

ELECTRON SCATTERING BY ELECTROSTATIC ELECTRON CYCLOTRON HARMONIC WAVES DURING STORM-TIME

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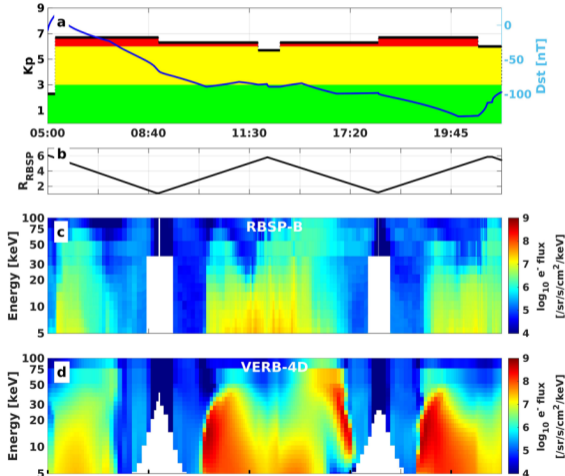
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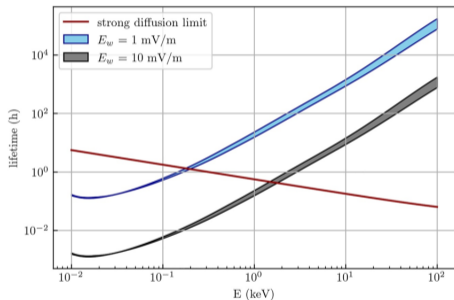
Motivation



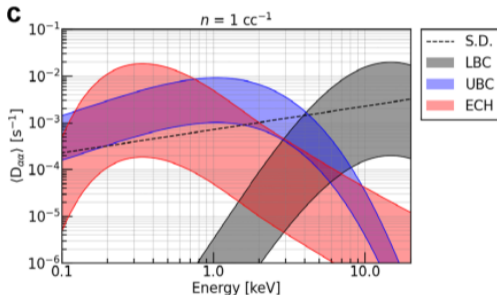
Haas et al., *Sci Rep*, 2023: Simulations of the March 2013 St. Patrick's Day storm
⇒ missing loss process in the electron ring current



Is the scattering by electron cyclotron harmonic waves (part of) the missing loss?

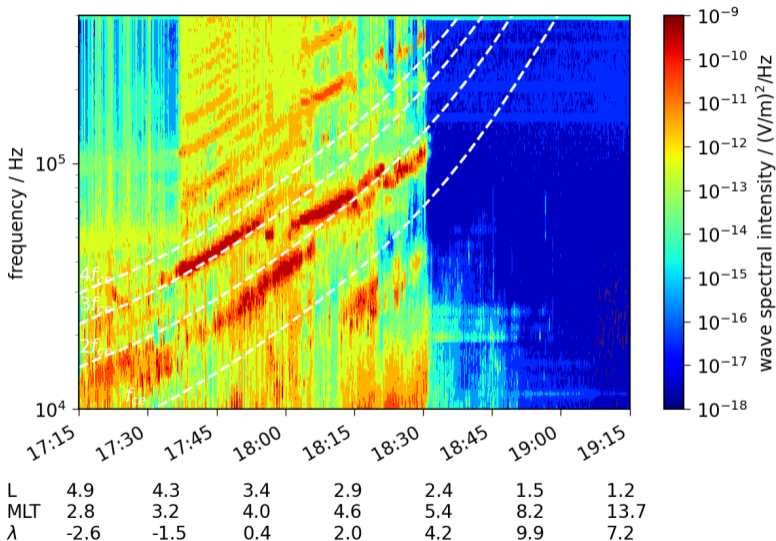


Stoll et al., JGR, 2023

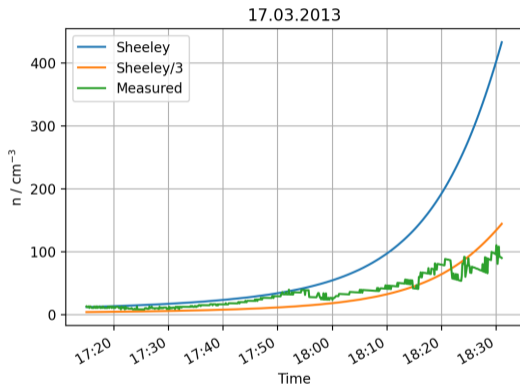
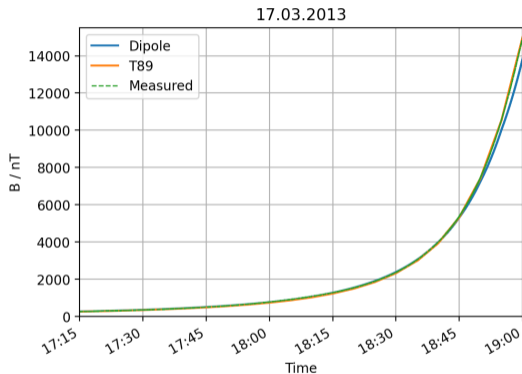


Fukizawa et al., JGR, 2022

ECH wave event on 17 March 2013



Magnetic field and plasma density

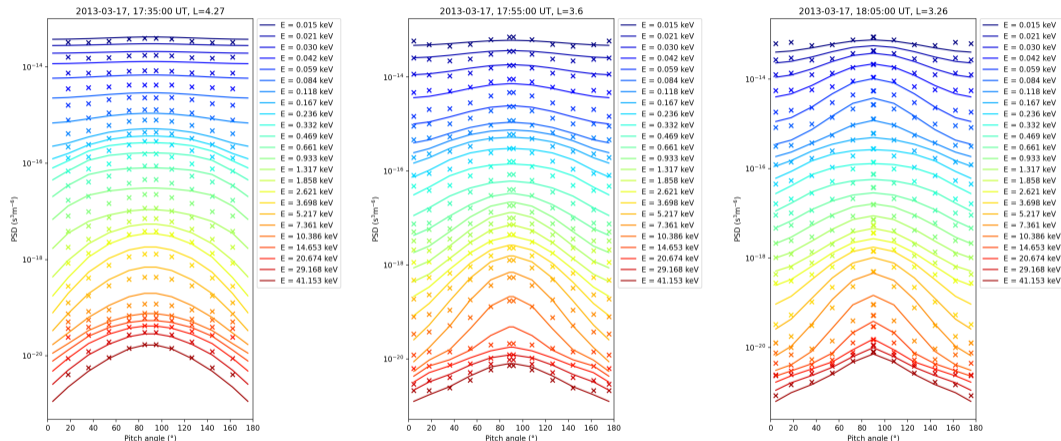


Model the electron distribution by (Ashour-Abdalla & Kennel, 1978)

$$f(v_{\perp}, v_{\parallel}) = \sum_{i=1}^m \frac{n_i}{\pi^{3/2} a_{\perp,i}^2 a_{\parallel,i}} \exp\left(-\frac{v_{\parallel}^2}{a_{\parallel,i}^2}\right) \cdot \left\{ \Delta_i \exp\left(-\frac{v_{\perp}^2}{a_{\perp,i}^2}\right) + \frac{1 - \Delta_i}{1 - \beta_i} \left[\exp\left(-\frac{v_{\perp}^2}{a_{\perp,i}^2}\right) - \exp\left(-\frac{v_{\perp}^2}{\beta_i a_{\perp,i}^2}\right) \right] \right\}$$

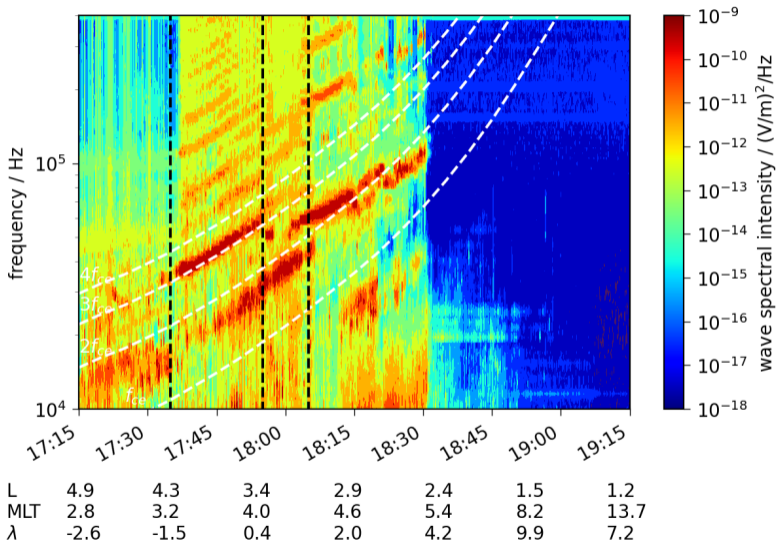
with electron density n_i , loss cone parameters Δ_i and β_i , and perpendicular and parallel thermal velocity $a_{\perp,i}$ and $a_{\parallel,i}$ (related to plasma temperature)

Fits to phase space density

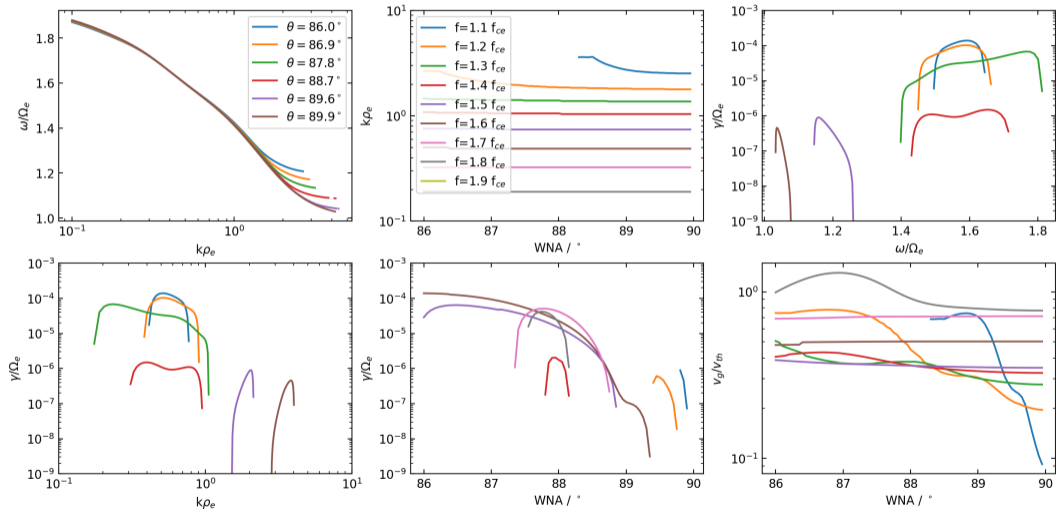


\Rightarrow obtain n_i , $T_{\perp,i}$, $T_{\parallel,i}$, Δ_i and β_i

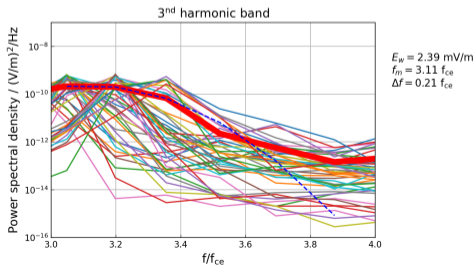
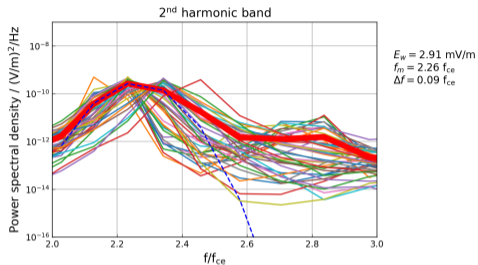
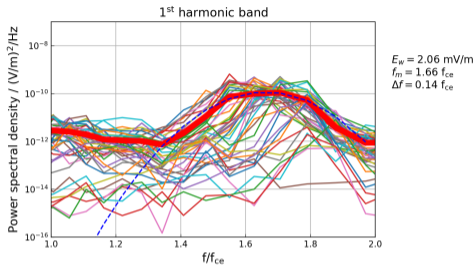
Fits to phase space density



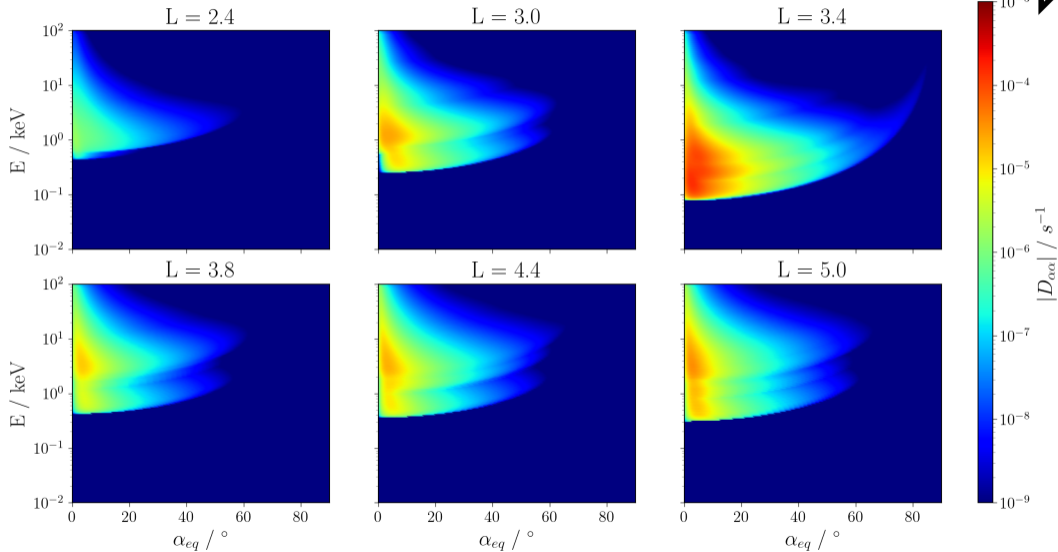
Dispersion relation (First band, $L = 3.6$)



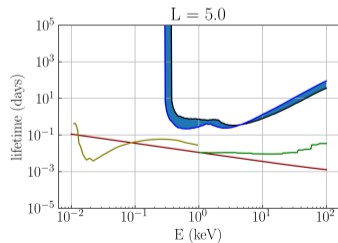
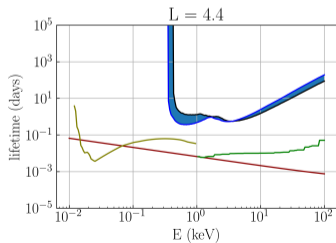
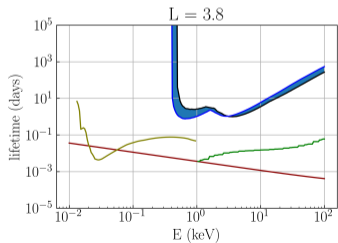
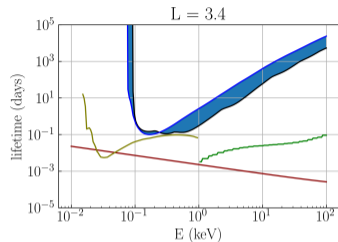
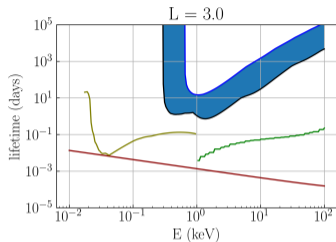
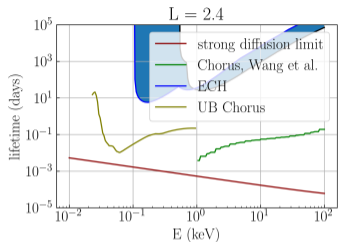
Wave amplitude

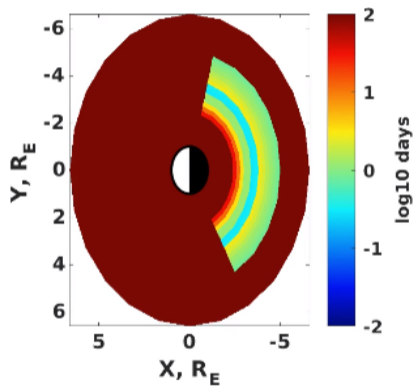


ECH wave-induced diffusion coefficients

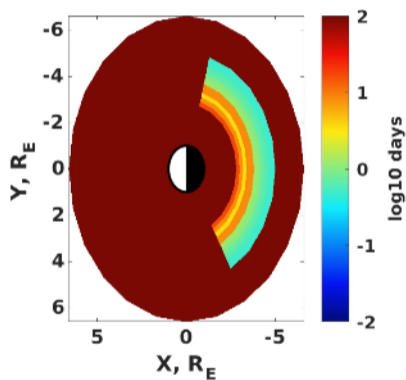


Lifetimes from the edge of the loss cone



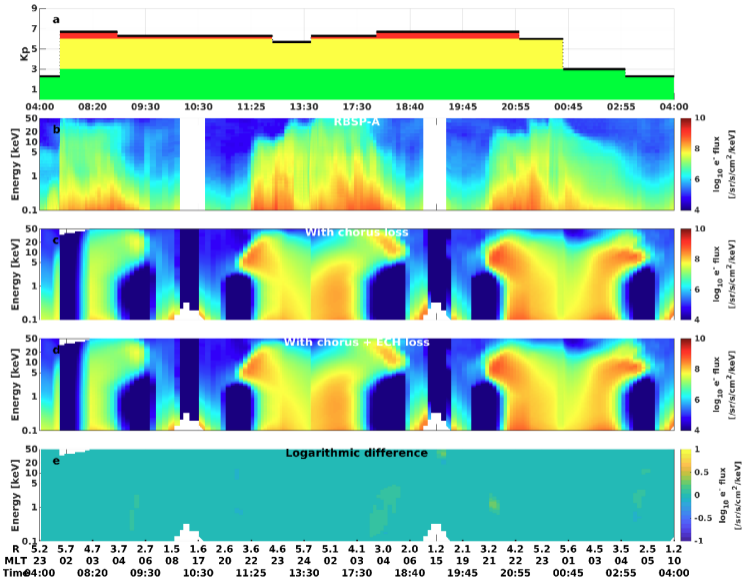


(a) ECH lifetimes at $E = 1$ keV, $\alpha = 50^\circ$



(b) ECH lifetimes at $E = 5$ keV, $\alpha = 50^\circ$

VERB-4D Simulations



Summary and Conclusion



- Calculated event-specific diffusion coefficients for ECH waves during March 2013 storm
- Implemented lifetimes to VERB-4D simulations
- Lifetimes due to direct scattering by ECH waves are too long to account for the missing loss
- Problems: Fit of loss cone distribution to phase space density, wave normal angle distribution