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Impact of the Pedestal Plasma Density on ELM Dynamics and Energy Loss Scaling[1] X.Q. XU, LLNL, J.F. MA, UT Austin, G.Q. LI, CASIPP, BOUT++ COLLABORATION — The latest BOUT++ studies show an emerging understanding of ELM dynamics and the consistent collisionality scaling of ELM energy losses with ITPA multi-tokamak database. A series of BOUT++ simulations are conducted to investigate the scaling characteristics of the ELM energy losses vs collisionality via a density scan, while keeping the plasma cross-sectional shape, total stored energy, total plasma current, pressure profiles fixed. The neoclassical collisionality at peak gradient position increases by a factor of 3262 from 0.0019 to 6.197. The critical trend of linear simulations emerges as a transition from ballooning-dominated states at high collisionality to peeling-dominated states at low collsionality with decreasing density. Nonlinear BOUT++ simulations show a two-stage process of ELM crash evolution of (i) initial bursts of pressure blob and void creation and (ii) inward turbulence spreading as void propagation. The inward void propagation stirs the top of pedestal plasma and yields an increasing ELM size with decreasing collisionality after a series of micro-bursts. The pedestal plasma density plays a major role in determining the ELM energy loss through its effect on the edge bootstrap current and ion diamagnetic stabilization.

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