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Nonlinear MHD effects on the structure of ELMs and edge instabilities[1] LINDA SUGIYAMA, M.I.T. — Toroidal fusion plasmas with steep edge pressure gradients exhibit many different types of electromagnetic instabilities in the plasma edge, ranging from large Type I ELM crash to saturated inter-ELM modes to small coherent oscillations without ELMs. Experimental observations find coherent spatial structures that typically have moderate toroidal numbers $n \sim 10$, which are poorly explained by the MHD linear eigenmode spectrum. While non-MHD effects may be important in some cases, within MHD alone strong toroidal and nonlinear mode coupling can produce such mode numbers for larger amplitude modes, when the full MHD model and plasma configuration are used. MHD also easily produces strong low-n harmonics (typically $n = 1$, but also higher) that have been observed in recent experiments. The low-n harmonics tend to be relatively larger in the magnetic field compared to density or temperature; most experiments have analyzed the magnetics. Strong $n = 1$ manifests as a band of higher-n field-aligned filaments that wraps once around the outboard plasma edge from top to bottom. Nonlinear effects are analyzed for a number of plasmas from different experiments with differing edge conditions and types of instability to attempt to determine what sets the dominant mode numbers.

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