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Multi-Machine Modelling of ELMs and Pedestal Confinement: From Validation to Prediction

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Future devices like JT-60SA, ITER and DEMO require quantitative predictions of pedestal density and temperature levels, as well as divertor heat fluxes, in order to improve global confinement capabilities while preventing divertor erosion/melting in the planning of future experiments. Such predictions can be obtained from dedicated pedestal models like EPED, and from non-linear MHD codes like JOREK, for which systematic validation against current experiments is necessary. In this paper, we show progress in the validation of the JOREK code using MAST, AUG, JET-ILW and JT-60U simulations, with quantitative comparisons to experiments (including ELM energy losses and divertor heat fluxes), and we present the latest achievements of EUROPED as an extension of the EPED model, to clarify the pedestal width description based on kinetic ballooning modes (KBMs) and turbulence. In particular, we describe how JOREK and EUROPED have been coherently coupled to improve pedestal predictions in cases where ideal MHD fails to describe experimental observations, which is the case for many type-I ELMs in JET-ILW. EUROPED is used to provide JOREK with the pedestal width for a given pulse, and JOREK then evolves the pedestal height until the ELM-onset is reached. In ELM-onset simulations for JET pulse number 82630, the pe_ped at the ELM-onset found by JOREK is lower than the linear ideal MHD peeling-ballooning limit, and close to the experimental value.

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Primary author: Dr PAMELA, Stanislas (CCFE - UKAEA)

Presenter: Dr PAMELA, Stanislas (CCFE - UKAEA)

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