

# The resistive wall mode in tokamaks: Adventures in the complex plane

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The pressure (measured by the parameter  $\beta \equiv p/(\frac{1}{2}\mu_0 B^2)$ ) of a future tokamak fusion reactor is severely limited by the amount of current (parameter  $q^* \sim 1/I_\varphi$ ) that can be tolerated in view of stability with respect to the external kink mode. For the record values of  $\beta$  reported in the literature, a conducting shell is required that is inconveniently close to the plasma. Obviously, this is (1) not attractive in a fusion reactor, (2) not effective on the time scale of resistive diffusion of magnetic field perturbations through the wall. The latter result in *the resistive wall mode instability*. Possible stabilization mechanisms include feedback and plasma rotation.

The new *solution path method* of constructing the full ideal MHD spectrum of *stationary plasma flows* [1], described in the first two chapters of our new textbook [2], has been generalized to include the dissipation of resistive wall modes. The solution path in the complex  $\omega$ -plane is modified by accounting for the energy dissipation in the resistive wall, whereas the eigenvalues on that path are found by imposing the boundary condition describing magnetic flux leakage. This results in characteristic solution path topologies that are instrumental in finding the parameter regimes of relative stability with respect to the resistive wall mode, incorporating both toroidal and poloidal plasma rotation.

[1] J. P. Goedbloed, Phys. Plasmas **16**, 122110 & 122111 (2009).

[2] J. P. Goedbloed, R. Keppens and S. Poedts, *Advanced Magnetohydrodynamics; with Applications to Laboratory and Astrophysical Plasmas* (Cambridge University Press, 2010).