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Hybrid simulation of magnetosheath plasma stretching

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In this paper we present results from a two-dimensional hybrid simulation study of slow stretching/expansion of the plasma as it flows through the magnetosheath (e.g. in the depletion region), which utilizes an expanding box model. In the code we impose the stretching/expansion as an external force: The physical sizes of the simulation box increase with time in two dimensions. We present results of a simulation which starts in a parameter region of high beta where the plasma is stable with respect to both the Alfvén ion cyclotron (AIC) and mirror instabilities. In this stable region the plasma behaves double-adiabatically and an important proton temperature anisotropy appears. When the plasma becomes unstable with respect to the mirror instability, the adiabatic behavior is broken and mirror waves keep the system close to marginal stability, the theoretical growth rate being about constant, small and positive. Mirror waves are continuously generated and the proton parallel beta decreases with time. This marginal stability behavior is disrupted for lower proton parallel beta, where the AIC mode becomes more unstable than the mirror one. AIC waves rapidly grow and coexist with mirror waves, in later times the growth of mirror waves is inhibited and AIC waves become dominant. During the stages dominated by mirror waves and AIC, anticorrelation between anisotropy and proton parallel beta is observed. The hybrid stretching/expanding box simulation is in agreement with the *in situ* observed marginal stability evolution of the magnetosheath plasma.