17th Technical Meeting on Energetic Particles and Theory of Plasma
Instabilities in Magnetic Confinement Fusion

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Numerical Studies on Saturated Kink and Sawtooth Induced Fast Ion Transport in JET

Tuesday, 7 December 2021 14:00 (30 minutes)

This presentation examines the energetic particle transport induced by saturated kink modes and sawtooth crashes in JET deuterium plasmas. It is known that kink mode-resonant transport[1-3] and phase-space redistribution from sawtooth crashes[4-5] can drive strong fast ion transport with dependencies on particle pitch and energy. Measurements with JET's Faraday cup fast ion loss detector array have shown that the internal kink growth phase preceeding sawtooth crashes produces substantial fast ion losses.[6] This report will numerically investigate the dominant energetic particle transport mechanism with a detailed examination of the fast ion phase-space dependencies, resonances, topological effects, and induced losses associated with the long-lived, resonant, kink mode and non-resonant sawtooth crash. The ORBIT-kick model[7] forms the basis of the transport studies with realistic fast ion distributions produced from TRANSP[8]. A recently created reduced model for sawtooth induced transport[9] is compared against the standard Kadomtsev model within TRANSP while the saturated kink modes are modeled with ideal MHD codes and analytic theory. Figure 1 compares ORBIT calculated and ECE meaasured T_e fluctuations for the saturated kink with methods based from [9] and demonstrates the power of the reduced modeling framework. The simulations are further validated against experiment with a newly developed synthetic Faraday cup fast ion loss detector[10] in addition to scintillator probe, neutron, and gamma-ray spectroscopy measurements.

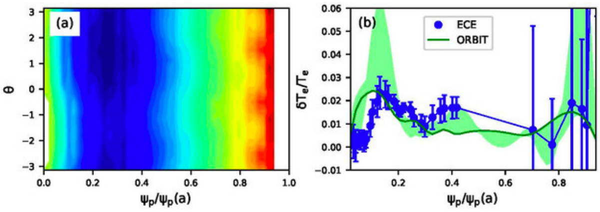

Figure 1: ORBIT calculated δT_e fluctuations found with a methodology similiar to reference [9] in (ψ_p, θ), (a), and the corresponding RMS ampltiude compared against ECE measurements, (b).

[1] Ya. I. Kolesnichenko, V. V. Lutsenko, et al. 1998 *Phys. Plasmas* **5** 2963

[2] Ya. I. Kolesnichenko, V. V. Lutsenko, et al. 2000 *Nucl. Fusion* **40** 1325

[3] R. Farengo et al. 2013 *Nucl. Fusion* **53** 043012

[4] D. Kim, M. Podesta, D. Liu, and F. M. Poli 2018 *Nucl. Fusion* **58** 082029

[5] D. Kim et al. 2019 *Nucl. Fusion* **59** 086007

[6] P. J. Bonofiglo et al. 2020 *Rev. Sci. Instrum.* **91** 093502

[7] M. Podesta et al. 2017 *Plasma Phys. Control Fusion* **59** 095008

[8] doi:10.11578/dc.20180627.4

[9] M. Podesta et al. 2021 *Plasma Phys. Control Fusion* Submitted

[10] P. J. Bonofiglo et al. 2021 *Nucl. Fusion* Submitted

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