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The Dynamics of Magnetic Vortices

The solar tachocline is a thin layer of the sun that is located between the radiative interior and the convective exterior. The dynanics is nearly two-dimensional and dominated by strong vorticity and shear. In this talk, we present recent investigations that use the Quasi-Geostrophic Magnetohydrodynamic (QG MHD) model to describe the dynamics of the solar tachocline since the deformations in the layer depth are small and the ambient rotation is strong compared to the local rotation rates. In particular, we revisit the classical test problems of Weiss (1966) to study the dynamics of magnetic vortices in the context of QG MHD that allows for an evolving magnetic field and weak deformations in the layer depth. It is determined that increasing magnetic fields tends to disrupt coherent vortices and forces energy to travel more to smaller scales.