GAMMA-400 Workshop

A Scientific Simulator for GAMMA-400

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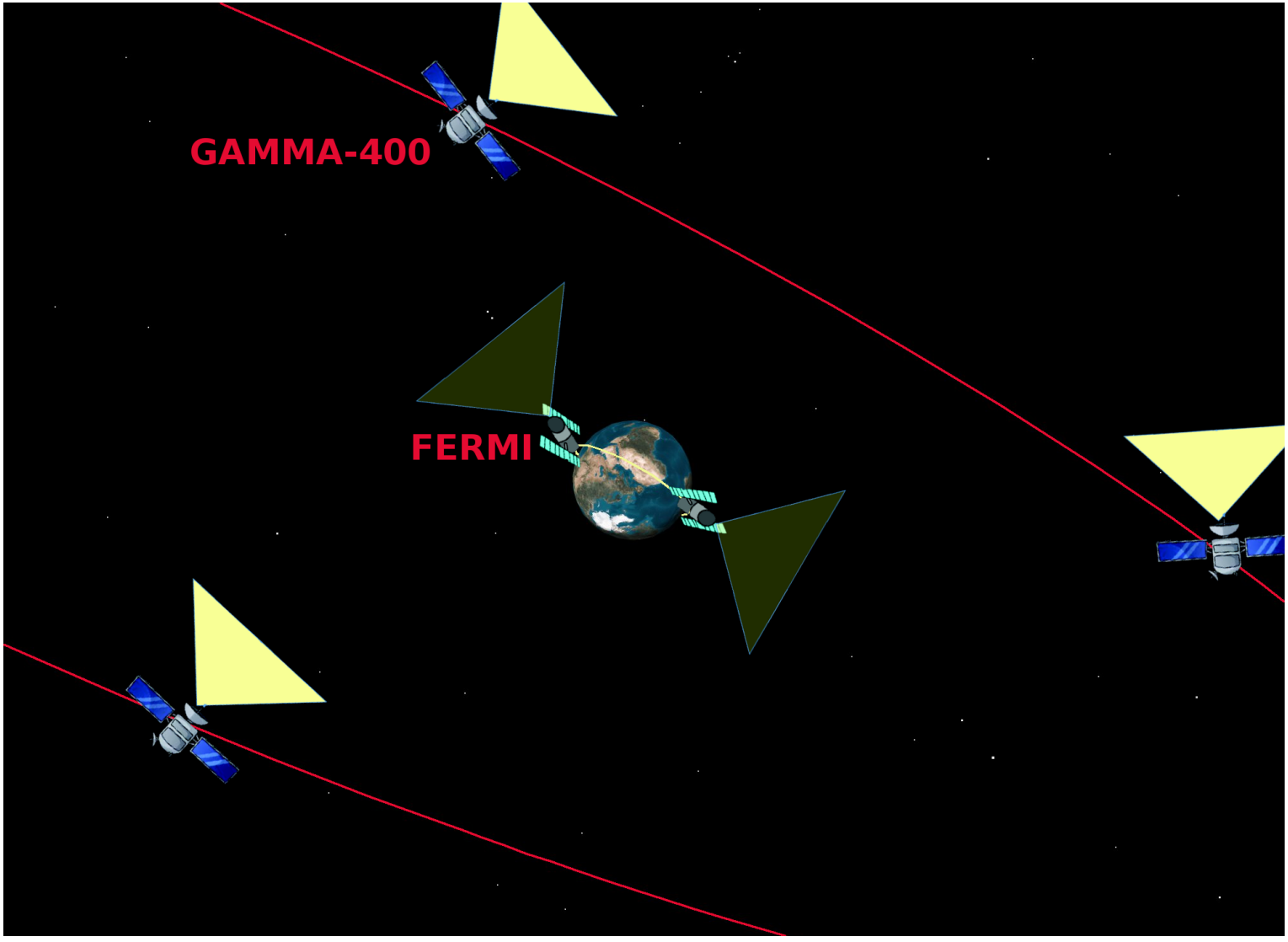


Fermi

Survey mode

GAMMA-400

Pointing mode

Orbit

Fermi	GAMMA-400
Survey mode	Pointing mode
Orbital period: 96.5 min	Orbital period: 7.1 days

$\Downarrow$

$\sim$ 106 Fermi orbit in 1 GAMMA-400 orbit

Fermi orbit simulator: gtorbsim

Calculate the position and orientation of the spacecraft.

Input:

- Ephemeris file
- South Atlantic Anomaly

gtorbsim: Ephemeris file

- NASA Flight Dynamic Facility (FDF) format (RXTE)
- Satellite Tool Kit (STK) format (Swift)
- NORAD Two Line Elements (TLE see http://celestrak.com/NORAD/elements)

Two Line Elements

```
FGRST (GLAST)
1 33053U 08029A   15162.82177654  .00002147  00000-0  11131-3 0  9992
2 33053  25.5838 332.0939 0012946  50.8442 309.3242 15.09926953385852
```

- Mean Motion (#orbit/day) $\sim$ ✓ and its first and second time derivative
- BSTAR drag term ✓
- Inclination $\sim$ ✓
- Right Ascension of the Ascending Node
- Eccentricity $\sim$ ✓
- Argument of Perigee
- Mean Anomaly

Two Line Elements: Precision of the parameters

The higher the precision the longer the simulation can last.

Fermi orbit inclination: 25.5838°

GAMMA-400: $\sim 51^\circ$

Hidden parameters: Earth Limb

Fermi Earth Avoidance Angle of 20°

$\Downarrow$

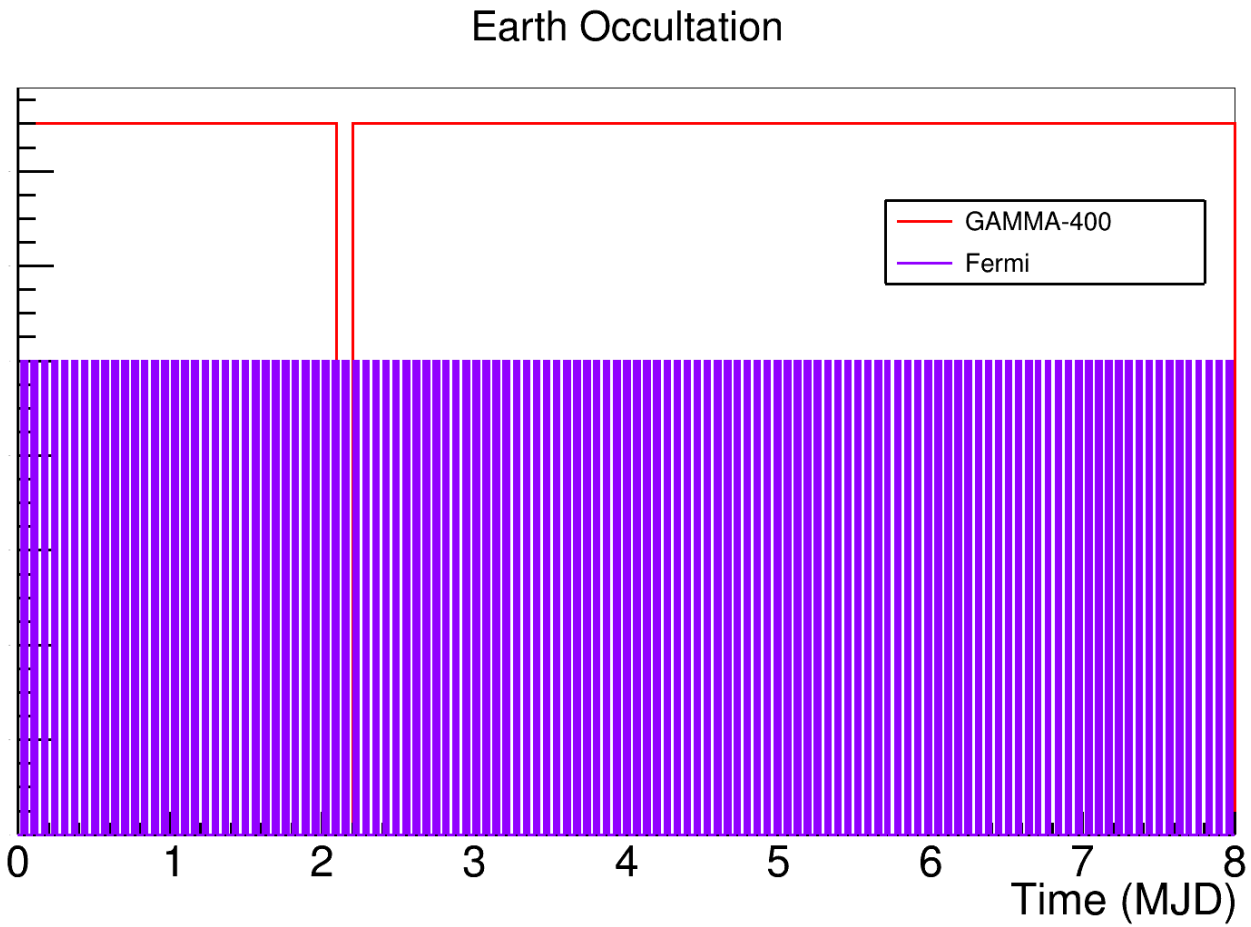
GAMMA-400 Earth Avoidance Angle of $\sim$0.4° (Earth seen with a $\sim$4.7° diameter)

Some results

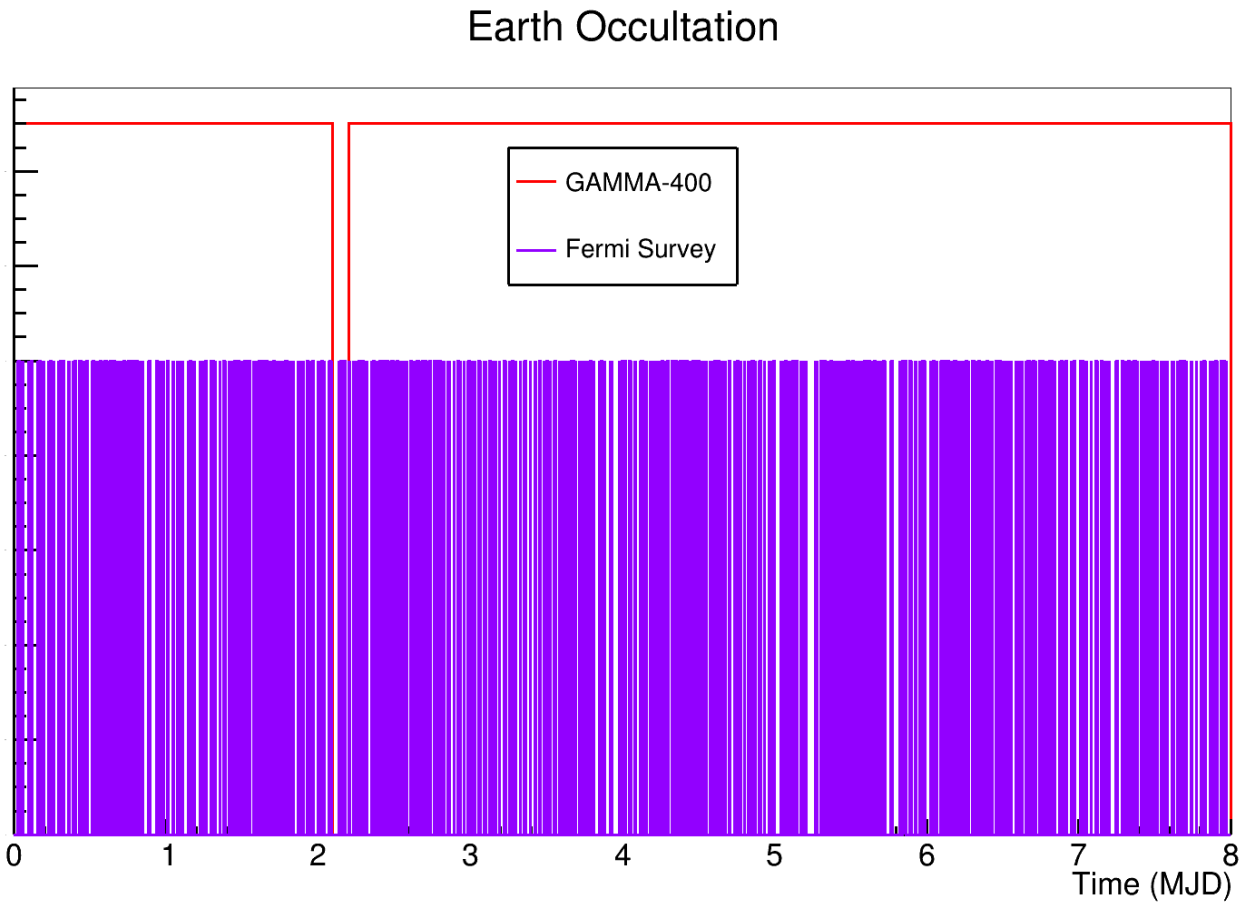
Observation of the Crab for 1 GAMMA-400 orbit:

- GAMMA-400: Pointing mode
- Fermi: Pointing mode
- Fermi: Survey mode

Earth Occultation



Earth Occultation



Earth Occultation

Results for 1 GAMMA-400 orbit (not an average)

		% of occulted time
GAMMA-400		1.3%
Fermi	Pointing	50.6%
	Survey (2.5sr FOV)	86.6%
	Survey (1.2sr FOV)	93.4%

Outlook

- Use Fermi Science Tools to simulate the orbit (occultation times/direction of the zenith etc...)
- Calculate the necessary time to reach the 7-year Fermi sensitivity for a source
- Calculate the sensitivity in a given observation time for a source
- Generate maps of the sky as seen by GAMMA-400

Conclusions

- Scientific simulator is necessary. The development is only at the beginning
- Starting point:
  - Orbital parameters as precise as possible
  - IRFs
- Goal:
  - Sensitivity for different sources/observation times
  - Sky map

SPARE SLIDES

Fermi Scientific Simulator: gtobssim

Input parameters:

- Flux of the source
- Pointing history of the satellite (real or created with gtorbsim)
- Instrument Response Function (IRF)

Instrument Response Function

Files containing:

- PSF
- Effective Area
- Energy resolution

At different θ, ϕ and in different energy bins