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RECENT ACCOMPLISHMENTS AND FUTURE PLANS OF ASDEX UPGRADE

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The ASDEX Upgrade design combines the successful divertor concept with the requirements of a next step fusion reactor, in paricular the need for an elongated plasma shape and poloidal magnetic field coils outside the toroidal magnetic field coils. ASDEX Upgrade is close to ITER in its magnetic and divertor geometry and in particular the relative length of both divertor legs compared with the plasma dimensions. The installed heating power of up to 28 MW (20 MW NBI, 6 MW ICRH, 2 MW ECRH) ensures that the energy fluxes through the plasma boundary are equivalent to those in ITER. The scientific programme gives priority to the preparation of the design (heating, fuelling, first wall materials), physics basis and discharge scenarios of ITER and to the exploration of regimes beyond the ITER baseline scenario. At present, the main programme issues cover investigations of advanced tokamak scenarios like the "improved H-mode", non-inductive current drive by NBI and ECCD, MHD mode control of ELM's, sawteeth and neo-classical tearing modes (NTM), anomalous particle and heat transport and plasma operation with tungsten-clad (~ 65%) first wall.

The improved H-mode which forms the basis of the long pulse ITER hybrid scenario is established over a broad range of conditions – moderately peaked electron density profiles from $n=n_{GW}$ down to values corresponding to the ITER collisionality, heating scenarios achieving $T_e=T_i$, q_{95} values down to 3, β_N values of at least 3, bootstrap fractions up to 50 % and the ρ^* range accessible within a factor of 2. The maximum performance parameter $H_{98(y,2)}\beta_N/q^2{}_{95}$~0.3 would allow ITER operation either at 50 % increased fusion gain or at 30 % reduced design plasma current. Off-axis NBI current drive shows a clear current profile modification, which is strongly reduced at higher input powers especially at low triangularity configurations. Triggering of ELMs by pellet injection or vertical plasma movements result in mitigation of the maximum divertor power loads.

The next planned major upgrades are the transition to a complete tungsten covered first wall, upgrading of the ECRH capabilities, an improved current profile control via 5 MW LHCD to create and sustain reliably optimized shear profiles and an installation of a stabilizing shell and active control coils at the low field side to overcome the reduced ideal MHD stability limits of reversed shear plasmas.