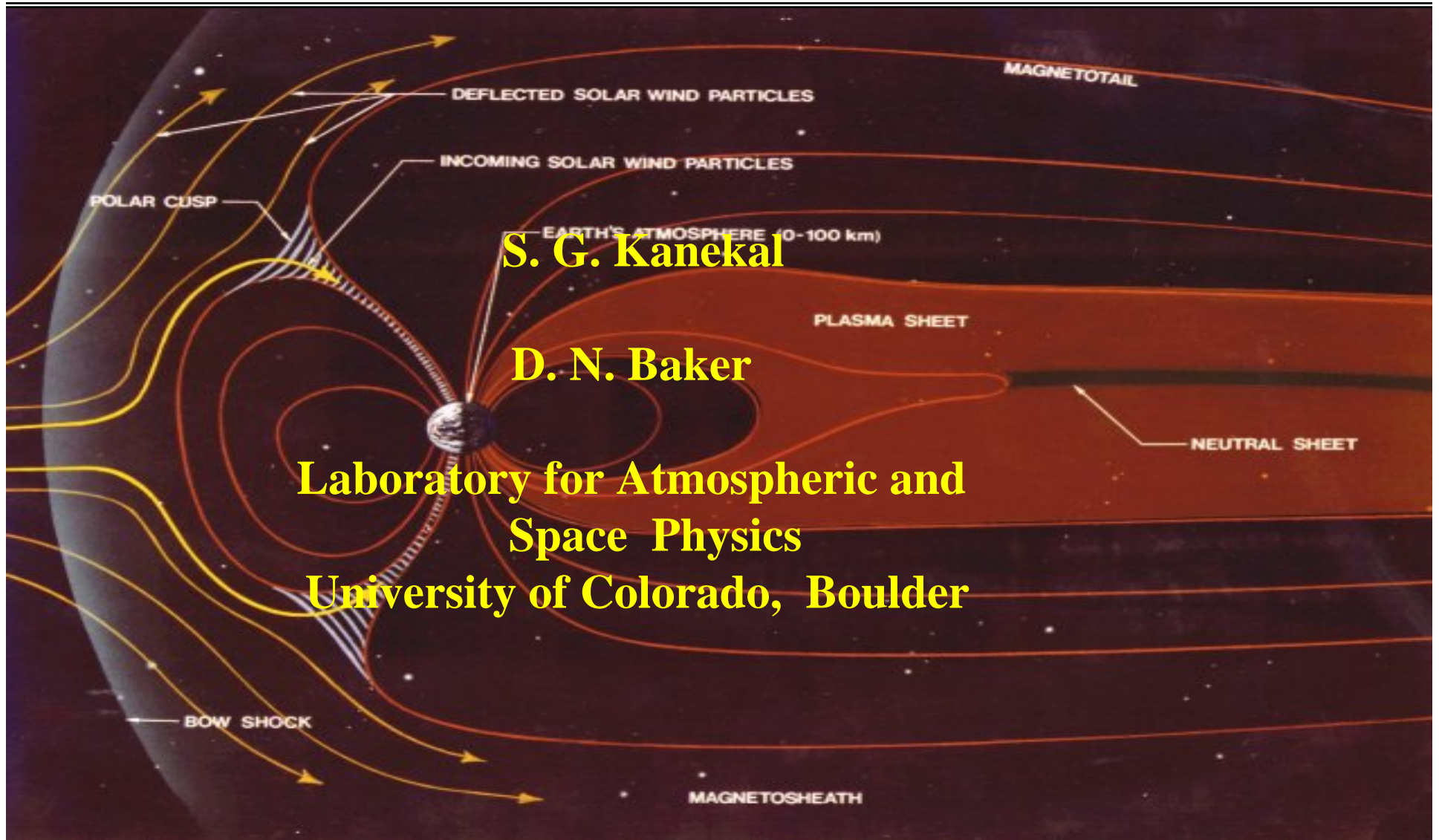


High latitude energetic particle boundaries: The SAMPEX database



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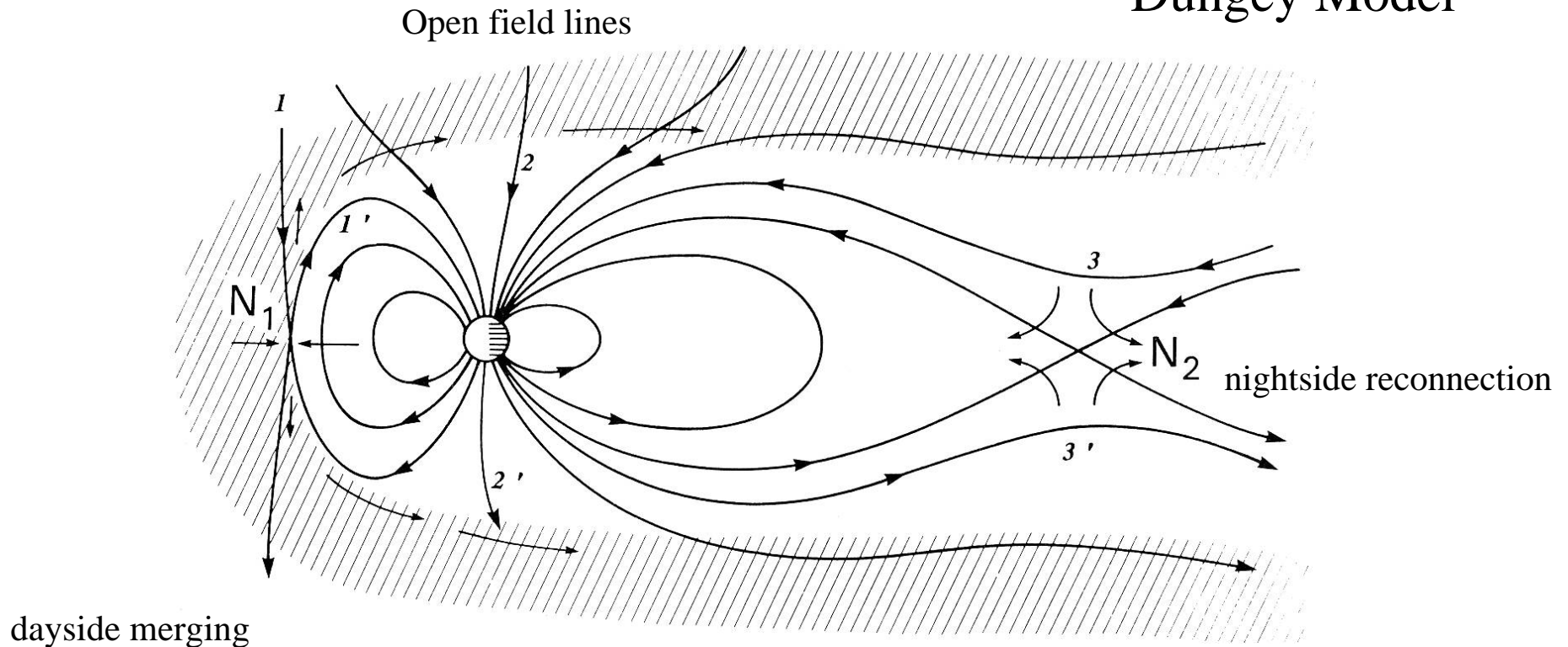
High latitude energetic particle boundaries

- ❖ high latitude energetic electron boundary
related to the open/closed field line boundary
- ❖ dynamics of open field line region (polar cap)
measures the coupling between the solar wind
and the magnetosphere
measures magnetosphere-ionosphere coupling
(e.g., energy storage and release during substorms)
- ❖ Dungey model of the open magnetosphere
open field line region determined by balance between
day side and night side reconnection



Reconnection, polar cap and high latitude energetic particle boundary

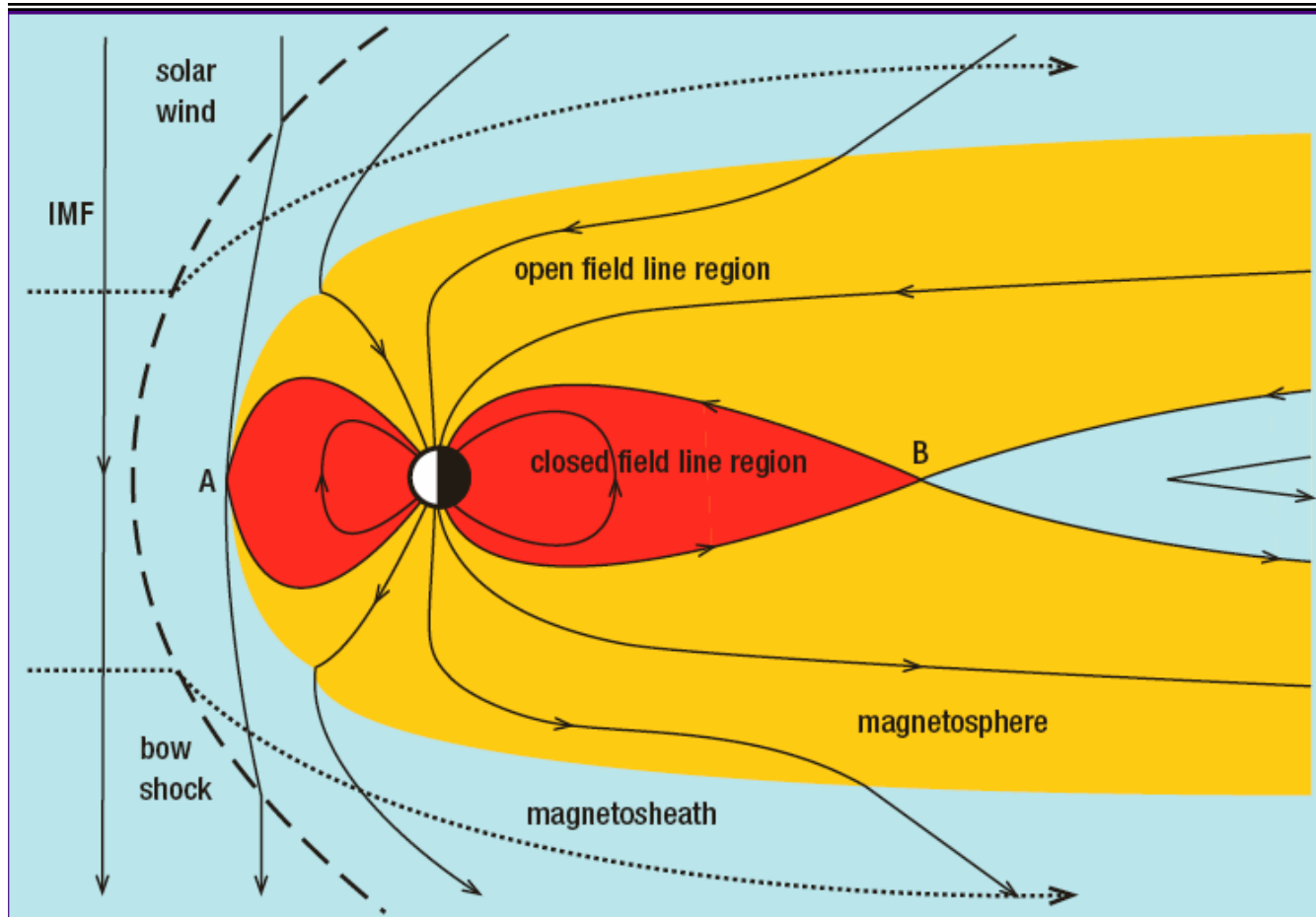
Dungey Model



Polar cap (open field line region) reflects the balance between day side (adds flux) and night side (remove flux) reconnection rates



Open field line region: expanding/contracting polar cap (ECPC)



$$\frac{dF_{PC}}{dt} = \Phi_D - \Phi_N.$$

F_{PC} = open flux in polar cap

Φ_D , Φ_N = day side, night side reconnection rates

e.g., Siscoe and Huang 1985

from - Gareth Chisham, Gary Abel and Steve Mila, *Astron. & Geophys.*, 45, 2004



Open field line region and high latitude energetic particle boundaries

Geomagnetic field determines the motions of charged particles

- ❖ stably trapped - many drifts around the Earth
- ❖ quasi trapped - lost within a drift
- ❖ low energy particles : convection and corotation fields
- ❖ higher energy ($\sim > 30$ keV) gradient and curvature

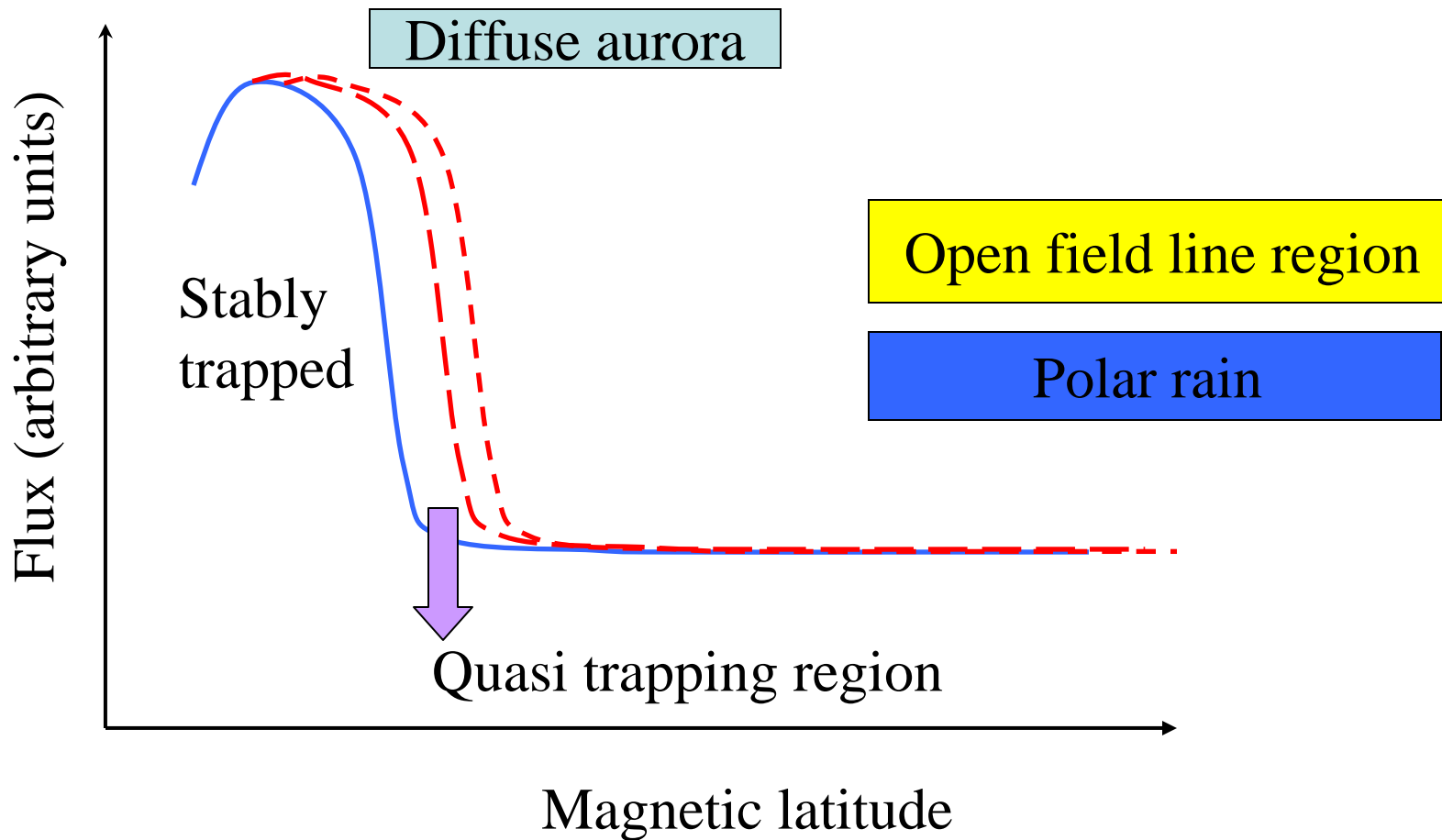
Relation between open field line region and high latitude charged particle boundaries is complex :

- ❖ quasi trapped population
- ❖ energy dependence

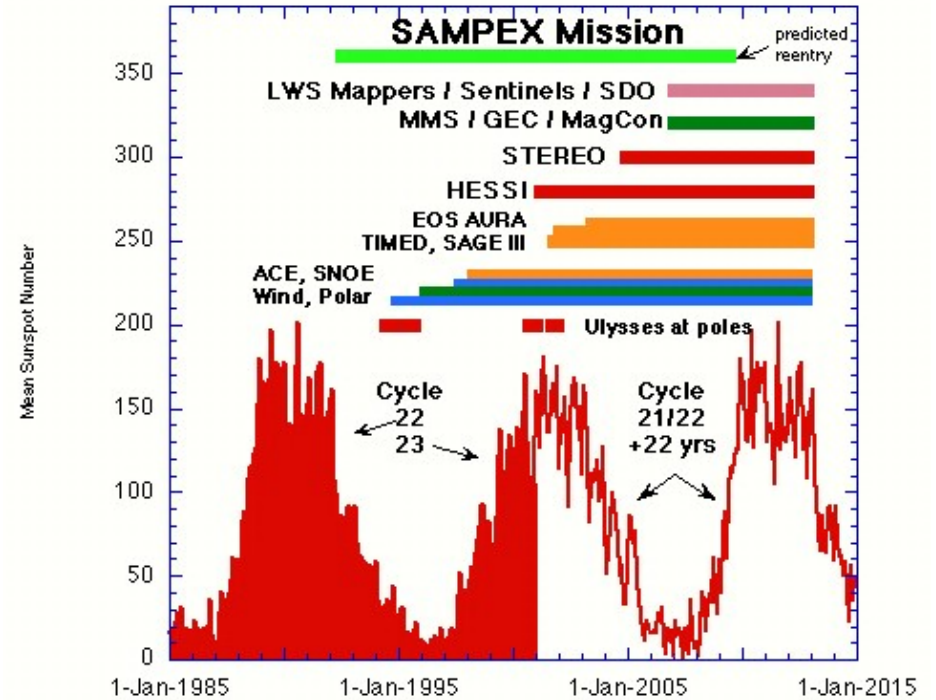
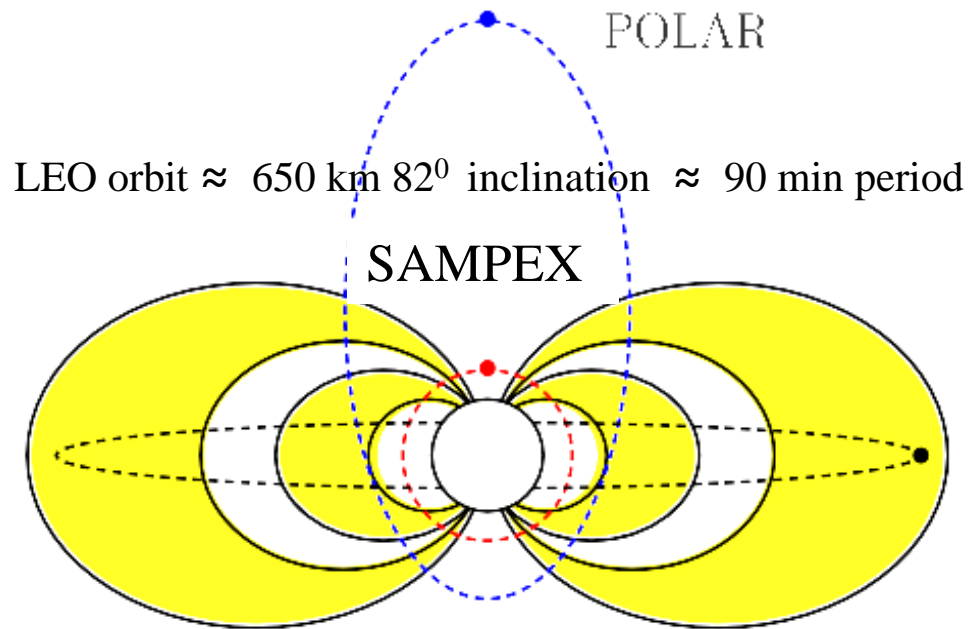
However dynamics high latitude boundary may be expected to reflect dynamics of open field line region



Open field line region and high latitude energetic particle boundaries



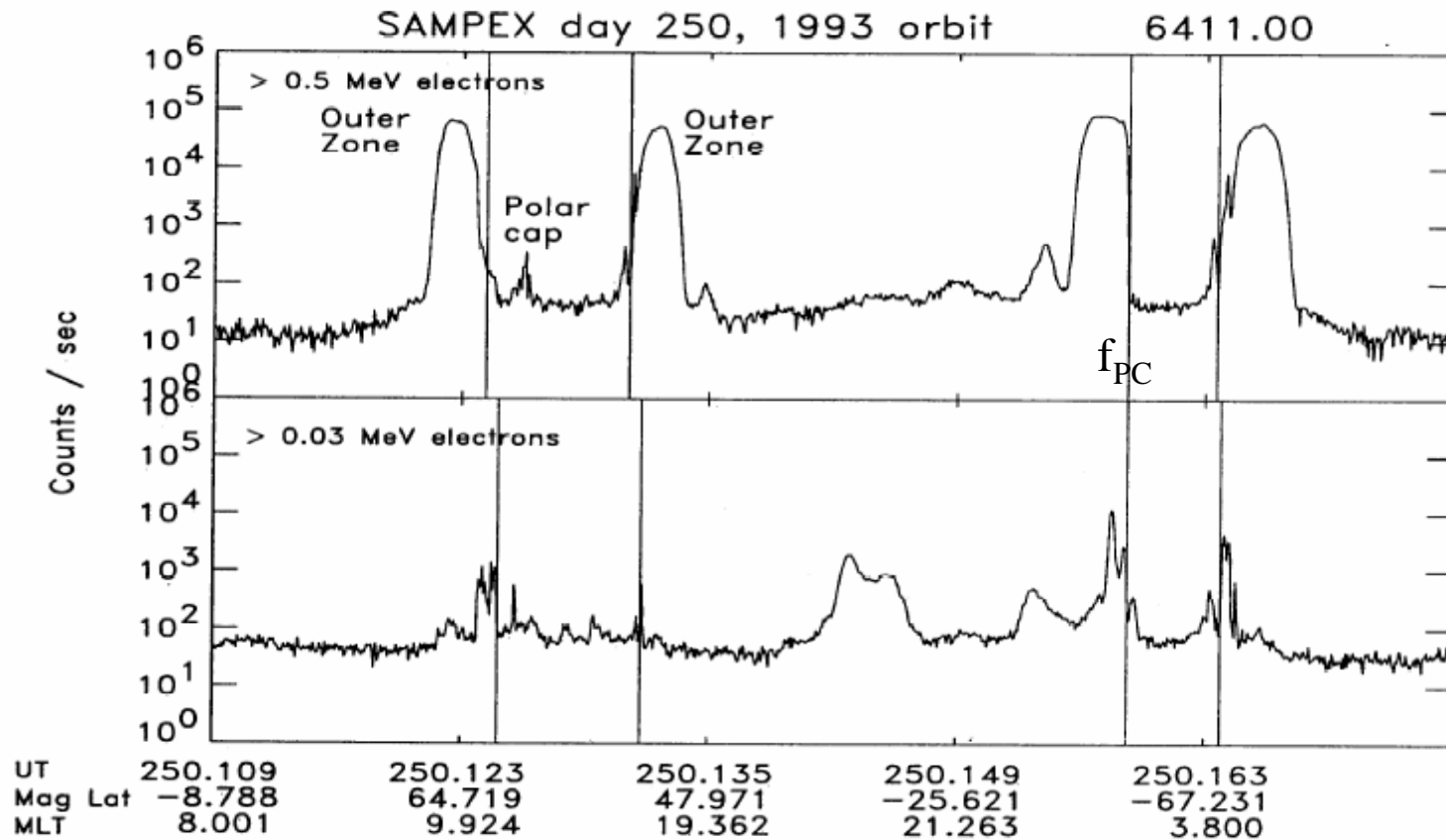
SAMPEX



electron and proton channels: covering energies from ~ 25 KeV to ~ 20 MeV
Four instruments : HILT, LICA, MAST and PET



SAMPEX : orbit data showing radiation belts and the polar cap



High latitude particle boundary location defined as that value of magnetic latitude where $f_{\Lambda} = \text{factor} \times f_{PC}$



QuickTime™ and a
Cinepak decompressor
are needed to see this picture.

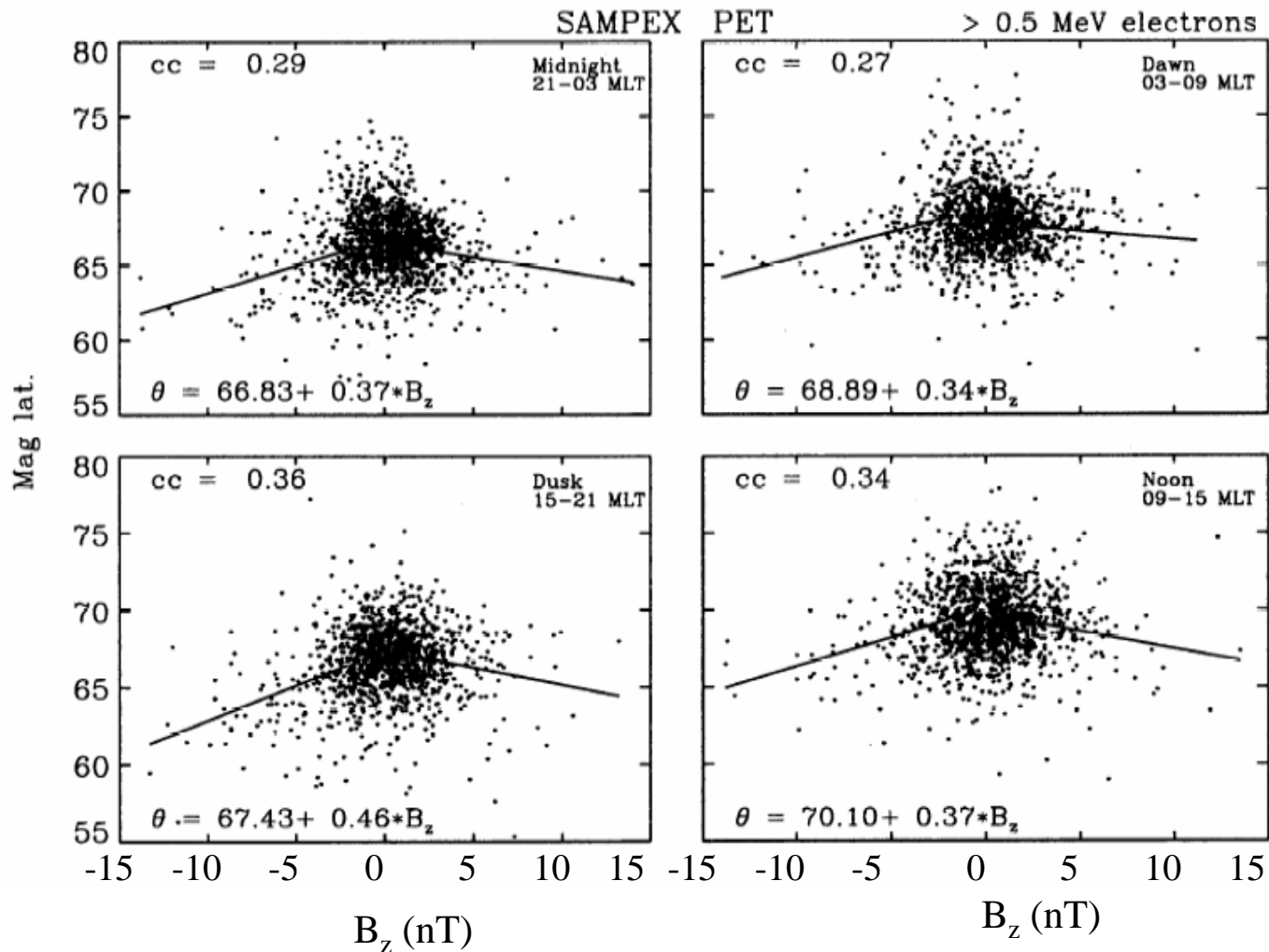
QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.



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High latitude boundary dynamics : IMF B_z dependence



Data period:
Aug/92 - Aug/94

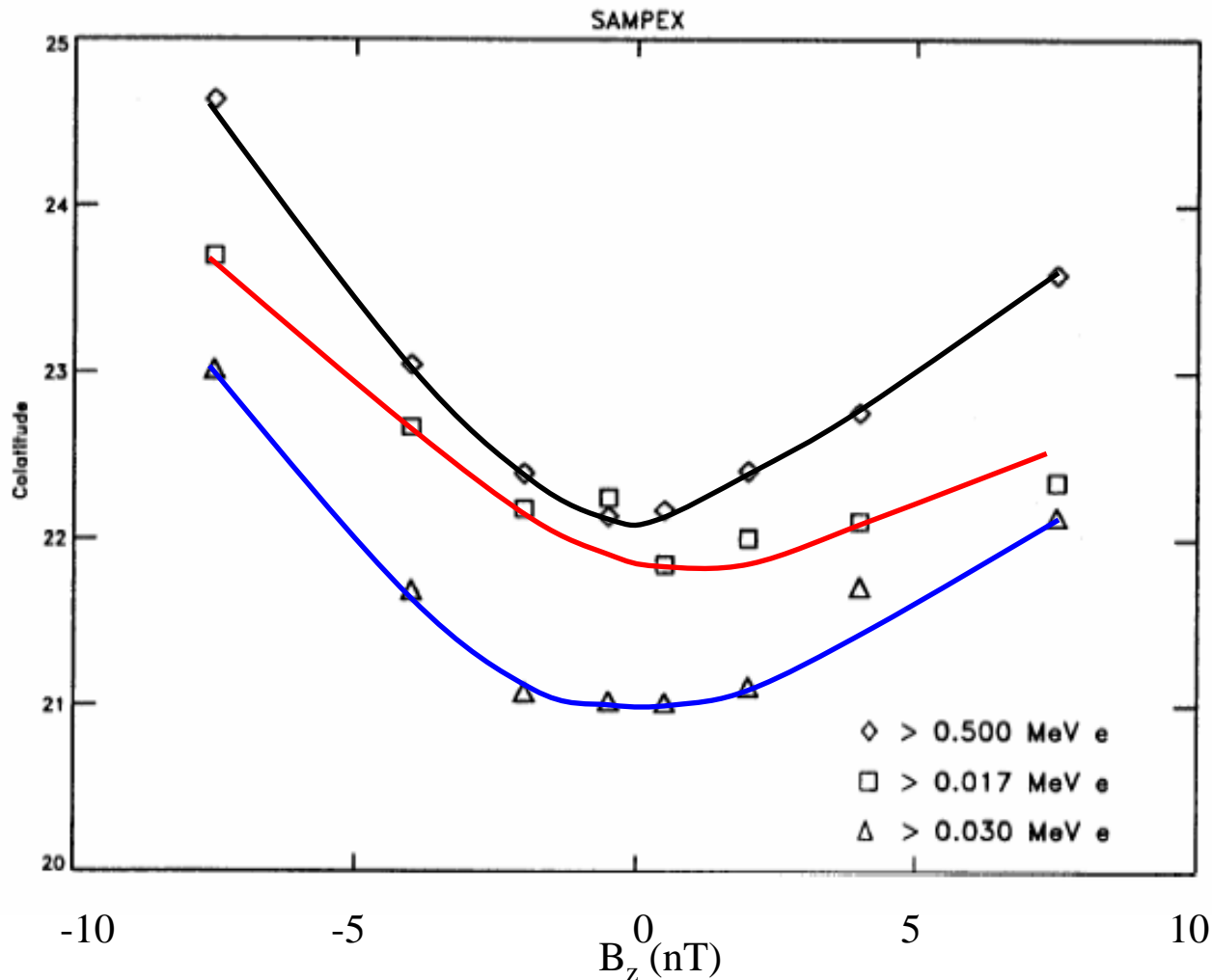
~ 15 orbits/day
2 north crossings
2 south crossings

Least square fits are
for $|B_z| > 2$ nT

Correlations are
statistically significant
at 99% CF
(Spearman and Kendall
tau tests)



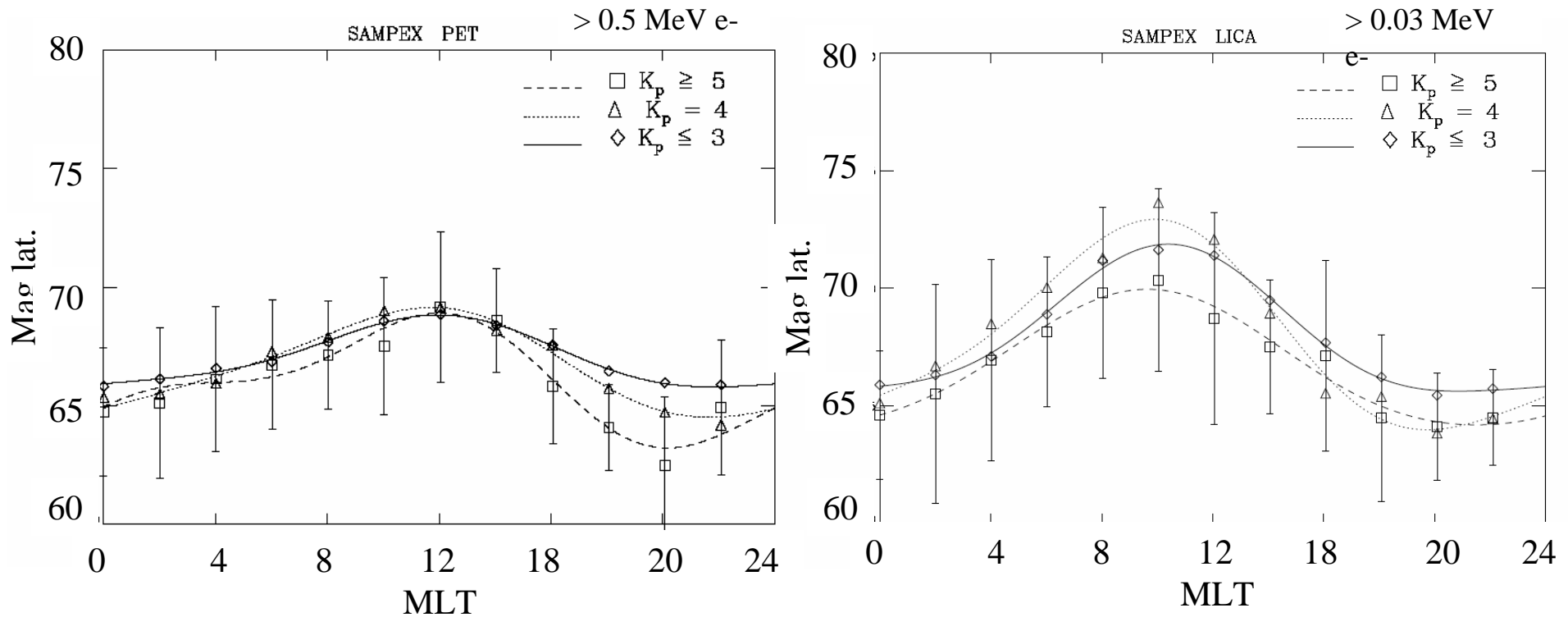
High latitude boundary dynamics : IMF B_z dependence



Note the increase in the “polar cap” size with the increase in the northward B_z component
 \Rightarrow
evidence for high latitude reconnection



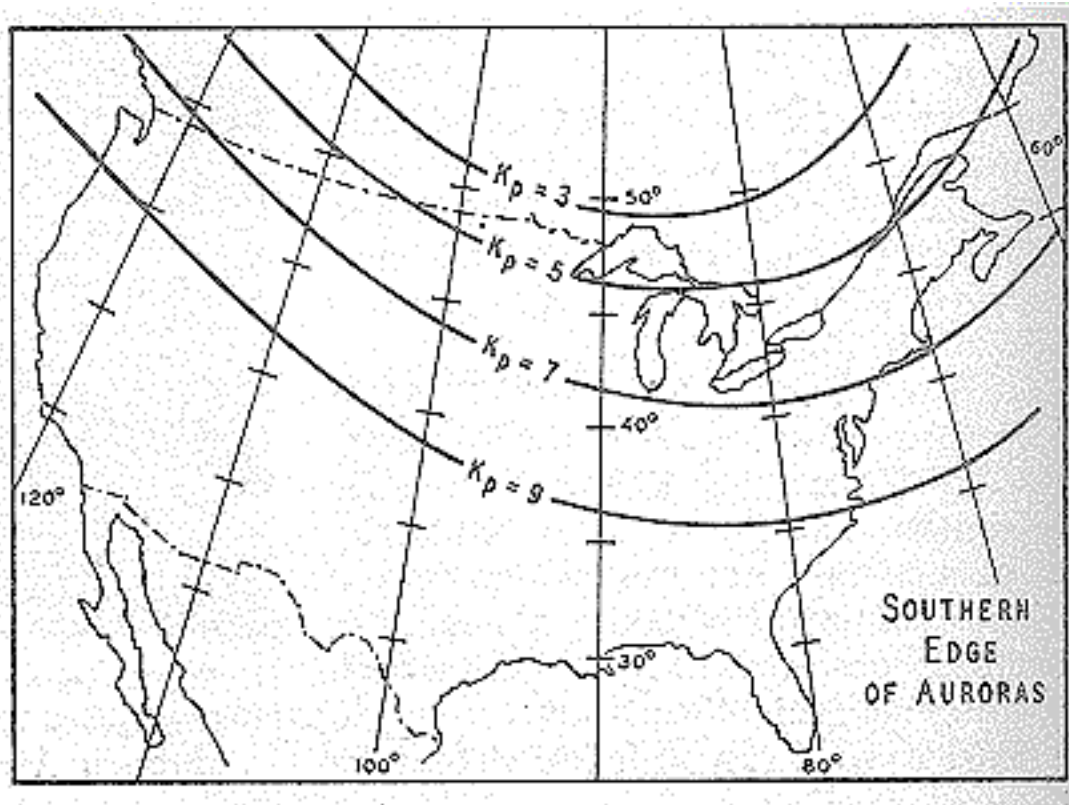
High latitude boundary dynamics : local time and Kp dependence



Note that the magnitude of motion of the boundary is dependent energy of the particles used to determine the boundary



Auroral oval Kp dependence



Sky & Telescope (June 1968)



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SAMPEX high latitude boundary database

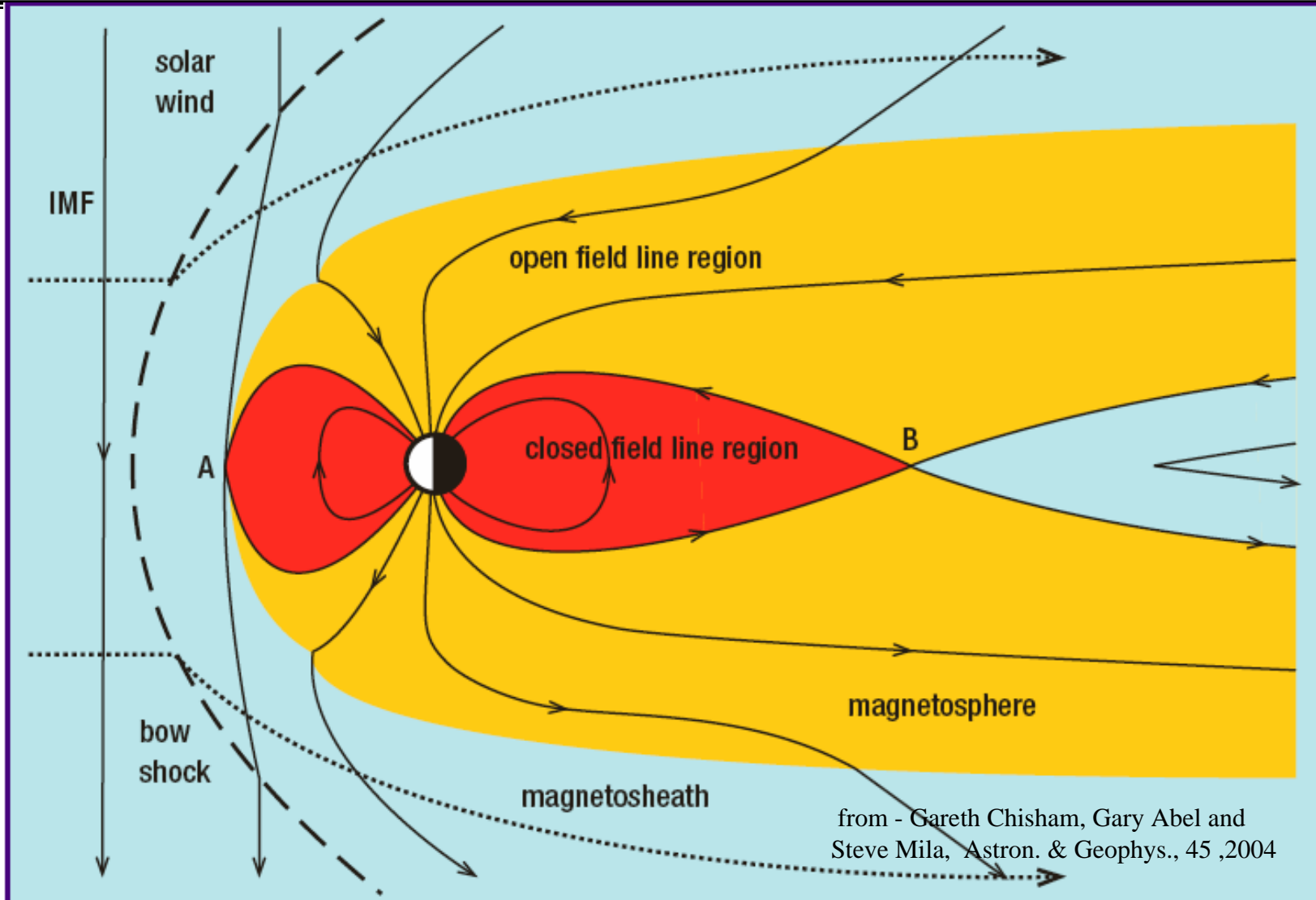
Energetic particle boundary location database

- ❖ several energy channels
- ❖ continuous coverage since 1992 (not all channels)
- ❖ two crossings twice per orbit => time resolution ~ 45 minutes
- ❖ Web site will be announced soon via IHY
ASCII files comprising times and locations of N/S polar cap

Dynamics of energetic particle boundaries provide information

- ❖ solar wind magnetosphere coupling
 - Substorm dynamics ~ hours
 - Storm dynamics ~ days
 - solar cycle effects ~ years





from - Gareth Chisham, Gary Abel and Steve Mila, *Astron. & Geophys.*, 45 ,2004



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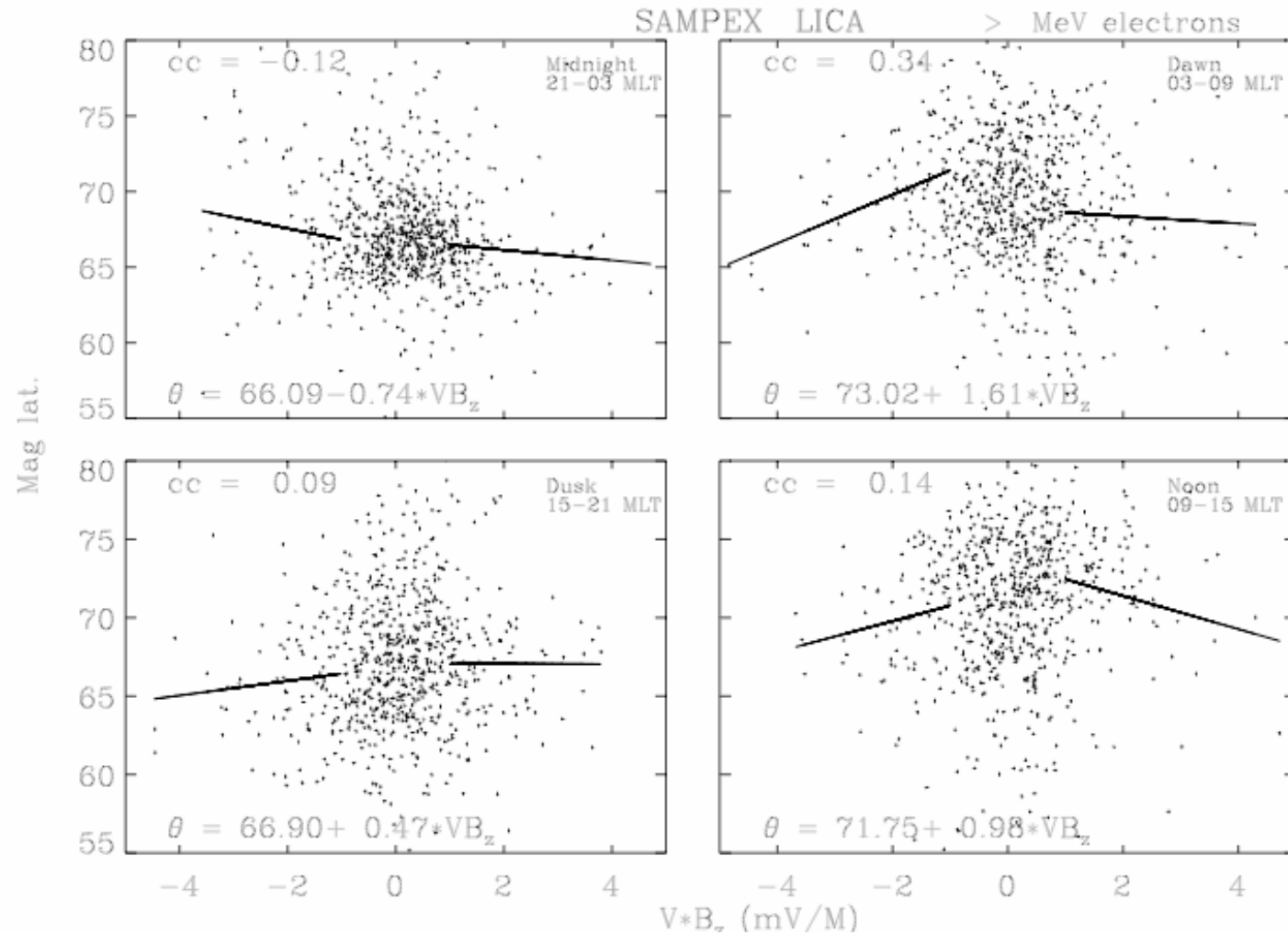




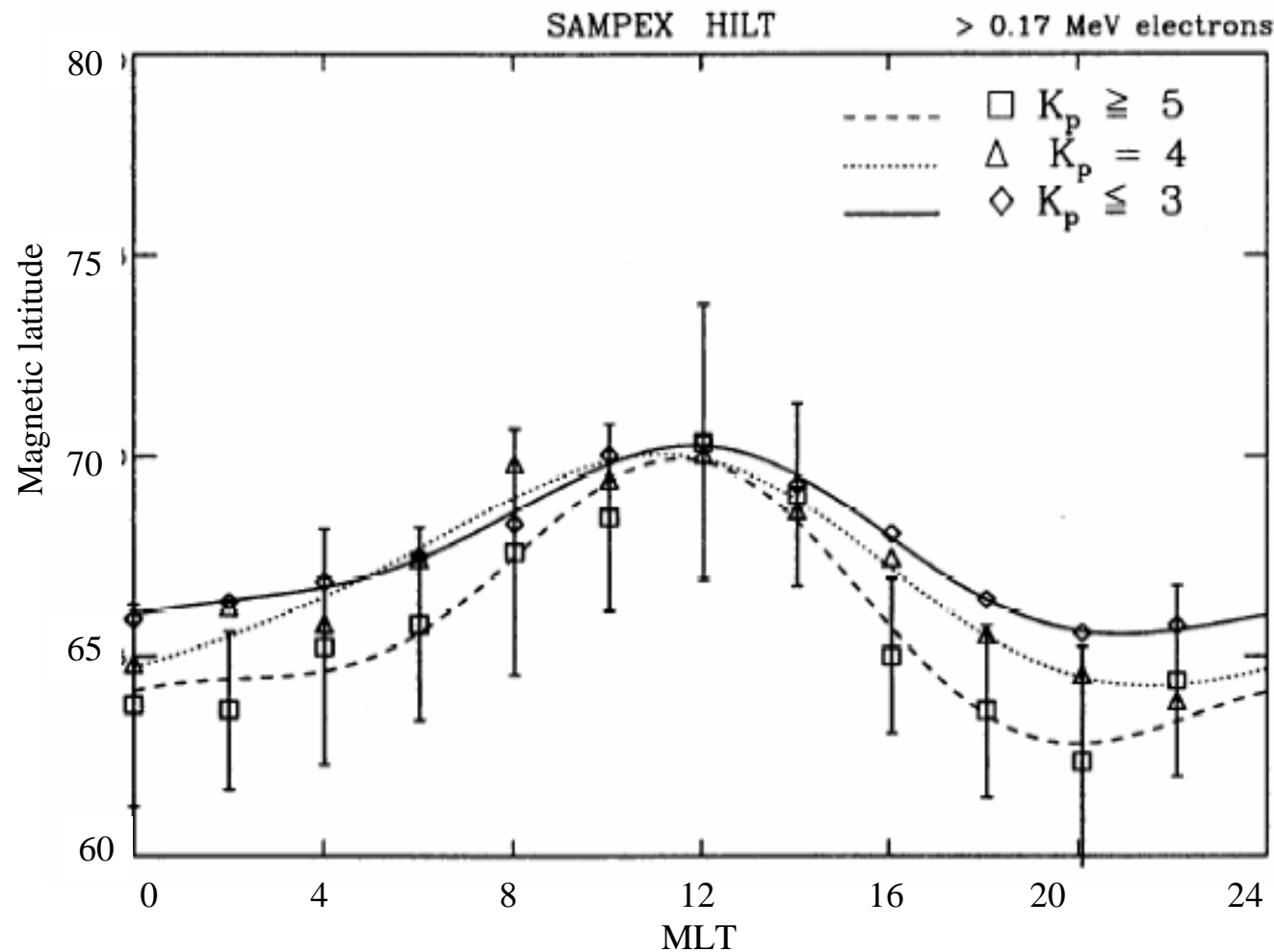
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High latitude boundary dynamics : VB_z dependence



High latitude boundary dynamics : local time and Kp dependence



Expansion of the polar cap shows local time dependence

