Investigation of fine structure of chorus wave packets using multicomponent data from Van Allen Probes and multipoint measurements from Cluster spacefleet

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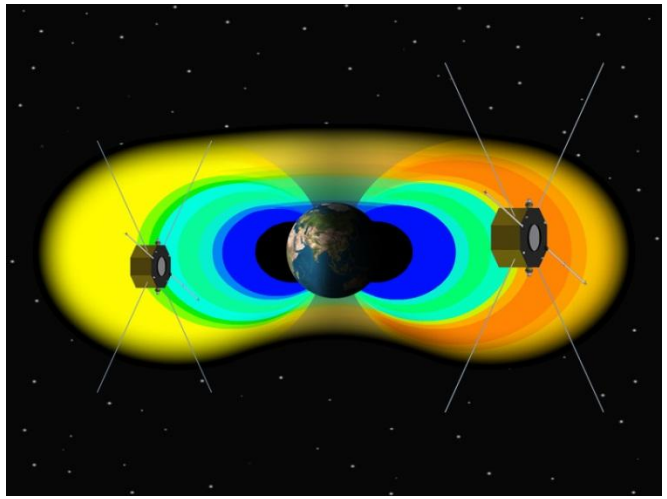

Van Allen Probes EMFISIS team:
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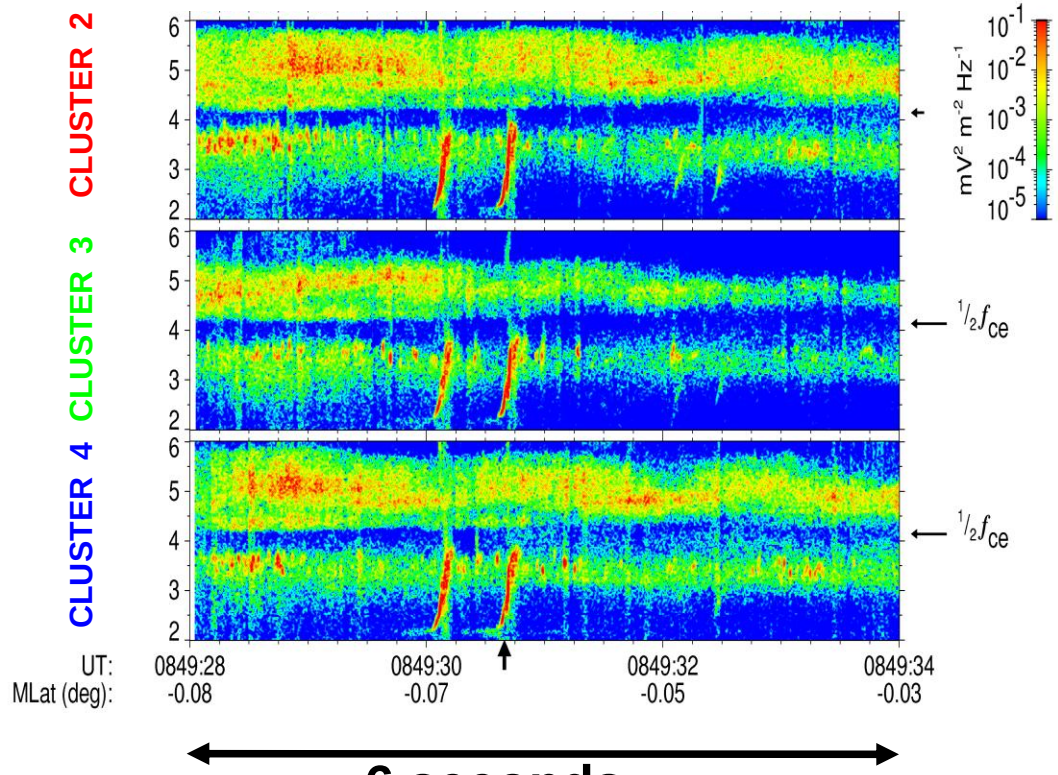
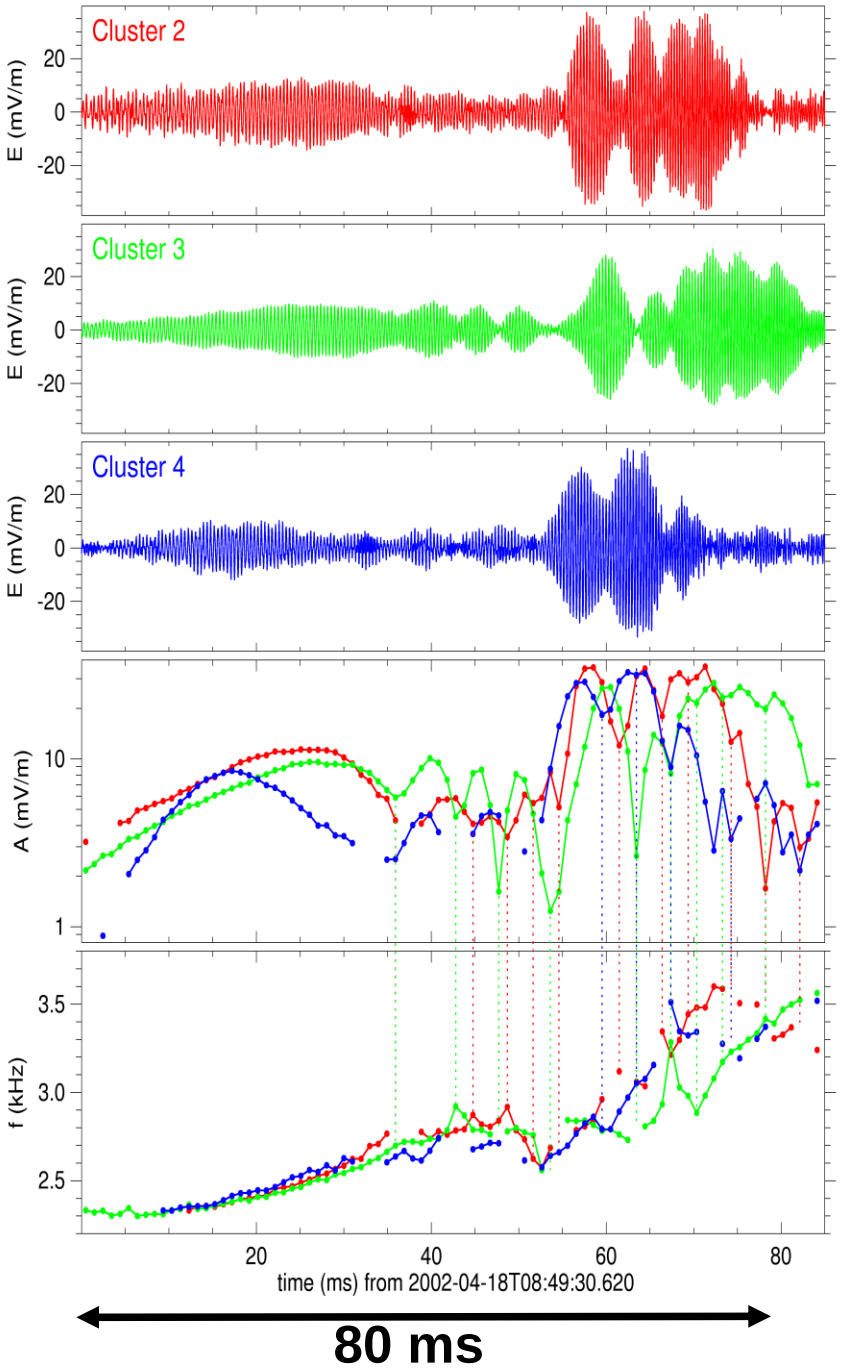


6 seconds



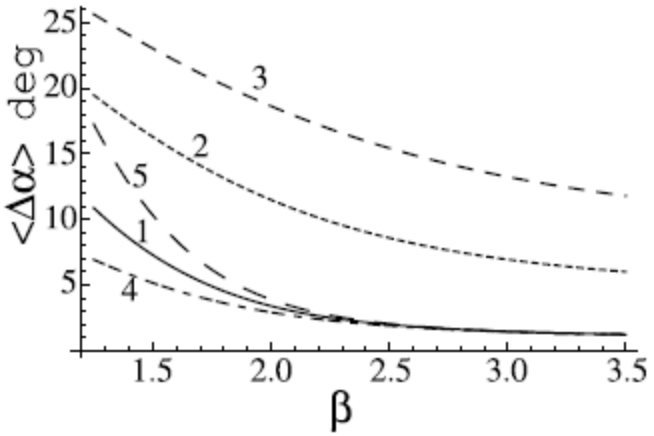
80 ms

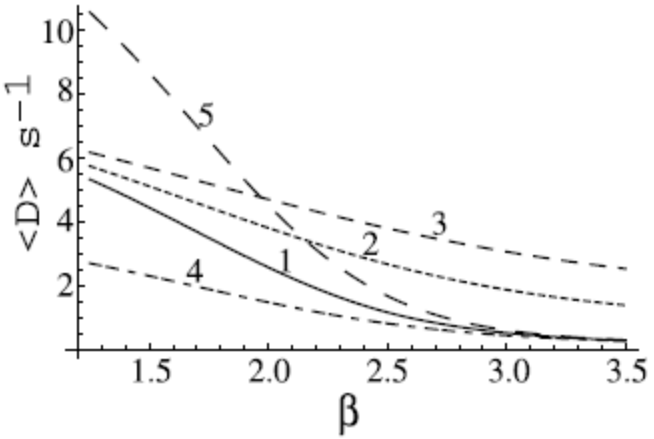
Fine structure of chorus wave packets

subpackets < 40 ms,

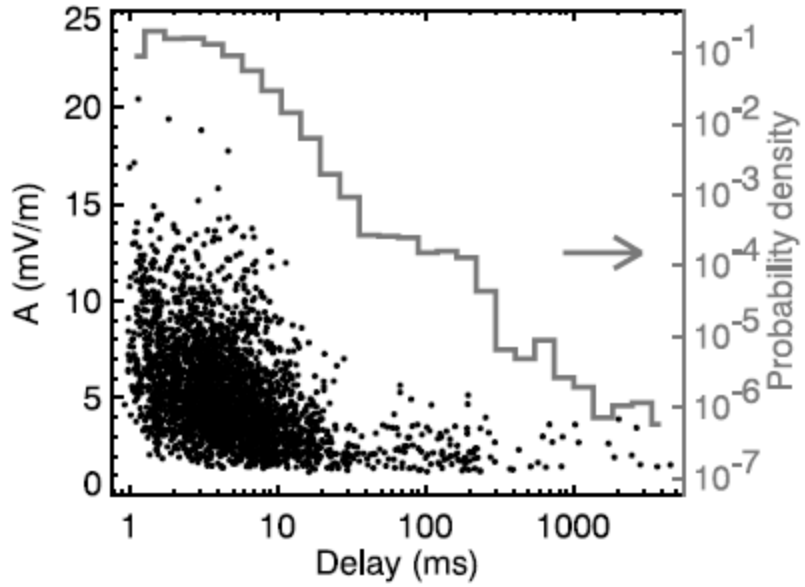
growth rates: 30 – 400 s^{-1}

(Santolik et al. JGR 2003)





"Electrons within several degrees of the loss-cone can be transported into the loss-cone by a single encounter with the chorus subelement wave" *(Lakhina et al., 2010)*

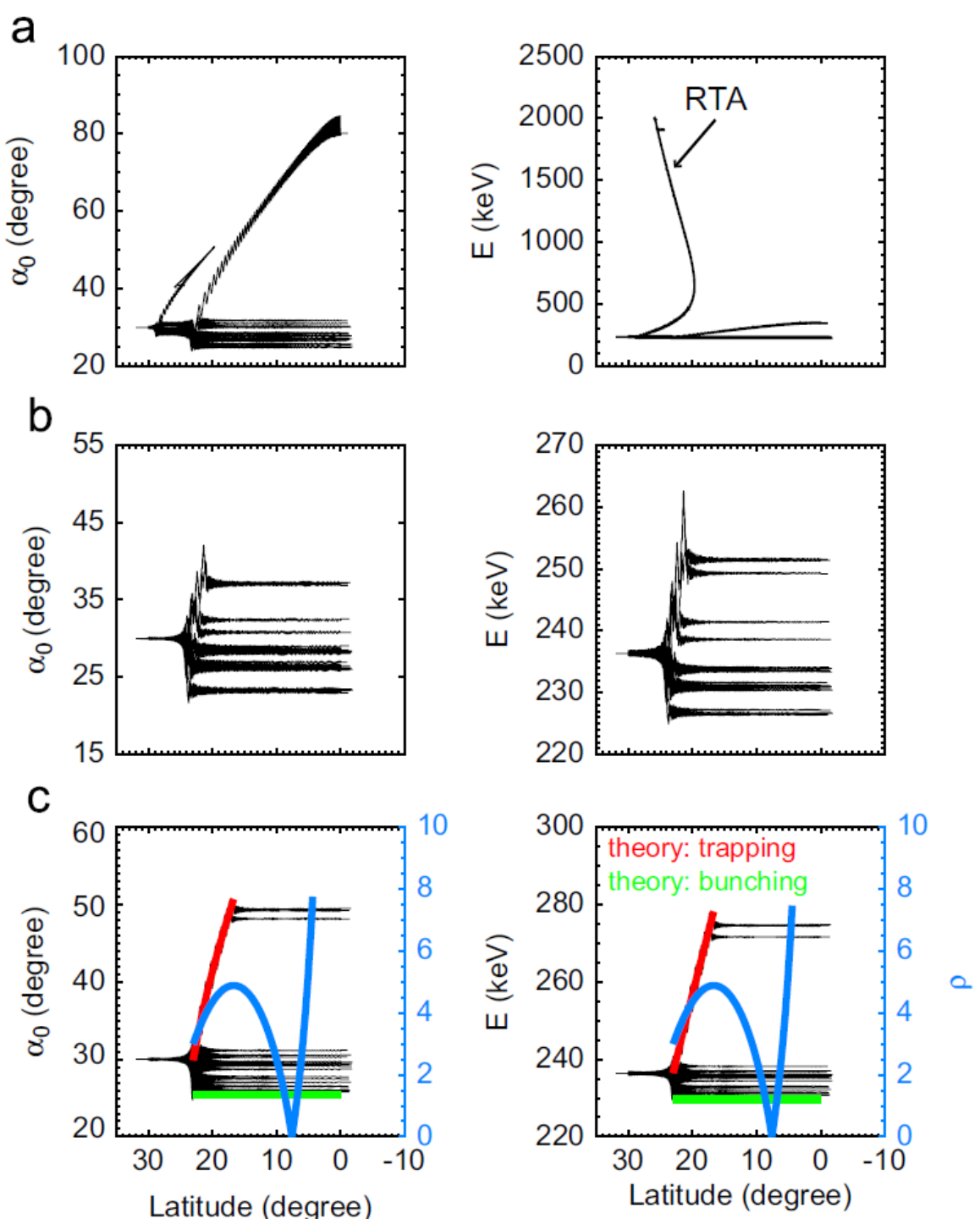


Power law exponent

$P = a\ T^{-beta}$

beta = 1.2 – 2

(Santolik et al. GRL 2004)

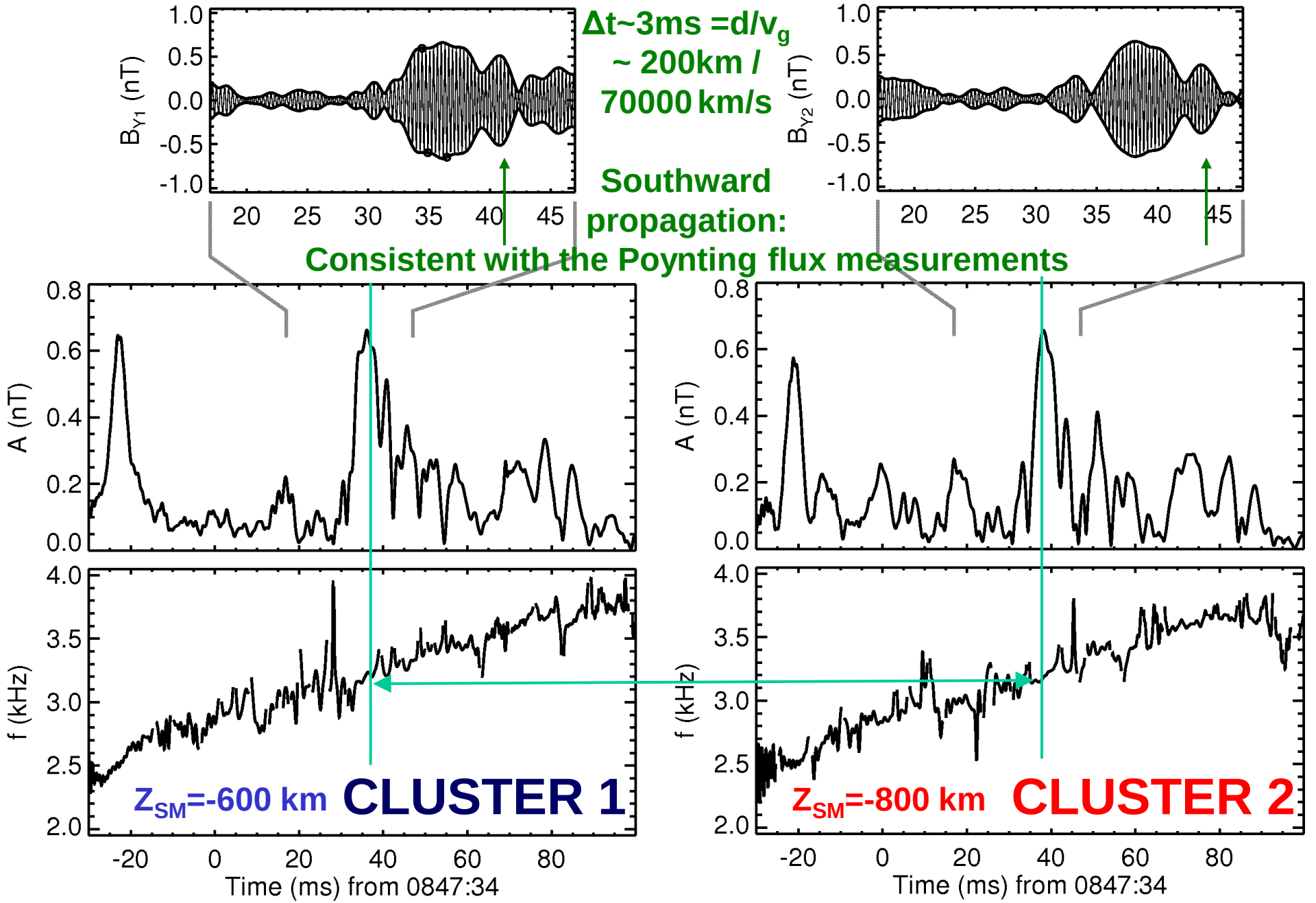


Test particle simulations in the wave field of chorus subpackets with amplitude modulation:

"... the resulting change in the electron pitch angle and energy could be very different from what has been predicted by ideal single-wave nonlinear theories."

(Tao et al. JASP 2013)

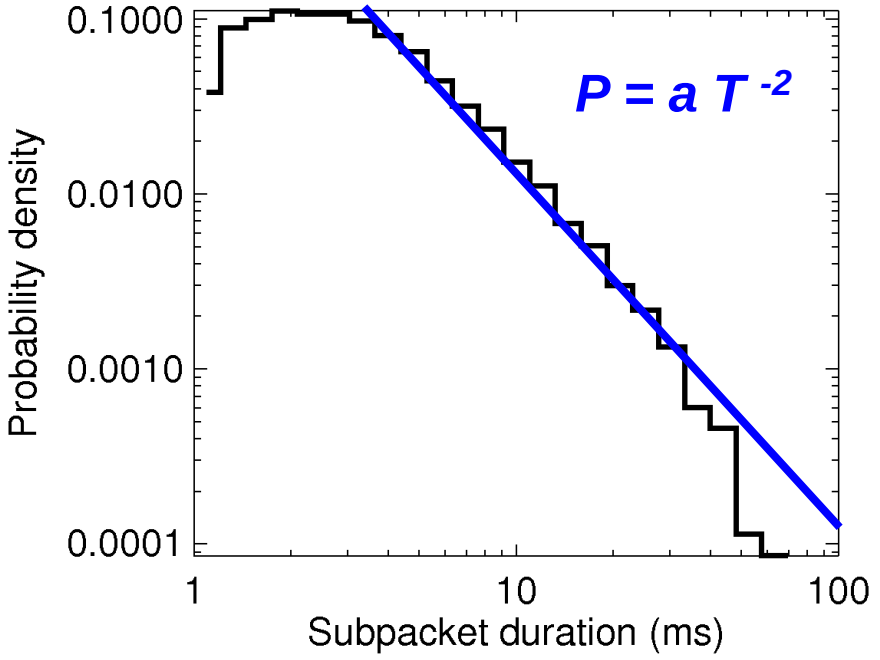
Fine structure of whistler-mode chorus 18 April 2002

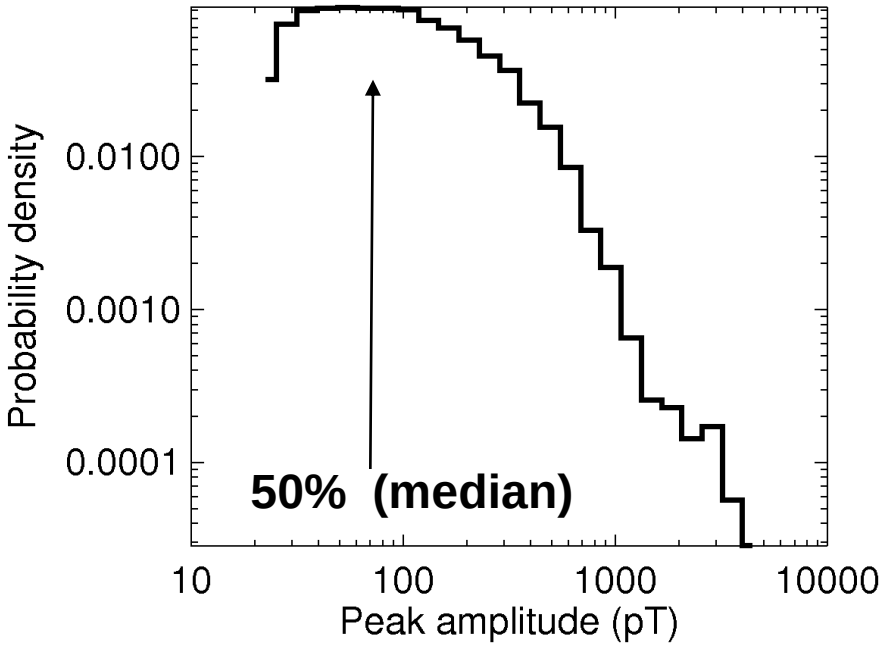


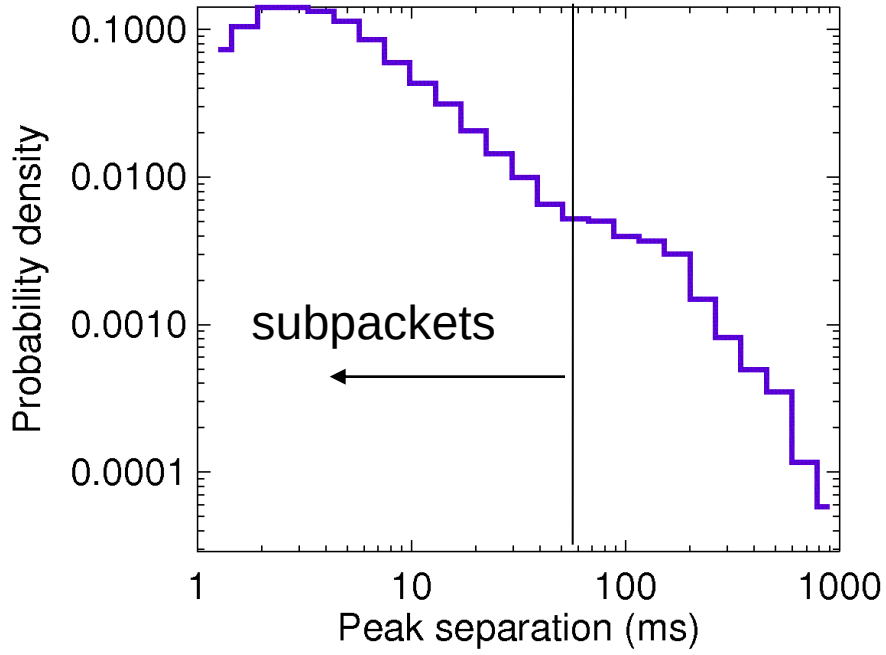
18 April 2002 0845-0854

WBD magnetic field waveforms

4 spacecraft, total time 520 seconds
1900 elements
37000 subpackets embedded
50% >80 pT 13% of time
41% >100 pT 11% of time
8% >300 pT **2% of time**
0.2% >1 nT **0.05% of time**
max 6.9 nT







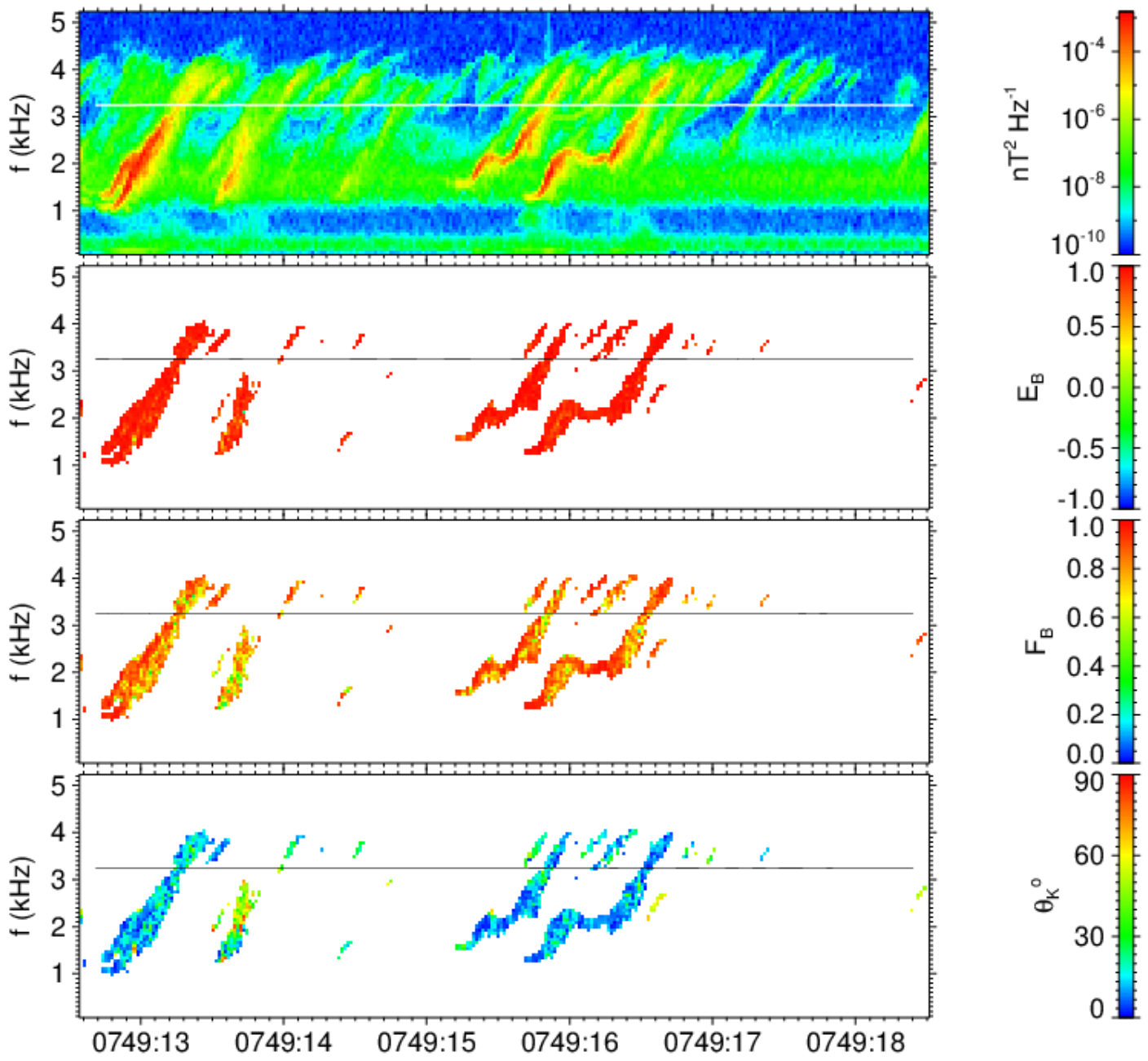
EMFISIS Waves, Van Allen Probe A, 14 April 2014

sum of the power-spectral densities of magnetic components

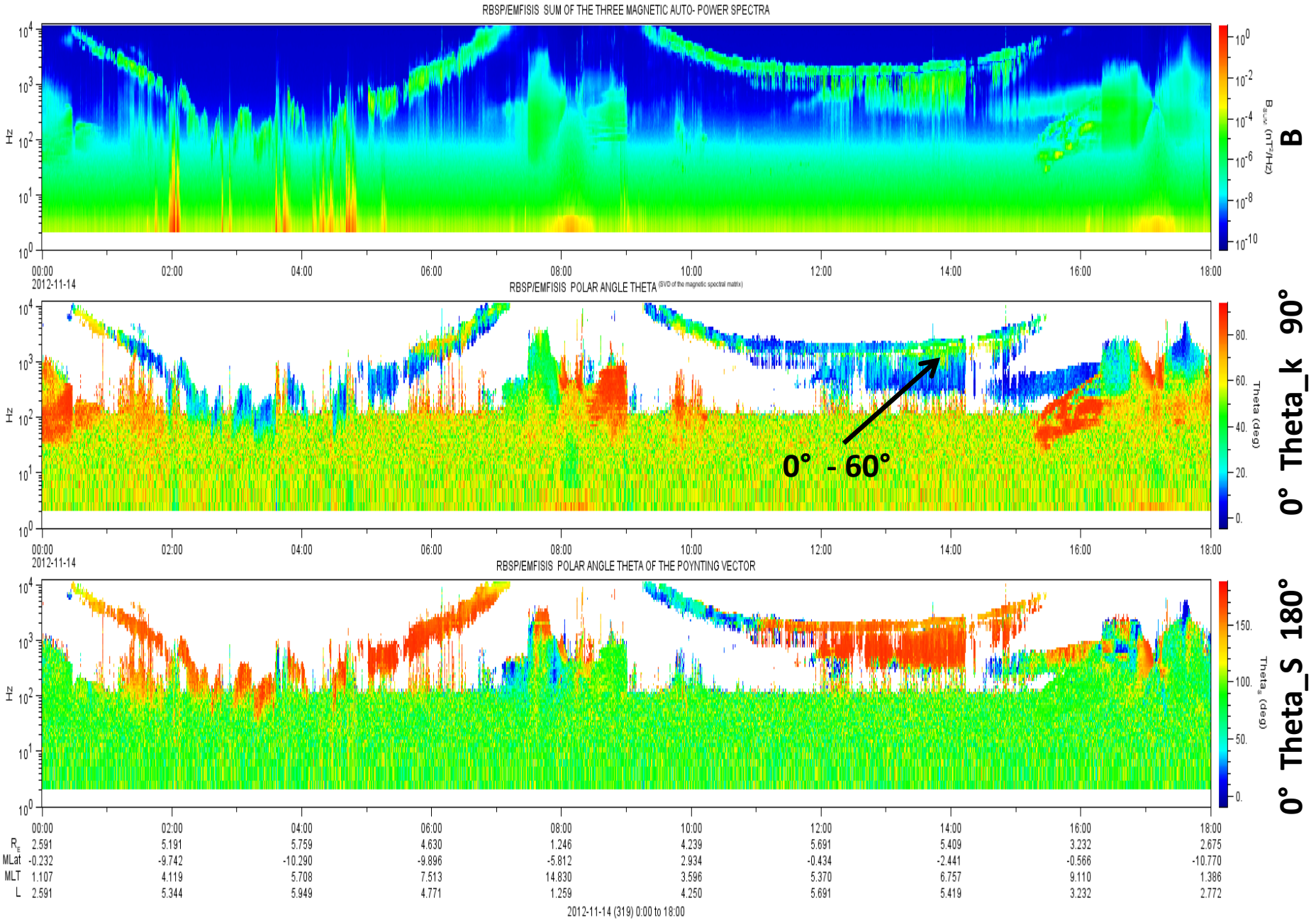
ellipticity of the magnetic field polarization

planarity of the magnetic field polarization

angle between the wave vector and the background magnetic field



EMFISIS Waves, Van Allen Probe A, 14 Nov 2012



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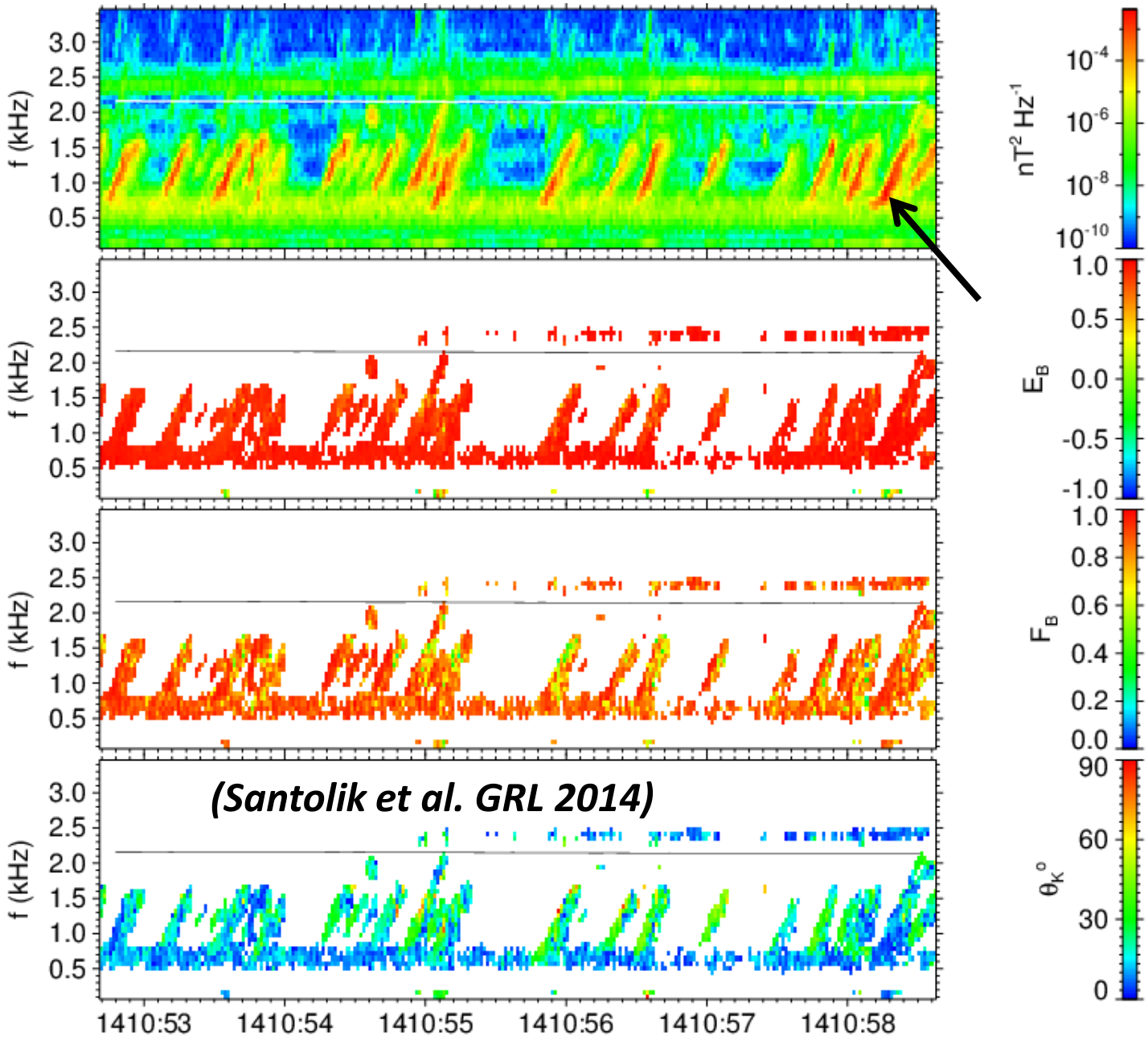


EMFISIS Waves. Van Allen Probe A. 14 Nov 2012

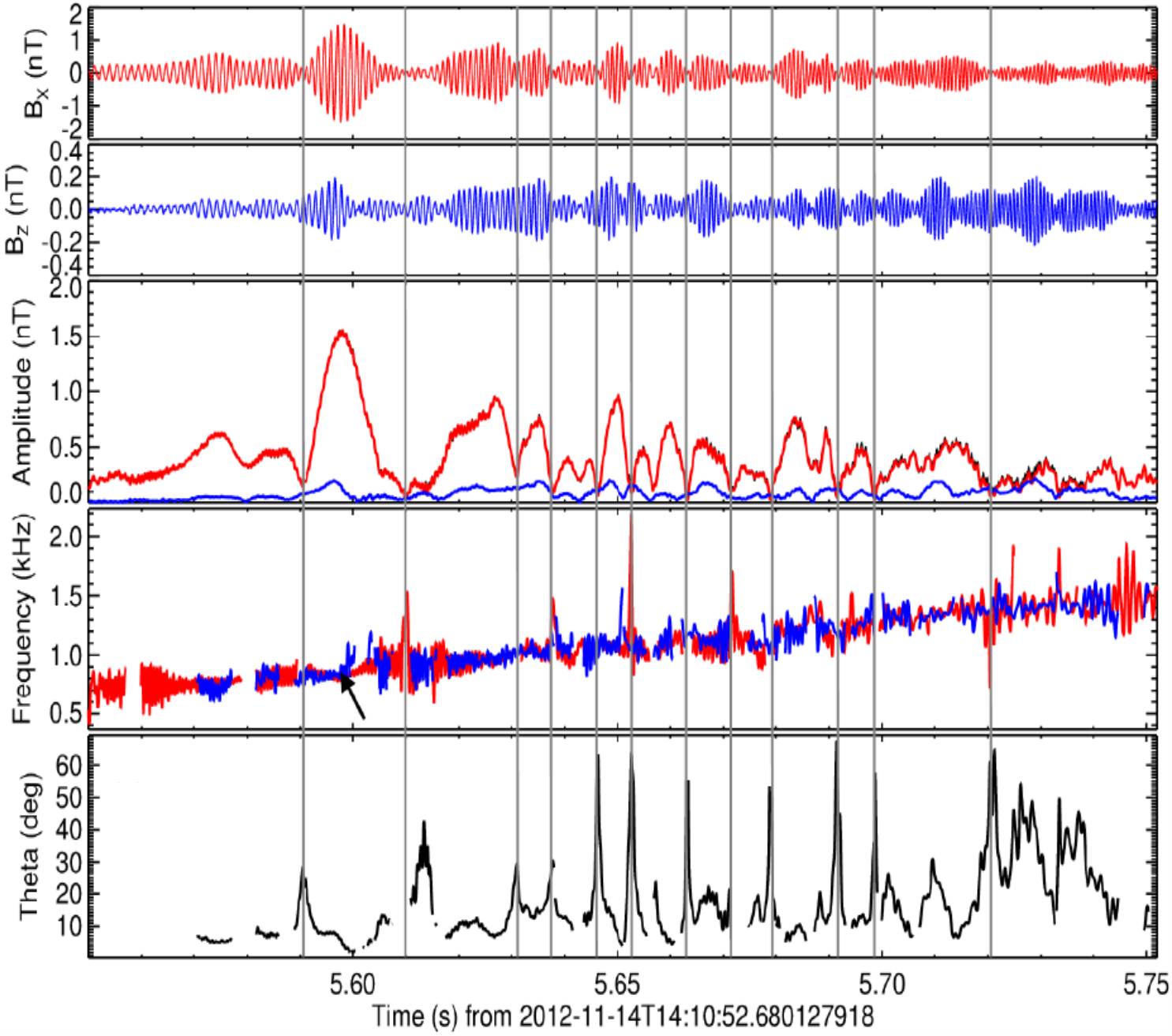
magnetic field perp. to B_0

parallel to B_0

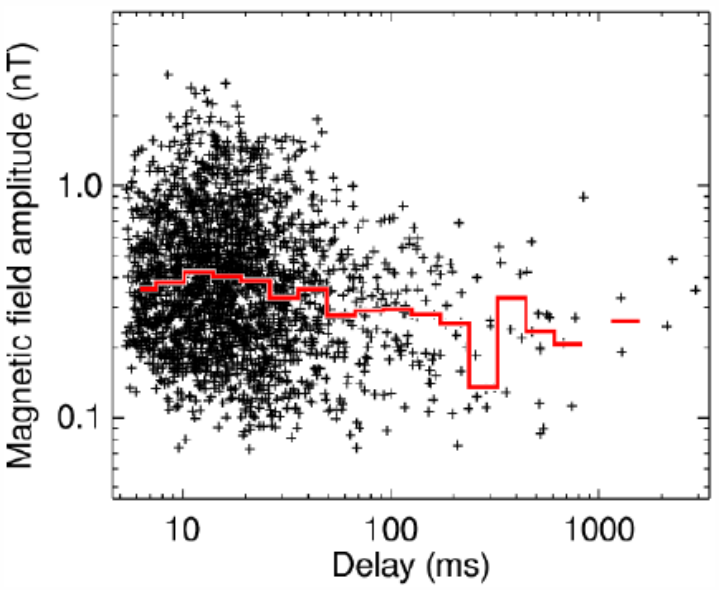
instantaneous amplitude

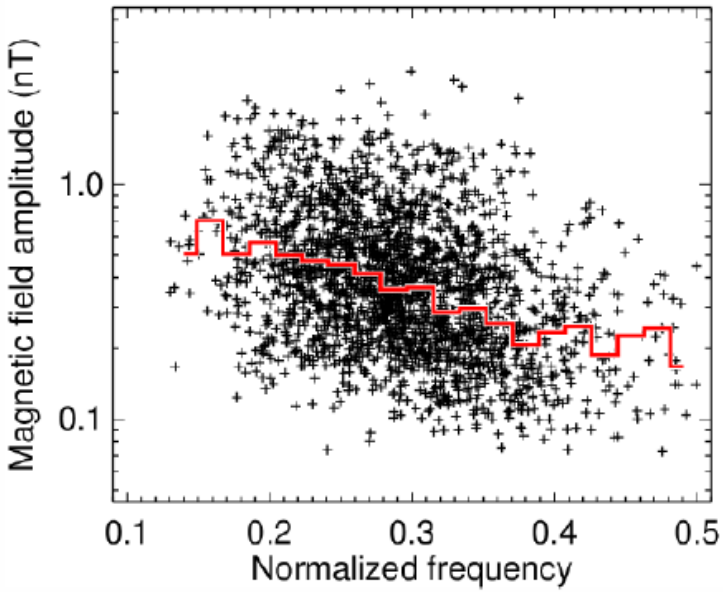
instantaneous frequency

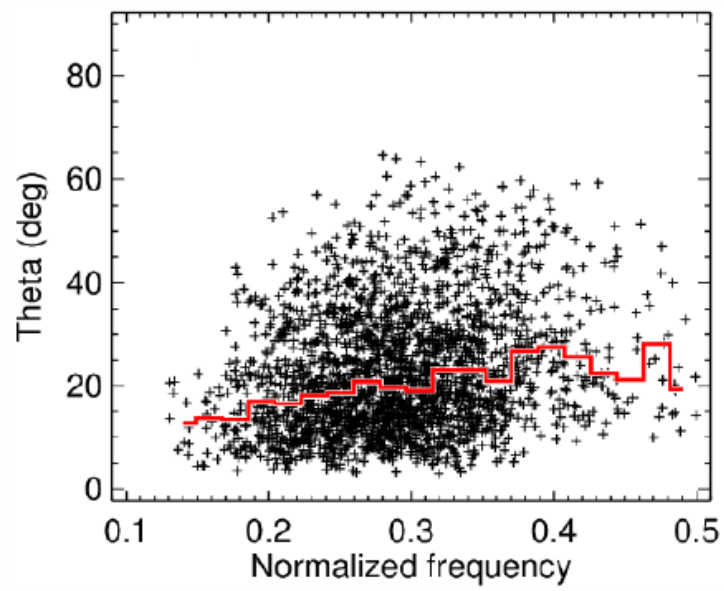
angle between the wave vector and B_0

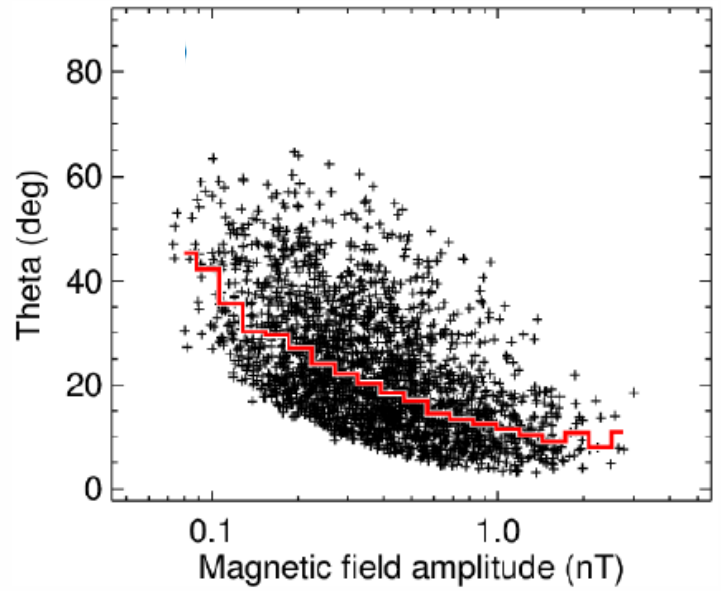


EMFISIS Waves, Van Allen Probe A, 14 Nov 2012









Summary

- New in situ measurements of whistler mode chorus have been collected by Van Allen Probes. We use multi-component waveforms to detect fine structure of chorus elements which can be important for the dynamics of the outer Van Allen radiation belt.
- The peak instantaneous amplitudes have been found at a level of a few hundred pT but they can also exceptionally reach up to a few nT.
- We also show that the wave vector direction turns by a few tens of degrees within a single chorus element and within its subpackets.
- Most intense subpackets propagate quasiparallel