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Magnetic Reconnection May Control the Ion-scale Spectral Break of Solar Wind Turbulence

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The power spectral density of magnetic fluctuations in the solar wind exhibits several power-law-like frequency ranges with a well defined break between approximately 0.1 and 1 Hz in the spacecraft frame. The exact dependence of this break scale on solar wind parameters has been extensively studied but is not yet fully understood. Recent studies have suggested that reconnection may induce a break in the spectrum at a "disruption scale" , which may be larger than the fundamental ion kinetic scales, producing an unusually steep spectrum just below the break. We present a statistical investigation of the dependence of the break scale on the proton gyroradius ρ_i, ion inertial length d_i, ion sound radius ρ_s, proton-cyclotron resonance scale ρ_c and disruption scale as a function of $\beta_{\perp i}$. We find that the steepest spectral indices of the dissipation range occur when β_e is in the range of 0.1-1 and the break scale is only slightly larger than the ion sound scale (a situation occurring 41% of the time at 1 AU), in qualitative agreement with the reconnection model. In this range the break scale shows remarkably good correlation with . Our findings suggest that, at least at low β_e, reconnection may play an important role in the development of the dissipation range turbulent cascade and causes unusually steep (steeper than -3) spectral indices.

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