Impact of pellets on SOL and on SOL-pedestal coupling in JET-ILW

C. Perez von Thun[1], L. Frassinetti[2], N. Panadero[3], B. Lomanowski[5], D.I. Réfy[6], E. de la Luna[3], M. Valovič[4], A. Chomiczewska[1], M. Lennholm[4], S. Silburn[4], M. Vecsei[6], J.M. Fontdecaba[3], A. Meigs[4], A. Shaw[4], and JET Contributors*

[1] *Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland.*
[2] *Division of Fusion Plasma Physics, KTH Royal Institute of Technology, Stockholm, Sweden.*
[3] *Laboratorio Nacional de Fusión, CIEMAT, Madrid, Spain.*
[4] *CCFE, Culham Science Centre, Abingdon, UK.*
[5] *Oak Ridge National Laboratory, Oak Ridge, United States of America.*
[6] *Centre for Energy Research, Budapest, Hungary.*

Dedicated experiments under ITER-relevant conditions (shallow pellet deposition, small pellet/plasma particle ratio, Be/W wall) have been carried out at JET to assess how shifting the radial particle source localisation from the plasma edge (gas dosing) to inside the H-mode transport barrier (pellets), affects the SOL plasma, the pedestal, and the coupling between two. Additionally, the impact of pellet ELM pacing ($f_{pel} > f_{ELM}$) and the role of gas dosing location (main chamber vs divertor) have also been assessed. In the divertor, the substitution of (main chamber) gas dosing by pellets at fixed fuelling rate (Γ_{tot}) yields no significant differences in terms of neutral pressures, divertor radiation, inner and outer target densities or outer target temperature. This is a reflection of the fact that the conditions in the divertor are mainly being set through recycling processes. In the upstream SOL, the measured pressure of neutrals is not found to be sensitive to the fuelling scheme but lower electron densities (shorter radial fall-off lengths) are measured with pellets than with gas, also when normalising against the separatrix density ($n_e/n_{e,sep}$). $n_{e,sep}$ itself remains essentially unaffected when main chamber gas is replaced by pellets at constant Γ_{tot}. Moving gas dosing location from the main chamber to divertor at fixed ELM frequency does however result in colder and denser divertor plasmas and higher $n_{e,sep}$. The importance of the ratio of separatrix density over pedestal top density ($n_{e,sep}/n_{e,ped}$) as a key parameter (anti-correlator) with the attainable pre-ELM pedestal pressure height ($p_{e,ped}$) [1] retains its validity when main chamber gas dosing is replaced by pellets, but only as long as $f_{pel} < f_{ELM}$. In discharges with $f_{pel} > f_{ELM}$ (pellet pacing) the reduction in $p_{e,ped}$ is stronger than one would anticipate from their $n_{e,sep}/n_{e,ped}$ ratio. This is a reflection of the fact that the pedestal pressure height reduction driven by gas fuelling and pellet ELM pacing obbey to fundamentally different physics. The extended 2-point-model based dependence of $n_{e,sep}$ on the electron temperature at the outer target, $T_{e,OT}$, previously found for gas discharges at JET [2], is also found to be valid with pellets. In pellet discharges, the $n_{e,sep}/n_{e,ped}$ ratio also appears to follow the same $T_{e,OT}$ dependence as in gas discharges. The fact that we cannot break the fuelling trends with pellets indicates the physics governing formation of separatrix densities are the same for gas dosing and pellets, and that recycling fluxes in the divertor and main chamber are the main drivers for fuelling the separatrix, and the pedestal.

References

[1] L. Frassinetti et al Nucl. Fusion **61** 126054 (2021)
[2] B. Lomanowski et al (2022), Nucl. Fusion accepted

*See the author list of 'Overview of JET results for optimising ITER operation' by J. Mailloux et al to be published in Nuclear Fusion Special issue: Overview and Summary Papers from the 28th Fusion Energy Conference (Nice, France, 10-15 May 2021)