Gamma-ray background study for future Compton-telescope missions using COSI flight data

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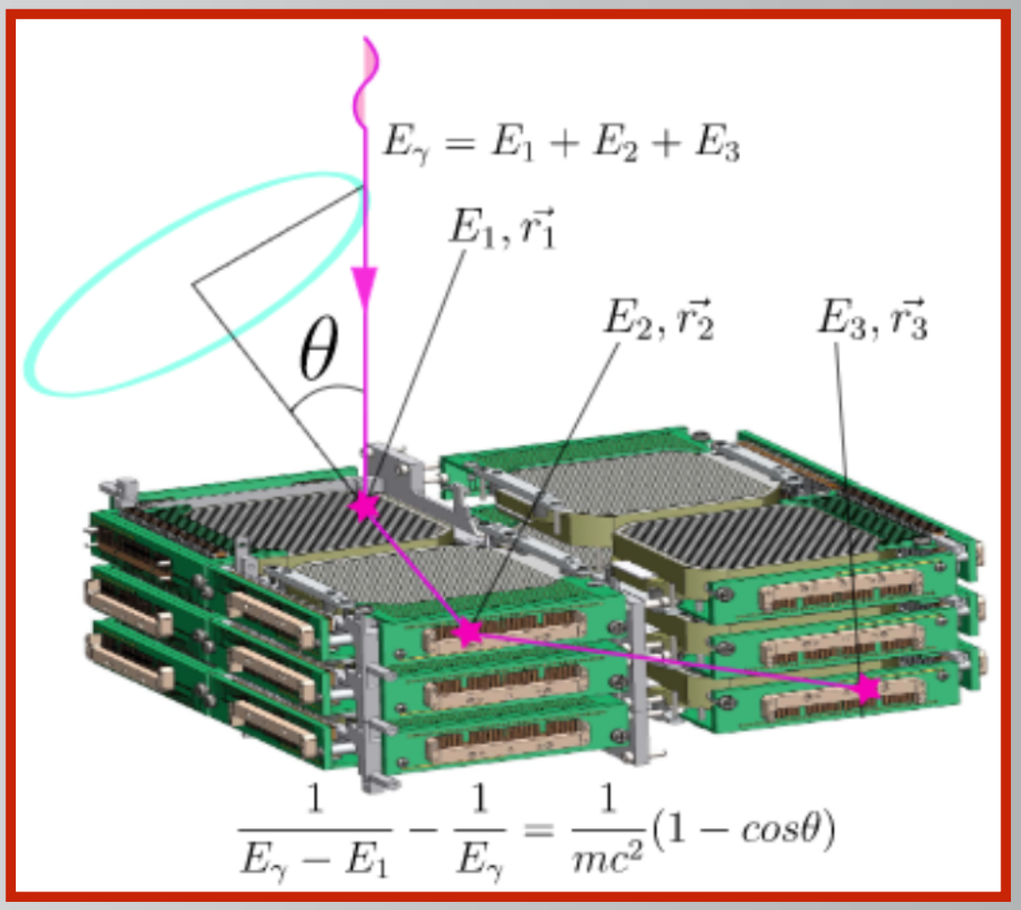
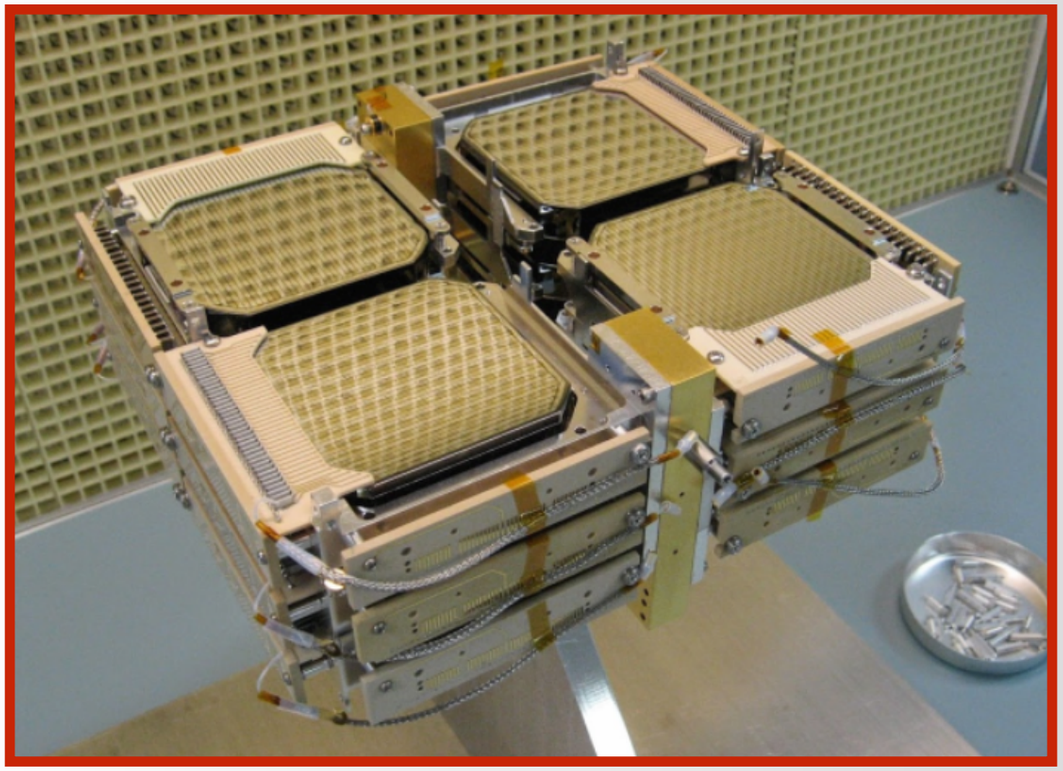
COSI Instrument

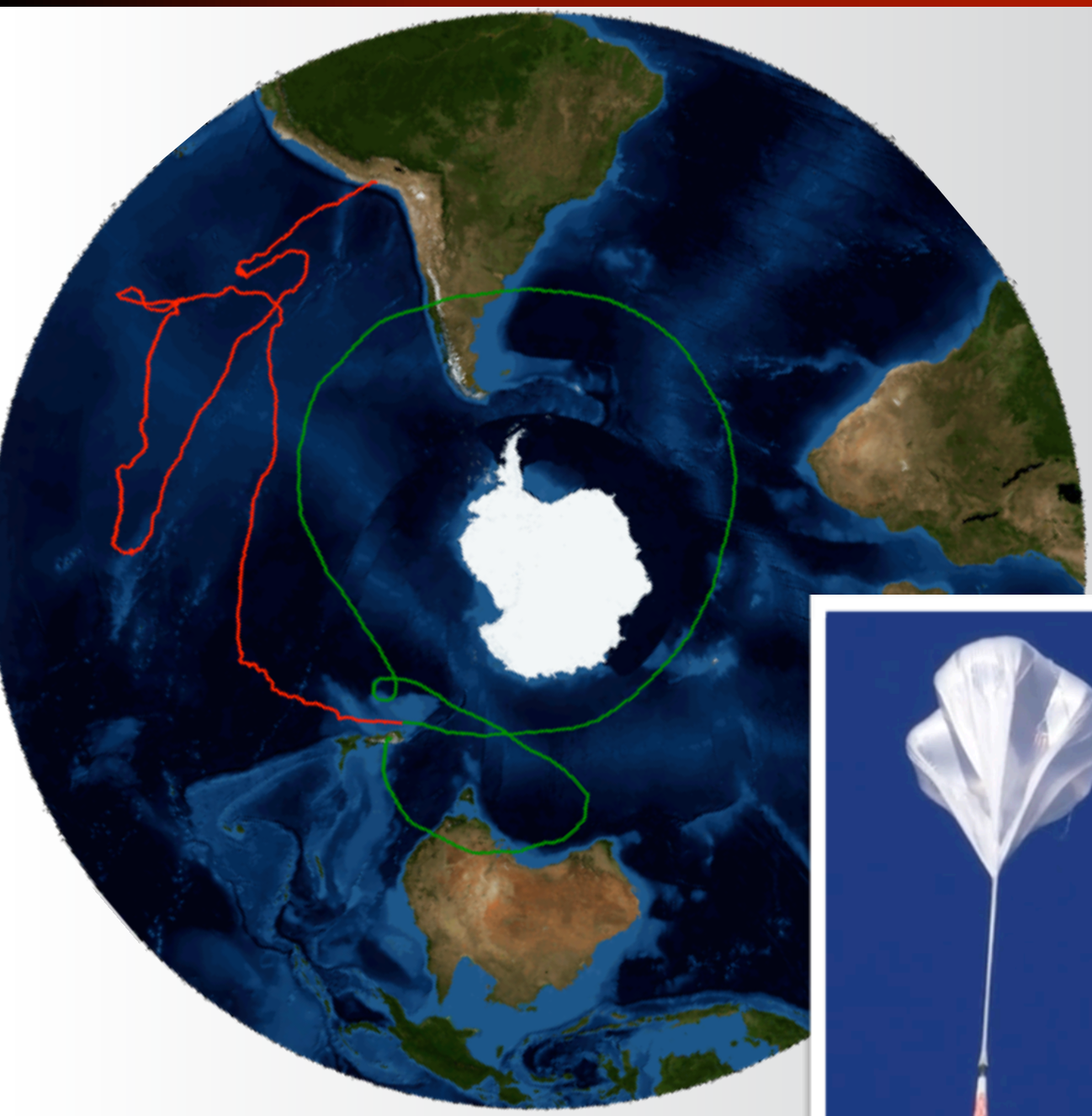
- Balloon-borne telescope: 0.2 - 10. MeV
- Ge cross-strip detectors (GeDs)
- 12 GeD: 8x8 cm^2 x 1.5 cm
- GeD: 37 x 2 mm strips / 0.25 mm gaps
- Controlled cryostat
- ACS: CsI panels
- Electronics + balloon gondola

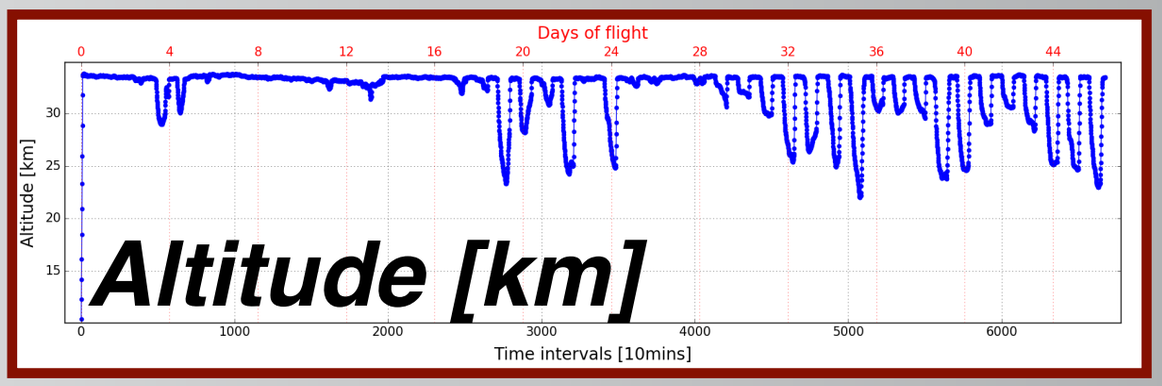


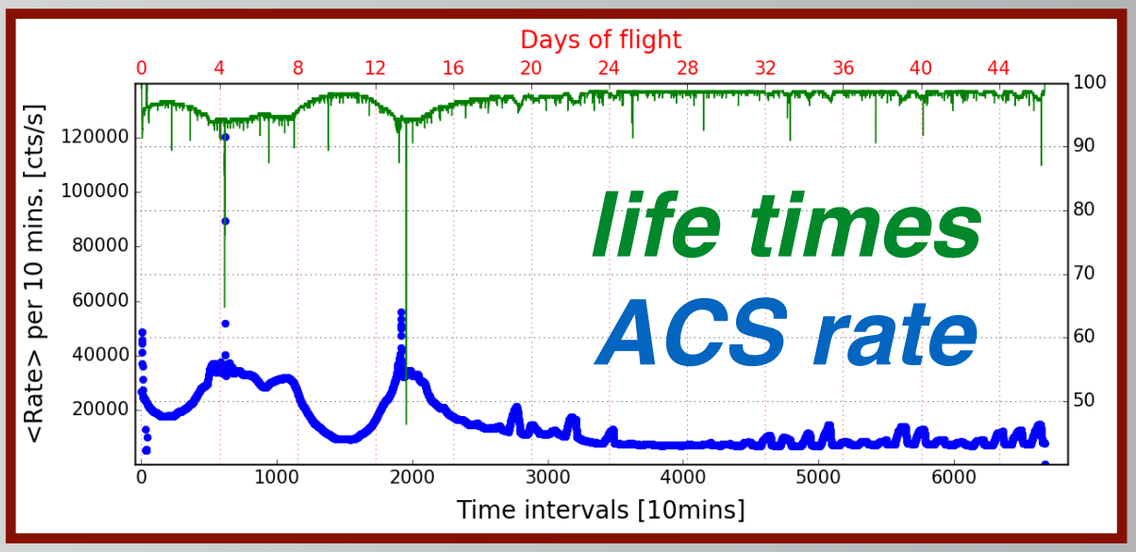


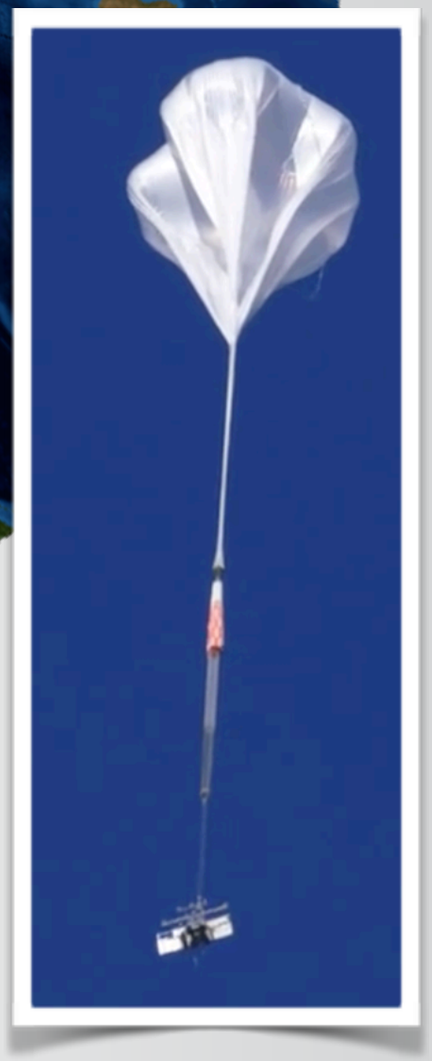
- Energy res: *1.5-3.0 keV FWHM*
- Angular res: up to *~4° FWHM*
- Field-of-view: almost *1/4 of sky*
- X/Y res: *2. mm or less*
- Depth-of-int: *~0.2 mm RMS*

COSI Flight 2016





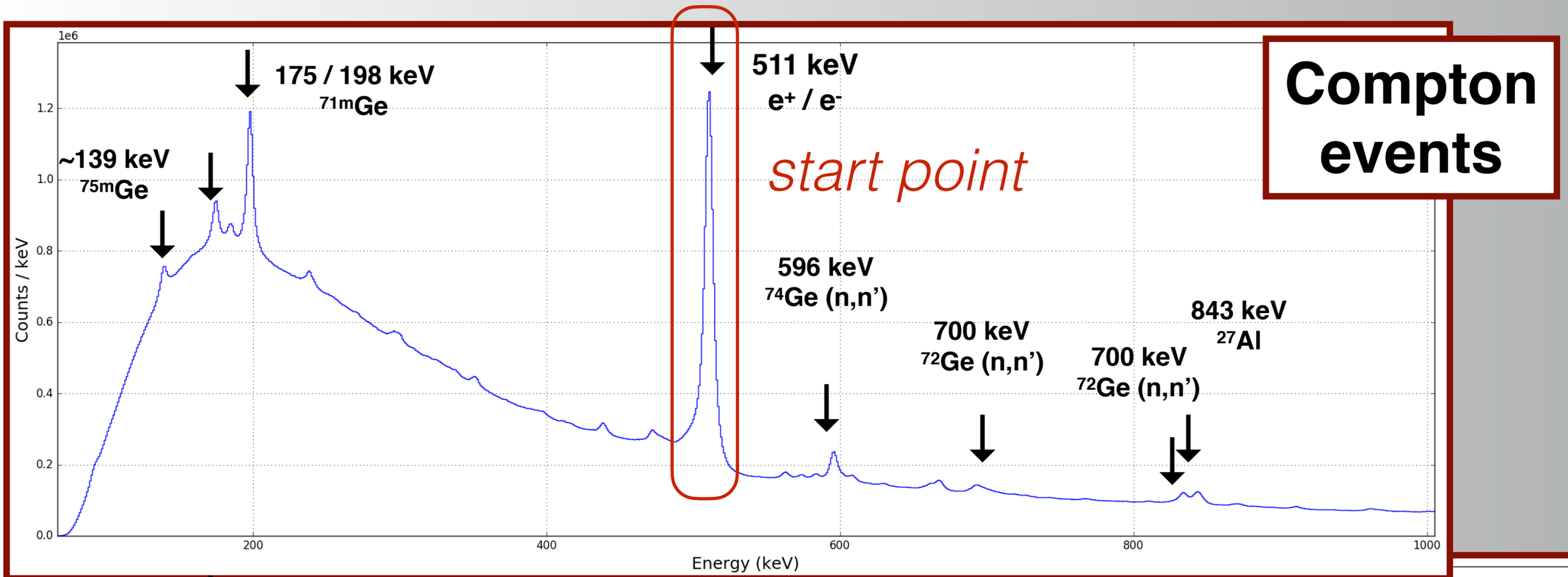




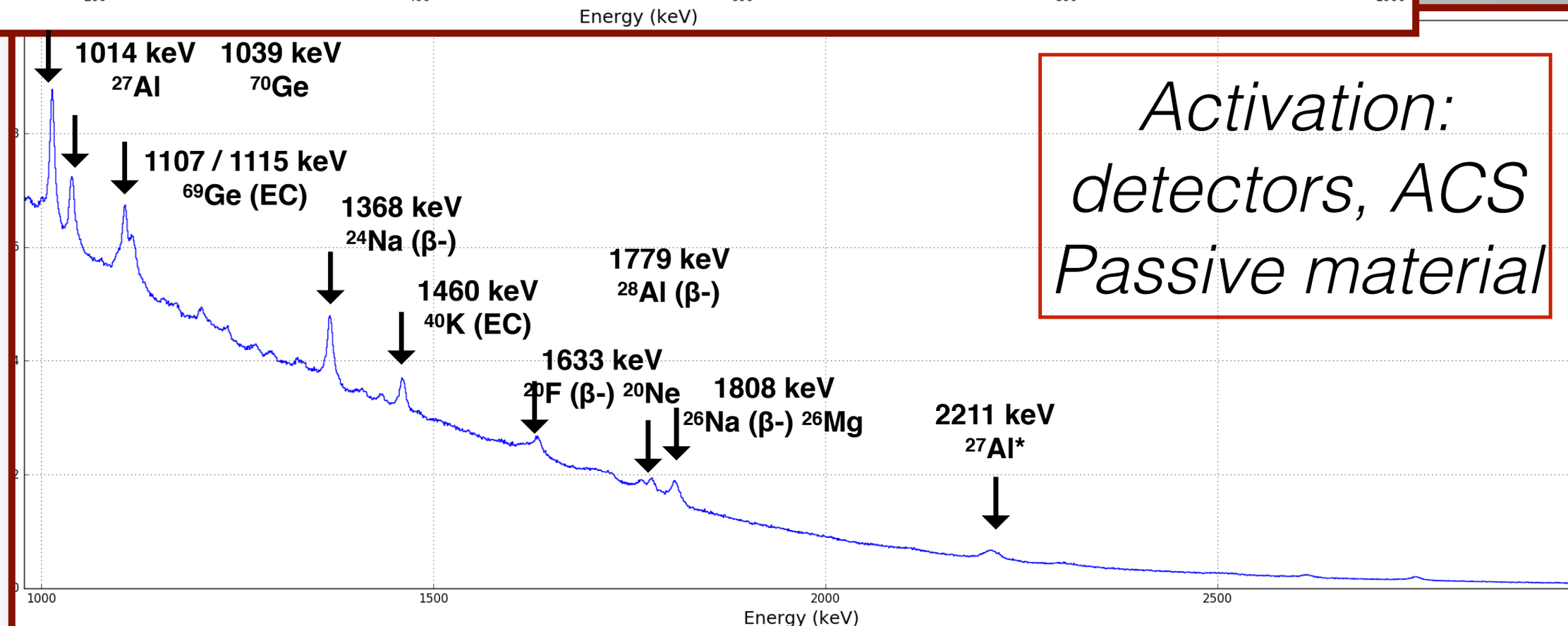
16 May- 2. July 2016
46 days of data

Detected events
(E, interaction location)
Geolocation *(lat, lon, alt)*
Instrument orientation
(galactic, horizon)
Shield rate, life times…

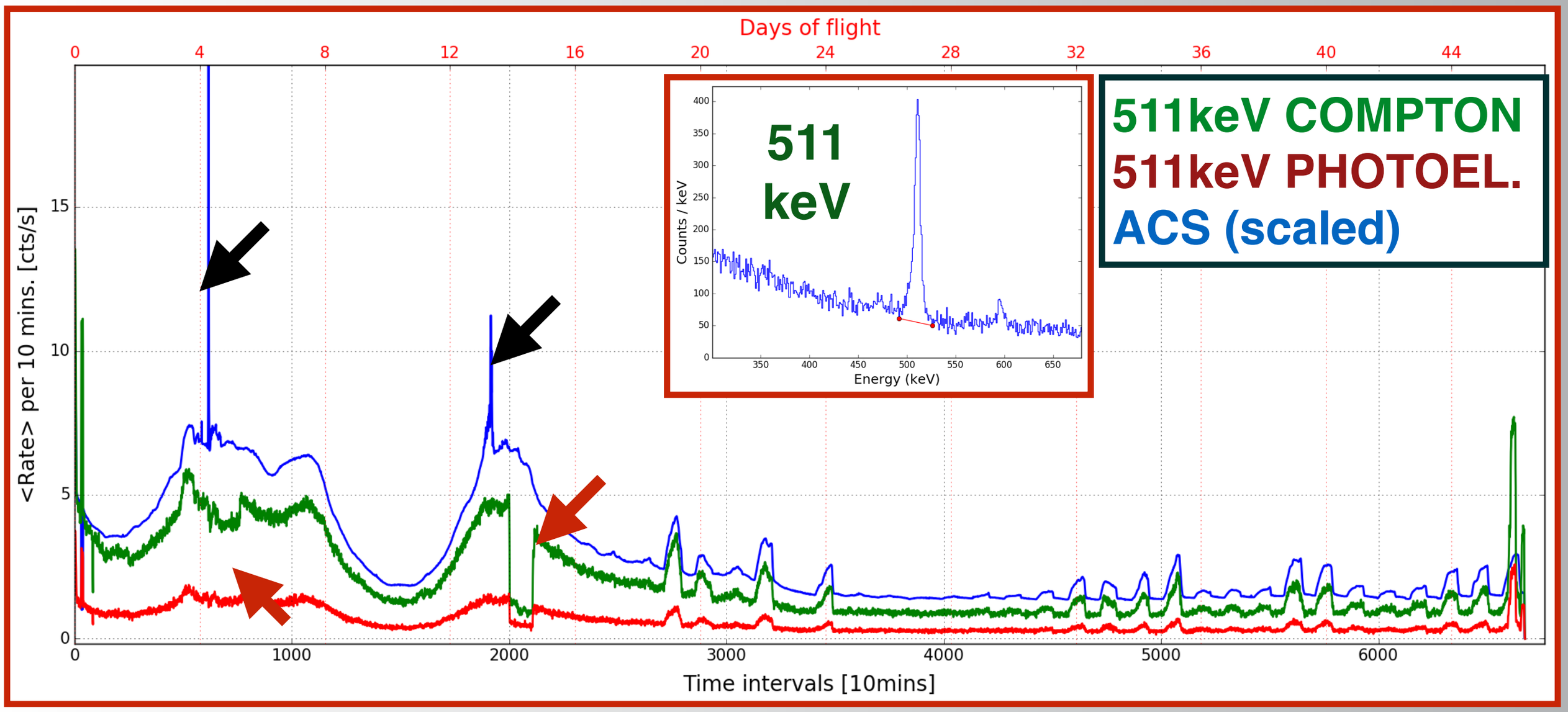
Integrated energy spectrum



β-
EC
IT

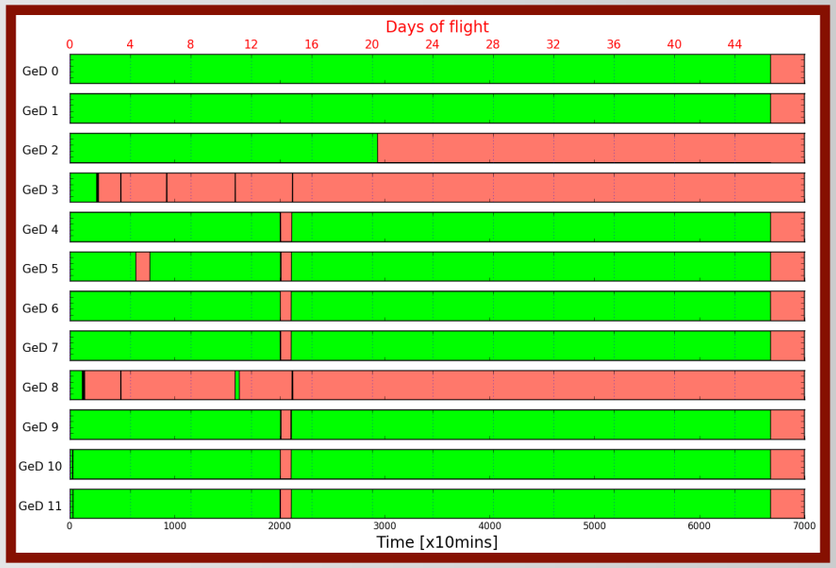


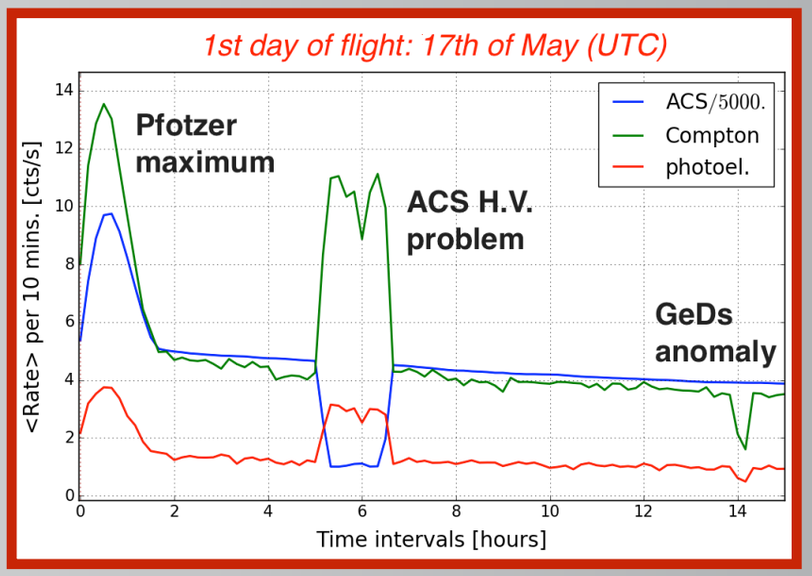
511 keV rate



511 keV rate ~

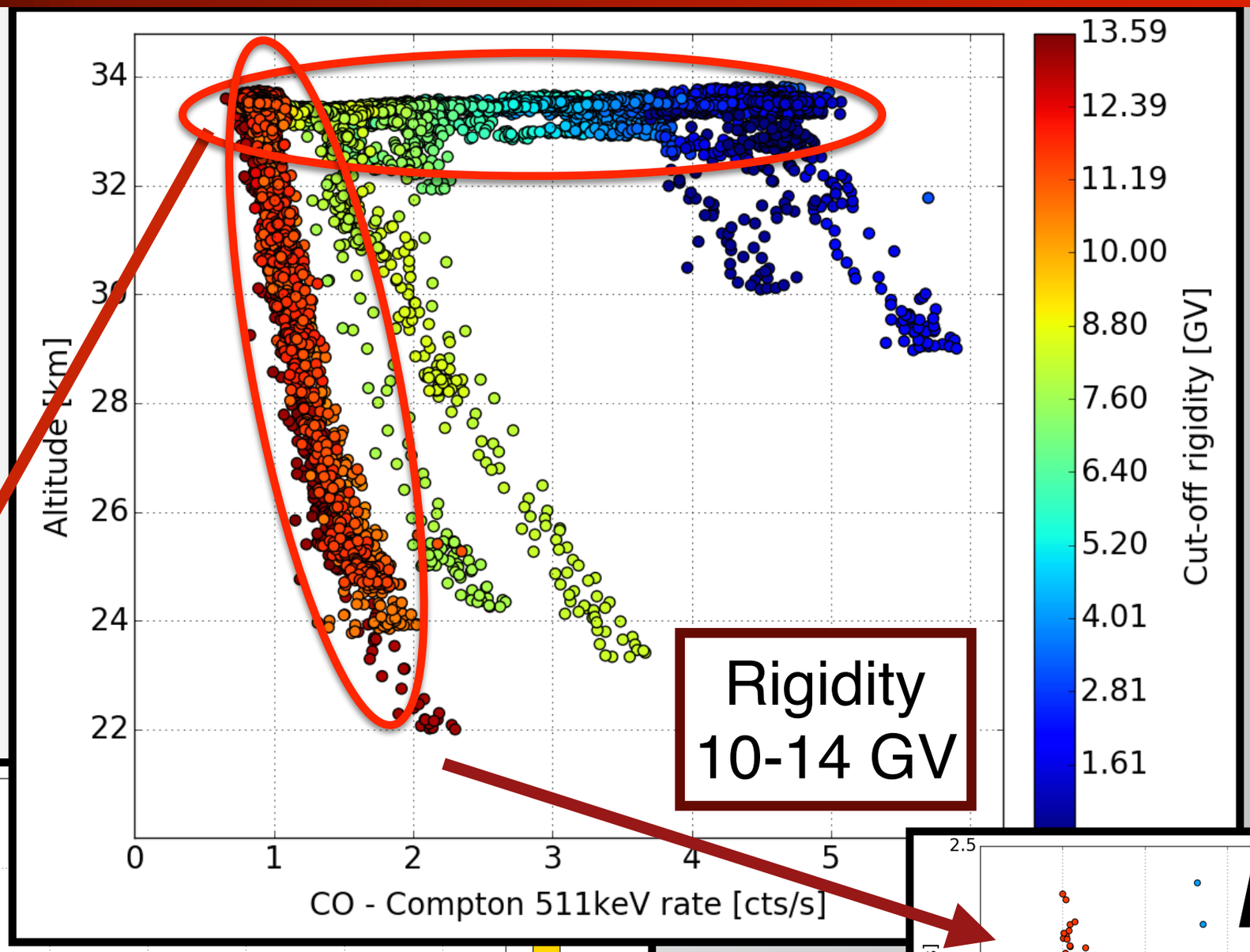
- *DREP*
- *GeDs ON/OFF*
- *Altitude*
- *Launch*





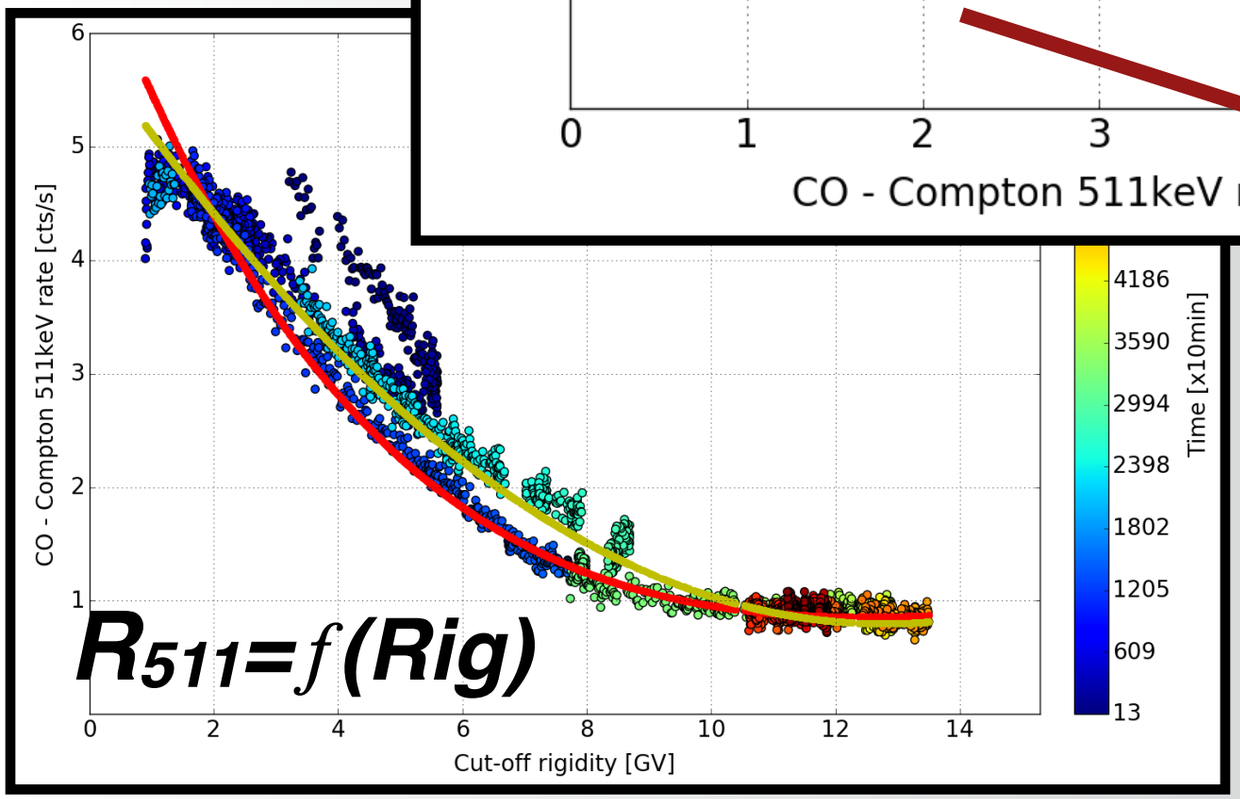
511 keV atmospheric model

Max Altitude 33-34 km

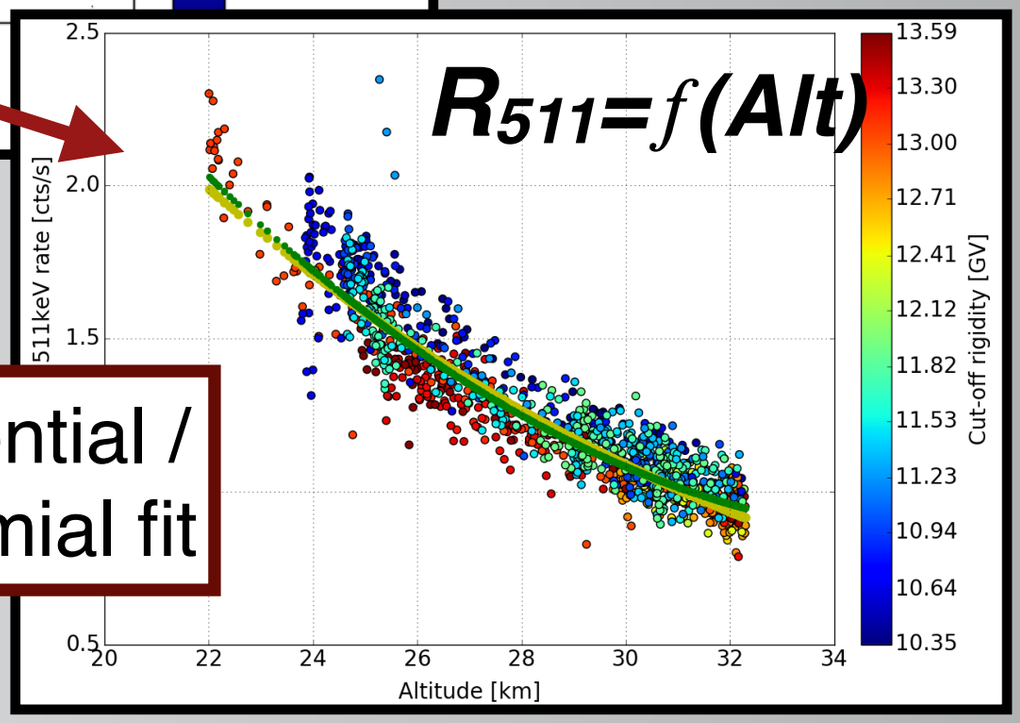


Rigidity 10-14 GV

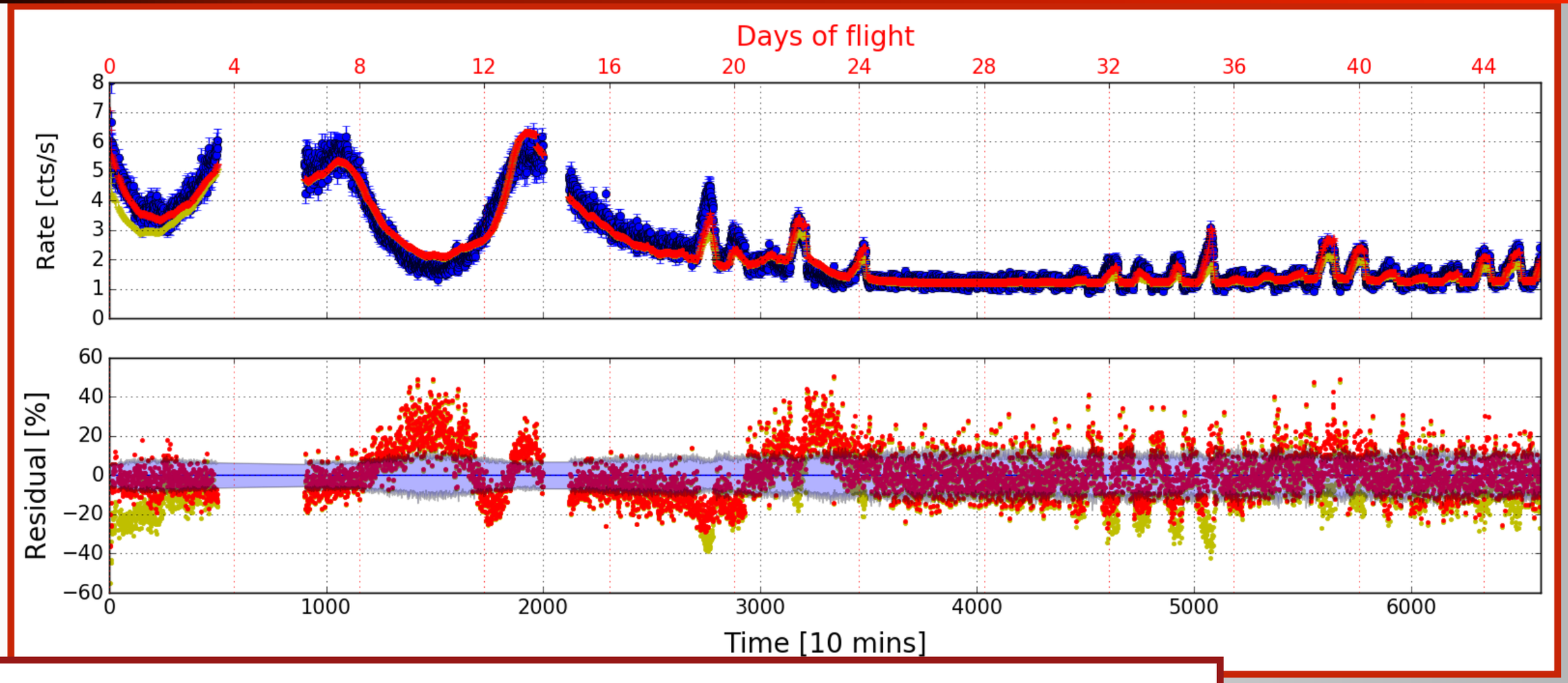
511 Rate ~ Altitude ~ Rigidity (2016)



exponential / polynomial fit



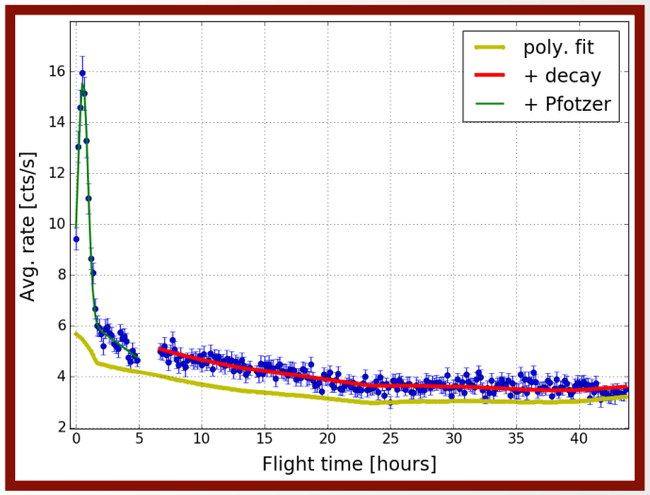
511 keV atmospheric model

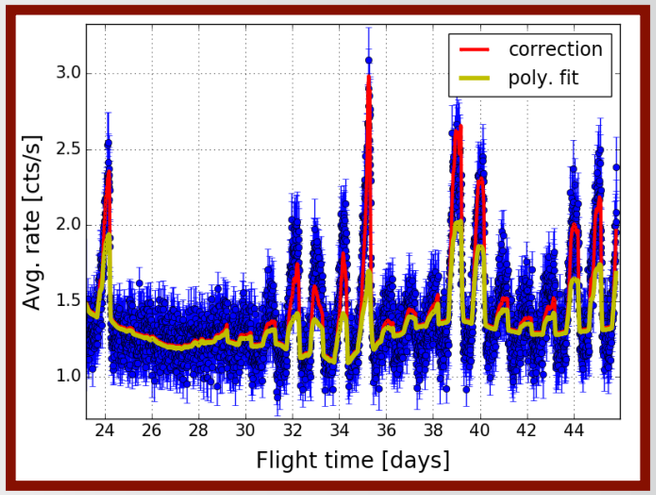


$$Poly_{2}[x(t)] + a \cdot e^{kt} + a' \cdot e^{k't} + b \cdot e^{q \cdot Alt}$$

$$x(t) = Altitude(t) \times Rigidity(t)$$

<fit res.> ≤ 9%



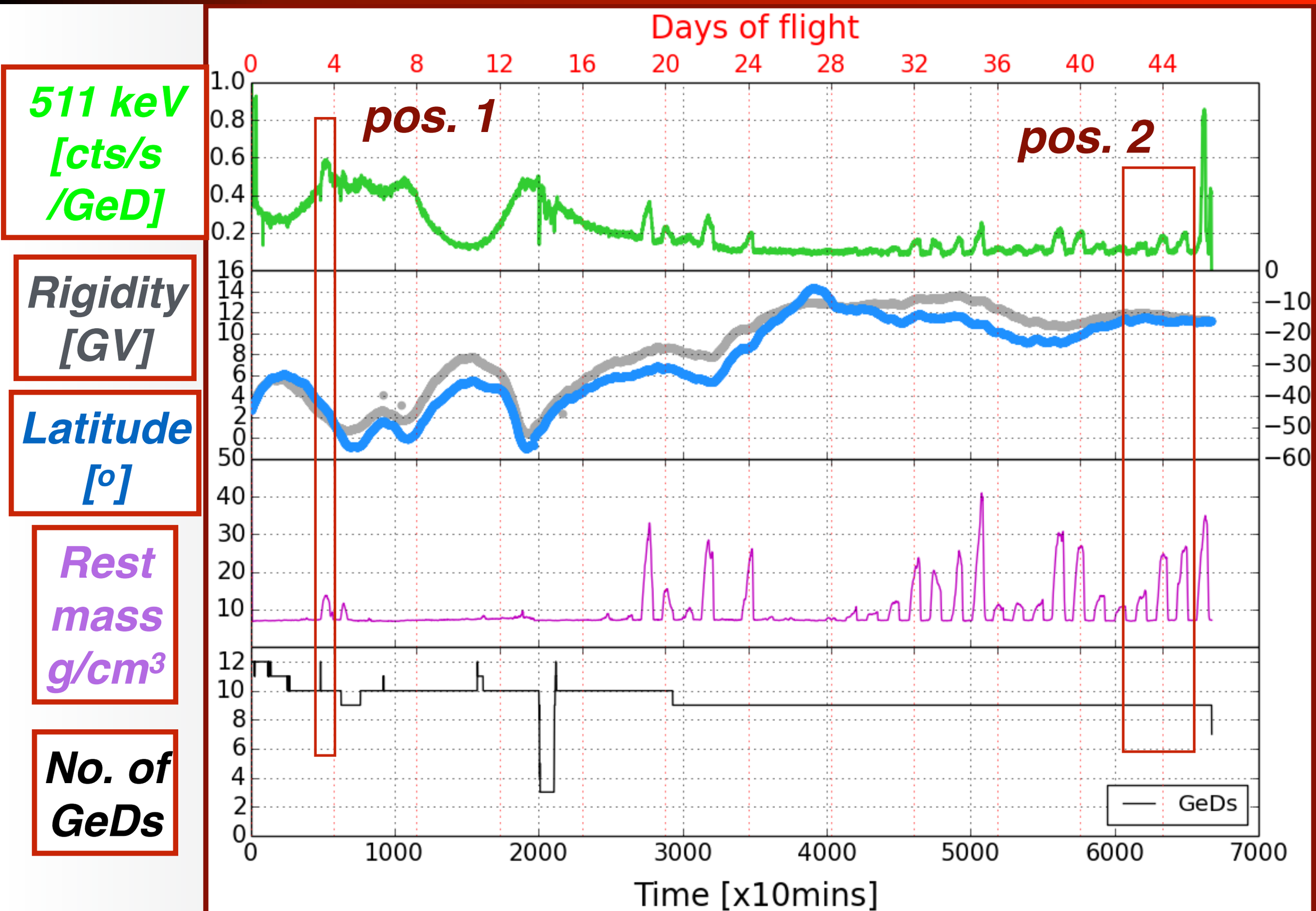


Other lines: 138,198, 596 keV

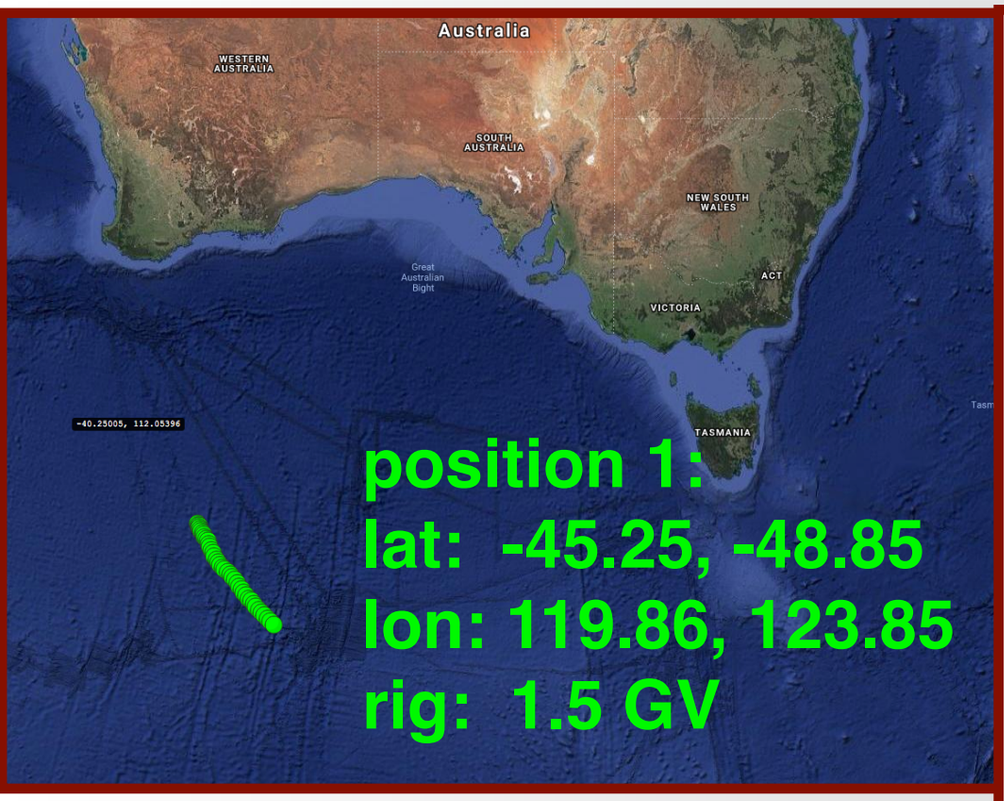
Continuum: 0.1 - 2.5 MeV

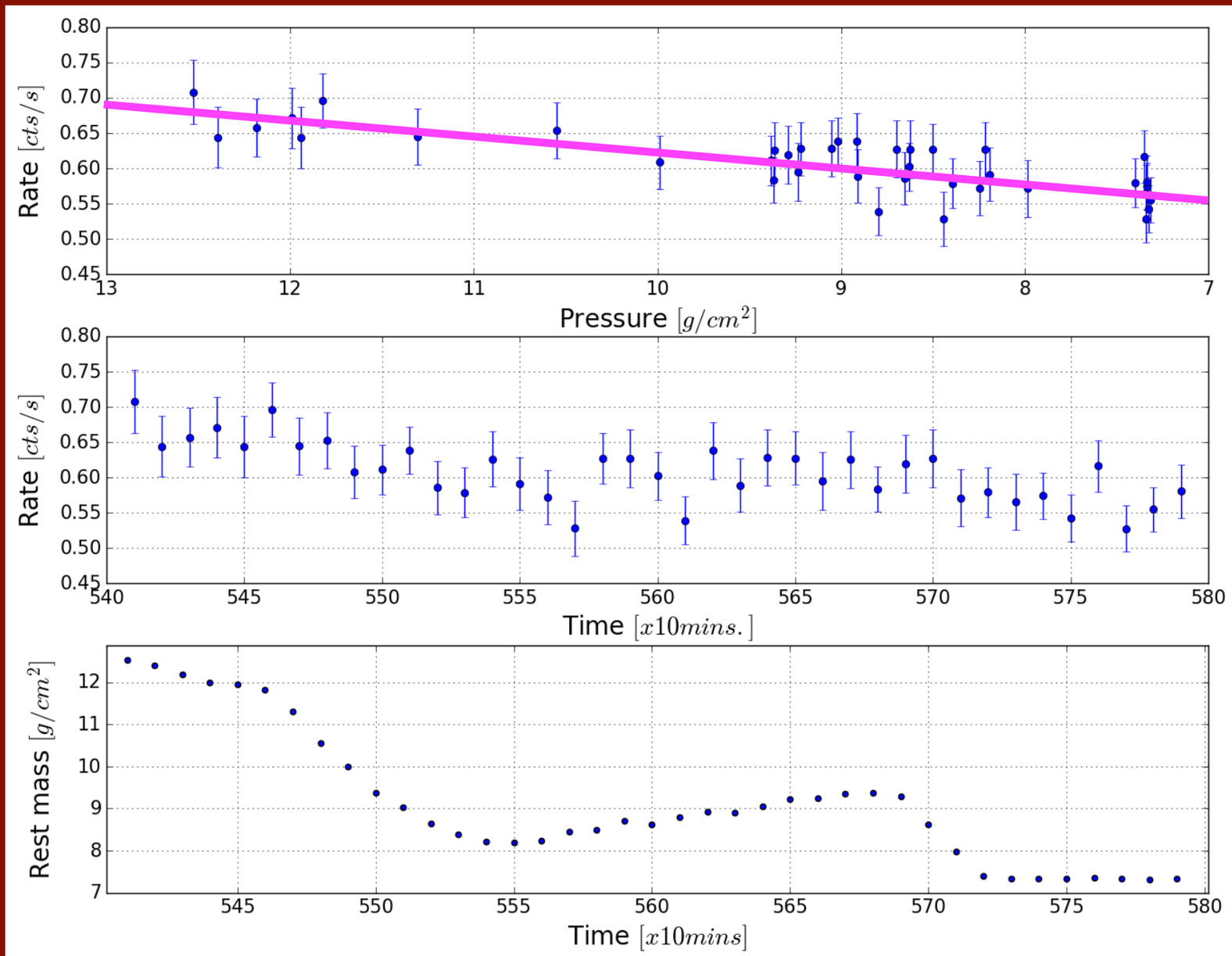
ΔE=100, 200… keV

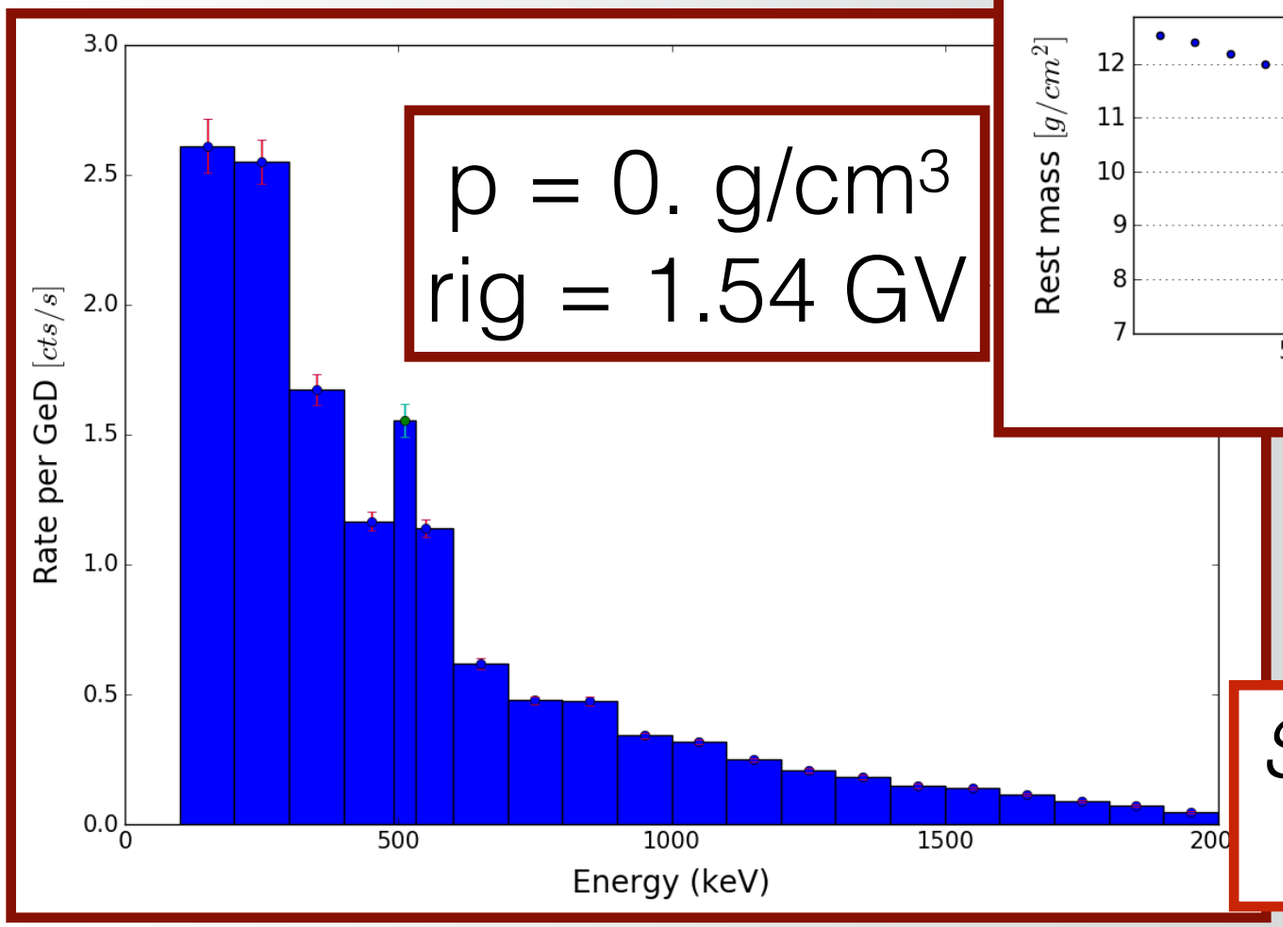
Going outside the atmosphere



Example 1: low cut-off rigidity





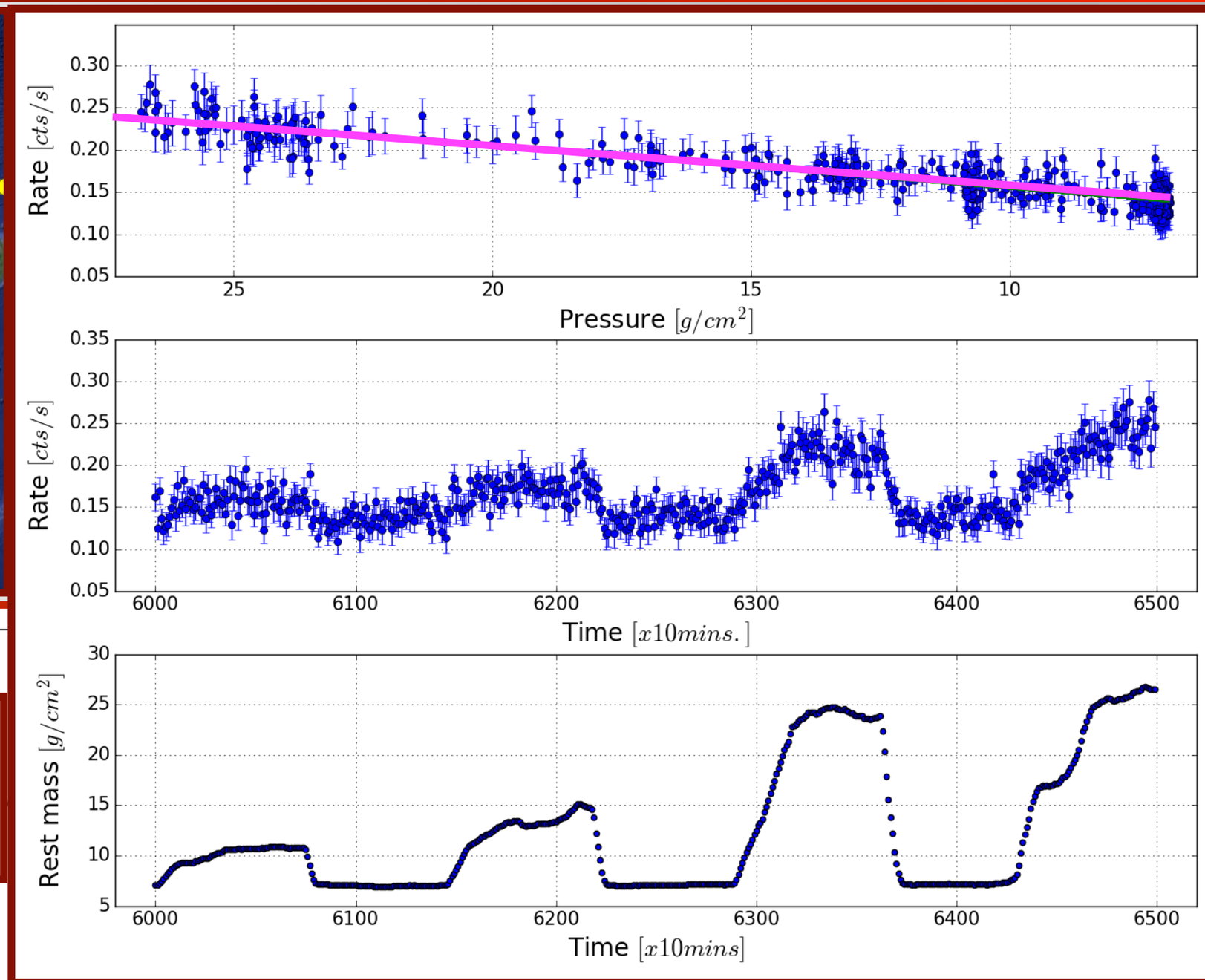


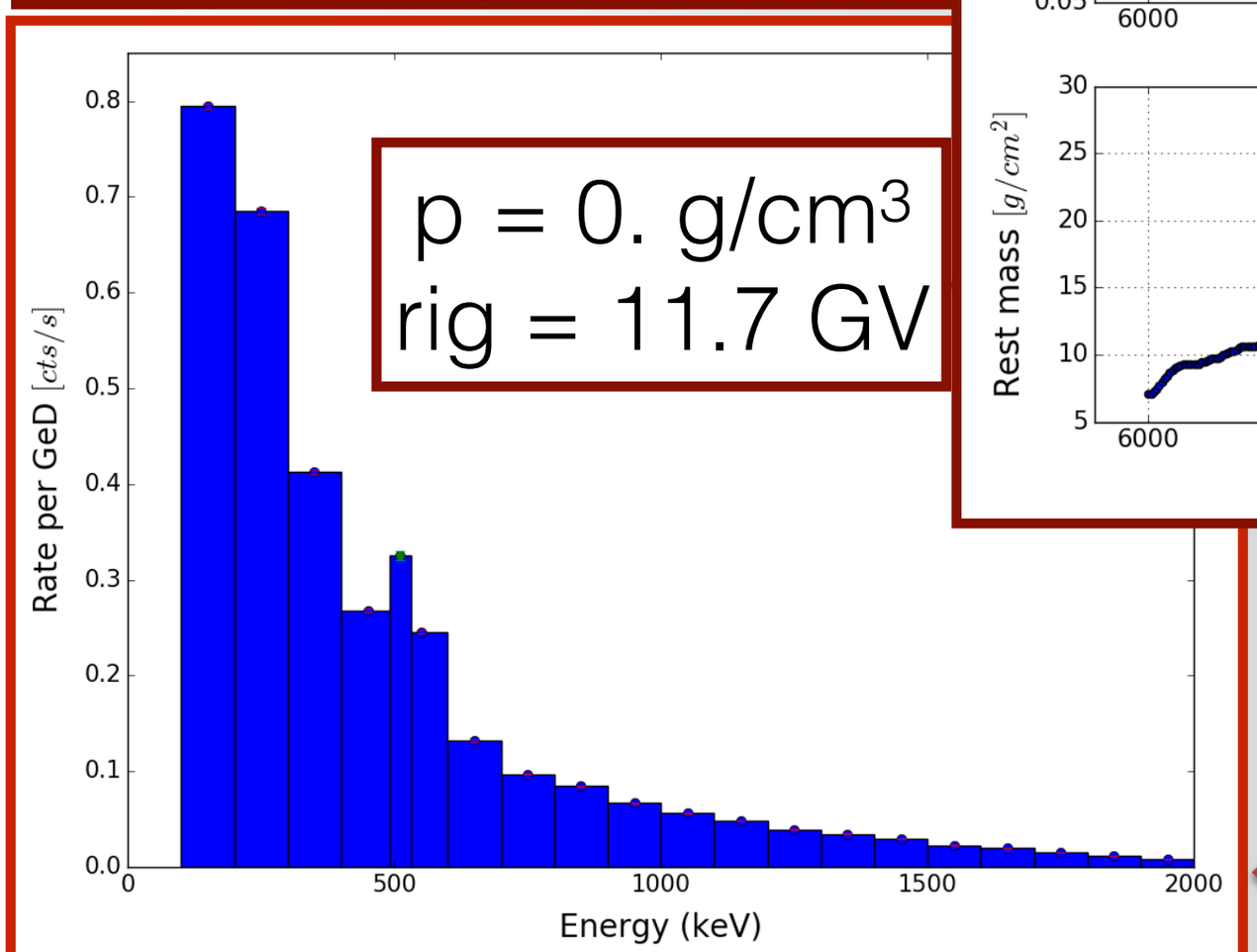
Rate *[cts/s/GeD] =* ***0.402(028)*** *+ 0.022(003)* ***x rest mass*** *[g/cm³]*

Same for ***ΔE=100 keV*** *in 0.1-2 MeV*

1 p_0 point per ΔE per rigidity

Example 2: tilted equatorial LEO



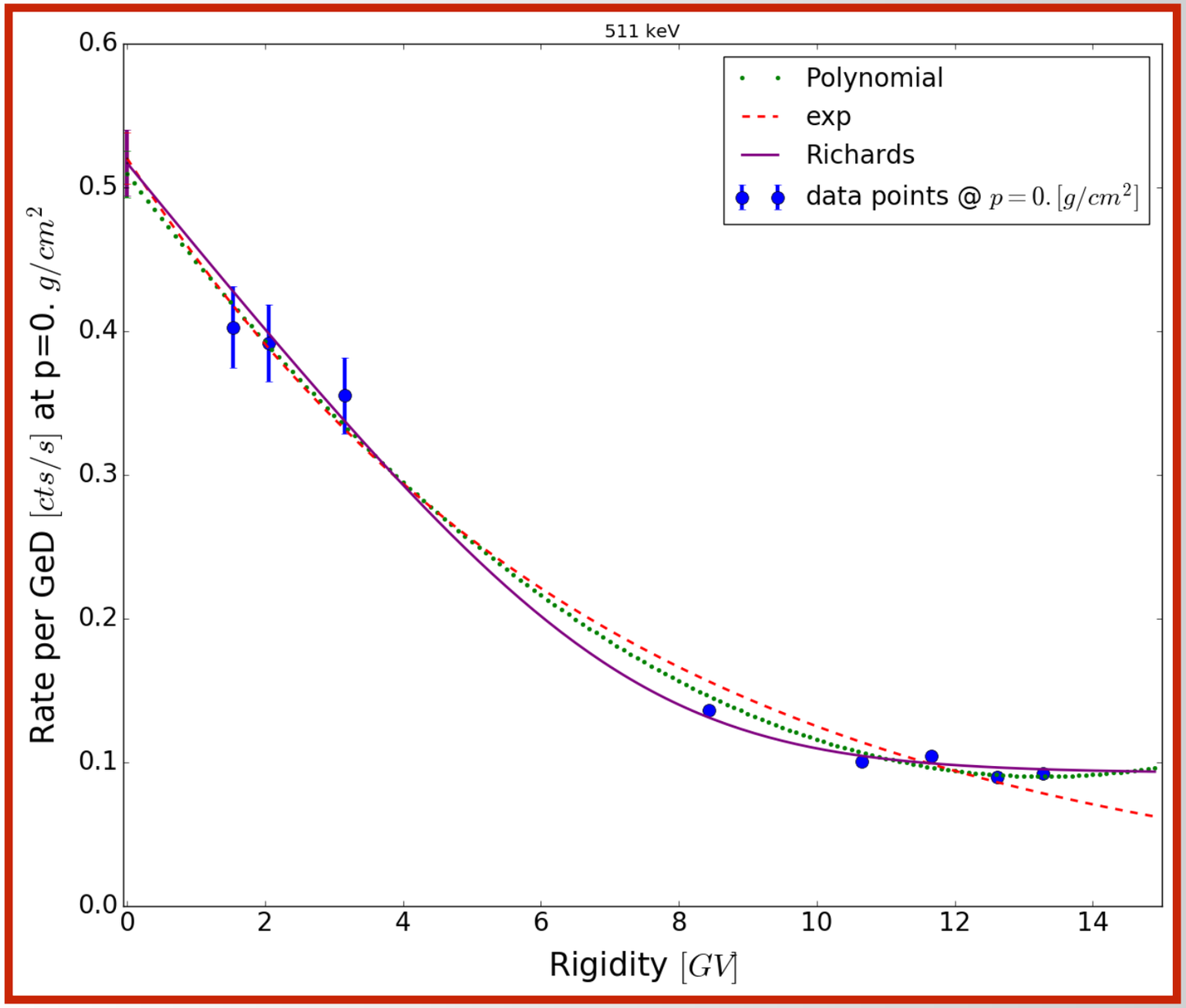


Rate *[cts/s/GeD] =* ***0.104(001)*** *+ 0.0050(0001)* ***x rest mass*** *[g/cm³]*

Angled equatorial LEO

Going further…

- *We have background spectra at p=0. [g/cm³] for different intervals of cut-off rigidity [GV]*
- *We can expand the model even further, extrapolating to cut-off rigidity = 0. GV → approximate an L2 orbit*



511 keV data points:
Rate [cts/s/GeD]
@ p=0. g/cm³
@ rigidity (1.5, 2, …)

Multiple fit functions:

Polynomial (2nd)

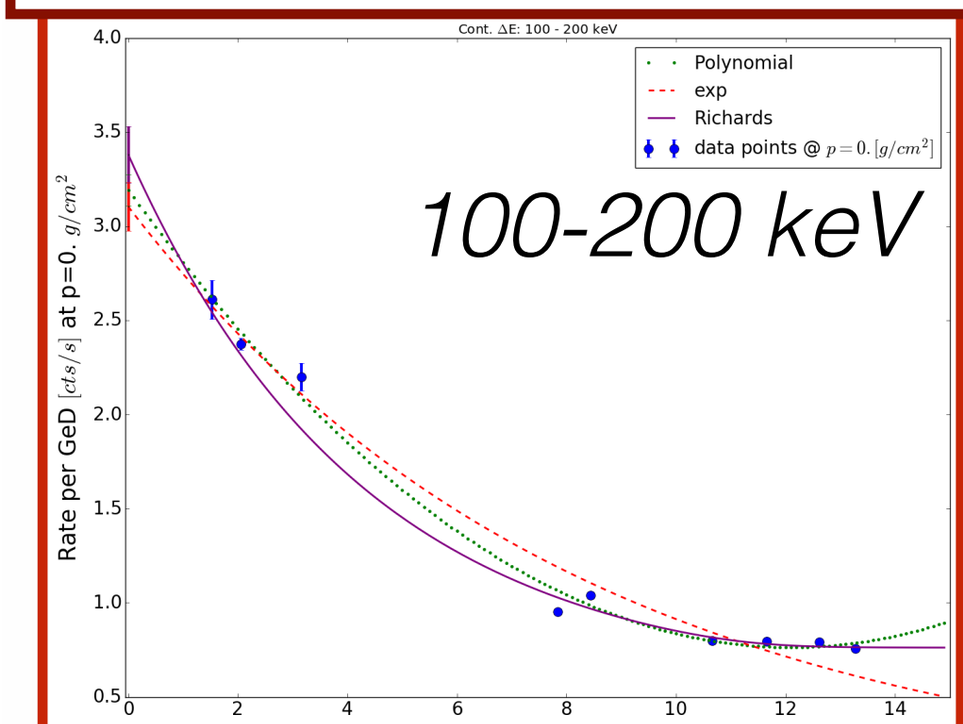
Exponential

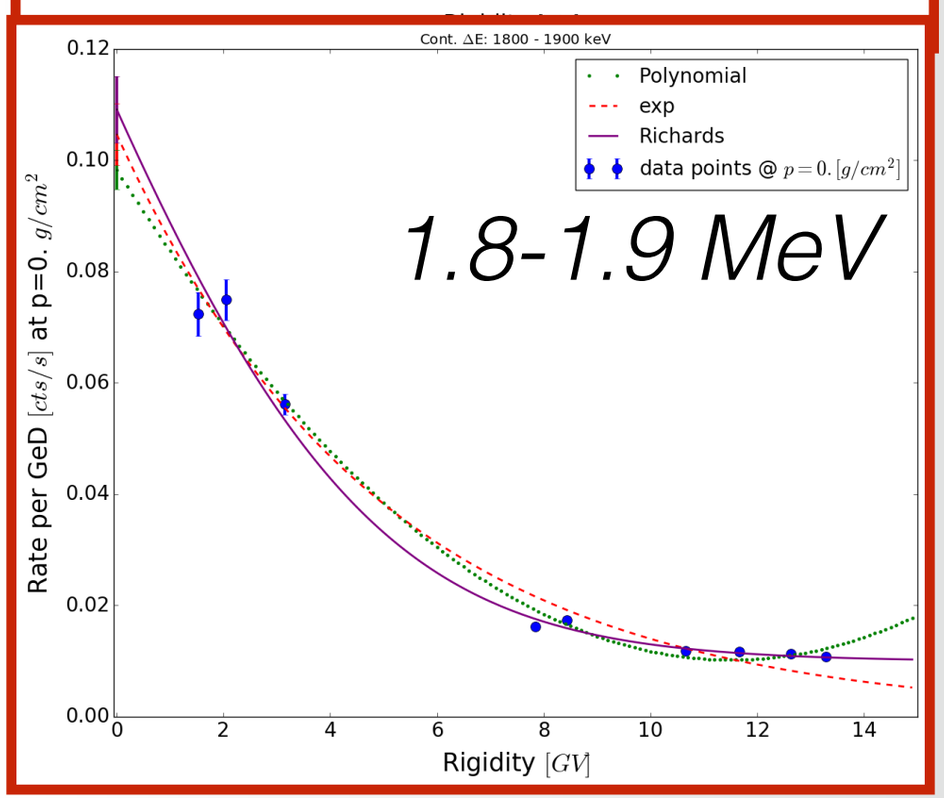
Richards' curve

(Logistic function)

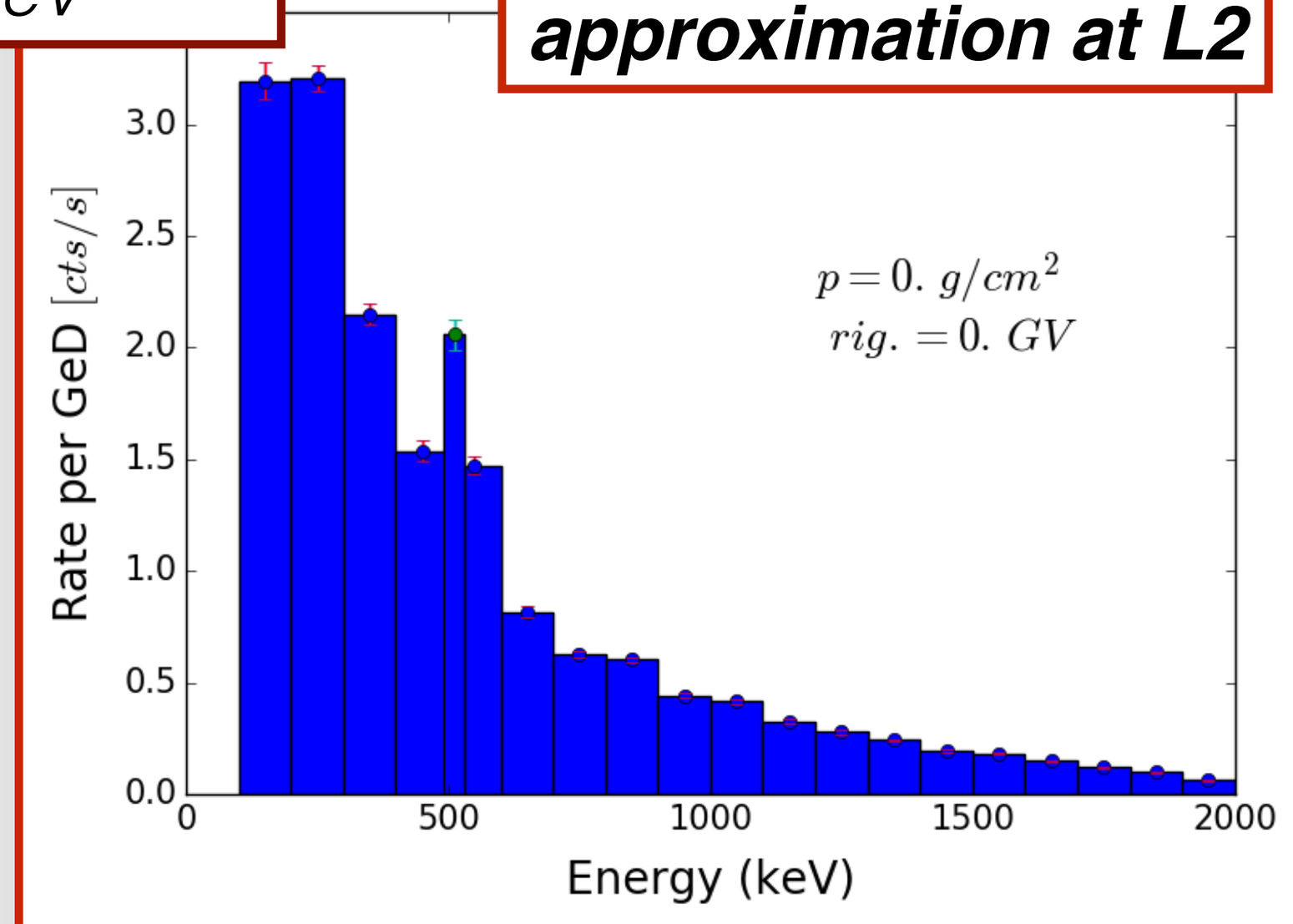
L2 orbit approximation

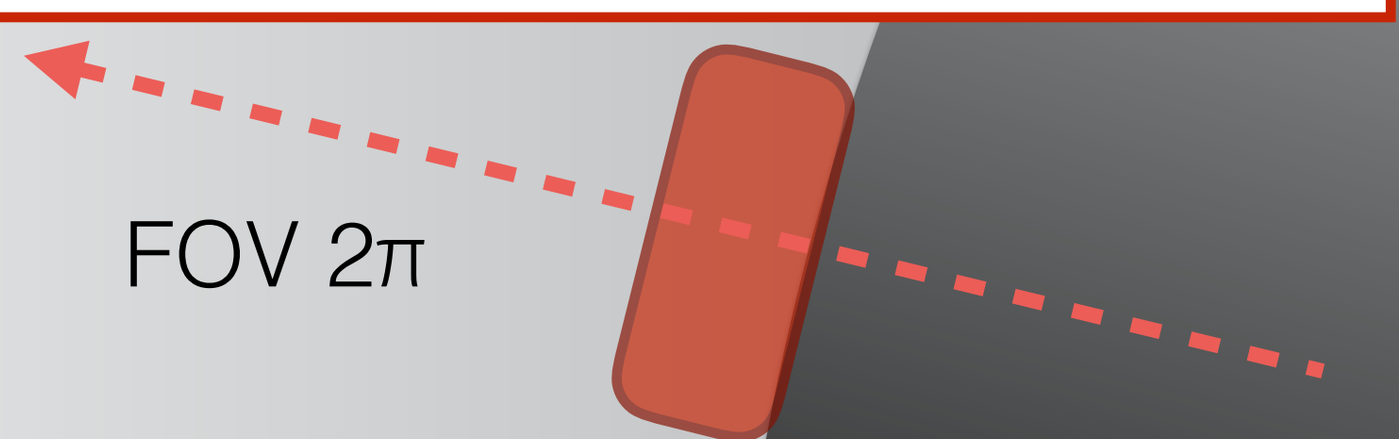
Continuum bands (ΔE=100 keV)
Between 0.1 - 2. MeV





Bkg. spectrum approximation at L2





Thank you