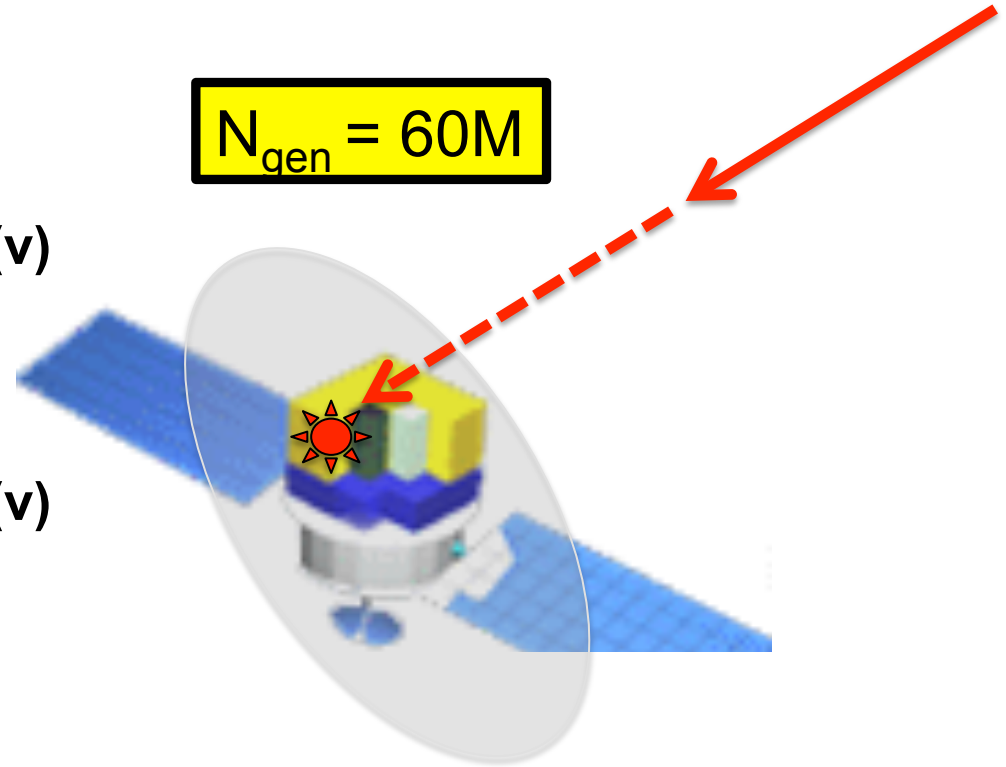
Generating the Instrument Response Functions

- We generate IRFs starting from MC simulations and then applying corrections as need based on flight-data
- Simulations details:
  - Full GEANT simulation of particle interactions with the LAT
    - Detailed detector geometry
    - Detailed particle interaction models
    - Calibrated instrument response to particles
- For IRFs, we only need to simulate γ-ray sample

The "allGamma" Monte Carlo sample

Steps to generating allGamma MC simulation:

1) **Randomly select a direction (v)**
2) **Make a circle with area 6m^2 normal to that direction**
3) **Pick a point on that circle**
4) **Back away by about 10 m in (v)**
5) **Throw the particle at the LAT along (v)**



Considerations for making the A_{eff} Tables

- Parameterization: what variables do we tabulate A_{eff} for?
- Binning: how many values of the A_{eff} will we need?
- Computation: how do we calculate A_{eff} for a particular bin?

Extra Columns in Monte Carlo "photon" Files.

- name = 'MC_DIRERR'
  - Angular separation between true and recon. directions.
- name = 'MC_ENERGY'
  - True γ-ray energy
- name = 'MC_DEC'
- name = 'MC_RA'
- name = 'MC_XDIR'
- name = 'MC_YDIR'
- name = 'MC_ZDIR'

Beware: arbitrary pointing

True direction of photon in LAT Frame

Some other columns in the MC you may need

- name = 'ENERGY'
- name = 'THETA'
- name = 'PHI'

} True direction of photon in LAT Frame (degrees)

- name = 'CONVERSION_TYPE'
  - 0 (Front) or 1 (Back)
- name = 'EVENT_CLASS'
  - Bitmap showing which classes this event belongs to
    - Bit 0 (P7TRANSIENT)
    - Bit 1 (oops…)
    - Bit 2 (P7SOURCE)
    - Bit 3 (P7CLEAN)
    - Bit 4 (P7ULTRACLEAN)

Bitwise operators

- Bitwise AND (usually “&”)
  - A & B -> returns bits that are set in both A and B
  - 37 & 15 = 5
- Bitwise OR (usually “|”)
  - A | B -> returns bits that are set in either A or B
  - 37 | 15 = 47
- Bit shift (usually “<<“ and “>>”)
  - 1 << 5 = 32
  - 32 >> 5 = 1
- Generic test for bit “i” in variable x
  - x & (1 << i) != 0
- Picking out bits 0,2,3,4
  - x & 29 (or x & 0x1D if you prefer hex)

EXTRA STUFF

Considerations for making the IRF Tables

- While A_{eff} is just a scalar, the point-spread function (P) and energy dispersion (D) are distributions.
- Useful to use common figures or merit to visualize the energy dependence of P or D.
  - I.e., 68% or 95% containment.
- Note that direction is actually two parameters (θ,ϕ)
  - Common to reduce the PSF parameterization to a single variable (α), the angular separation between the true and reconstructed direction.