Fast measurements of ion temperature in ELM filaments in the ASDEX Upgrade scrape-off layer

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Interaction of plasma filaments with the main chamber during ELMs, and to lesser extent during inter-ELM periods, might be an issue for the first wall lifetime in future burning plasma reactors such as ITER. However, the understanding of the ELM filament transport in the scrape-off layer (SOL) is still incomplete. This is partly because important ELM filament parameters, such as the radial propagation speed or the electron temperature, are measured only sporadically. One of the key quantities, the ion temperature in ELM filaments, $T_{i,fil}$, is not measured at all on the filament time scale.

We present the first fast measurements of $T_{i,fil}$ in the ASDEX Upgrade (AUG) far SOL, obtained from a new $E \times B$ analyser [1]. Type I ELMs were sampled with the acquisition frequency of 2 MHz in the discharges with the total heating power of 13.2 MW. The measured $T_{i,fil}$ tends to decrease over an ELM, similar to the ion saturation current density in ELM filaments. These observations provide evidence that primary, more intense filaments are characterized by larger radial propagation speeds, consistent with some earlier observations [2] as well as the interchange modelling [3]. The measured $T_{i,fil}$ agrees with the predictions from a simple fluid model of the ELM filament transport in the SOL [4]. At the same time, $T_{i,fil}$ averaged over an ELM is consistent with the ELM ion temperature obtained from earlier retarding field analyser measurements in AUG [5].