# JET's contribution to Fusion Science and ITER

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JET is the largest fusion device in the world and is the only tokamak device that (i) can operate with deuterium-tritium plasmas, (ii) confines the 3.5MeV fusion alpha's (due to the combination of its size and high plasma current capability) and (iii) can operate with Beryllium, one of the wall materials for the next step fusion device ITER. It is therefore no wonder that JET has largely contributed to progress in fusion research over the past 20 years.

Highlights of fusion research at JET in the past years include operation the first large scale generation of fusion power (16MW) from D-T reactions, equivalent to a record fusion gain of 0.7, i.e, very close to break-even; long plasma pulses (about 1 min) with an ITER like plasma cross-section; new diagnostic techniques for the detection of magneto hydrodynamic modes with very high resolution, for the observation of the dynamics of fast particles (alpha's, fast deuterons, ...) and for the determination of the plasma current profile by observing macroscopic waves (Alfven Waves). JET has made significant contributions to a better understanding of the plasma-surface interaction : divertor physics, edge instabilities causing large fluxes of heat and particles (so-called 'ELMs'), and characterization of the plasma boundary, and has developed original techniques to measure the erosion and redeposition physics in the edge. JET has also largely contributed to the development of the operational scenarios foreseen for ITER, the so-called ELMy H-Mode and Advanced Scenarios, created by a special tailoring of the plasma current, in order to reduce turbulence. Whilst a tokamak is in principle a pulsed device (due to the transformer action to induce the plasma current), the latter scenarios could also lead to stationary operation because of the presence of large non-inductive plasma currents. JET has recently demonstrated long pulses (~8s) where nearly the full plasma current (1.8MA) is generated without the use of the transformer.

JET is intended to operate until 2010 and major upgrades are planned or underway. One upgrade, currently being implemented, consists in a new ICRH antenna, based on the so-called conjugate T technique, which would allow steady high power coupling (~7MW/m$^2$) under strongly varying plasma edge conditions, as expected for ITER. A major part of a future upgrade is the installation of a Beryllium first wall and a Tungsten divertor in JET, the first wall material foreseen for ITER. Until now, the first wall in JET consists mainly of carbon. Operation with a full metallic wall, will induce differences in the way JET can be operated. The lessons learned will contribute to an accelerated use of ITER.