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# Atomic Physics in ITER – The Foundation for the Next Step to Fusion Power

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*Domain* : Fusion

ITER represents the next step towards practical magnetic confinement fusion power [1]. Its primary physics objective is to study plasmas in which the fusion power exceeds the external heating power by a factor of 5 to 10. Among its technological objectives are the use of superconducting magnets and remote maintenance, the handling of high heat fluxes, and the testing of tritium breeding concepts. Atomic physics processes will play a fundamental role in facilitating the achievement of these objectives [2]. First, atoms and molecules generated by the interaction of the ITER plasma with surrounding material surfaces will impact and, in some respects, dominate the particle, momentum, and energy balances in both the adjacent and confined, core plasmas. High quality atomic physics data for the relevant species (including hydrogen atoms and molecules, as well as intrinsic impurities beryllium, tungsten, and carbon) will be required to interpret and predict their behavior as they travel into the plasma. Second, extrinsic impurity gases, such as neon and argon, will be introduced into the edge plasma so that their radiation will spread heat coming out from the core more uniformly over the surrounding material surfaces than it would otherwise. Third, many of the diagnostics used to monitor the dense ($n_e \sim 10^{20}$ m$^{-3}$), hot ($\sim 1 \times 10^8$ K) core plasma leverage off of atomic physics effects. Beam emission and charge exchange recombination spectroscopy based on a dedicated diagnostic neutral atom beam will yield ion temperatures and rotation velocities as well as local impurity ion densities, including that of the helium ash generated by the fusion reactions. X-ray crystal spectrometers will provide independent and complementary measurements of the impurity ion temperatures and rotation velocities. A diagnostic based on the motional Stark effect will measure the local orientation of the magnetic field.

[1] ITER Technical Basis, ITER EDA Documentation Series No. 24, IAEA, Vienna (2002).
[2] ITER Physics Basis Editors, Nucl. Fusion 39, 2137 (1999).