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Study of Nonlinear Phase of the ELMs by Comparison between ECEI ELM Observation and Nonlinear MHD Simulations

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A control of the ELM-crash is required for a stable plasma operation in a fusion reactor if the H-mode is adapted as an operation scenario. In the KSTAR H-mode plasma, a comparative study between 2D ECEI images of ELMs and MHD simulations has been performed in order to study the underlying physics of the ELM necessary for establishing an effective and robust ELM control. As a first step, the BOUT++ linear simulation is used to generate a mode structure at the edge of the H-mode plasma. The simulation results are converted into the synthetic images and compared with the observed images. An excellent agreement between two images provides confidence on ECEI edge observation. With same set of equilibria, a linear stability is investigated using BOUT++ and M3D-C1. The results from two codes are qualitatively matched. In the JOREK simulation, an apparent poloidal rotation of the mode is studied. The reproduced rotation is agreed well with the measured one by ECEI as ~ 5 km/s in ion diamagnetic drift direction. Since recently observed ELM dynamics in KSTAR, for example, saturation and transient phase before the crash, multiple mode excitation and mode number transition during inter-ELM-crash periods, are associated with the nonlinear phenomena, the nonlinear simulation should be considered in comparative study. Preliminary nonlinear BOUT++ simulation results were obtained and post analysis process was established. A post analysis process of other two codes will be also developed for the comparison with the ECEI observations. Ultimately the comparative study between the observation and the nonlinear simulations will make a possible to study the role of electron and ion during the ELM-cycle, effect of diffusion coefficient and rotation on ELM dynamics. This work is supported by NRF of Korea under contract no. NRF-2014M1A7A1A03029865.

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