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The effects of ion beams on the growth and the dissipation of solar wind plasma temperature anisotropy

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The fast solar wind plasma close to the Sun at 0.3AU shows evidence of beams in the proton and α particles velocity distributions and turbulent magnetic fluctuations power spectrum (e.g., Helios I and II data). The beams are directed along the background magnetic field, and relax with heliocentric distance. For the first time we use the 2.5D and 3D hybrid expanding-box models to study the α and proton beams in the solar wind plasma for a range of parameters, relevant to the very inner heliosphere, in anticipation of Parker Solar Probe observations. We study the growth and nonlinear saturation of ion-kinetic instabilities driven by the alpha and proton beams, and the nonlinear interactions between protons and α streaming velocity distributions. We demonstrate the effects of the instabilities and solar wind expansion on the generation of the non-Maxwellian features in the ion velocity distributions, anisotropic heating, and on the magnetic fluctuations power-spectra in the high-frequency range near the ion gyrofrequencies. We conclude that the nonlinear evolution and relaxation of the ion beams may significantly affect the solar wind plasma properties at 1AU.