HYBRID MODELING OF MULTI-ION SOLAR WIND PLASMA HEATING

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Observations of the solar wind plasma show that heavy ions are propagating faster then protons by an Alfvén speed near 1AU. The velocity distribution of heavy ions, and protons show temperature anisotropy with $T_\perp > T_\|$, the opposite of the expected for collisionless adiabatic expansion. In addition, the velocity distribution of the ions is non-Maxwellian in the fast solar wind and proton velocity distribution contains beam components.The heating of solar wind plasma and the kinetic properties of protons and heavy ions are investigated using 1D and 2D hybrid kinetic models. In these models the dynamics of protons and heavy ions is followed as an ensemble of particles using particles-in-cell method of solution, while electrons are assumed to be massless neutralizing fluid. This approach allows to resolve the necessary temporal and spatial scale of ion heating processes. Linear solutions of the Vlasov dispersion relation are used to select the parameters of the hybrid models, and help interpret the results. I will discuss recent results of ion heating by a wave spectrum of ion-cyclotron waves in multi-component plasma. I will show the linear growth, nonlinear saturation of the ion temperature anisotropy, the resulting non-Maxwellian velocity distribution. I will discuss the effects of background plasma inhomogeneity on the propagation of the ion-cyclotron waves and on the heating of the heavy ions. I will discuss the observational implications of the results, and the expected signatures in remote sensing observations of ion emission lines.