H-Mode confinement properties close to the power threshold in ASDEX Upgrade

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The H-mode is foreseen for ITER as baseline scenario. Its confinement properties and the heating power threshold required to enter it are predicted by scaling laws deduced from international data bases. The prediction indicates that a device like ITER will operate at heating powers only slightly above the power threshold, whereas a large part of the confinement data used for the prediction have obtained in present tokamak with heating power significantly above the power threshold. It is therefore essential to assess the confinement behaviour of H-modes just above the power threshold. This is the aim of the present paper which is based on confinement and power threshold data from ASDEX Upgrade.

For this purpose, the confinement quality is characterized by the H-factor, $H98y2$, which quantifies the confinement time with respect to a widely used scaling, $ITERH98y2$. In addition, the heating power is compared to the threshold power P_{thres} provided by the scaling law derived from the ITPA threshold data base. For ASDEX Upgrade one finds a large number of discharges exhibiting $H98y2 \approx 1$ in the range $1. \leq P_{heat}/Pthres \leq 1.5$. One observes that the probability for small ELMs (type-III in general) to occur increases with decreasing P_{heat}/P_{thres} and they have a tendency to populate the region $H98y2 < 1$, but type-I ELM discharges with good confinement contribute by a large amount to the data. Our study indicates that the shots with good confinement but low heating power cover the whole operational range of ASDEX Upgrade: the are not restricted to any particular region in plasma current, edge safety factor, density or shaping. Values up to 2.3 for β_N with $\nu^* \geq 0.1$ were obtained. Moreover, such discharges are also found at densities close to the Greenwald limit. These shots exhibit, as expected, a trend to better confinement as triangularity increases which is favorable for ITER. As these data points are taken at a given time in the discharge, after the L-to-H transition, we have verified that this state has not been obtained by applying at any time before a high power which would not be possible in ITER.

These results will be discussed and the confinement dependencies found in ASDEX Upgrade compared to the usual scaling law. The effects of edge parameters as well as ELM type will also be presented.

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