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## Alfvénic instability and critical balance in ion-scale electromagnetic turbulence driven by electron temperature gradient

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We investigate the saturation of turbulence in a three-field, fluid model of a magnetised plasma in a Z-pinch magnetic geometry. The model is derived by taking a long-wavelength limit of gyrokinetics and subsequently ordering the electron-temperature-gradient (ETG) to be much larger than all other equilibrium gradients, while still retaining the curvature and magnetic-field-gradient drifts. This system is linearly unstable to two-dimensional, curvature-mediated ETG modes, which themselves are known to undergo a secondary instability and generate zonal-flows, as seen in the Hasegawa-Mima (HM) system. By including the linear terms associated with the parallel physics in the secondary instability calculation, we find a three-dimensional branch to the HM secondary instability. The unstable secondary modes are Alfvénic, and their growth rate is comparable to that of the zonal-flows. We present numerical evidence that the level of heat transport in simulations is strongly tied to whether this Alfvénic secondary instability is adequately resolved. Further, we argue that this is the mechanism by which our model breaks up its two-dimensional, unstable structures and establishes a critically-balanced cascade of free energy.

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