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Kinetic-Alfven and whistler waves in astrophysical plasma turbulence at subproton scales STANISLAV BOLDYREV, University Wisconsin-Madison, KONSTANTINOS HORAITES, University of Wisconsin -Madison, QIAN XIA, University Wisconsin-Madison, JEAN CARLOS PEREZ, University of New Hampshire — The analytical study of sub-proton electromagnetic fluctuations in a collisionless plasma with plasma beta of order unity is presented. In the linear limit, a rigorous derivation from the kinetic equation is conducted focusing on the role and physical properties of kinetic-Alfven and whistler waves. Then, nonlinear fluid-like equations for kinetic-Alfven waves and whistler modes are derived, with the special emphasis on the similarities and differences in the corresponding plasma dynamics. The kinetic-Alfven modes exist in the lower-frequency region of the phase space, $\omega \ll k_{perp}\, v_{Ti}$, where they are described by the kinetic-Alfven system. These modes exist both below and above the ion cyclotron frequency. The whistler modes, which are qualitatively different from the kinetic-Alfvén ones, occupy a different region of the phase space, $k_{perp}\, v_{Ti} \ll \omega \ll k_{z} v_{Te}$, and they are described by the electron MHD system or the reduced electron MHD system if the propagation is oblique. Here k_z and k_{perp} are the wave numbers along and transverse to the background magnetic field, and v_{Ti} and v_{Te} are ion and electron thermal velocities. The models of sub-proton plasma turbulence are discussed and the results of numerical simulations are presented. Possible implications for solar-wind observations are pointed out.

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