Stability Analysis of Core-Strahl Electron Distributions in the Solar Wind

Konstantinos Horaites[1], Patrick Astfalk[2],
Stanislav Boldyrev[1,3], Frank Jenko[2,4,5]
[1]Department of Physics, University of Wisconsin – Madison,
[2]Max Planck Institute for Plasma Physics,
[3]Space Science Institute,
[4]Technical University of Munich,
[5]The University of Texas at Austin

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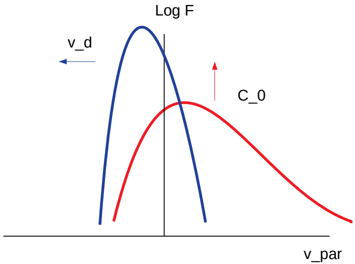
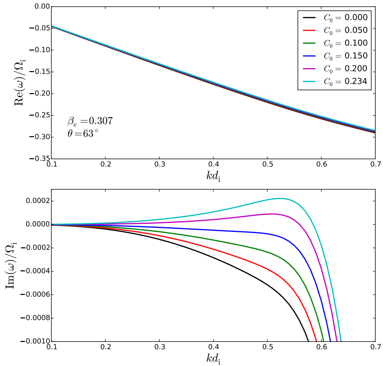
Core-Strahl Model $f = f_c + f_s$

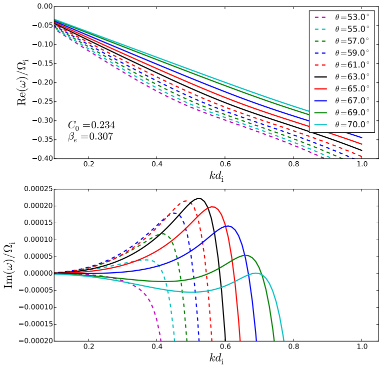


$$f_c(\mathbf{v}) = \frac{n_c}{\pi^{3/2} v_{th}^3} \exp\left(\frac{-(\mathbf{v} - v_d \hat{v}_\parallel)^2}{v_{th}^2} \right), \tag{1}$$

$$f_s(\mu, v) = C_0 A(v) \frac{n_c}{v_{th}^3} \left(\frac{v}{v_{th}} \right)^{2\epsilon} \exp\left[\tilde{\gamma} \Omega (v/v_{th})^4 (1 - \mu) \right]. \tag{2}$$

KAW Instability

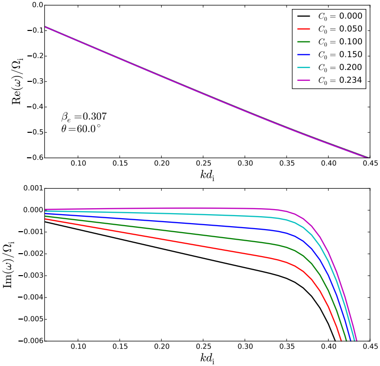


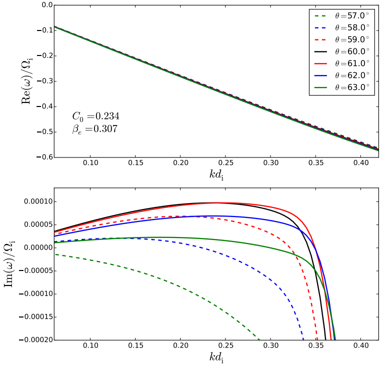


$\mathrm{Im}(\omega)\uparrow$ as $C_0 \uparrow$.

Max. growth rate at $\theta \approx 63^\circ$.

Magnetosonic Instability





Im(ω)↑ as C_0 ↑.

Max. growth rate at $\theta \approx 60°$.

Conclusions

- Core-strahl eVDF is unstable to KAW and magnetosonic modes
- The unstable waves exhibit Landau resonance with the core electrons.
- No whistler instability found!
- Instabilities could generate turbulence at scales $kd_i \lesssim 1$.