Abstract per la Prima Conferenza Italiana sui Plasmi 2026, Frascati, 3-6 febbraio 2026

Vertical Displacement Oscillatory Modes driven unstable by fast particles: a new fast ion instability of tokamak plasmas

F. Porcelli[1], D. Banerjee[1], S. Cavallero[1], C. C. Kim[2]

[1]DISAT, Politecnico di Torino
[2]SLS2 Consulting, San Diego, CA, USA

Abstract

Recent progress on the theory, numerical simulations, and experimental observations of Vertical Displacement Oscillatory Modes (VDOM) in tokamak experiments is reported [1]. VDOM are axisymmetric modes (toroidal mode number n=0) driven unstable by energetic particles and can have an impact on plasma disruptions, plasma edge stability and confinement [2, 3]. They are a candidate to explain Alfvén-frequency n=0 modes recently observed on JET [4], TCV, and MAST-U. The specific types of fast ion distribution functions that can provide an instability drive for VDOM are discussed. Numerical results obtained by the NIMROD code regarding the simulation of n=0 modes driven by fast ions are shown.

References

1. Porcelli, F., et al, *n=0 Vertical Displacements, impact of magnetic X-points, and Vertical Displacements Oscillatory Modes driven by fast ions in tokamak plasmas* in *30th IAEA Fusion Energy Conference*, IAEA, Editor. 2025, IAEA: Chengdu.
2. Barberis, T., F. Porcelli, and A. Yolbarsop, *Fast-ion-driven vertical modes in magnetically confined toroidal plasmas*. Nuclear Fusion, 2022. **62**(6).
3. Barberis, T., A. Yolbarsop, and F. Porcelli, *Vertical displacement oscillatory modes in tokamak plasmas*. Journal of Plasma Physics, 2022. **88**(5).
4. Oliver, H.J.C., et al, *Axisymmetric eigenmodes excited by alpha particle energy gradients in JET D-T plasmas*. Phys. Rev. Lett., 2025. **submitted July 2025**.