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Topology of kinetic range turbulence in the solar wind: observations and simulations

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There is now considerable evidence that below ion gyroscales there is a kinetic range of turbulence that shows non-trivial scaling both in the power spectral density and in the higher order moments of fluctuations. We present an investigation of magnetic field fluctuations in sub-ion scale plasma turbulence in the solar wind, using high-cadence measurements from the STAFF search coil instrument on Cluster. We will compare observational results with sub-ion scale fluid model simulations such as Electron MHD and Electron Reduced MHD to shed light on the type of topological coherent structures that we might expect to see on these scales. Our results suggest current sheet domination at the MHD scales transitioning to filament domination at the sub-ion scales, which we attribute to the force-free structures (Beltrami fields) forming from the dominant Hall physics. Comparison of magnetic compressibility ratios (magnetic field component polarization ratios) seen as a function of plasma beta, with those exhibited by the different linear plasma modes from solutions of the linearised compressible Hall-MHD model. These suggest that the fluctuations seen in our observations share polarizations akin to highly oblique (near perpendicular) Alfven and Kinetic Alfven wave modes.