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The Onset of Magnetic Reconnection: Tearing Instability in Current Sheets with a Guide Field

Magnetic reconnection is fundamental to many solar phenomena, ranging from coronal heating, to jets, to flares and CMEs. A poorly understood yet crucial aspect of reconnection is that it does not occur until magnetic stresses have built to sufficiently high levels for significant energy release. If reconnection were to happen too soon, coronal heating would be weak and flares would be small. As part of our program to study the onset conditions for magnetic reconnection, we have investigated the instability of current sheets to tearing. Surprisingly little work has been done on this problem for sheets that include a guide field, i.e., for which the field rotates by less than 180 degrees. This is the most common situation on the Sun. We present numerical 3D resistive MHD simulations of several sheets and show how the behavior depends on the shear angle (rotation). We compare our results to the predictions of linear theory and discuss the nonlinear evolution in terms of plasmoid formation and the interaction of different oblique tearing modes. The relevance to the Sun is explained.