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Quasi-linear theory of forced magnetic reconnection uniformly connecting linear and Rutherford regimes¹ WENLONG HUANG, Anhui University of Technology, PING ZHU, Huazhong University of Science and Technology, University of Wisconsin-Madison — Using the in-viscid two-field reduced MHD model, a new analytical theory is developed to unify the Hahn-Kulsrud-Taylor (HKT) linear solution and the Rutherford nonlinear regime. Adopting a quasi-linear approach, we obtain a closed system of equations for plasma response in Taylor's problem. An integral form of analytical solution is obtained for the forced magnetic reconnection, uniformly valid throughout the entire regimes from the HKT linear solution to the Rutherford nonlinear solution. In particular, the quasi-linear effect can be described by a single coefficient K_s . The HKT linear solution for response can be recovered when the index $K_s \propto S^{8/5} \psi_c^2 \rightarrow 0$. On the other hand, the quasi-linear current perturbation plays a key role in the island growth when $K_s \sim 1$. Our new analytical solution has also been compared with reduced MHD simulations with agreement.

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