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Two fluid stability of rotating tokamak plasmas using machine learning[1] DYLAN BRENNAN, Princeton University, ANDREW COLE, Columbia University, CIHAN AKCAY, JOHN FINN, Tibbar Plasma Technologies Inc — The stability boundaries of two fluid resistive instabilities in a tokamak with a resistive wall, are examined as a function of omega vs beta, the toroidal rotation frequency vs the ratio of thermal to magnetic energy. A numerical solver for the two fluid layer response is presented, which is valid across various two fluid regimes. The equilibria are stable for low beta, and the marginal stability values in beta and rotation are computed. The results show the Semi-Collisional regime to be most relevant to large tokamak experiments such as ITER. The stability boundary extends to lower beta as the frequency of the plasma response approaches that of the rotation. At high rotation, the plasma response has strong variation across the layer, breaking the constant-psi assumptions typically made in reduced models. Here the stability boundary is again found to move to lower beta, indicating that accurate treatment of two fluid layer responses is critical to quantitatively predicting the stability boundaries of disruptive modes. To facilitate a more fluid workflow in exploring these effects, regression models are trained on the numerical layer data to return the complex layer response given equilibrium quantities, rapidly producing new results as the equilibrium and outer region structure are varied.

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Dylan Brennan
Princeton University

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