Skobeltsyn
Institute of Nuclear Physics

Lomonosov Moscow State University

Empirical model of the pitch-angle distribution of trapped protons at the inner boundary of the Earth's radiation belt

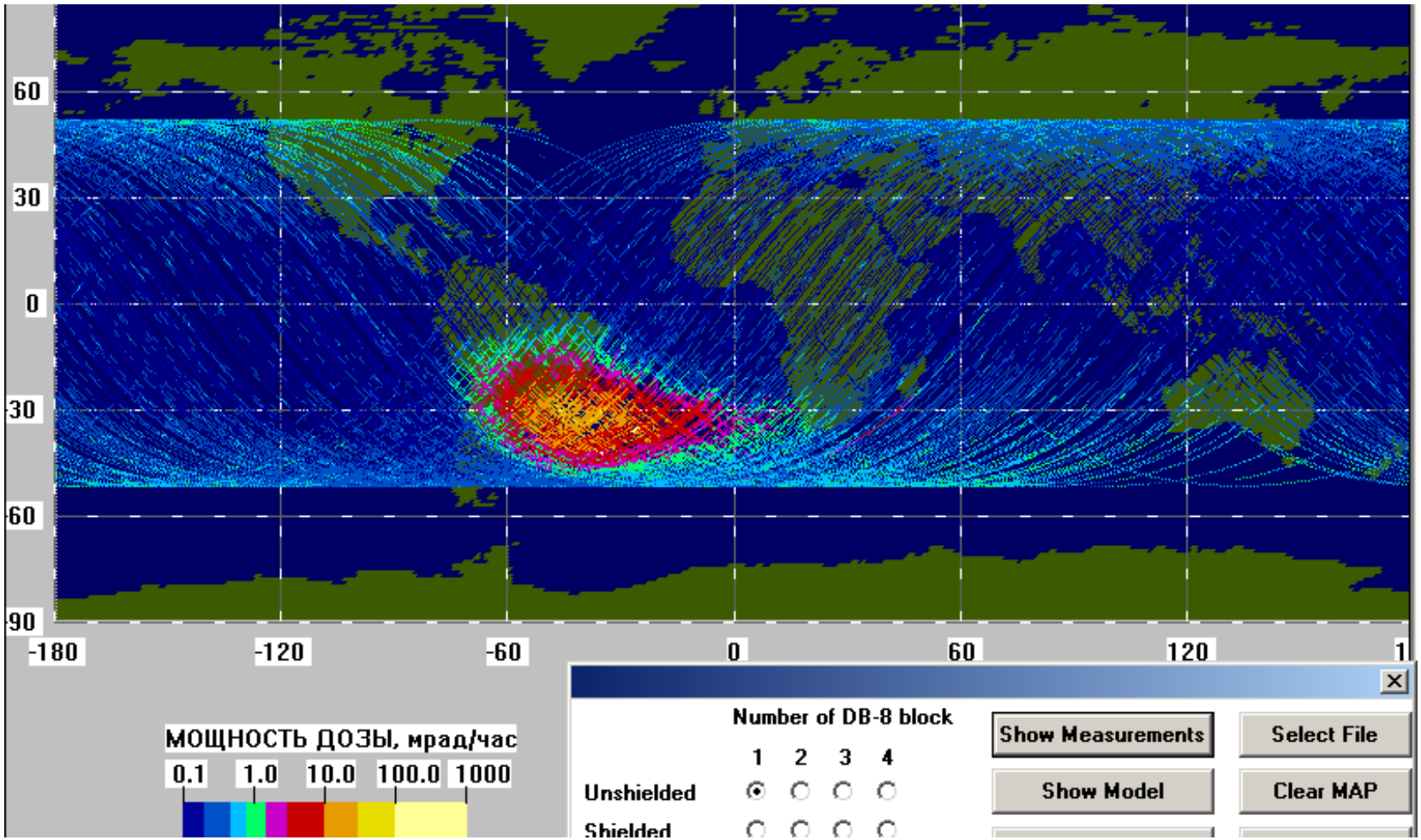
N. V. Kuznetsov, N.I. Nikolaeva

Skobeltsyn Institute of Nuclear Physics
of Moscow State University

Skobeltsyn Institute of Nuclear Physics

Lomonosov Moscow State University

Dose rate distribution on height of ISS flight



Skobeltsyn Institute of Nuclear Physics

Lomonosov Moscow State University

Instruments

Energy, MeV	FOV	Geometrical factor, cm^2*ster	Satellite
0.03-0.08	~±5˚	0.01	NOAA-17 (SEM-2)
0.08-0.24	- “ -	- “ -	- “ -
0.24-0.8	- “ -	- “ -	- “ -
0.8-2.5	- “ -	- “ -	- “ -
2.5-6.9	- “ -	- “ -	- “ -
7-15	±25˚	0.097	Universitetskiy-Tatiana (DB3)
15-40	~ ±17.5˚	0.02	- “ -
16-35	±60˚	1.2	NOAA-17 (SEM-2)
35-70	±60˚	1.2	- “ -
70-140	±90˚	5.5	- “ -
1-5	±30˚	0.5	CORONAS-F (MKL)
14-26	±90˚	30	- “ -
26-50	±70˚	2	- “ -
50-90	±70˚	2	- “ -

NOAA-17
820 km 98deg

Universitetskiy-Tatiana
970 km 83 deg

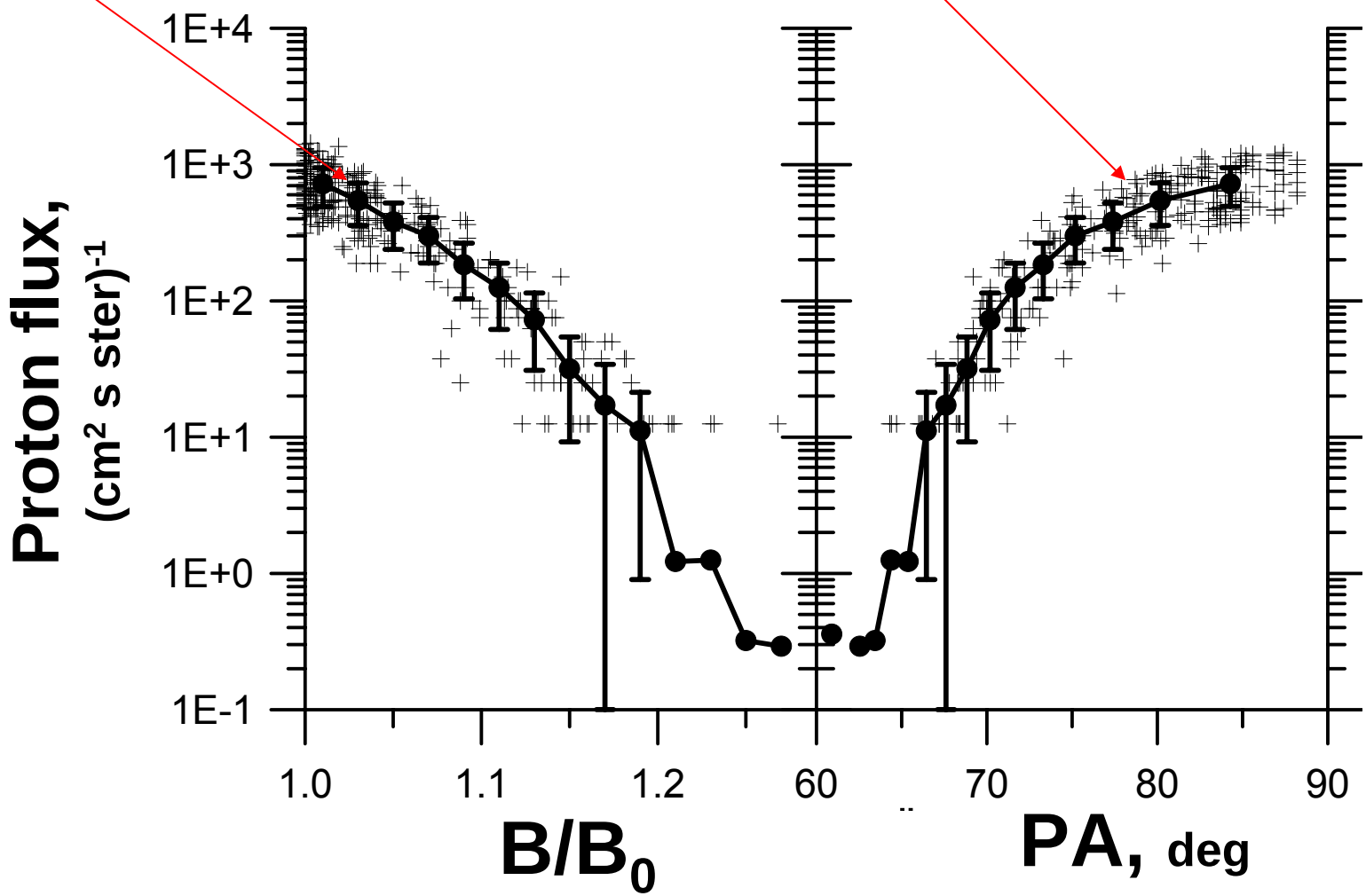
CORONAS-F
360 km 83 deg

Data processing

$$F_L^{(\exp)}(B/B_0) = \mathrm{N}_L(B/B_0)/G$$

$$F_L^{(\exp)}(\alpha)$$

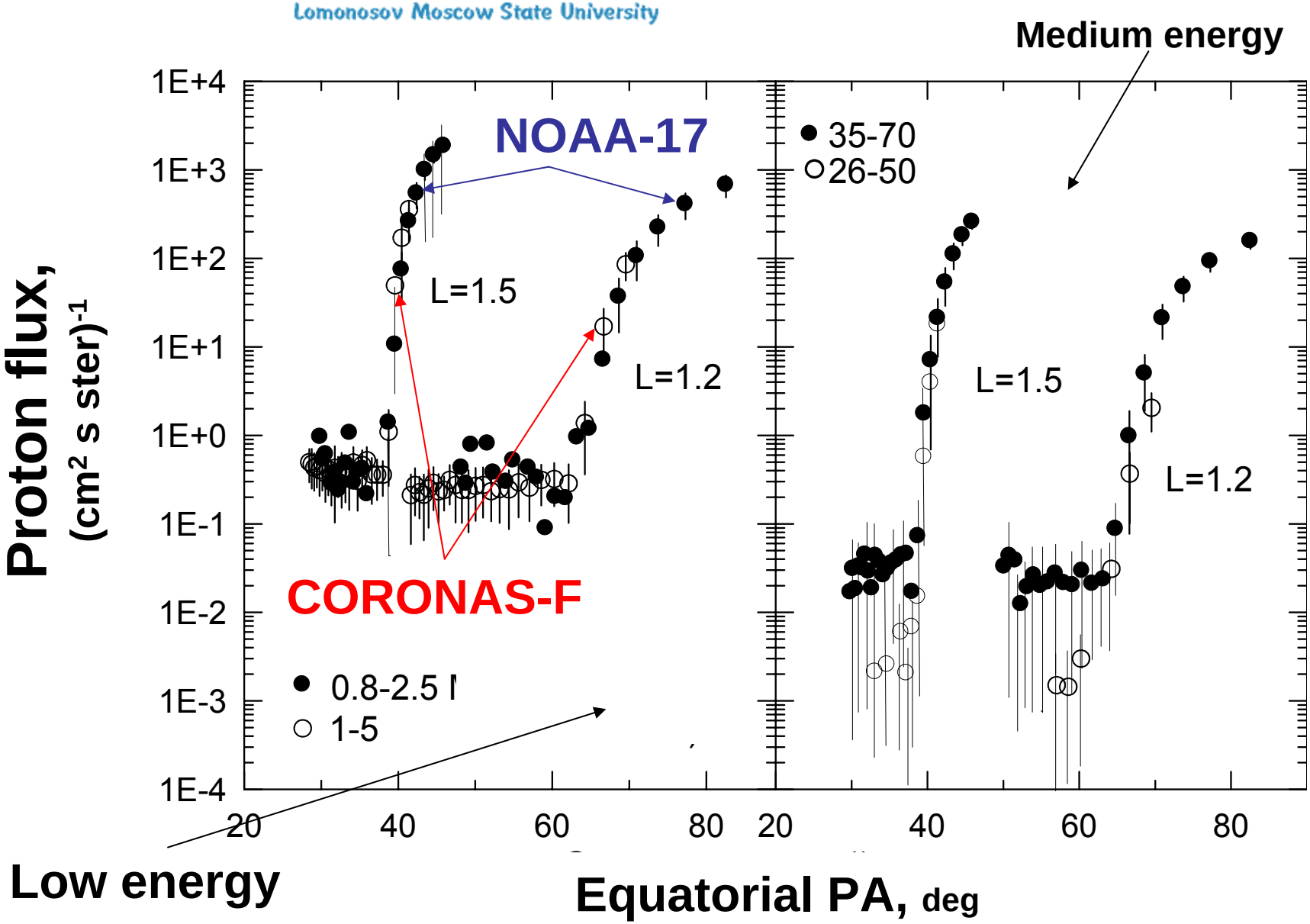
$$\sin^2(\alpha_B)/B = \sin^2(\alpha_0)/B_0$$



Skobeltsyn Institute of Nuclear Physics

Lomonosov Moscow State University

Data comparison

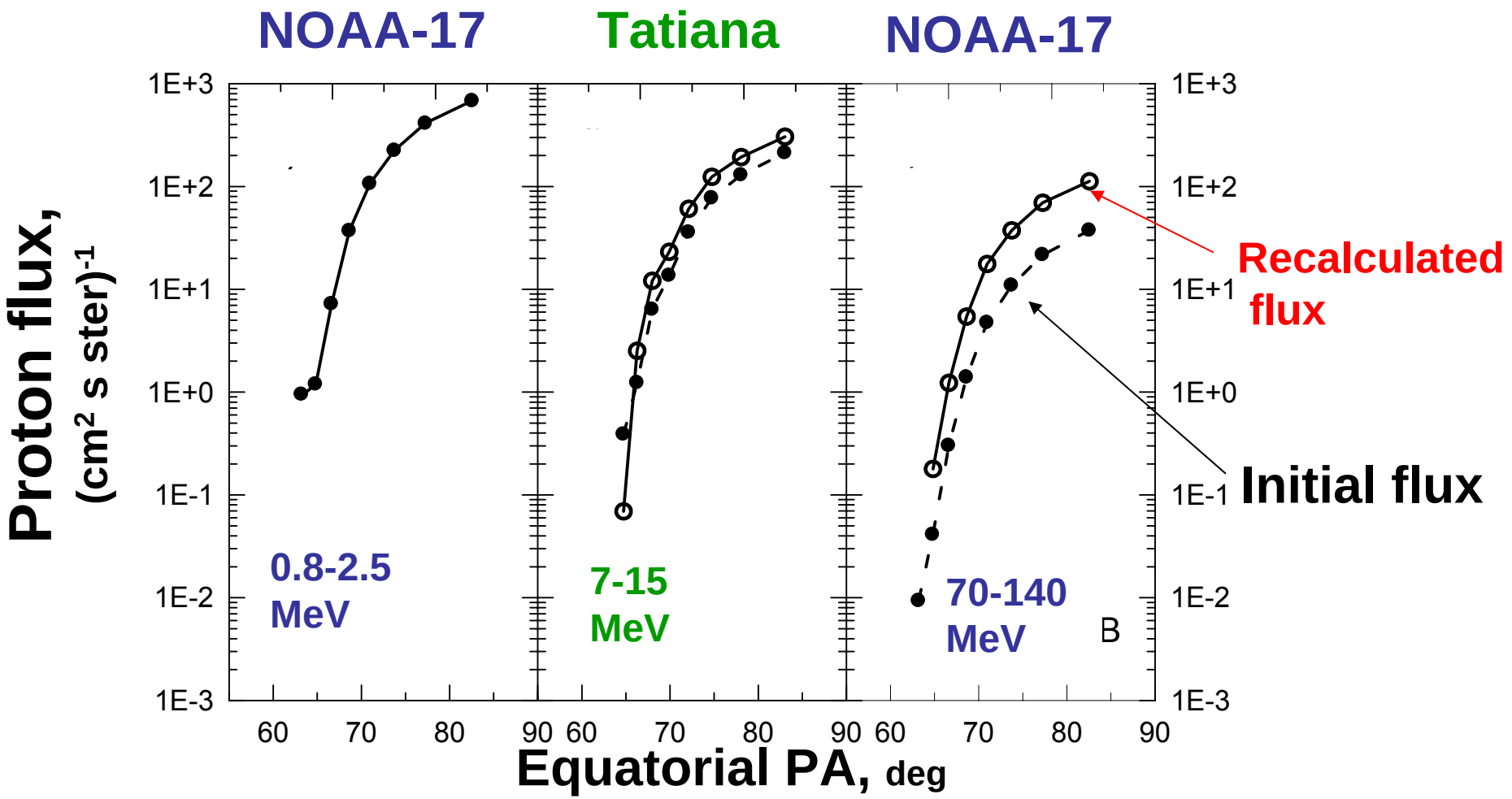


Data analysis procedure

$$N_L(B/B_0) = s\int_{\theta(\alpha,\Phi)\geq\theta_{det}} j_L(\alpha_B)\cos\theta\sin\alpha_B d\alpha_B d\Phi;$$

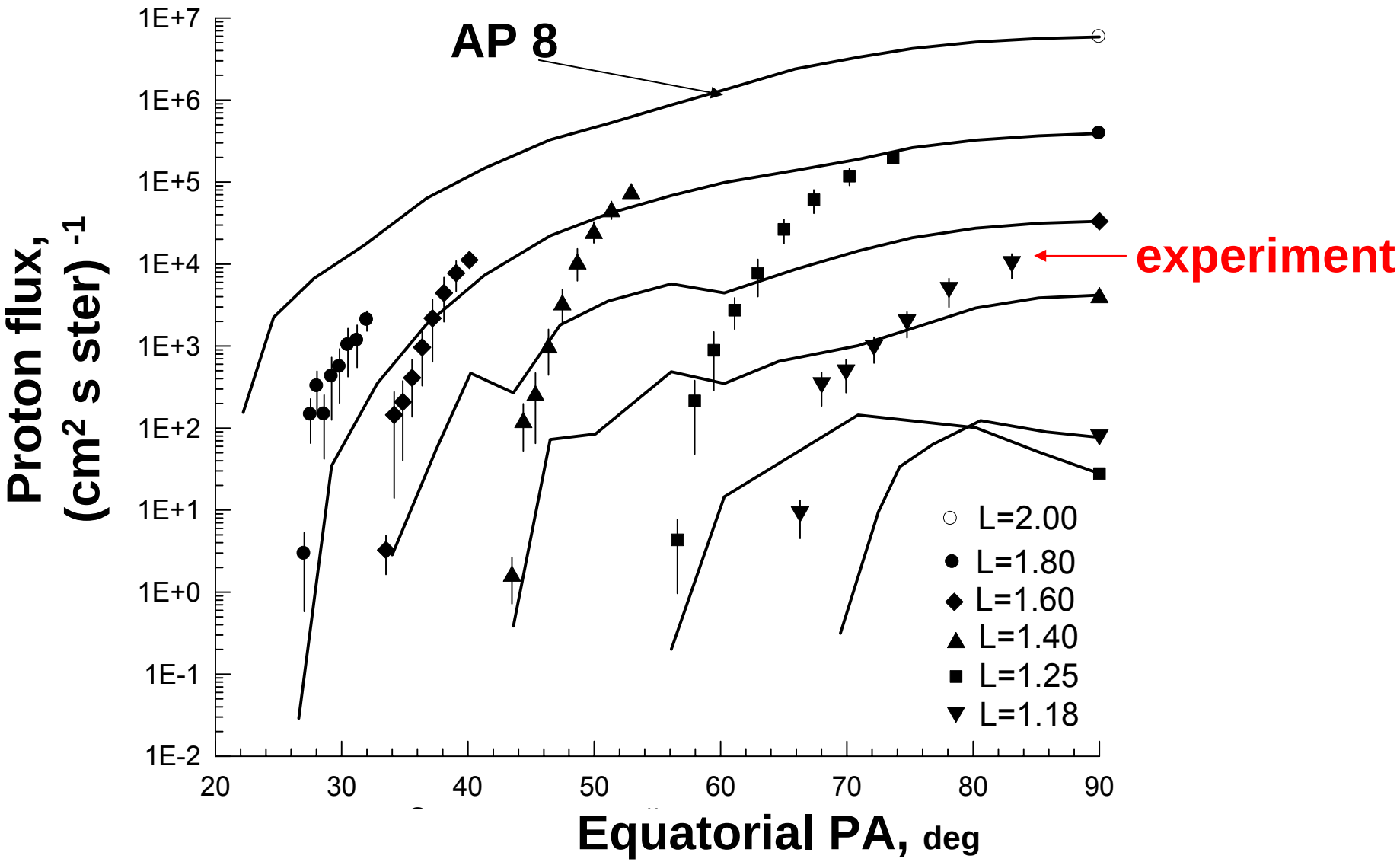
Count rate of the detector

$$\cos\theta = \sin\alpha\cdot\cos\Phi$$



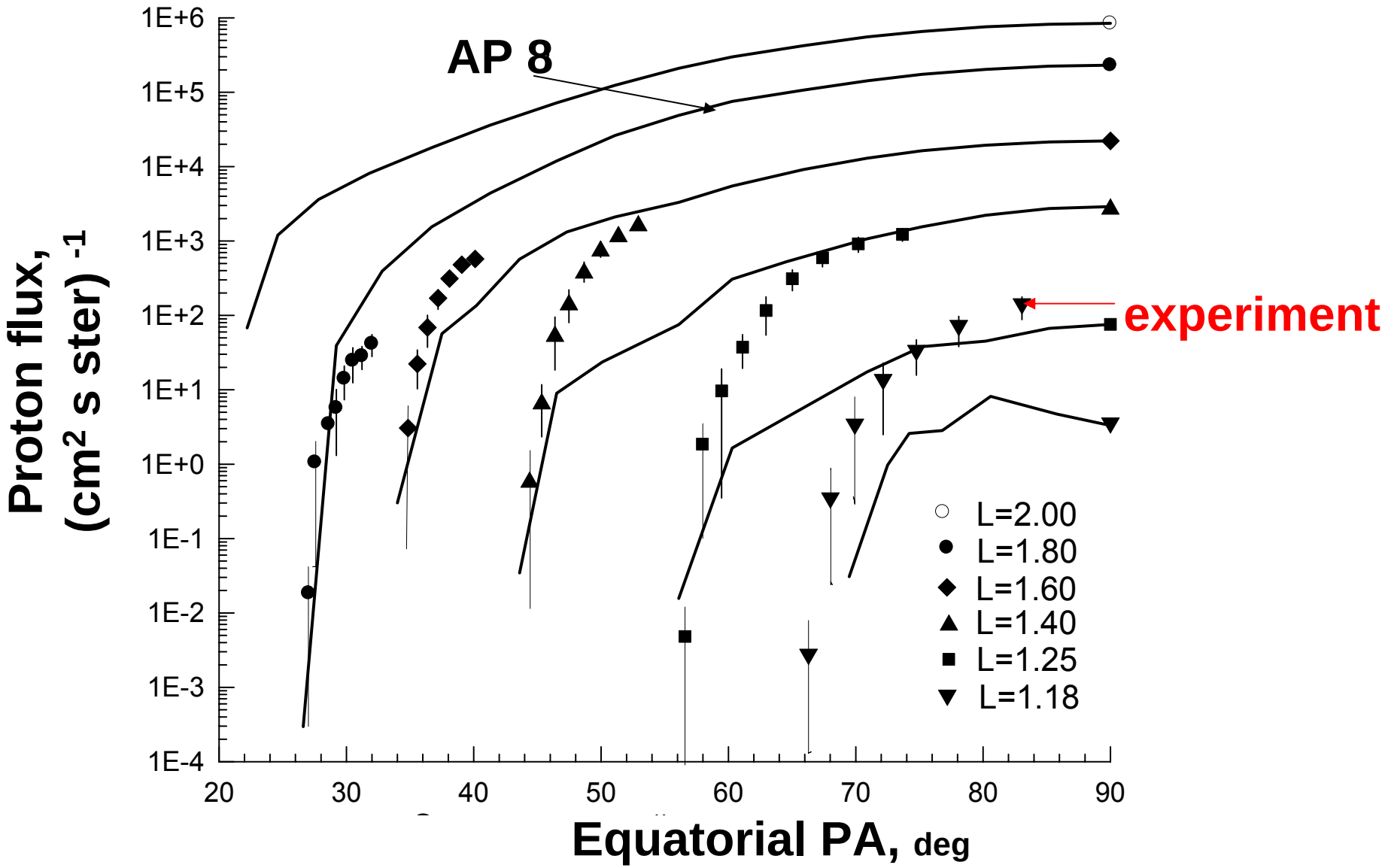
Experimental and model data comparison

E=80-240 keV



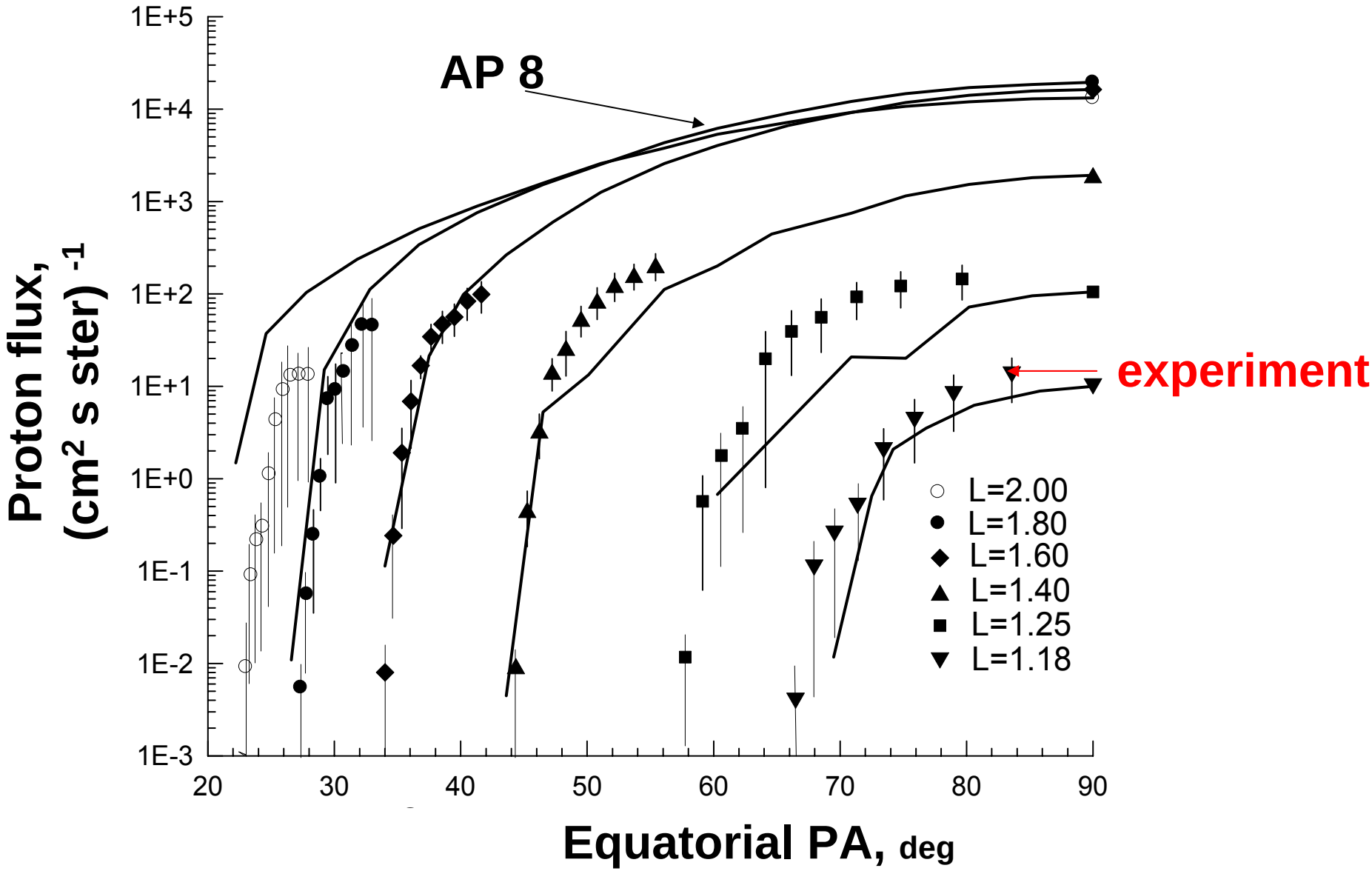
Experimental and model data comparison

E=0.80-2.5 MeV



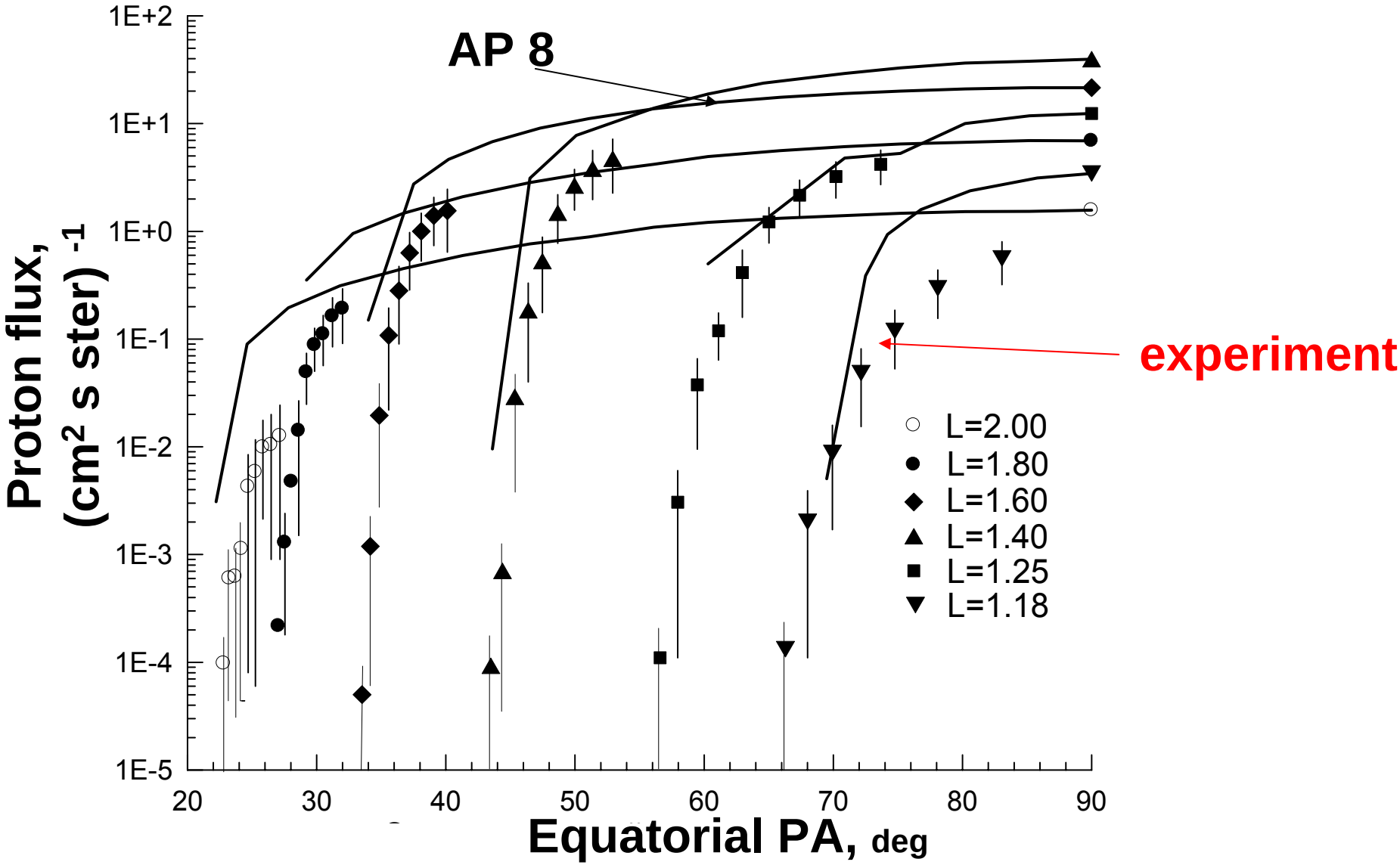
Experimental and model data comparison

E = 7-15 MeV



Experimental and model data comparison

E = 70-140 MeV



Data description

(L=1.14÷~1.4, E=30keV÷140 MeV)

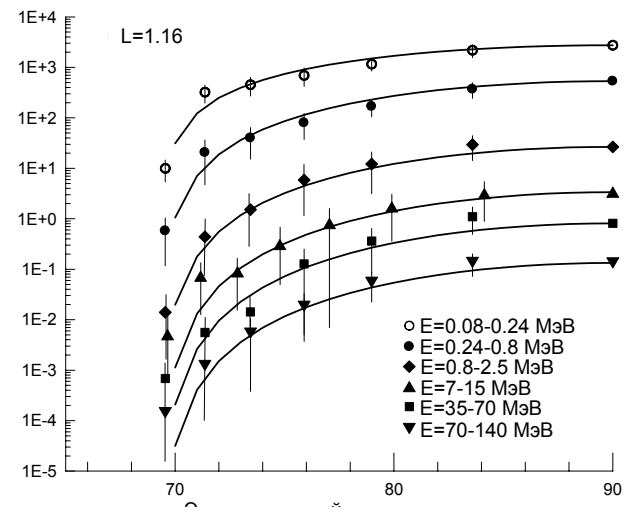
$$j_{E,L}(\alpha_0) = j_{\perp}(E,L)\cdot \sin^{k}\left(\alpha_0 - \chi\cdot\alpha_0^{(con)}(L)\right)$$

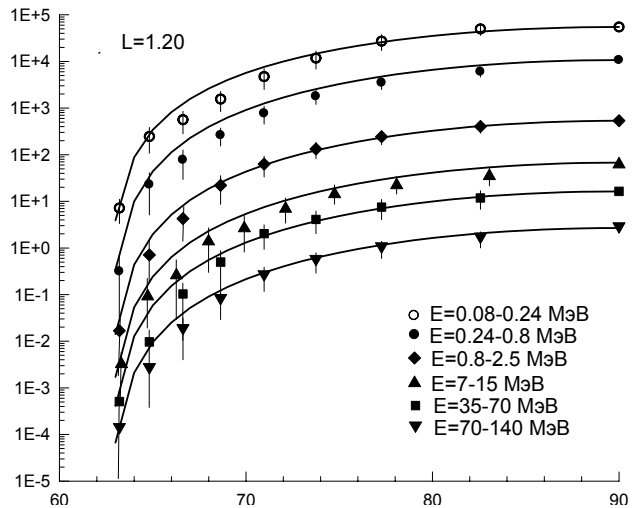
$$j_{\perp}(E,L) = \left(\frac{1}{A_l(E)} + \frac{1}{A_h(E)}\right)\cdot \exp\left(75(L-1)\left(\frac{1.2}{L}\right)^{\delta}\right)$$

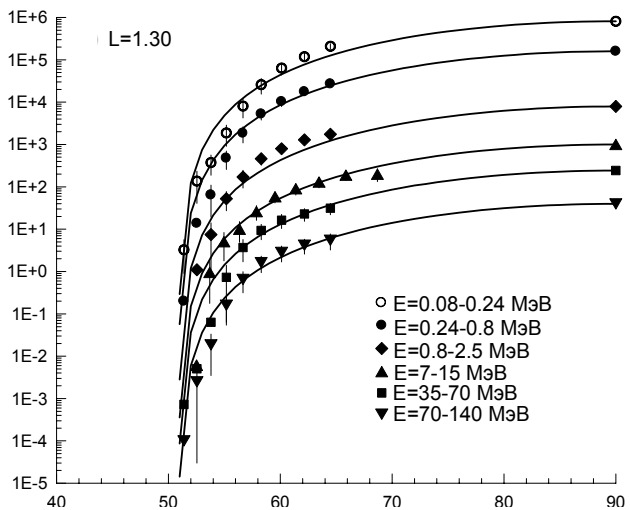
$$\alpha_0^{(con)} = 132/(1+6\ln L)$$

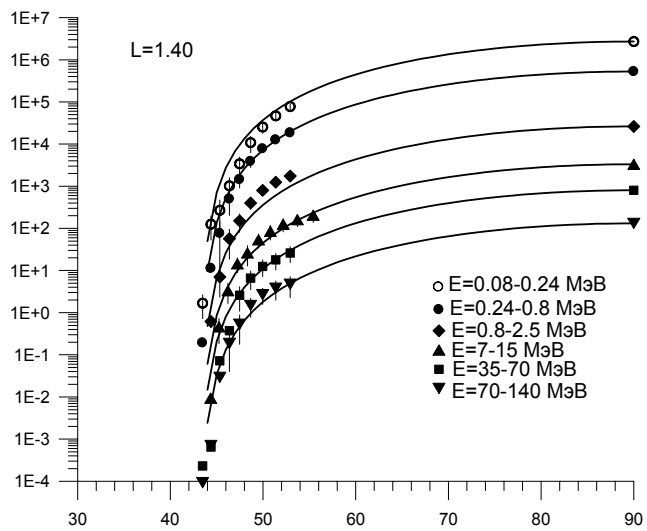
$$\chi = (90-\alpha_0)/(90-\alpha_0^{(con)})$$

Model and experimental data comparison









Conclusions

The pitch-angle distribution of fluxes of protons with energies from 30 keV to 140 MeV drift is studied on L-shells from L=1.14 to L=1.40-1.50 according to the the data of three low-orbit satellites

The experimental data are used for the development of the empirical model of trapped protons on the lower boundary of Earth's radiation belt