Cosmic Ray Latitude Intensity

Nicola Mazziotta
INFN-Bari
mazziotta@ba.infn.it
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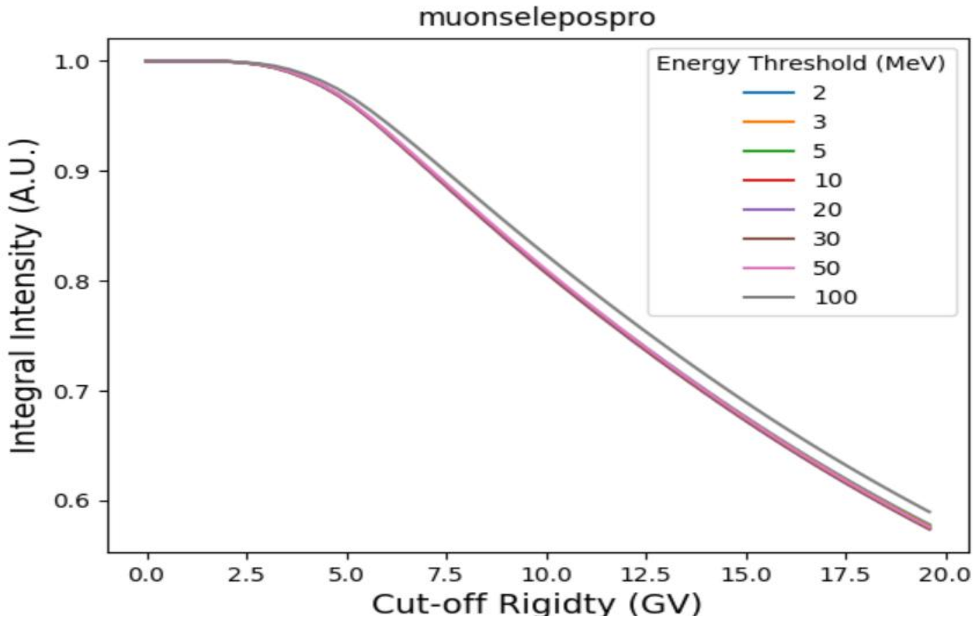
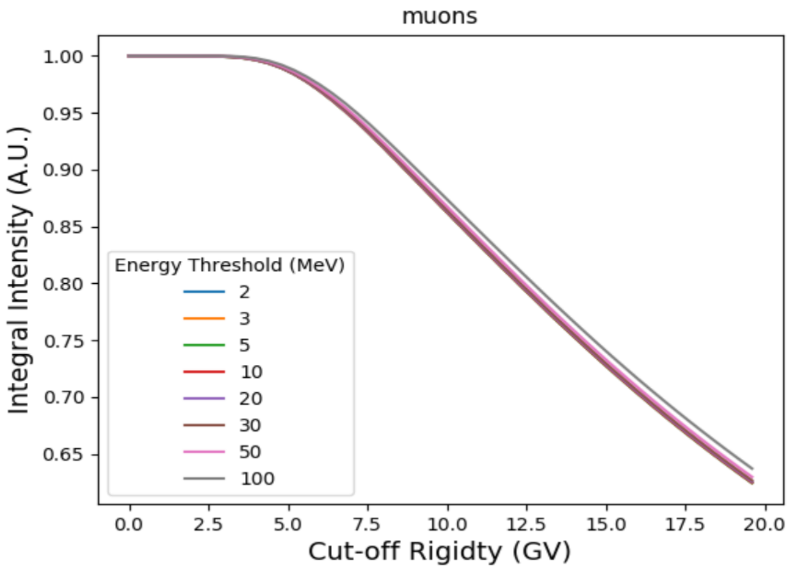
Secondary cosmic ray (CR) intensity at sea level

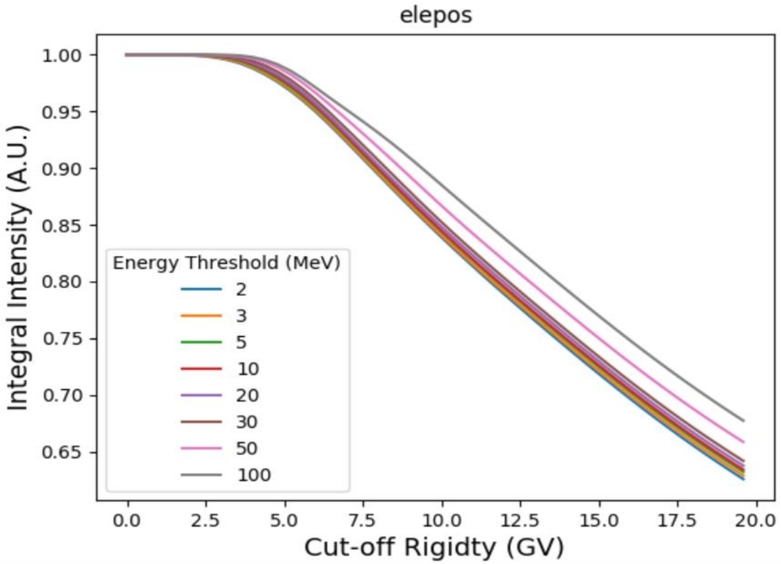
- $I_s(E_s, \Omega; lon, lat) = \int dT\, Y_{CR}(E_s | T) I_{CR}(T) f(T; T_{cut}(lon, lat))$
- s is the secondary particle species, i.e. muons, electrons, positrons, protons, …
- T_{cut} is the cut-off energy as a function of the longitude and latitude at 20 km of altitude (assumed as the average primary interaction point)
- Y is the muon yield at sea level
- I_{CR} is the cosmic ray (CR) intensity (mainly proton)
- f(T;Tcut(lon, lat)) is a function that includes the cutoff in the CR spectrum

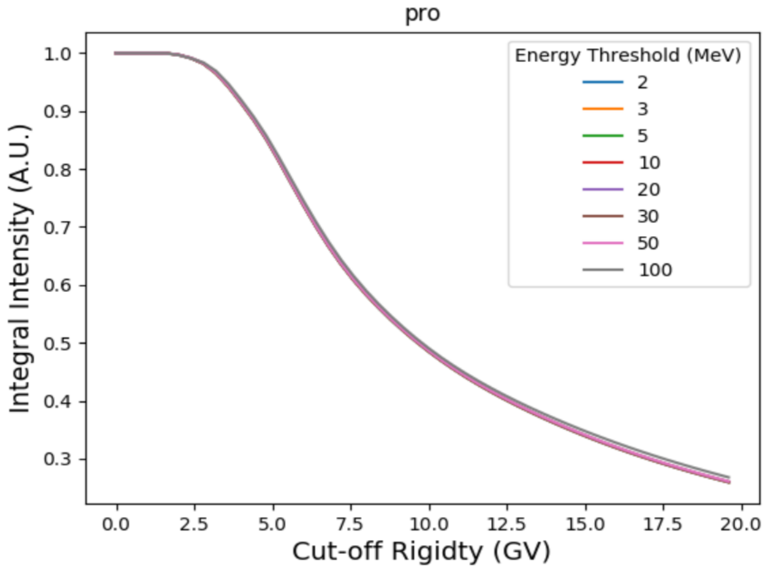
Rate at the sea level

- $r(lon, lat) = \int d\Omega \, dE_s \, I_s(E_s, \Omega; lon, lat) \, A(E_s, \Omega)$
- $A(E_s, \Omega) = H(E_s - E_{th})$
- $r(T_{cut}) \propto \int dE_s \, dT \, Y_s(E_s | T) I_{CR}(T) f(T; T_{cut})$
- $T_{cut} = T_{cut}(lon, lat)$ (i.e. IGRF vertical cut-off at 20km)

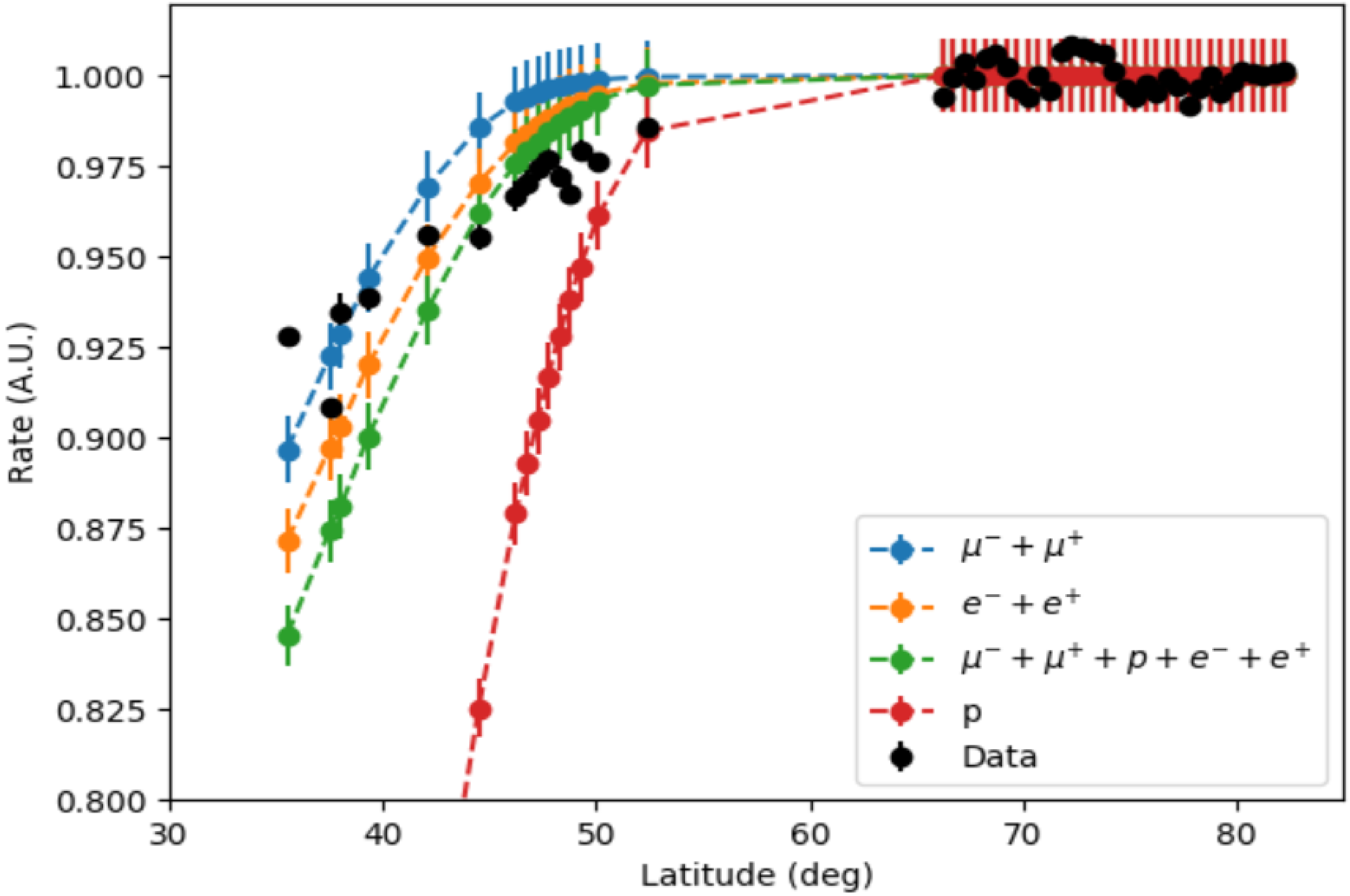








Polar rate



Rate (A.U.)
1.000
0.975
0.950
0.925
0.900
0.875
0.850
0.825
0.800
30
40
50
60
70
80
Latitude (deg)
$\mu^- + \mu^+$
$e^- + e^+$
$\mu^- + \mu^+ + p + e^- + e^+$
p
Data

Evaluation of Geomagnetic Latitude Dependence of the Cosmic-ray Induced Environmental Neutrons in Japan

Journal of NUCLEAR SCIENCE and TECHNOLOGY, Vol. 44, No. 2, p. 114–120 (2007)

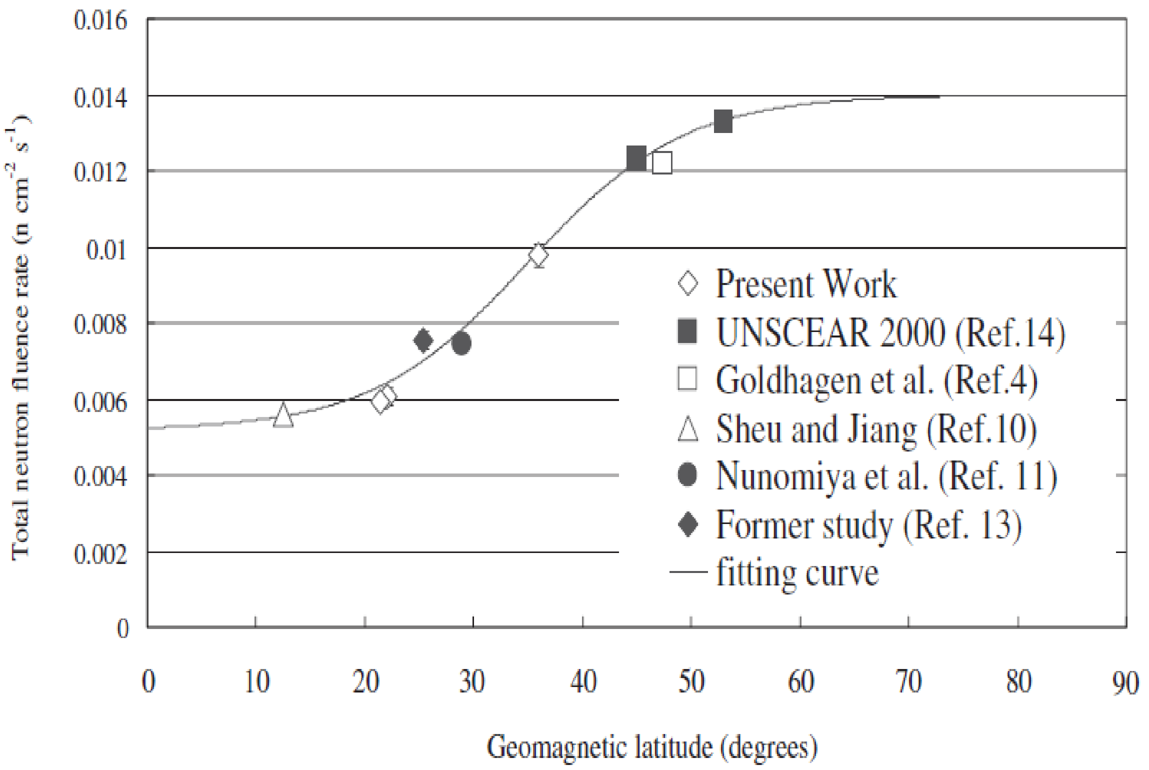
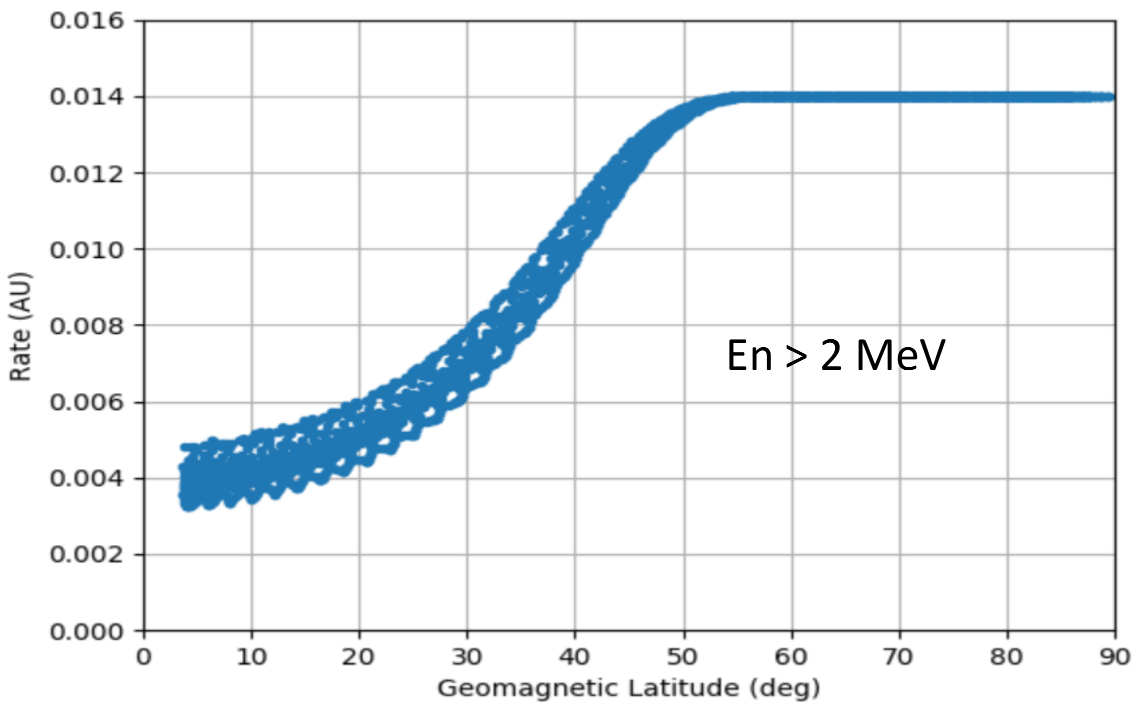


Fig. 5 Geomagnetic latitude variation of the cosmic-ray neutron fluence rate



Neutron monitor yield function: New improved computations

JOURNAL OF GEOPHYSICAL RESEARCH: SPACE PHYSICS, VOL. 118, 2783–2788, doi:10.1002/jgra.50325, 2013

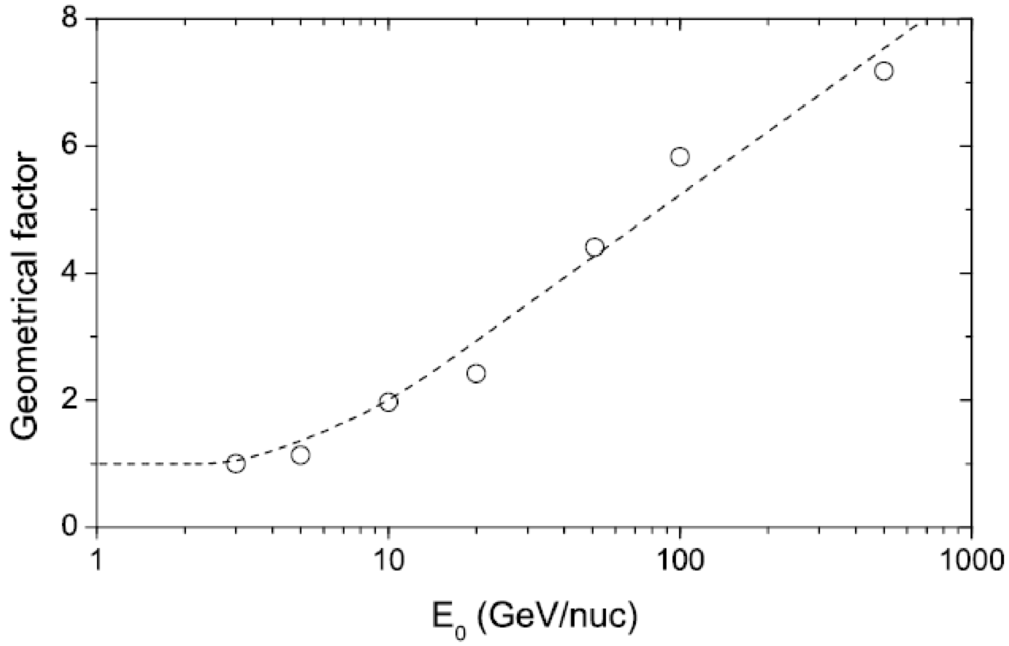
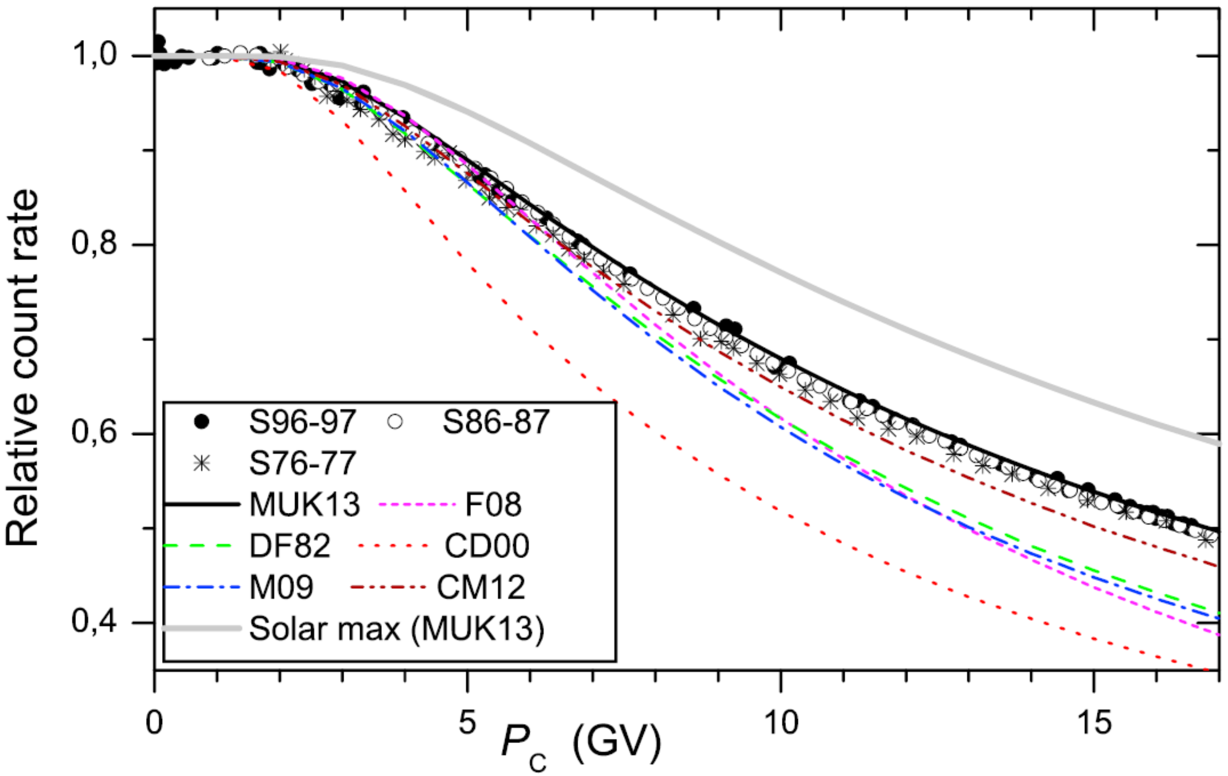
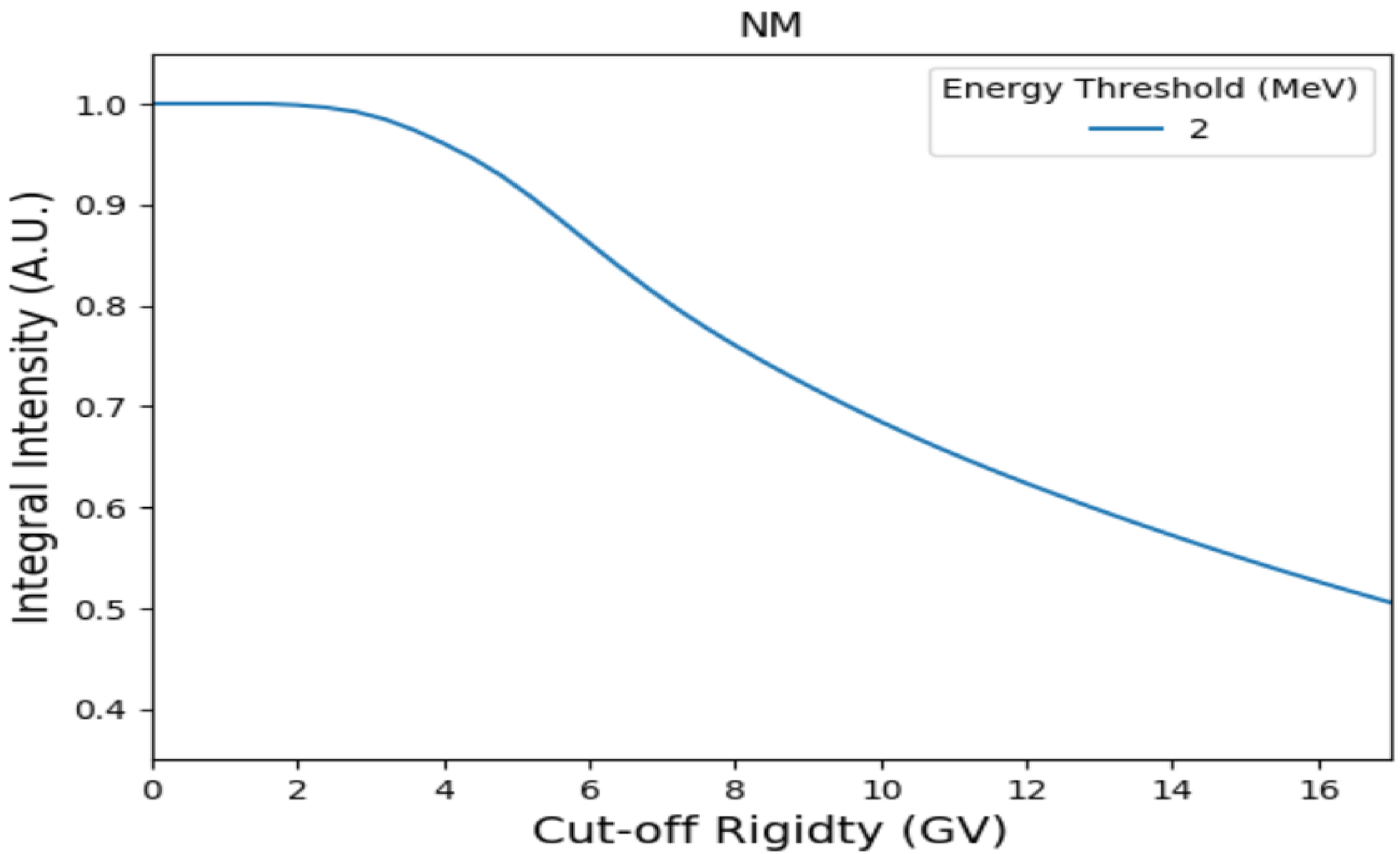


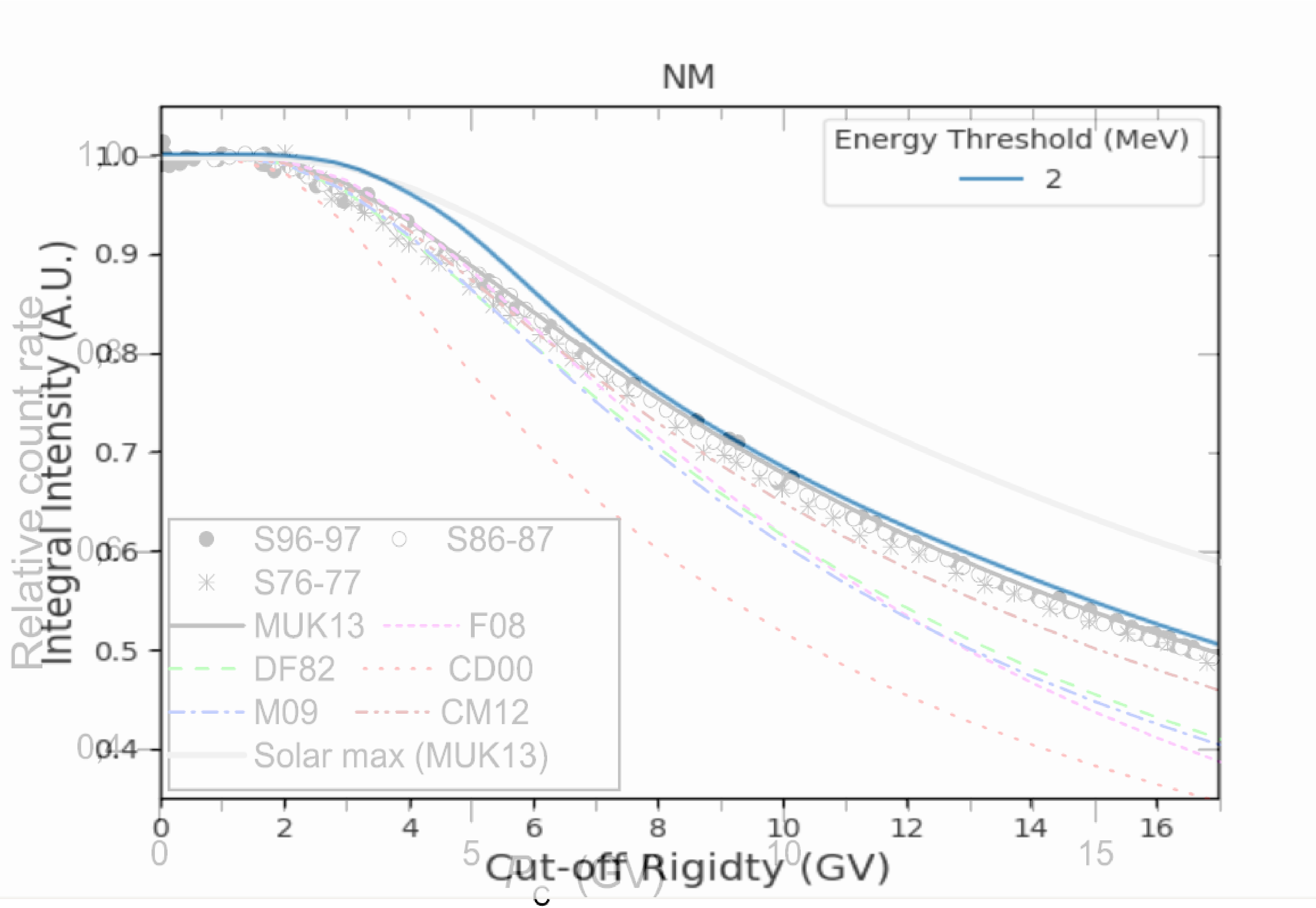
Figure 2. The effective geometrical factor *G* (equation (4)) as function of the primary CR particle's energy for protons. Dots are the results of the Monte-Carlo simulations and the dashed line is the used approximation.

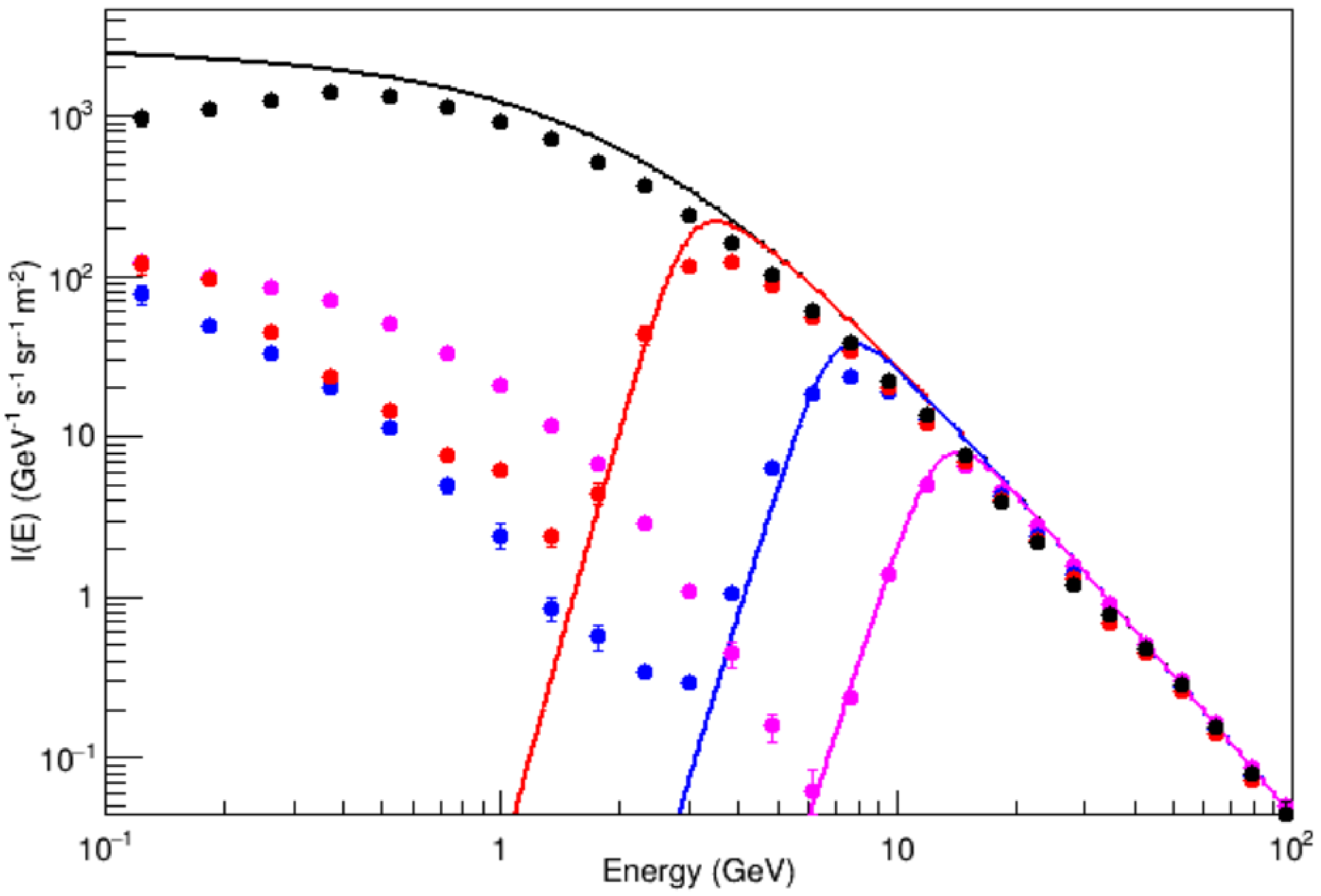


NM Yield

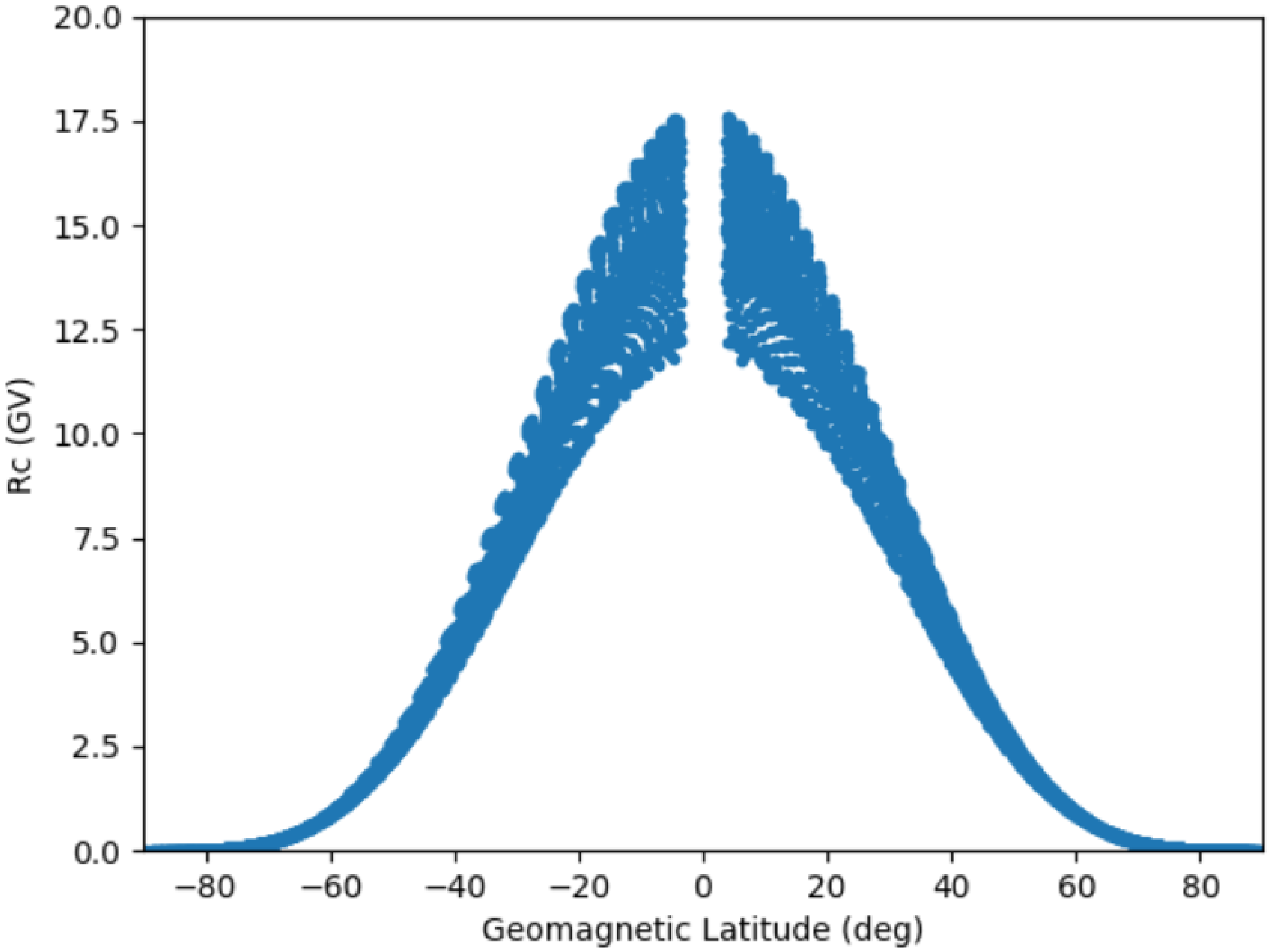
- Secondary Neutrons + Protons Yield at sea level > 2 MeV weighted with the effective geometrical factor




NM
Energy Threshold (MeV)
2
S96-97
S86-87
S76-77
MUK13
F08
DF82
CD00
M09
CM12
Solar max (MUK13)
Integral Intensity (A.U.)
Relative count rate
Cut-off Rigidty (GV)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0
2
4
6
8
10
12
14
16
5
15



I(E) (GeV^{-1} s^{-1} sr^{-1} m^{-2})
10^3
10^2
10
1
10^{-1}
10^{-1}
1
10
10^2
Energy (GeV)


20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Rc (GV)
−80
−60
−40
−20
0
20
40
60
80
Geomagnetic Latitude (deg)