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Plasma instabilities in a bounded system

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In space and astrophysical plasmas, the system size is often much larger than the characteristic scale of the phenomena, and in such cases the influence of the boundary can often be neglected. However, in some problems, the system size can be comparable to the characteristic scale of the phenomena. We considered a system in which a beam exists within a finite-sized sheet region bounded by strong magnetic fields, and carried out a linear mode analysis. It was found that only waves with discrete wavenumbers perpendicular to the beam can be excited within the region, and that these wavenumbers depend on system parameters.

As an example of such a system, we consider a current sheet bounded by strong magnetic fields. In situations such as during magnetic reconnection, beams or temperature anisotropies can form in the direction perpendicular to the sheet current. To model this, we performed two-dimensional full particle simulations with varying sheet thickness. When the sheet thickness was not very large, oblique propagation modes were excited within the sheet, similar to those reported by Lu et al. (2011). When the sheet thickness became significantly larger than the ion inertial length, Weibel instabilities propagating perpendicular to the sheet dominated near the center of the sheet which is consistent with the linear analysis in Infinite homogeneous plasma, while oblique propagation modes dominated near the edges. In this presentation, we will discuss the conditions for the excitation of oblique propagation modes.