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Electron density estimation in the magnetotail a multi-instrument approach

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Northern Lobe
Ne < 0.1 cm⁻³; Te < 100 eV

Plasmasheet
Ne > 0.1 cm⁻³; Te > 100 eV

Southern Lobe
Ne < 0.1 cm⁻³; Te < 100 eV

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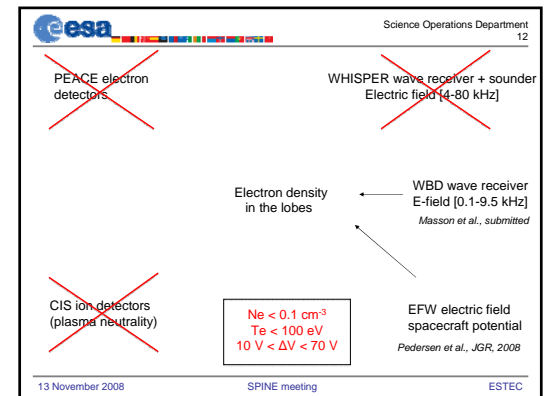
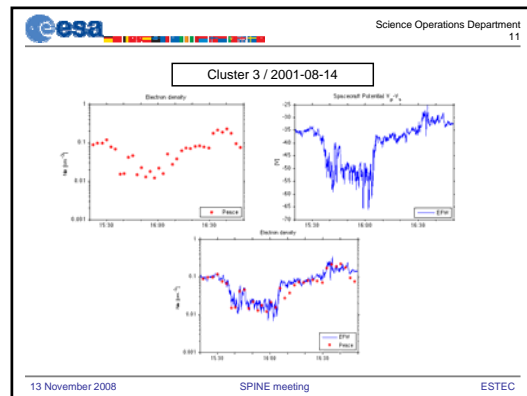
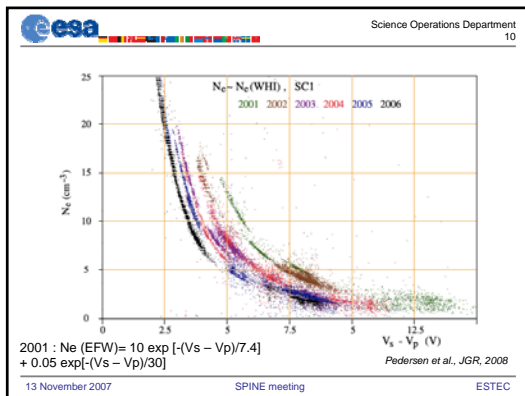
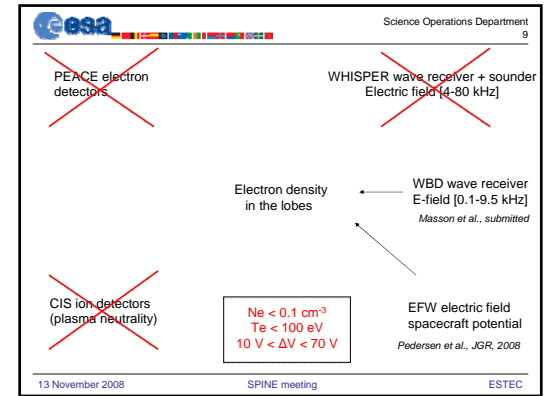
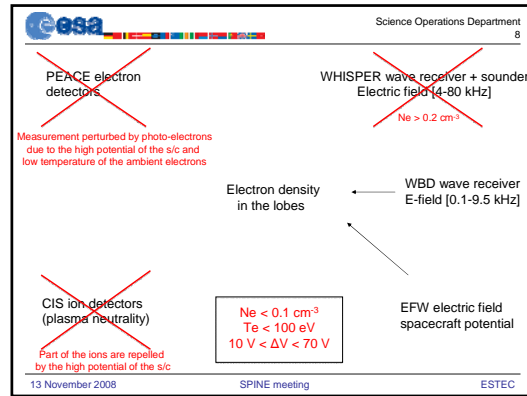
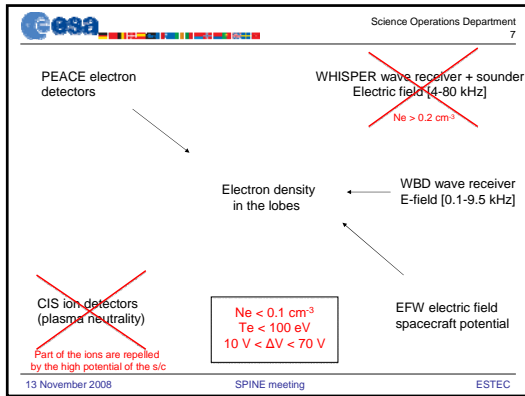
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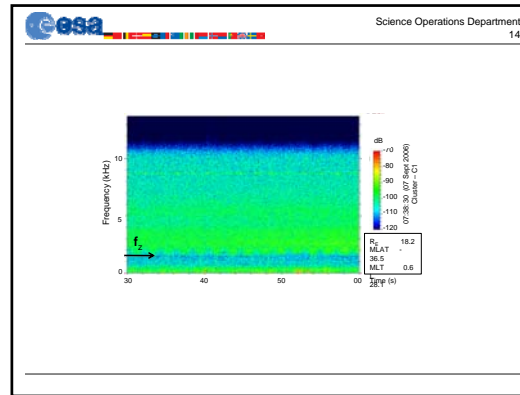
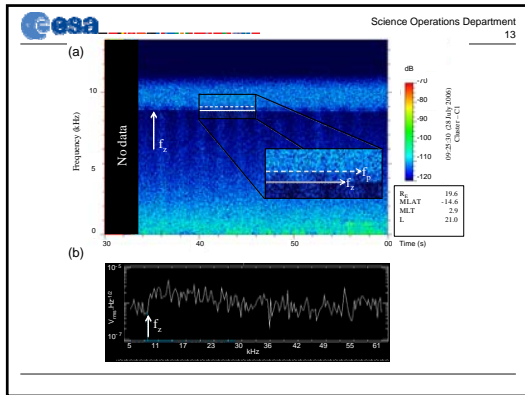
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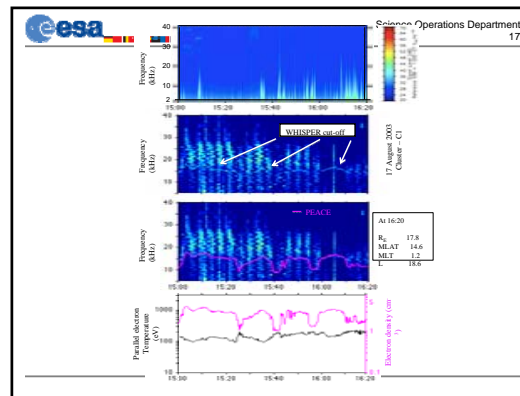
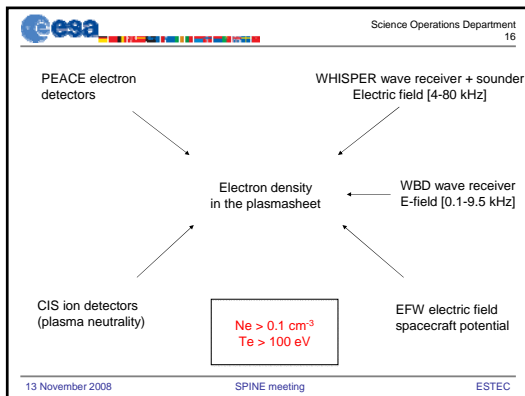
New theoretical interpretation

- Observations show the the cut-off of the Z-mode
- Conditions: $f_p > f_{ce}$
- Cutoff frequency observed by WBD is f_z

$$f_z = 1/2 [-f_{ce} + (f_{ce}^2 + 4f_p^2)^{1/2}] - f_p - 1/2 f_{ce}$$

Example
 $f_z = 1.5$ kHz
 $B = 36$ nT $\Rightarrow f_{ce}$ [Hz] = 28 B - 1 kHz
 $\Rightarrow f_p \sim 2$ kHz, $f_p \sim 9 \cdot N_e$
 \Rightarrow Plasma density $N_e = 0.05$ e-/cc

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WHISPER approach

Agreement within 5% with PEACE PP data

From 100 ev up to 2.5 keV

For limited data points per time interval

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In-flight calibrations PEACE

Electron density

- reference source: WHISPER relaxationsounder
- adjustment principle:
 - optimisation technique to fine tune geometric factor in order to achieve "correct" density
 - note: does not reveal if the energy efficiencies are correct or not, but these are determined via velocity cross-calibration
- WHI sounder N_e range 0.2 – 80 cm^{-3} (SSR paper) is narrower than PEA (-0.001 to 1000 cm^{-3})



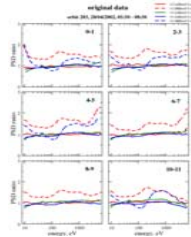
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Inter-spacecraft calibration

checking for "identical" behaviour in similar plasma conditions

- Aim: to compare sensors on all spacecraft at small separations
- example: comparing PSD from C2 LEEA/HEEA, C3 LEEA, C4 LEEA/HEEA to C1 LEEA.



The 6 panels correspond to the 6 anode pairs.
 - should get a ratio of 1 across all energies if there is good inter-sensor calibration


Time periods selected

Cusp 01: Jan 01 – May 01


Cusp 02: Jan 02 – Jun 02

Tail 03: July 03 – Dec 03


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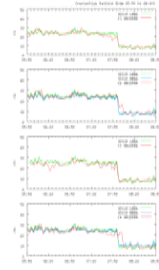
Before



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After



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