Abstract
Terrestrial Gamma-ray Flashes (TGFs) are short (<10 us to ~2 ms) flashes of high energy (≥ 40 MeV) photons, produced by thunderstorms. When interacting with the atmosphere, the TGFs produce relativistic electrons and positrons at high altitudes, and a fraction is able to escape the atmosphere and can travel large distances inside the ionosphere and the magnetosphere. This phenomenon is called a Terrestrial Electron Beam (TEB). The Atmosphere-Space Interactions Monitor (ASIM), dedicated to the study of TGFs and associated events, started to operate in June 2018. ASIM contains an optical instrument (MMIA) made of micro-cameras and photometers, as well as the Modular X- and Gamma-ray Sensor (MXGS) for high energy radiation. MXGS is composed of the low energy detector (LED, 50 keV to 400 keV) and the High Energy detector (HED, 300 keV to 40 MeV).

This presentation is focused on a new event which was detected on March 24, 2019. The TEB originated from rainbands produced by the tropical cyclone Joaninha, in the Indian Ocean, close to Madagascar. This observation was made during the tropical cyclone Joaninha in March 2019, and can travel large distances inside the ionosphere and the magnetosphere. This phenomenon is called a Terrestrial Electron Beam (TEB).

Monte-Carlo simulations
Forward modeling strategy, 2 stages :
I: TGF generation, e±-e production, and propagation in the atmosphere
- Geant4-based
- Uses IGRF-12 or WMM for the magnetic model (very similar).
- MMIA photometers
- HED (400 keV - >~30 MeV)
- Field of view ~400X400 km
- Nothing, as expected (lightning ~800 km away)

II: Response of the instrument + environment
- Geant4-based
- Develops with B.E. Carlson
- Includes ASIM + ISS's Columbus module

In contrast with the first ASIM TEB (180916, [4]),
- Scatter spectrum \( \chi^{2}(102) = 0.70 \) \( \chi^{2}(102) = 0.70 \)
- No line at all visible
- Other interpretations are also possible (relative scaling is arbitrary)
- Instrument calibration to be re-checked carefully. But should be OK, a priori consistent with RREA model simulations.

Preliminary conclusions / pending questions
- First TEB event detected by ASIM with both LED (50-370 keV) and HED (400 keV - >~30 MeV)
- Multitude of recorded data, fits expectations overall
- Consistent with RREA model simulations
- First rough measurement of the incoming direction of the electrons (to our knowledge) using LED “Imaging.” To be verified.
- Problems to be solved:
  - 511 keV line weaker to previous event (180916)
  - “softness” compared to previous event (180916)

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References
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The First Terrestrial Electron Beam Observed by The Atmosphere Space Interactions Monitor
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Observation of a Terrestrial Electron Beam during the tropical cyclone Joaninha in March 2019
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