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Non-linear interplay between edge localized infernal mode and plasma flow

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Quiescent H-mode (QH-mode) was first discovered in DIII-D as an ELM-free H-mode regime, which is usually accompanied by the presence of edge harmonic oscillations (EHOs). EHOs are believed to provide necessary transport to eliminate ELMs by dynamics of the plasma itself. The saturated kink-peeling mode has been suggested as a possible candidate for EHO. In this work, we consider another instability –the edge localized infernal mode (ELIM) –as a possible candidate, for plasmas where the large edge bootstrap current causes local flattening of the plasma edge safety factor, or even the magnetic shear reversal in the pedestal region. An ELIM is a low-n (n is the toroidal mode number) instability similar to the conventional infernal mode, but being localized at the plasma edge where safety factor is locally flattened. Finite plasma pressure in the pedestal region drives this mode. A saturated ELIM, due to non-linear interaction with toroidal plasma edge flow, can be responsible for EHO.
Our investigation is divided into three stages: (i) linear stability, or the ELIM onset condition, at a given plasma flow; (ii) comparison of various toroidal torques, generated by a linear mode instability; (iii) non-linear interplay between an ELIM and the toroidal plasma flow.

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