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Investigating the EDA H-mode edge

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The global pursuit of sustainable energy has placed nuclear fusion at the forefront of transformative technologies. My thesis will investigate the Enhanced Dα (EDA) H-mode as a promising no-ELM regime for future fusion reactors, that features the quasi-coherent mode (QCM), which enhances local transport, while avoiding edge-localized modes, and offering high energy confinement, minimal impurity accumulation, and compatibility with tungsten walls. By leveraging recent experimental observations at ASDEX Upgrade, this study will extend the EDA H-mode parameter space to the separatrix, possibly unveiling the physics behind this regime, which are not yet fully understood.

Key objectives include recover the plasma parameter profiles across the edge region, obtain empirical scaling laws to separatrix parameters, analyse turbulence regimes and transitions, and correlate confinement regime transitions with separatrix operational space. A comprehensive dataset encompassing plasma current, fueling rates, and heating power will be analysed to derive insights into the physics underlying this high-performance regime.

The results may be able to bridge the operational conditions of EDA H-modes at current tokamaks with the challenges posed by future devices such as ITER and SPARC, emphasizing the role of separatrix collisionality and pedestal gradients, while contributing to the broader goal of achieving stable, efficient, and sustainable fusion energy.

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