WHISTLER TURBULENCE CASCADE: PARTICLE-IN-CELL SIMULATIONS

S. Peter Gary[1], **Shinji Saito**[1], **and Hui Li**[1]

[1] *Los Alamos National Laboratory, Los Alamos, NM USA*

Solar wind observations, as well as MHD simulations, show that long wavelength magnetic turbulence in collisionless, magnetized plasmas yields magnetic power spectra which scale as $k^{-5/3}$ where k is the wavenumber. This domain is called the inertial range, by analogy with turbulent velocity fluctuations in neutral fluids. However, at wavelengths shorter than the ion inertial scale, the analogy with neutral fluid turbulence breaks down. Solar wind measurements, along with Hall MHD and electron MHD model simulations, show that inertial range spectra change character at wavenumbers near the inverse proton inertial length, breaking to steeper power law spectra with $k^{-\alpha}$ scalings such that $\alpha \geq 2$. Under the hypothesis that this change in character is due to the presence of non-Alfvénic fluctuations, rather than to dissipation, we have carried out the first particle-in-cell simulations of two-dimensional whistler turbulence. The computations, done in a homogeneous, magnetized plasma model, show that an initial ensemble of relatively long-wavelength whistlers exhibits a forward cascade to shorter wavelengths. The resulting spectra are relatively steep ($\alpha \geq 3$), relatively anisotropic (fluctuation energy is preferentially transferred toward directions perpendicular to the background magnetic field), and compressive. The magnetic compressibility increases, but α decreases with increasing amplitude of the initial fluctuations. Under appropriate conditions, the simulations yield electron velocity distributions which show both parallel heating associated with the Landau resonance with obliquely propagating whistlers, and perpendicular scattering associated with the cyclotron resonance with whistlers at propagation parallel to the background magnetic field.