



Project Apeiro



Airborne Payload for Cosmic
Ray Flux Measurement and
Analysis



www.project-apeiro.com

What are cosmic rays?



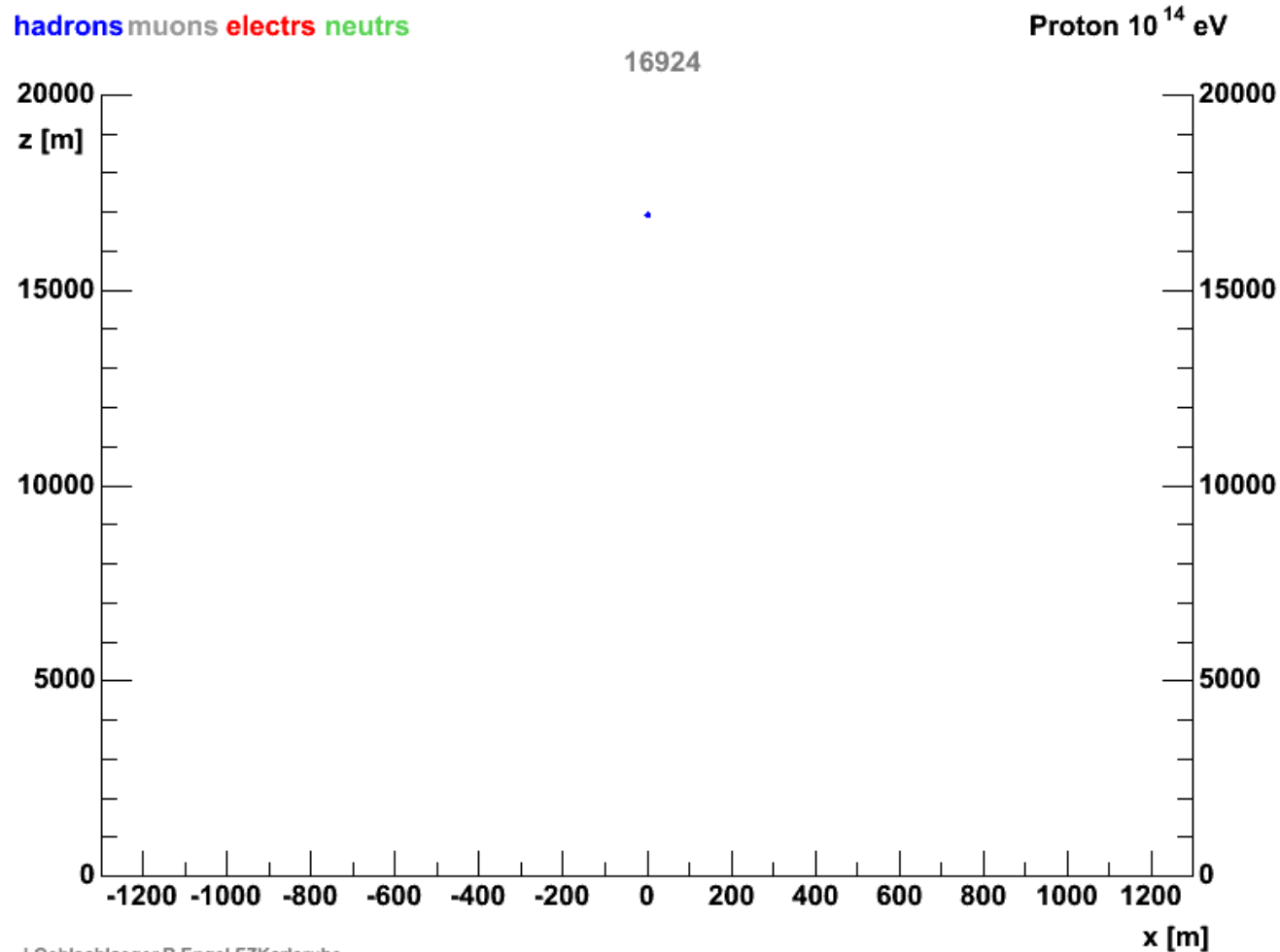
What are cosmic rays?

- Charged particles
- Incident on surface of Earth from all directions
- Most likely sources: Sun, distant nebulae, supernova, etc.
- The primary shower interacts with Earth's atmosphere to form the secondary shower



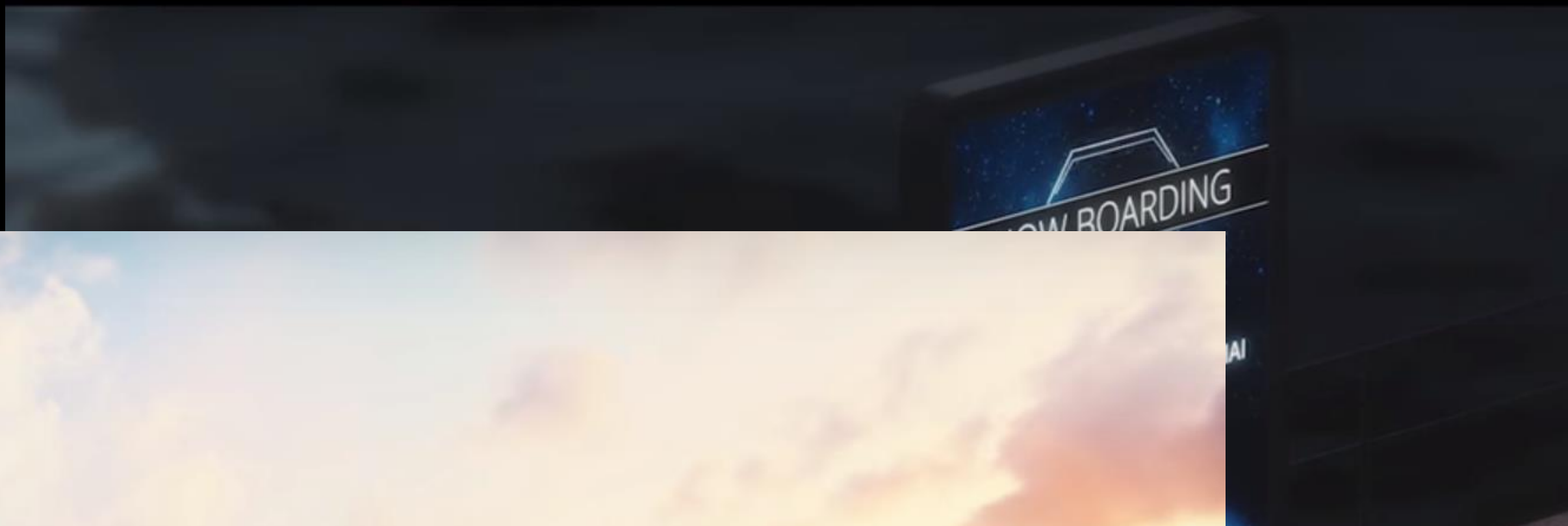
artist impression from www.earthsky.org

Cosmic Ray Shower



J.Oehlschlaeger,R.Engel,FZKarlsruhe

Corsika simulation of 100TeV
proton primary cosmic ray
generating secondary cosmic ray
shower



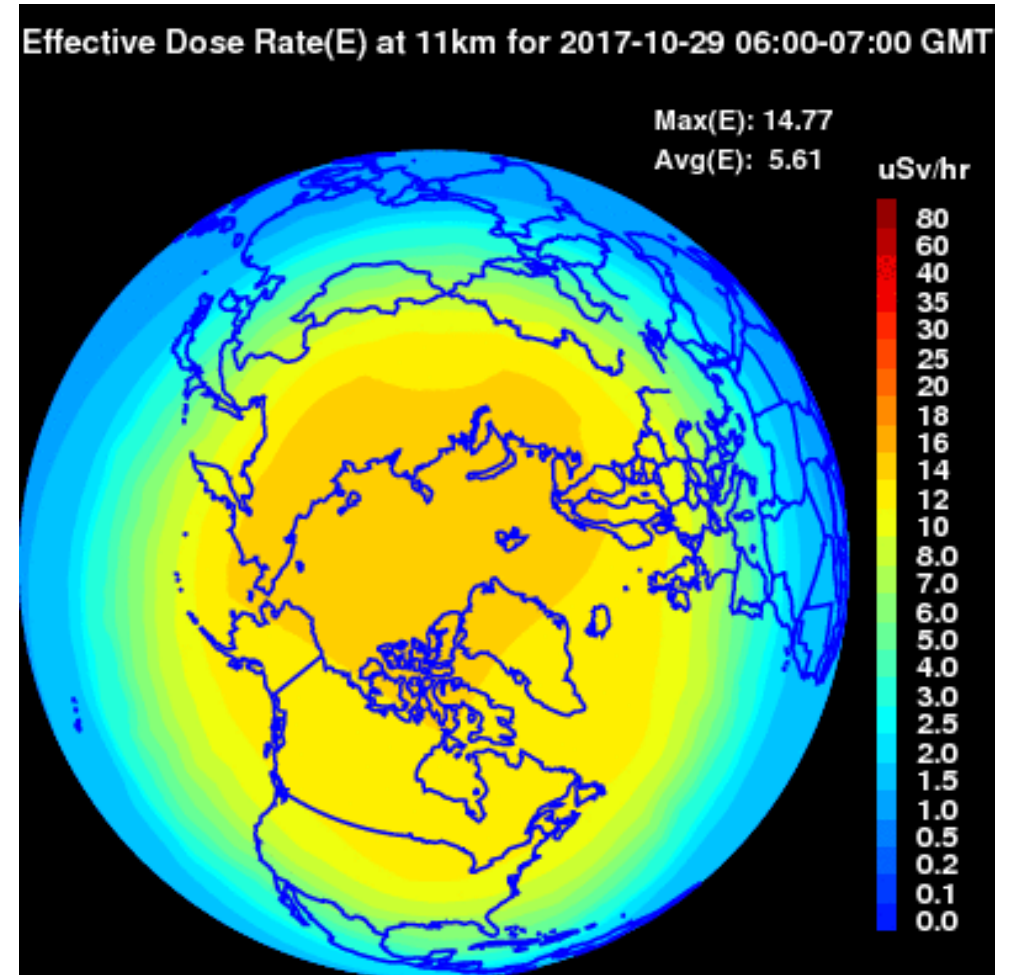
Modelling Space Radiation

NAIRAS: Nowcast of Atmospheric Ionizing Radiation System

- NASA funded Applied Sciences Program
- Real-time
- Data-driven
- Assesses biologically harmful radiation exposure levels for aviation

Rad-X

NASA's mission to probe radiations where aircraft fly using high altitude ballooning



Cosmic Ray Detector



Scintillator Crystal

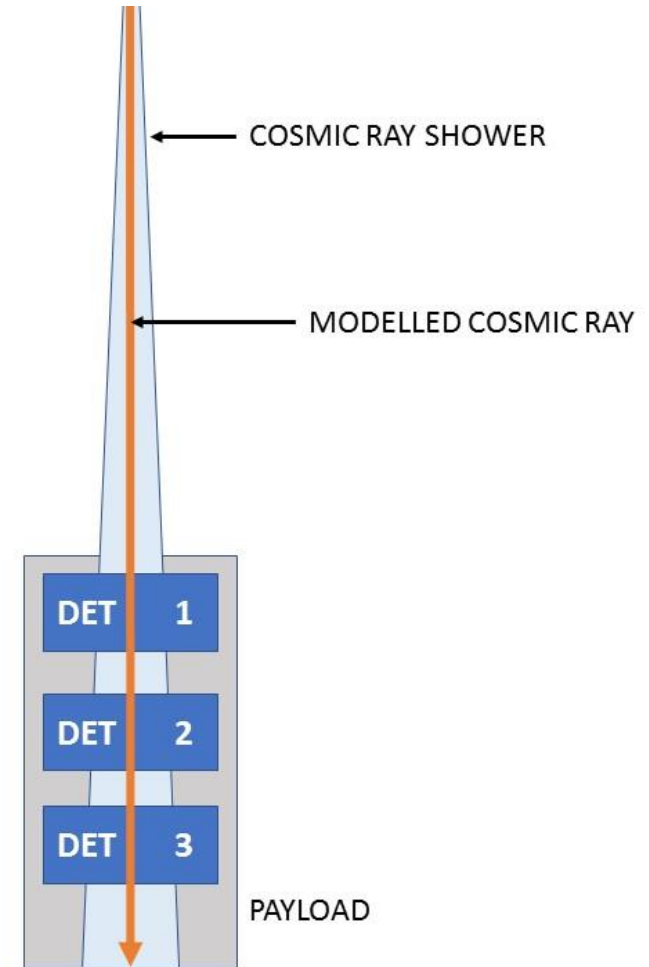
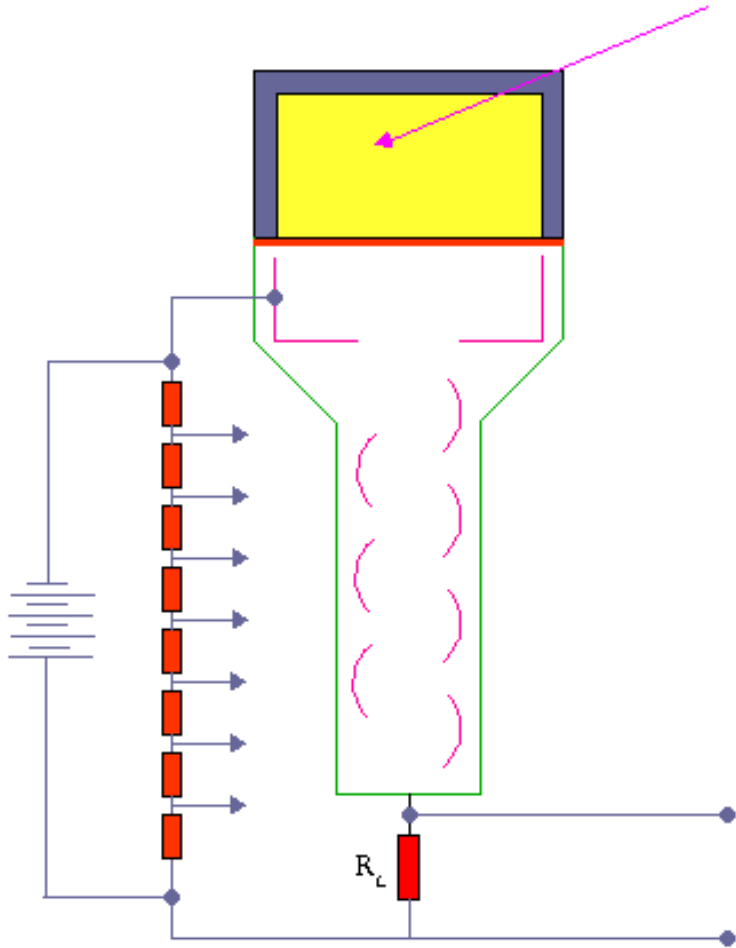
Produces light when struck
by cosmic rays



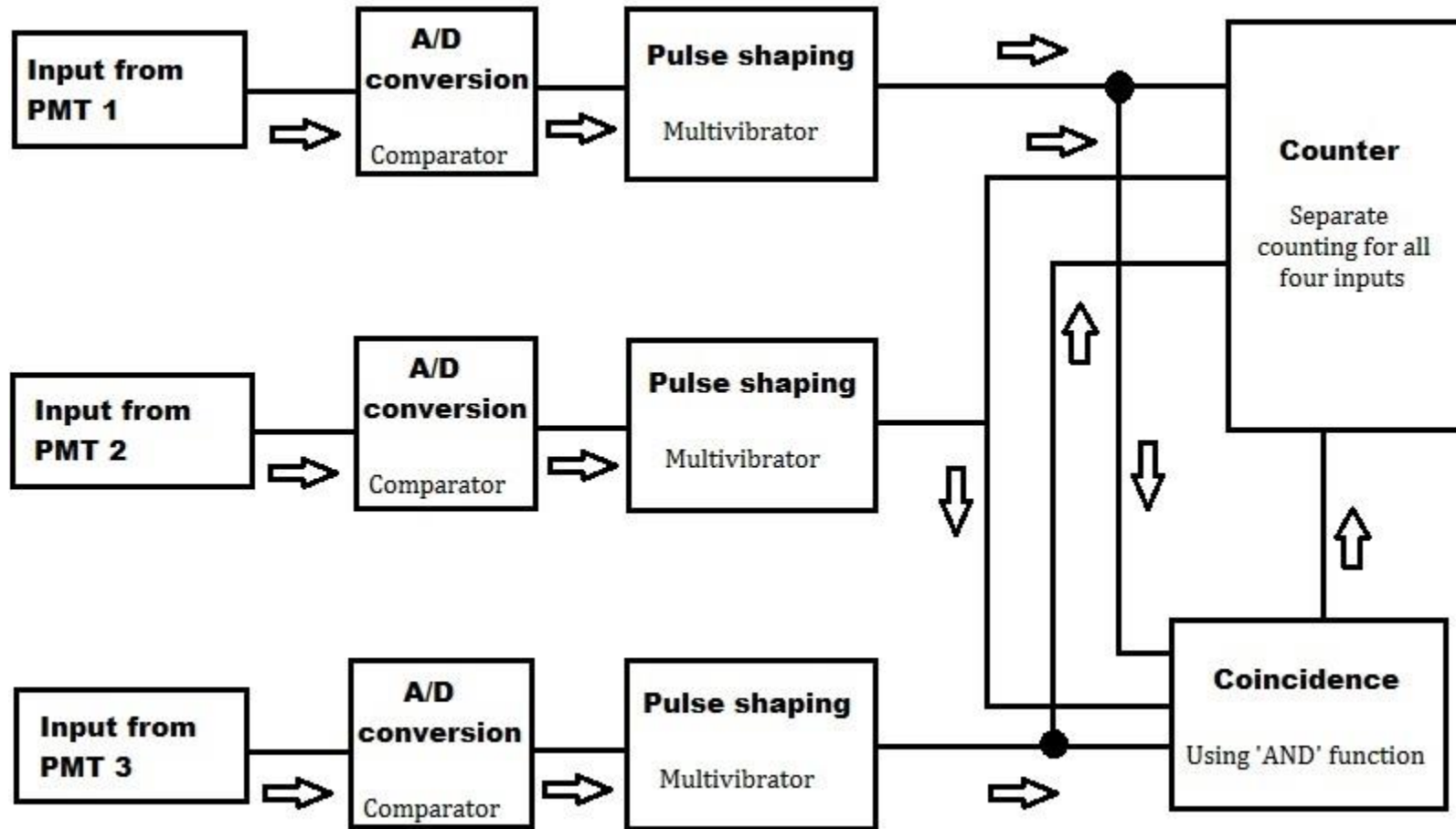
Photomultiplier Tube

Generates analog electronic
pulses corresponding to
detection of light

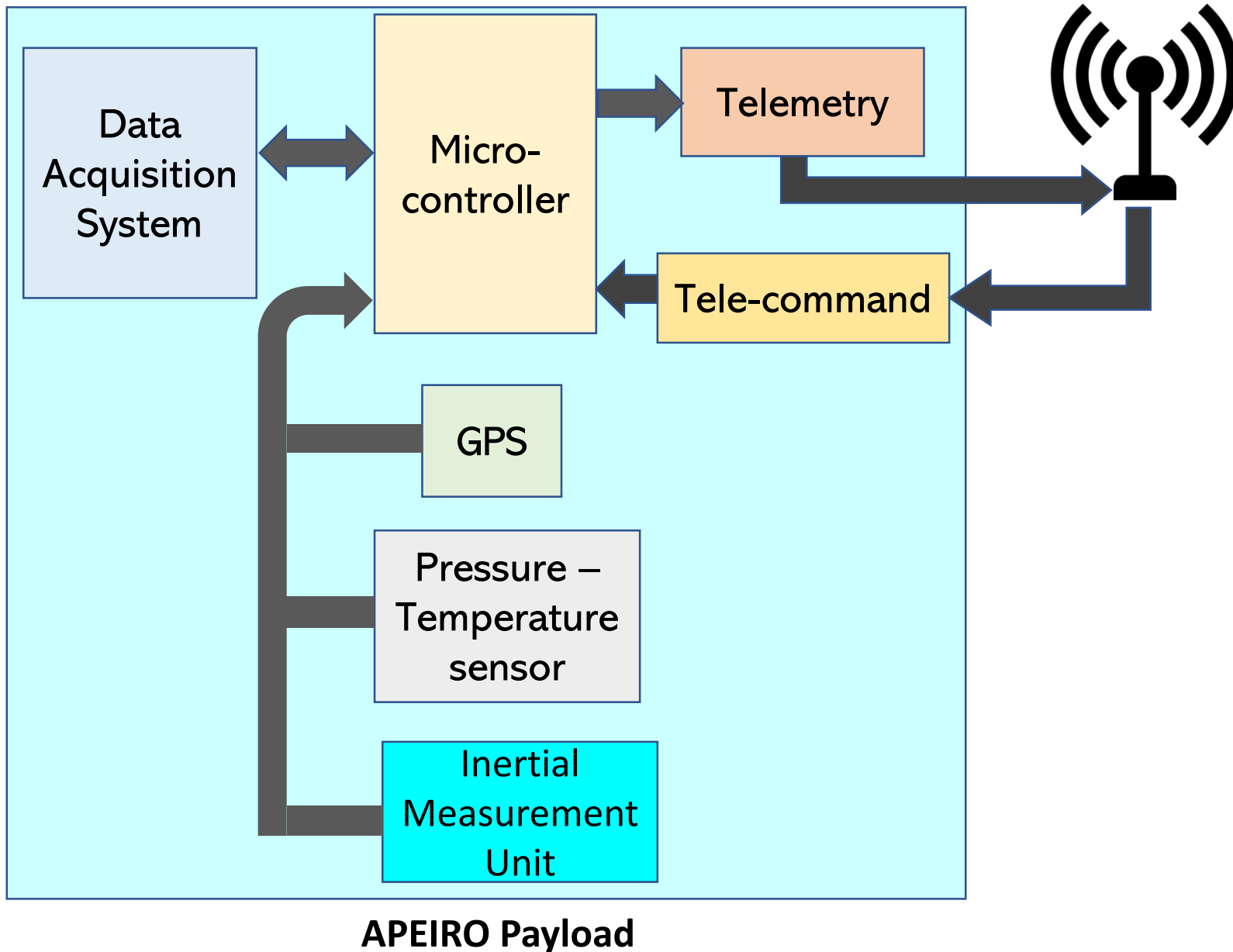
Cosmic Ray Detector



Data Flow



Data Flow



Ground Station
Control Room at TIFR Hyderabad

Project Apeiro - Motivation



Astronomy and Astrophysics club of
BITS Pilani, Goa



What do we need?

Cosmic Ray Detector

- How to detect the charged particles?
- How to generate signals?

Data Acquisition

- How to collect and store the data?

Data Transmission

- How to transmit data over long range?

Testing the equipment

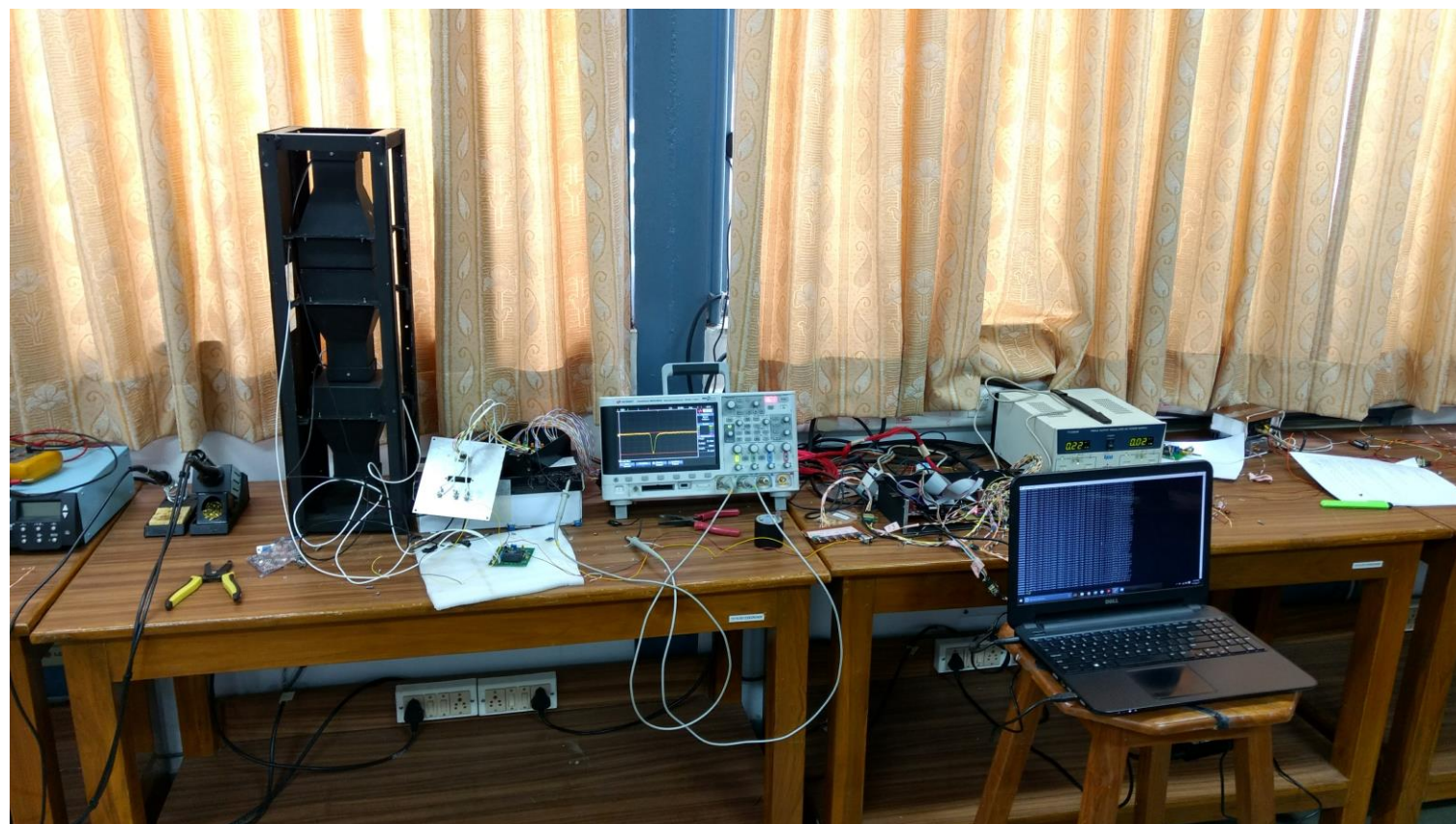
- A flight is not possible without testing and calibrating the equipment

Conducting the flight

- How to actually fly the payload?

Funding the project

- How do we generate funds for the equipment?



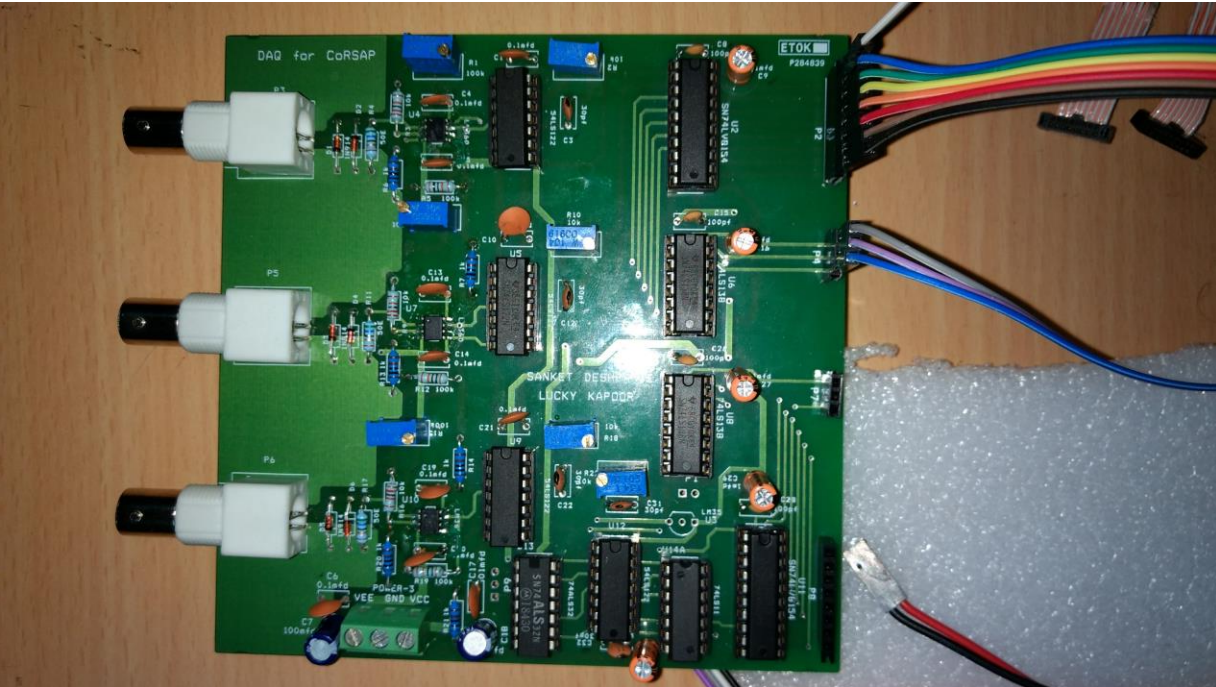


HV protection using rubber composite material

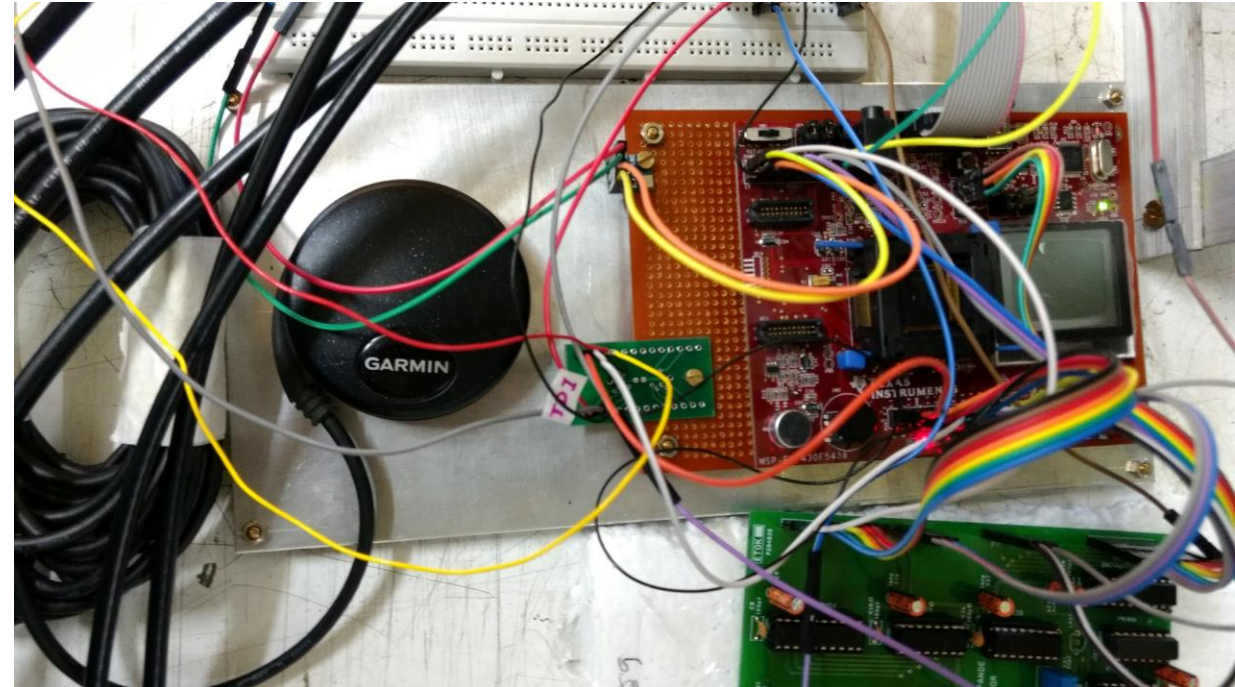


The team at National Balloon Facility, Hyderabad

Data Acquisition

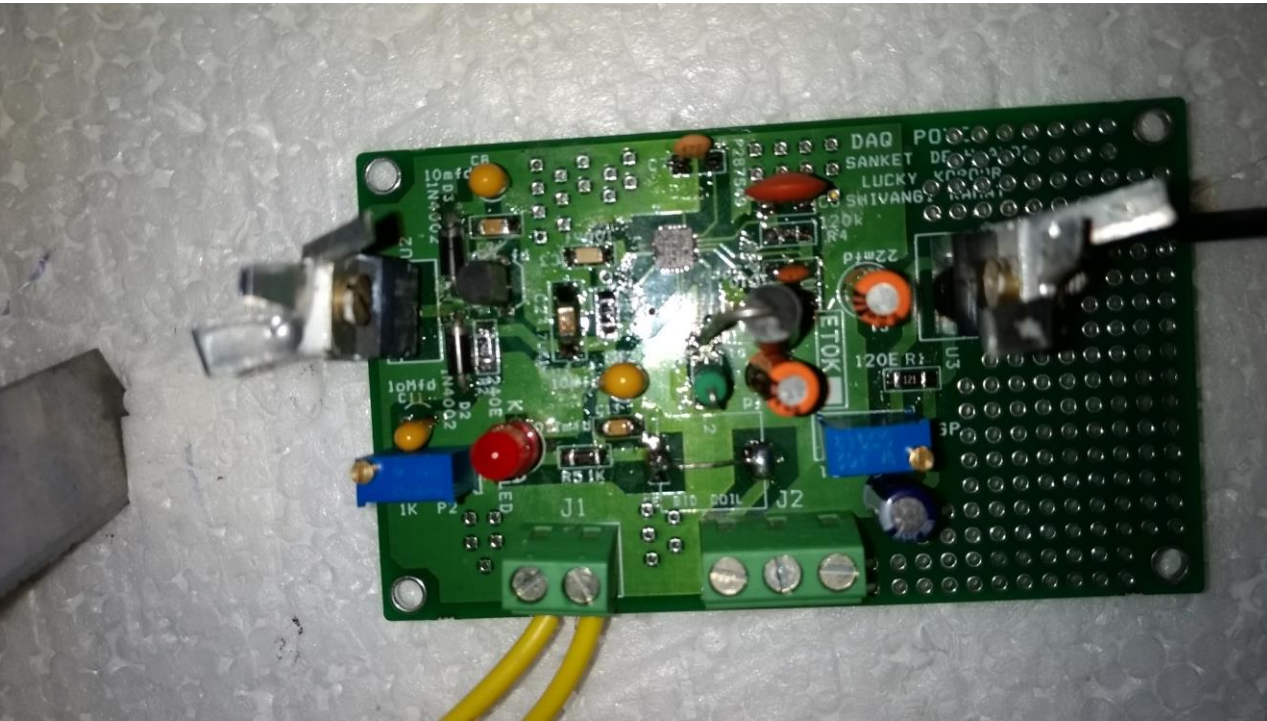


Data Acquisition Board



Microprocessor interfaced with GPS and memory

Power Supply

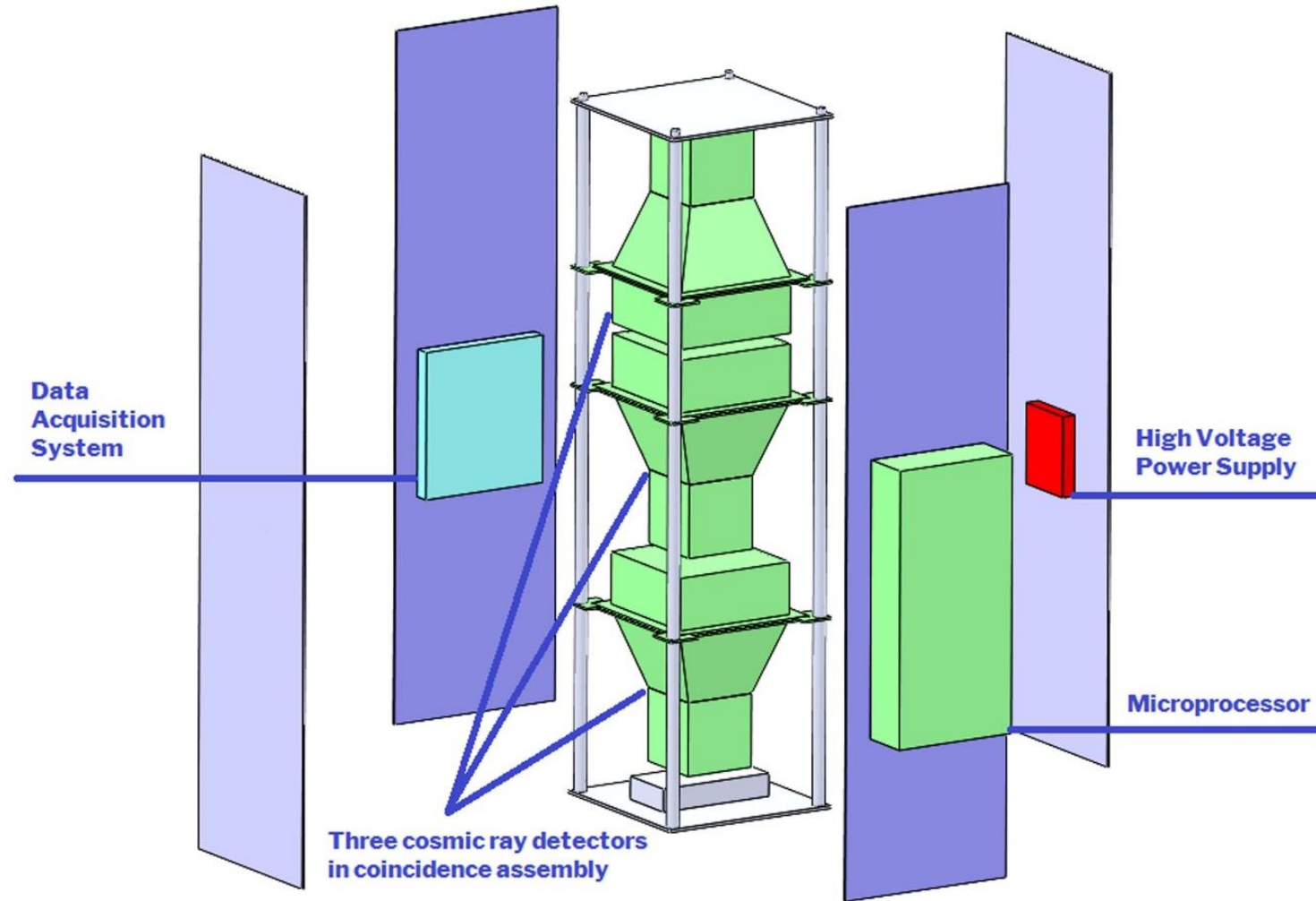


Low Voltage Power Supply

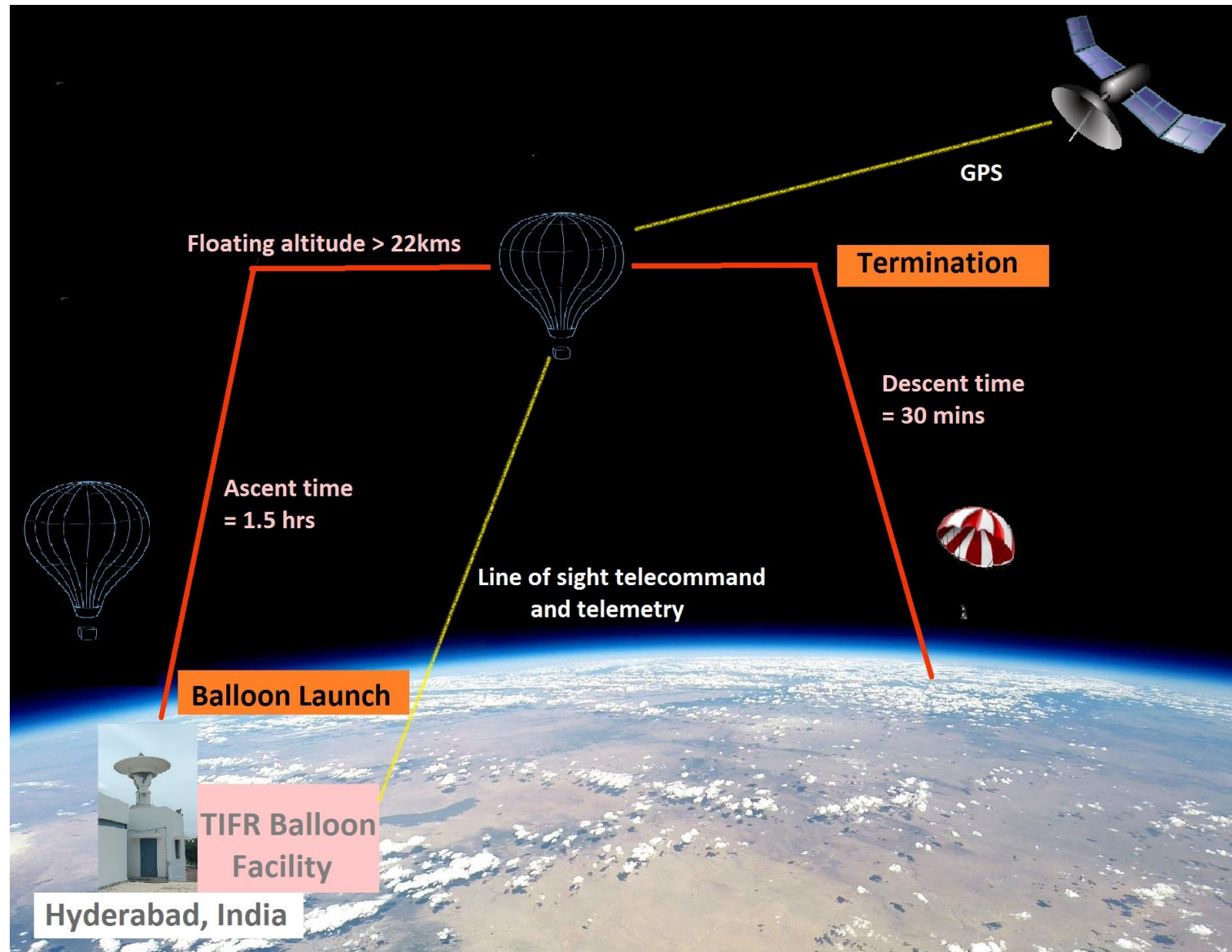


High Voltage Power Supply

Payload exploded view



Flight Plan



Space Grade Equipment

- Temperatures falling to -70 degrees Celsius
- Vibrations due to balloon flight
- Ionization of air molecules leading to fire if exposed to high voltage points
- Data recovery issues
- Shielding from radiations and EMI

Testing and calibration

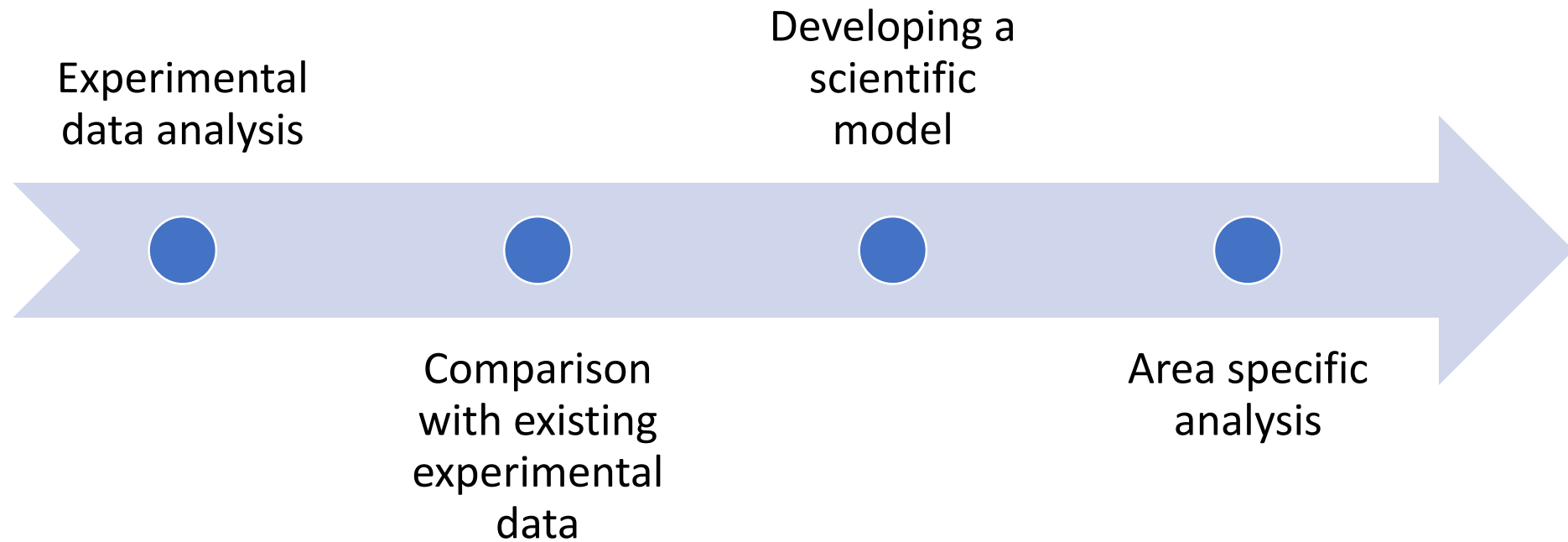


Vibration Bench



Thermo Vac Chamber

Scientific Endeavors



Further Merits

Reusability

- Can be used for several similar experiments

Recognition

- First Indian student high altitude flight

Encouragement

- For peers in BITS and other institutes

Collaborations

- Opened the doors for collaborative effort

Publications

- Impetus to student research activities

Recognition

- Collaboration with the India based Neutrino Observatory (INO) group of the Tata Institute of Fundamental Research, Mumbai for scientific expertise, equipment and guidance
- Collaboration with the ASTROSAT group of the TIFR, Mumbai for scientific equipment
- Collaboration with the National Balloon Facility, TIFR, Hyderabad for conducting the balloon flight

Thank you

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