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Statistical magnetospheric location of auroral omega bands obtained by empirical magnetic field models

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- **Omega bands are curved aurora forms, appearing as rows of inverted Greek letter Ω drifting eastward**
- **Their magnetospheric signatures and sources are poorly understood due to a small number of conjugated spacecraft observations**
- **The goal of the study is to find a characteristic magnetospheric magnetic field configuration corresponding to this type of aurora on the basis of an empirical model and the list of omega bands observed in the Fennoscandian Lapland**

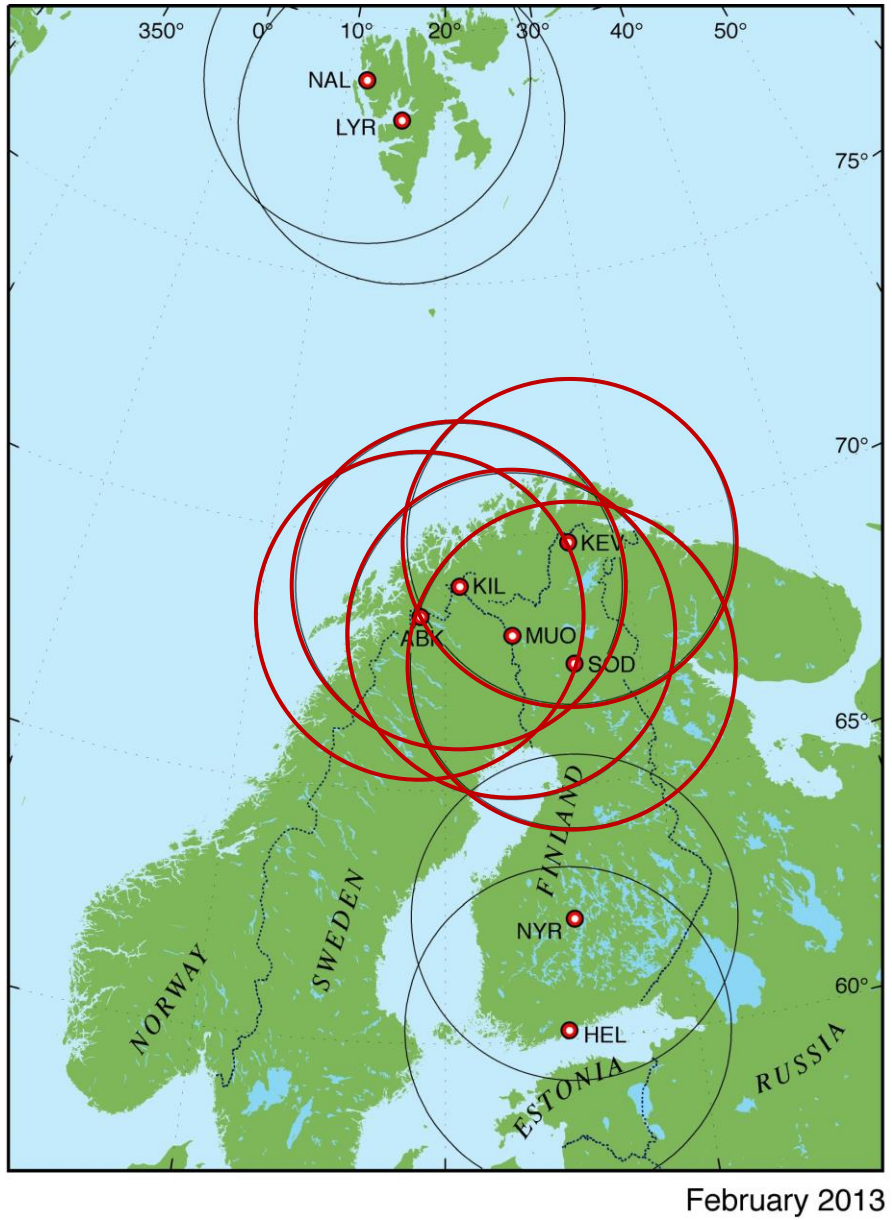
Data

- **The list of omega bands observed in the Fennoscandian Lapland in the period 1997-2007** (*Partamies et al.*, 2017)

- **Corresponding MIRACLE all-sky camera observations**

- **ASC stations coordinates in MAG system (calculated for 2007):**

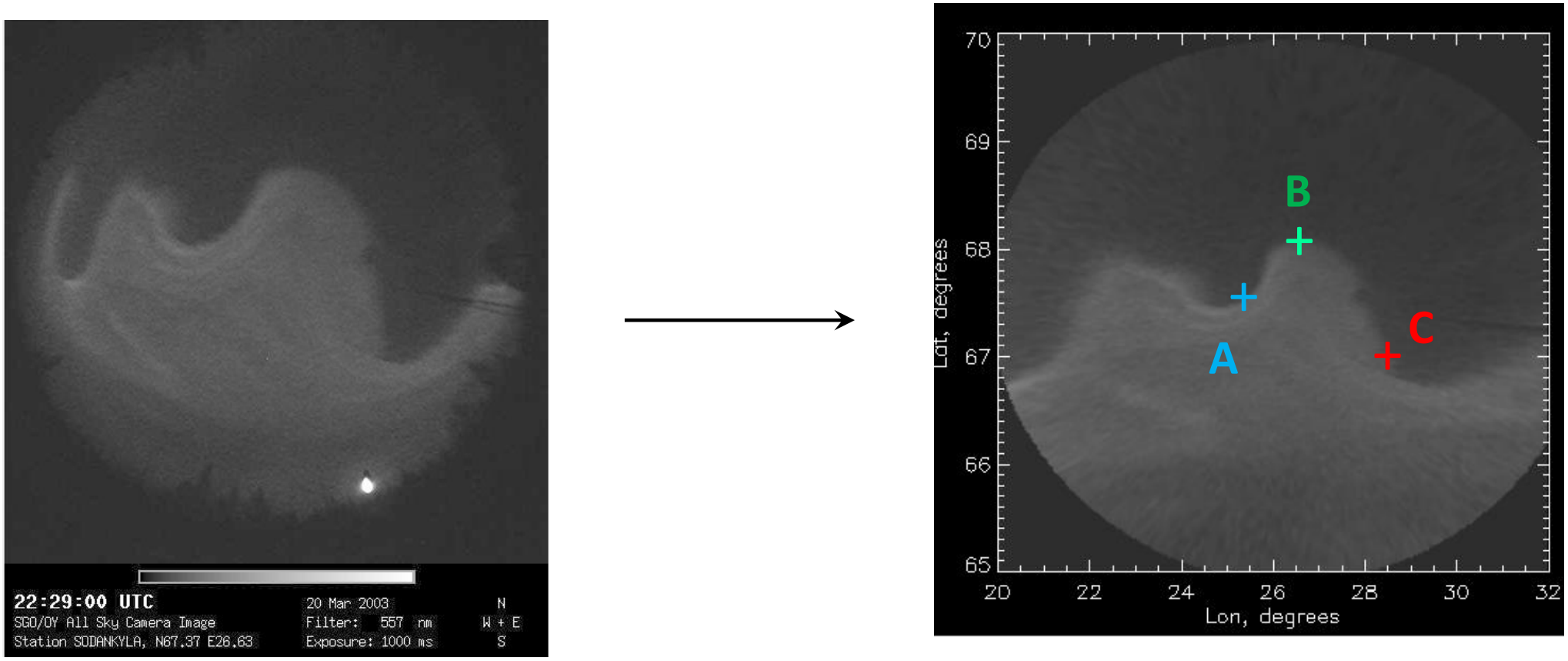
Abbr.	Name	MLat,º	Long,º
ABK	Abisko	66.1	114.6
KEV	Kevo	66.1	122.6
KIL	Kilpisjärvi	66.4	117.0
MUO	Muonio	65.0	118.1
SOD	Sodankylä	64.0	119.8



From https://space.fmi.fi/MIRACLE/ASC/

Data

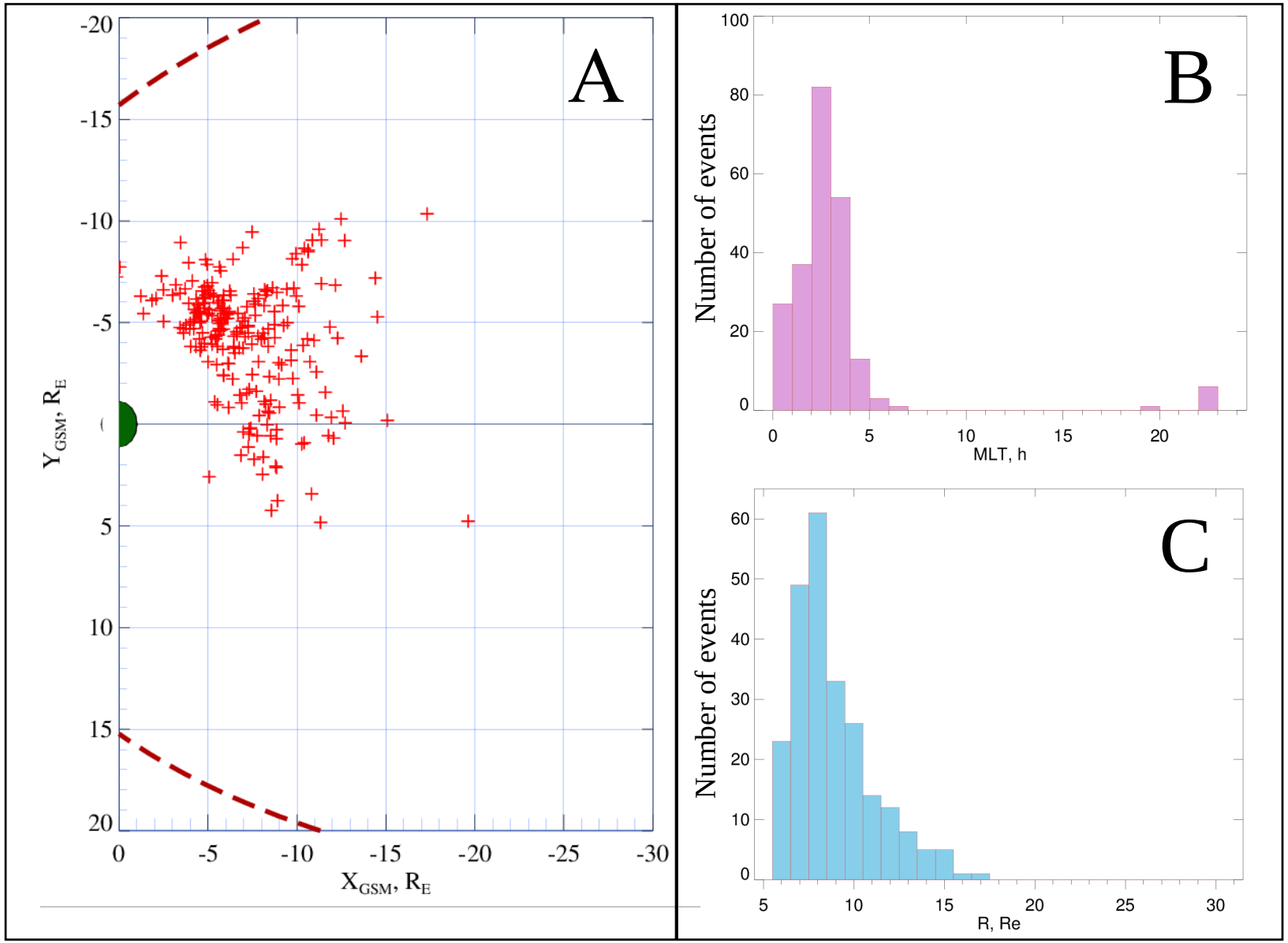
- **Magnetic field line tracing: IGRF-12 and the empirical model TA16** (*Tsyganenko&Andreeva*, 2016)
- **TA16 input parameters: : Pdyn, Sym-H, N index** (*Newell et al.*, 2007)**, IMF By**
- **Footpoints for magnetic field line tracing:**



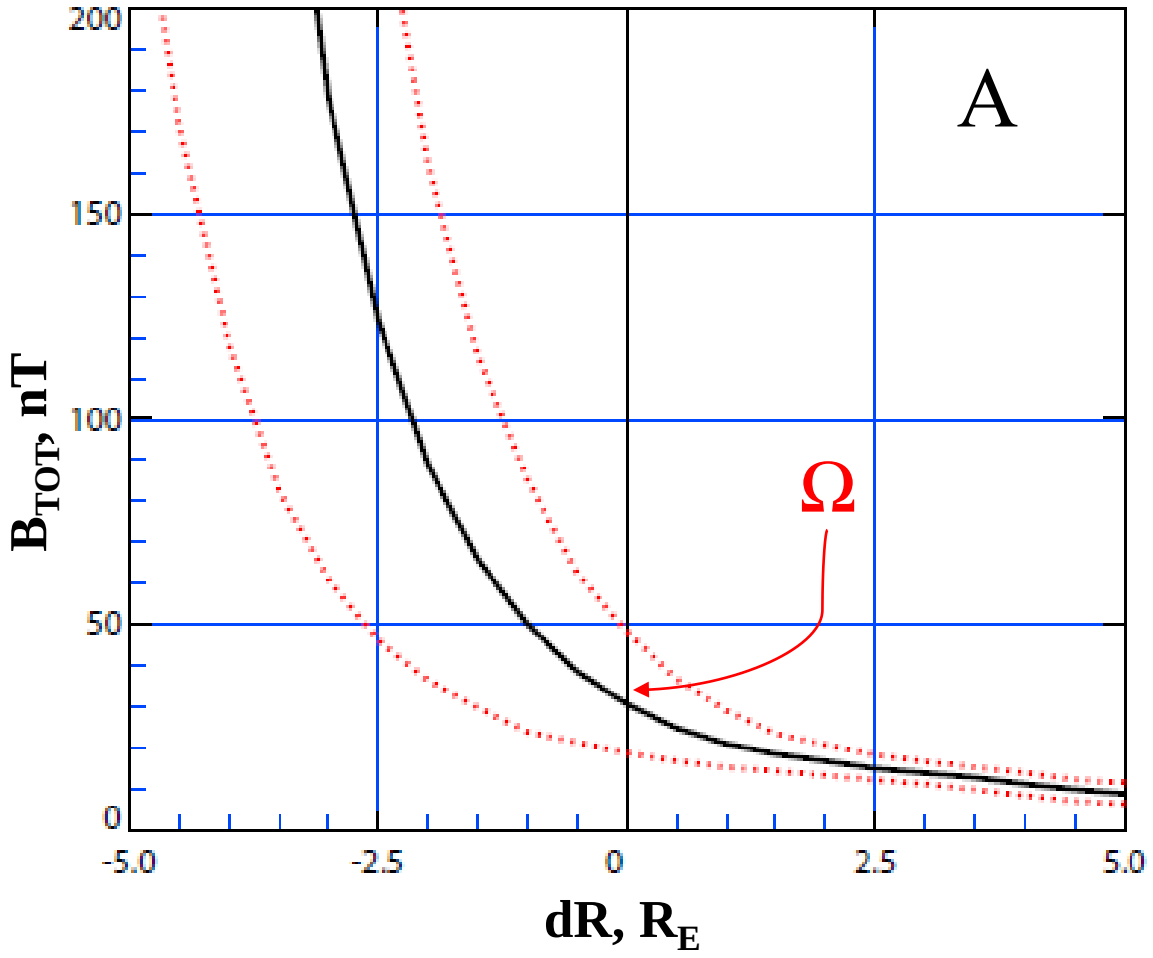
(left) ASC image of Ω-structure, Sodankylä, 20.03.2003; (right) its projection in GEO coordinates at 110 km

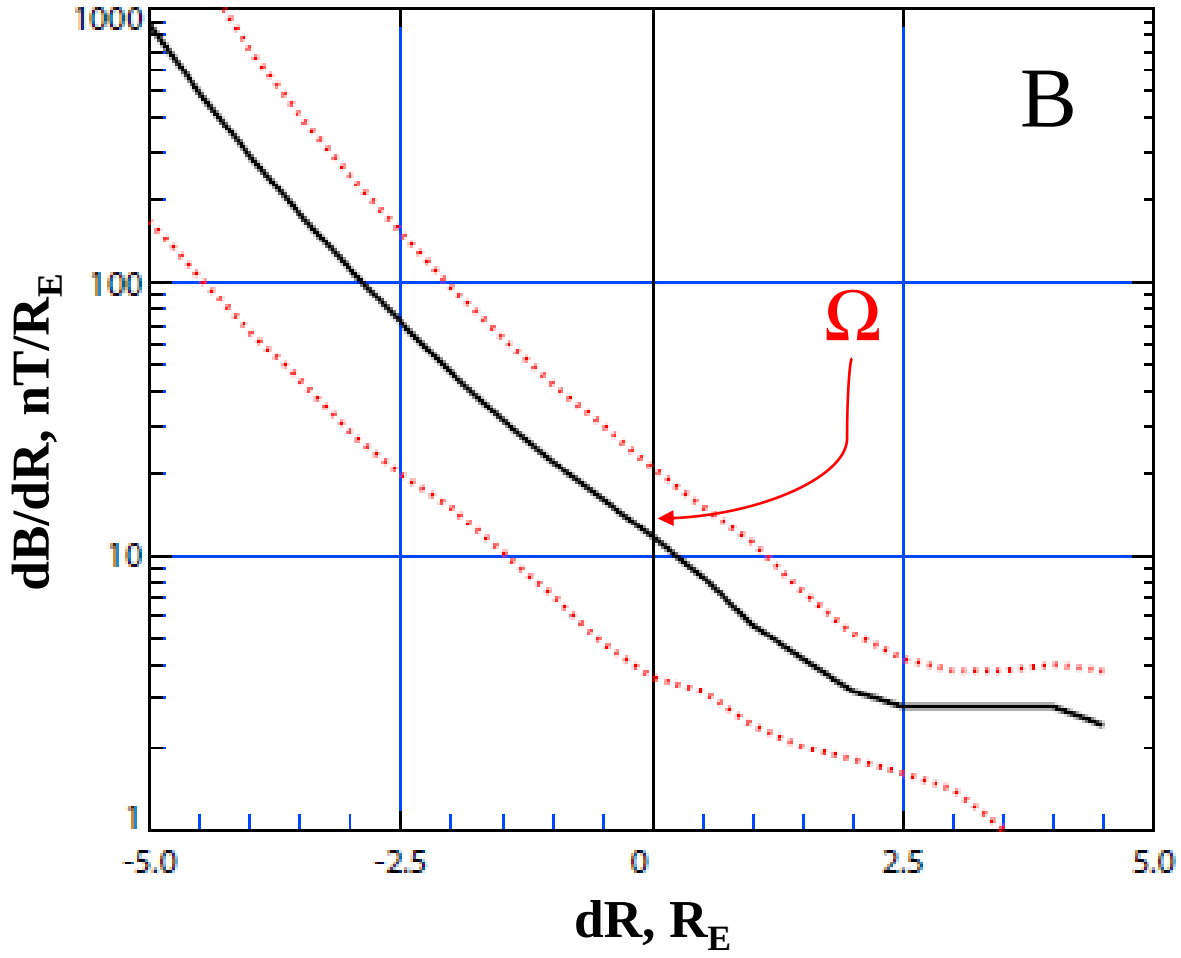
Mapping results

- 244 events from the original list
- (A) Ω-projections in GSM equatorial plane
- (B)&(C): occurrence vs MLT and radial distance (Re)
- 90% of events are within 2-4 MLT and R~6.0-13.5 Re
- Maximum at R=8 Re
- Results are in agreement with previously reported case-studies



Magnetospheric magnetic field configuration





Superposed B(R) [left] and |dB/dR|(R) [right] profiles in the vicinity ±5 Re of omega-band projection. Zero-epoch dR=0 corresponds to the omega projection

Magnetospheric magnetic field configuration

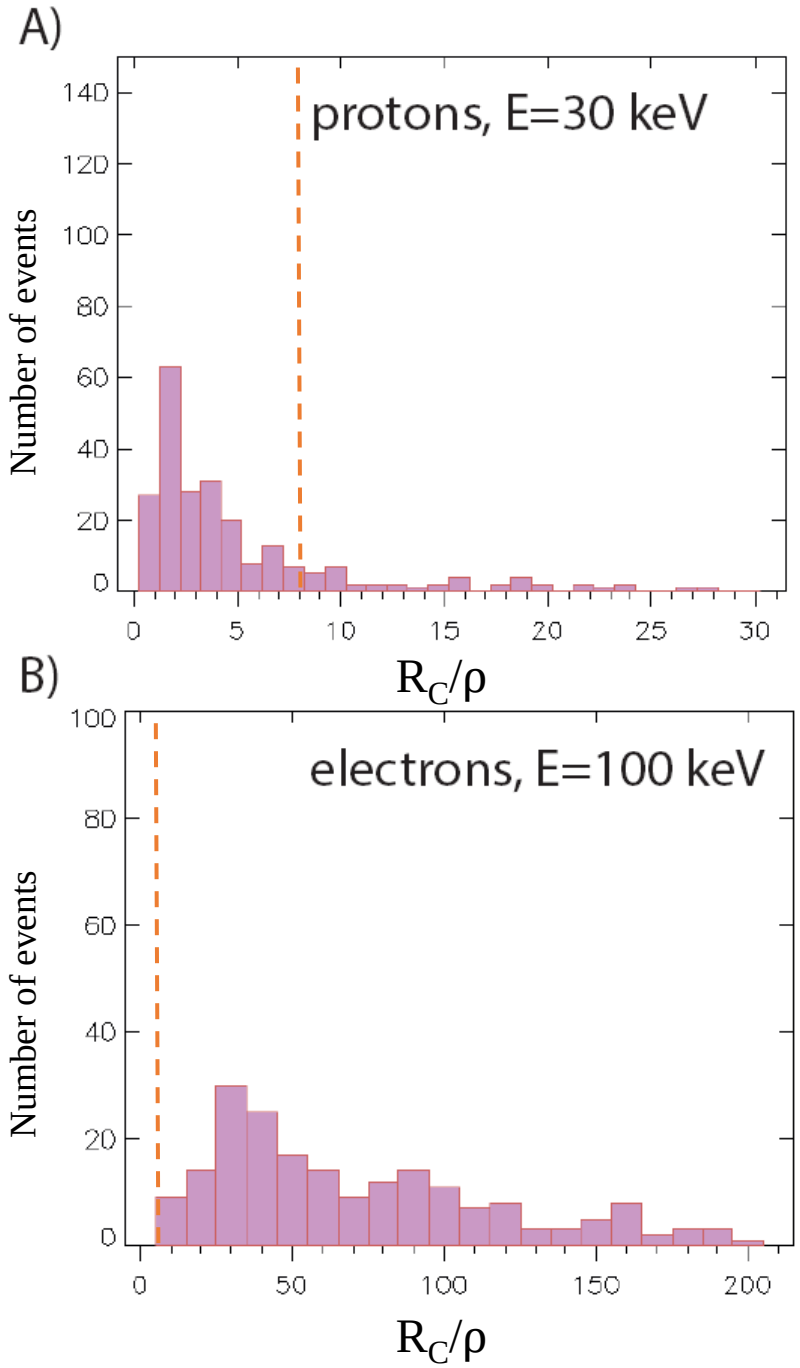
- **Isotropic boundary algorithm (IBA) method to evaluate the magnetic field configuration in the tail** (*Sergeev et al.*, 1993)

- **Isotropic boundary:** $R_C/\rho=8$

R_C – the curvature radius of the field line,
ρ – the particle gyroradius

- **In the vicinity of omega-band possible source: a chaotic motion of 30-keV energetic protons and adiabatic motion of 100-keV electrons**

- **=> stretched magnetic field lines, but the tail current sheet is rather thick**



Summary

- **The first statistical study of the omega-bands projections using the large set of the MIRACLE ASC observations and new empirical magnetic field model TA16**

- **It is demonstrated that 90% of the omega bands map to between 6-13.5 Re (occurrence max at ~8 Re) => region, where rapid flows stop (occurrence rate of RFTs drop at radial distances 10-15 Re)** (*Schödel et al.,* 2001)

- **Superposed radial profiles of the magnetic field and radial gradient in the tail are calculated => a magnetospheric source of Ω is located in the transition region between the tail-like and dipolar fields**

- **In this region : a chaotic motion of 30-keV energetic protons and adiabatic motion of 100-keV energetic electrons**

References

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