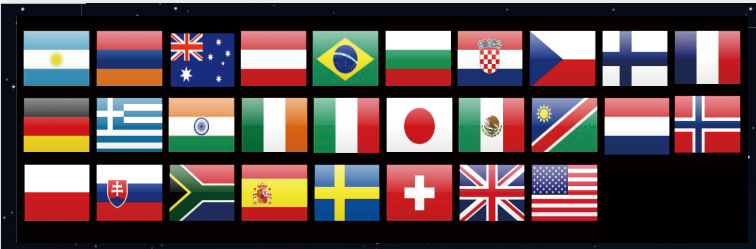
Status and Strategy of the CTA-Japan

Masahiro Teshima
ICRR, the University of Tokyo
Max-Planck-Institute for Physics

CTA: Big International Project



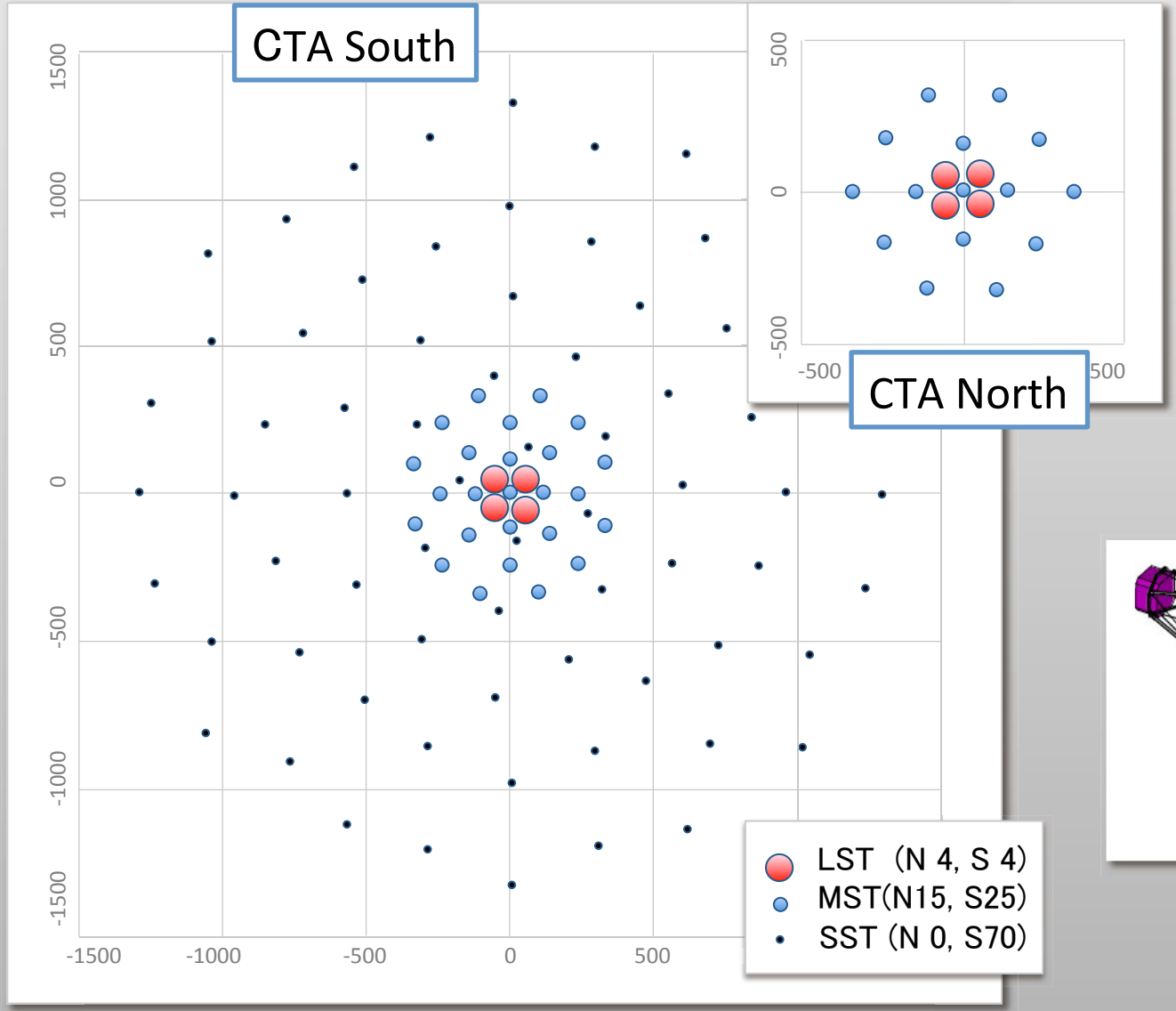
- 1200 scientists from 29 countries
- 101 scientists from Japan
- LST is the main contribution from CTA-Japan
- Japan is expected as a major contributor

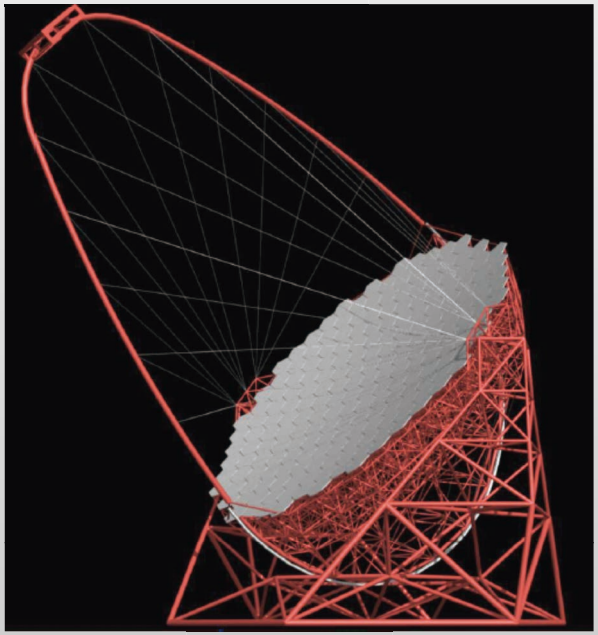
In comparison with current instruments, HESS, MAGIC and VERITAS

- Sensitivity x 10
- Angular resolutions x 3
- Energy band x 10
- Gamma ray horizon (z<4)
- Objects x 10

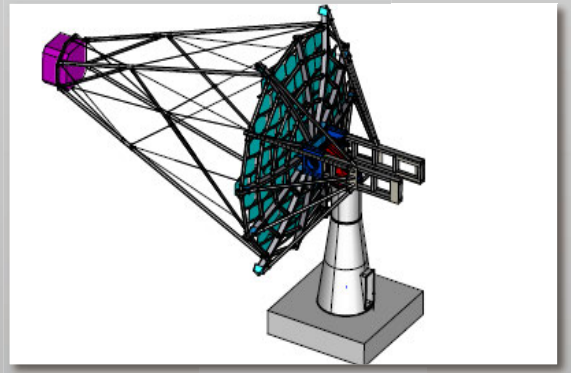
CTA huge array
(Cherenkov Telescope Array)

CTA consists of two stations, South and North

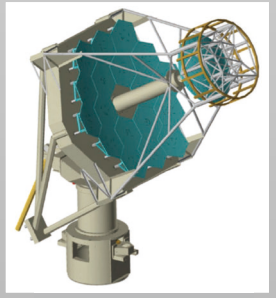




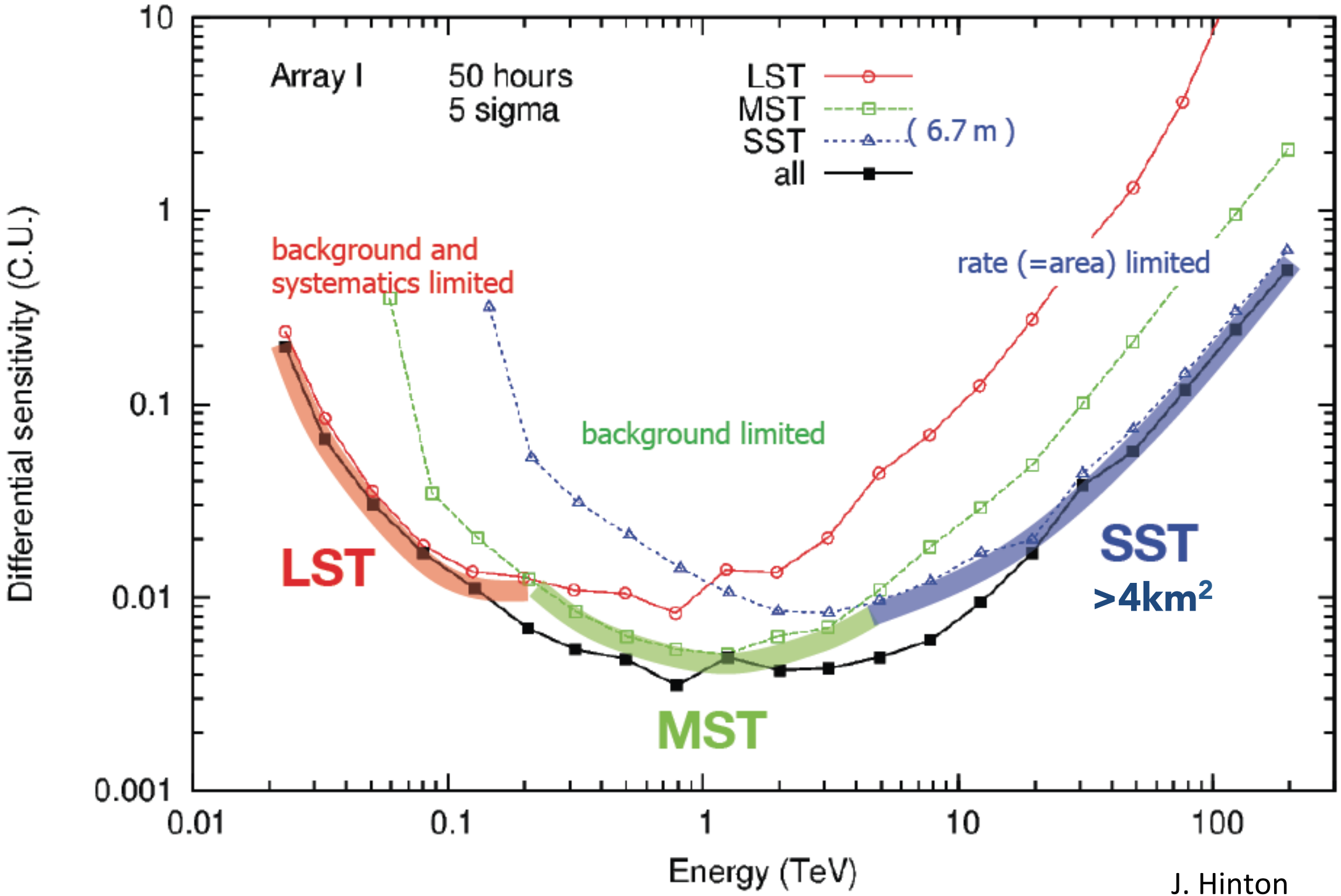
LST 23m



MST 12m



SST 4.3m

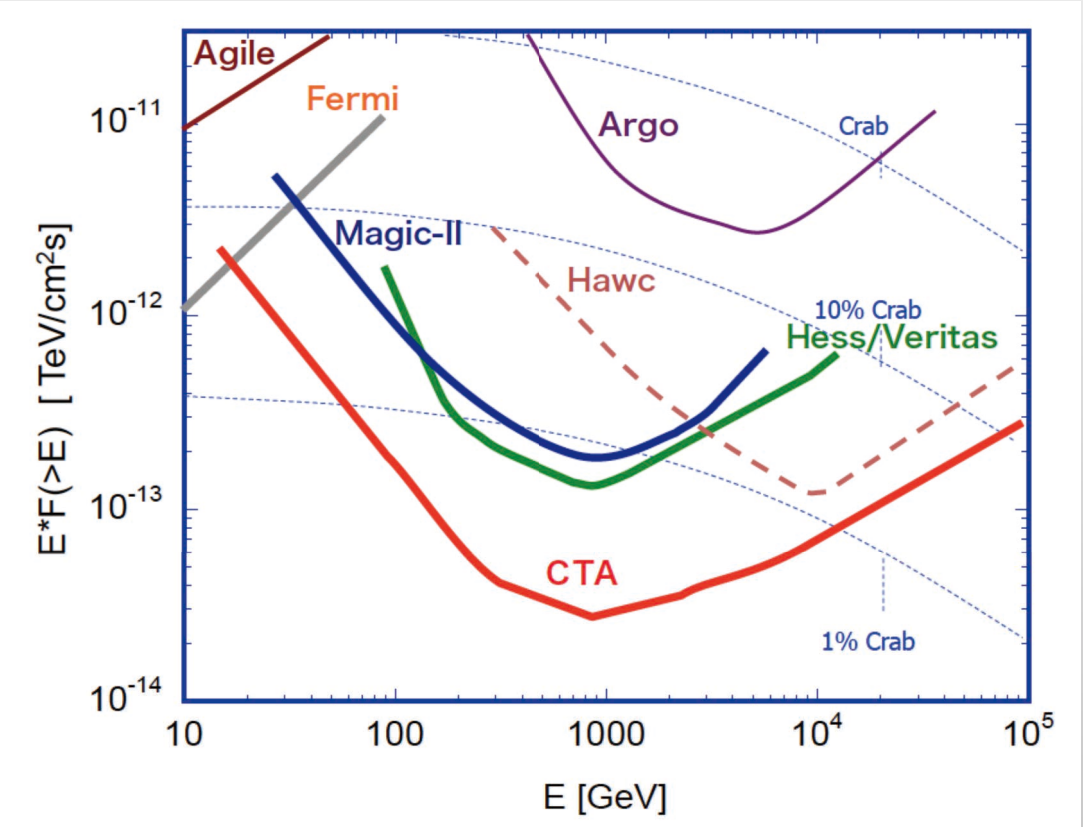

Array I
50 hours
5 sigma
LST
MST
SST
(6.7 m)
all
background and
systematics limited
background limited
rate (=area) limited
LST
MST
SST
>4km²
Differential sensitivity (C.U.)
Energy (TeV)
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

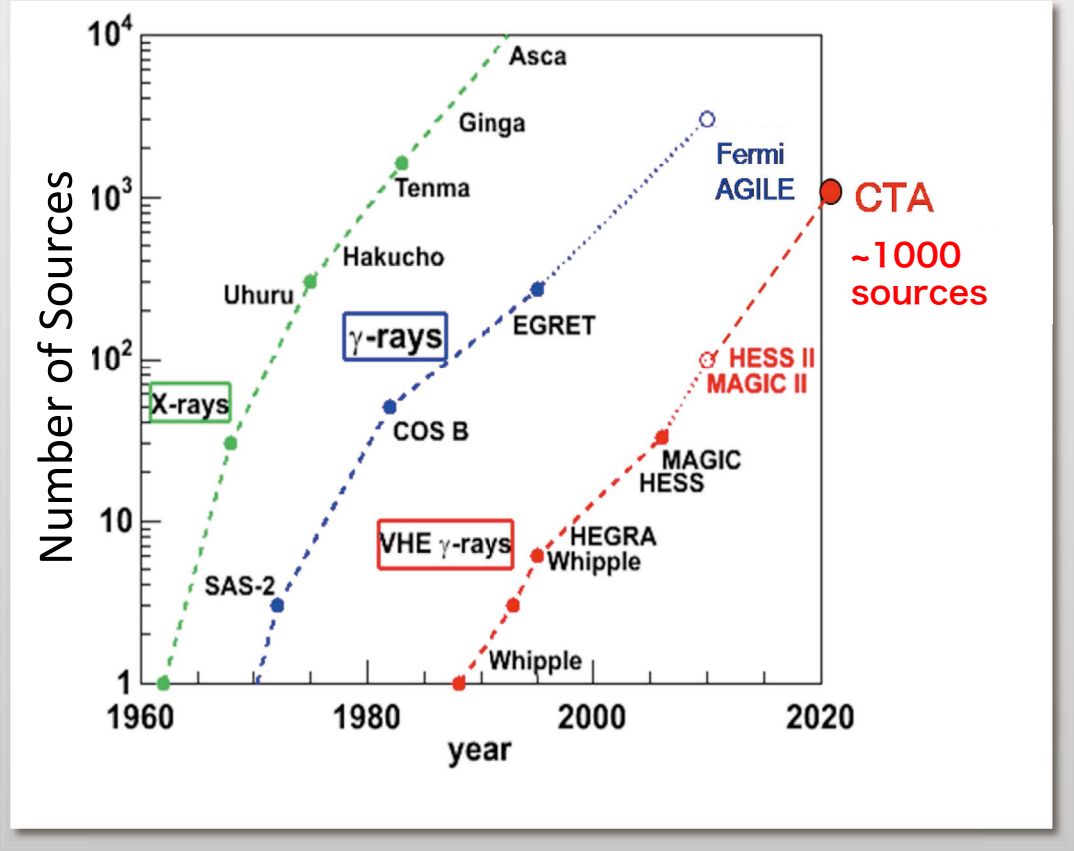
J. Hinton

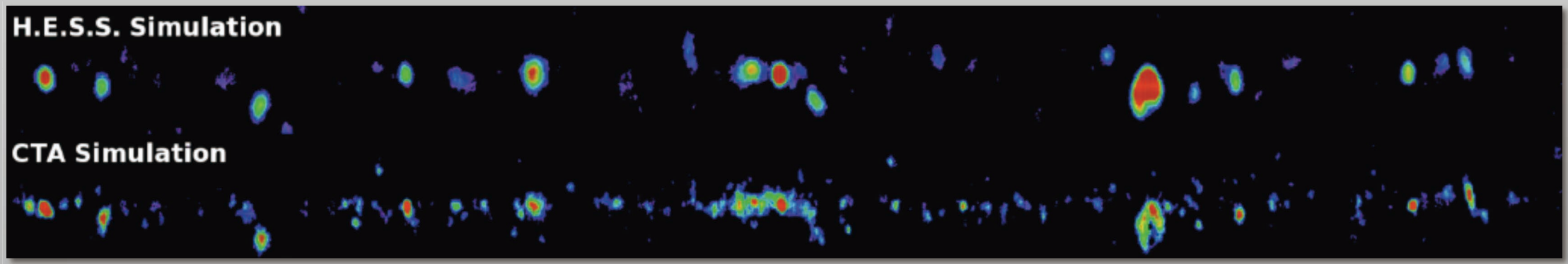
CTA（Cherenkov Telescope Array）covering 20GeV-100TeV

An order of magnitude better sensitivity
Wide energy coverage

More than 1000 sources will be discovered







Simulation Galactic Plane scan（HESS and CTA）

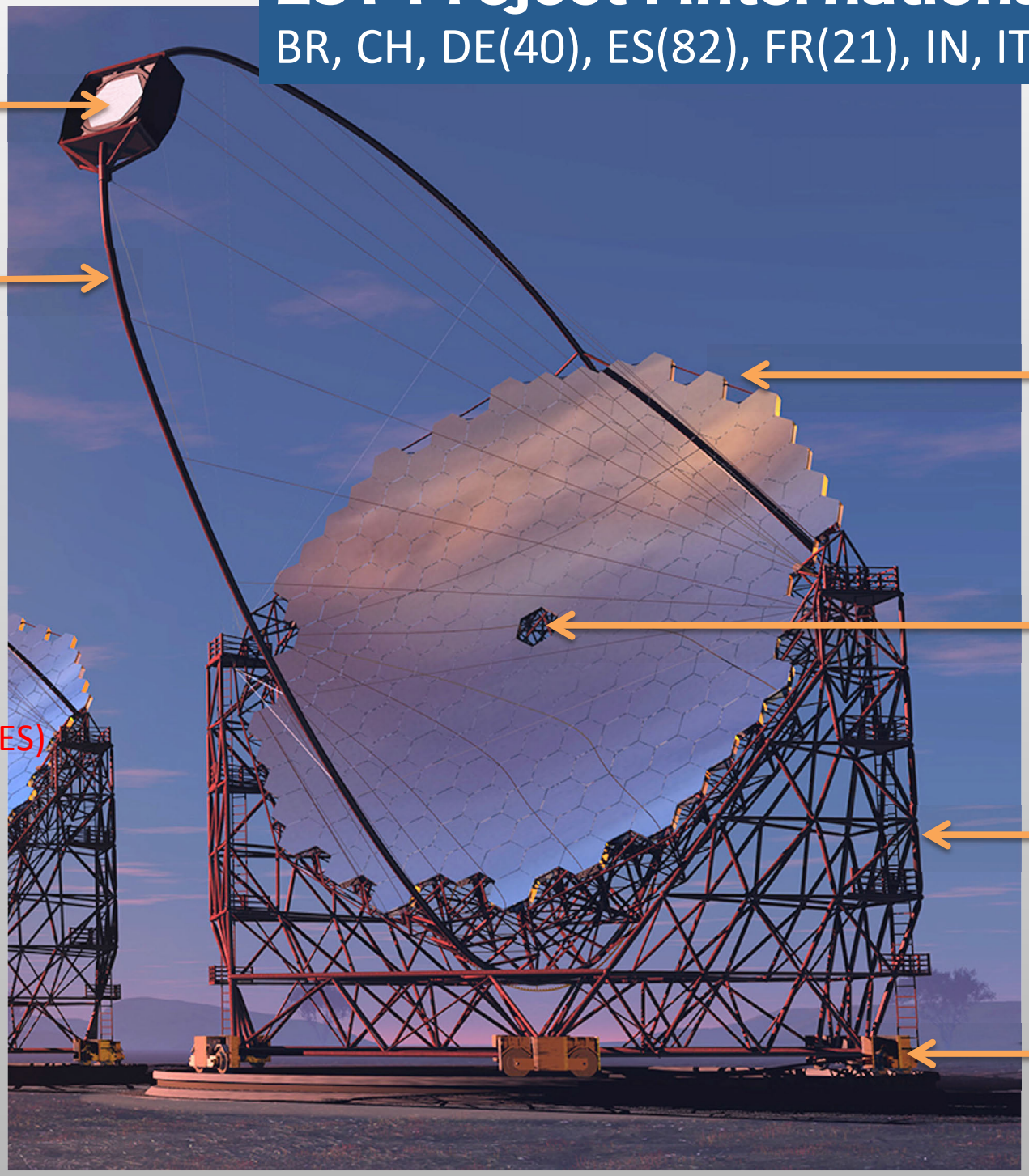
CTA Large Size Telescope

Major specifications

- Threshold energy **>20GeV**
- Telescope Structure
  - Diameter of dish 23 m
  - Parabolic optics 389 m^2
  - focal length 28 m
  - Weight 100 tons
  - CFRP mirror supp. structure
  - Fast rotation 180°/20sec
  - Tracking accuracy 14arcsec

LST Project : International Effort

BR, CH, DE(40), ES(82), FR(21), IN, IT(28), JP(60), SE



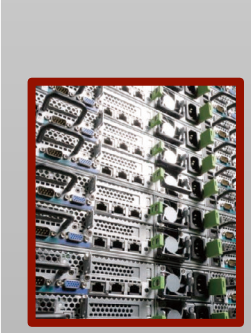
FPI/Elec (JP/IT/ES)
Camera body (ES/DE)

CSS (FR/IT)

MIR (JP)
Interface PL (DE/BR/JP)
Actuator (JP/CH)
CMOS-Cam (DE/JP)

StarGuider (SE)
CalibBox (IN/IT)

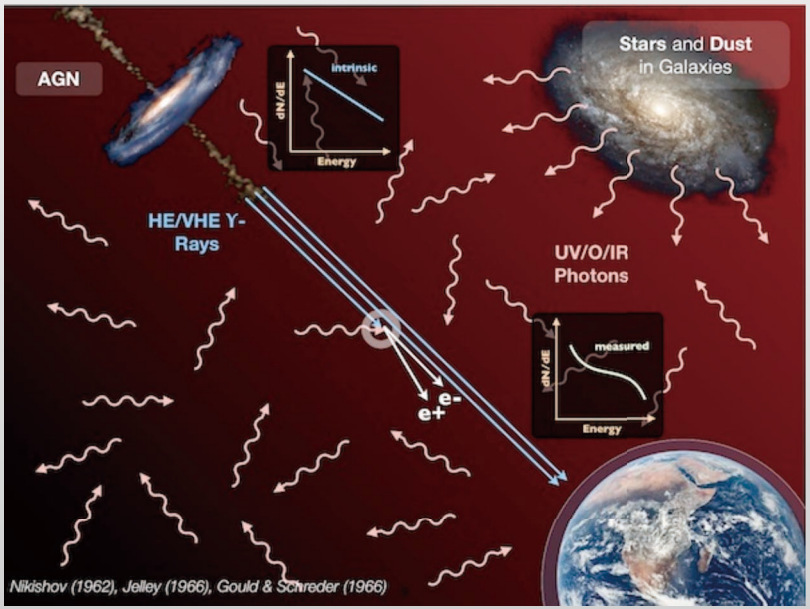
Flywheel, UPS (JP/DE/ES)
Comp. (DE/DATA)

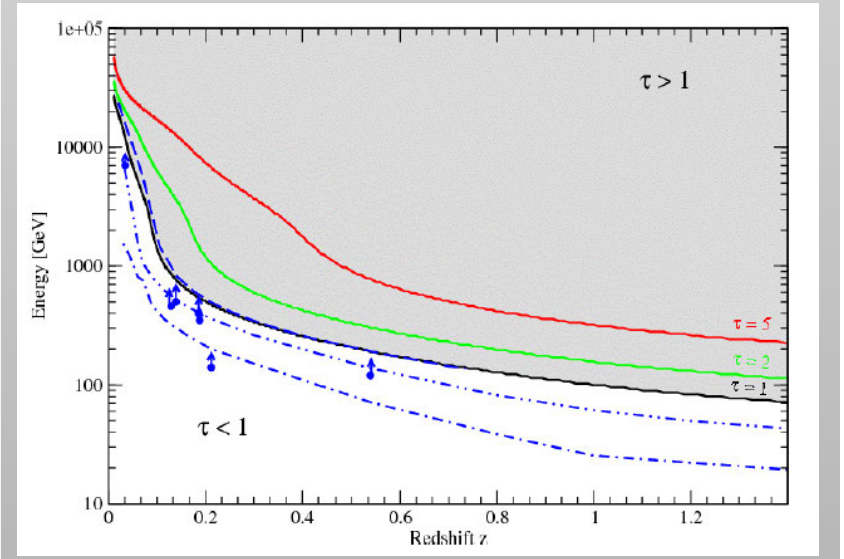


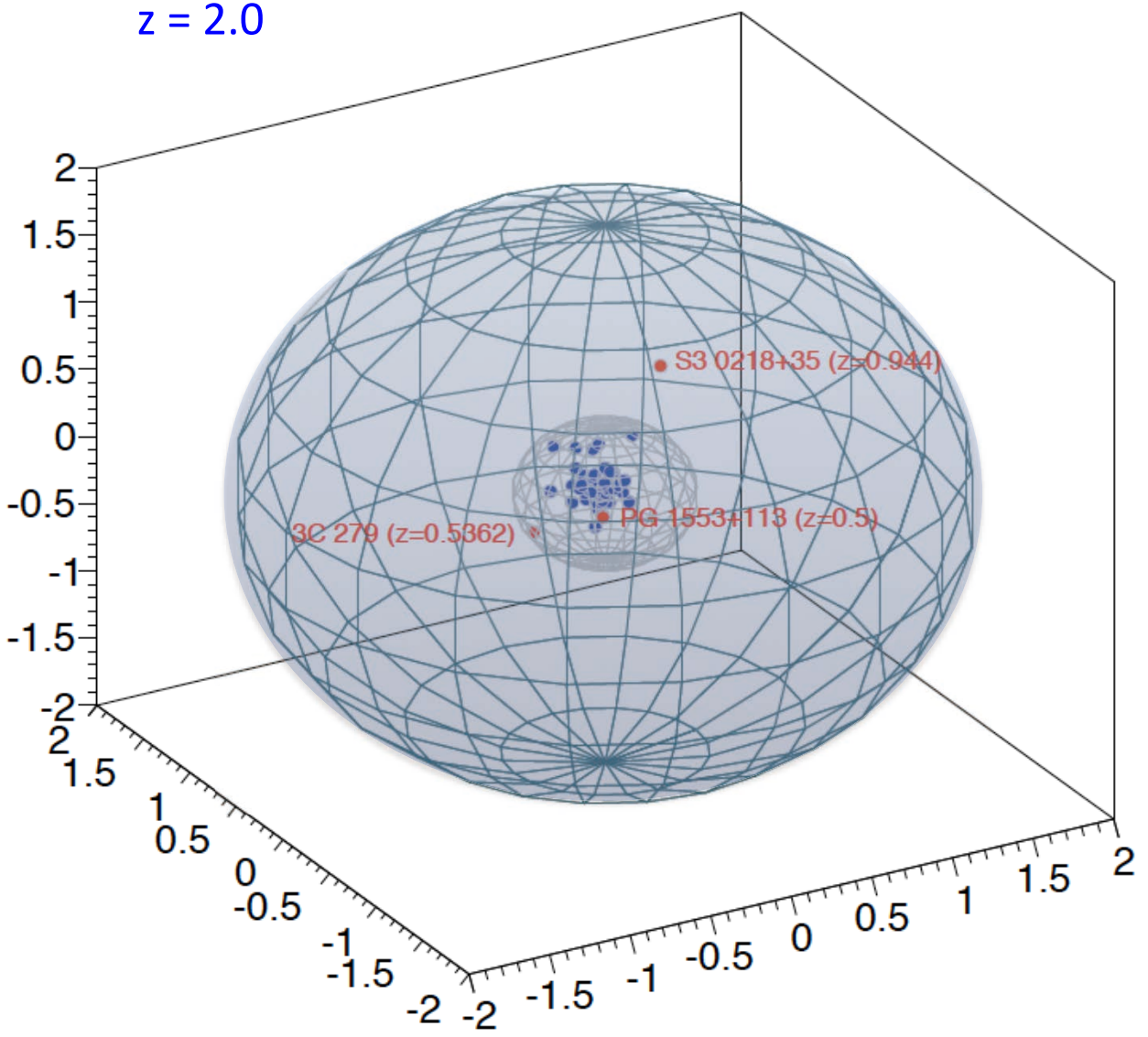
Structure (DE)
Access Tower (DE/ES)

Drive (DE/FR/ES)
Bogie (DE/ES)
Rail (DE/ES)
Found. (DE/ES/INFRA)

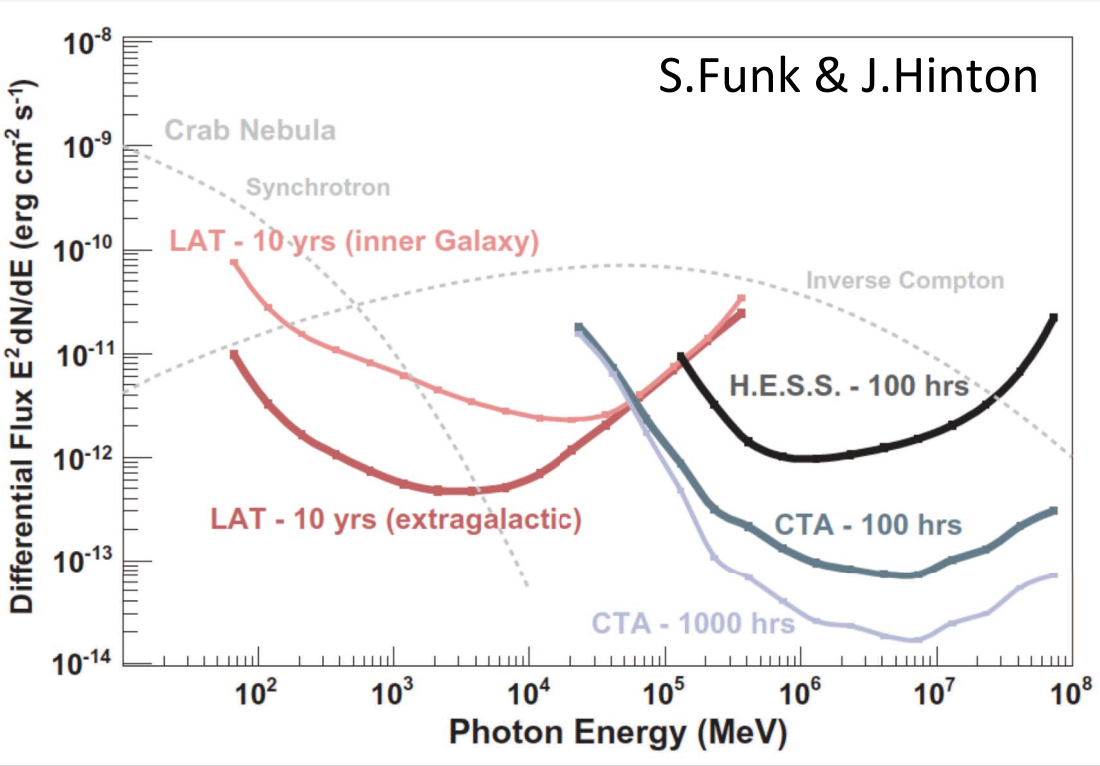
Ultimate Survey Machine for the extragalactic sources, AGN Survey (z < 2.0)







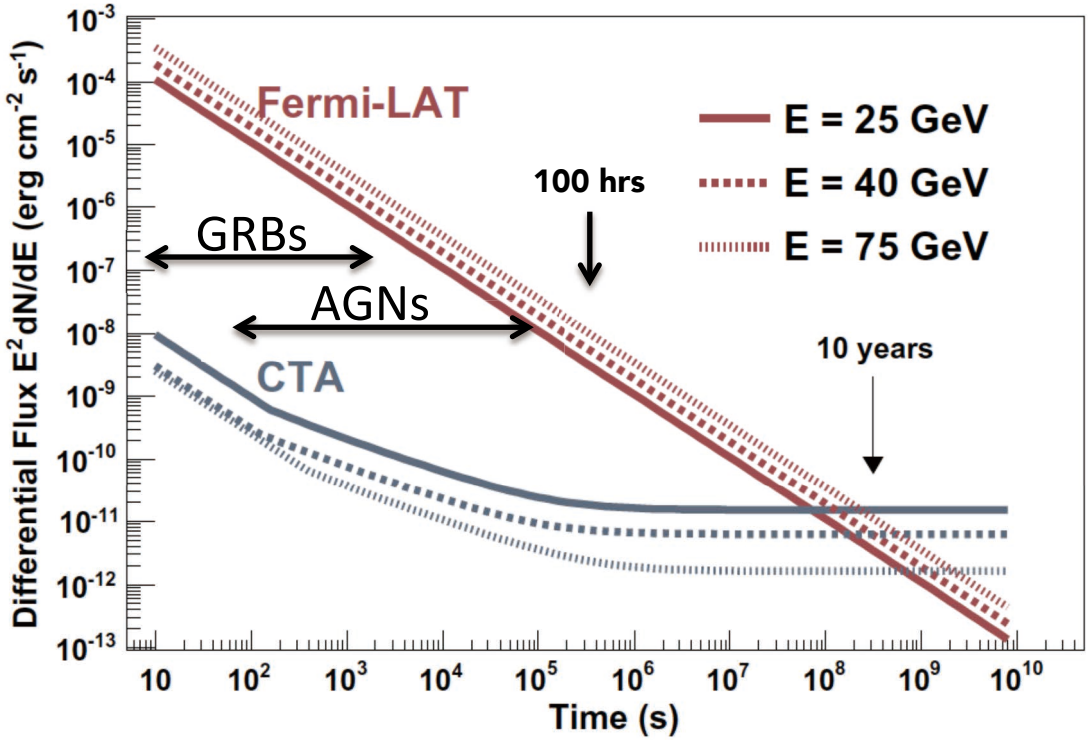
Comparison and Complementarity with Fermi



ENERGY DOMAIN

Cover 4 decades of Energy!!

After long observation, Crossing Energy is ~40GeV

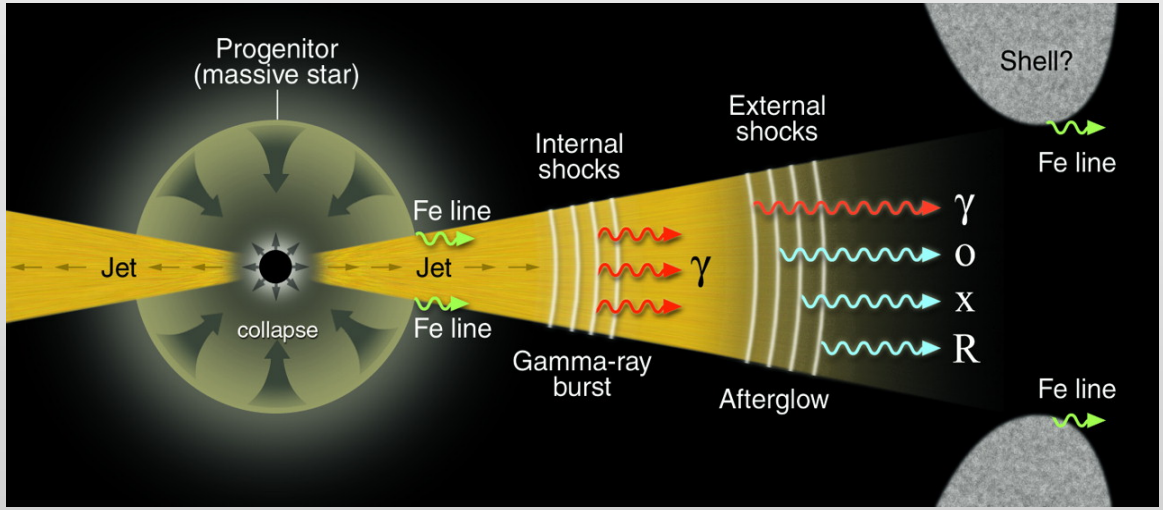


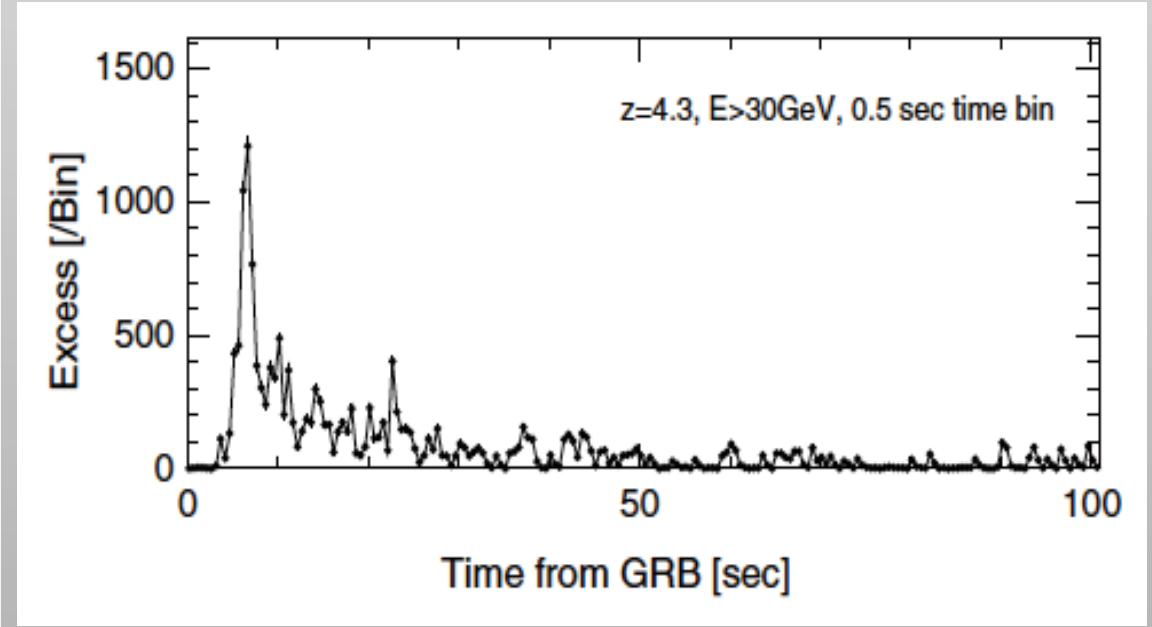
TIME DOMAIN

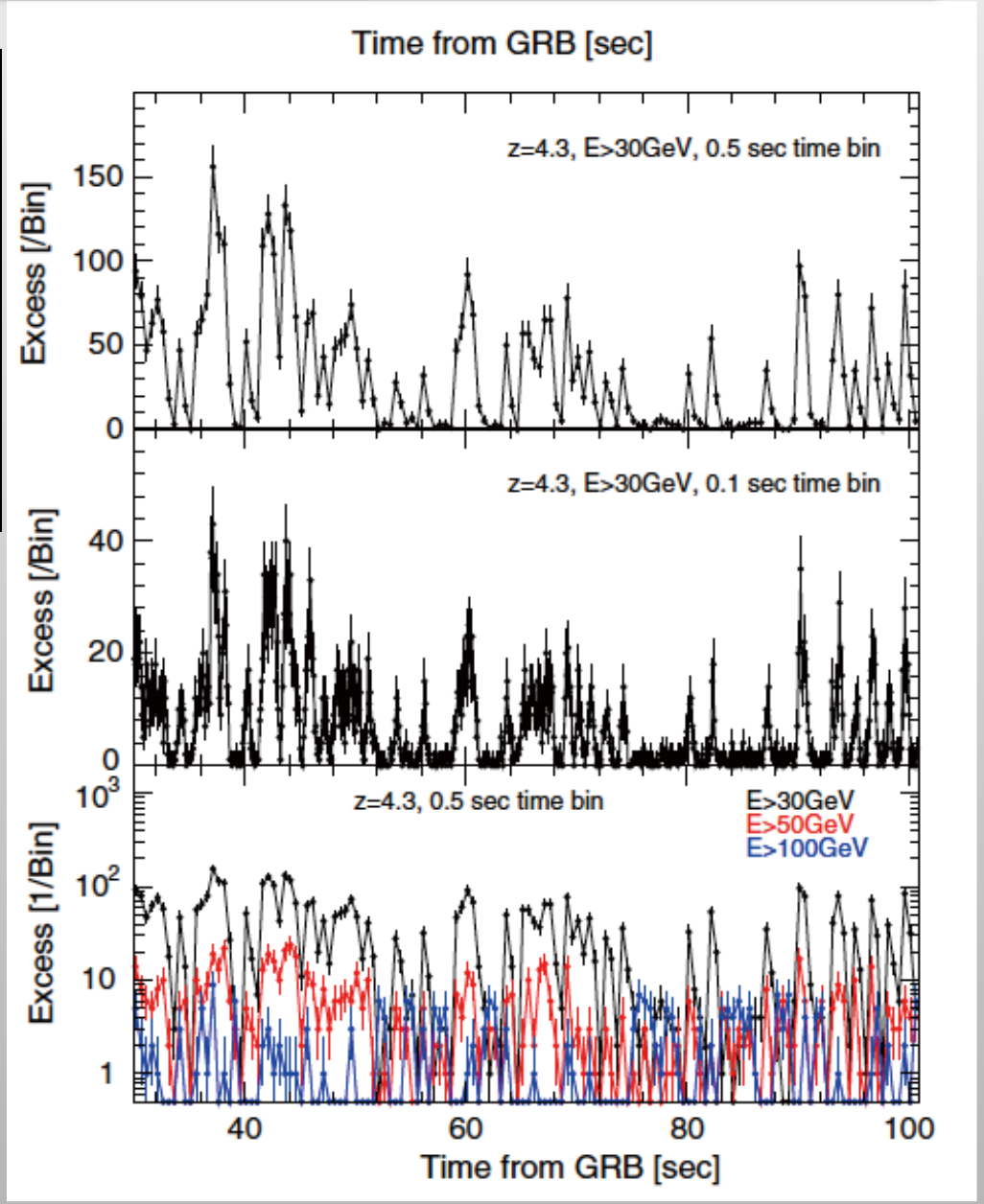
CTA-LSTs give a significant sensitivity for transient sources,

GRBs, AGNs, and Galactic Transients

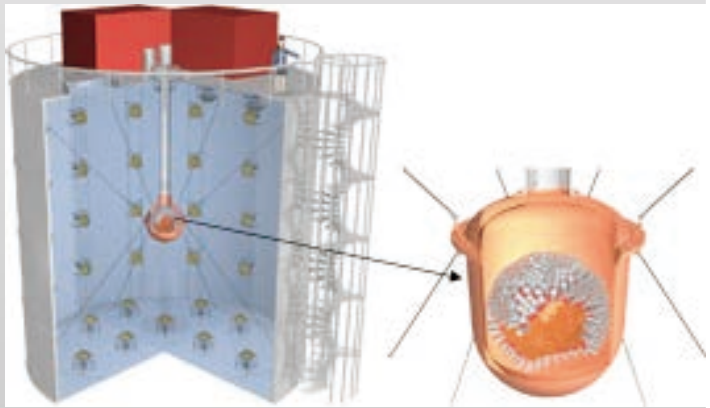
GRB: Simulation
(template: GRB080916C)
Birth of the BlackHole

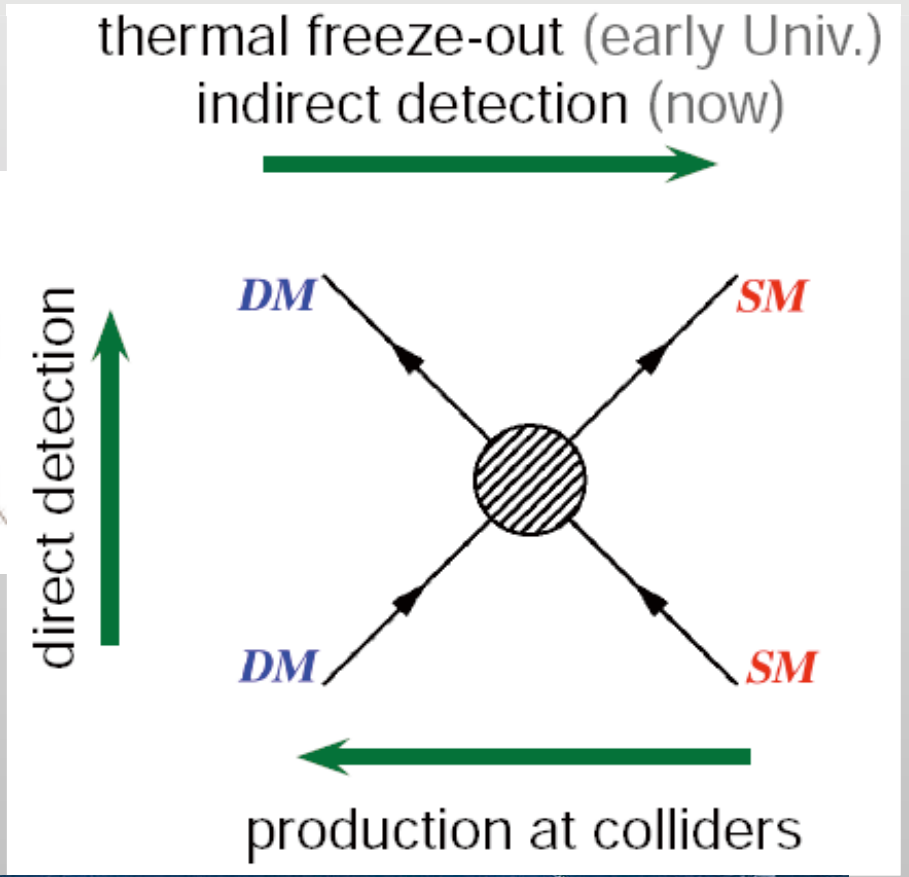


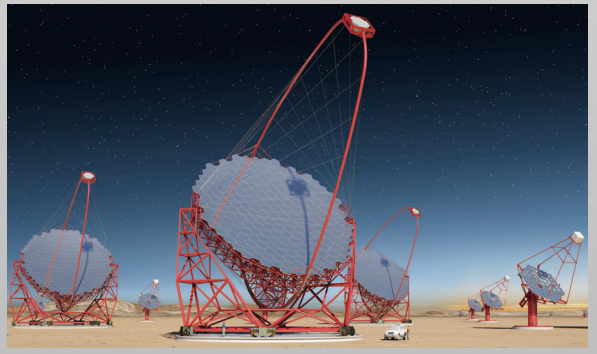


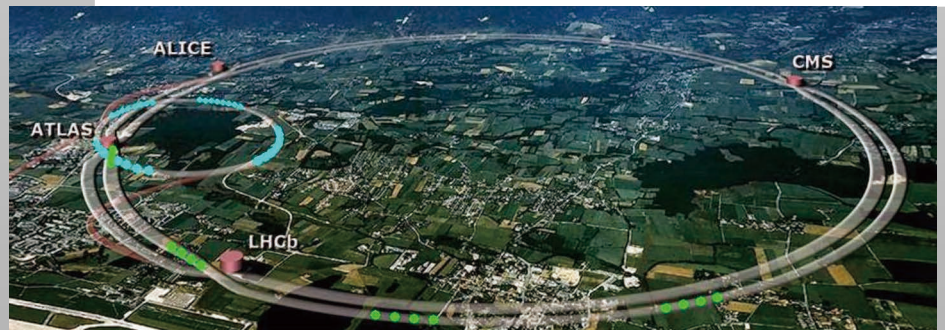


Search for DM
m_x~ 50-2000GeV





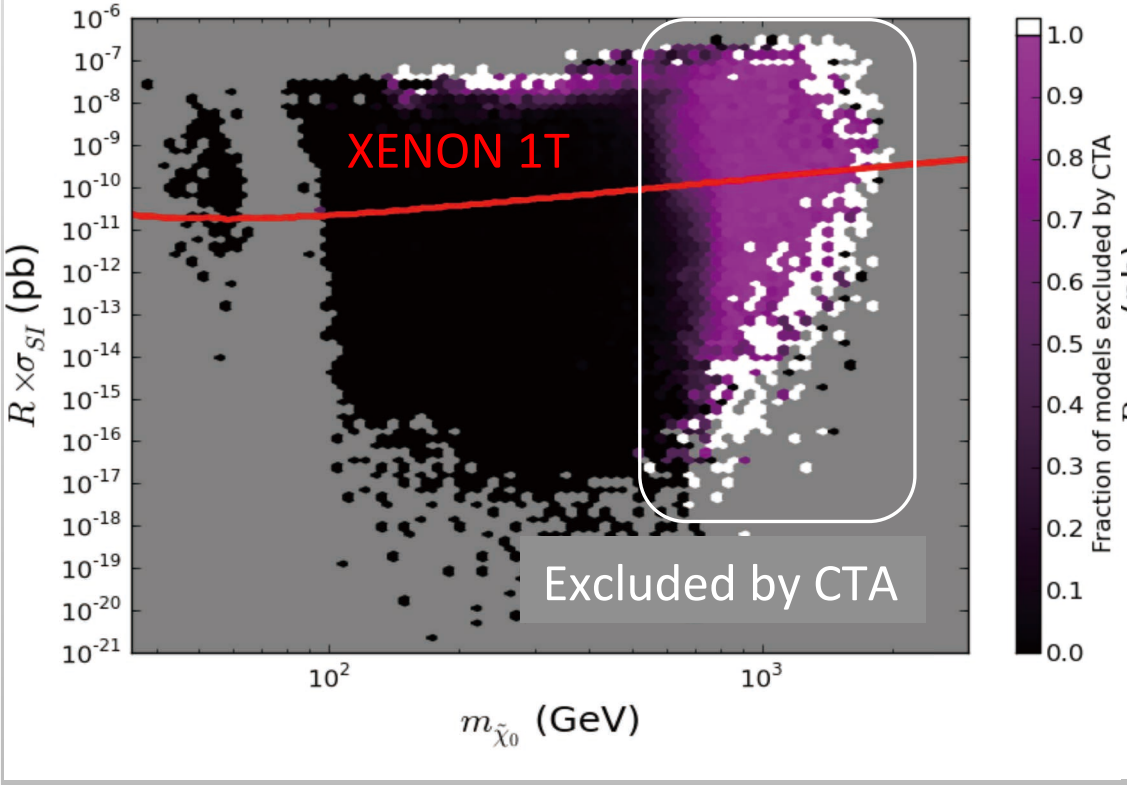


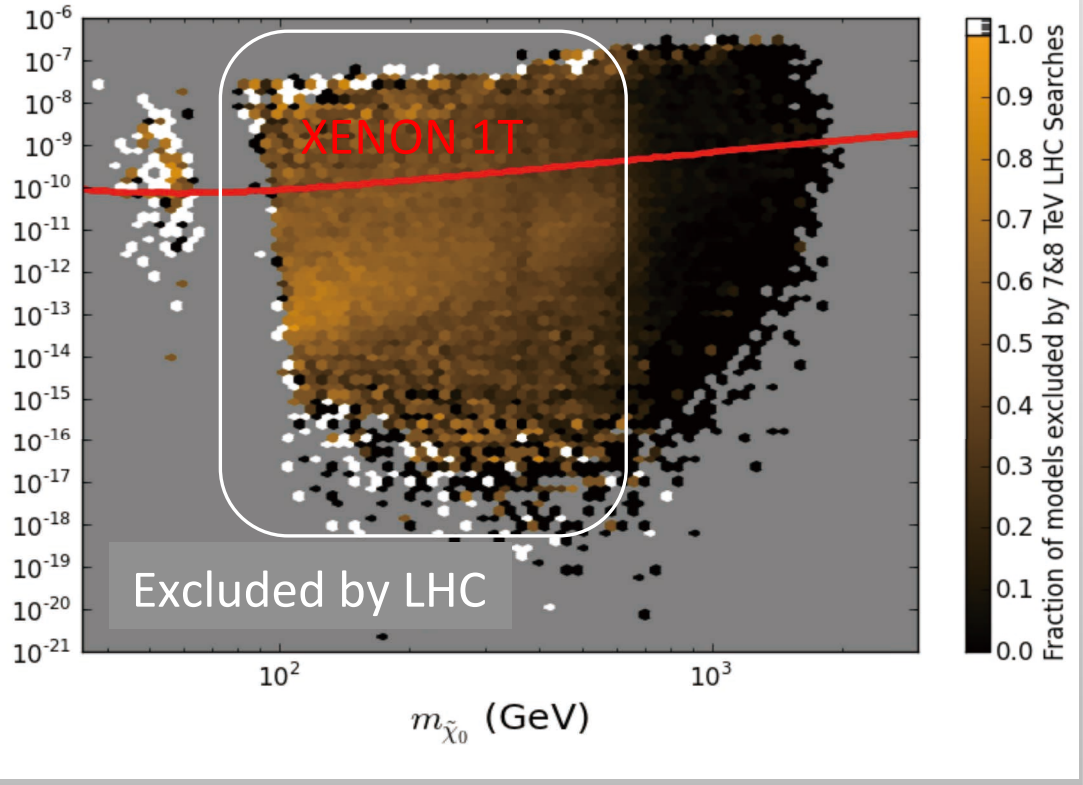


Complementarity with Direct Search, Indirect Search, and accelerators

Red : XENON 1T Sensitivity
Purple : CTA Sensitivity
Brown : LHC Sensitivity

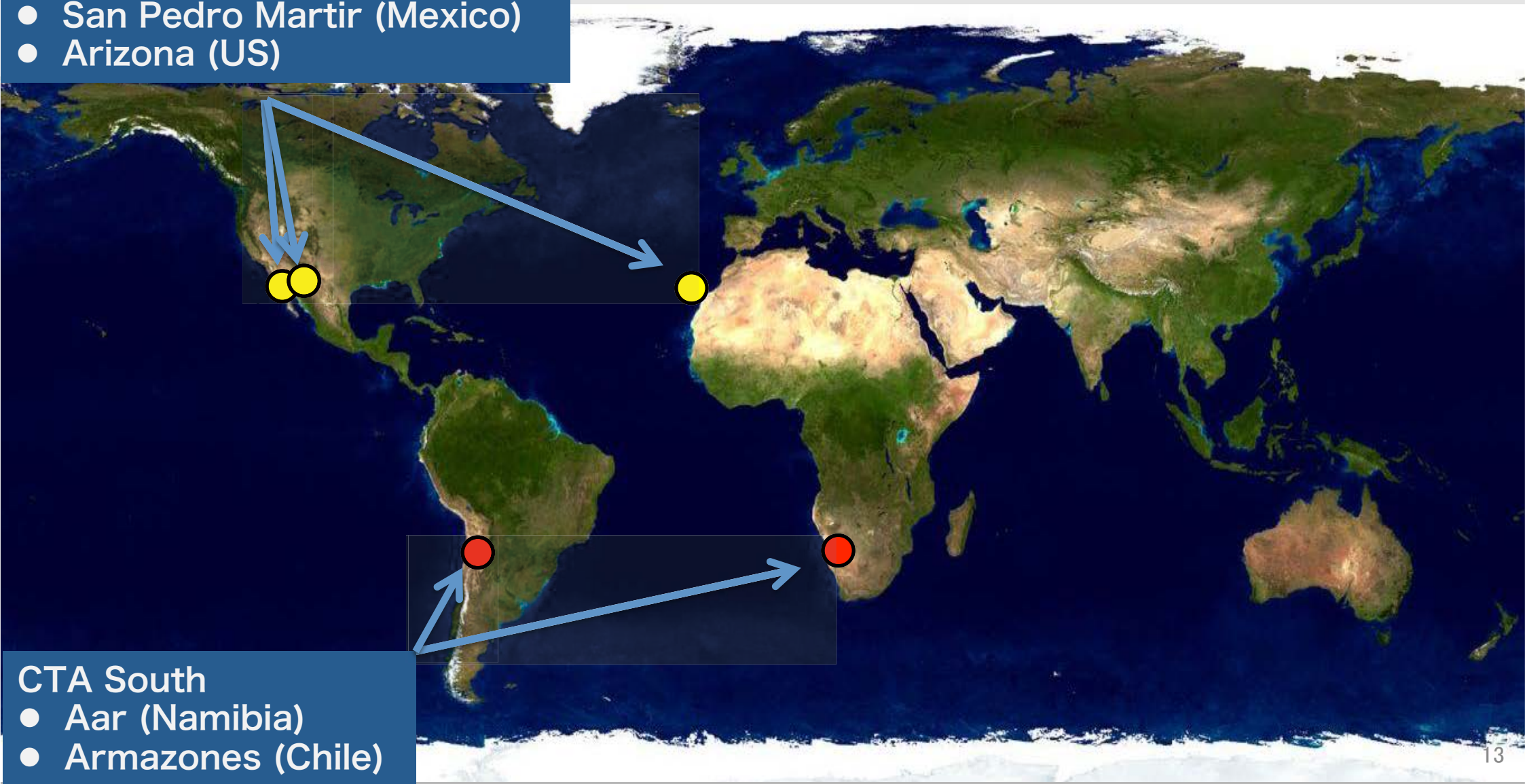
Cahill-Rowley+ hep-ph/1305.6921



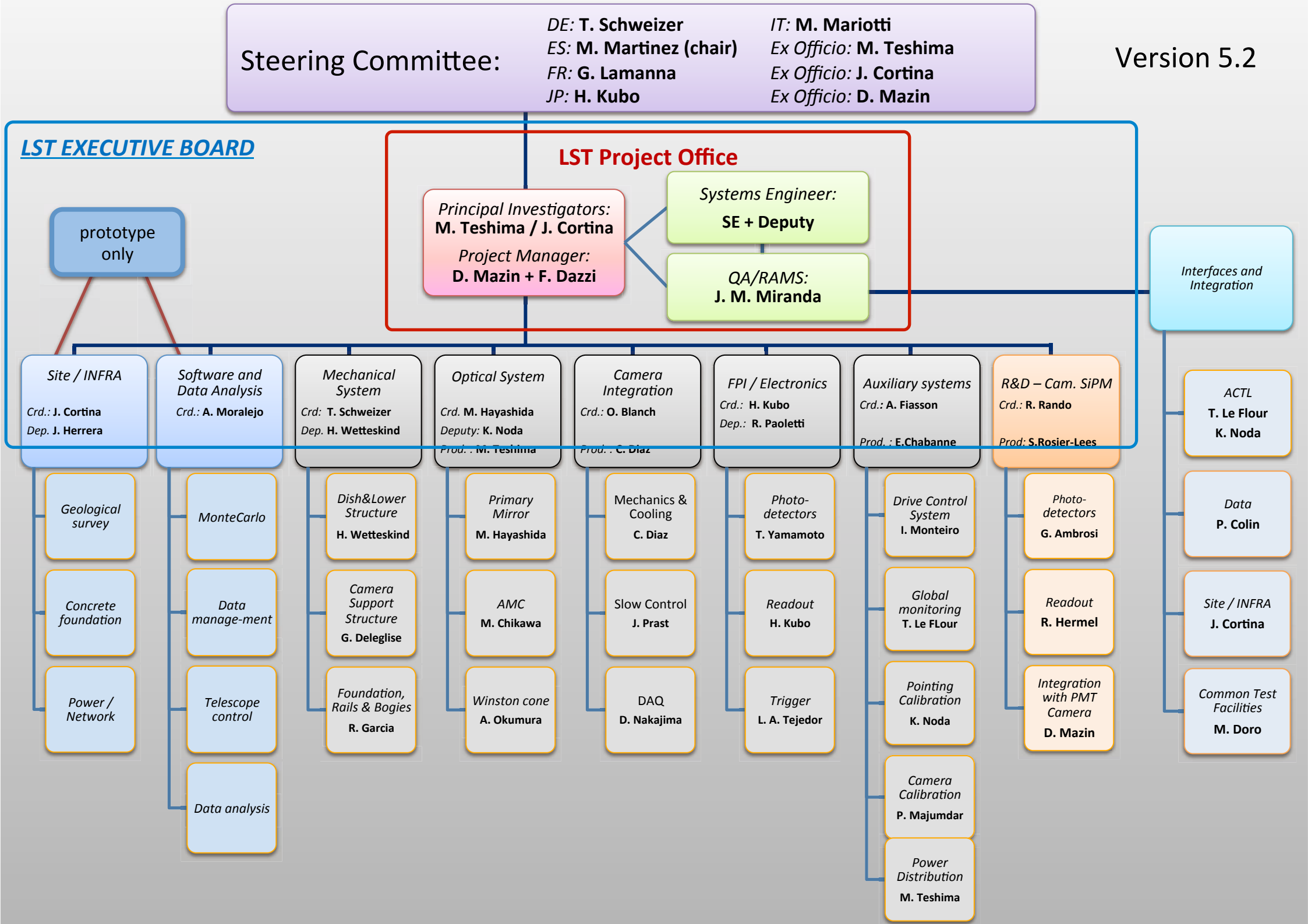


CTA Candidate site

CTA North
- Canaries (Spain)
- San Pedro Martir (Mexico)
- Arizona (US)



CTA South
- Aar (Namibia)
- Armazones (Chile)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Ex Officio: M. Teshima
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Project Manager:
D. Mazin + F. Dazzi
Systems Engineer:
SE + Deputy
QA/RAMS:
J. M. Miranda
prototype only
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Site / INFRA
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Dep. J. Herrera
Software and Data Analysis
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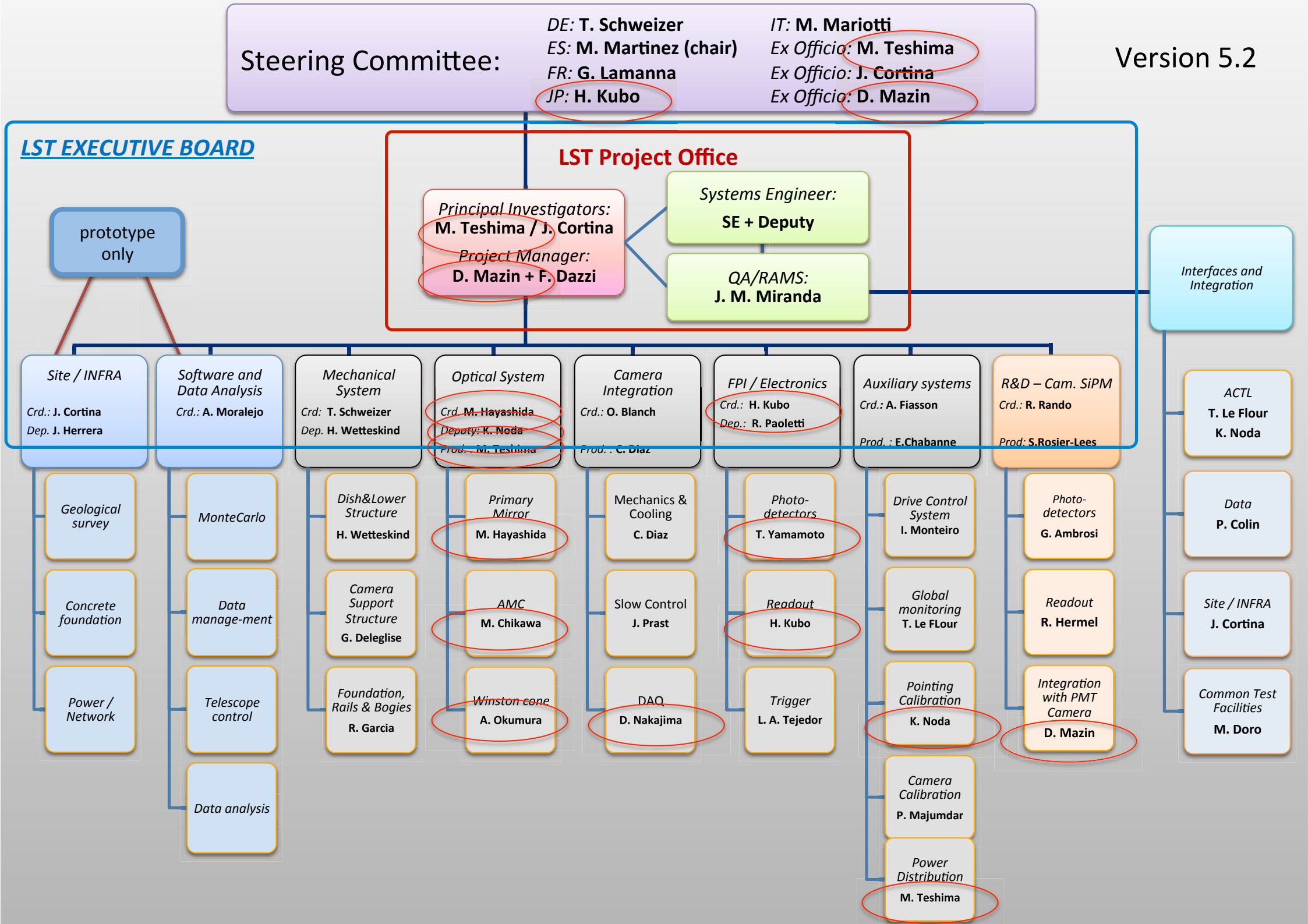
R&D – Cam. SiPM
Crd.: R. Rando
Prod: S.Rosier-Lees
Geological survey
Concrete foundation
Power / Network
MonteCarlo
Data manage-ment
Telescope control
Data analysis
Dish&Lower Structure
H. Wetteskind
Camera Support Structure
G. Deleglise
Foundation, Rails & Bogies
R. Garcia
Primary Mirror
M. Hayashida
AMC
M. Chikawa
Winston cone
A. Okumura
Mechanics & Cooling
C. Diaz
Slow Control
J. Prast
DAQ
D. Nakajima
Photo-detectors
T. Yamamoto
Readout
H. Kubo
Trigger
L. A. Tejedor
Drive Control System
I. Monteiro
Global monitoring
T. Le FLour
Pointing Calibration
K. Noda
Camera Calibration
P. Majumdar
Power Distribution
M. Teshima
Photo-detectors
G. Ambrosi
Readout
R. Hermel
Integration with PMT Camera
D. Mazin
ACTL
T. Le Flour
K. Noda
Data
P. Colin
Site / INFRA
J. Cortina
Common Test Facilities
M. Doro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CTA-Japan (計101名, 院生28名含)

青学大 大平豊、澤田真理、柴田徹、馬場彩、山崎了、吉田篤正
茨城大 小野祥弥、加賀谷美佳、片桐秀明、長紀仁、柳田昭平、吉田龍生
宇宙研 井上芳幸、李兆衡
大阪大 藤田裕
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東大天文 川中宣太、戸谷友則
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名大KMI 松本浩典
名大理 佐野栄俊、立原研悟、鳥居和史、早川貴敬、福井康雄、福田達哉、山本宏昭、吉池 智史
名大STE 奥村曉、河島孝則、 田島宏康、日高直哉
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Executive Board PI:手嶋、Co-PI:窪、Collaboration Board Chair:戸谷
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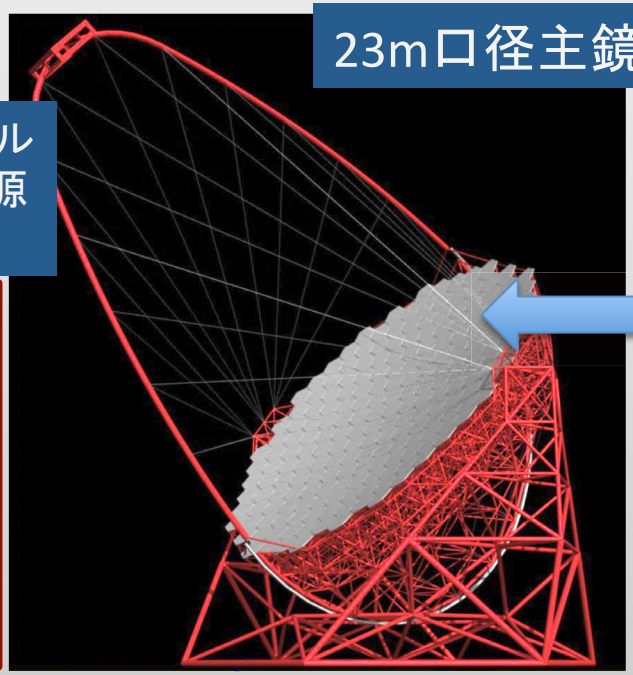
光検出器/較正：山本常、回路：窪、SCカメラ：田島

Japanese contribution to LSTs
1510mm Mirrors, Active Mirror Control, Flywheel

23m口径主鏡は200枚の分割鏡からなる

フライホイール
高速回転電源
1MW >30sec

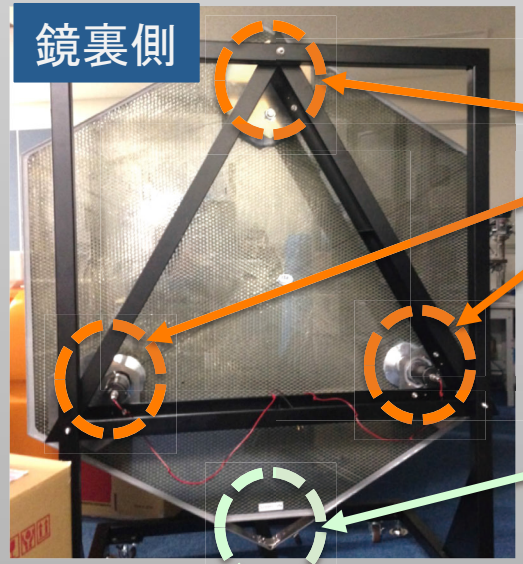


ミラー諸元

- 面積 $2m^2$
- 軽量化 47kg
- 高耐候性 >10年以上
- 高反射率 >93%
- 多層膜コート

能動的ミラー制御

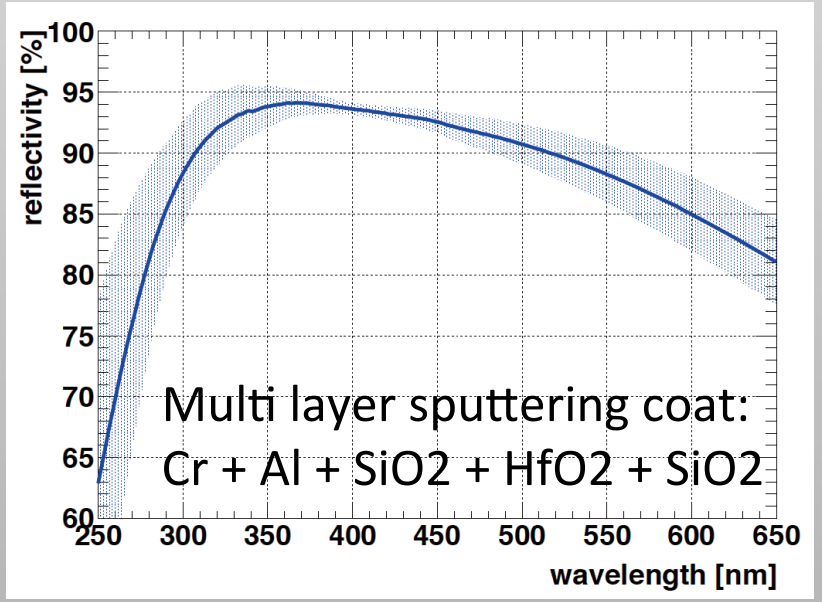
- 防水型 CMOS Camera で鏡方向を±5秒角で読み出す
- アクチュエーターにより、分割鏡の方向を±5秒角で制御し、主鏡のたわみを補正する

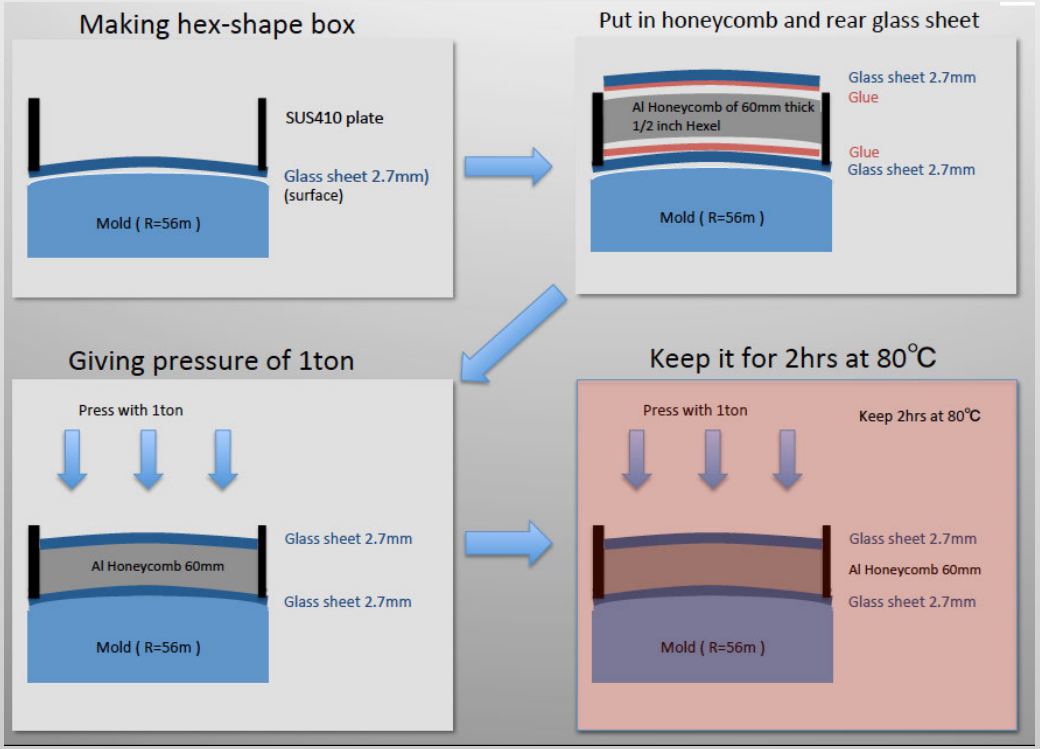


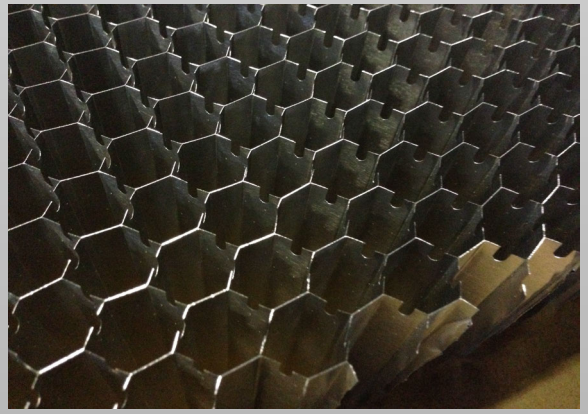
アクチュエーター

CMOS Camera

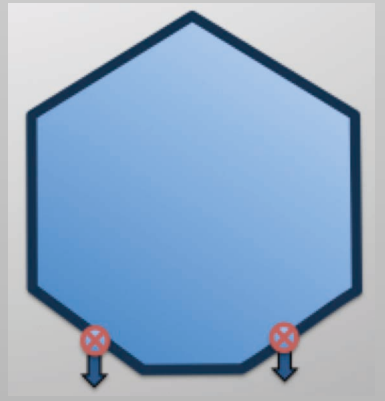
Mirror production process Sputtering and Cold Slump





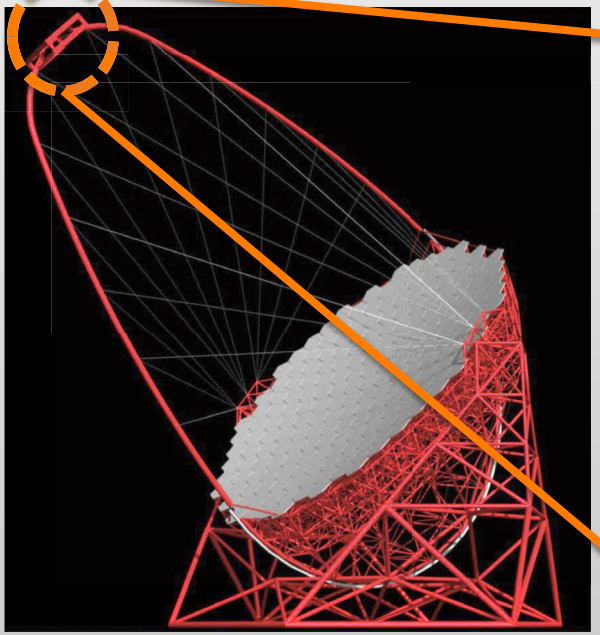


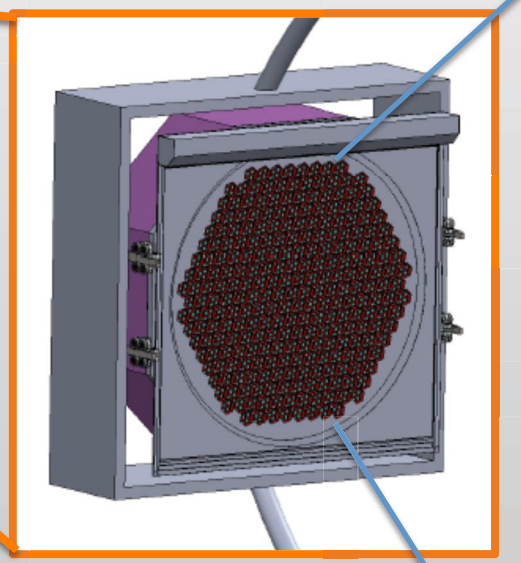
Honeycomb with slites

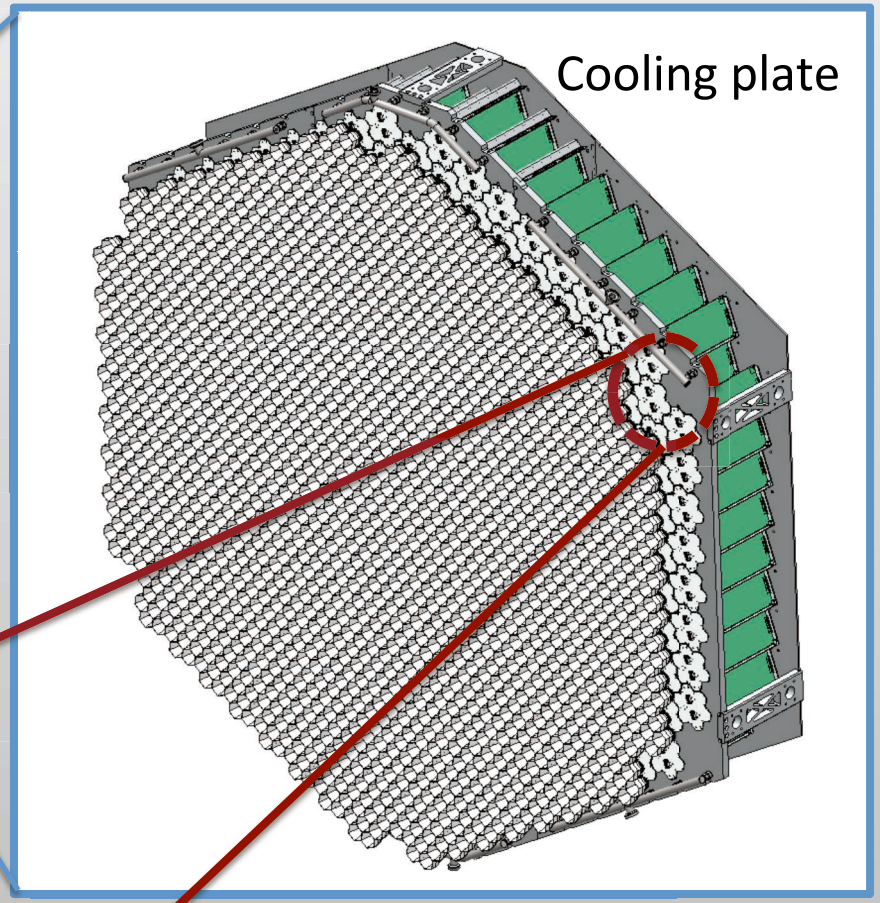


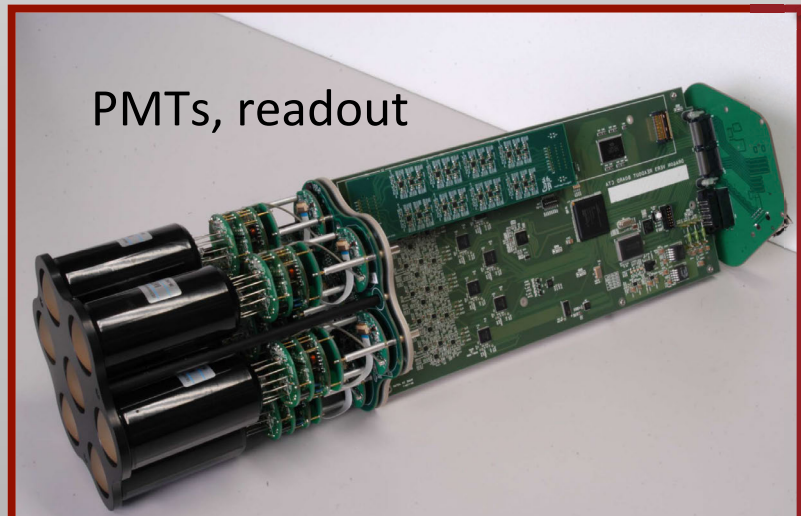
water drains

Japanese contribution to LST Camera
Cooling, Photomultipliers, Electronics, DAQ



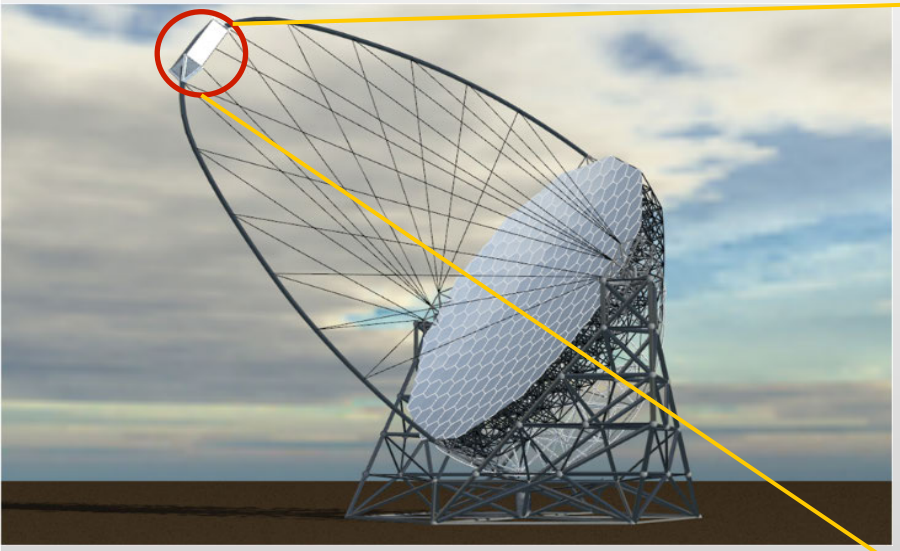


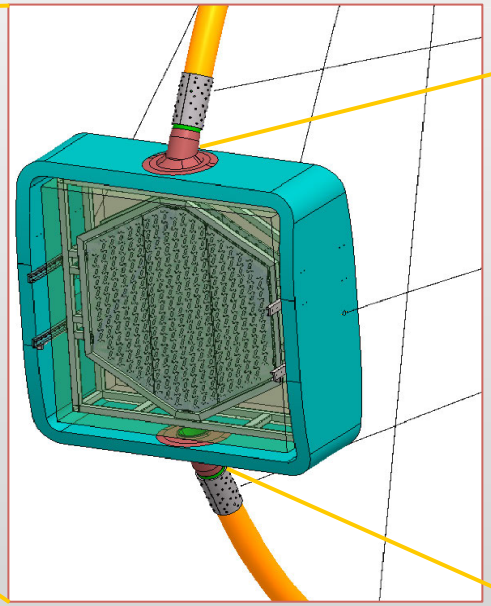




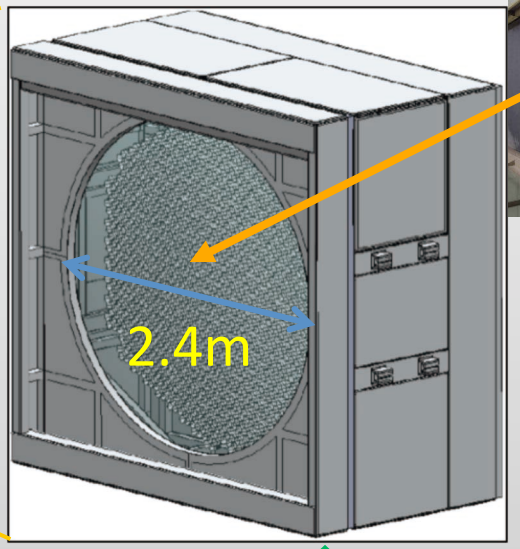
x 1855 PMTs
x 1855 GHz readout system

LST Camera Structure





Entrance

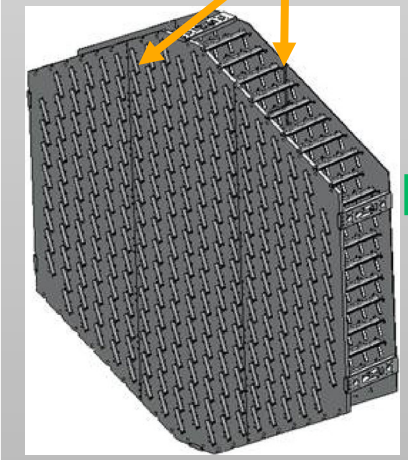


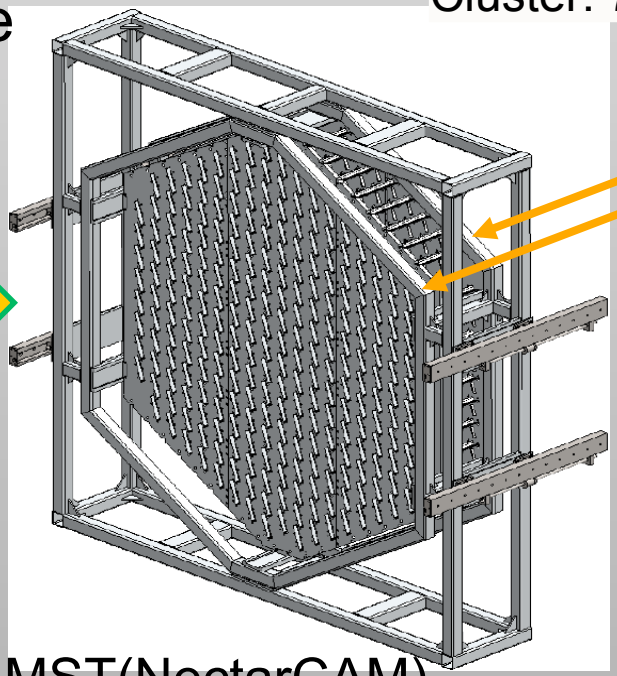
Weight
< 2000 kg

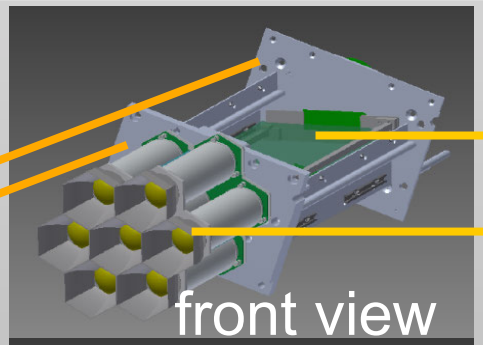
Cluster: 7 PMTs + Readout

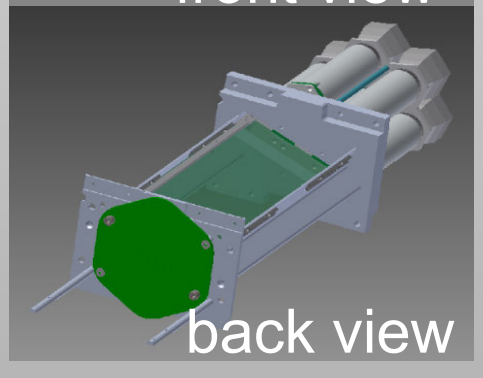
1855 PMTs

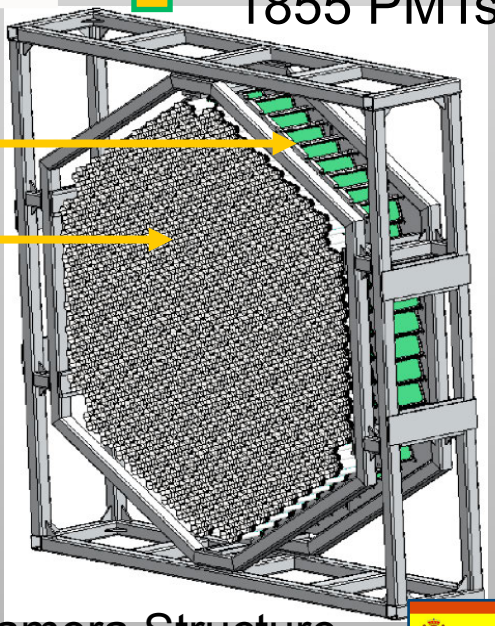
Alumi. plate











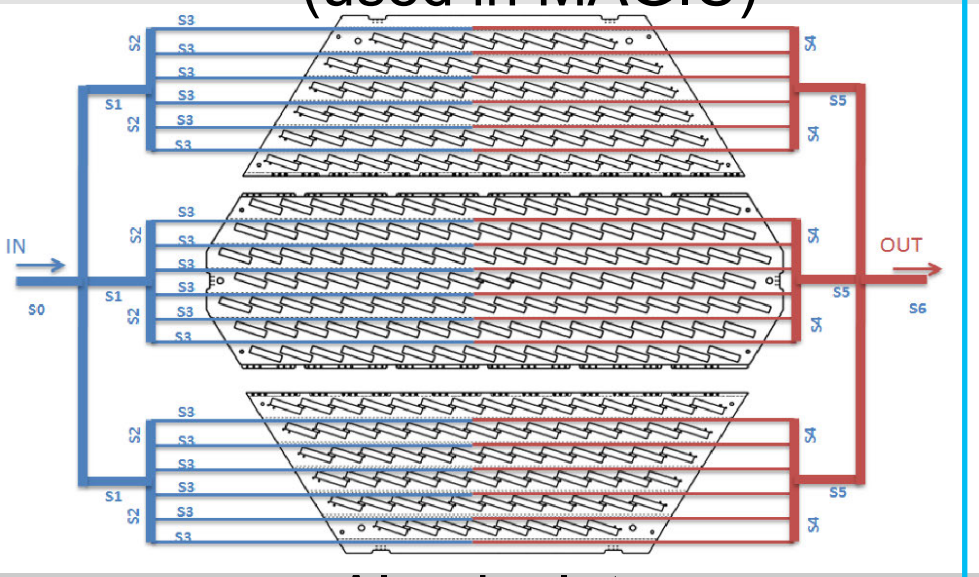
Commonality with MST(NectarCAM)

Camera Structure
Cluster structure

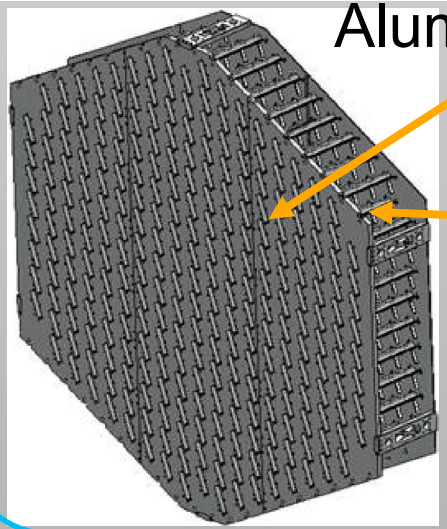
Camera Cooling

- Camera power 7kW⇒ Hybrid of Water and air cooling
- Design • Manufacturing：Spain, France, Japan

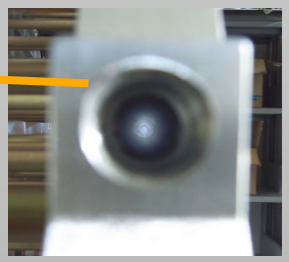
Water cooling (used in MAGIC)



Alumi. plate

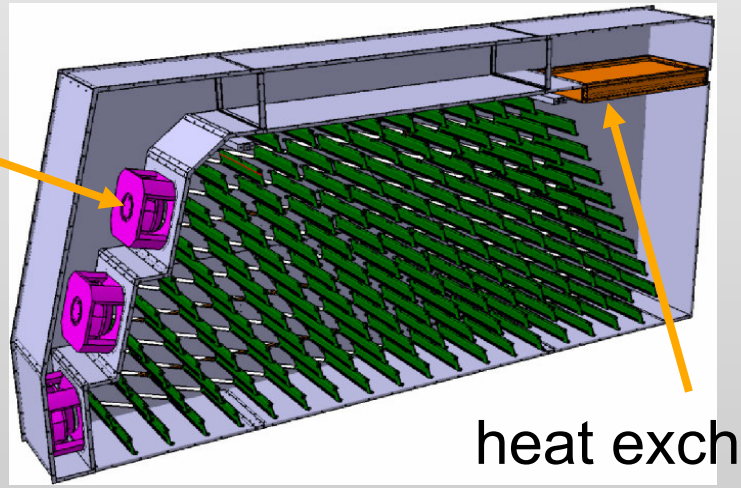


water holes

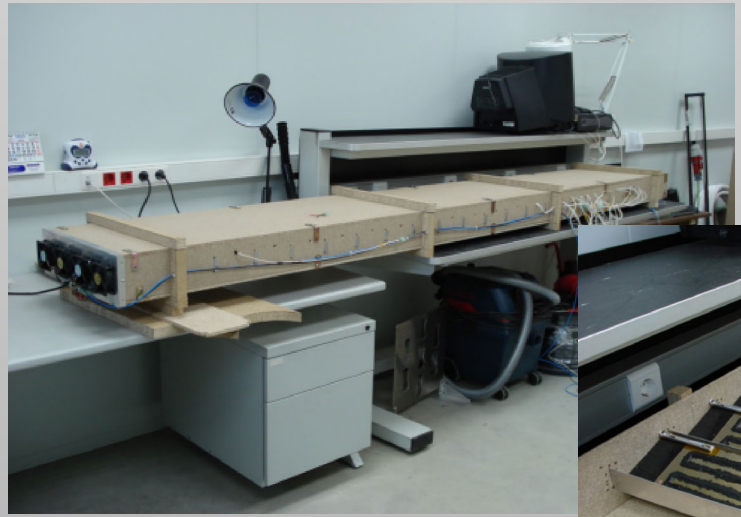


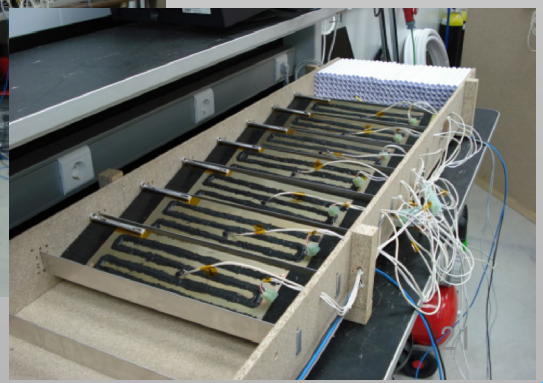
Air cooling

Fans



heat exchanger





PMT + CW-HV

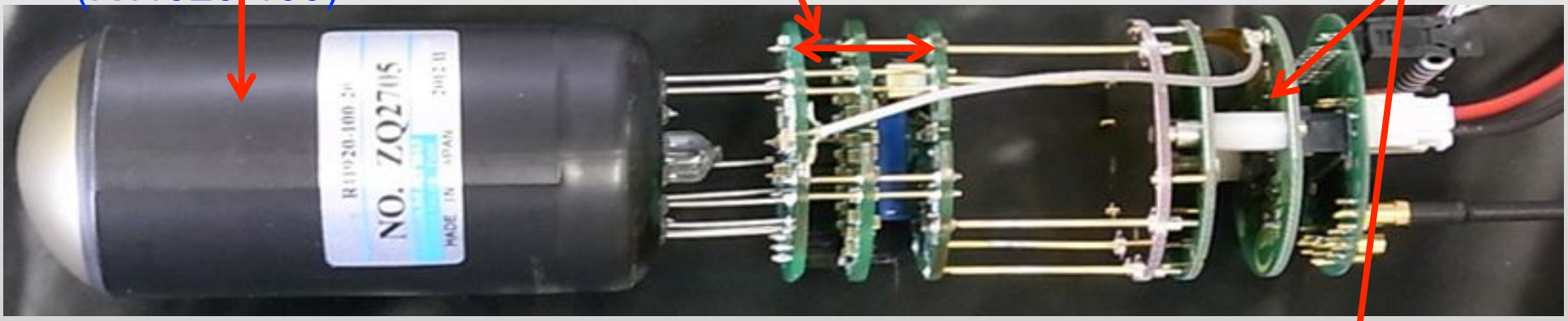
- 1855 PMTs /cam
  1.5”PMT
  developed with HPK
  (R11920-100)

Cockcroft-Walton HV

Low power consumption 50mW/ch

HPK, 850-1500V (1st Dy: 350V)

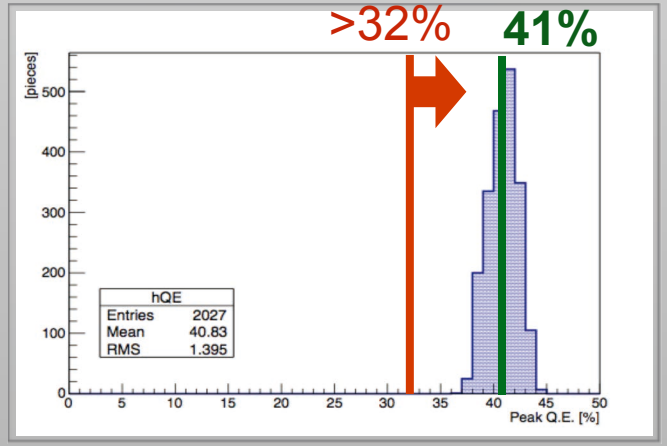
Preamp PCB



High Q.E.

Req. >32%

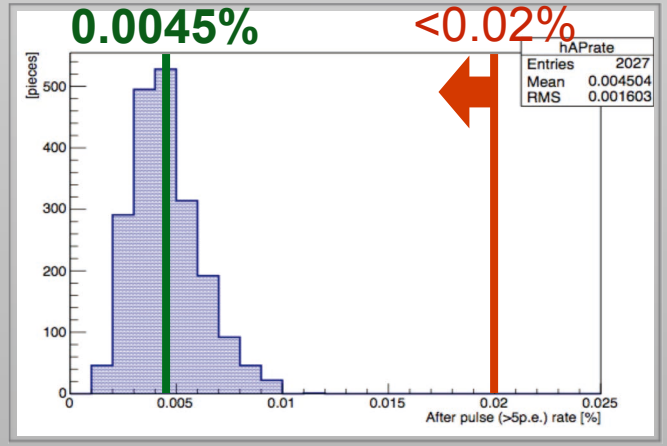
average 41%

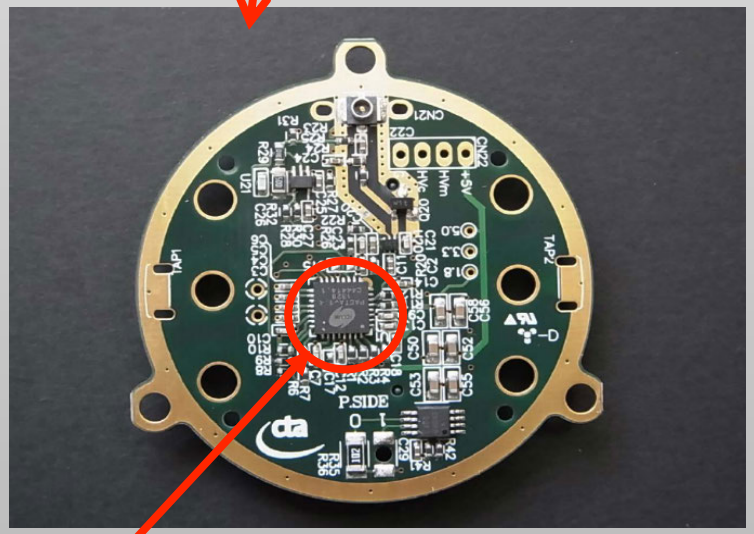


Low after pulse rate

Average 0.0045%

Req. <0.02%





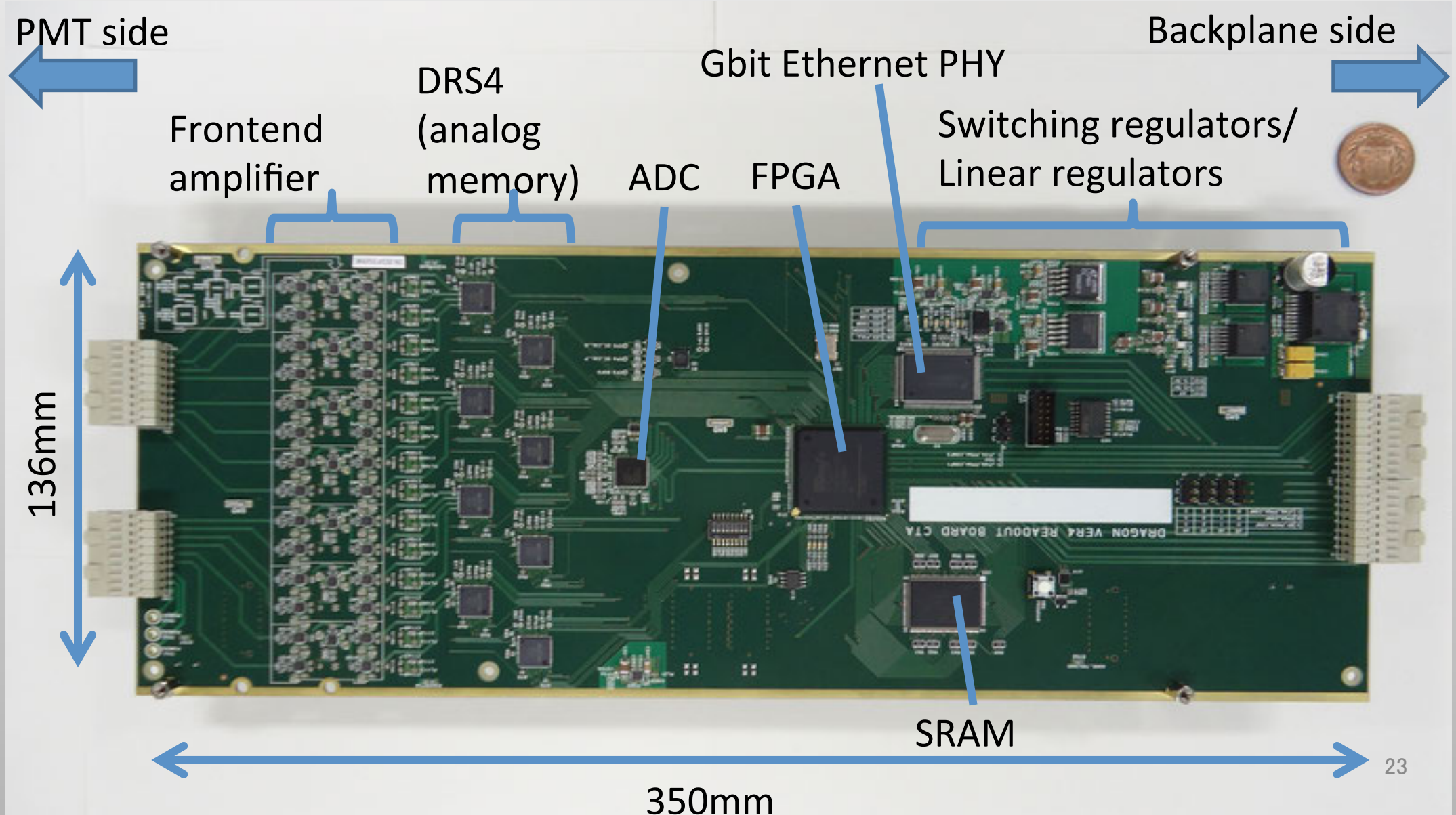
ASIC：Spain

Design：Japan

Readout electronics Dragon

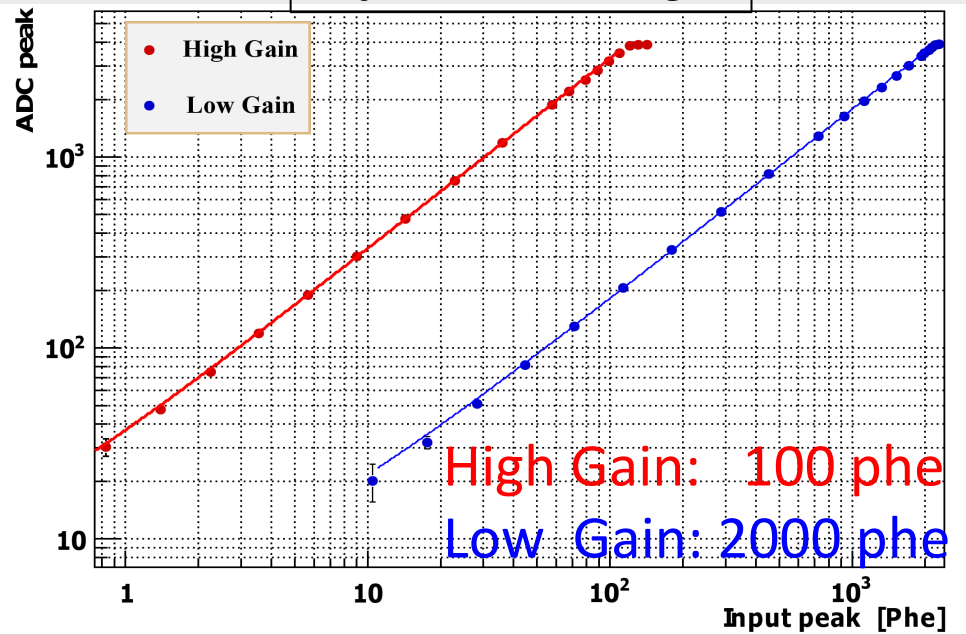
Analog-memory *DRS4 chip from PSI*

LST Readout 1G Sample/s×4 μsec depth

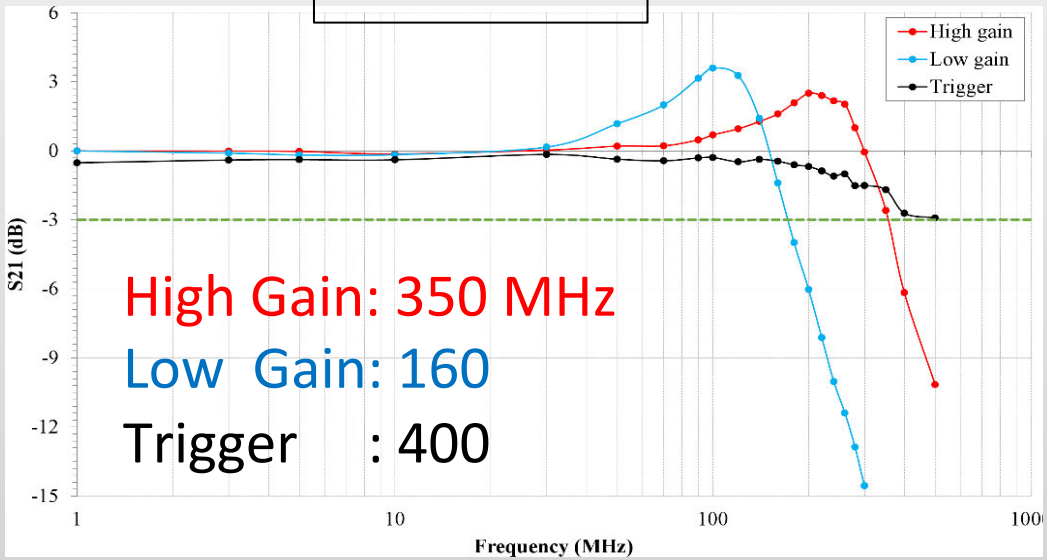


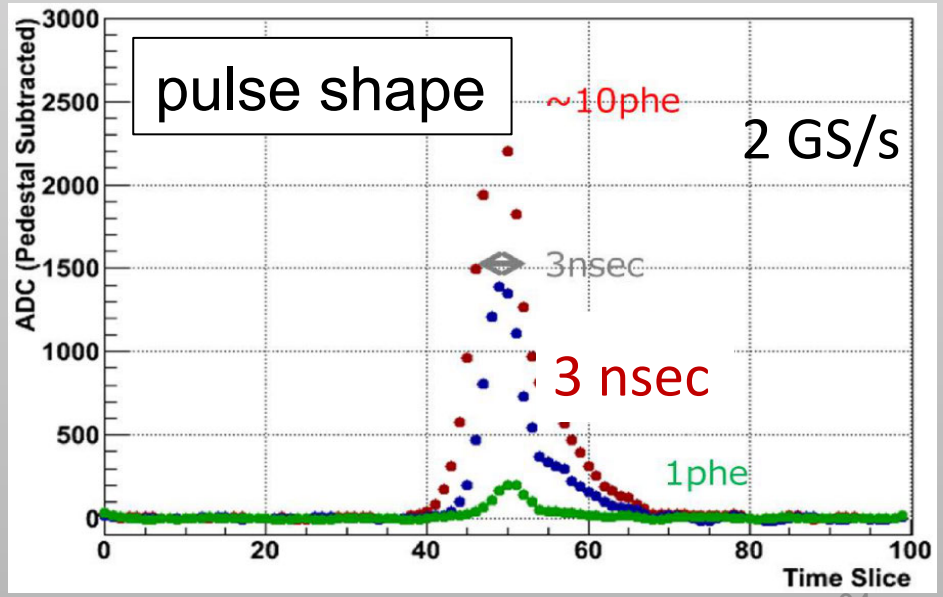
Performance of DRS4 readout Dragon

Dynamic range



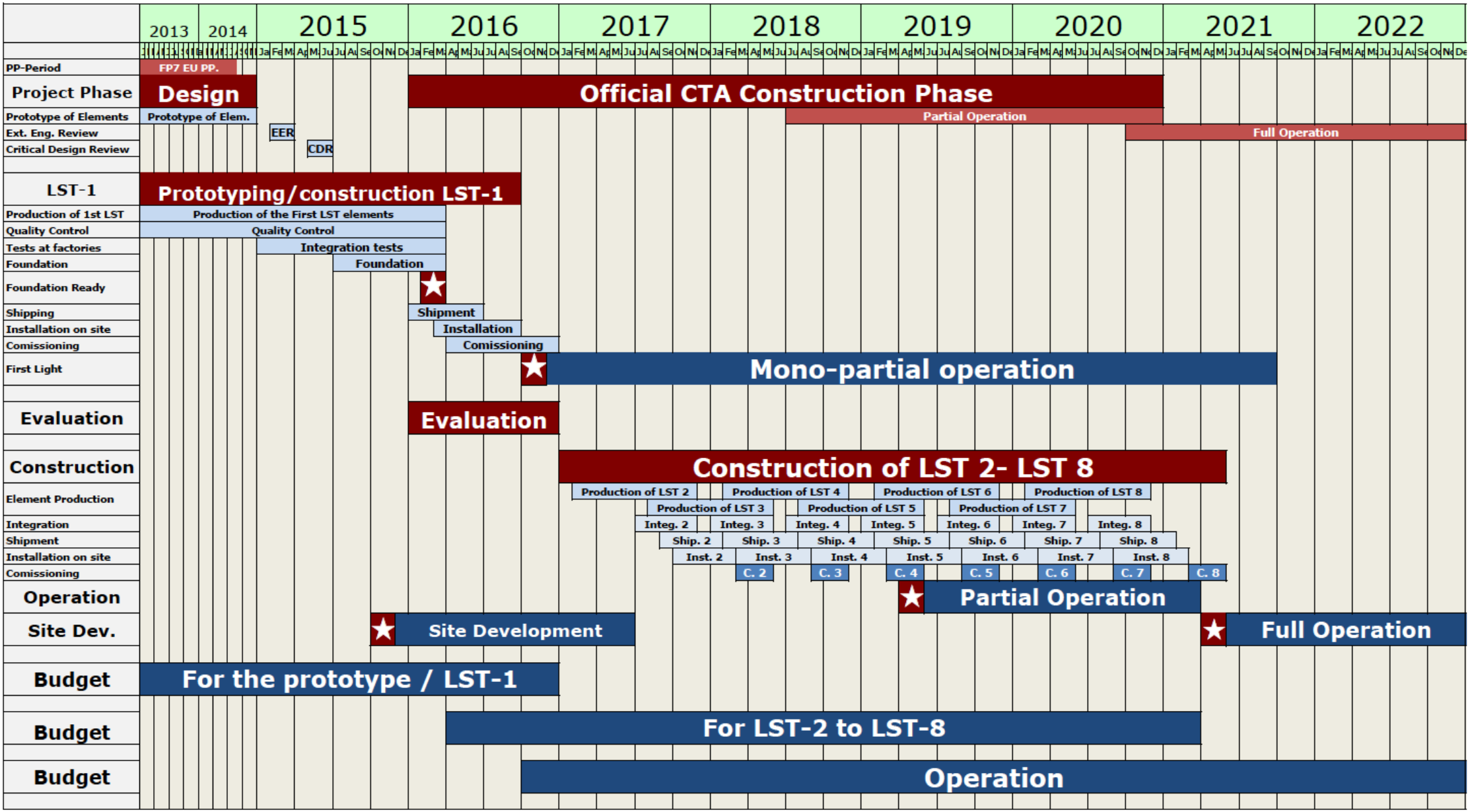
Bandwidth





Schedule of the LST construction

LST Construction Schedule (January 2015)



Roque de los Muchachos

Observatorio del Roque de los Muchachos

- Telescopes
- Meteorology
- Residence and services
- ORM Status Report
- Visits
- General public
- Communications media

See also

- Telescope web pages
- IAC Telescopes and instruments
- How to get to the ORM
- How to get to the CALP
- The Sky Law
- ORM images
- Gran Telescopio CANARIAS (GTC) (External link)
- Site testing (External link)
- LPIYA

Telescopes

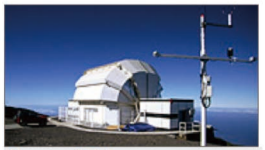
Gran Telescopio CANARIAS (GTC)
Type: Nightly, Ø 1135 cm
Web

William Herschel Telescope
Type: Nightly, Ø 420 cm
Web

Telescopio Nazionale GALILEO
Type: Nightly, Ø 350 cm
Web

Nordic Optical Telescope (NOT)
Type: Nightly, Ø 256 cm
Web

Isaac Newton Telescope
Type: Nightly, Ø 250 cm
Web



Liverpool Telescope
Type: Nightly, Ø 200 cm
Web

MERCATOR
Type: Nightly, Ø 120 cm
Web

AUTOMATIC TRANSIT CIRCLE
Type: Nightly, Ø 18 cm
Web

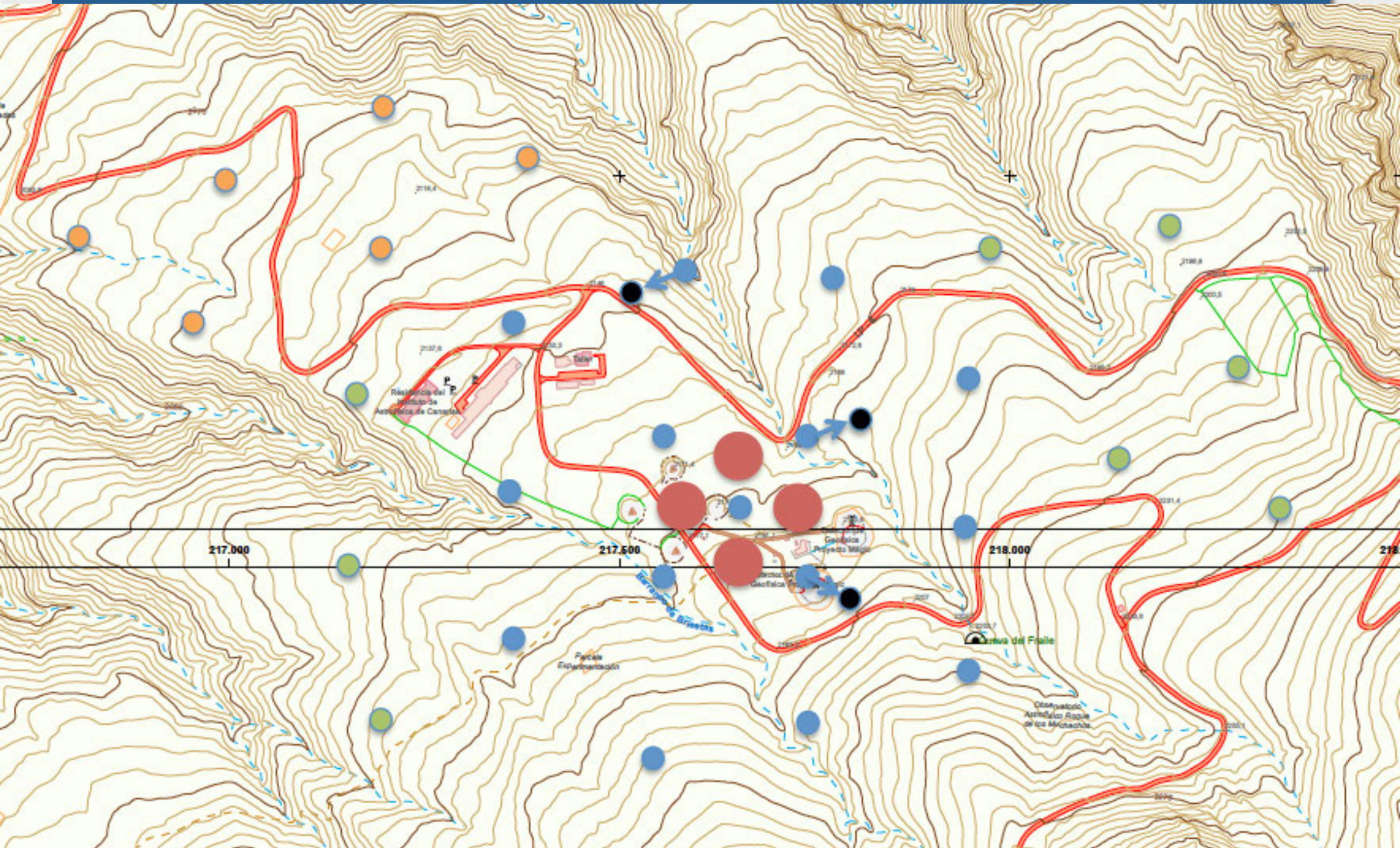
Swedish 1-m Solar Telescope (SST)
Type: Solar, Ø 100 cm
Web

DOT
Type: Solar, Ø 45 cm
Web

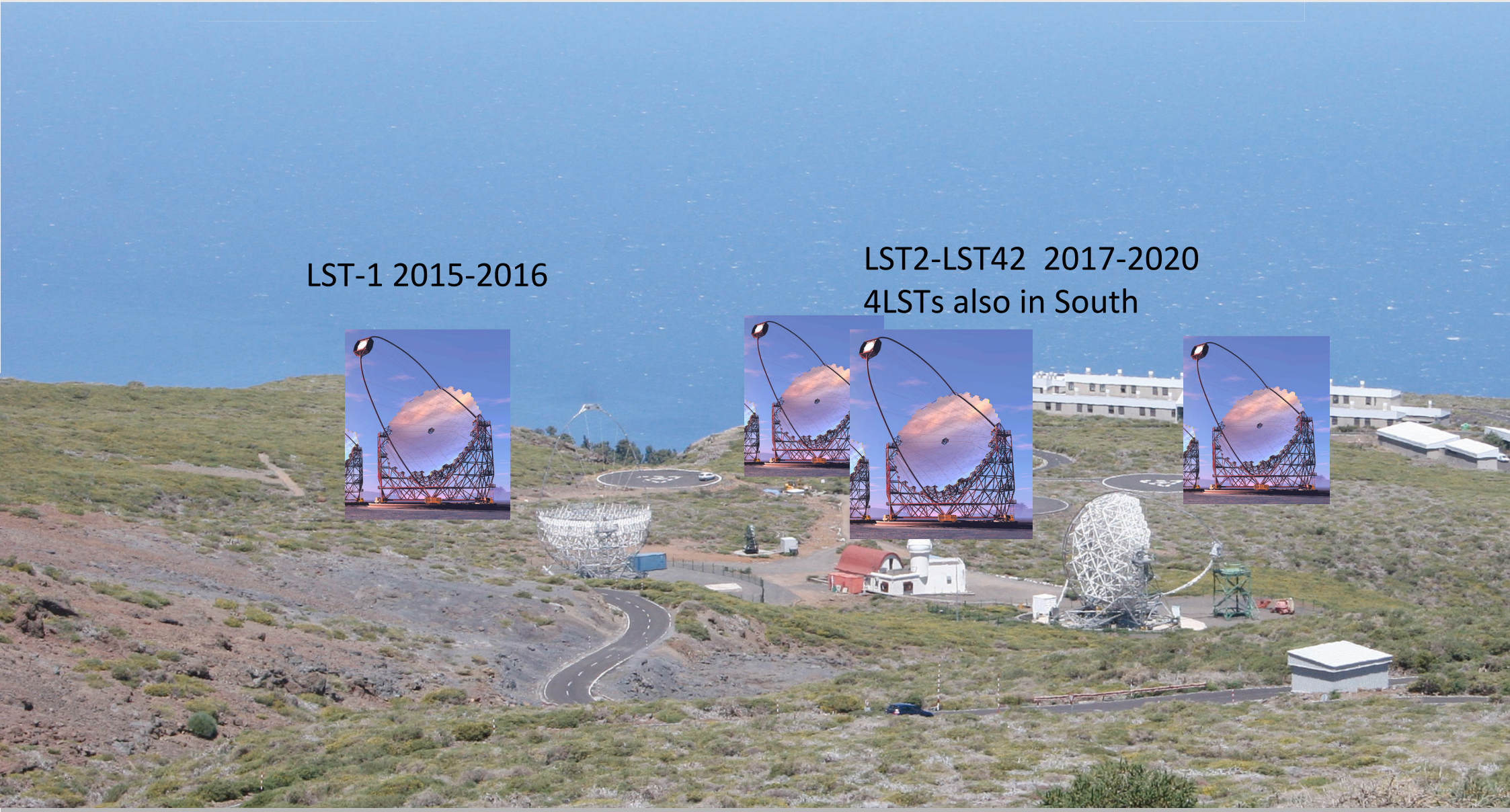
MAGIC
Type: Other, Ø 1700 cm
Web

SuperWASP
Type: Other, Ø 200 cm
Web

Possible CTA North in La Palma



4 LSTs and two MAGICs at ORM MAGIC



Summary

- CTA will study with an unprecedented sensitivity
  - Cosmic Ray Origin
  - Super Massive Blackholes, their environment and evoluation
  - Dark Matter at G.C. and dwarf galaxies
- CTA-Japan makes a major contribution to CTA-LSTs
- Construction 2016-2020
  - Design Study → Preparatory Phase → Construction
  - Finance Germany 51MEuro, Italy 30MEuro, Spain 50MEuro