Orbit Generator

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OrbitGenerator

Library for simulating the particle fluxes impinging on a satellite in LEO.

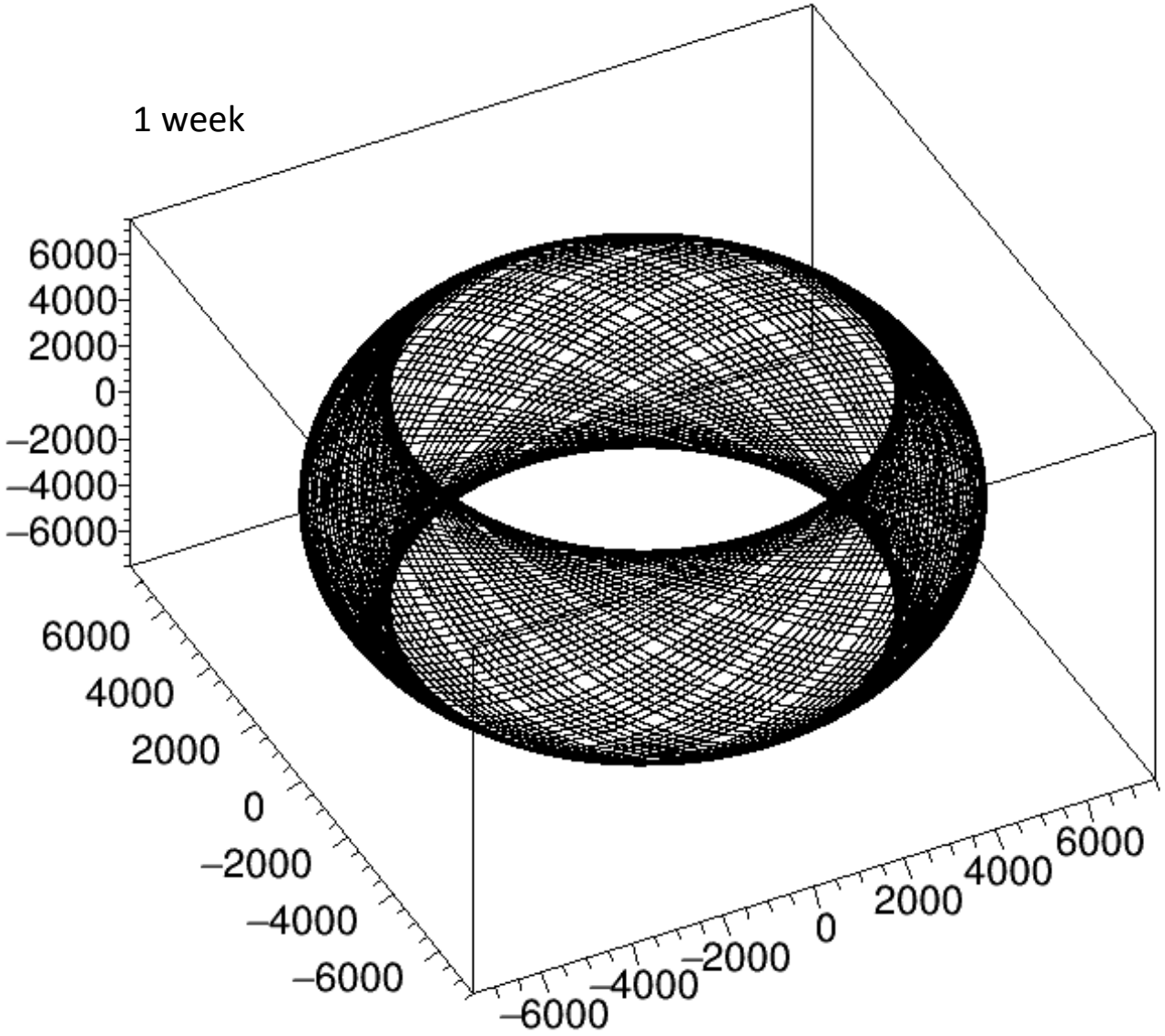
Code hosted on CERN GitLab: https://gitlab.cern.ch/oliva/OrbitGenerator

`git clone https://:@gitlab.cern.ch:8443/oliva/OrbitGenerator.git`
Then follow instructions in **`README.md`**.

It makes use of third party software, adapted and included in the package, as:
`predict-2.3.1`: LEO orbit description
`AE8/AP8`: radiation belt model from NASA
`AACGM_v2`: altitude-adjusted corrected geomagnetic coordinates

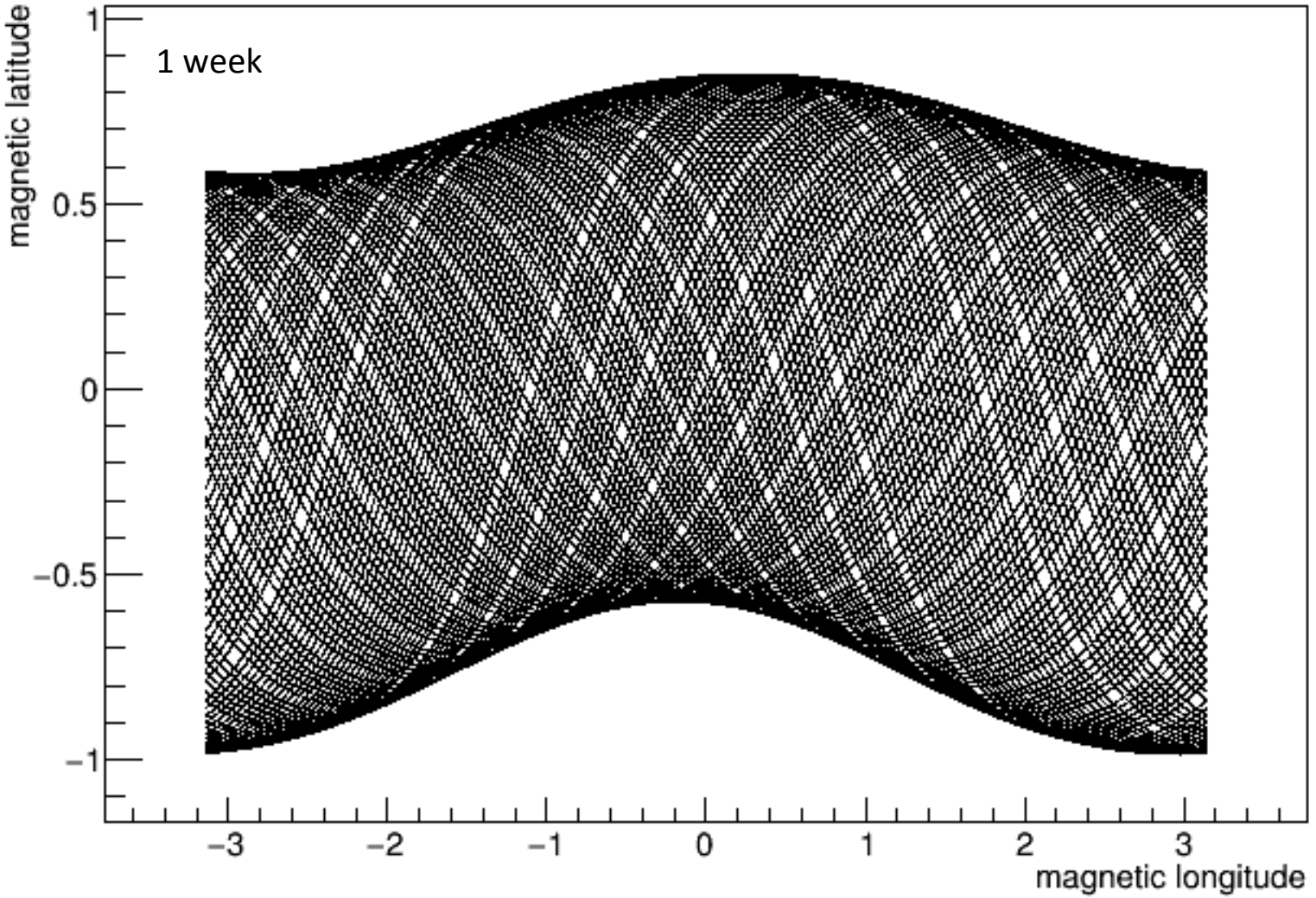
Orbit

1. Simple Circular Orbit (with TIANGONG-2 average parameters)
2. Orbit calculated with predict-2.3.1 (with TIANGONG-2 TLE)



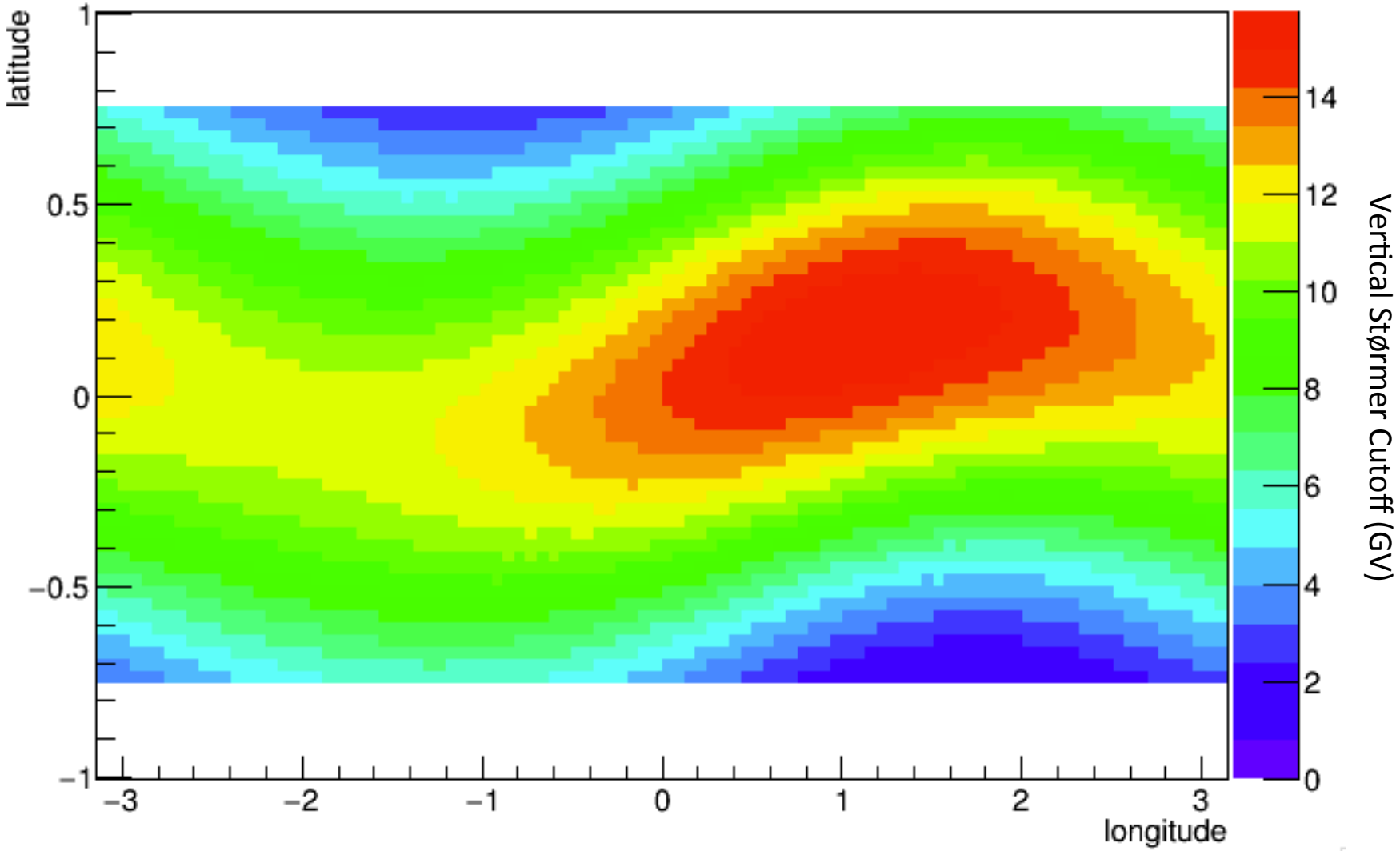
Geomagnetic Coordinates

1. **CGM**: Centered Dipole Geomagnetic Coordinates (tilted)
2. **EDGM**: Eccentric Dipole Geomagnetic Coordinates (tilted + shifted)
3. **AACGM**: Altitude-adjusted Corrected Geomagnetic Coordinates (ill defined in some region)



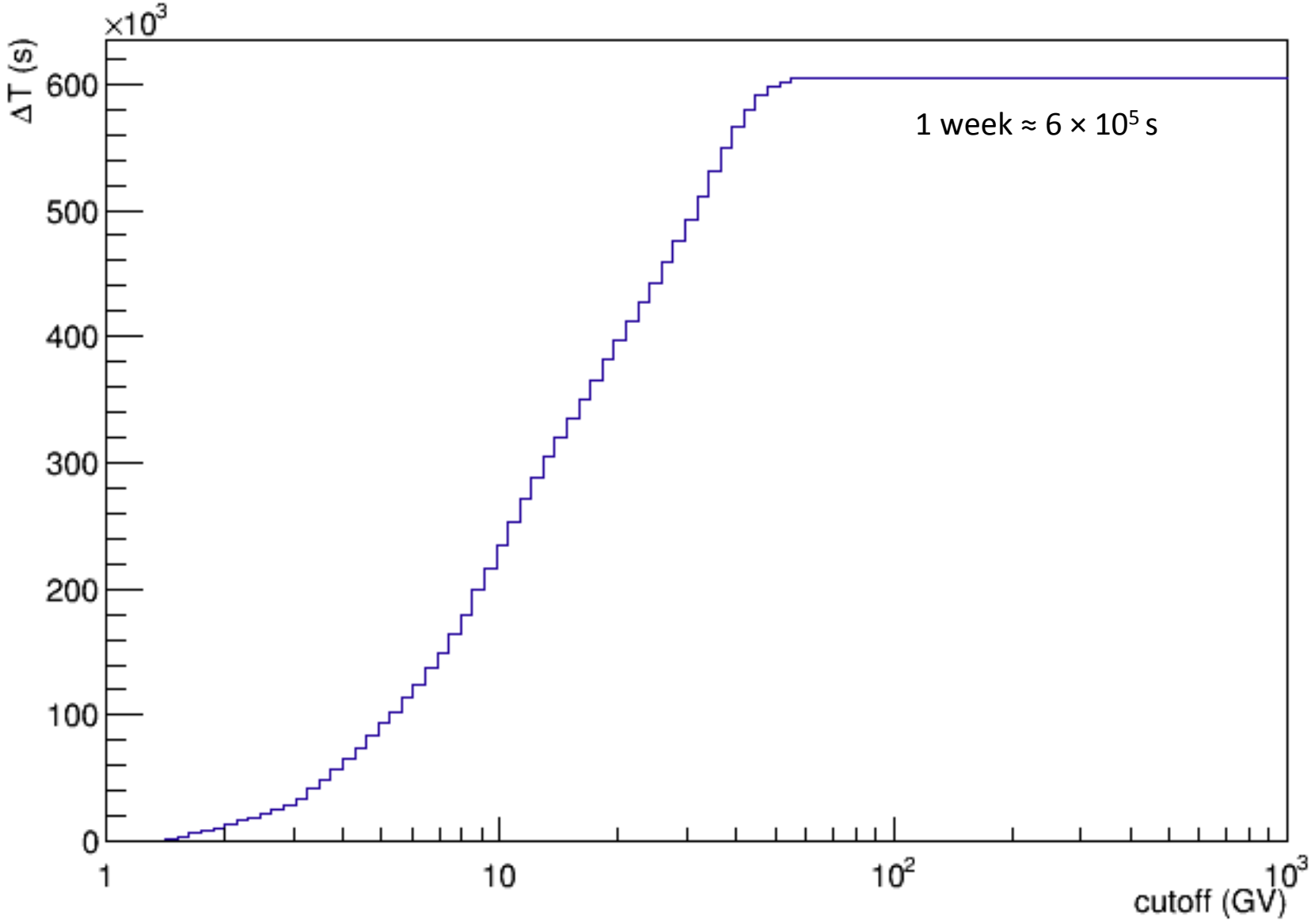
Geomagnetic Cutoff

1. Vertical Størmer Cutoff (GV)
2. Directional Størmer Cutoff (maximum, minimum in the field-of-view)

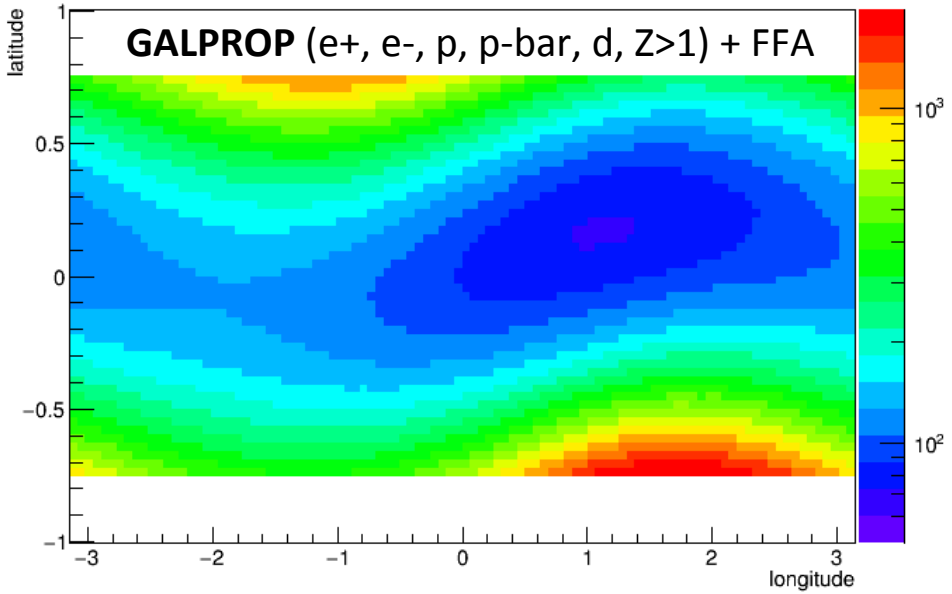


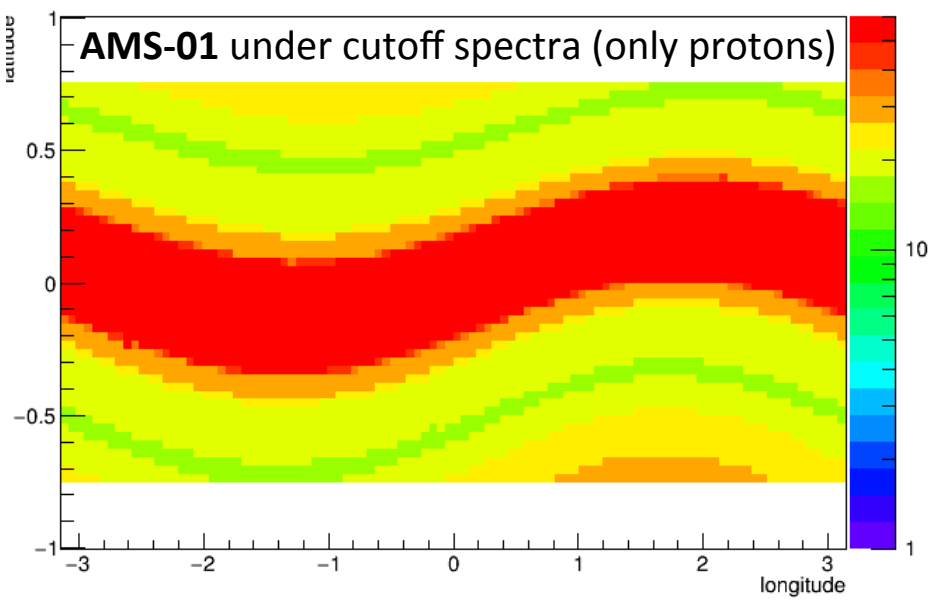
Example: Exposure Time Calculation

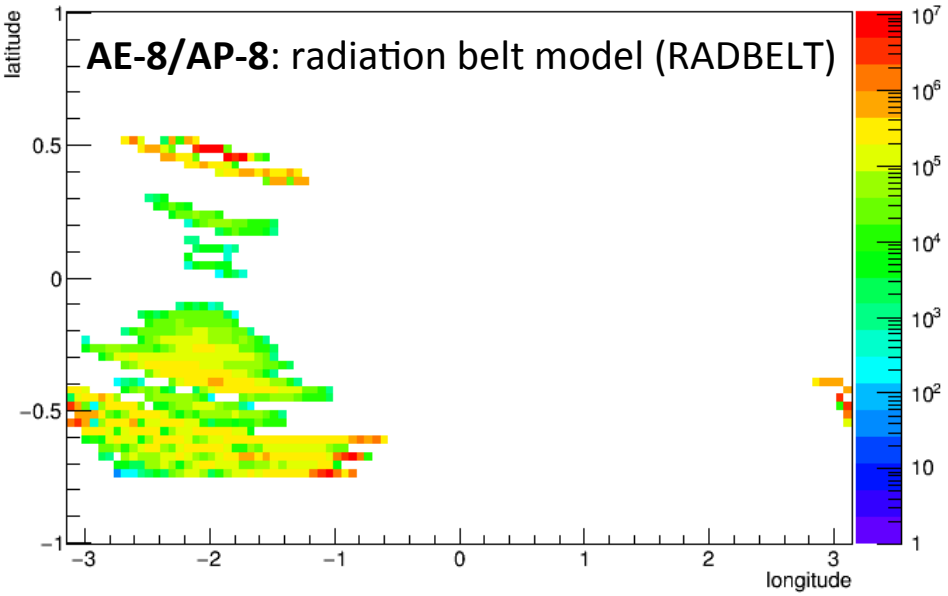
Time spent collecting particles above a given maximum cutoff in the field-of-view.



Particle Fluxes







Only proton fluxes,
Solar Modulation Potential = 650 MV,
Acceptance = 1 m^2 sr,
Integrated flux in all available range.

Full Simulation

Start with a GMT time, T
Calculate orbit parameters
Calculate global rate = $\Sigma_{particles}$ ($rate_{CRs}$ + $rate_{trapped}$ + $rate_{sec}$)
Extract particle kind and flux type (CRs, trapped, secondary)
Generate energy from corresponding spectrum
Generate direction isotropically
Calculate directional cutoff
If is CRs and under directional cutoff, don't save the event
(also shadow of the Earth is approximately included)
→ Store the event
Extract ΔT according to global rate and increase time T += ΔT for next particle

Conclusion

Library for simulating the particle fluxes impinging on a satellite in LEO.

Developed mostly for HERD trigger and calibration studies.

As an example can be used as a tool to understand available rates for given acceptance, or as a generator particles for a realistic MC.

For the time being the software is written in a very simple fashion, if needed we can think about a more scalable approach.