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Advanced tokamak experiments in full-W ASDEX Upgrade

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Since 2007 the tokamak ASDEX Upgrade (AUG) successfully operates with fully W-coated plasma facing components. Operation in this environment is facilitated using high levels of deuterium puff to minimize W erosion of the out-board limiters by ELMs and by seeding impurities in order to control divertor temperature at a low level to protect especially the W-coatings of graphite tiles. These measures effectively mitigate W erosion and accumulation, but are incompatible with operation at collisionalities low enough to obtain significant global current drive with the available means, i.e. NBCD and ECCD at high power levels. As a consequence advanced tokamak studies relying on the modification of current profiles by external current drive made poor progress in the first years following full W coverage. Additionally, polarized reflections of Halpha-light from W-coated surfaces distort the current profile measurement based on the Motional Stark Effect, as it turned out several years later. This contribution reports on how these multiple operational restrictions have been overcome in AUG with a variety of measures including optimization of shape and gas puff timing, change to a full-W divertor with better pumping and optimization of the heating schemes. In parallel current profile diagnostics have been significantly improved, including polarimetry. Equilibrium reconstruction has been included into the concept of integrated data analysis, allowing a direct analysis of the influence of stochastic and systematic errors in the data on the estimated current profiles. Improved H-mode operation at moderate collisionality could be recoverd and studies of H-modes with centrally elevated q-profiles could be successfully extended making use of the extended ECRH capapilities. A non-inductive scenario at q95 = 5.5 could be obtained, which does not depend on q-profile tayloring during the current ramp-up phase and its successive diffusion. These high beta plasmas are also compared to results with the TGLF modell.

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