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EX/P6-03: Fast-ion Redistribution and Loss due to Edge Perturbations in the ASDEX Upgrade, DIII-D and KSTAR Tokamaks

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The impact of Edge Localized Modes (ELMs) and externally applied resonant and non-resonant Magnetic Perturbations (MPs) on fast-ion confinement / transport has been investigated in the ASDEX Upgrade, DIII-D and KSTAR tokamaks. These studies were enabled by coordinated multi-machine experiments and new diagnostic capabilities that provide detailed experimental results of the interaction between energetic particles and instabilities in particle phase-space. New findings include: bursts of fast-ion losses induced by ELMs dominate the losses in H-mode plasmas as measured by fast-ion loss detectors (FILDs) at different toroidal and poloidal positions; in low-collisionality H-modes, ELM and inter-ELM fluctuations in fast-ion losses appear often strongly connected with main ELM properties and edge flows; filamentary fast-ion losses are observed during ELMs suggesting a strong interaction between fast-ions and the instabilities concomitant to the ELM blobs and filaments; large changes in escaping-ion phase-space are observed within single ELMs; during the mitigation / suppression of type-I ELMs by externally applied MPs, the large fast-ion blobs / filaments observed during ELMs are replaced by a loss of fast-ions with a broad-band frequency and an amplitude of up to 6 times higher than the NBI prompt loss signal without MPs; a clear synergy in the overall fast-ion transport is observed between edge perturbations and internal MHD fluctuations such as Alfvén Eigenmodes (AEs) and sawteeth. Measured fast-ion losses are typically on banana orbits that explore the entire pedestal / Scrape-Off-Layer (SOL). A systematic study of the observed fast-ion losses induced ELMs (mitigated and not-mitigated) and MPs as a function of the MP configuration and magnitude will be presented together with F3D-OFMC and ASCOT simulations of the MP induced fast-ion losses.

Country or International Organization of Primary Author

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Collaboration (if applicable, e.g., International Tokamak Physics Activities)

multi-machine contribution: AUG, DIII-D and KSTAR

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