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Progress in Preparing Scenarios for ITER Operation

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In recent years, dedicated experiments and coordinated scenario simulations, initiated by the Integrated Operation Scenarios Topical Group of the ITPA, have significantly advanced the preparation of ITER operation. This contribution will review the progress made.
Plasma formation studies report robust plasma breakdown in devices with metal walls over a wide range of conditions, while other experiments use an inclined EC launch angle at plasma formation to mimic the conditions in ITER. For H-modes at q95˜3 many experiments have demonstrated operation with scaled parameters for the ITER baseline scenario at ne/nGW˜0.85. Most experiments, however, obtain stable discharges at H98(y,2)˜1.0 only for βN=2.0-2.2. During the current rise, a range of plasma inductance (li(3)) can be obtained from 0.65 to 1.0, with the lowest values obtained in H-mode operation. For the rampdown, the plasma should stay diverted and maintain H-mode. For an ohmic rampdown a reduction of the elongation from 1.85 to 1.4 would minimise the increase in plasma inductance from 0.8 to 1.3-1.4.
Simulations show that the proposed rampup and rampdown schemes developed since 2007 are compatible with the present ITER design for the poloidal field coils. ITER scenario preparation in hydrogen and helium requires high input power (>50MW). H-mode operation in helium may be possible at input powers above 35MW at a toroidal field of 2.65T, for studying H-modes and ELM mitigation. In hydrogen, H-mode operation is expected to be marginal, even at 2.65T with 60 MW of input power.
For a hybrid scenario at 12 MA the code simulations give a range for Q = 6.5 − 8.3, using 30MW NBI and 20MW ICRH. For non-inductive operation at 7 − 9 MA the simulation results show more variation. At high edge pedestal pressure (Tped ˜ 7 keV) the codes predict Q = 3.3 − 3.8 using 33 MW NB, 20 MW EC and 20 MW IC. Simulations using a lower edge pedestal temperature (˜ 3 keV) but improved core confinement obtain Q = 5 − 6.5, when ECCD is concentrated at mid-radius and ˜20 MW off-axis current drive (ECCD or LHCD) is added.

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