GALACTIC COSMIC RADIATION MODEL

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- FOR SPACE STATION, ONE NEEDS FREE SPACE MODELS OF :

(1) GALACTIC COSMIC RADIATION
(2) DYNAMIC TRAPPED BELT MODELS
(3) SOLAR PARTICLE EVENTS
(4) DYNAMIC GEOMAGNETIC TRANSMISSION MODEL
(5) RADIATION TRANSPORT MODEL(S)
(6) SPACECRAFT MASS SHIELDING MODEL
(7) COMPUTERIZED ANATOMICAL MODELS

- EACH IS A SUBJECT BY ITSELF AND WILL BE DISCUSSED SEPERATELY.

- THIS IS A QUICK OVERVIEW OF JUST THE GCR MODEL.

- DURING THE STS-91 FLIGHT, THE ALPHA MAGNETIC SPECTROMETER WAS FLOWN IN THE CARGO BAY OF THE SHUTTLE.

- STS-91 FLIGHT WAS IN AN ORBIT RATHER SIMILAR TO THE ORBIT OF THE ISS.

- THE SPECTROMETER HAS PROVIDED EXCELLENT DATA ON PROTONS, HELIUM, AND CARBON NUCLEI.

- A VERY BRIEF COMPARISON OF OUR GCR MODEL IS GIVEN WITH THE AMS HELIUM DATA.

- THE HELIUM DIFFERENTIAL ENERGY SPECTRUM DATA WERE MEASURED IN 0.1 RADIAN MAGNETIC LATITUDE INTERVALS.

- THIS DATA ALLOWS ONE TO CHECK BOTH THE FREE SPACE GCR HELIUM MODEL, AND THE GEOMAGNETIC TRANSMISSION FUNCTIONS.

- THE GEOMAGNETIC TRANSMISSION FUNCTION WAS CALCULATED USING THE GEOMAG3 PROGRAM FROM THE *CRÈME* CODE, AND GEOMAGNETIC RIGIDIGY CUTOFFS FROM SHEA AND SMART MODEL, USING THE DGRF1990 (EPOCH 1990) GEOMAGNETIC FIELD MODEL FOR K_P=0.

- CUTOFF SCALED TO THE 400 km ISS ALTITUDE USING

$$P_c\ (400\ \text{km}) = P_c\ (450\ \text{km}) \times [L^2\ (450\ \text{km})/L^2\ (400\ \text{km})]$$

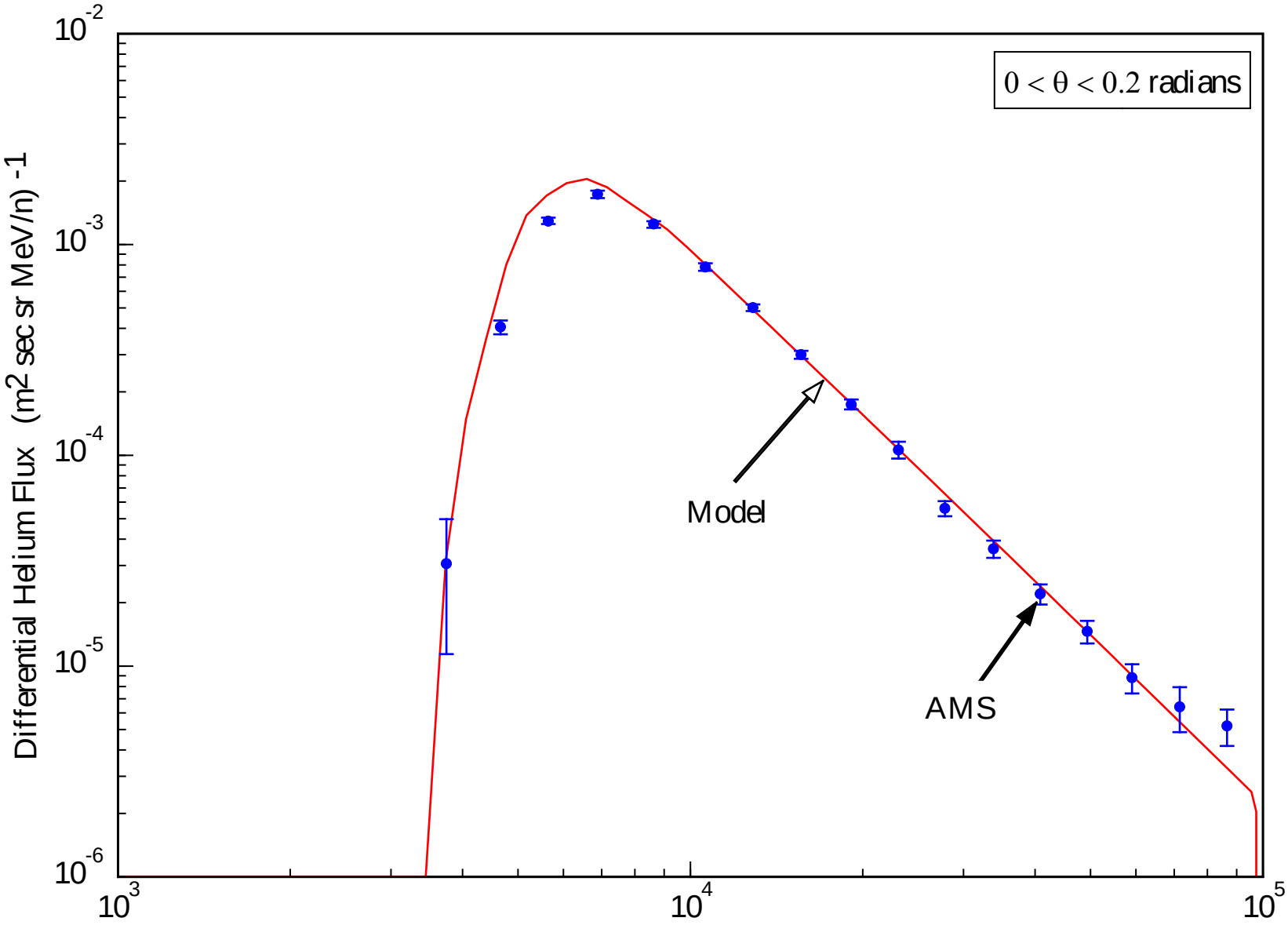
- THERE IS VERY GOOD AGREEMENT (BETTER THAN 7%) BETWEEN THE MODEL PREDICTIONS AND AMS DATA AT HIGHER ENERGIES.

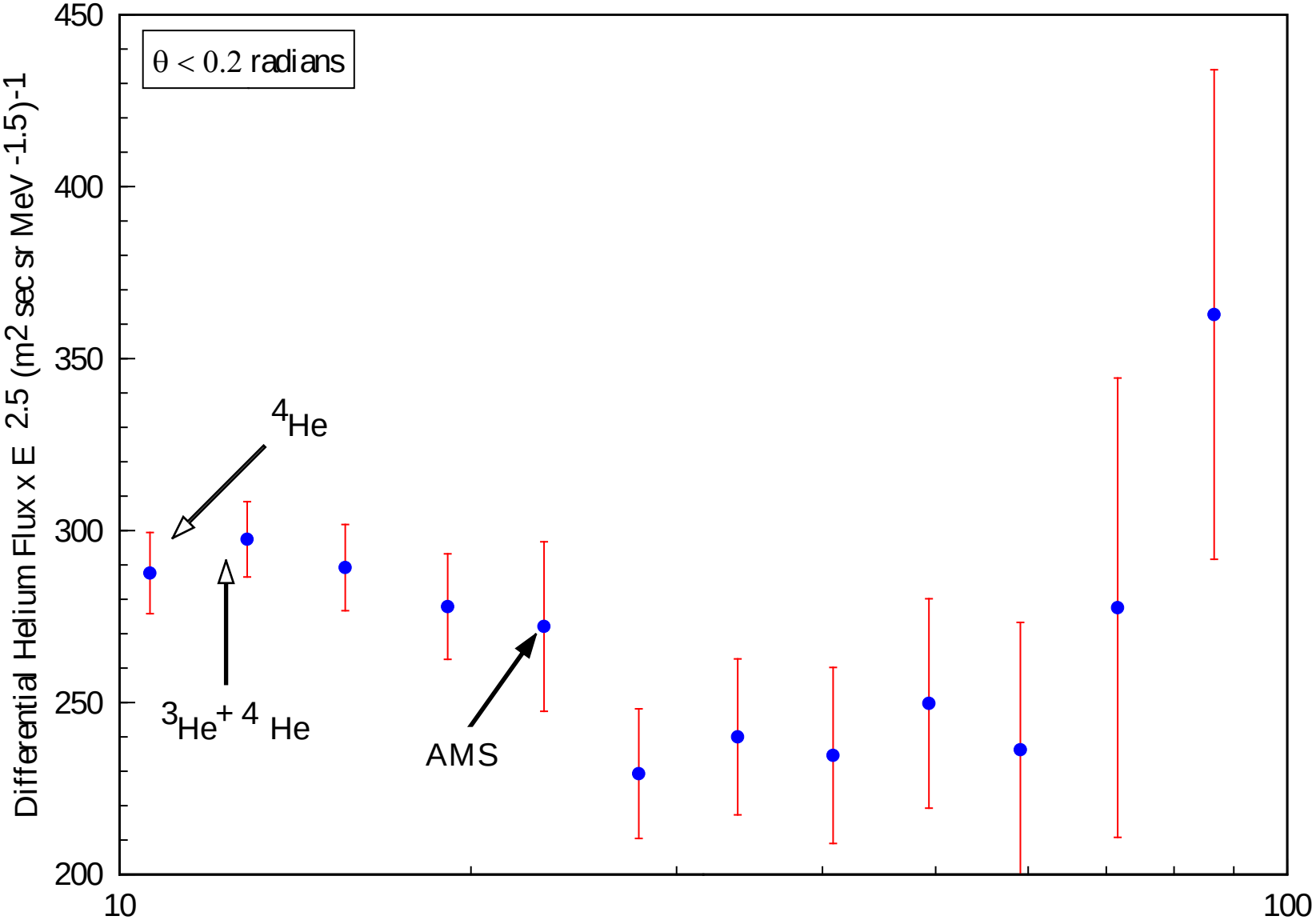
- IN ORDER TO GET REASONABLE AGREEMENT BETWEEN THE GEOMAGNETICALLY TRANSMISSED SPECTRUM AND MEASUREMENTS, IT WAS NECESSARY TO SEPARATE OUT THE FREE SPACE SPECTRUM INTO SEPARATE ^{3}He AND ^{4}He COMPONENTS AND TRANSMIT THEM SEPARATELY THROUGH THE CUTOFF CODES.

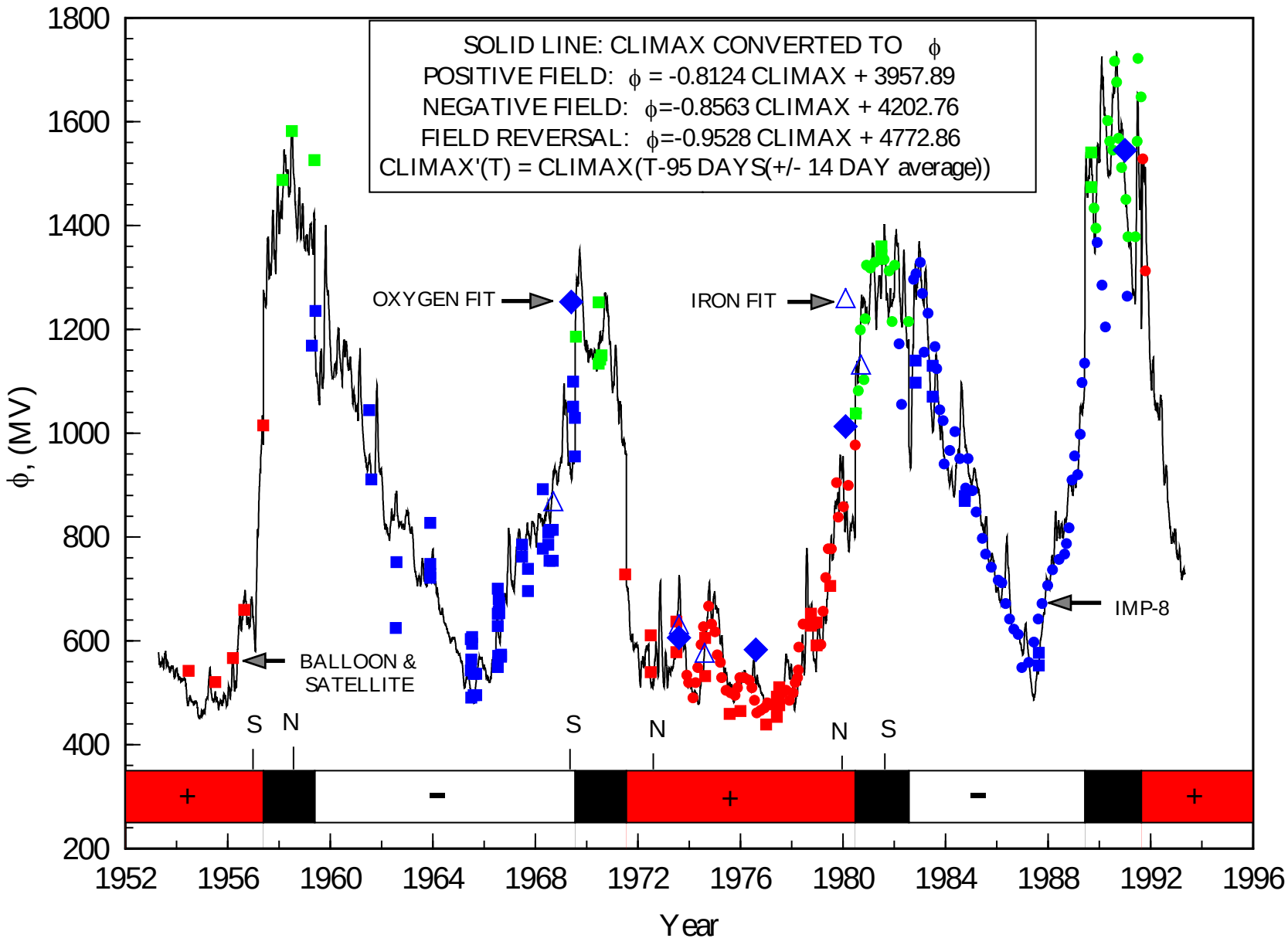
- THE ^{3}He/^{4}He RATIO IS A STRONG FUNCTION OF ENERGY THAT PEAKS IN FEW GeV/n REGION, AND IS A FUNCTION OF SOLAR MODULATION. THUS, IT IS NECESSARY TO TAKE THIS INTO ACCOUNT WHEN DOING RADIATION TRANSPORT CALCULATIONS.

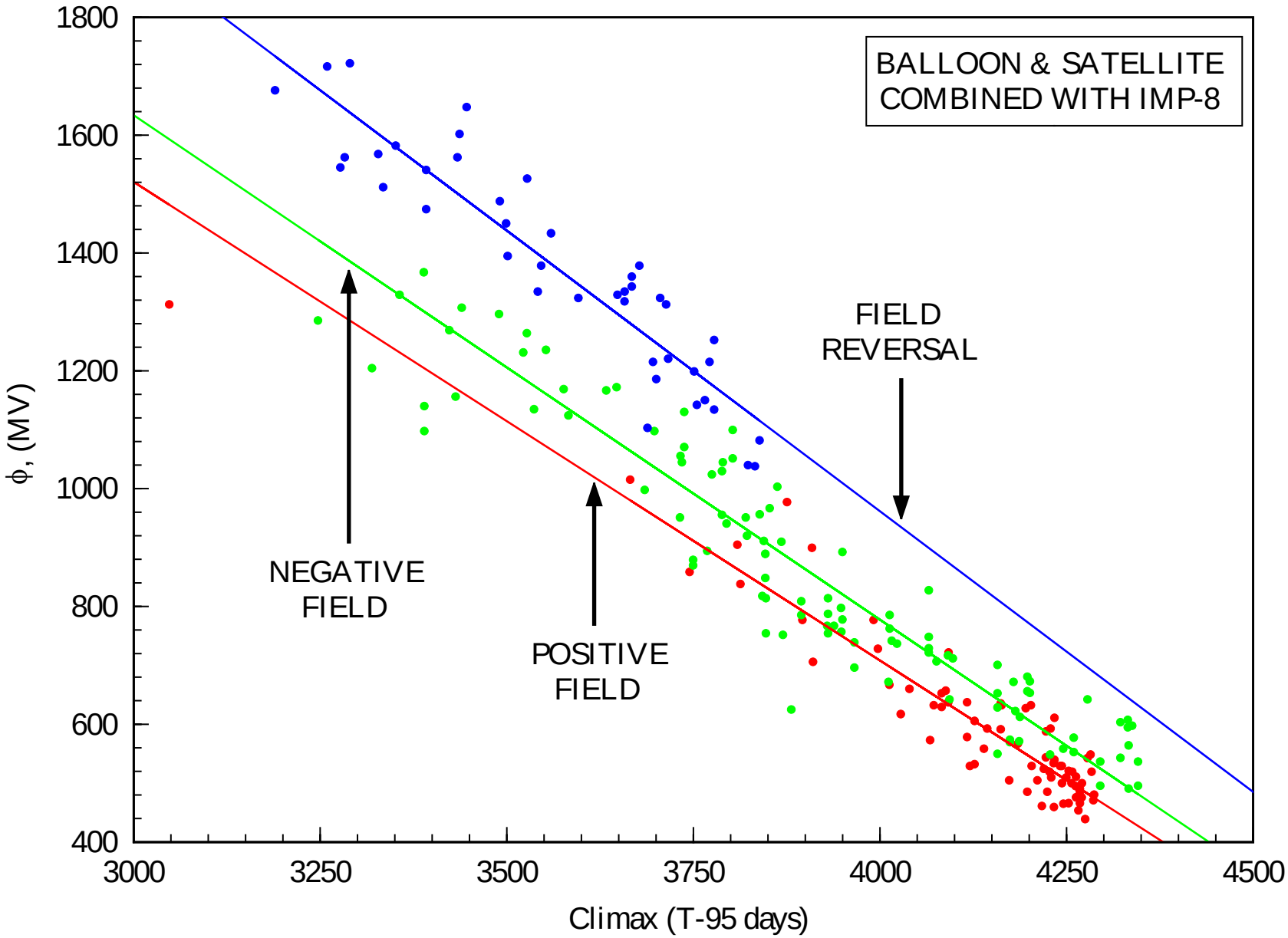
- THE DEFAULT MODE OF *GEOMAG3* CODE EITHER UNDERESTIMATES THE TRANSMISSION OR HAS MUCH SHARPER FALL OFF NEAR THE STORMER CUTOFF (PROBLEM OF NOT FULLY SAMPLING THE CUTOFF GRID).

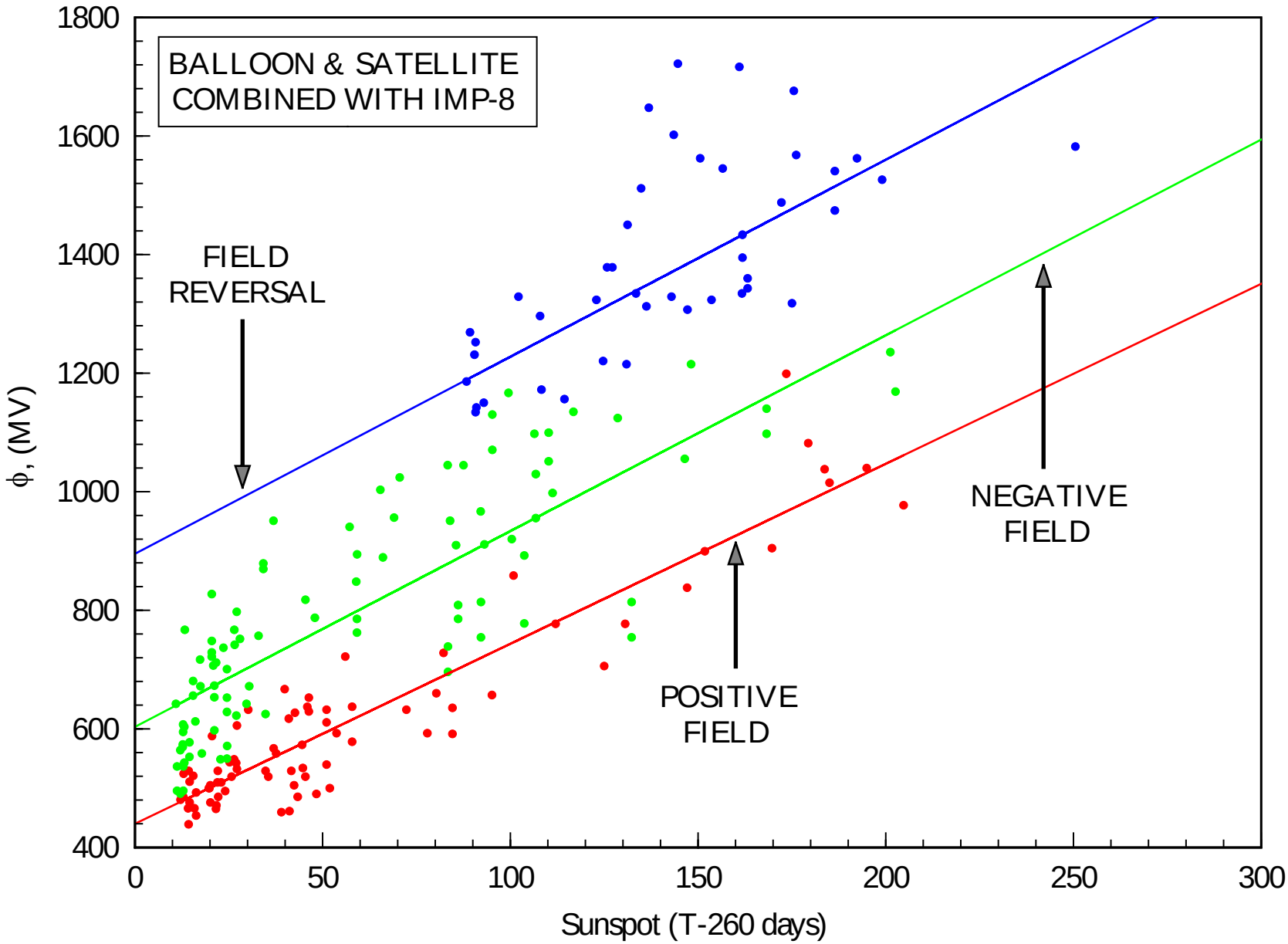
- THE MODEL CONSISTANTLY OVERESTIMATES THE TRANSMISSION PROBABILITY. A SLIGHT SHIFT IN THE OFF-CENTER DIPOLE AXIS IS NEEDED TO BRING THE OBSERVATIONS IN TO GOOD AGREEMENT WITH THE MODEL.

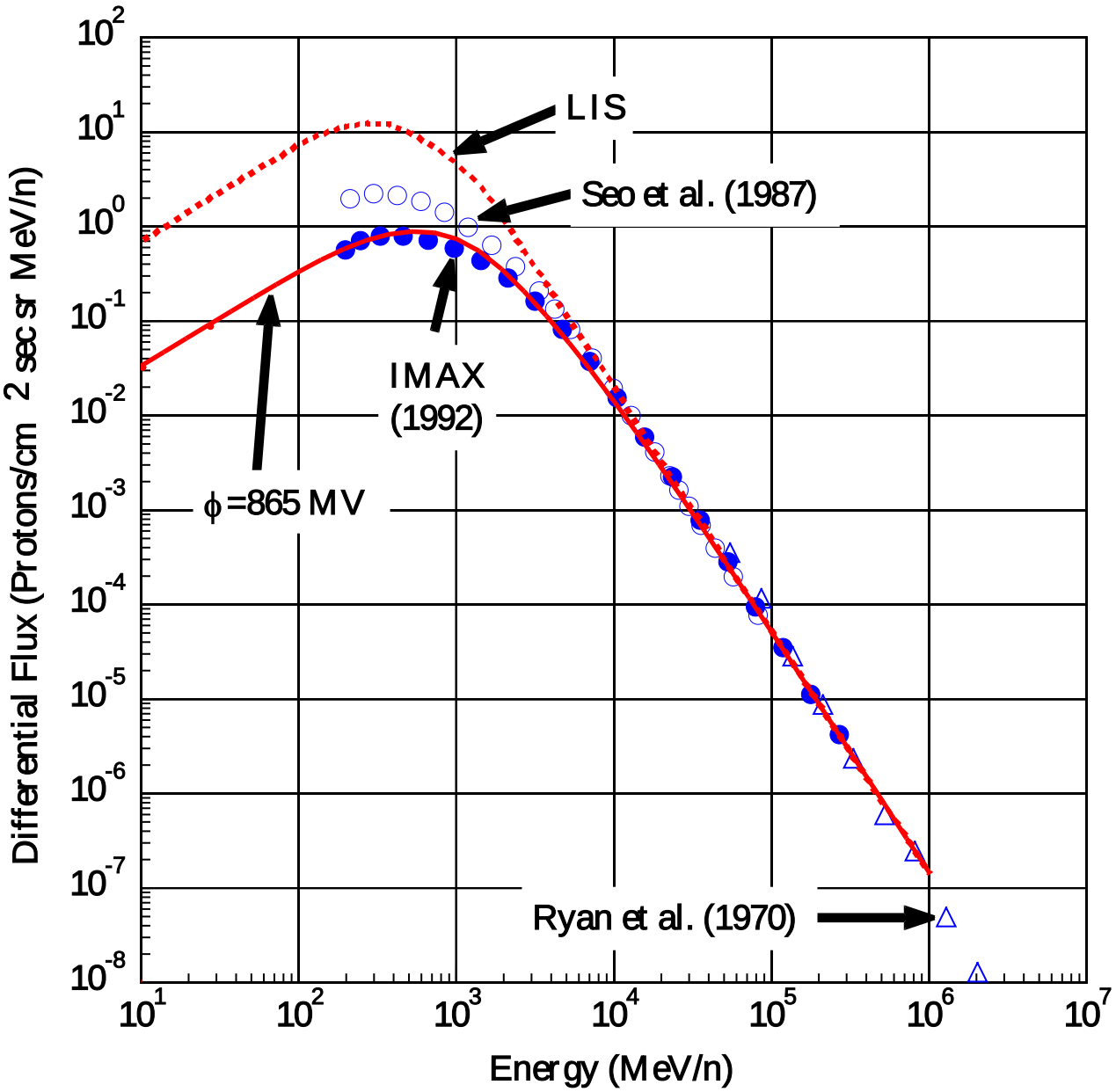

$0 < \theta < 0.2$ radians
Differential Helium Flux (m2 sec sr MeV/n) -1
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{3}
10^{4}
10^{5}
Model
AMS

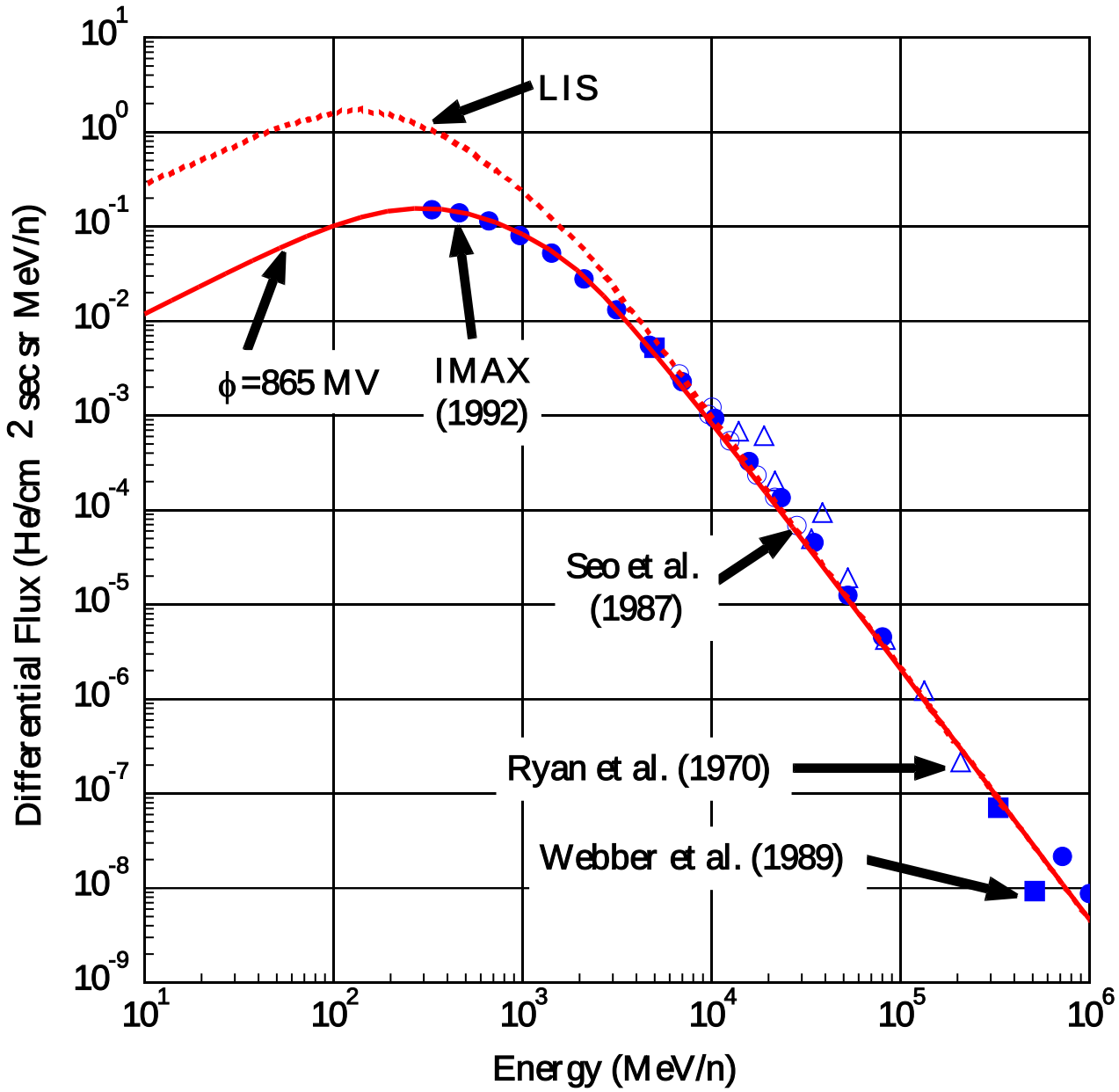

θ < 0.2 radians
Differential Helium Flux x E 2.5 (m2 sec sr MeV -1.5)-1
450
400
350
300
250
200
10
100
4He
3He+ 4 He
AMS


SOLID LINE: CLIMAX CONVERTED TO ϕ
POSITIVE FIELD: ϕ = -0.8124 CLIMAX + 3957.89
NEGATIVE FIELD: ϕ=-0.8563 CLIMAX + 4202.76
FIELD REVERSAL: ϕ=-0.9528 CLIMAX + 4772.86
CLIMAX'(T) = CLIMAX(T-95 DAYS(+/- 14 DAY average))
OXYGEN FIT
IRON FIT
IMP-8
BALLOON & SATELLITE
S
N
S
N
N
S
+
-
+
-
+
ϕ, (MV)
Year
1800
1600
1400
1200
1000
800
600
400
200
1952
1956
1960
1964
1968
1972
1976
1980
1984
1988
1992
1996


BALLOON & SATELLITE
COMBINED WITH IMP-8
FIELD
REVERSAL
NEGATIVE
FIELD
POSITIVE
FIELD
ϕ, (MV)
Climax (T-95 days)
1800
1600
1400
1200
1000
800
600
400
3000
3250
3500
3750
4000
4250
4500


BALLOON & SATELLITE
COMBINED WITH IMP-8
FIELD
REVERSAL
NEGATIVE
FIELD
POSITIVE
FIELD
φ, (MV)
Sunspot (T-260 days)
1800
1600
1400
1200
1000
800
600
400
0
50
100
150
200
250
300


LIS
Seo et al. (1987)
IMAX
(1992)
ϕ=865 MV
Ryan et al. (1970)
Differential Flux (Protons/cm 2 sec sr MeV/n)
Energy (MeV/n)
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
10^1
10^2
10^3
10^4
10^5
10^6
10^7


LIS
ϕ=865 MV
IMAX
(1992)
Seo et al.
(1987)
Ryan et al. (1970)
Webber et al. (1989)
Differential Flux (He/cm 2 sec sr MeV/n)
Energy (MeV/n)
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
10^-9
10^1
10^2
10^3
10^4
10^5
10^6