Efficient plasma heating schemes are a prerequisite for reaching fusion relevant temperatures in fusion machines. On the road to fusion, non-activated scenarios - such as (³He)-H plasmas - will be used to characterise machine performance. Moreover ³He minority heating is intended to be adopted in D-T plasmas in ITER to boost the fusion reactivity in the activated phase.

Fundamental ³He minority cyclotron heating experiments were performed in hydrogen majority plasmas during the 2014 JET hydrogen campaign. Up to 5MW of ICRF power were coupled using dipole phasing on the A2 antennas and for f=33MHz; B₀=3.25T and N₀~4x10¹⁹/m³. The central temperature increase was about 0.2keV per MW launched and the highest temperature achieved was 2.7keV (for comparison, hydrogen minority heating in deuterium plasmas has a heating potential that is well a factor of 2 higher). It was shown through break-in-slope analysis of the energy that 90% of the RF power launched was retrieved in the main plasma. But the presence of sawteeth renders the interpretation of the heating efficiency non-straightforward. In line with preparatory modelling and analysis, optimal heating was achieved at a ³He minority concentration of 3-4%. 20 to 30% of the launched power is radiated as bulk radiation; at higher powers, the radiated power increases but the fraction stays roughly unchanged; the fraction of the radiated power is higher at lower concentrations. Due to the high sawtooth frequency, the electron temperature profile hardly recovers in between sawtooth crashes (fₛₜ scales as T⁻³/₂), limiting the potential of ICRH to build up a strong electron - and through equipartition ion - gradient helping to ensure RF induced impurity flushing from the core. More ICRH power is required to ensure impurity flushing. Fast minority ion tails were observed; as expected from theory, the tails are most prominent at modest concentrations.

Real time control of the ³He concentration was updated and tested; it accounts for the presence of new intrinsic impurities present in JET-ILW plasmas. Interpreting the maximum of the electron absorption as a signature of a very nearby located mode conversion layer, the real time control estimates of the ³He concentration based on light in the divertor were crosschecked.

First tests were performed to assess the potential of a ³He replacement scheme relying on puffing extra D-like impurities into the H plasma.

*See the Appendix of F. Romanelli et al., Proceedings of the 25th IAEA Fusion Energy Conference 2014, Saint Petersburg, Russia