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Sounding plasma turbulence at sub-ion scales with Fast Iterative Filtering in space and time.

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We present the results from a spacetime study of Hall-MHD and Hybrid-kinetic numerical simulations of decaying turbulence. By combining Fourier analysis and Multivariate Iterative Filtering (a new technique developed for the analysis of nonstationary nonlinear signals) we calculate the $k\omega$-power spectrum of magnetic, velocity, and density fluctuations at the maximum of turbulent activity. Results show that the magnetic power spectrum at sub-ion scales is formed by localized structures and/or perturbations with temporal frequencies much smaller than the ion-cyclotron frequency Ω_i. Going toward smaller ion-kinetic scales, the contribution of low-medium frequency perturbations ($\omega < 3\Omega_i$) to the magnetic spectrum becomes important. Our analysis clearly indicates that such low-frequency perturbations have no kinetic-Alfvén neither Ion-cyclotron origin. At higher frequencies, we clearly identify signatures of both whistler and kinetic-Alfvén wave activity. However, their energetic contribution to the turbulent cascade is negligible. We conclude that the dynamics of turbulence at sub-ion scales is mainly shaped by localized intermittent structures, with no contribution of wavelike perturbations.