

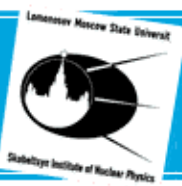
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Institute of Nuclear Physics

Lomonosov Moscow State University

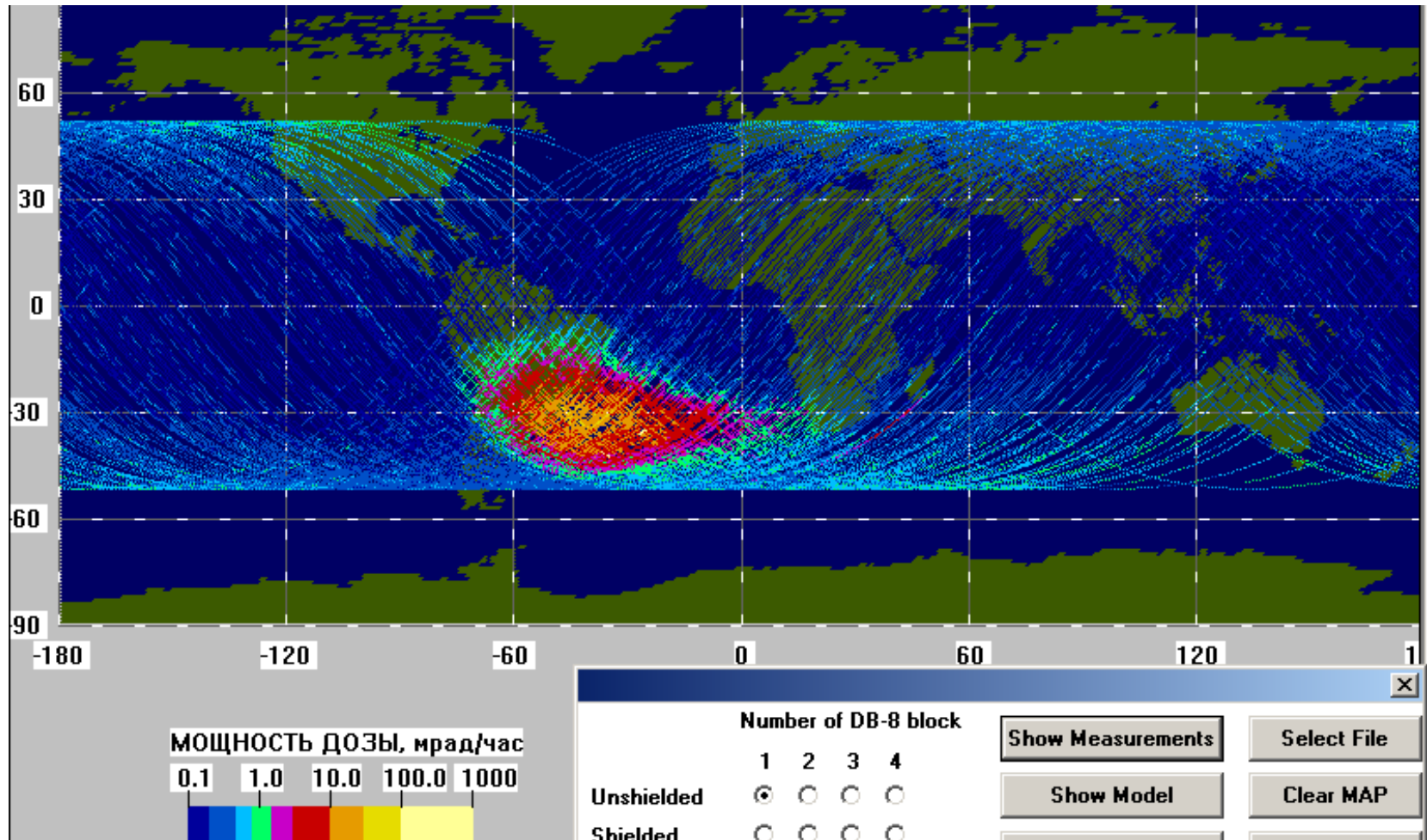
***Empirical model of the pitch-angle
distribution of trapped protons at the
inner boundary of the Earth's
radiation belt***

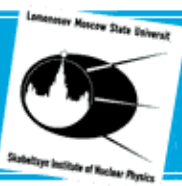
N. V. Kuznetsov, N.I. Nikolaeva

**Skobeltsyn Institute of Nuclear Physics
of Moscow State University**



Dose rate distribution on height of ISS flight





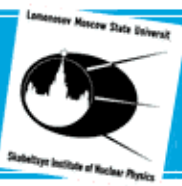
Instruments

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

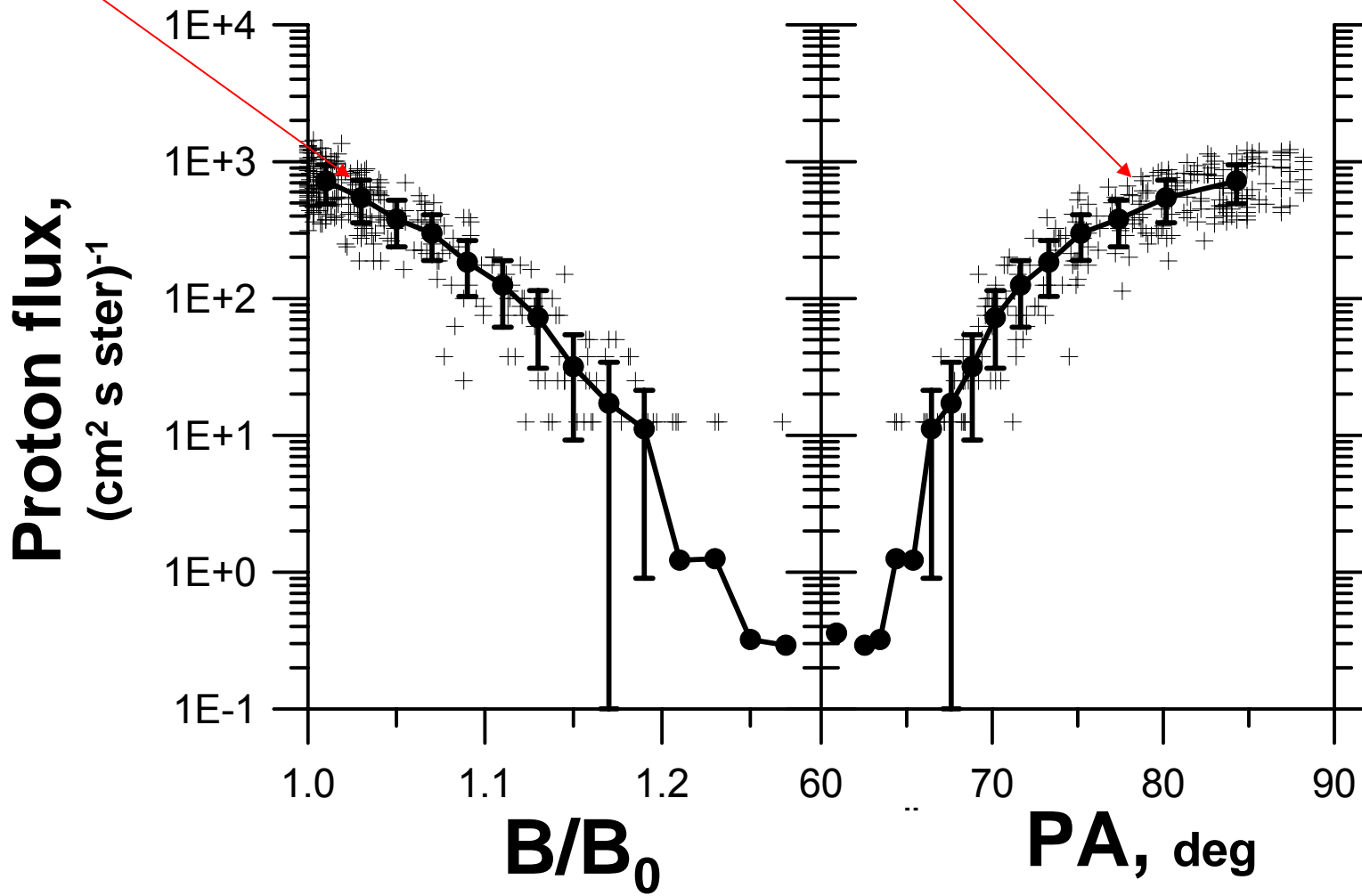


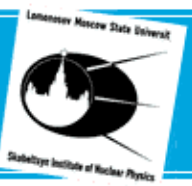
Data processing

$$F_L^{(\text{exp})}(B/B_0) = N_L(B/B_0)/G$$

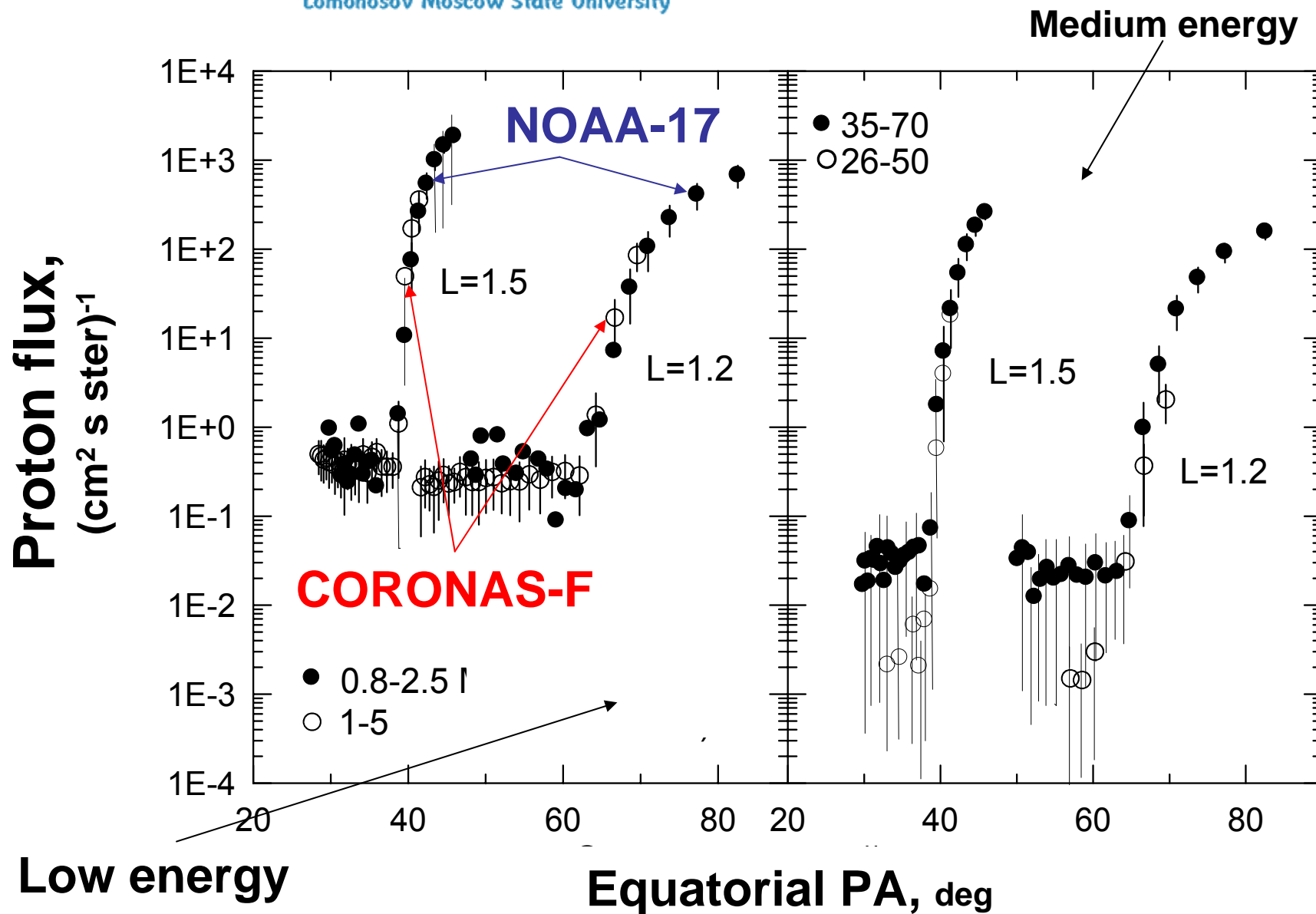
$$F_L^{(\text{exp})}(\alpha)$$

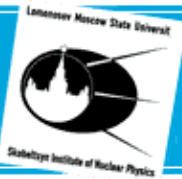
$$\sin^2(\alpha_B)/B = \sin^2(\alpha_0)/B_0$$





Data comparison





Data analysis procedure

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

Count rate of the detector

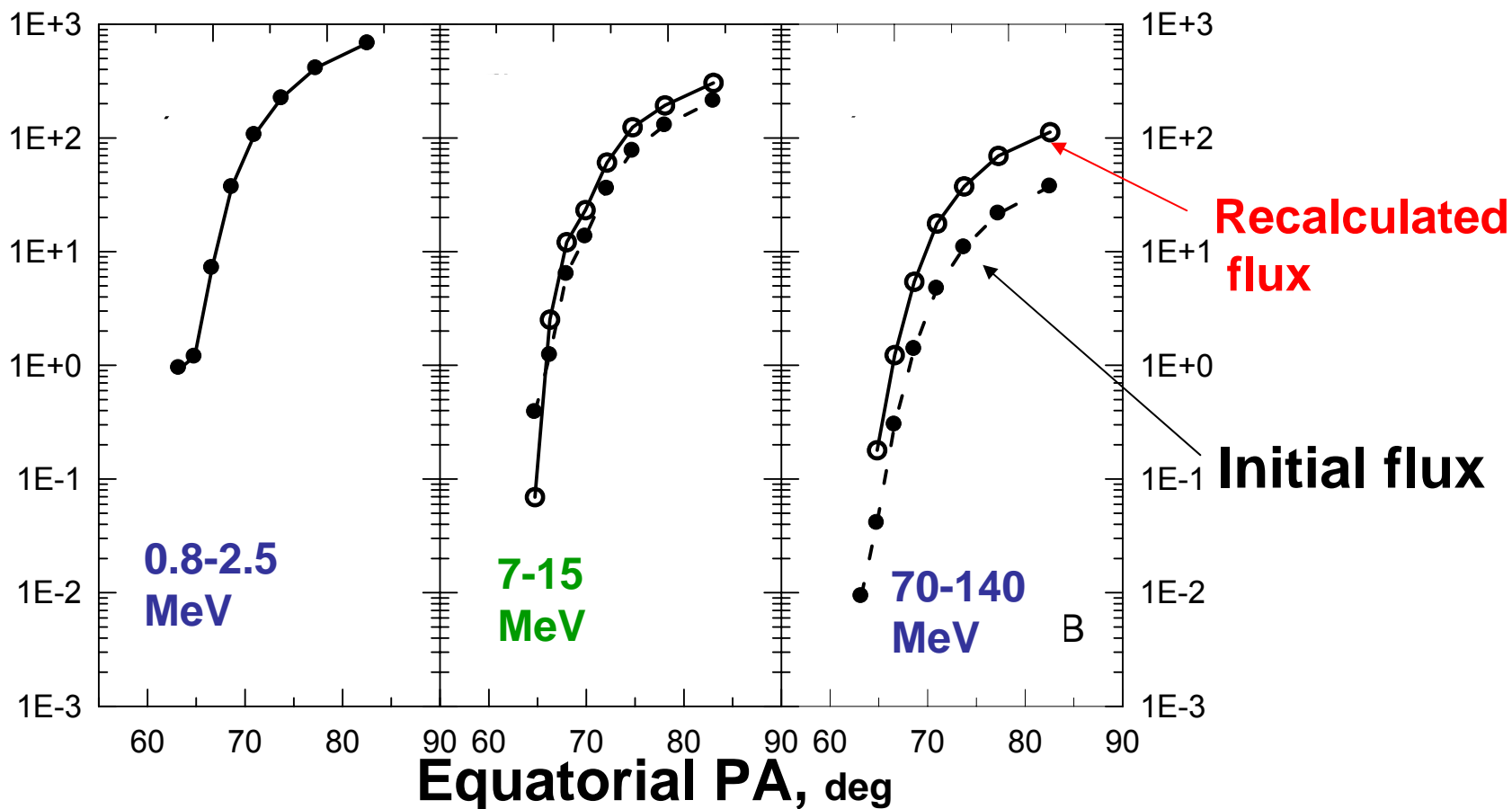
$$\cos \theta = \sin \alpha \cdot \cos \Phi$$

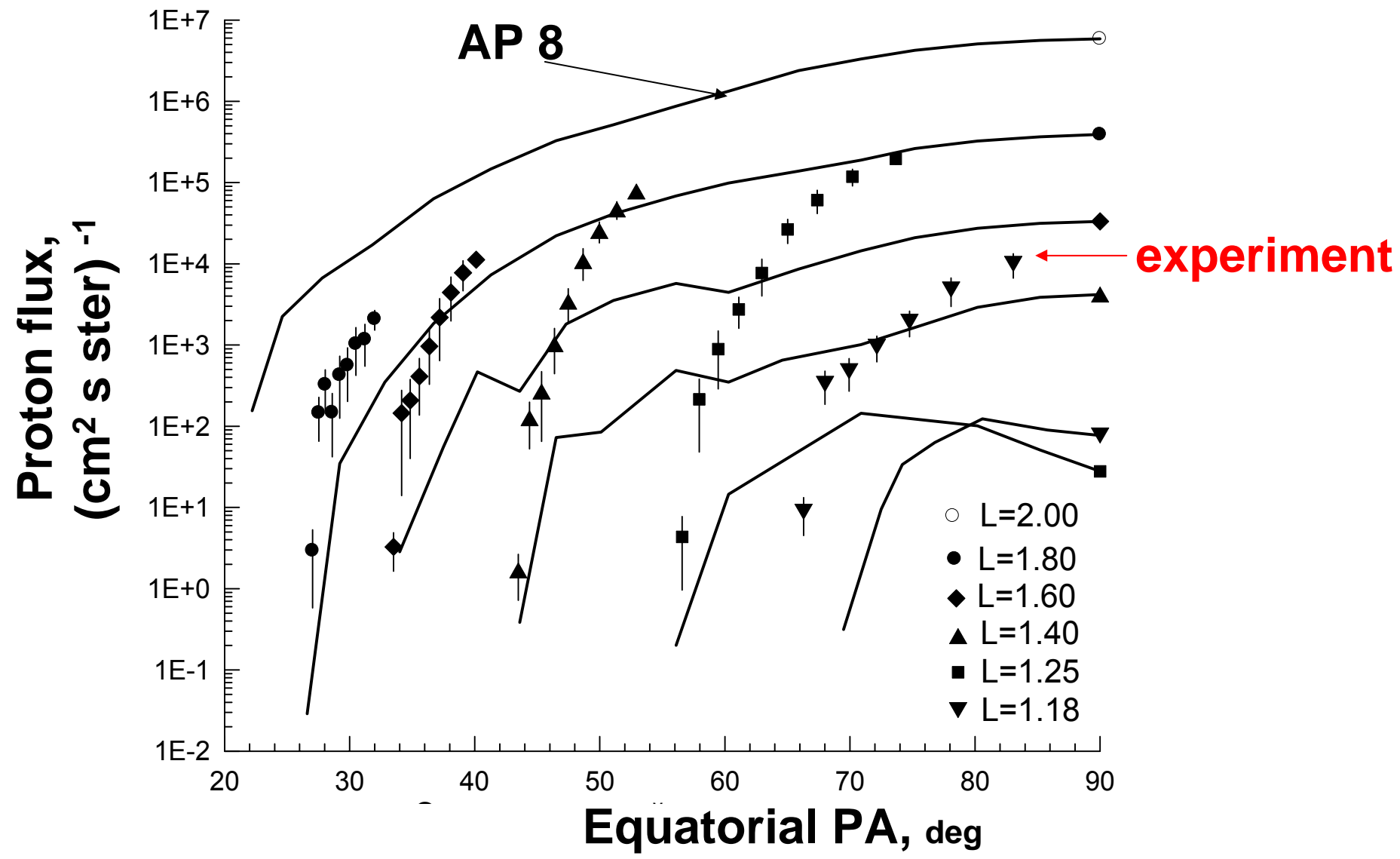
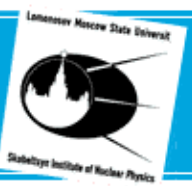
NOAA-17

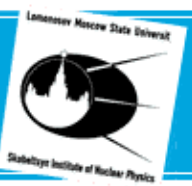
Tatiana

NOAA-17

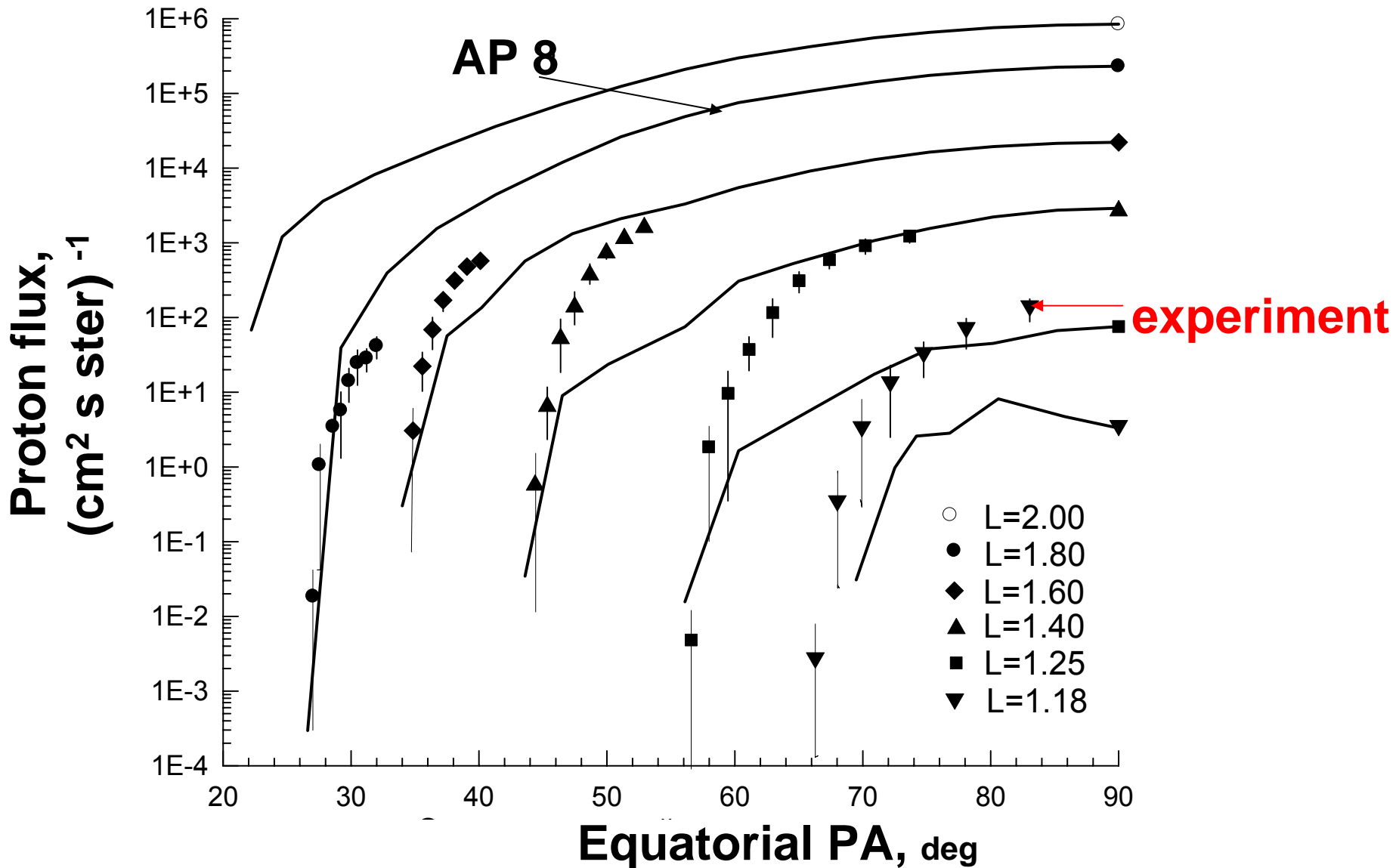
Proton flux,
(cm² s ster)⁻¹

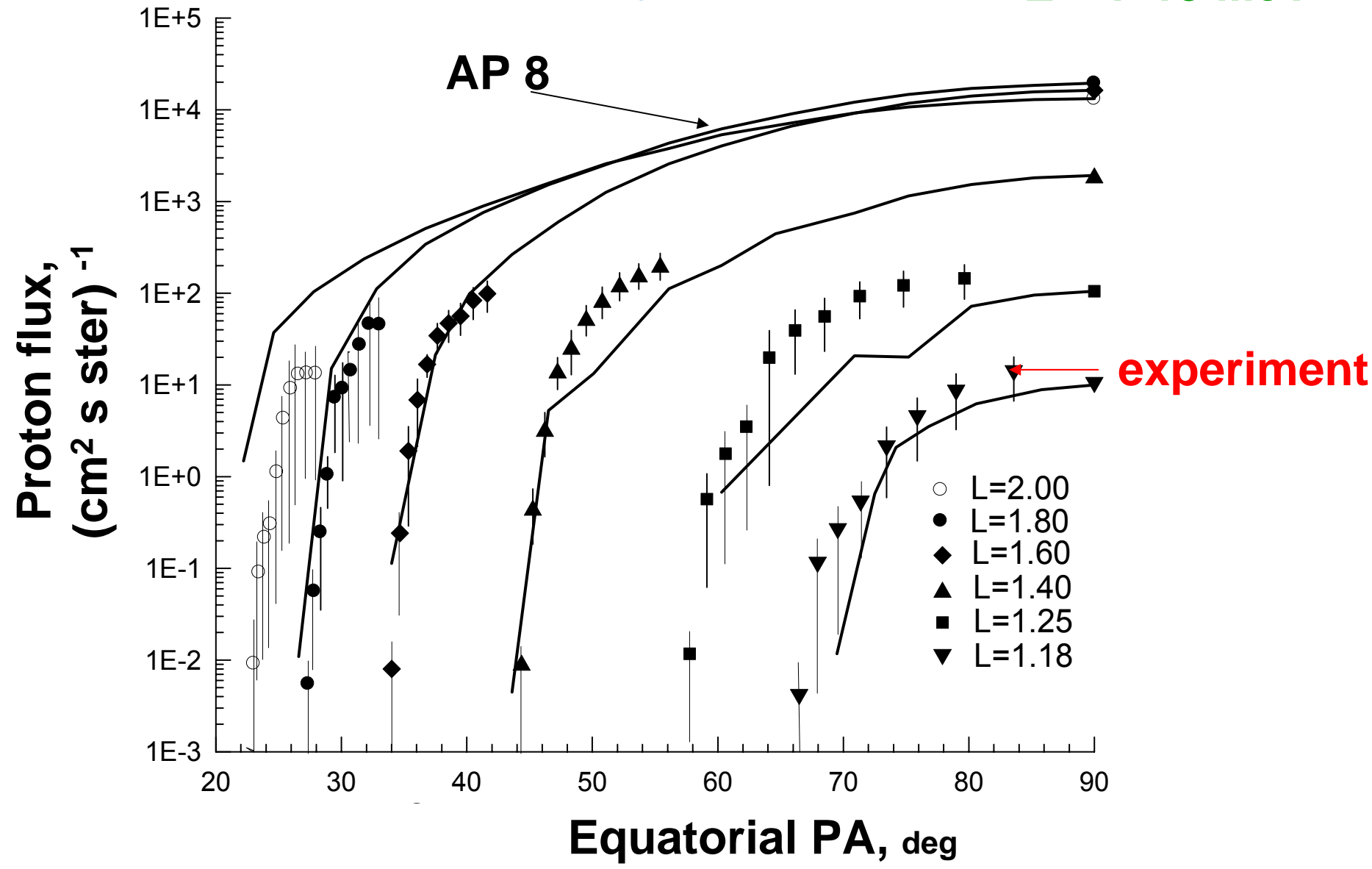
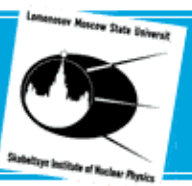


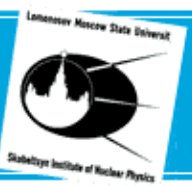




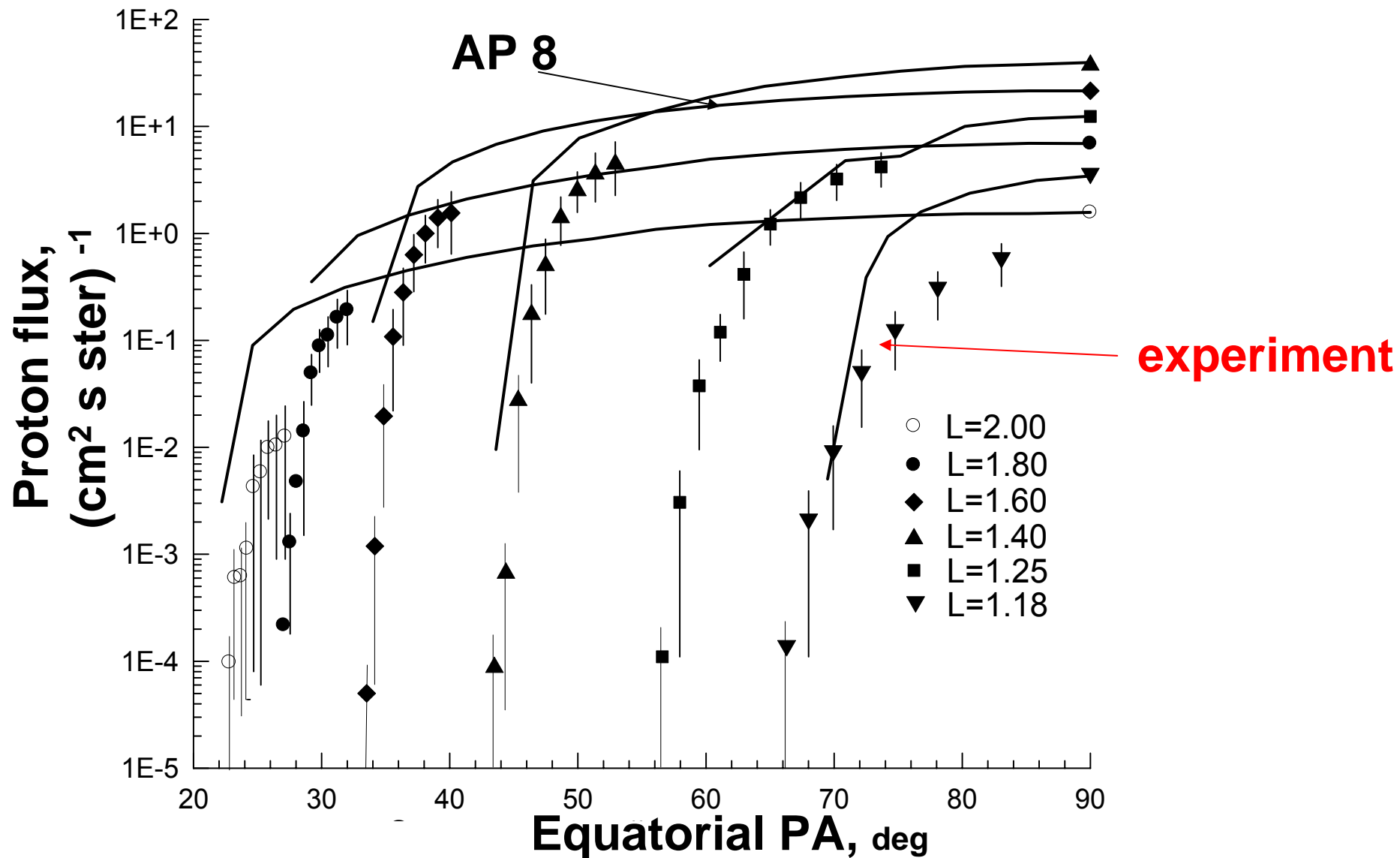
E=0.80-2.5 MeV







E = 70-140 MeV



Data description

($L=1.14 \div \sim 1.4$, $E=30\text{keV} \div 140 \text{ MeV}$)

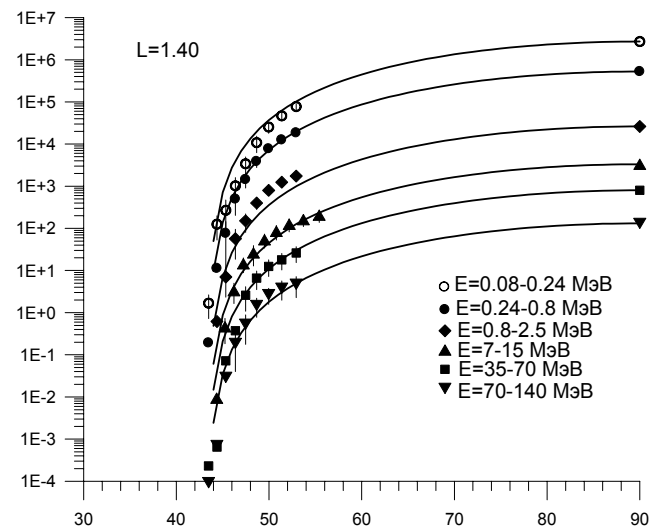
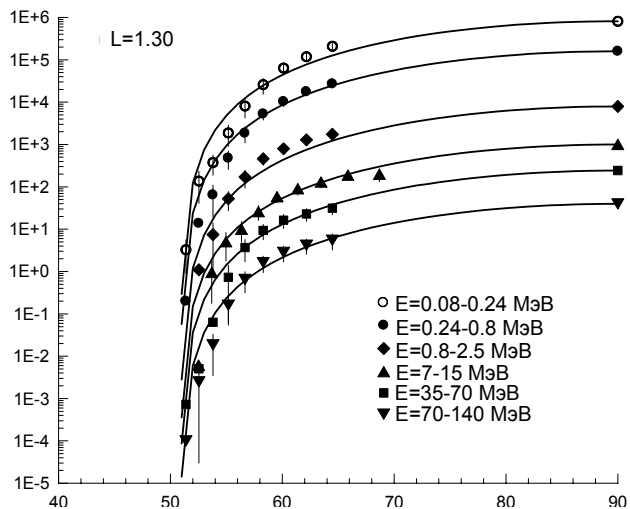
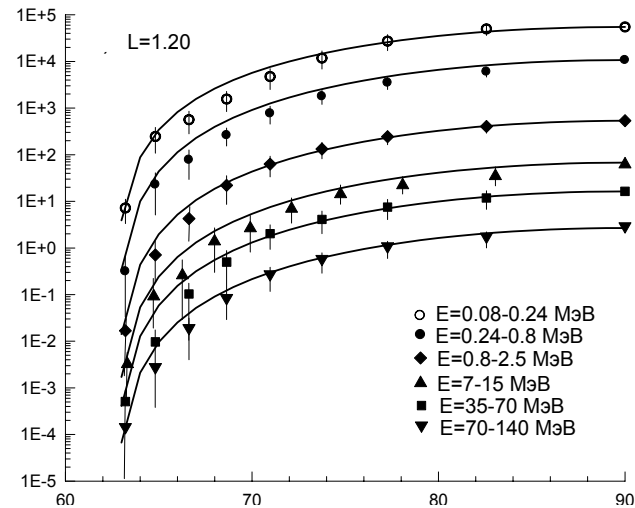
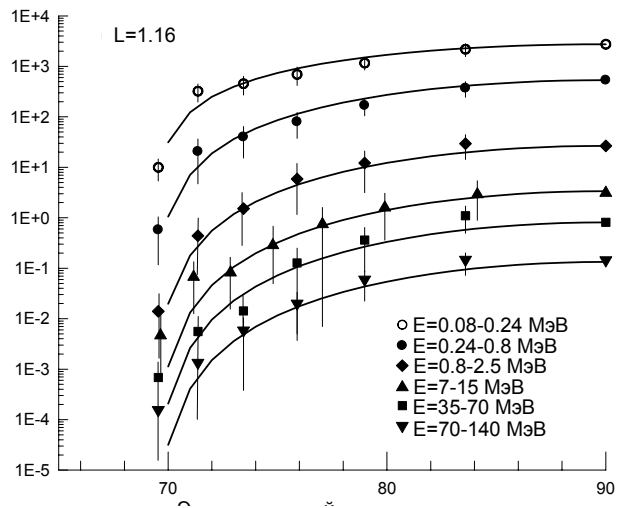
$$j_{E,L}(\alpha_0) = j_{\perp}(E, L) \cdot \sin^k \left(\alpha_0 - \chi \cdot \alpha_0^{(con)}(L) \right)$$

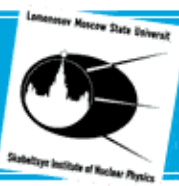
$$j_{\perp}(E, L) = \left(\frac{1}{A_l(E)} + \frac{1}{A_h(E)} \right) \cdot \exp \left(75(L-1) \left(\frac{1.2}{L} \right)^{\delta} \right)$$

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

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

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