# ELM simulation in CFETR steady state scenario

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EPED1 model and self-consistent core-pedestal coupling in the integrating modeling is used to design the pedestal structure of the China Fusion Engineering Testing Reactor (CFETR) steady state scenario. The key parameters, such as $\beta_p$ and $q_{95}$, are based on the grassy edge-localized-mode (ELM) experimental database. In this work, we use the BOUT++ 6-field two-fluid code to simulate the onset of the ELM in CFETR steady state scenario. The ELM size is around 0.2% in nonlinear simulations, which is in the experimental range of the grassy ELM discharges, 0.1%~1% observed in multiple tokamak devices. Linear and nonlinear simulations show the dominant high-n ballooning modes peak around n=40. Comparing to the Type-I ELM crashing dynamics, the grassy ELM crashing has a smaller initial crash and is then followed by three phases of the turbulence spreading stage, which are dominated by multi-modes, high-n mode of n=45 and low-n mode of n=5, respectively. Different from Type-I ELMs, perturbation of high-n mode has a narrow width around $\psi = 0.95$, and magnetic island formation and reconnection occur only beyond $\psi = 0.95$ , leading to a small initial crash. Mode-mode interaction in multi-mode coexistence stage stops the growth of individual mode and reduce the transport of particle and heat. And these are the two reasons why the ELM size is small. The in-out asymmetry of transient heat flux with a ratio of $E_{out}/E_{in} = 3.4$ is found during grassy ELM crash. To evaluate the erosion of the divertor target, the energy fluence at the outer divertor target is calculated, which is 0.029 MJ/m$^2$, 5.5 times smaller than the tungsten melting limit 0.16 MJ/m$^2$. The calculated energy fluency still follows the experimental scaling law from Type-I ELM experiments. The heat flux is dominant by the filaments, which can be seen at the outer mid-plane (OMP) and outer target. And the heat flux is significantly widened by the filaments.