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P2.1030 Characterization of divertor heat fluxes in partially detached L-mode plasmas at COMPASS

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Partial detachment is the required regime for the baseline burning plasma scenario in ITER and next step devices, as it allows to convert the majority of the energy carried by charged particles through the scrape-off-layer (SOL) into isotropic radiation and thus avoids a localized heat flux deposition in the divertor region.
Traditionally, the heat flux footprint in attached plasmas was analyzed using a fit to a special function - a convolution of an exponential decay and a Gaussian broadening. This approach reflects the simple model of transport in the SOL the exponential decay of heat flux upstream and its broadening due to collisional processes and finite Larmor effects downstream. Since this function has 5 fitting parameters, it can be technically used to fit profiles in almost any conditions. However, should power dissipation become significant (as it is the case in detached plasmas), the two main parameters, q and S, lose their original meaning. In this work, we present two novel approaches to characterize such divertor heat flux profiles using experimental results from the COMPASS tokamak, where variable amounts of nitrogen seeding were applied into L-mode plasmas to achieve partial detachment [1].
The first approach we introduce is based on construction of a buffered heat flux qbuff, the heat flux which is removed from the footprint due to power dissipation. It was found that the radial profile of qbuff can be well characterized by an exponential decay and both fitting parameters depend linearly on the nitrogen content in the vessel. The success of this technique, however, relies on the availability of high-resolution divertor probe diagnostics, which may not be accessible on all machines. The second approach aims at characterizing the footprint by a new set of generic parameters: (i) peak heat flux qpeak, (ii) fraction of power delivered to the target fdiv and (iii) divertor footprint spreading factor Sf, which characterizes the spatial extend of the footprint. Possible application of both approaches on data from other machines is discussed.
[1] M. Komm et al., submitted to Nucl. Fusion (2019)

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