Cosmic Ray Latitude Rate

Nicola Mazziotta
INFN-Bari
mazziotta@ba.infn.it
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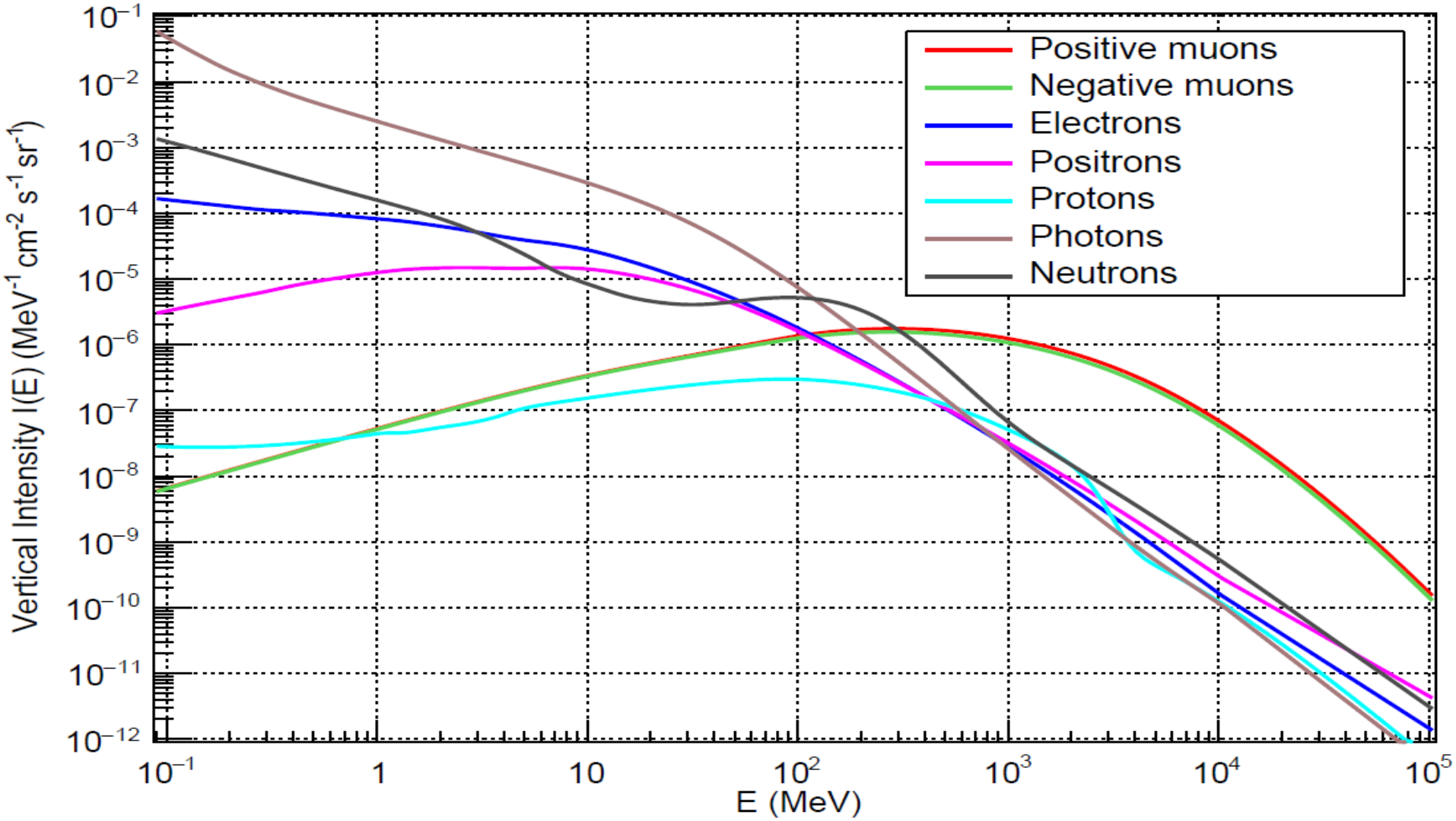
Rate at the sea level

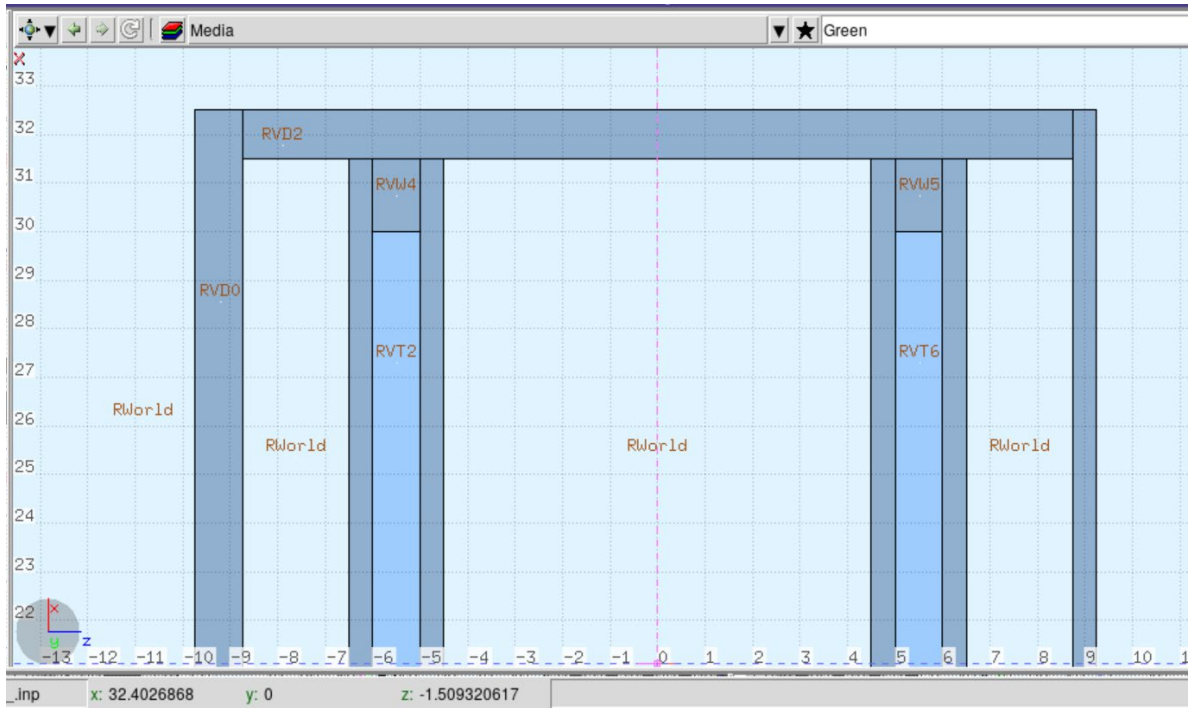
- $Rate(lon, lat) = \int dE\ dcos\theta\ dE\ I(E, cos\theta; lon, lat)\ A(E, cos\theta)$
- $A(E, cos\theta)$ = Detector acceptance (Monte Carlo calculation)
- $I(E, cos\theta)$ = Cosmic ray (secondaries) intensity at sea level
- CR intensity model:
  - $I(E, cos\theta) = I_v(E)\ cos^2\theta$
  - $I(p, cos\theta) = I_v(p \rightarrow p\ cos\theta)\ cos^3\theta$
- Vertical CR intensity $I_v(E; lon, lat)$ from PARMA model https://phits.jaea.go.jp/expacs/

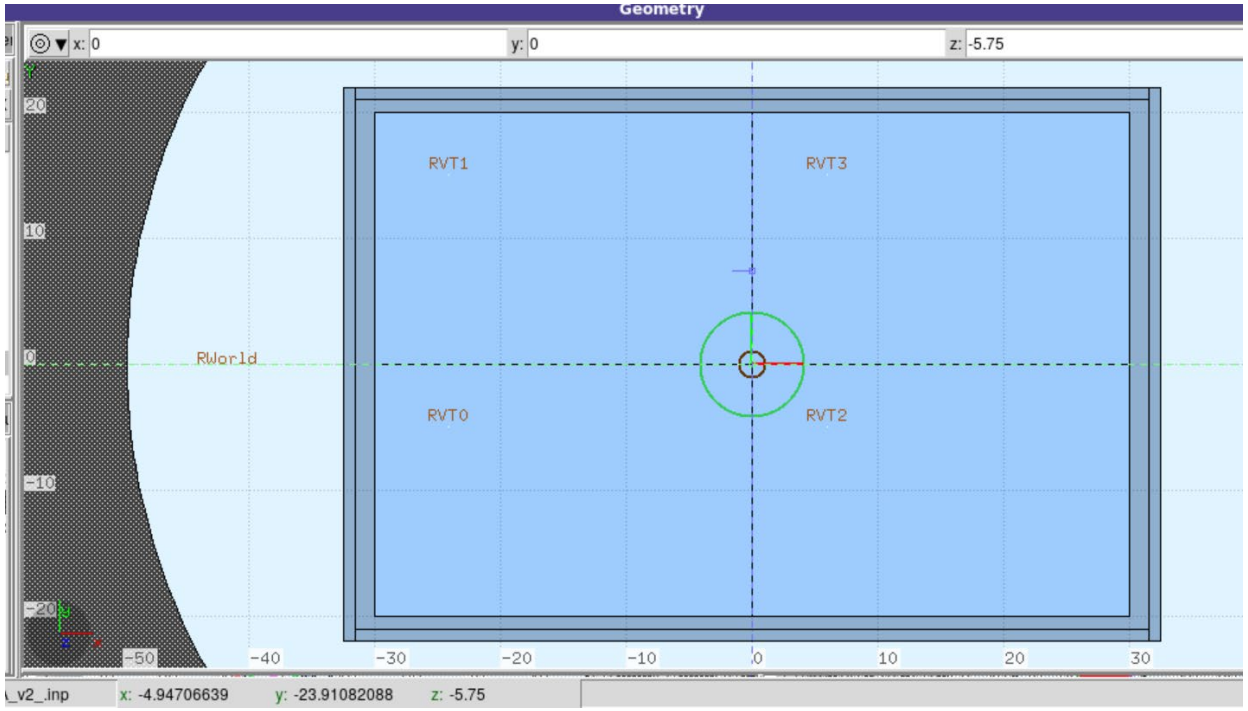
CR vertical intensity (40° N 15° E, Aug 1 2018)



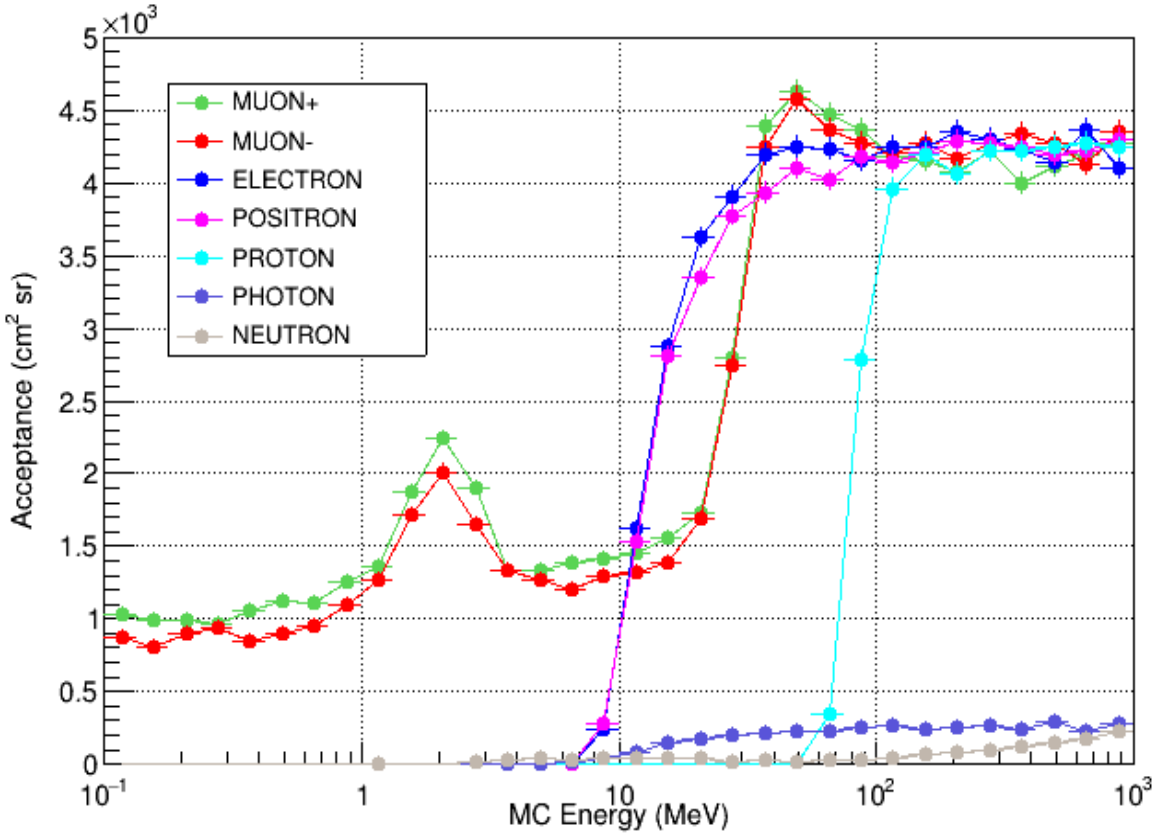
Acceptance calculation

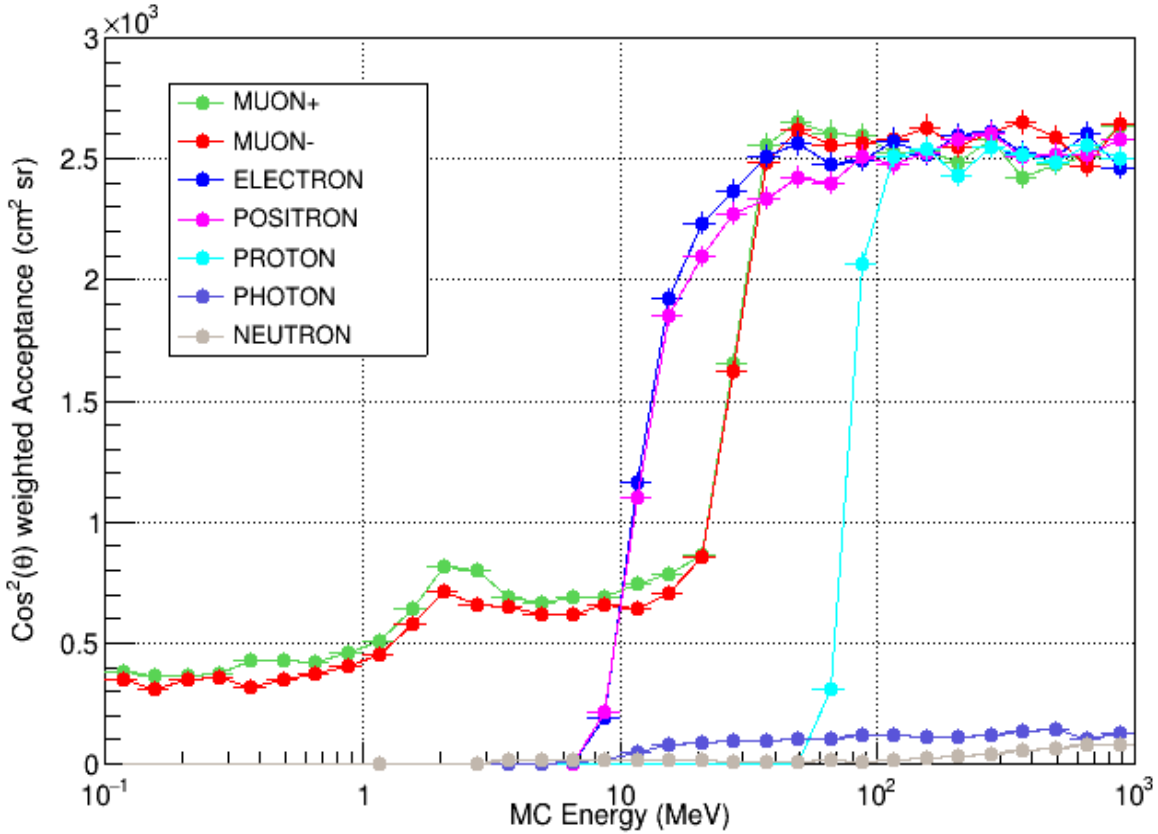
- The detector acceptance has been evaluated with FLUKA
  - Isotropic and uniform distribution generating downward directions within a sphere of radius R with a fluence equal to $1/\pi R^2$
  - Tracks traversing both the top and the bottom detector layers with an energy loss > 1 MeV



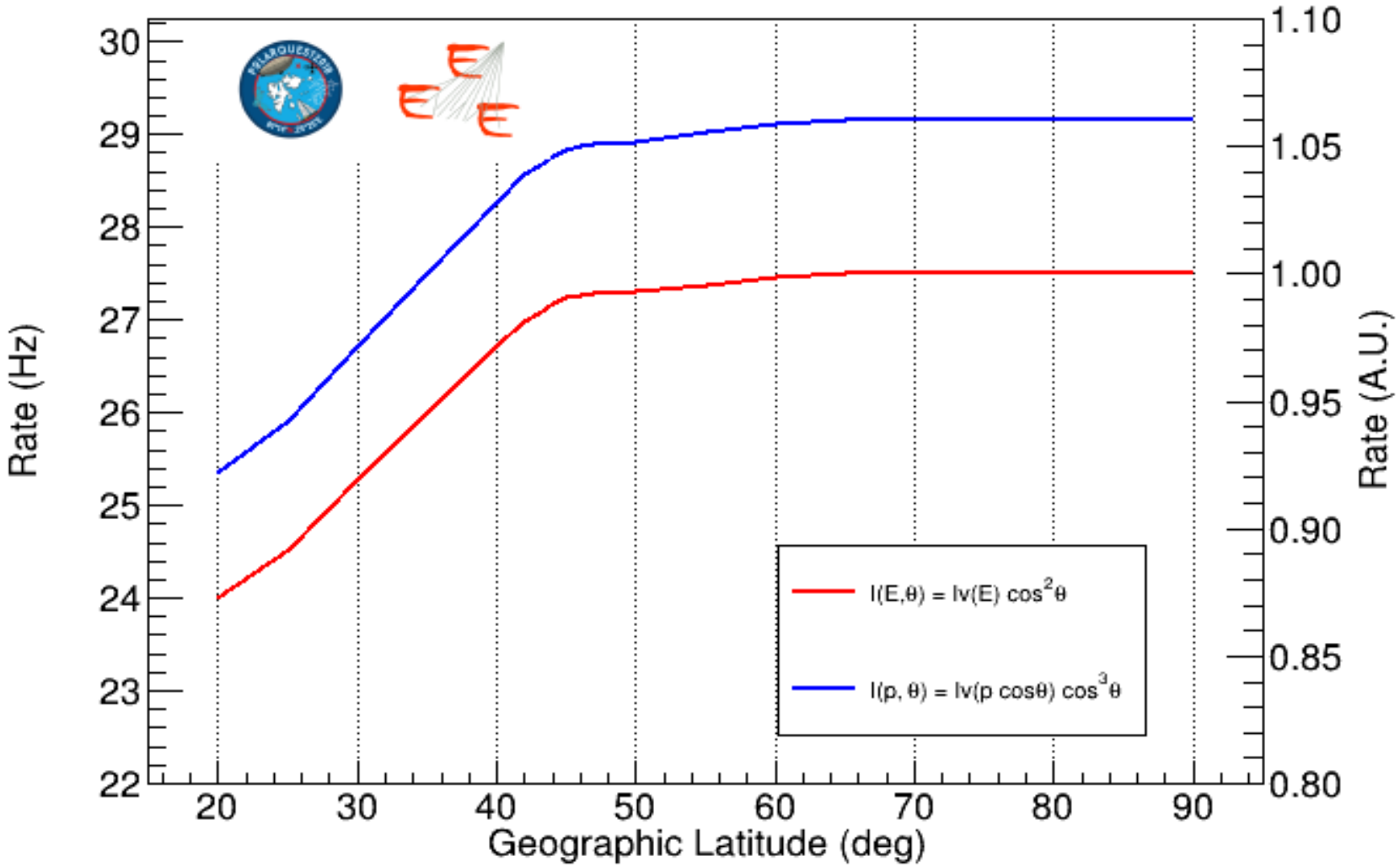


POLAR acceptance

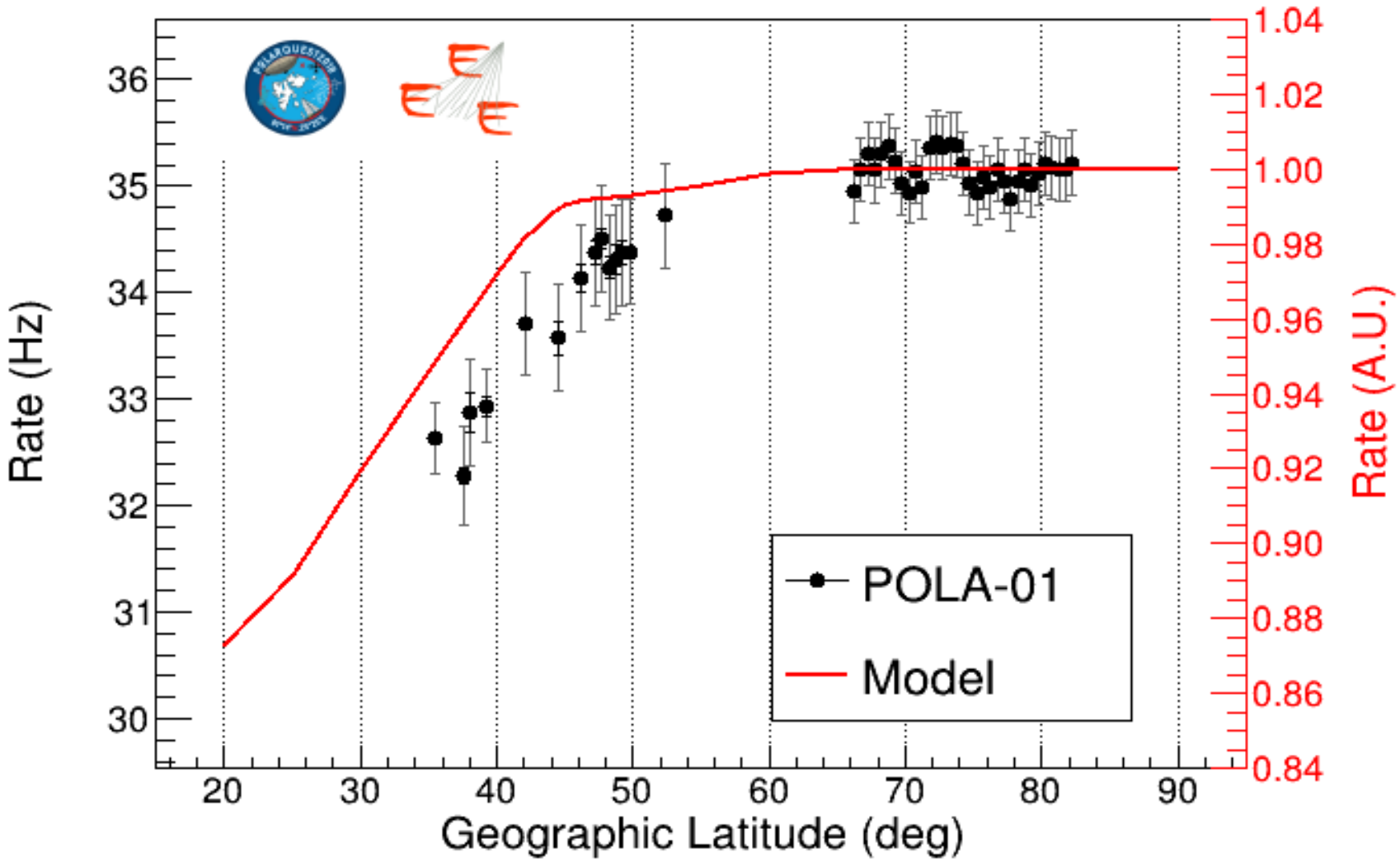




MC Rate


Rate (Hz)
Rate (A.U.)
Geographic Latitude (deg)
30
29
28
27
26
25
24
23
22
1.10
1.05
1.00
0.95
0.90
0.85
0.80
20
30
40
50
60
70
80
90
I(E,θ) = Iv(E) cos²θ
I(p, θ) = Iv(p cosθ) cos³θ

Rate Vs Latitude



Rate Vs Cut-off

- Fit with Dorman's function: $I(P) = I_0\left(1 - e^{-\alpha P^{-k}}\right)$
- $P = cut\text{-}off\ in\ GV\ (IGRF\ at\ Aug\ 2018)$
- $I_0 = (35.15 \pm 0.04)\ Hz$
- $\alpha = 6.8 \pm 1.1$
- $k = 0.45 \pm 0.08$