INTERACTIONS OF RUNAWAY ELECTRONS WITH ALFVÉN AND WHISTLER WAVES

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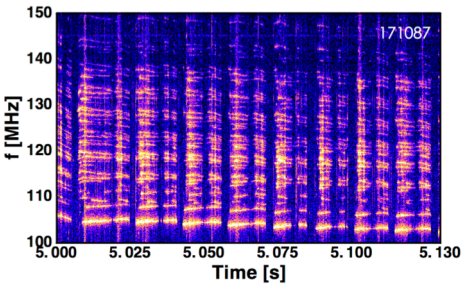
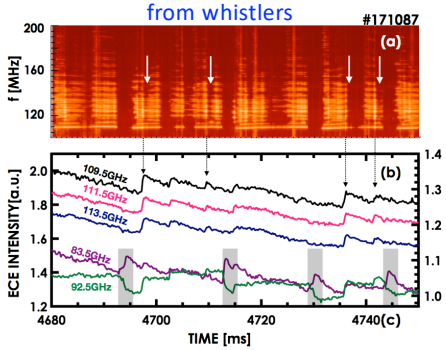
- **Runaway electrons can be scattered by waves in both the whistler and Alfvén frequency ranges**
- **This scattering can dissipate runaway energy density and increase electric field thresholds for runaway formation**
- **Runaway-whistler interactions**
  - Activity in the whistler wave range was measured on DIII-D in discrete frequency lines
  - These signals were correlated with the presence of runaway electrons
  - ECE measurements show enhanced runaway scattering when whistler activity was present
  - Full-wave AORSA modeling indicates strong damping variation with frequency due to reflections off fast-wave cutoff layer
  - Observed frequencies and variations are consistent with the whistler dispersion relation and anomalous Doppler resonance
- **Runaway-Alfvén wave interactions**
  - Particle simulations show that runaways can be scattered non-resonantly by Alfvén waves
  - This scattering can reduce runaway currents faster than classical Coulomb drag
  - Simulations have shown this effect in the pellet-injected dissipation regime

D. Spong, et al., Phys. Rev. Lett. ***120*** *155002 (2018)*
W. Heidbrink, et al., EPS (2018)
C. Liu, et al., Phys. Rev. Lett. ***120*** *265001 (2018)*

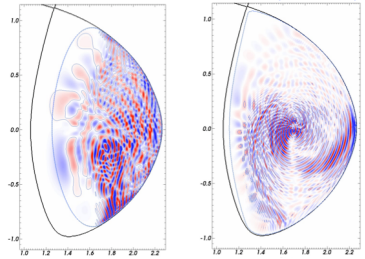
Runaway driven whistler frequency bands observed on DIII-D



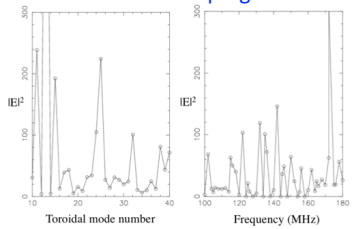
Electron scattering (ECE bursts) from whistlers



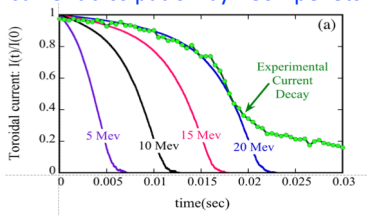
Whistler mode structures (AORSA)



Whistler mode damping variations



Simulated/measured runaway current dissipation by neon pellets



Alfvén wave scattering effects on current decay