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Self-consistent multi-scale integrated modeling of ELM mitigation due to SMBI

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Plasma facing materials will be damaged due to high heat and particle exhaust during ELMs. It is crucial to find out the mechanism of ELM (edge localized mode) mitigation for the next generation tokamak, especially for ITER and future devices. SMBI has been successfully applied to mitigate the ELMs especially for Type-I ELMs in experiments on many magnetic confined devices. Transport dynamics during SMBI [1] and nonlinear ELM physics [2-4] during fueling have been simulated separately before. The simulations of mean profile variations and fuelling depths during SMBI with *trans-neut* code have been benchmarked well with TPSMBI code in both 1D slab and cylindrical coordinates under various simulation conditions [5] and have also been validated with HL-2A experiment measurement of mean profile variation and Dα signals during SMBI in a real HL-2A tokamak geometry [6,7]. However, it is still a great challenge to self-consistently simulate the whole ELM cycle by doing the multi-scale coupling between the transport on macroscopic scales and the ELM on microscopic scales. In this paper, we have developed one self-consistent two-fluid physical integrated model which couples the transport during SMBI and ELM crash MHD physics. One integrated modeling code, named *trans-turb-couple*, has been developed on OMFIT platform. The integrated model will be introduced. The self-consistent coupling scheme and the integrated code development on OMFIT platform will be explained. The integrated simulation results of ELM nonlinear physics, turbulent particle and heat transport due to ELM, mean plasma profile evolution during ELM crash process and the pedestal recovering process with external heating and fueling sources. It will also make comparisons of ELM nonlinear integrated simulations with and without SMBI in HL-2A real tokamak geometry to find out the underlying physics of SMBI induced ELM mitigation.

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