# High-Q Spectral Peaks Are Coherent From the Solar Wind to the Geomagnetic Field over 200-4000 μHz

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## Summary

This paper analyzes three 60 d sections of geomagnetic data from the Advanced Composition Explorer (ACE) located at the L1 Lagrange point and from Honolulu Observatory (HON) during 2001−2 using nonstationary spectral analysis tools. Power spectra at ACE have a -5/3 slope for log frequency vs log power over 200-4000 μHz (or 2500−125 s period), demonstrating the presence of Kolmogorov turbulence. Multitaper power spectra after post-whitening at both ACE and HON display the ubiquitous presence of narrowband ($\lesssim$ 2 μHz), very statistically significant ($p \geq 0.99$), high $Q$ (~100-1000) features. Canonical coherence analysis shows that the peaks are frequently coherent between ACE and HON at very high significance ($p \geq 0.99$) using a nonparametric permutation test approach. There is pervasive nonstationarity in the HON data as measured by the frequency offset coherence over 200−4000 μHz. The offset coherence is more subdued at ACE. The nonstationarity introduces additional peaks in the HON data that are not present at ACE. A mixture central/noncentral chi square model was fit to raw spectral estimates to model narrowband, high $Q$, quasi−deterministic features embedded in a stochastic background. The noncentral fraction is up to 35% of the power at ACE and HON, peaking over 2000-3000 μHz. These characteristics demonstrate that the solar wind is turbulent but can also support the presence of narrowband phenomena that propagate into the geomagnetic field. These features may be due to the presence of solar p-modes in the solar wind that couple into the magnetosphere and ionosphere, although the high nonstationarity at HON precludes certainty. The implications for geomagnetic induction will be explored.

**Keywords:** source field characteristics, nonstationarity