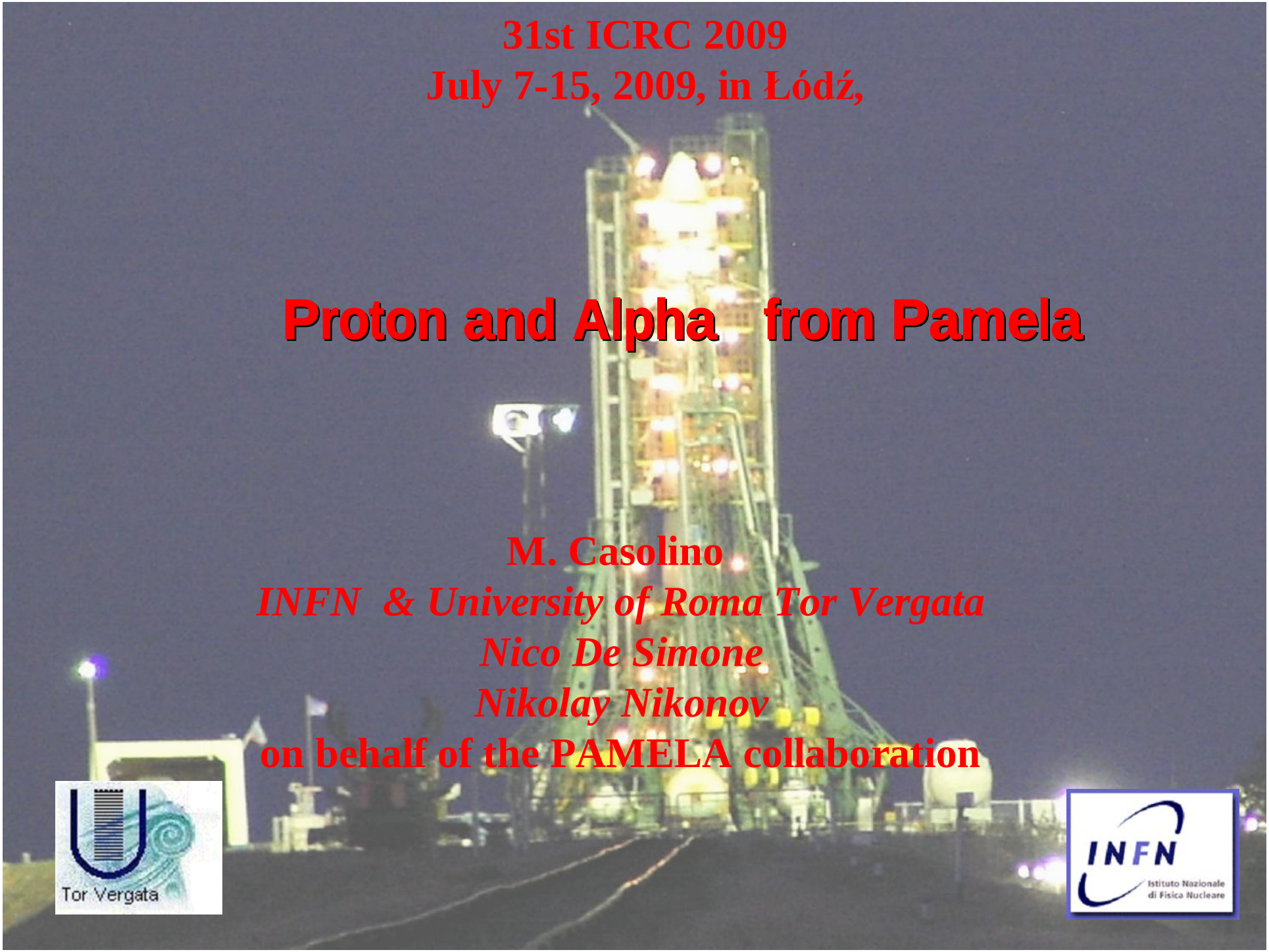


31st ICRC 2009
July 7-15, 2009, in Łódź,

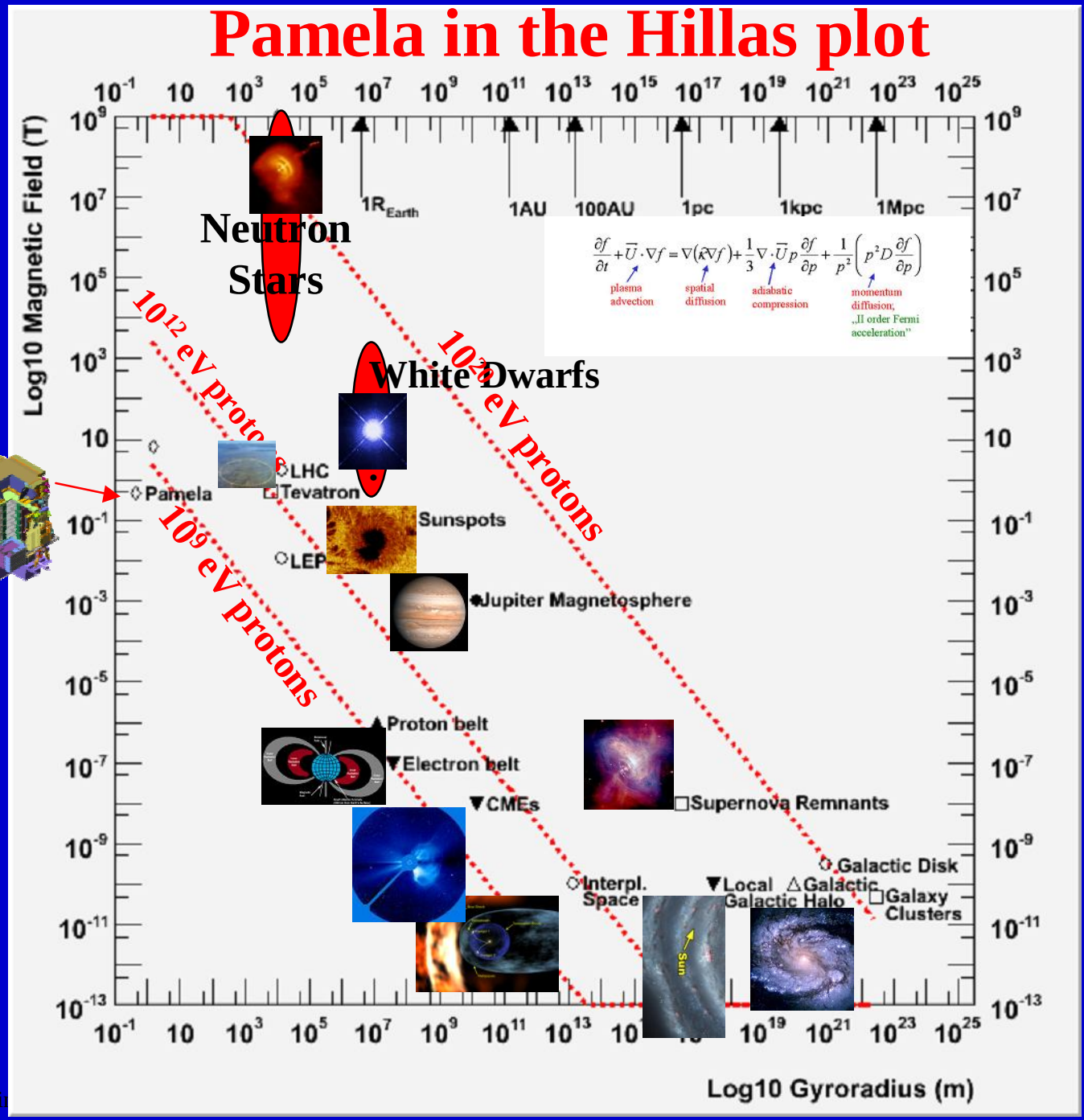
Proton and Alpha from Pamela

M. Casolino
INFN & University of Roma Tor Vergata
Nico De Simone
Nikolay Nikonov
on behalf of the PAMELA collaboration

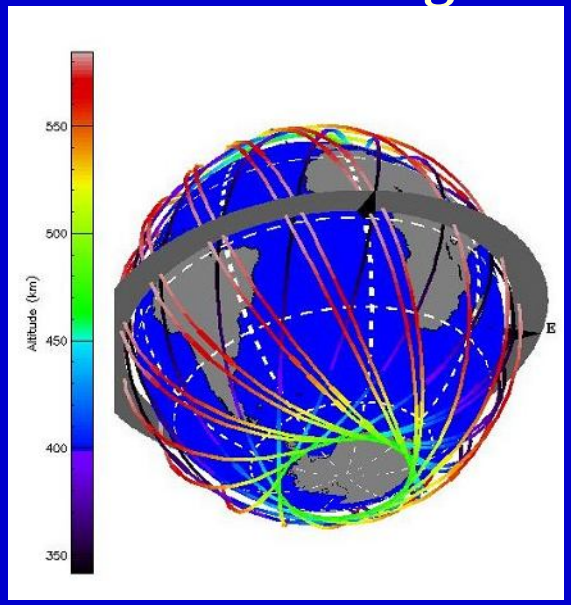
Tor Vergata

INFN
Istituto Nazionale di Fisica Nucleare

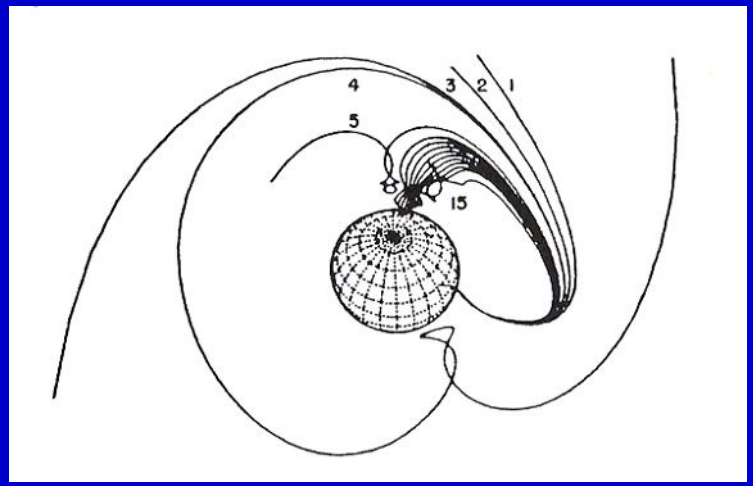
Pamela in the Hillas plot

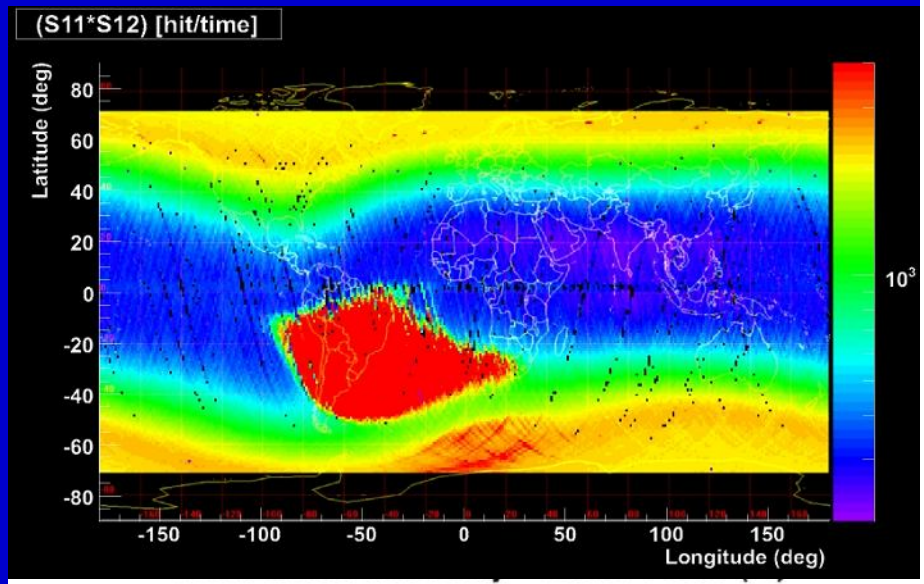


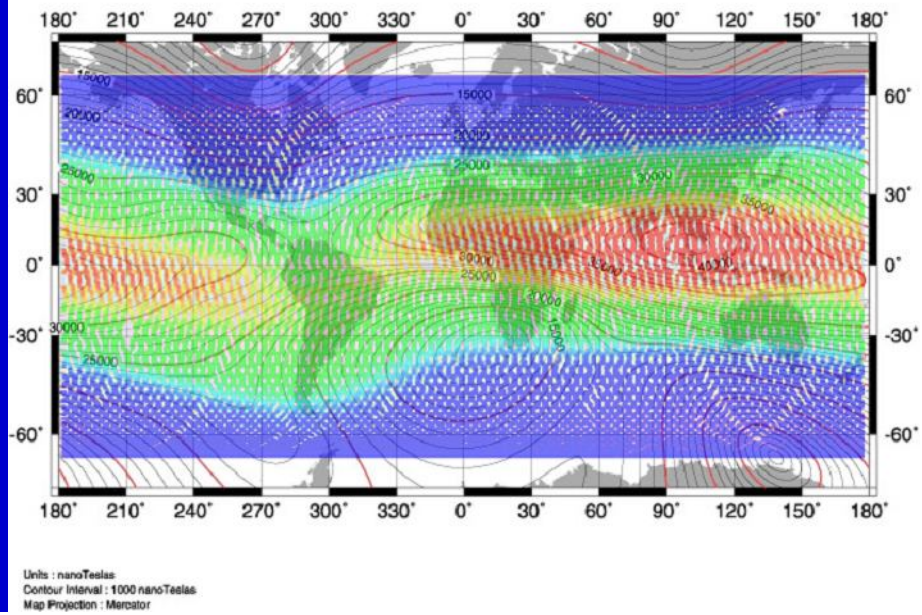
Selection of galactic component according to geomagnetic cutoff



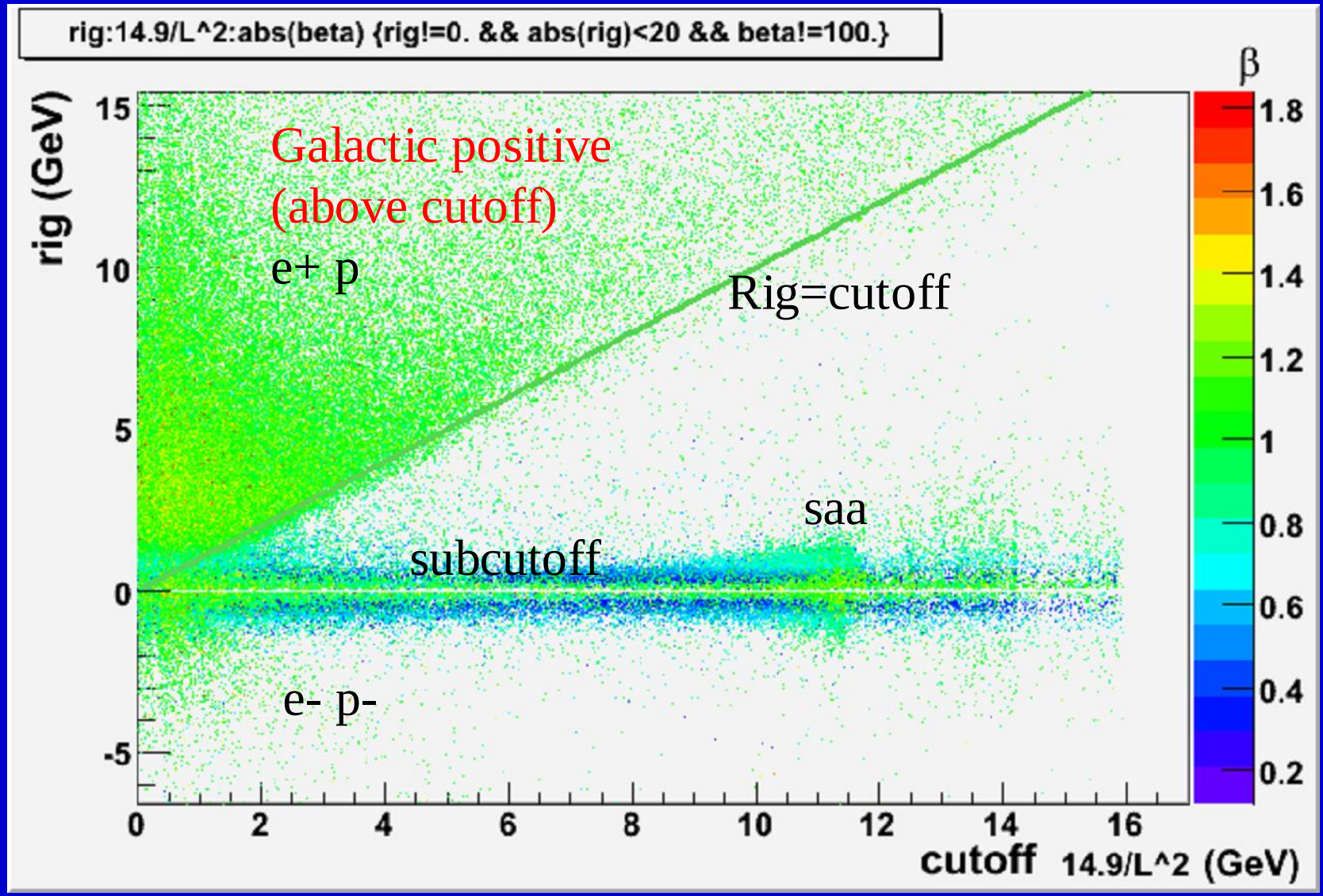
$R_{cutoff}=14.9GV/L^2$







Particle rigidity vs Vertical Stormer Cutoff



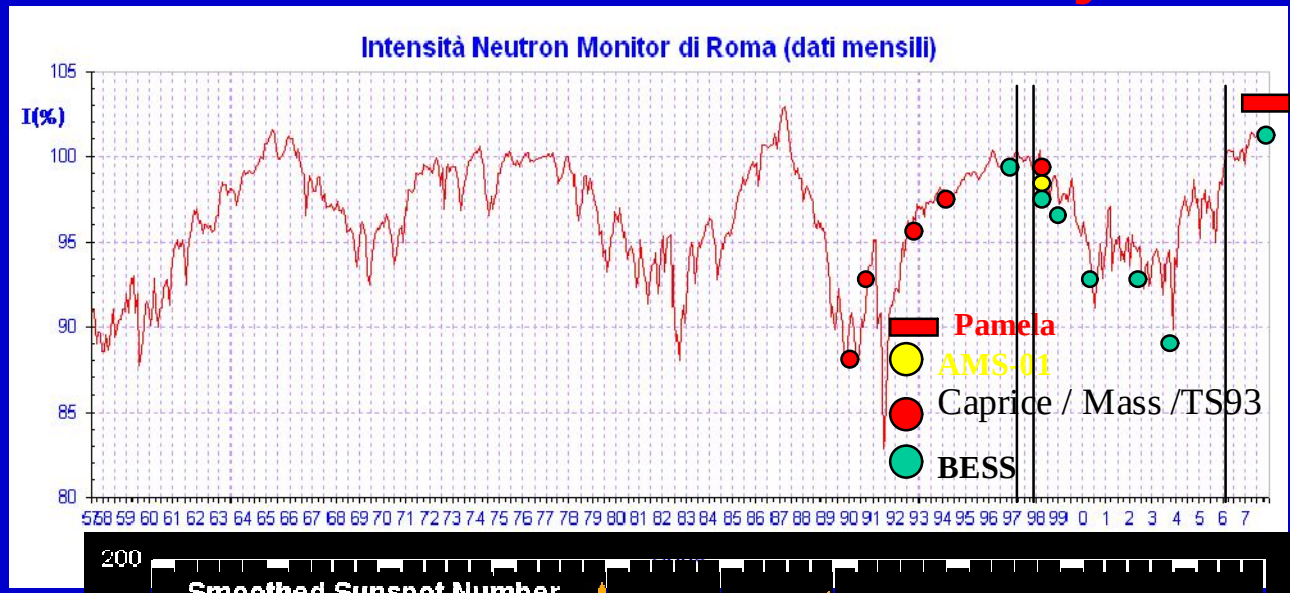
Solar Modulation of Galactic Cosmic Rays

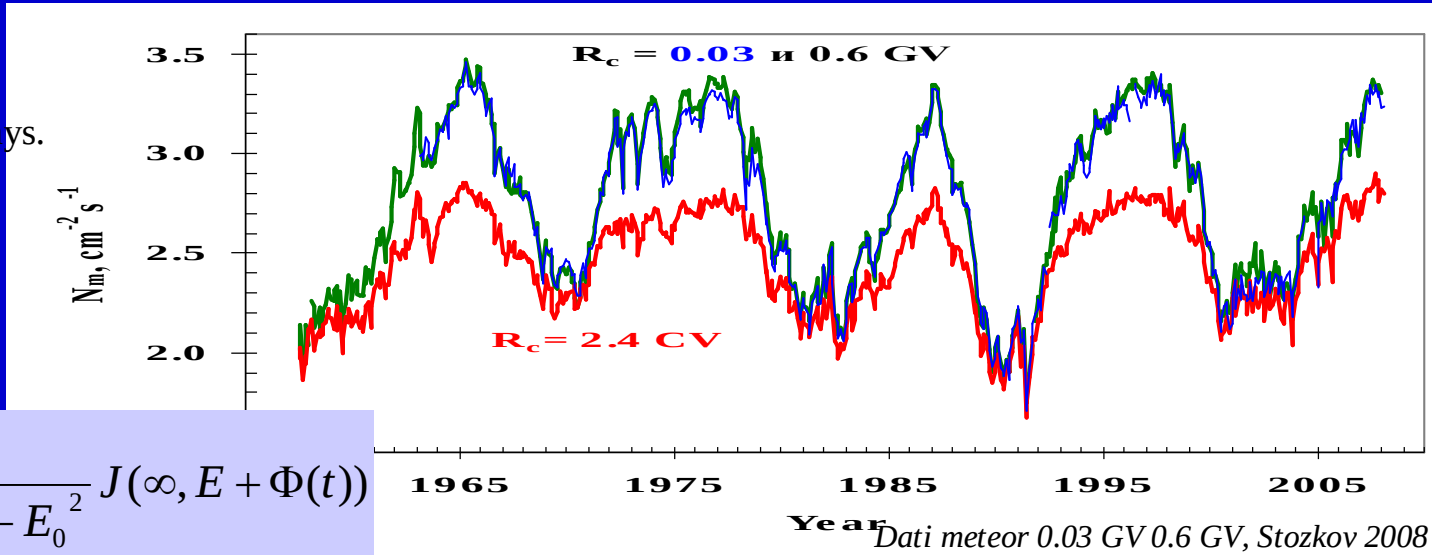
→Balloon: low frequency modulation
→Pamela: low and high frequency modulation

→Long solar minimum

→Variation in Galactic flux
→Short Term (months)
→Long term (years)

→Charge dependence
(e.g. Asaoka Y. et al. 2002, Phys. Rev. Lett. 88, 051101)





Dati meteor 0.03 GV 0.6 GV, Stozkov 2008

$$J(r,E,t) = \frac{E^2 - E_0^{\,2}}{(E^2 + \Phi(t))^2 - E_0^{\,2}} J(\infty, E + \Phi(t))$$

Solar modulation at minimum of solar cycle XXIII years 2006-2008

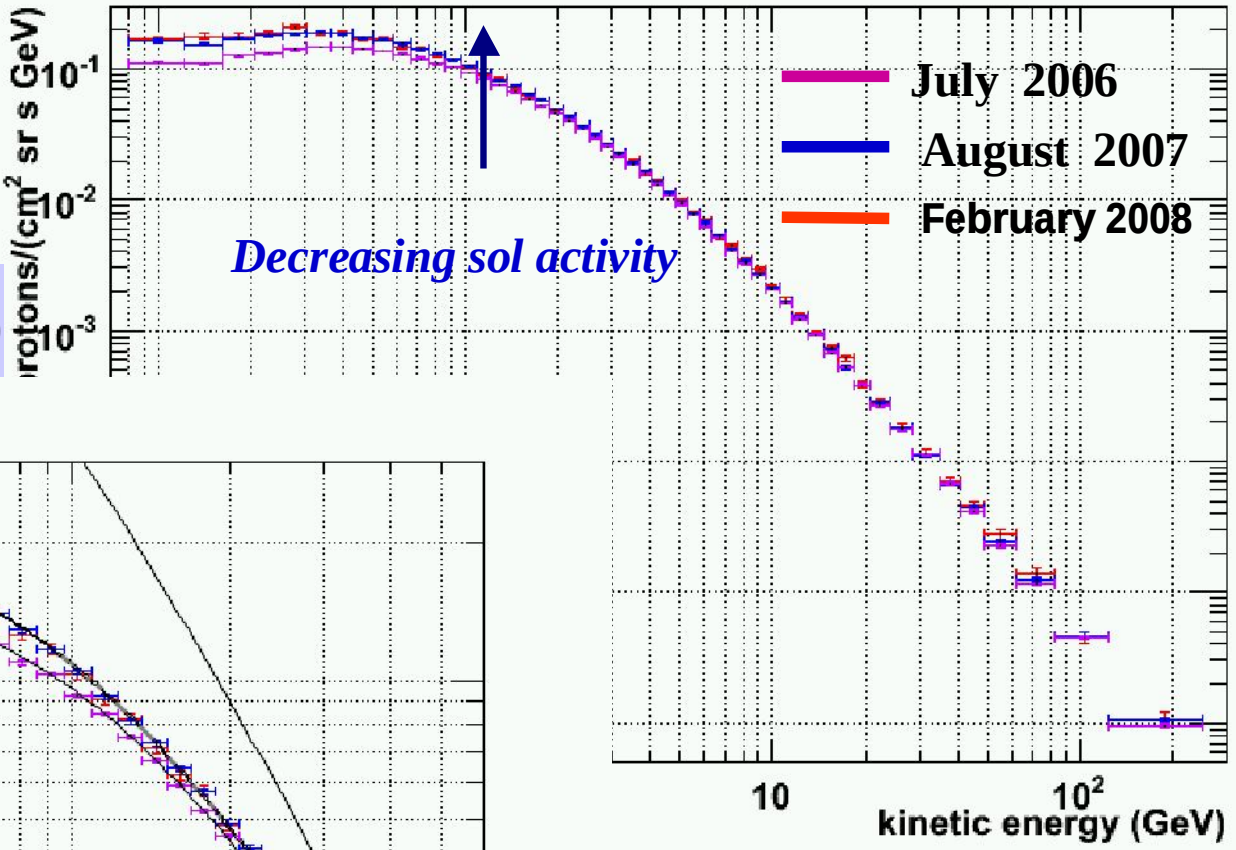
$F_{is} = 1.54\ \beta_{is}^{0.7}\ R_{is}^{-2.76}$

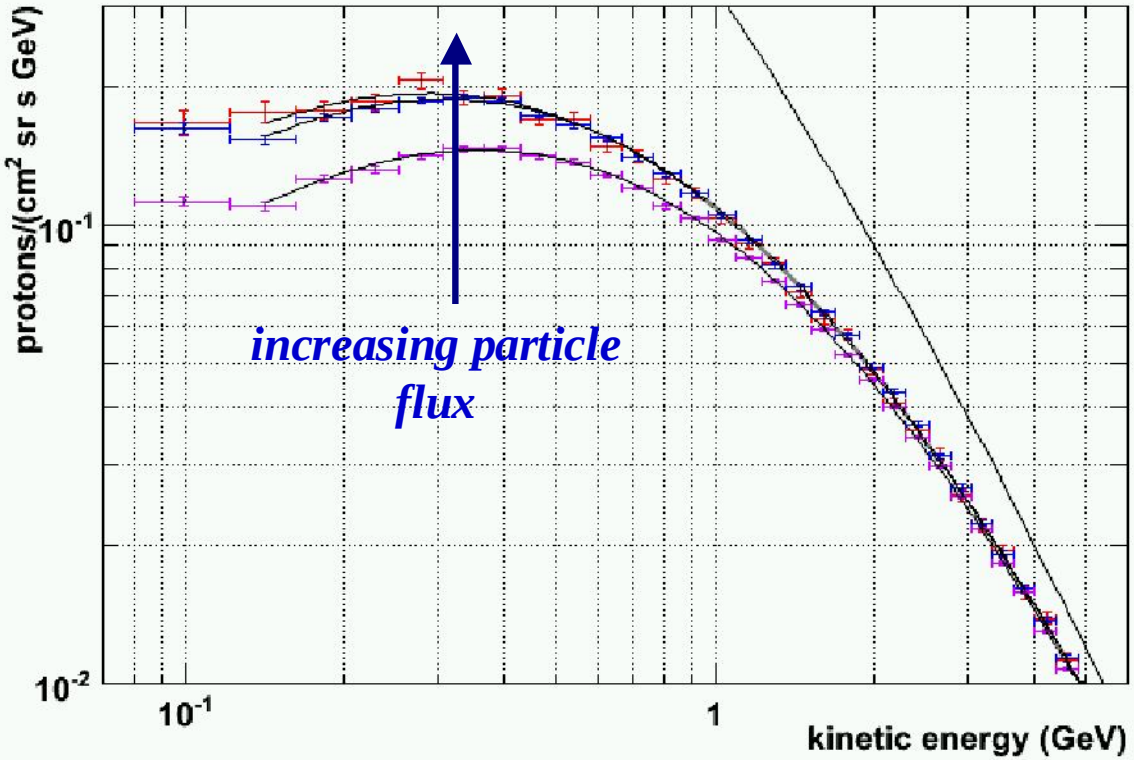
p/(cm² s sr GV)

Spectral index

2.75 ±0.01

$$J(r,E,t) = \frac{E^2 - E_0^{\,2}}{(E^2 + \Phi(t))^2 - E_0^{\,2}}\, J(\infty, E + \Phi(t))$$



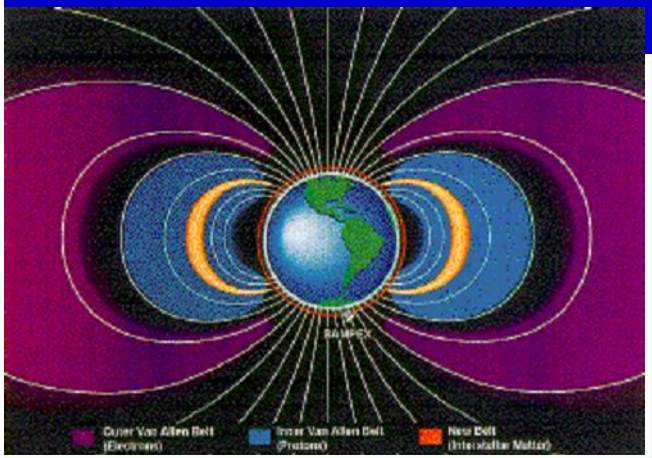


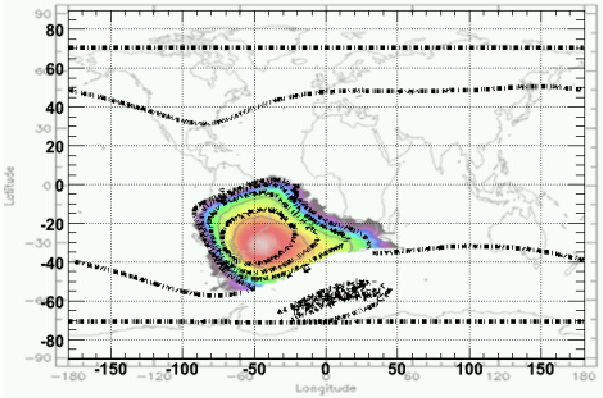
Solar modulation parameters

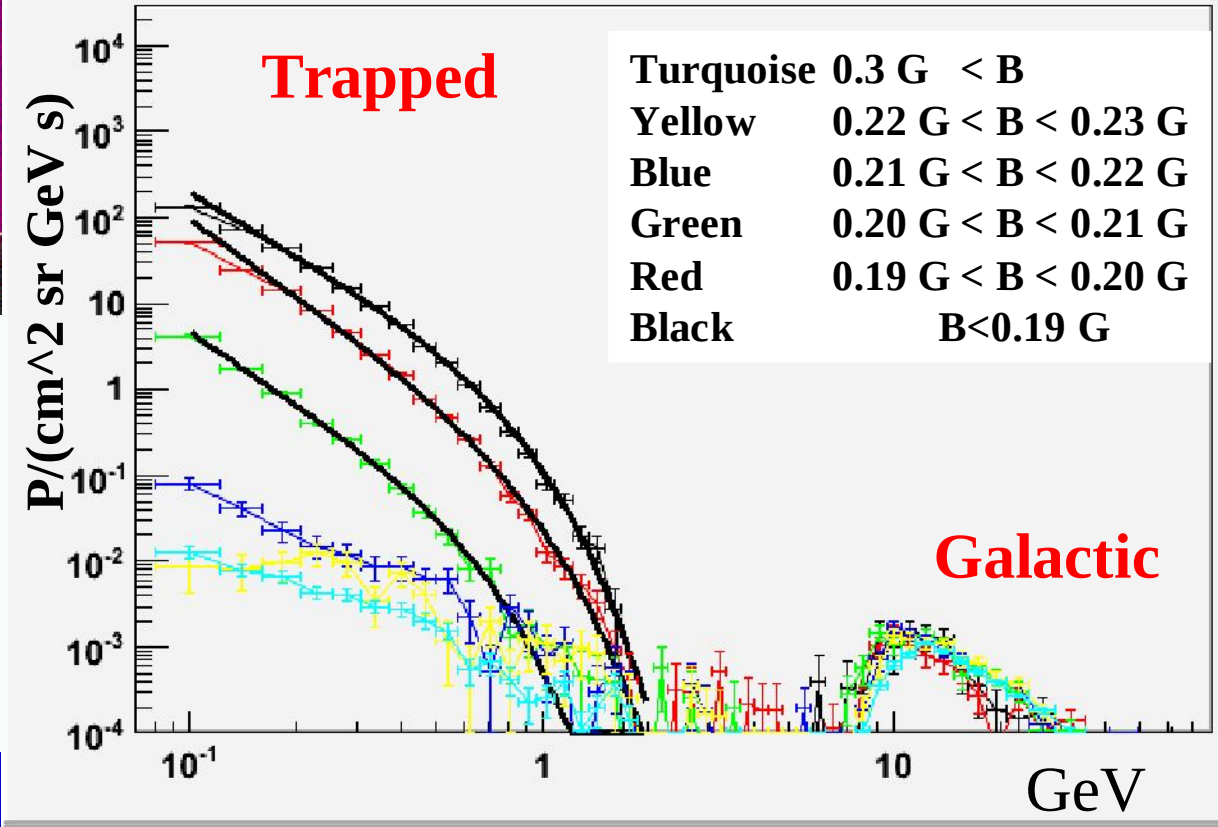
	ϕ(GV)	error
JUL06	5.01-01	± 2e-03
JAN07	4.16-01	± 2-03
AUG07	4.02-01	± 3-03

Trapped proton flux in the Van Allen belt (South Atlantic Anomaly)

Arxiv 0810.4980v1







Integral Pamela flux (E>35 MeV)

(PSB97 plot by SPENVIS project, model by BIRA-IASB)

$$\Phi = A\,E^{-(\gamma_0+\gamma_1 E)}$$

	A	γ_0	γ_1	χ^2/ndf
nero	0.11±0.01	6.0±0.4	3.1±0.5	7.1
rosso	(2.3±0.3) 10^{-2}	5.9±0.5	2.6±0.6	6.8
verde	(5±3) 10^{-4}	8.1±1.8	4.7±1.8	10.

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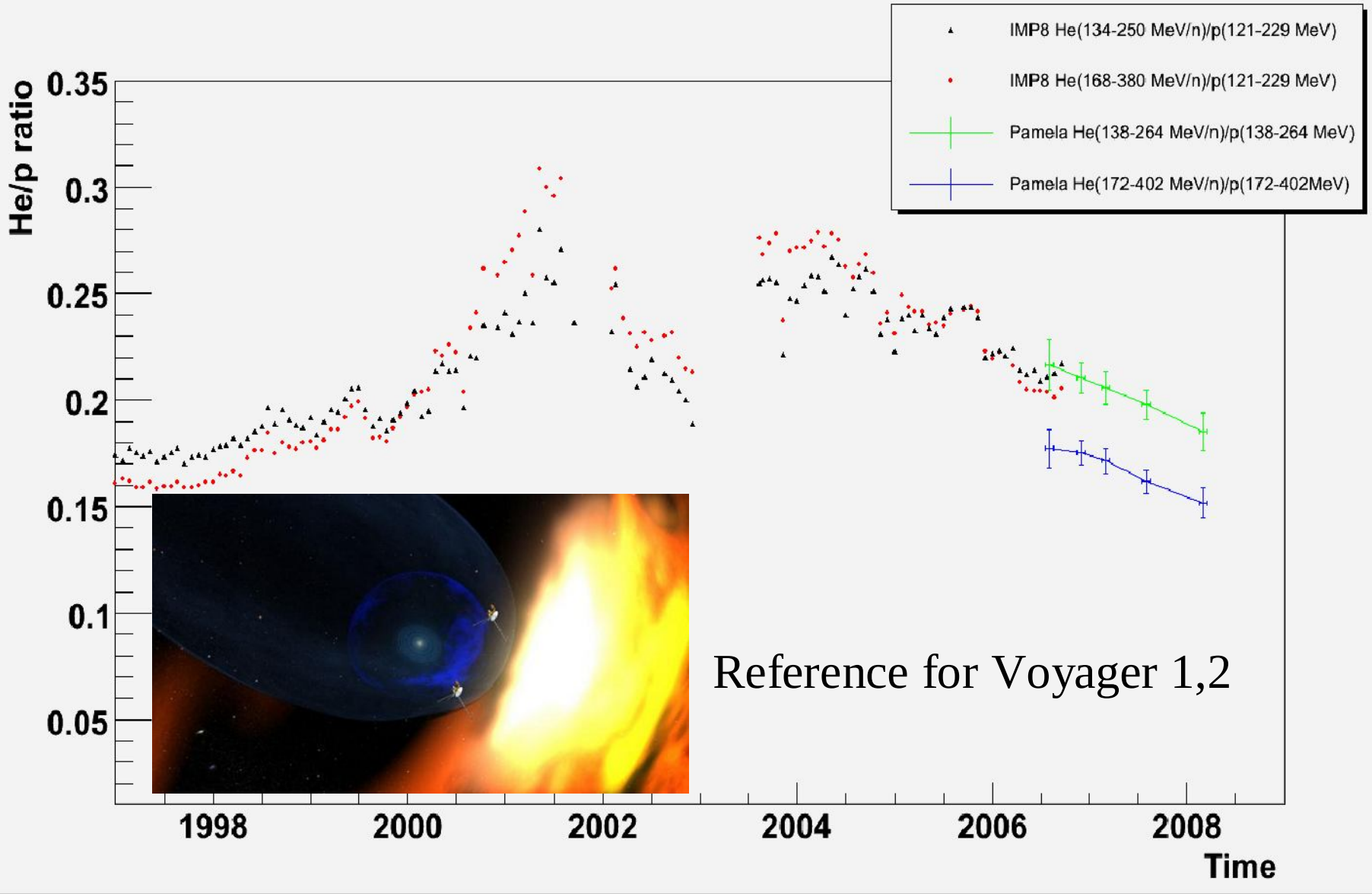
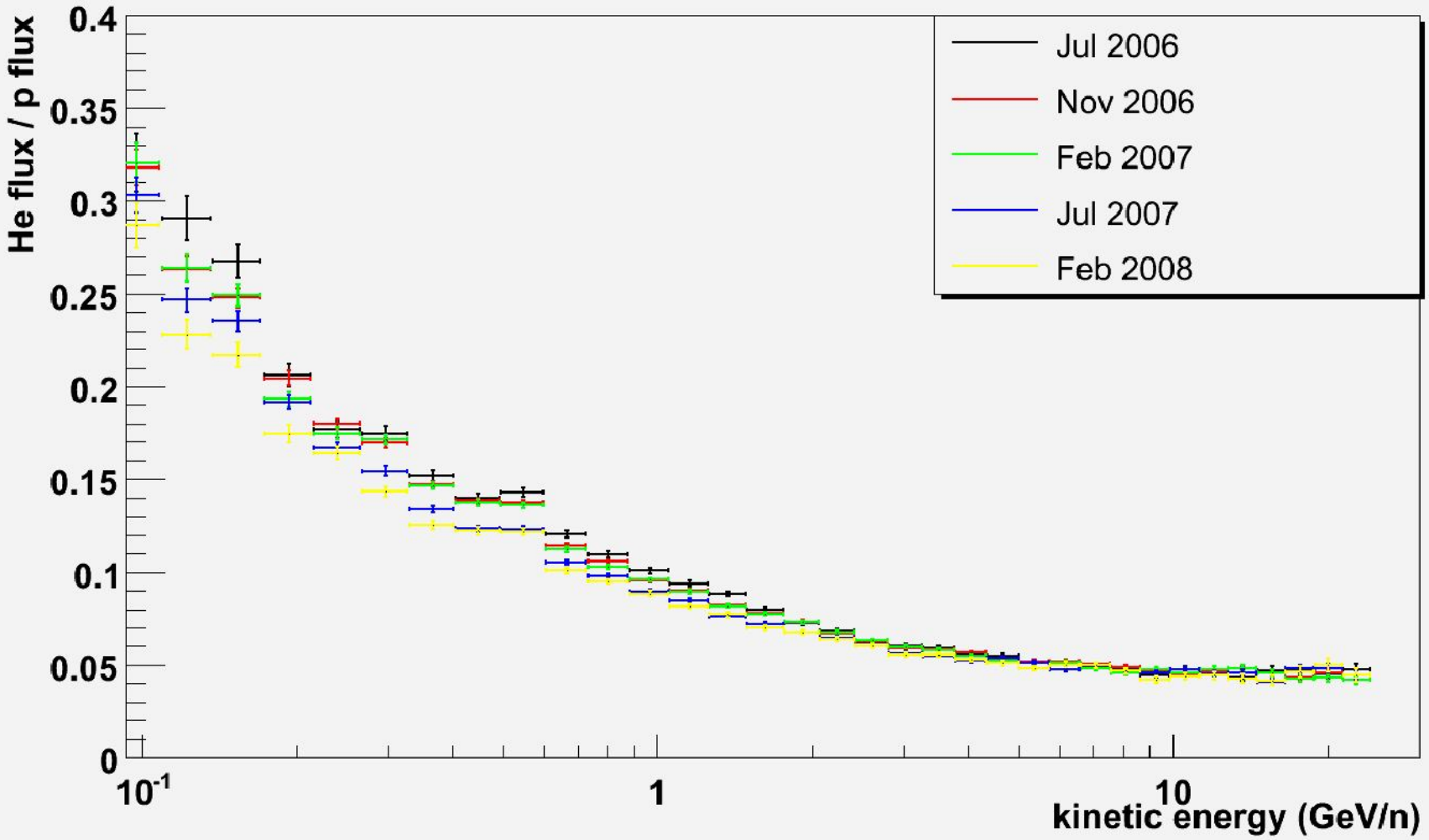
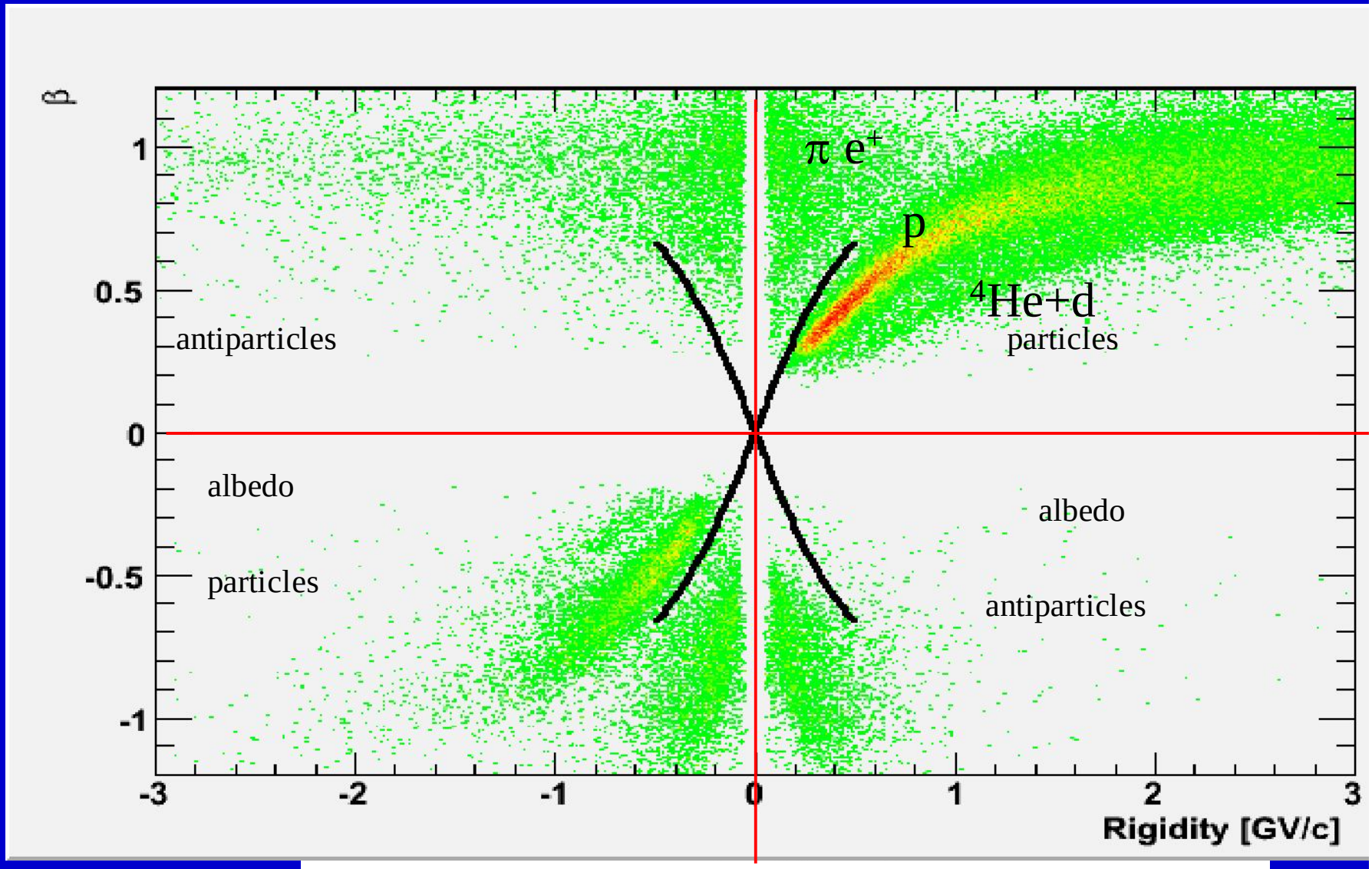
Helium spectrum at 1 AU: after Imp-8



Helium/proton ratio at 1AU – Reference for Voyagers



Particle identification: basic principle



Beta = v/c (from TOF)

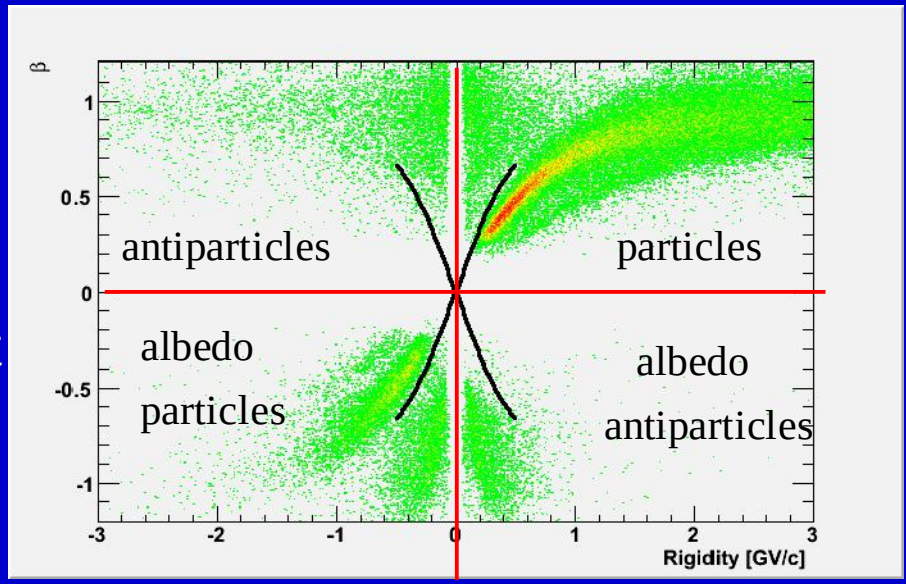
Rigidity (from Tracker)

Proton Absolute flux

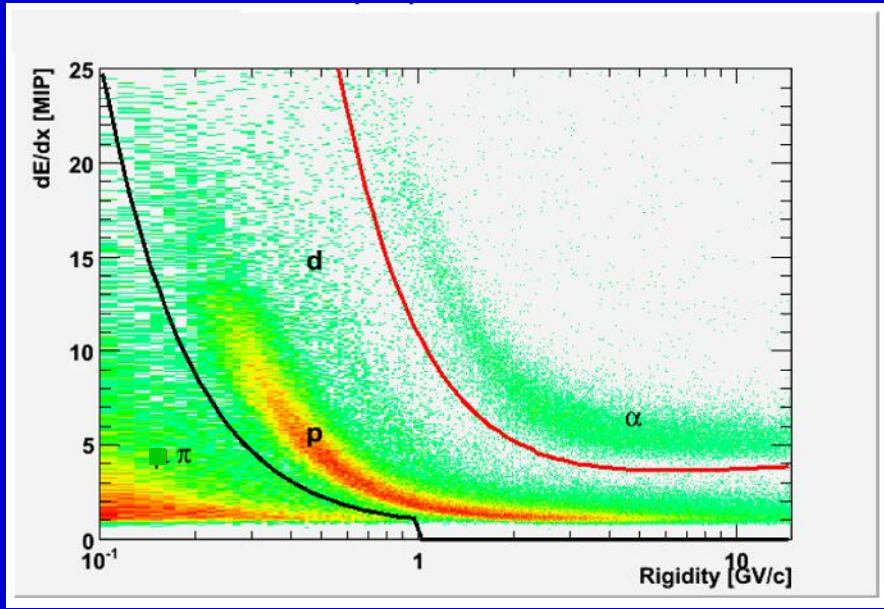
- Montecarlo efficency for cuts
- Trigger efficiency
- Tracking efficiency
- Multiple Scattering
- Correction for energy loss in det
- Back scattering…
- Systematics under close investigation, currently about 1-2% uncertainty on abs flux.

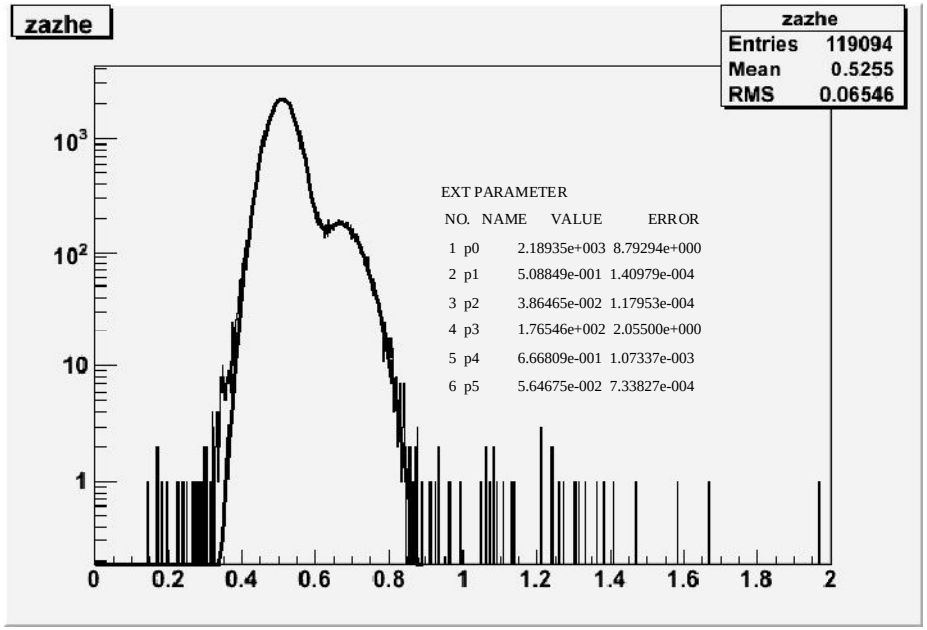
Selection criteria

Fitted, single track
High lever arm, Nx
Rigidity R>0
Beta>.2
No anti



Energy loss from tracker





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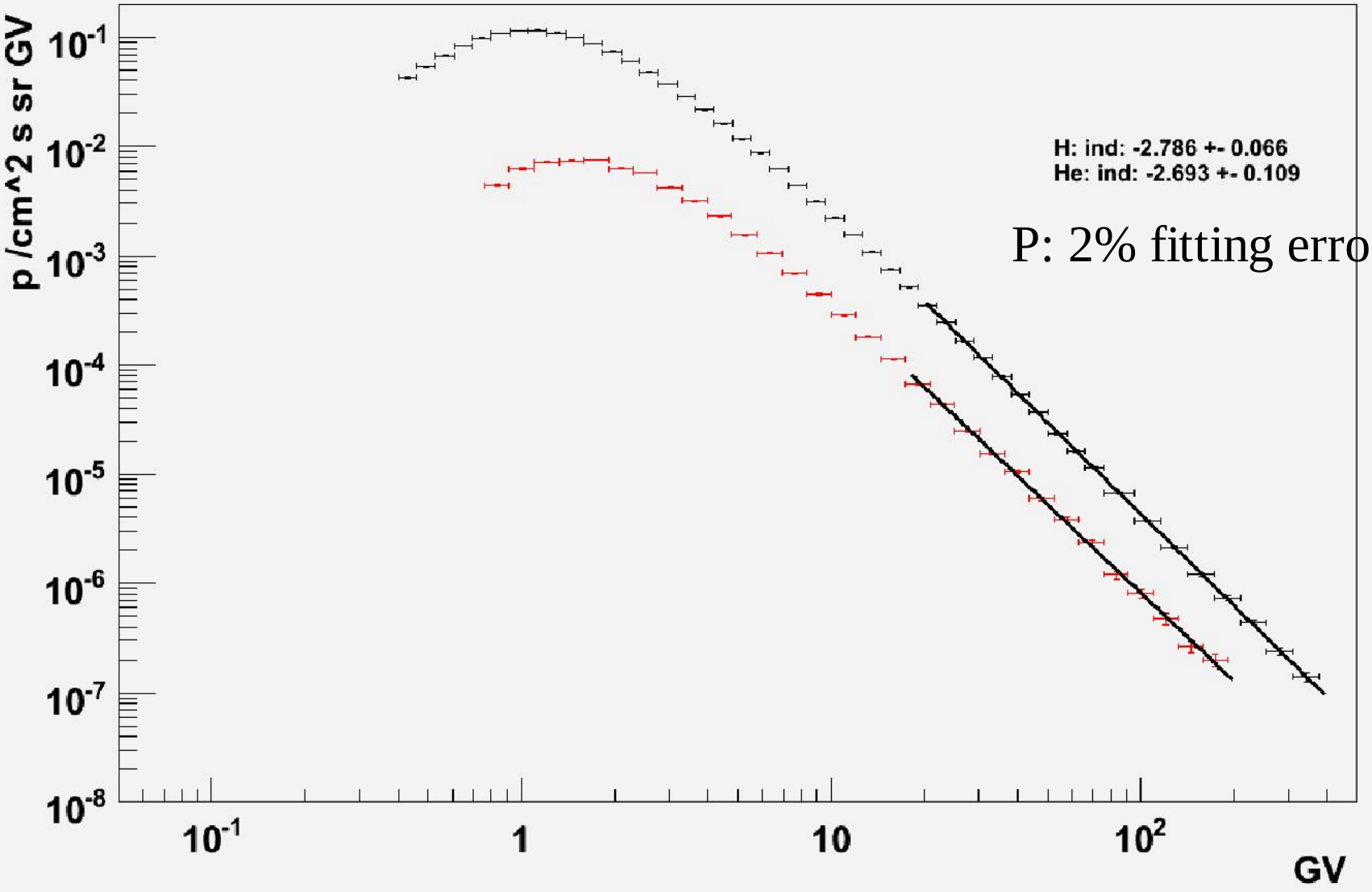
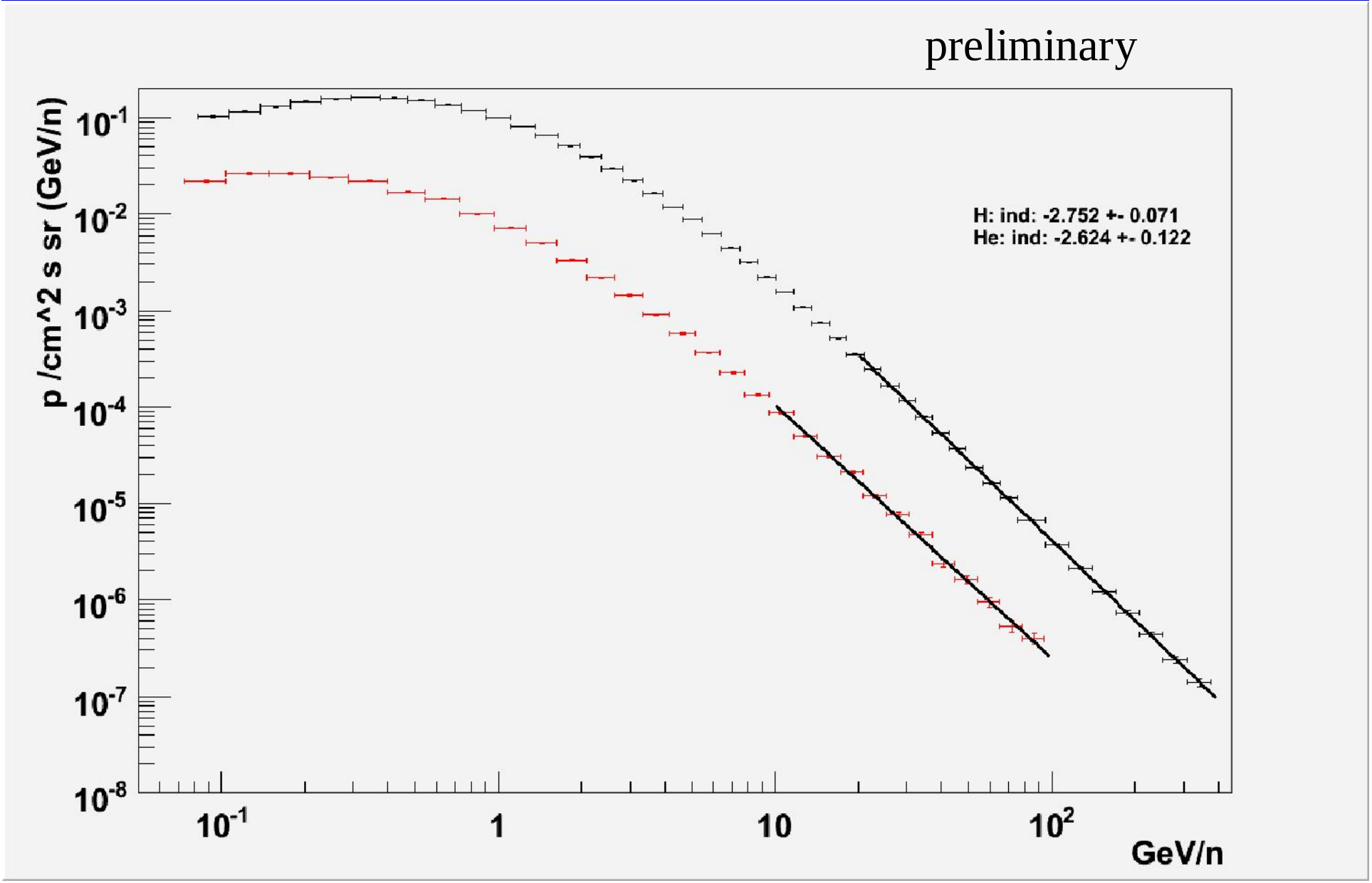
Proton and Helium spectra, rigidity Jul 2006

preliminary

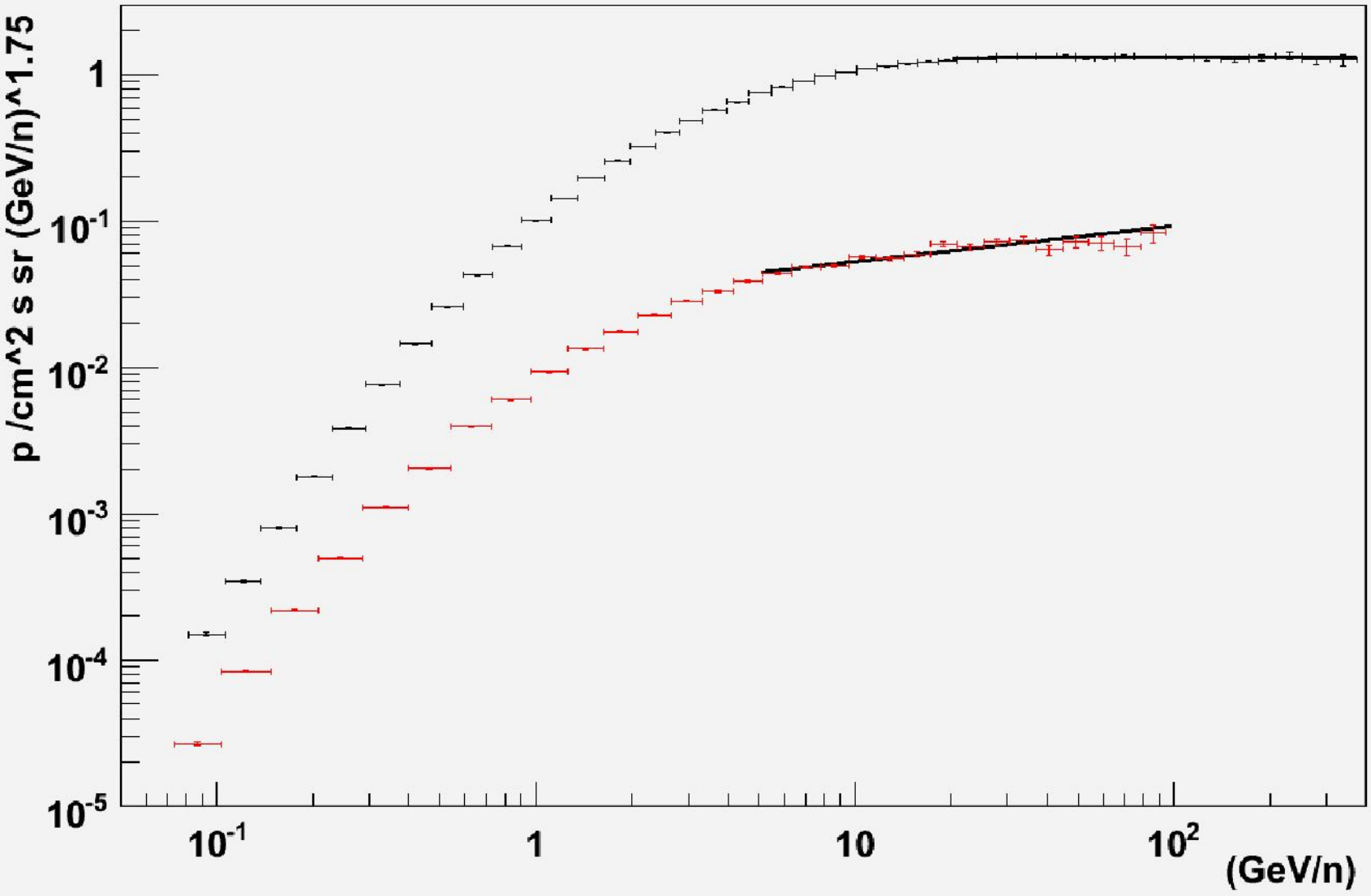


P: 2% fitting error

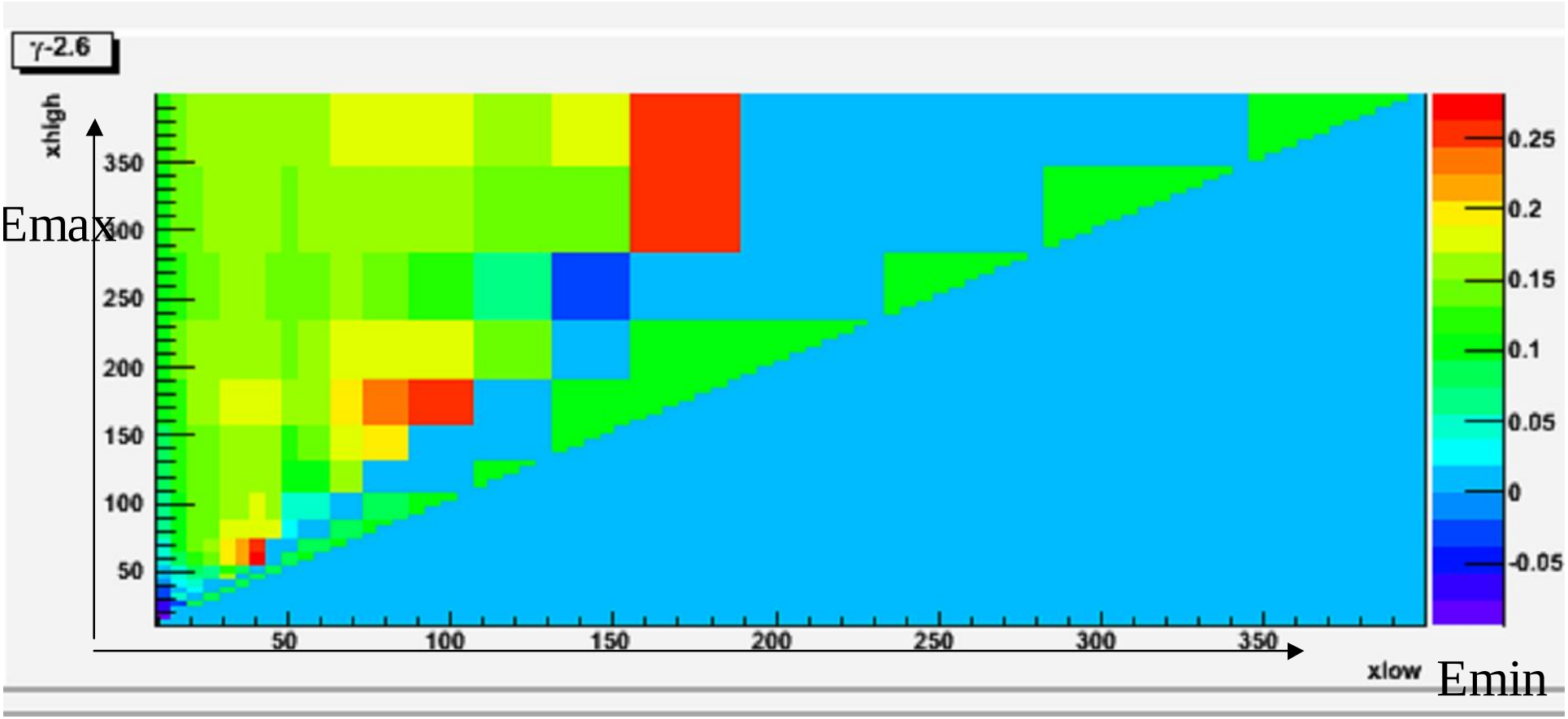
Proton and Helium spectra, kinetic energy, Jul 2006



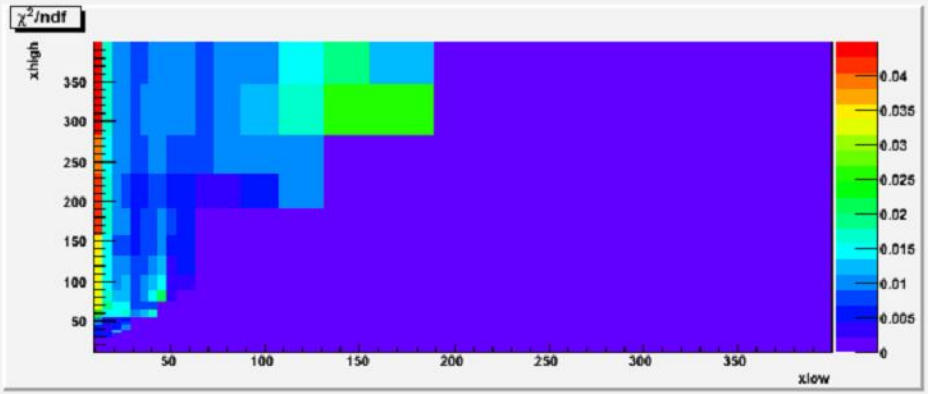
preliminary

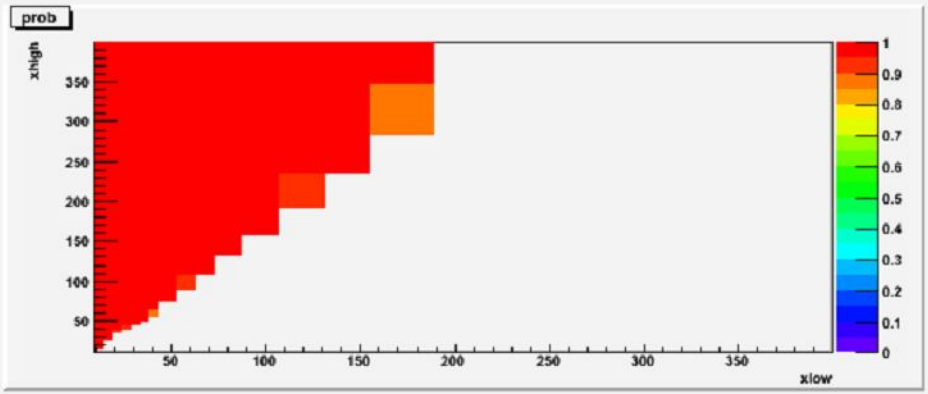


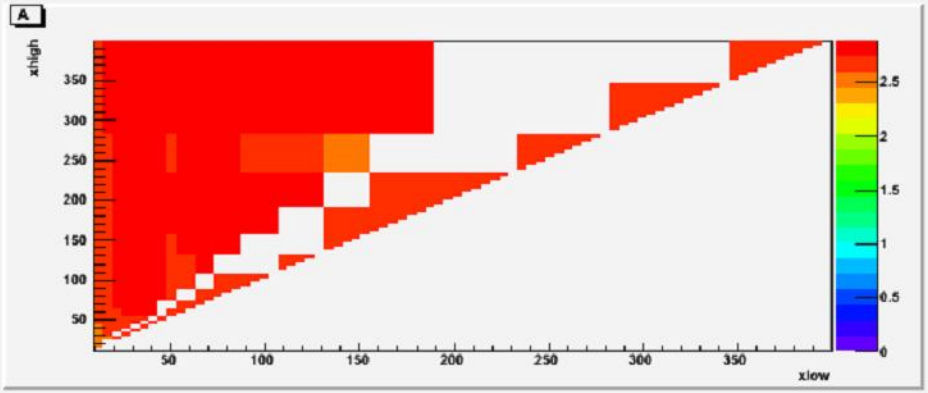
Proton flux fitting
vs starting and ending energy

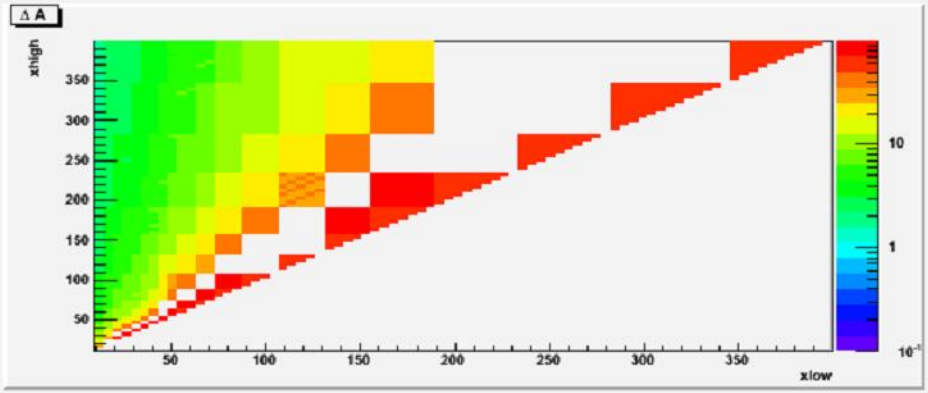


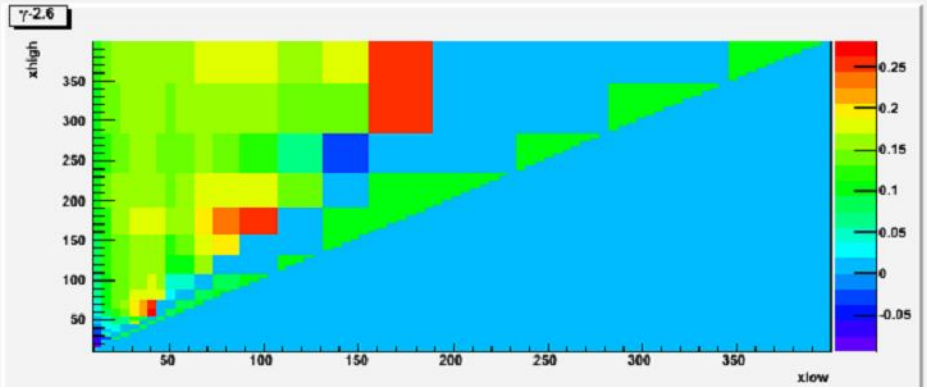
Proton fitting in various energy range

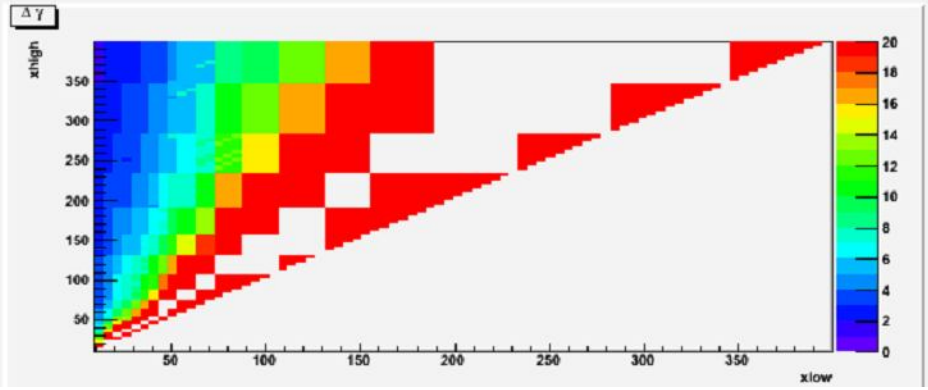




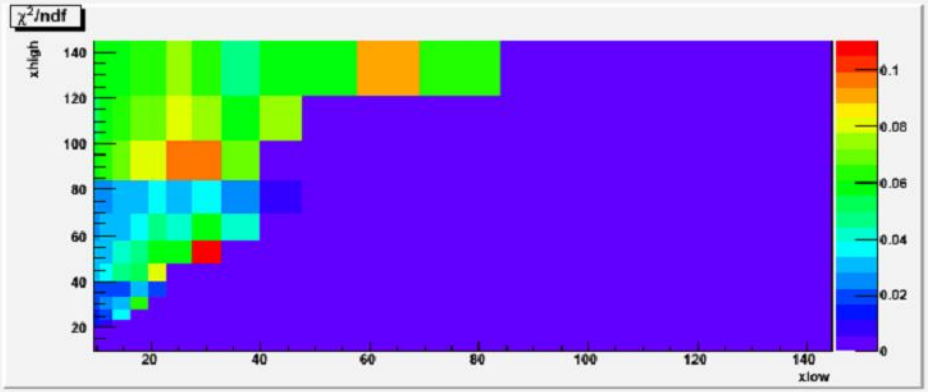


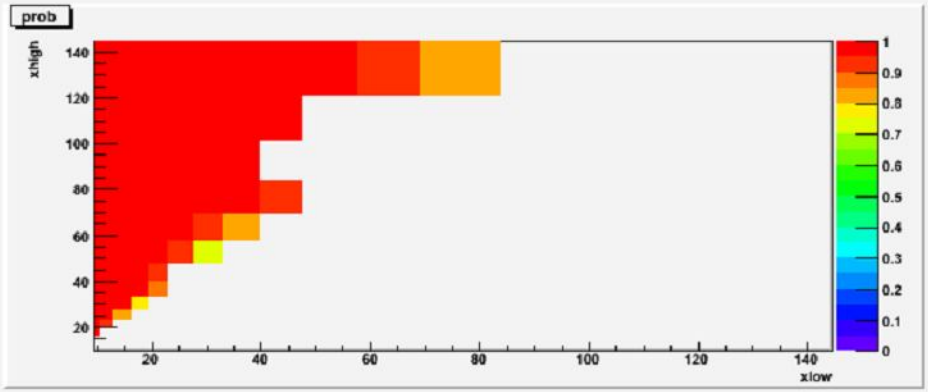


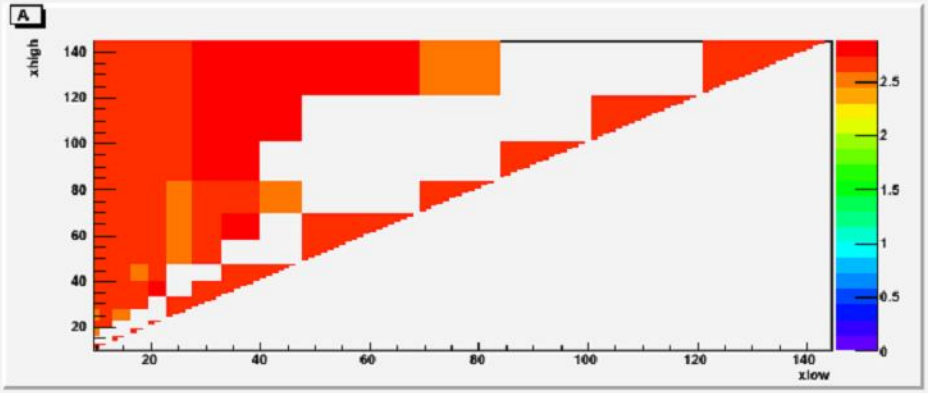


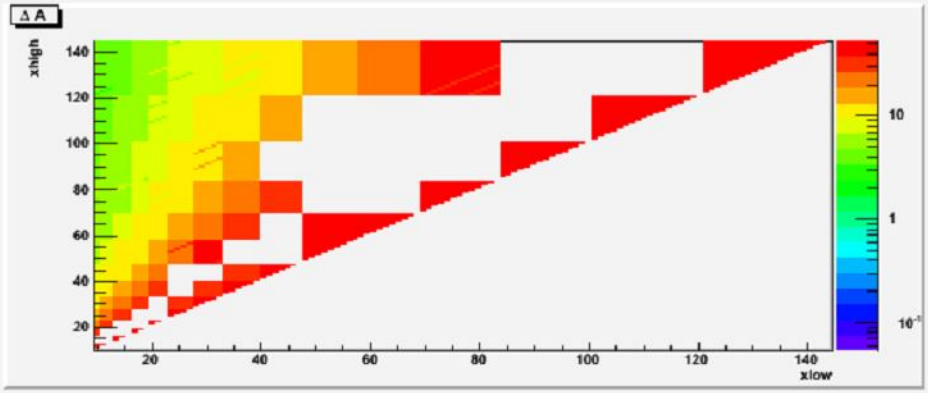


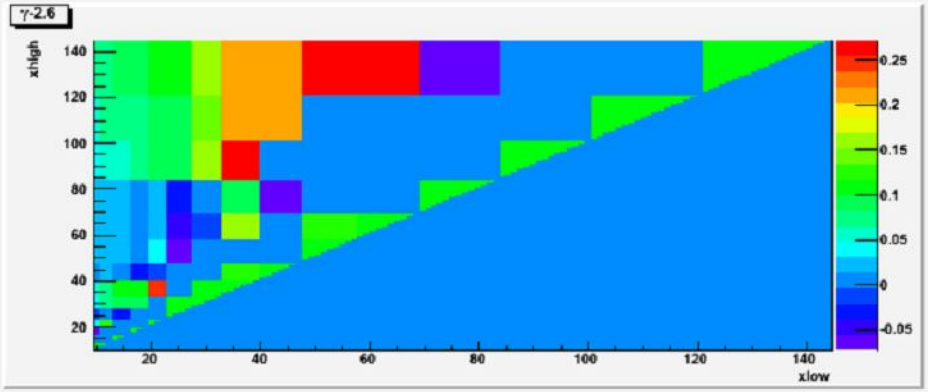
He fitting at various energy range

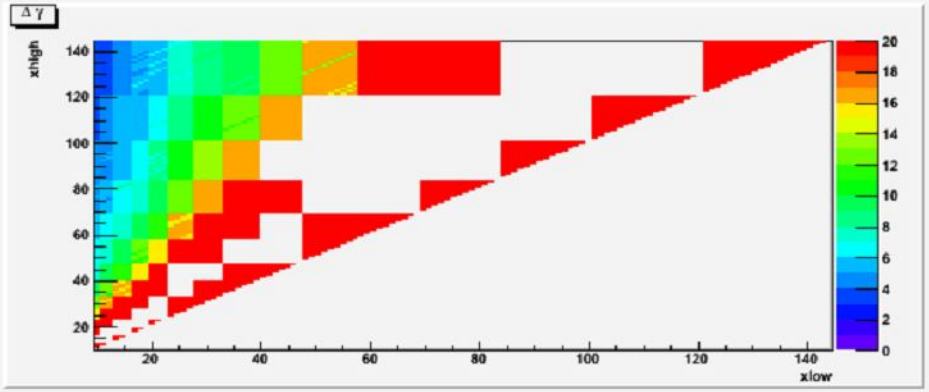






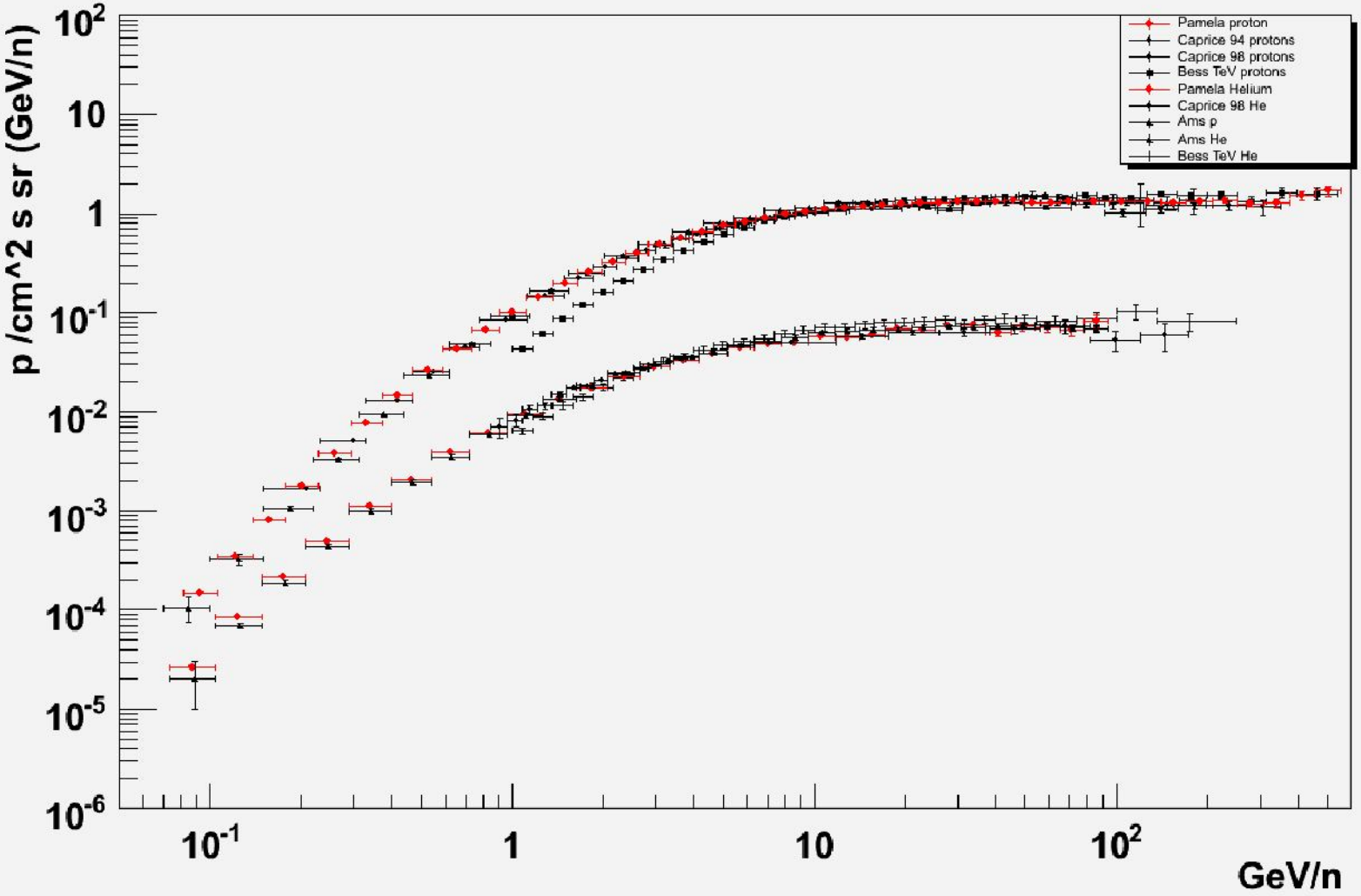






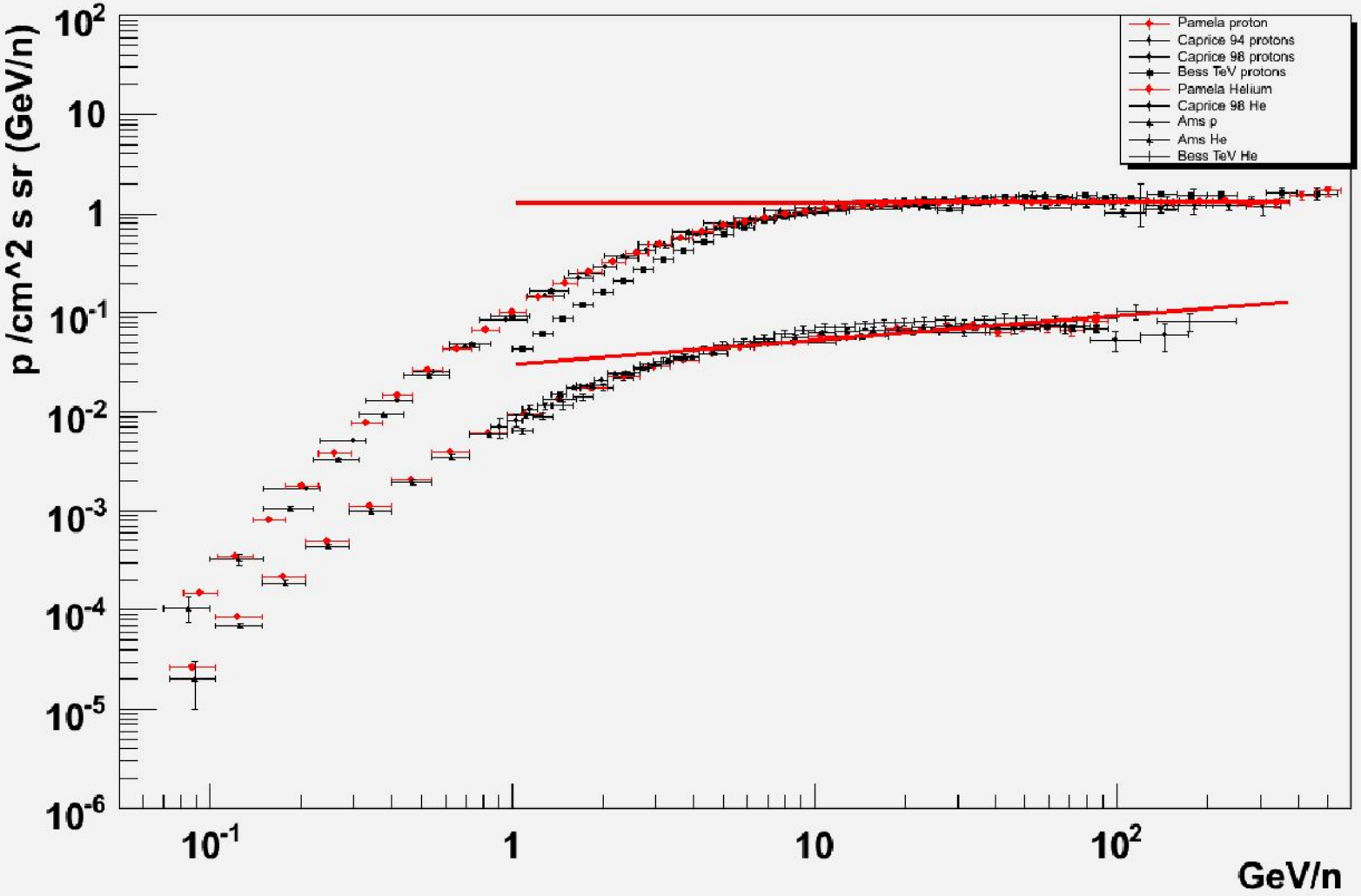
Comparison with other experiments

preliminary

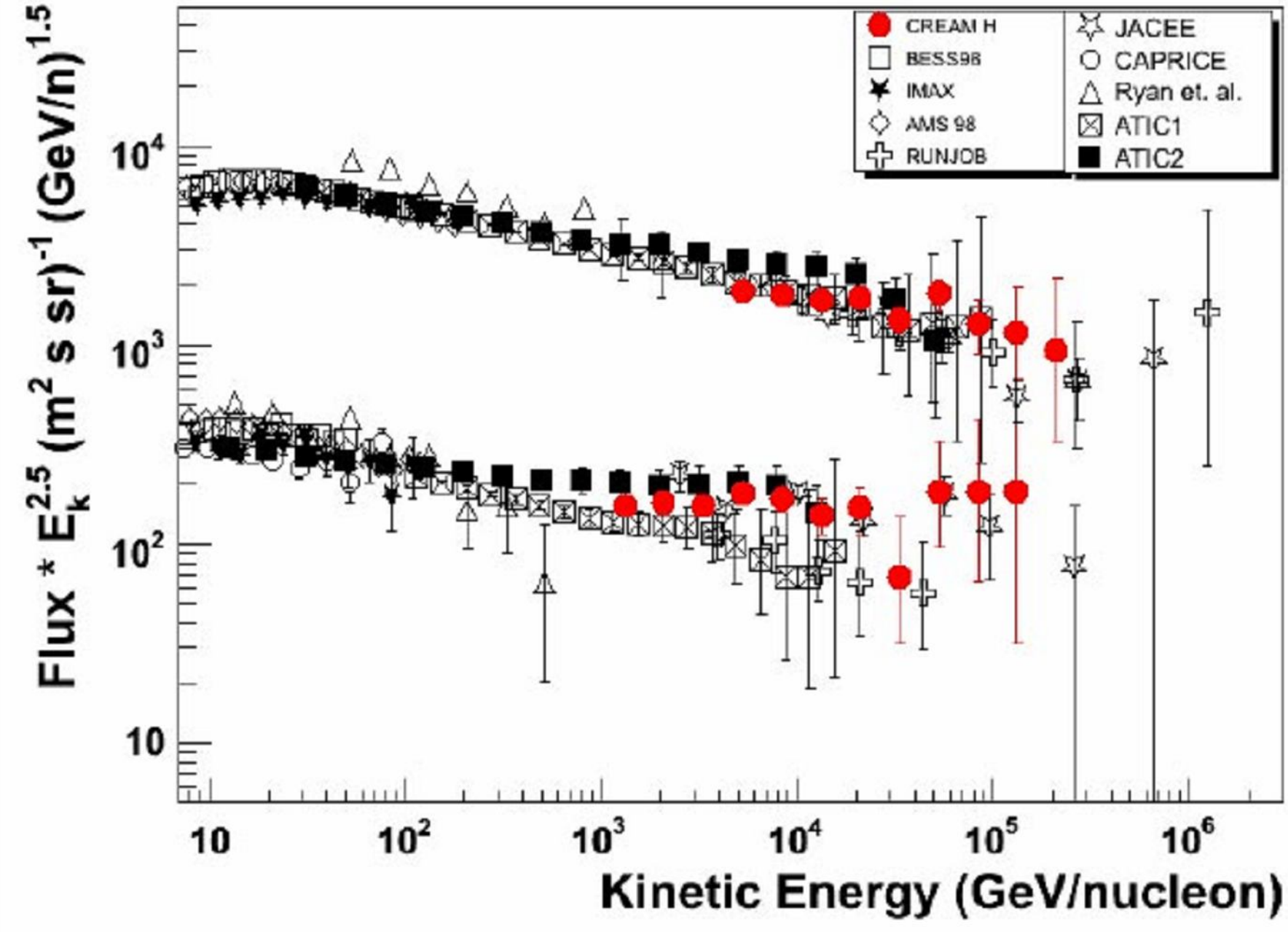


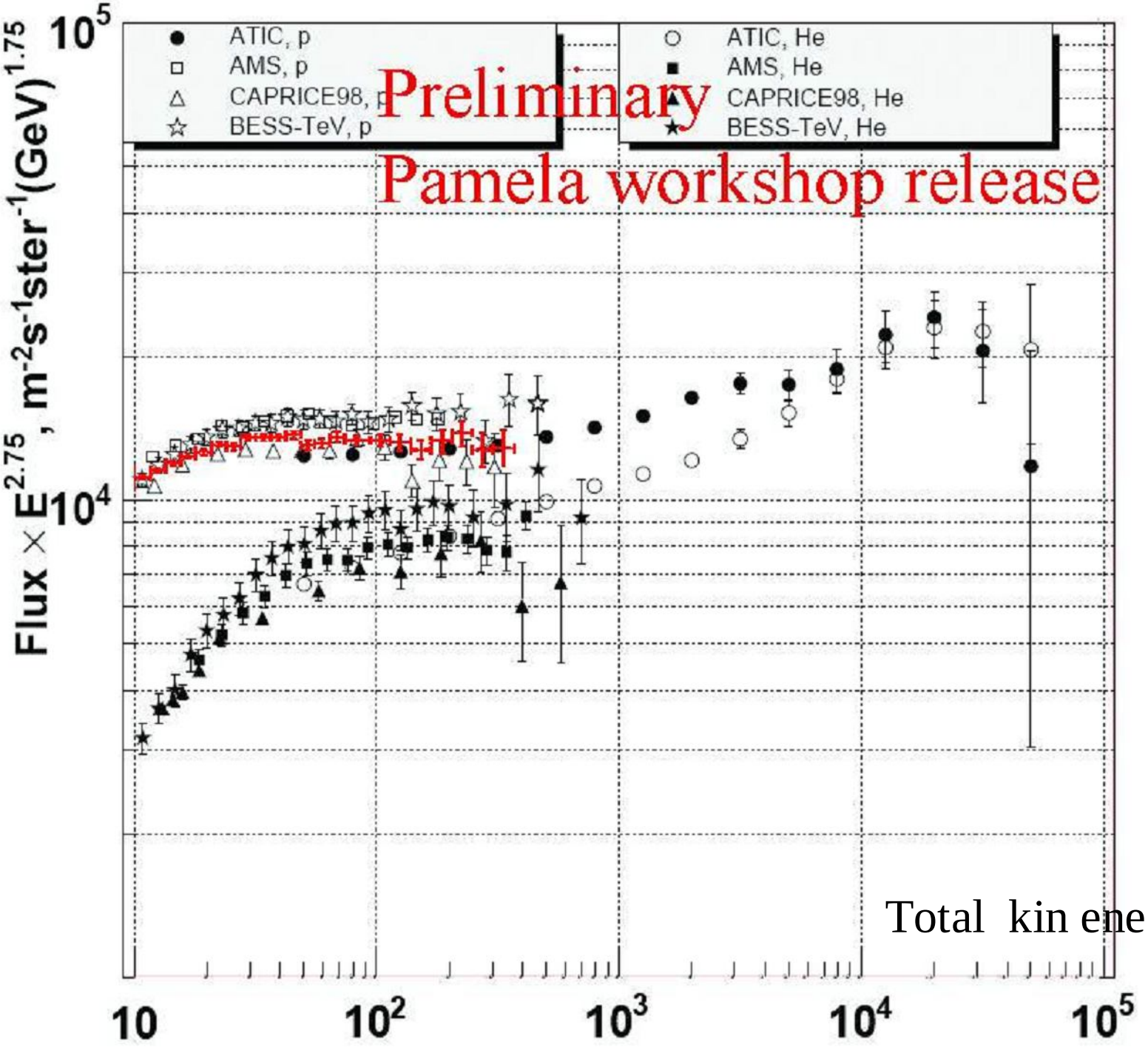
Comparison with other experiments

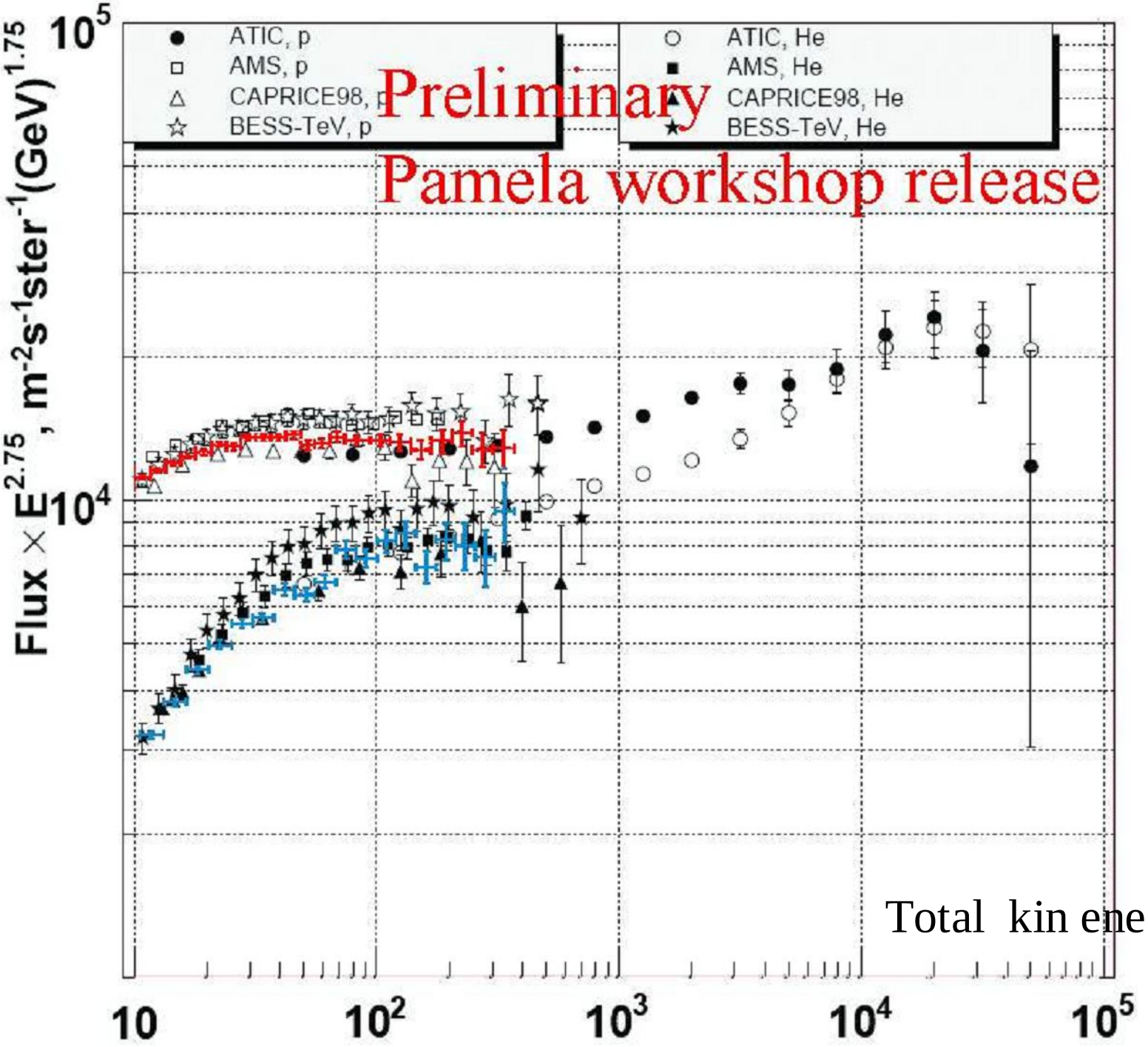
preliminary



H and He Spectra




ATIC, p
AMS, p
CAPRICE98, p
BESS-TeV, p
ATIC, He
AMS, He
CAPRICE98, He
BESS-TeV, He
Preliminary
Pamela workshop release
Flux × E^2.75, m^-2 s^-1 ster^-1 (GeV)^1.75
10^5
10^4
10
10^2
10^3
10^4
10^5
Total kin ene


ATIC, p
AMS, p
CAPRICE98, p
BESS-TeV, p
ATIC, He
AMS, He
CAPRICE98, He
BESS-TeV, He
Preliminary
Pamela workshop release
Flux × E^2.75, m^-2 s^-1 ster^-1 (GeV)^1.75
10^5
10^4
10
10^2
10^3
10^4
10^5
Total kin ene

Current work: extend the maximum energy range for p (1TeV) and He (500 GeV)

Understand systematic and statistical errors to reach required precision of less than 1%