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Data Analysis of Quasi-Two-Dimensional Nonlinear Interactions in Avalanchelike Phenomena in HL-2A Plasmas

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Extensive studies on regulations of the plasma profile by flucating modes may shed light on the plasma control techniques for ameliorating impurity content and plasma performance [1]. In this report, we present the data processing of radially distributed BES measurements related to the two-dimension mapping of the avalanche structure and its related impurity analysis in the HL-2A neutral beam heated H-mode plasmas[2].
To gain deeper understanding of the generation of avalanche, the cross-correlation function (CCF) analysis has been performed to the radially distributed BES channels illuminating a radially elongated structure. In addition, we have investigated possible nonlinear interactions among various turbulence components. It is demonstrated that the avalanche gets energy from and modulates ambient turbulence via nonlinear interaction from the bi-spectrum analysis of the density and magnetic fluctuation data. The significant coupling around f2 ˜150 kHz indicates that the nonlinear three-wave interaction is responsible for the avalanche generation.
Furthermore, the impurity behavior during avalanche is further investigated by numerically simulating the impurity transport process. The impurity tranpsort is calculated using STRAHL code, and fitted to experimental meausrements, including the derived C6+ profile calculated based on the multichannel CXRS data using CHEAP code and the time evolution of FeXVI measured by VUV spectrometer. The impurity data analysis suggests that the avalanch provide a transport channel for avoidance of heavy impurity accumulation.
References
[1] Doyle, E. J. et al. Chapter 2: Plasma confinement and transport. Nucl. Fusion 47, S18 (2007)
[2] Sun T. F., Liu Yi et al Nucl. Fusion 61, 036020 (2021)

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