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Solitary zonal structures in subcritical drift waves: a minimum model[1] YAO ZHOU, HONGXUAN ZHU, ILYA DODIN, Princeton Plasma Physics Laboratory — Solitary zonal structures have recently been identified in gyrokinetic simulations of subcritical plasmas with background shear flows, while the physical mechanism that underpins these structures is not well understood. These structures share similarities with the drift-wave–zonal-flow (DW–ZF) solitons known as solutions to the modified Hasegawa–Mima equation (mHME). However, the solitons cannot be sustained when background shear flows are introduced to the mHME. We show that, by further including a primary instability in the mHME to model subcriticality, solitary zonal structures can readily be restored. Accordingly, these structures can also be retained in models that subsume the mHME and yield primary instabilities, such as the modified Hasegawa–Wakatani equation. Remarkably, all these structures satisfy the same "equation of state" of the DW–ZF solitons, which is a simple algebraic equation that connects the DW envelope and the ZF velocity.

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