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P1.1031 Theory of external-infernal modes in high performance quiescent tokamak regimes

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Tokamak high-confinement regimes are normally affected by the presence of often violent edge localised modes (ELMs). ELMs deposit unacceptable peak heat loads causing a severe deterioration of the plasma facing components. Thus a vivid interest has arisen on the development of naturally ELM-free regimes. One of the most promising ELM-free regimes is the quiescent high-confinement (QH) mode. In QH plasmas, ELM activity is replaced by dominantly low-n steady mild rotating MHD edge harmonic oscillations (EHOs) pedestal localised. EHOs have been observed in DIII-D, ASDEX-U, JET, JT60 and NSTX. Particle transport is enhanced by EHOs allowing density and pedestal gradient control and potentially removal of fusion ash without the impulsive heat load problem. Extensive numerical modelling and dedicated experiments on DIII-D identify the E x B shearing rate as the key parameter for the QH accessibility with EHOs. A successful access to and control of this favourable regime, still requires a deeper understanding of its mechanisms in terms of basic stability concept. Within the ideal drift-MHD linear stability framework, we give a novel interpretation for the onset mechanism of these instabilities. Provided the possibility of edge infernal-type instabilities in QH plasmas, we show that the interplay of poloidal flows (MHD and diamagnetic) allows the suppression of short wavelength modes so that low-n oscillations, namely EHOs, can emerge. Our model retrieves several features measured experimentally such as mode rotation frequencies, radial struture, amplitude of the critical E x B shearing rate. The theoretical results are then applied to the interpretation of JET-C discharges exhibiting edge MHD activity in an ELM-free regime. In outlook these results can suggest improved diagnostics approaches and control tools for reactor grade tokamaks.

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