OBSERVATIONS AND SIMULATIONS OF ELECTROMAGNETIC WAVES IN THE VAN ALLEN RADIATION BELTS
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We have analyzed several interesting whistler waves events using observations from the Van Allen Probes satellites.

As seen in the figures on this panel, the observations show that the whistler waves were localized within the regions of plasma density inhomogeneity.

In agreement with theoretical predictions, we have observed waves confined within enhancements, depletions, and along gradients of the plasma density called density ducts.

Given the wave and particle data, along with spacecraft trajectory data (shown on the next panel), we can extract the important parameters related to the event. This includes the wave amplitudes, frequencies, wavenumbers, and propagation angle.

We then use these parameters as inputs to numerical simulations developed by Dr. Anatoly Streltsov to model the observed events in maximum detail.

We use a magnetohydrodynamics code to simulate the propagation of the whistler waves within density ducts.

Simulations of the exact event conditions are ongoing, but preliminary results (seen below) show that the whistlers can become trapped in the density ducts with minimal leakage.

As the Van Allen Probes continue collecting data, we will look for other interesting events showing whistler wave ducting. We will analyze the events and model them to achieve physical understanding of the ducting process.

The results of this research will be important for proposed studies of launching whistler waves into the Radiation Belts to remove harmful energetic particles. This could be done with ground transmitters (shown below) or with spacecraft.

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