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Fluid Simulation of Particle and Heat Fluxes during Burst of ELMs on EAST and DIIID

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In this paper we report the simulations of the evolution of the particle and heat flux during the burst of ELMs in realistic discharges on DIIID and EAST tokamaks. A set of six-field two-fluid equations based on the Braginskii equations with non-ideal physics effects is found to simulate pedestal collapse under the BOUT++ framework [1]. In general studies with shifted-circular geometry, the analysis of radial transport coefficients indicates that the ELM size is mainly determined by the energy loss at the crash phase. The typical values for transport coefficients in the saturation phase after ELM crashes are Dr~200m2/s, χir~χer ~ 40m2/s. The DIIID ELMy H-mode discharge #144382 is a lower single-null, small ELM crash event detected with multiple fast acquisition data chords in the pedestal, scrape-off layer (SOL) and divertor [2]. The measured density, temperatures and electric field profiles inside the separatrix are used in our simulation. The ELMs of this discharge is destabilized by the resistive-ballooning modes according to the linear analyzes. In order to consider the kinetic modification of parallel transport in SOL, the sheath limit of the flux limited expression are applied for the parallel thermal conduction. The energy loss during our simulation is around 18kJ, which is close to the experiment measured value 17kJ. The collapse width of the electron density profile is the same as the measurements. The peak amplitude of heat flux distributions on divertor targets in our simulation is 700W/cm-2 at 0.28ms after ELM crash, compared to the measured value 500W/cm-2. The radial heat flux distributions indicate that this ELM is convective dominant. For EAST ELMy H-mode discharge #38300 [3], which is close to double null geometry, the measured profiles of density and temperatures inside the separatrix are used in our simulation. This discharge is ideal peeling-ballooning unstable. The power loss of the simulation is around 0.7MW, which is the typical value of EAST discharges with LHCD. The dependency of the direction of toroidal magnetic field on the asymmetric distribution of particle fluxes on upper and lower divertor targets will be reported in this paper.

[1] Nuclear Fusion, 53, 073009 (2013).
[2] M.E.Fenstermacher, et al. 40th EPS, P4.104.
[3] PPCF., 55, 125008 (2013).

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