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Vortex induced collisionless reconnection at the magnetopause – magnetosphere boundary

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The Earth's Magnetopause can be viewed as the boundary separating the Earth's magnetosphere and the solar wind. Therefore, the understanding of the dynamics at play in this region is of primary importance for space weather modeling. We focus our attention on the low latitude flank of the Magnetosphere where the velocity shear between the Magnetosheath and Magnetospheric plasmas is the energetic source of Kelvin-Helmholtz instability. On the shoulder of the resulting vortex chain, different secondary instabilities are at play depending on the local plasma parameters and compete with the vortex pairing process. Most important, secondary instabilities, among other magnetic reconnection, control the plasma mixing as well as the entry of solar wind plasma in the Magnetosphere. We make use of a two-fluid model, including the Hall term and the electron mass in the generalized Ohm's law, to study the 2D non-linear evolution of the Kelvin-Helmholtz instability at the Magnetopause – Magnetosphere interface, in the intermediate regime between subsonic and supersonic regimes.

In the presence of a weak in-plane magnetic field, the dynamics of the Kelvin-Helmholtz rolled-up vortices self-consistently generates thin current sheets where reconnection instability eventually enable spontaneous or induced fast reconnection to develop. This evolution enable to study guide field multiple-island collisionless magnetic reconnection as embedded in a large-scale dynamic system, unlike the classical static reconnection setups. This study provides a clear example of nonlinear, cross-scale, collisionless plasma dynamics.