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P5.1093 Role of electrostatic fluctuations in the loss of runaway electrons in ADITYA-U tokamak

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Formation of relativistic runaway electrons (REs) beam during plasma disruption, which can seriously damage the first wall, is a major threat to the safety of large tokamaks like ITER. In order to suppress the disruption-generated runaway beam, techniques such as massive gas injection, resonant magnetic perturbations etc. are tried out, but their adequacy are yet to be fully established [1]. Hence a better understanding of REs loss mechanism is crucial for the development of better RE mitigation schemes. The dependence of RE loss on magnetic as well as edge electrostatic fluctuations have been studied in ADITYA-U [2] tokamak (minor radius, a=25 cm and major radius, R=75 cm). The studied discharges have: plasma current 80-120 kA, chord-averaged electron density ~ (1-4) × 10^19 m^-3, chord-averaged electron temperature ~ 200-500 eV and toroidal magnetic field ~ 0.75 - 1.2 T. Earlier in ADITYA tokamak it had been observed that the overlapping of two MHD islands (m/n=2/1 & 3/1) significantly enhances the radial RE transport [4], whereas the RE transport is reduced when good magnetic surfaces stay between the islands. In addition to that, it has been observed that the turbulent electrostatic fluctuations in the edge of ADITYA-U also play a dominant role in the RE loss mechanism. The edge electrostatic fluctuations are suppressed by the periodic gas puffs and it has been shown that it leads to substantial decrease in HXR flux intensity signifying reduction in RE loss. The HXR flux intensity decreases by >80% during the suppression of turbulent electrostatic fluctuations in edge plasma after the injection of gas puff. In this paper, we present the experimental observations demonstrating the strong effect of electrostatic fluctuations on RE dynamics in the edge region of ADITYA-U tokamak. The study provides a basis to explore the possibility of a new RE mitigation scheme based on enhancing seed RE loss with the assistance of external electrostatic perturbations.

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[2] Tanna, R, Raj, Harshita , J.Ghosh, et.al , (2019) Nucl. Fusion, Accepted Manuscript

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