Formation of a broad plasma mixing layer via foward and inverse energy cascades of the Kelvin-Helmholtz instability

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2D MHD simulation of the Kelvin-Helmholtz instability (KHI) in a highly asymmetric density layer shows that rapid formation of a plasma mixing layer can be achieved by forward and inverse energy cascades of the KHI. The forward cascade is triggered by the growth of the secondary Rayleigh-Taylor instability (RTI) [Matsumoto and Hoshino, 2004, 2006] excited during the nonlinear evolution. The inverse cascade is accomplished by a nonlinear coupling of neighboring higher wave number modes. The growth rate of the largest vortex allowed in the system reached about four times the one predicted by the linear theory. By a combination of the turbulent evolution triggered by the secondary RTI and the rapid growth of the largest vortex, formation of a plasma mixing layer of a spacial scale of $7R_E$ (the earth radius) is achieved in a time scale of 10 minutes, when 1000km and 400km/s are adopted for the half width of the shear layer and the solar wind flow speed. The resultant diffusion coefficient reached ~10^{17} cm^2s^{-1}. The mechanism proposed here is responsible for the formation of the low latitude boundary layer (LLBL) for a purely northward IMF case.