On the existence of Petschek reconnection for a uniform resistivity

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Abstract: We address the controversial topic of the existence of a Petschek solution in steady-state magnetic reconnection for a uniform resistivity, by using recent results obtained in two-dimensional time-dependent magnetohydrodynamic simulations. The use of overspecified boundary conditions is shown to be an efficient simple procedure to set up a Petschek solution with a classical localized nonuniform resistivity that is exponentially decreasing from the *X* point. The response to changing the resistivity profile in various ways is then studied as a second step. It is found that a Petschek configuration is obtained when a quasiuniform resistivity is adopted. This is the case if the resistivity profile exhibits a weak negative gradient close to the *X* point, which dominates an inherent numerical contribution; otherwise an instability develops which disrupts the configuration. We conclude that a truly uniform resistivity is probably only marginally stable. Finally, we discuss the validity of the arguments given in the literature about the "incorrectness" of Petschek's original model.