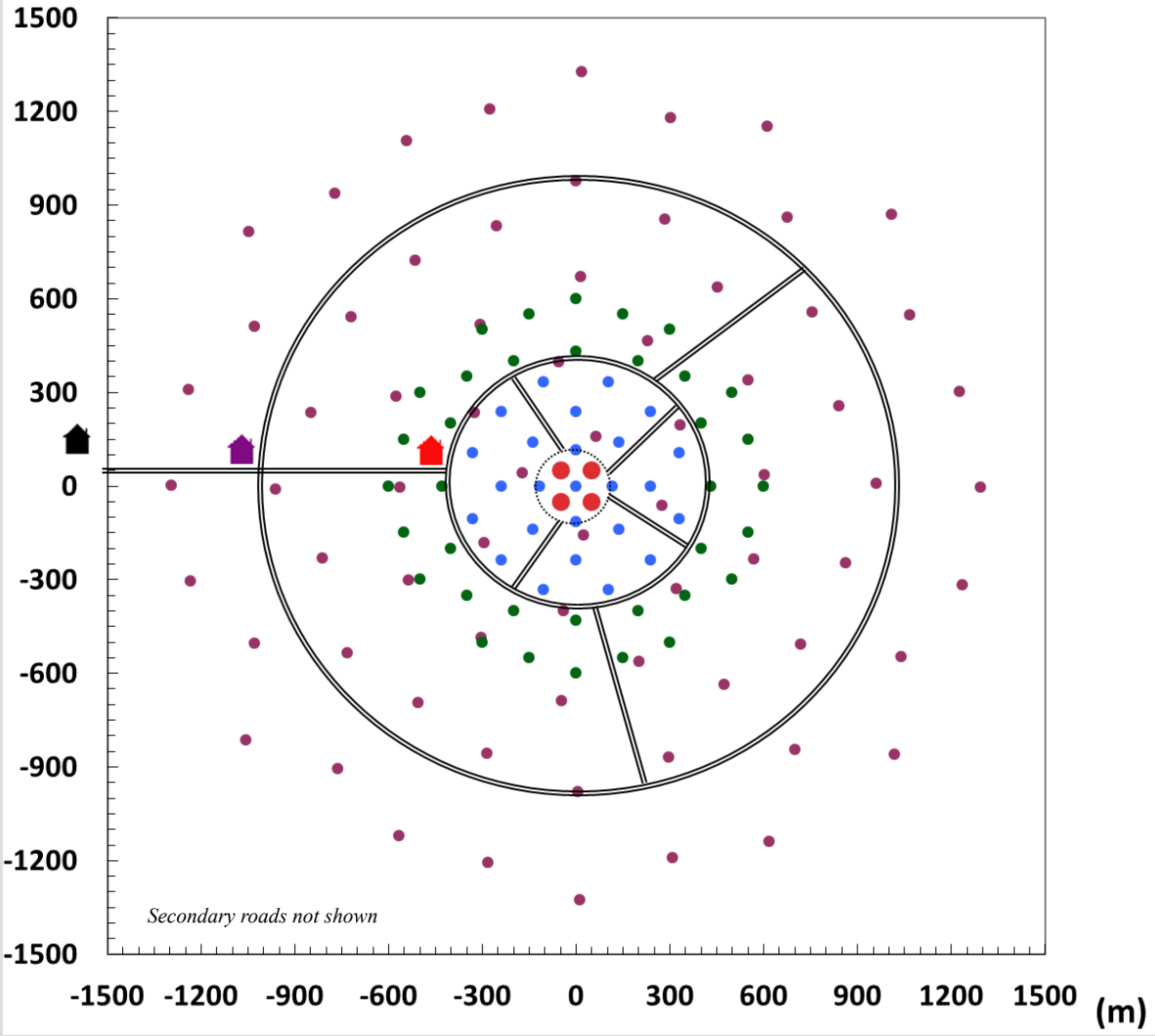


Civil infrastructures @ site(s)



Civil infrastructures @ site(s)

SOUTHERN SITE: 4x LST + 25x MST + 36 SCT + 70x SST = 135 telescopes



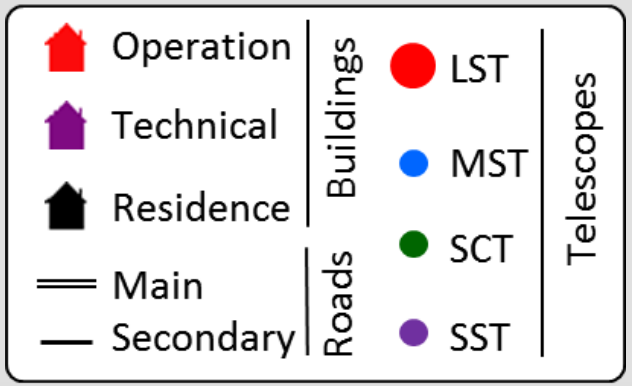
HOT NUMBERS

Roads and parking
- Main: 13.2 km
- Secondary: 17.2 km
- Parking: 4400 m^2
- Central area: 30000 m^2

Buildings: 3x

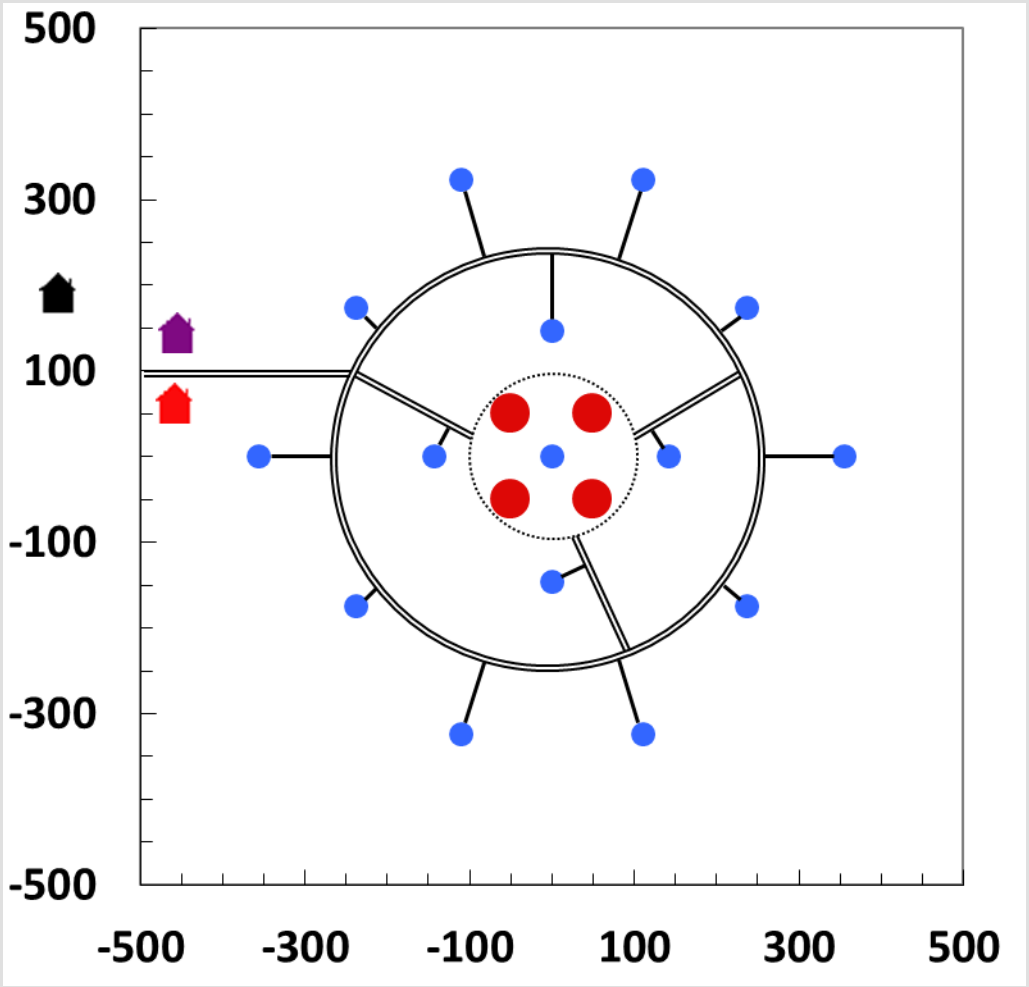
Power: 4 MW peak

Data Network : 1 Gbit/s



Civil infrastructures @ site(s)

NORTHERN SITE: 4x LST + 15x MST = 19 telescopes



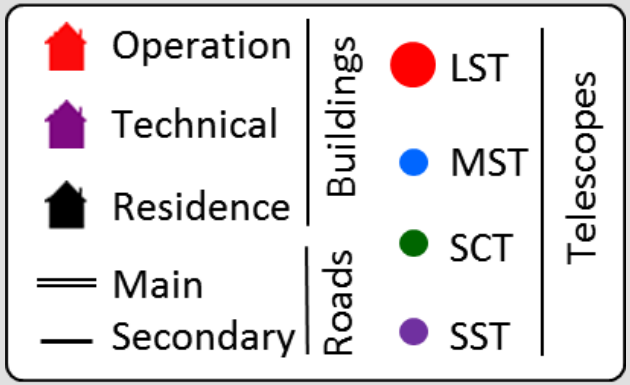
HOT NUMBERS

Roads and parking
- Main: 3.0 km
- Secondary: 0.8 km
- Parking: 2000 m^2
- Central area: 30000 m^2

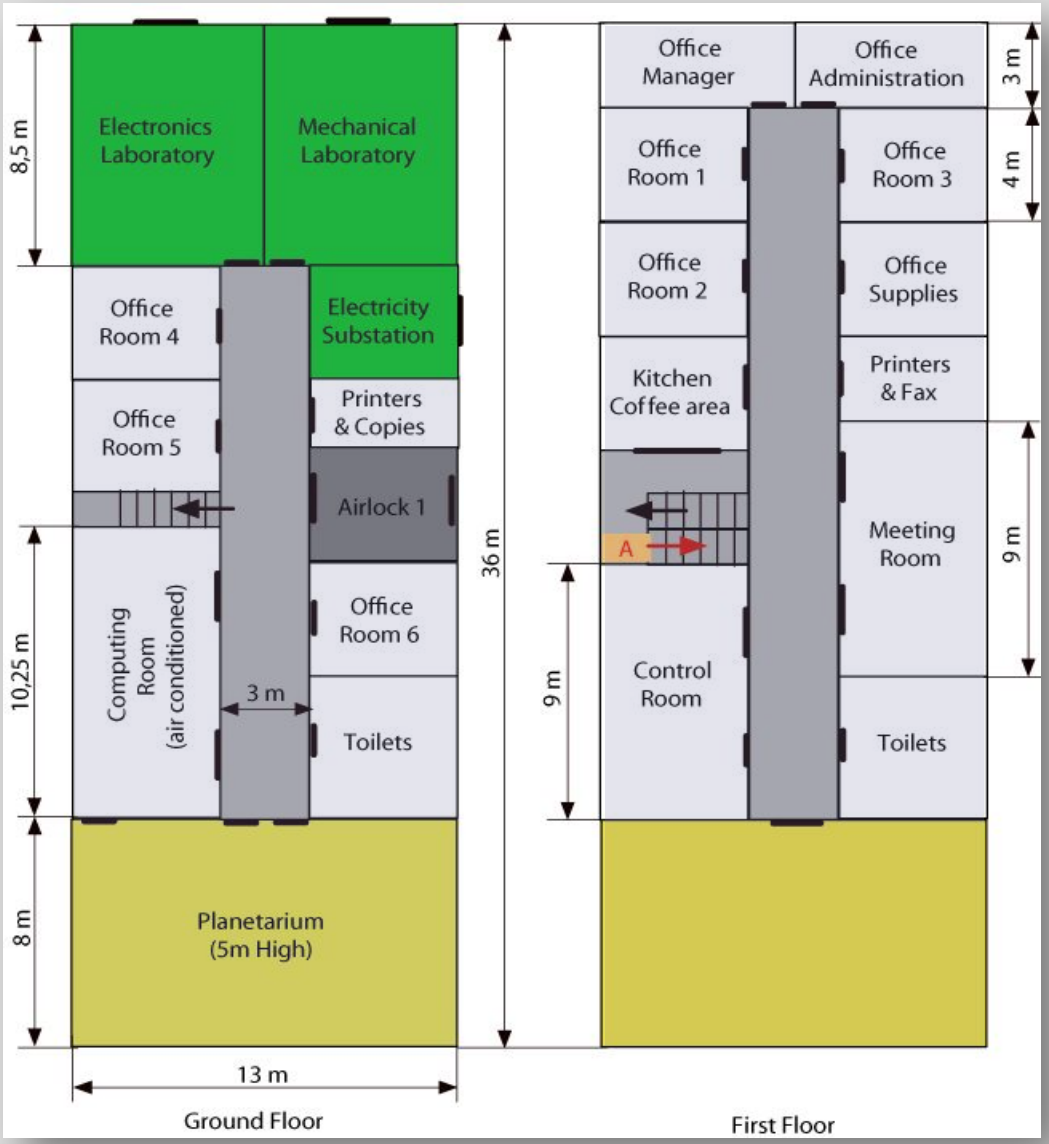
Buildings: 3x

Power: 2 MW peak

Data Network: 1 Gbit/s



Civil infrastructures @ site(s)



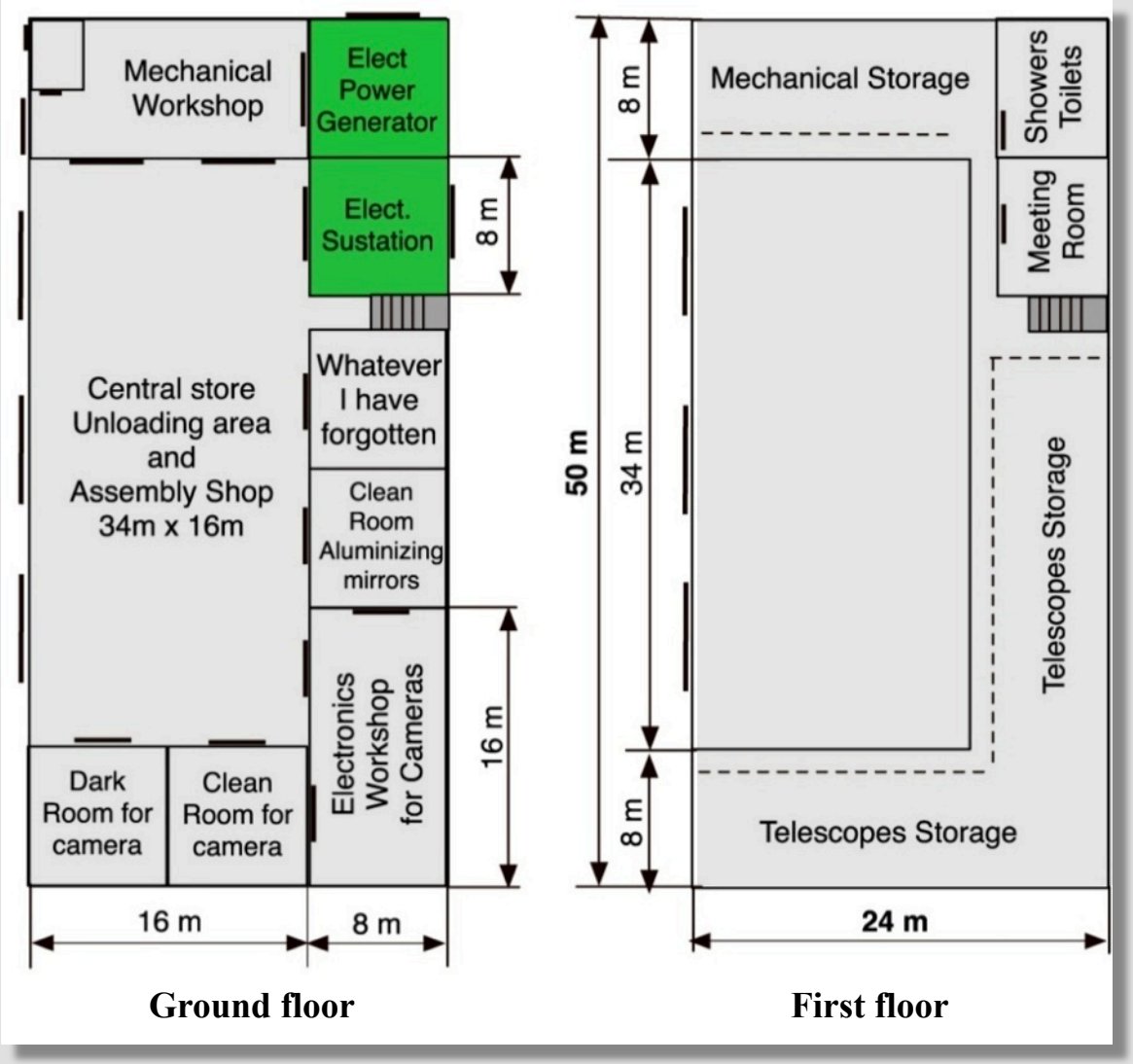
OPERATION BUILDING

Personnel: 12-15 persons

Working area: 832 m^2

Power: consumption depends on computers (ROM 100 kW)

Civil infrastructures @ site(s)



TECHNICAL BUILDING

Inside working area: 2000 m^2

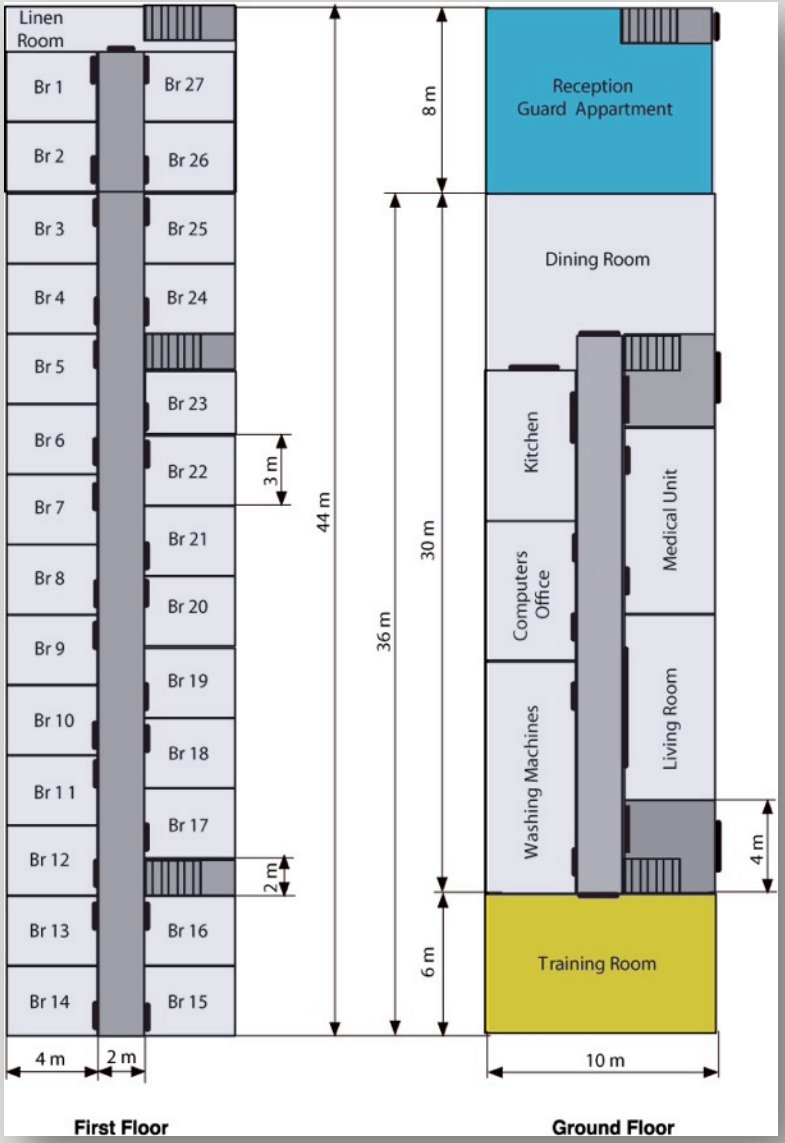
Outside working area: 2800 m^2

Location: entrance of site

Main labs:

- unloading and assembly
- storage
- workshops
- clean and dark rooms
- coating chambers

Civil infrastructures @ site(s)



RESIDENCE BUILDING

Living area: 880 m^2

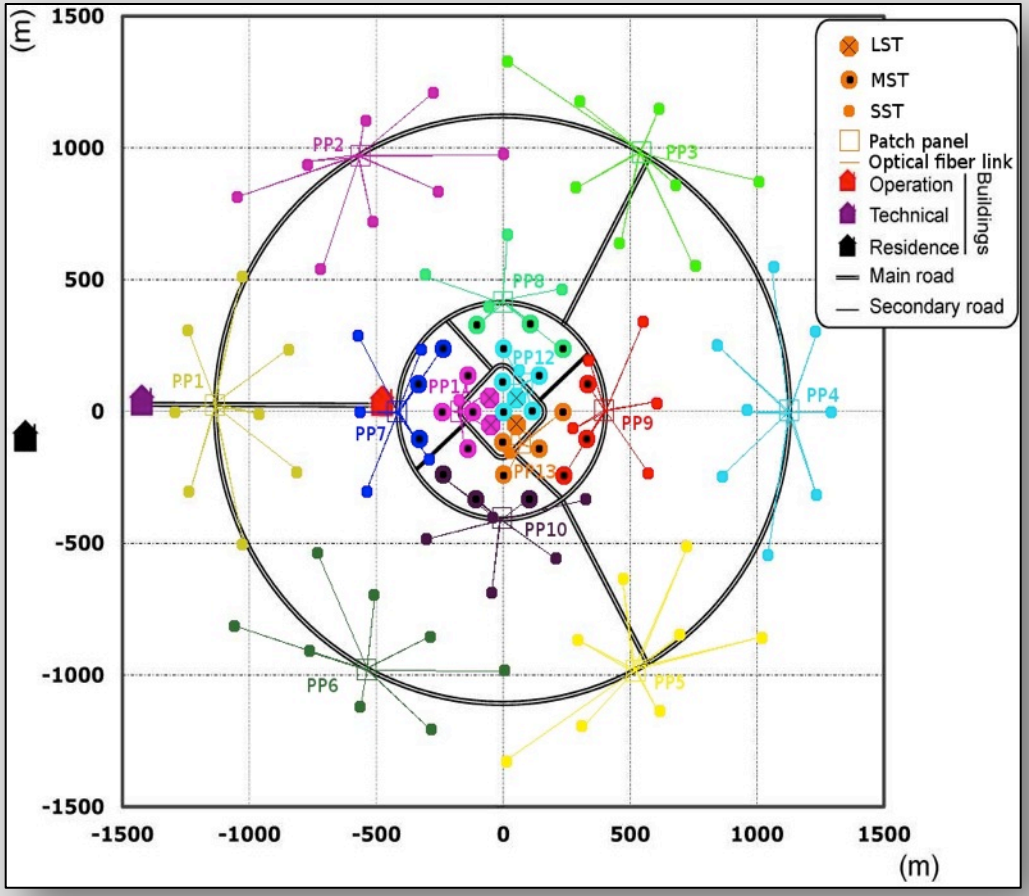
Max occupancy: ~ 30 pers.

Location: far enough to avoid disturbance (light)

Additional services:

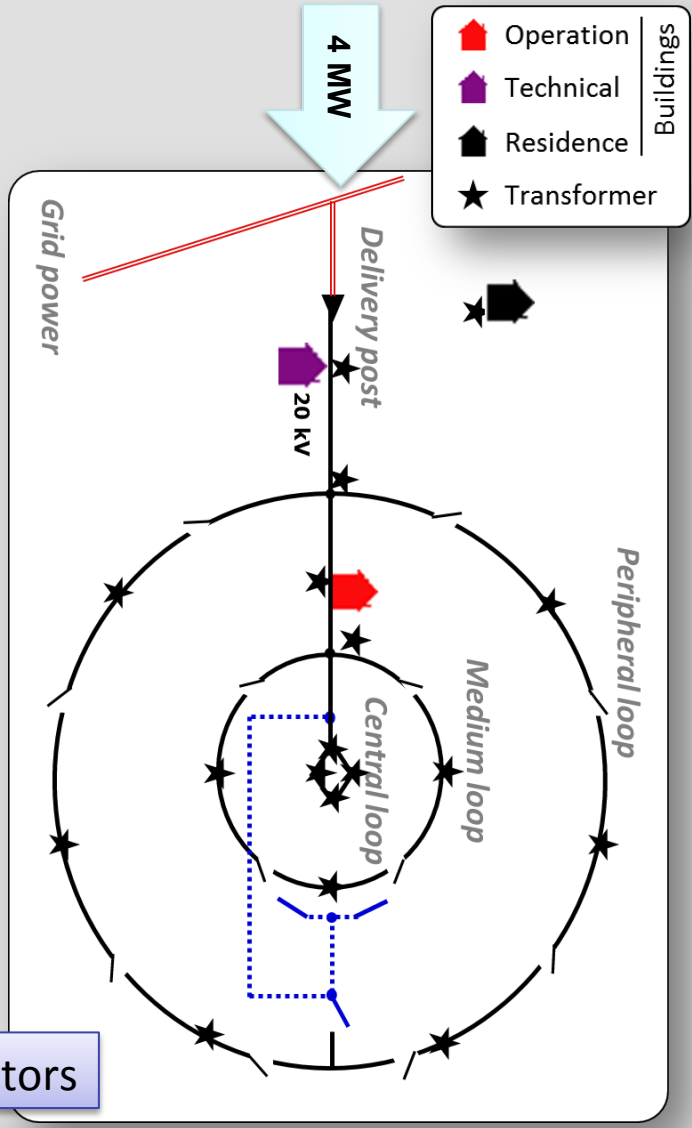
- reception/guard apartment
- medical unit

Civil infrastructures @ site(s)



Data network architecture

Power network architecture



+ Diesel/gas generators