Studying the pedestal dynamics with high time-resolution density profiles predicted via machine learning

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In this work, we use machine learning to predict the electron density profile from reflectometry data [1], with the aim of achieving an accuracy close to HRTS (High Resolution Thomson Scattering) [2]. This allows an increase in the sampling rate, from Hz (the HRTS sampling rate) to kHz (the rate of reflectometry reconstructions), while keeping the spatial resolution of HRTS. For this purpose, the model was trained to transform the reflectometry data into a prediction of what the HRTS profile would look like at the same point in time. We employ this method to generate such density profiles in order to study the temporal dynamics of the JET pedestal during ELM (edge-localized mode) cycles. Specifically, we focus on the following pedestal parameters: pedestal top, position, width, and gradient. The parameters are obtained using a modified hyperbolic tangent fit, which is the same fitting function that was used to create the JET pedestal database [3]. The analysis is applied on the pulse that achieved the current energy record in the recent D-T (deuterium-tritium) campaign at JET. The results show a gradual increase in the pedestal top and gradient, as well as a narrowing of the pedestal width and an inward shift of the pedestal position between ELM crashes. At the ELM crash, it is possible to observe that the pedestal top and gradient abruptly drop, with the pedestal width rapidly increasing and the position shifting outwards.

References

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This work has been carried out within the framework of the EUROfusion Consortium, funded by the European Union via the Euratom Research and Training Programme (Grant Agreement No 101052200 — EUROfusion). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them.