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EX/P5-19: ICRF Operation with Improved Antennas in a Full W-wall ASDEX Upgrade, Status and Developments

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Operation of ICRF (Ion Cyclotron Range of Frequencies) antennas in many magnetic fusion experiments is often accompanied by enhanced plasma-wall interactions. These become more problematic in high-Z machines, such as the full tungsten (W) ASDEX Upgrade (AUG), where the W released from the wall during the ICRF operation contributes to radiation losses from the plasma. A significant part of the ICRF-specific plasma-wall interactions in AUG can be attributed to the existence of the parallel component of RF electrical field near antenna E||. This field contributes to elevated sheath potentials which can directly influence the W sputtering. It can also affect as well as depend on the plasma convection in the scrape-off-layer. In AUG, two strategies to establish the compatibility of ICRF antennas with the W wall are being pursued.
The first, long term strategy is based on reduction of the E|| field by following the guidelines on antenna design elaborated with the help of finite-elements EM calculations. The experiments with the modified 2-strap antenna have been conducted in 2011. During single antenna ICRF operation at low deuterium injection rates, the modified antenna showed better balance between the central heating and the W source. However, an uncertainty exists whether the observed improvement is caused by the reduced E||, or by influence of the limiter shape on geometry of magnetic field line connections. In order to help to resolve this, a new retarding field analyser was installed in AUG to measure the plasma potential on the field lines connected to the modified antenna. After 2012, two new 3-strap antennas compatible with the 3dB splitter scheme for ELM-resilient ICRF operation will be installed. The design of these antennas follows the guideline on reduction of E|| that utilizes the balance between the pi-phased contributions of the image RF currents.
The second, short term strategy on extending the ICRF operational space with the W wall to the low gas injection rate conditions in AUG, makes use of low-Z materials in the vicinity of ICRF antennas. For the coming 2012 experimental campaign, two antennas have thus been equipped with the boron-coated side limiters (50 mcm thick coating), which have been previously characterized as the most important W sources during ICRF operation.

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