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Role of explosive instabilities in high-beta disruptions in tokamaks

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Explosive growth of a ballooning finger is demonstrated in nonlinear magnetohydrodynamic calculations of high-beta disruptions in tokamaks. The explosive finger is formed by an ideally unstable n=1 mode, dominated by an m/n=2/1 component. The quadrupole geometry of the 2/1 perturbed pressure field provides a generic mechanism for the formation of the initial ballooning finger and its subsequent transition from exponential to explosive growth, without relying on secondary processes. The explosive ejection of the hot plasma from the core and stochastization of the magnetic field occur in Alfvenic time scales, accounting for the extremely fast growth of the precursor oscillations and the rapidity of the thermal quench in some high-beta disruptions.

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