



Human Spaceflight,  
Microgravity and Exploration

Physical Sciences in Space: **“Fundamental Physics”**



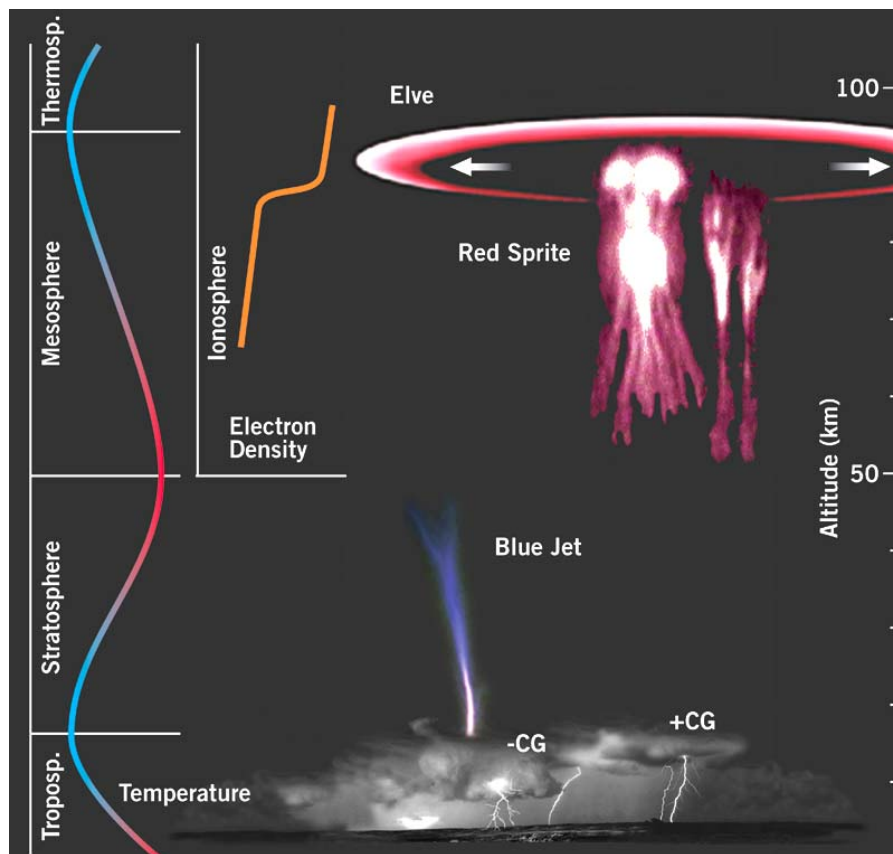
# ASIM Science

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*7th December ISS climate change experiments CFI  
information & networking meeting*



# What is ASIM looking at?



At the Earth to see:

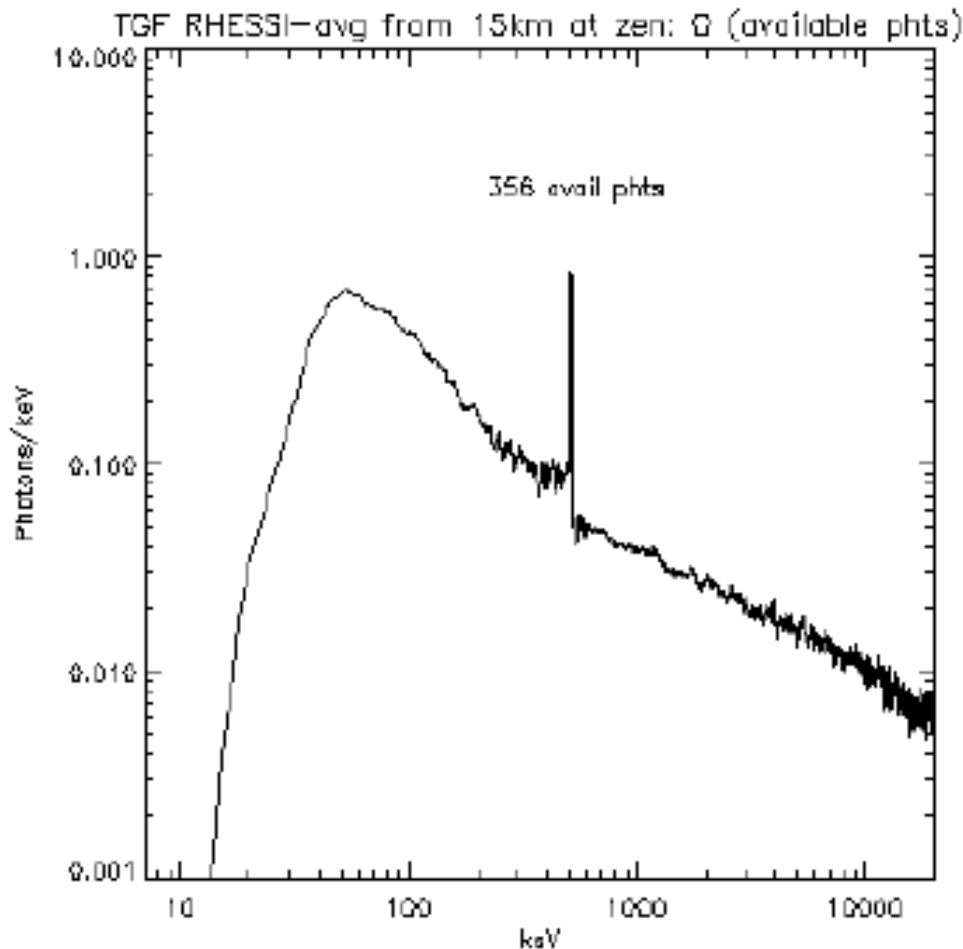
“TLE”s

Transient Luminous Events:

- Sprites **1-2 ms, 10 MJ-1GJ**
- Blue jets **0.5 s, ~1GJ**
- Elves **<1 ms, most common**



# What is ASIM looking at?



At the Earth to see:

Terrestrial Gamma-Ray  
Flashes “TGF”s

1-5 ms,  $h < 70$  km

**Bremsstrahlung**  
from run-away  $e^-$  discharge?

Are Sprites and TGFs  
related?



# Why look at TLEs and TGFs?

- Both TLEs and TGFs are known only since ~20 years → not yet well understood
- Understand coupling of atmospheric layers:  
Troposphere ↔ Stratosphere ↔ Mesosph. ↔ Near-Earth Space  
**>>>Energy exchange<<<**
  - 1) Thunderstorms power global electric circuit “ground ↔ ionosphere”
  - 2) Space processes influence electric environment of atmosphere → many effects and processes

What role do TLEs and TGFs play?



# ASIM Science Goals

- 1: Provide the most comprehensive **survey** to date of the occurrences of TLEs and TGFs on a global scale.
- 2: Study the **physics** of TGFs and their relationship with TLEs.
- 3: Study the **physics** of TLEs.
- 4: Determine the characteristics that make **thunderstorms** TLE- and TGF-active.
- 5: Study the **coupling to the ionosphere of thunderstorms** and TLEs.
- 6: Study the effects of thunderstorms and TGFs on the **Earth’s radiation belts**

The research objectives that rely on modeling, but with ASIM data as inputs are:

- 7: Quantify **chemical effects** of TLEs and TGFs on the stratosphere, mesosphere, lower thermosphere
- 8: Quantify effects of TLEs and TGFs on the **atmospheric electric circuit**
- 9: Quantify **perturbations to atmospheric dynamics** from TLEs and TGFs

Secondary science objectives include:

- 10: Auroral studies
- (11: *Studies of greenhouse gas concentrations above thunderstorms (NO<sub>x</sub>, O<sub>3</sub>)*)
- (12: *Studies of meteor ablation in the mesosphere and thermosphere*)



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# ASIM Science Goals

To establish for the first time whether TGF  
and TLE are linked!



# Why space? Why the ISS?

- **TLEs** (optical) also observed from ground campaigns
- **TGFs** (Gamma-ray) only seen from outside atmosphere

**ISS orbit is well suited for such observations:**

- **Altitude** (outside atmosphere but still close enough)
- **Latitudes** with most thunderstorm activity well covered
- All **local times** are covered

→ good signal and good event statistics



# What kind of payload is needed?

## External payload - Columbus

**Orientation:** Nadir ( Limb – currently descoped)

### Photon detectors:

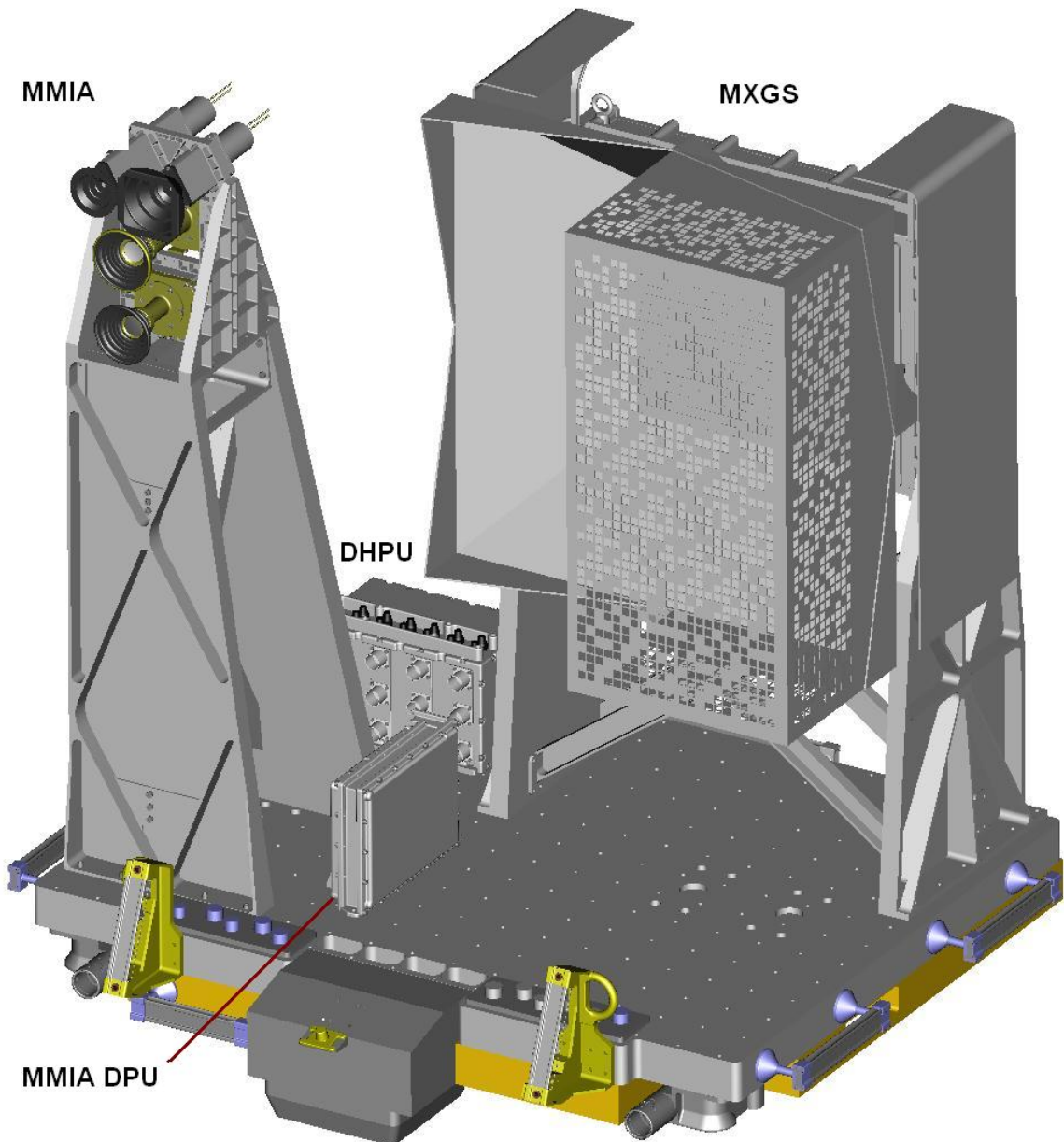
- 2 **Photometers** (narrow bands in UV and Far-UV)  
→dynamics, spectrophotometry, FUV →high altitude events
- 2 **Cameras**: (UV and IR) →spatial structure, location, image ratio, identify TLEs “on top” of bright lightning background
- 1 **Imaging Gamma-Ray detector 15-500 keV(20 MeV?)**



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design  
solution:

ASIM  
payload on  
CEPF

