AEM
AGENCIA ESPACIAL MEXICANA

JEM-EUSO mission in México

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UNAM

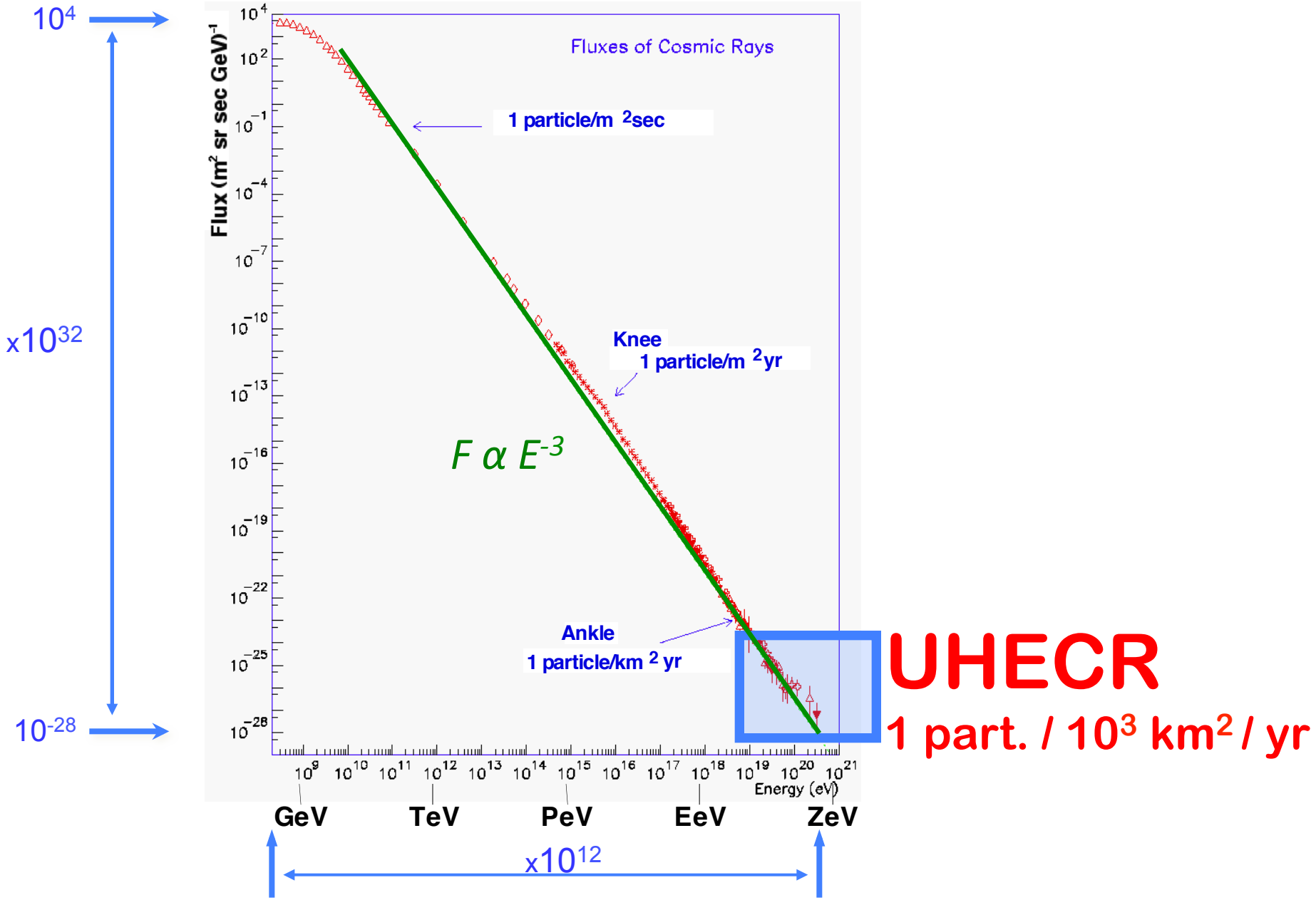
Responsible JEM-EUSO Mexico
Chair of JEM-EUSO Intl. Science Comm.

An example of the development of

- space technology, human resources and infraestructure
- through frontier science in space
- in international collaboration

that we are carrying out in Mexico with the joint support of AEM and the academia

COSMIC RAYS & ULTRA-HIGH ENERGY COSMIC RAYS



A 10^{20} eV proton:

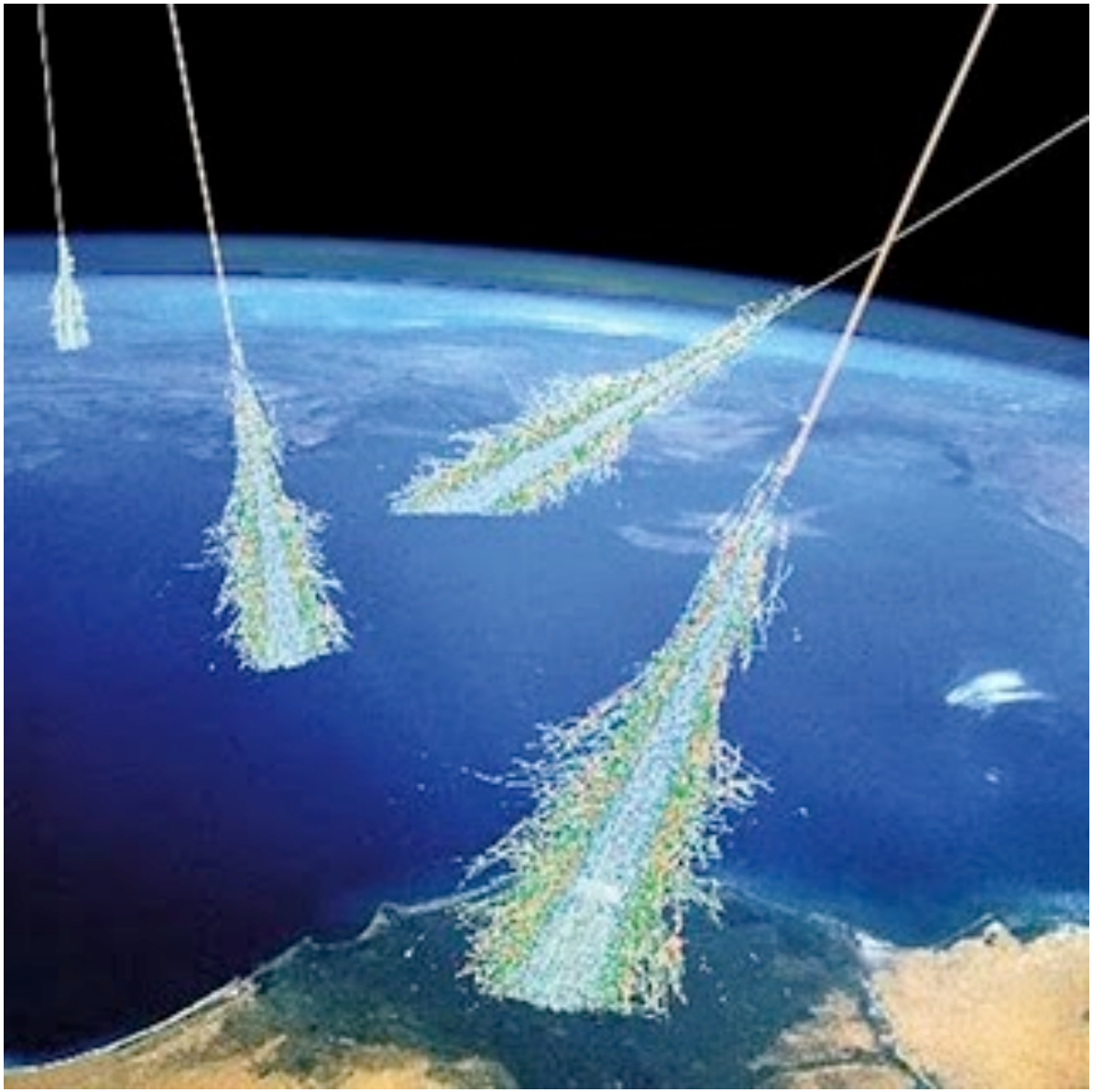
macroscopic energies on microscopic particles

3×10^{20} eV = 50 joules = 1 Tyson

UHECR rain over the Earth's atmosphere

Over all Earth surface:

1 event per minute at 10^{20} eV



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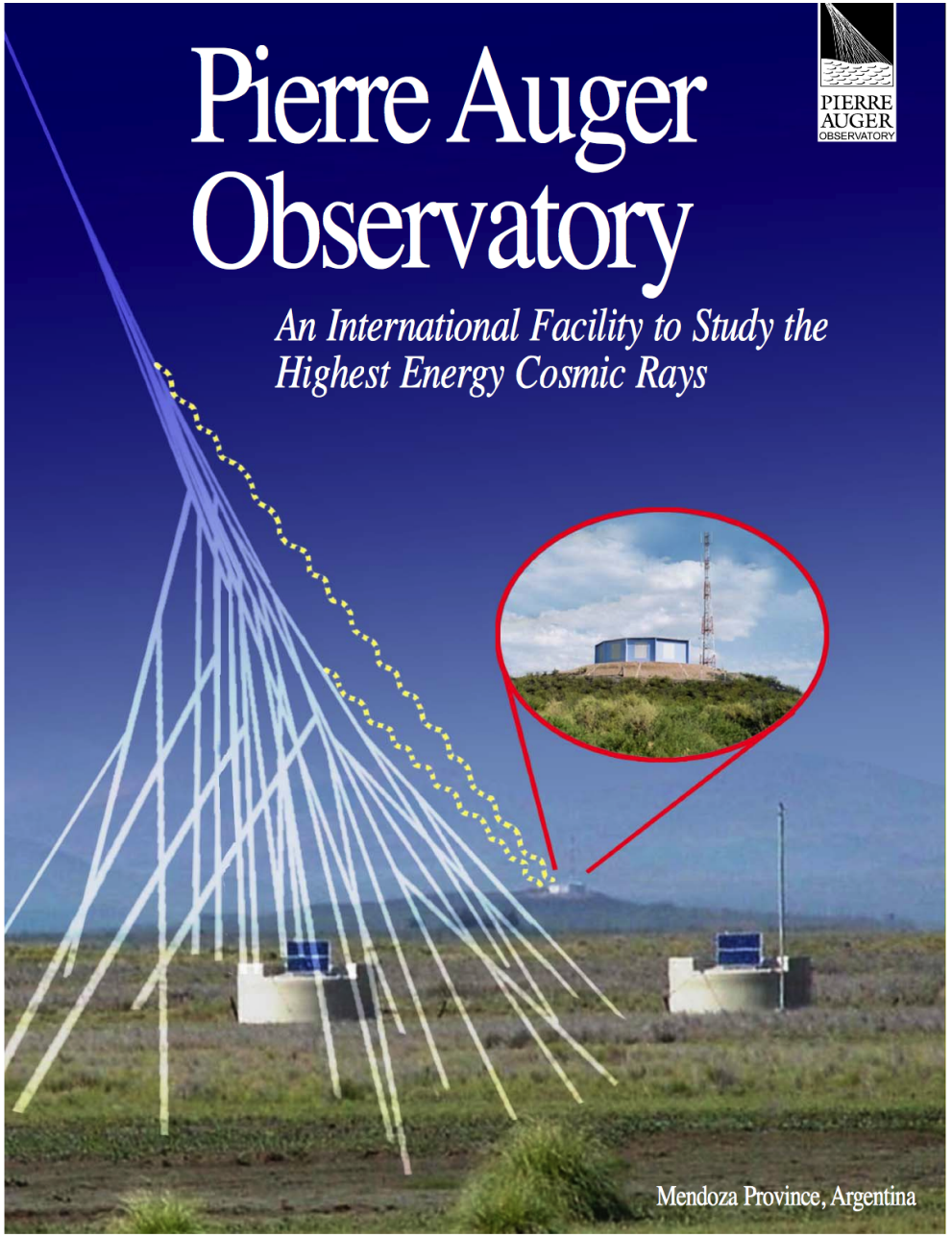
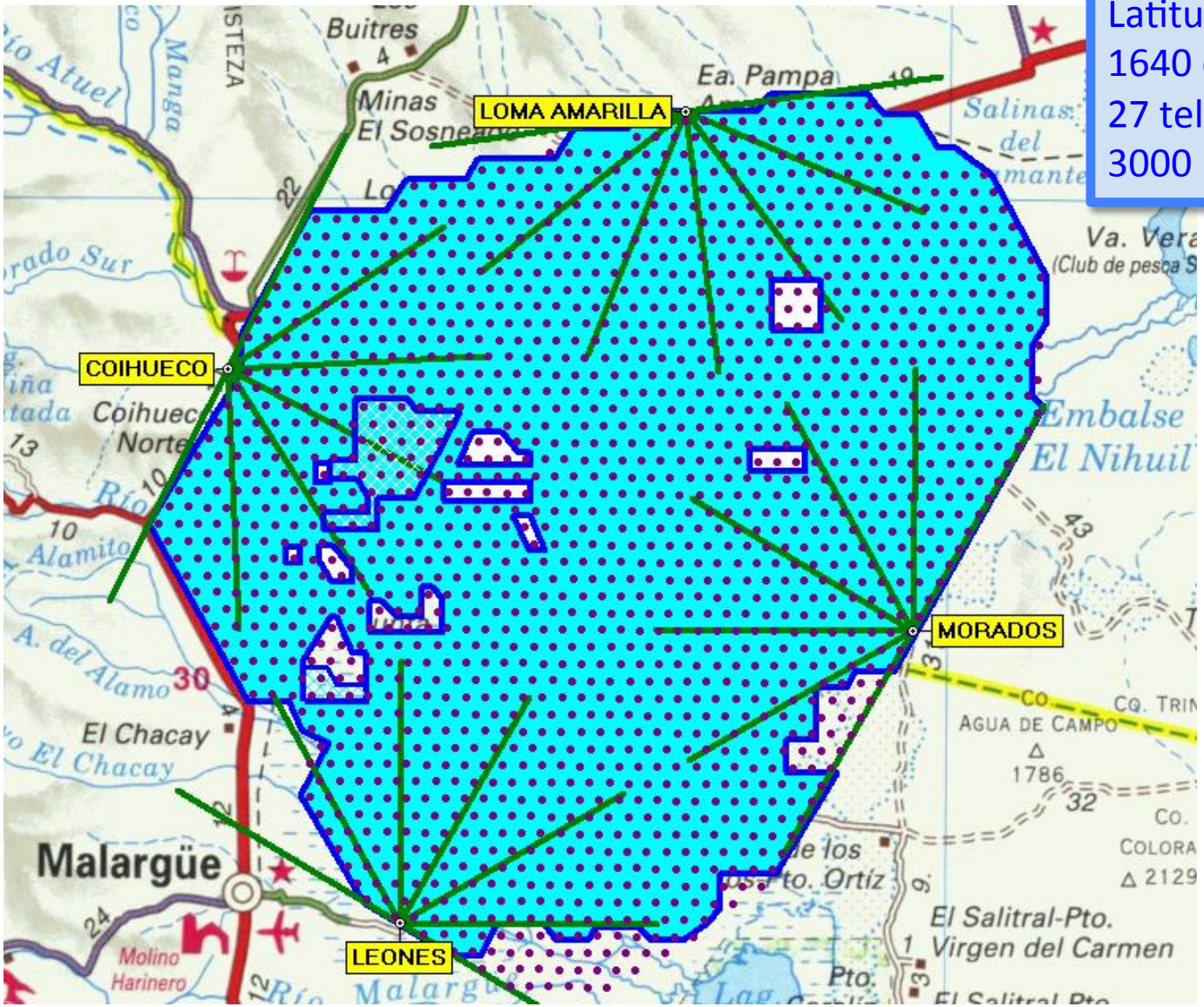
UHECR ground observation

Argentina
Australia
Bolivia*
Brasil
Czech Republic
France
Germany
Neatherlands
Italy
Poland
Portugal
Mexico
Slovenia
Spain
United Kingdom
USA
Vietnam*

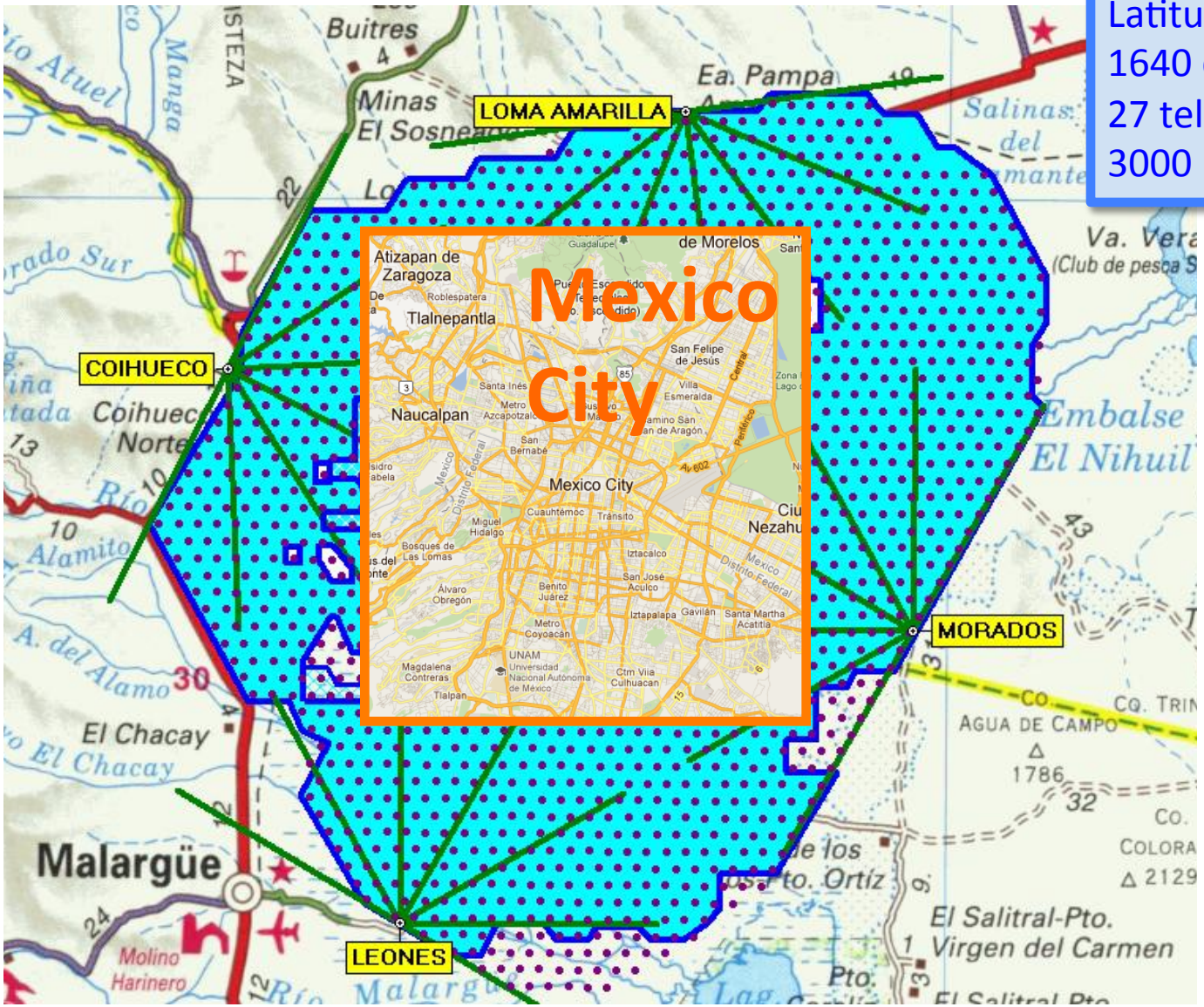


Pierre Auger Observatory



Latitud: -35° (Argentina)
1640 detectores Cherenkov
27 telescopios de 10m^2
3000 km^2 de area

Pierre Auger Observatory



Latitud: -35° (Argentina)
1640 detectores Cherenkov
27 telescopios de $10m^2$
3000 km^2 de area

Pierre Auger Observatory

UHECR status in just one word

Previous to Auger

$$\frac{1 \text{ particle}}{100\ km^2\ yr\ sr}$$

Key Auger result:

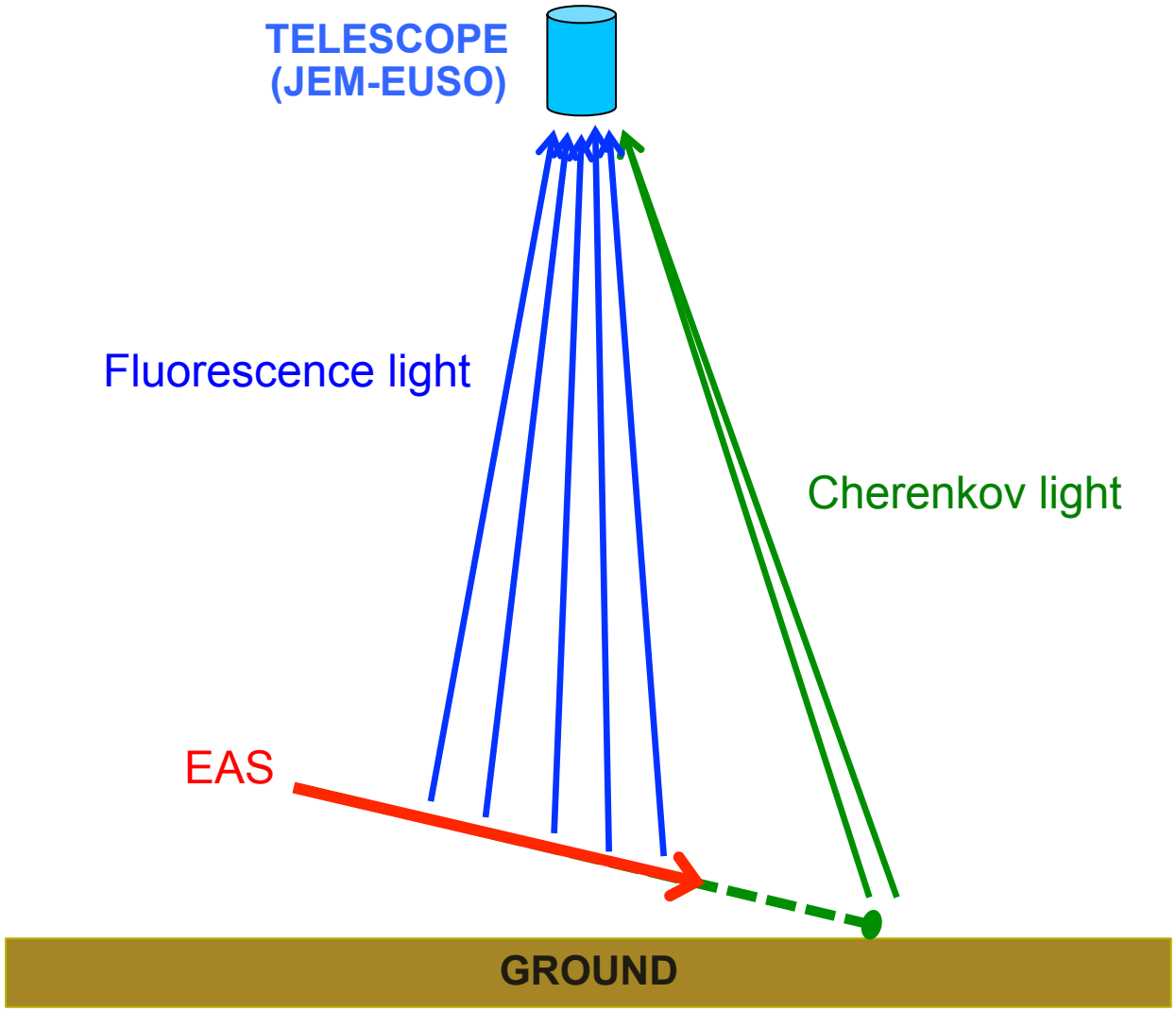
$$\frac{1 \text{ particle}}{\cancel{100}\ 1000\ km^2\ yr\ sr}$$

A quantitative jump in exposure

(orders of magnitude: e.g., $10^3 \rightarrow 10^6$ km^2 yr sr)

is needed to effectively open such an astronomical window @ $E > 10^{20}$ eV

Observing UHECR from space



JEM-EUSO mission

- First space observatory for extreme energy astroparticles
  - ➔ ASTRONOMY with CHARGED PARTICLE
  - ➔ study HADRONIC INTERACTIONS (E > LHC)
- Messengers: extreme energy cosmic rays, photons & neutrinos
- Operational prototype of a new technique

JEM-EUSO instrument

HIGH COMPLEXITY SPACE MISION (TECHNICAL & LOGISTICAL)

- Deployment @ ISS (400 km of height)
- Refractor telescope: large Fresnel lenses
- UV: spectral band 200-400 nm
- Field of View: ± 30 deg
- Dimensions: 2.70 m diameter x 4 m length
- Mass: 2 tn
- Atmospheric monitoring system: LIDAR + IR camera
- Launching date: 2017/18

Internacional JEM-EUSO Collaboration

International effort

300+	scientists
80+	research institutions
13	countries

Japan, USA, France, Germany, Italy, **México**, Korea, Russia, Switzerland, Spain, Slovakia, Poland, Bulgaria

Leading institution: RIKEN, Japan

Key agencies are essential to the project and it is under consideration / study by several of them:

JAXA Japan Aerospace Exploration Agency

esa

NASA

ROSCOSMOS

AEM AGENCIA ESPACIAL MEXICANA

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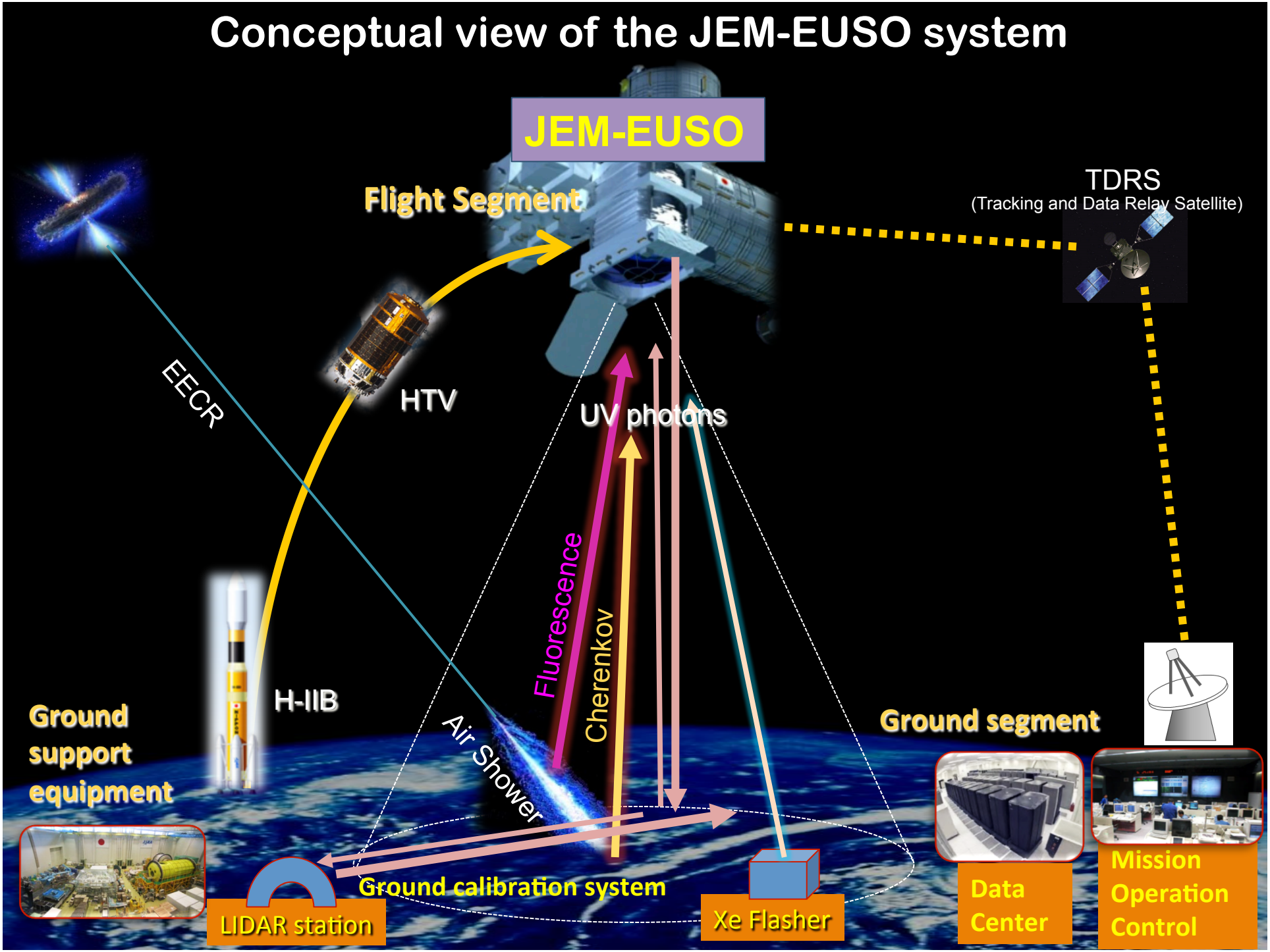
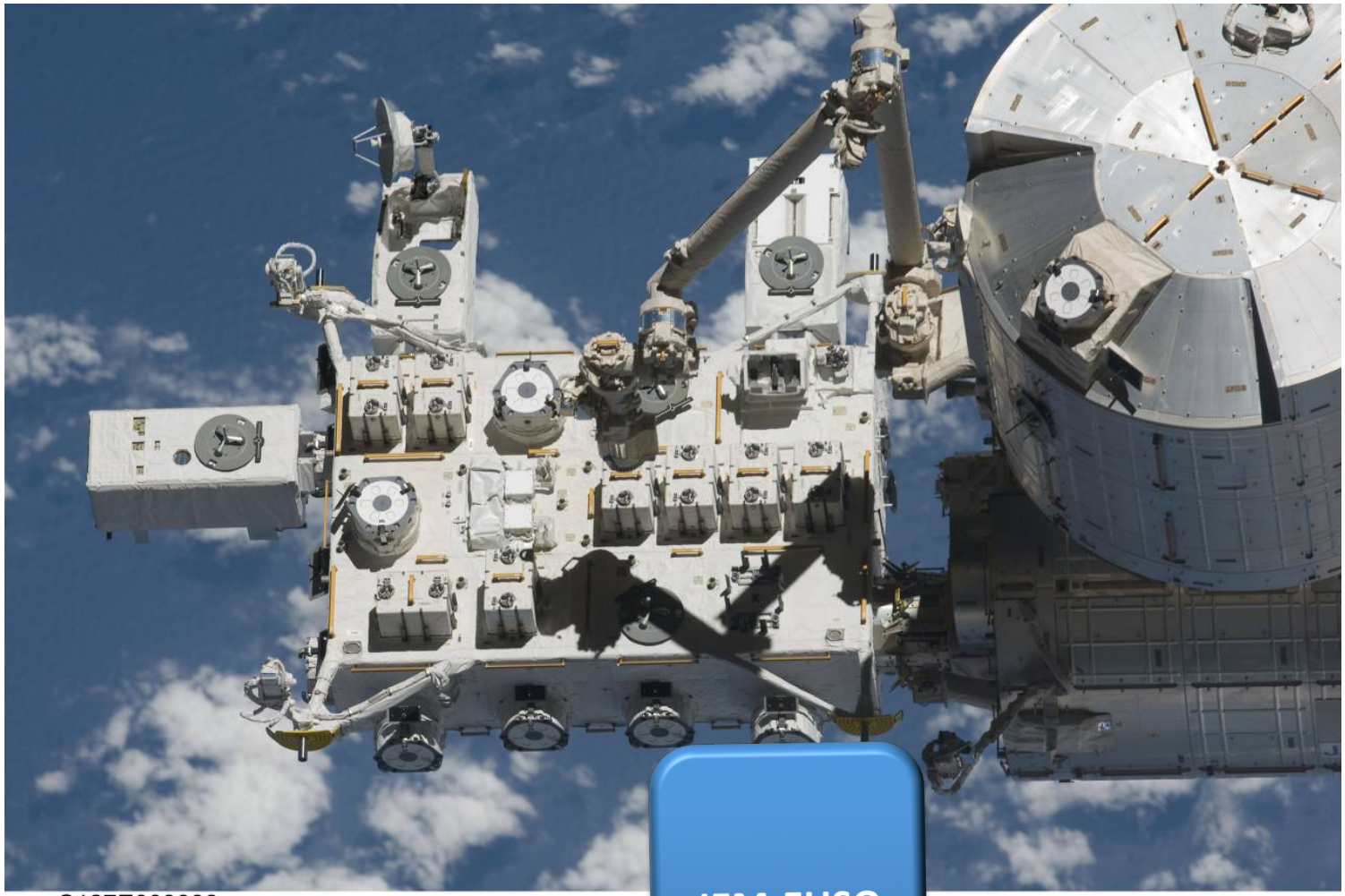
other National agencies


Conceptual view of the JEM-EUSO system
JEM-EUSO
Flight Segment
TDRS
(Tracking and Data Relay Satellite)
EECR
HTV
UV photons
Fluorescence
Cherenkov
H-IIB
Air Shower
Ground support equipment
Ground segment
Ground calibration system
LIDAR station
Xe Flasher
Data Center
Mission Operation Control

JEM-EF (Expose Facility)



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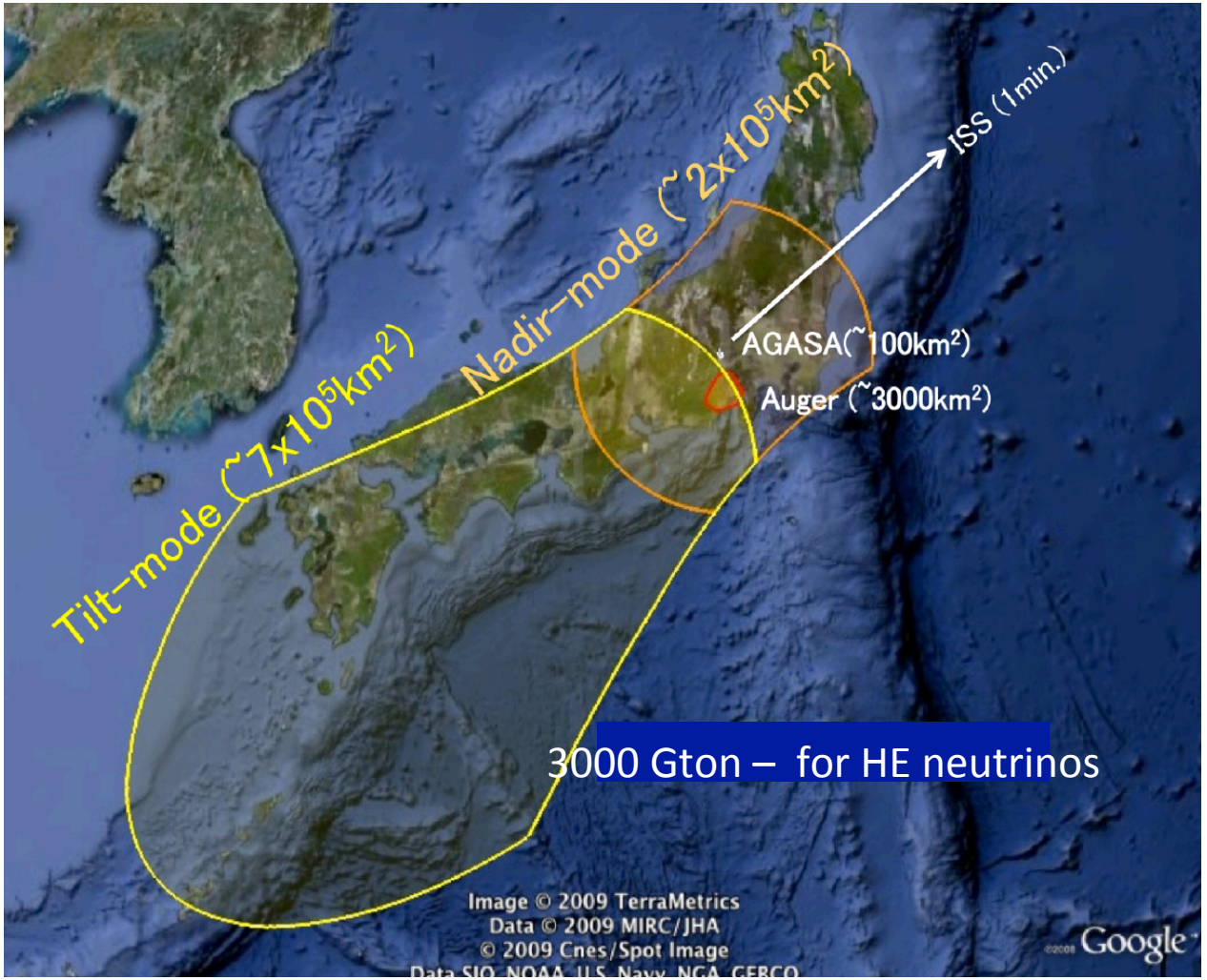
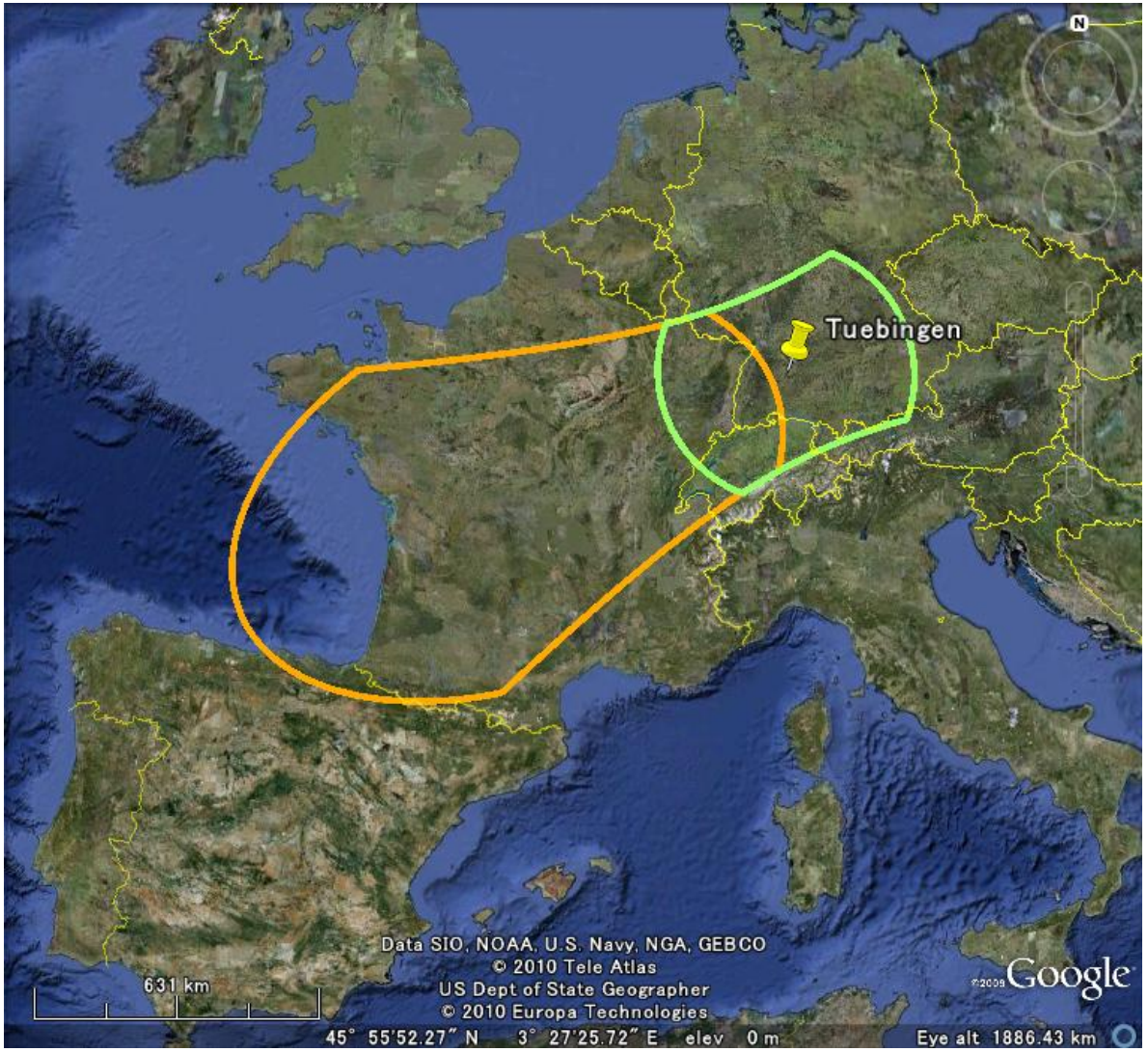
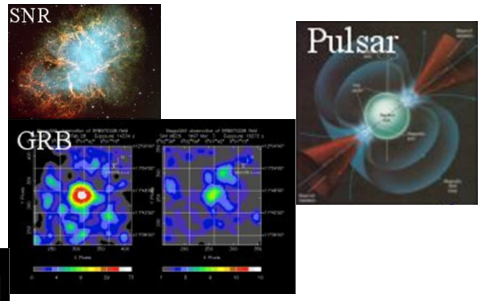
JEM-EUSO effective scale

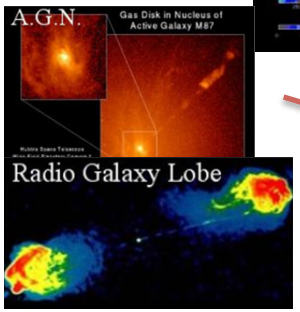


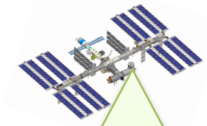
JEM-EUSO effective scale



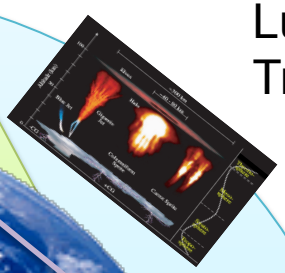
JEM-EUSO Science Objectives







p, γ, ν, X



Luminous
Transient Events

Dust and
Meteors

ν_τ

Cloud coverage

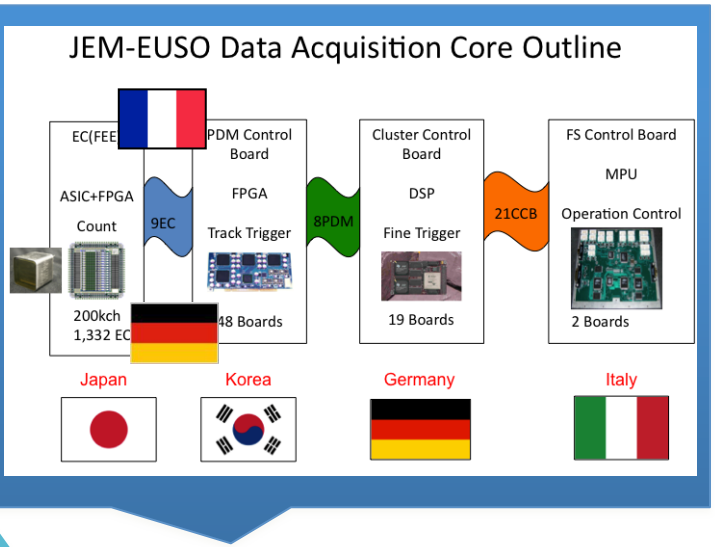
Distribución internacional de responsabilidades

Atmospheric monitoring

HK system + Power supply

Optics: USA + Japan

Fresnel Lens #2



Precision Fresnel lens

Iris

Fresnel lens #1

DAQ Electronics

Support Structure: Italy

Calibration

Mexico chair of the science committe

Science and Simulation

Focal Surface: Japan

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Mexican contributions to JEM-EUSO

- Housekeeping system
- Low voltage power supply system
- TrackSim: trigger algorithm characterization
- End-to-End Scientific Simulations
- Cloud coverage effects
- Definition and validation of scientific objectives
- Meteorite ablation inside the atmosphere

Mexican contributions to JEM-EUSO

- Housekeeping system
- Low voltage power supply system
- TrackSim: trigger algorithm characterization

} Flight components & Ground calibration hardware & software

- End-to-End Scientific Simulations
- Cloud coverage effects

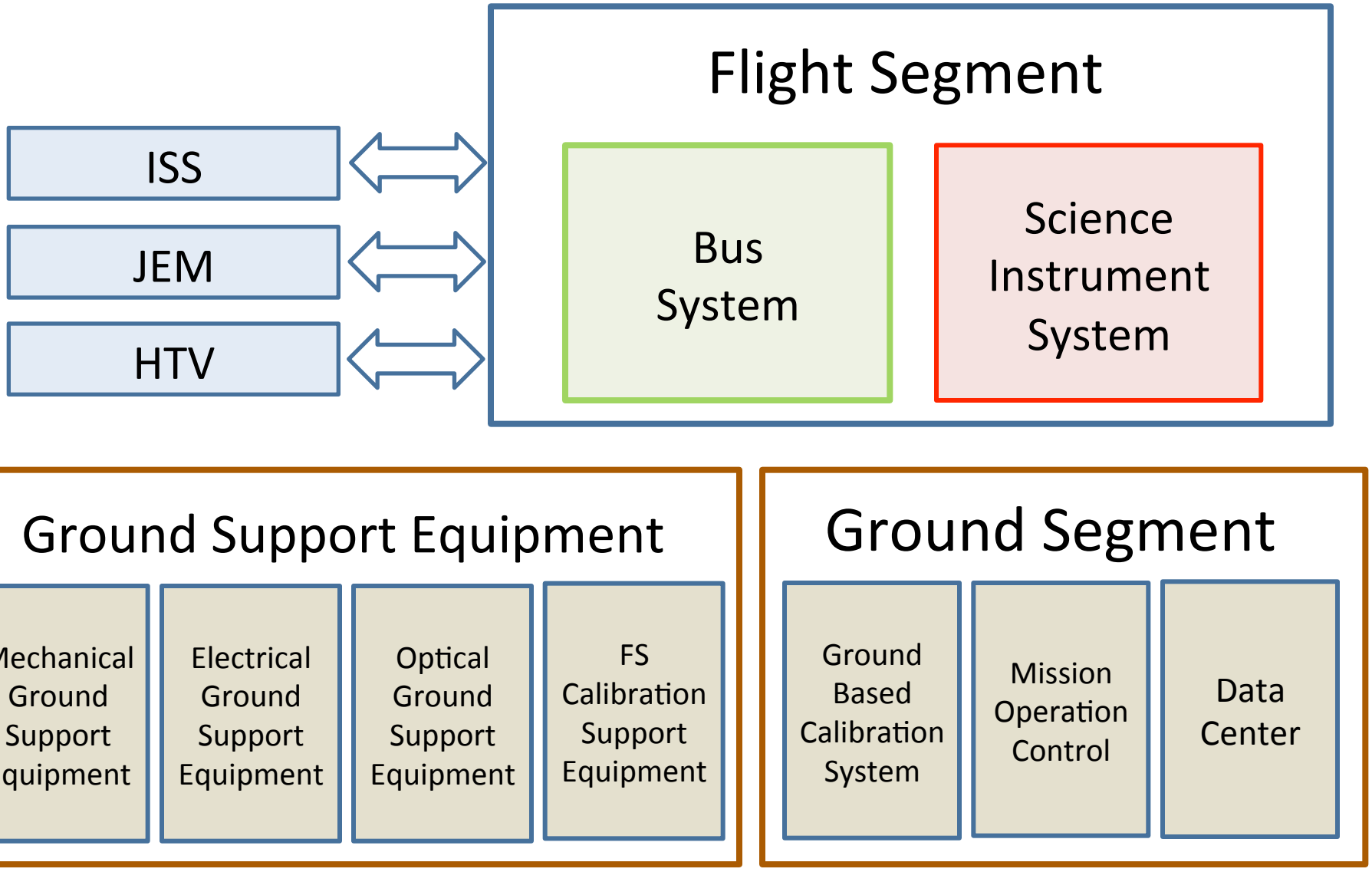
} Data analysis & software and hardware validation

- Definition and validation of scientific objectives
- Meteorite ablation inside the atmosphere

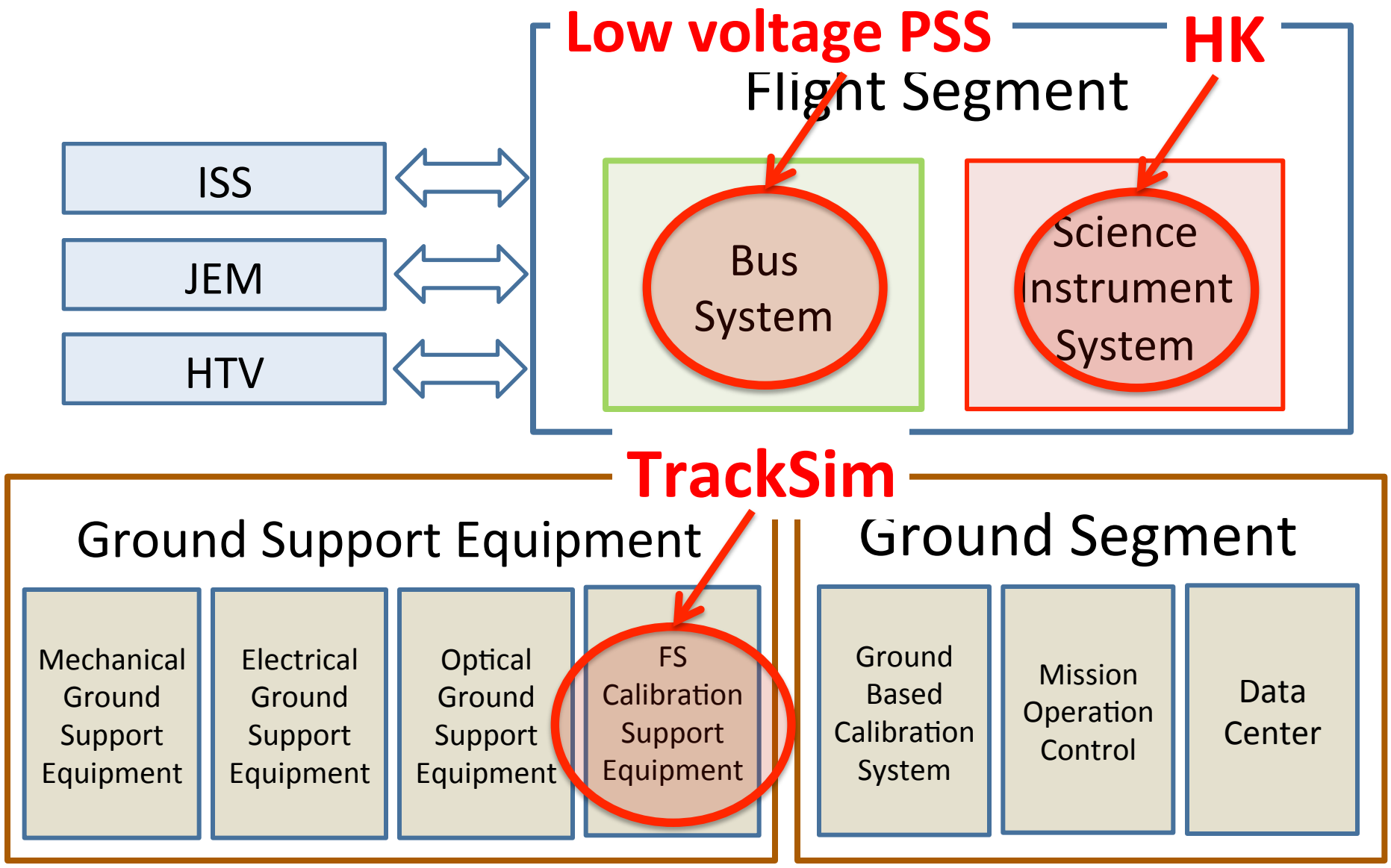
} Science

Formation of human resources in engineering, data analysis and managment and science

JEM-EUSO System: Mexican contributions



JEM-EUSO System: Mexican contributions



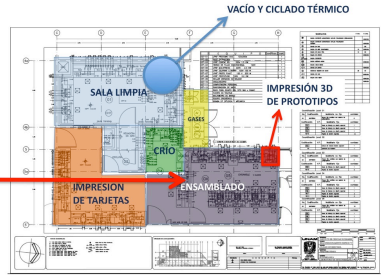
MOTOR FOR INFRASTRUCTURE DEVELOPMENT:

INTEGRATED INFRAESTRUCTRE
FOR SPACE QUALIFICATION @ ICN/CAT - UNAM

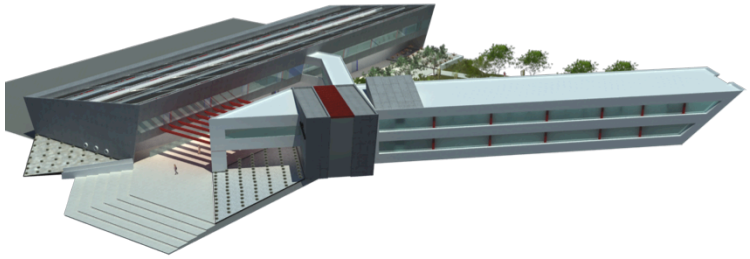
ICN SEGMENT
CU-UNAM

GAMMA BEAM
ICN

CONTROL REMOTO DE EFECTOS DE RADIACIÓN SOBRE COMPONENTES EN CONDICIONES DE OPERACIÓN



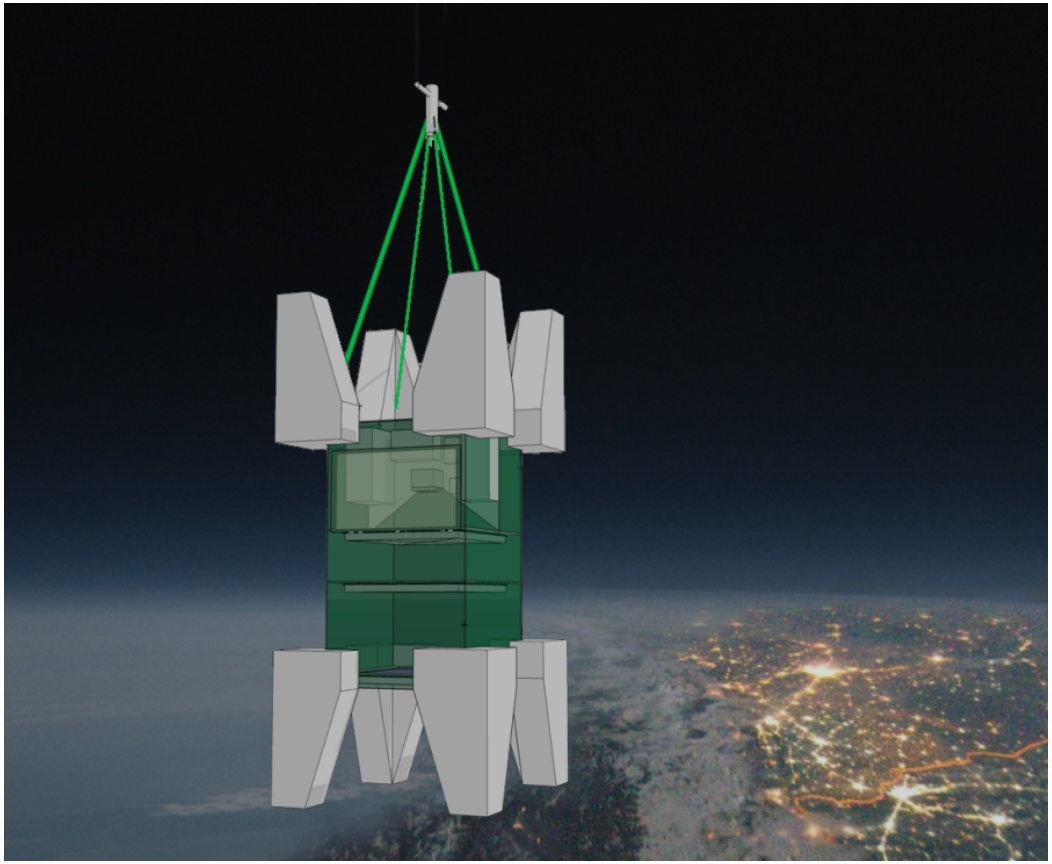
CAT SEGMENT
JURIQUILLA-UNAM



Prototypes to be flown onboard stratospheric balloons (2014)

Agency: CNES

Science team: France, Germany, Japan, Italy, Korea, Mexico, Poland, Spain



Other spin-offs

➔ Cooperation AEM (México) & NASA around NASA stratospheric balloons:

Long duration flight of JEM-EUSO prototypes over the Pacific Ocean

+ Ingeneering validation flights as piggy-backs

➔ Development of small stratospheric balloon infraestructure in México for engineering validaton in suborbital condtions and education at different levels

- Afordability, recoverability and fast turn over
- Strong participation of university students

➔ Development of housekeeping systems for other space missions

Conclusions

Frontier science space experiments, when combined with strong international collaboration, have the potential to serve not only to the advancement of science, but also to the development of society as a whole by spreading tecnological knowledge (socio-economic benefits), promoting the building of infraestructure and by creating an effective door through which countries can enter into the world of space science, technology and application.

We hope that this forum will take under its umbrella initiatives of this kind, and that other countries will see basic science in space as a viable and attractive pathway for technical development.