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Edge instabilities and stability in free and fixed boundary plasmas[1] LINDA SUGIYAMA, Massachusetts Institute of Technology, HENRY STRAUSS, HRS Fusion, M3D TEAM — Magnetically confined fusion plasmas can achieve good confinement by operating in H-mode, using a D-shaped plasma cross-section with a magnetic X-point(s). The steep edge pressure gradient can destabilize electromagnetic instabilities, from large periodic edge crashes (ELMs) to small continuous oscillations, to stability. Applied nonaxisymmetric magnetic fields can pump out plasma density, altering edge pressure and stability. Nonlinearly, if the plasma magnetic boundary is free to move, edge instabilities can drive a tangle-like magnetic field structure [1]. Despite being a small perturbation phenomenon in Hamiltonian systems, the tangle does not appear in standard linearized plasma theory. Its largest deviation, near the X-point(s), is remote from the driving region and cannot grow on the same exponential time scale due to propagation delay. We clarify the nonlinear nature of the tangle and, using the M3D code, investigate differences in linear and nonlinear stability of edge instabilities, for fixed and free plasma boundaries.

[1] L. Sugiyama, et al., *Phys. Plasmas* **17** 062505 (2010).

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