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Pellet Fuelling of Plasmas Including ELM Mitigation in MAST

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Pellet fuelling is studied using top-high field side pellet injection into NBI heated H-mode plasmas, in both single and double null configurations. ELMs are mitigated by external magnetic perturbation coils (RMPs). Pellet-triggered Thomson scattering, visible bremsstrahlung imaging, fibrescope combined with a fast camera and BES diagnostics are used to study various aspects of pellet fuelling process.
The ratio of intensities of the Balmer line and the continuum is used to produce 2D images of the density and temperature of the pellet cloud. The pellet cloud has a size ~5cm with no strong elongation along the magnetic field lines.
Interaction of pellet fuelling with the ELM mitigation has been tested in MAST using RMPs. In the majority of cases the fuelling pellet is followed by an ELM, either promptly during the pellet lifetime or with a small delay. Unfavourable cases exist with post-pellet compound ELMs which promptly remove all pellet material. There are however favourable examples with conventional post pellet ELMs allowing longer pellet retention times. In these cases the size of the post-pellet ELM is correlated with the size of the pre-pellet ELM suggesting that the post-pellet ELM loss is controlled by RMPs, though some correlation with pellet size exists. Profiles of electron density loss during post-pellet ELMs show a characteristic shape extending up to r/a~0.7. This area encompasses the region of inverted density gradient raising the question about the character of core particle transport during the post-pellet ELM. To elucidate this mechanism of particle loss, BES data have been analysed.
To assess post-pellet inter-ELM particle transport, a micro-stability survey is performed using the linear gyrokinetic GS2 code. It is shown that in the region of large inverted density gradient caused by the pellet ITG and ETG modes can be stabilised. In this region TEMs are also stable due to the stabilising effect of opposing electron diamagnetic and precession drift velocities. In the outer zone, where dn/dr<0, ITG modes are also stabilised but they are replaced by TEMs and micro-tearing modes.

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