ELM frequency dependence of cross-pedestal argon transport at AUG

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A controllable amount of radiative cooling at the plasma periphery of magnetic fusion reactors is essential to reduce heat loads reaching plasma facing components. Injecting argon (Ar) into tokamak plasmas has proven most successful to increase both core and divertor radiation [1] and is likely to be used at ITER for this purpose. Understanding the behaviour of medium-Z impurities is therefore key to the magnetic fusion endeavour. Charge exchange spectroscopy (CXRS) measurements at ASDEX Upgrade (AUG) have shown that the majority of transport in the H-mode edge transport barrier (ETB) is at the neoclassical level and that v/D increases with charge state [2]. Additionally, edge localized modes (ELMs) present in H-mode operation have a significant effect on impurity transport characteristics. Specifically, it has been found that if the ELM frequency (f_{ELM}) is high enough, the peaked impurity concentration can be flattened due to a flush-out effect [3].

In this contribution we report on recent experiments in which emission lines of Ar seeded into AUG H-mode plasmas were monitored by the recently recommissioned SPRED spectrometer. Coupled with the 1D transport code STRAHL, transition lines Ar^{6+}, Ar^{7+}, Ar^{13+}, Ar^{14+} and Ar^{15+} in the 18 – 60 nm wavelength range observed with a 1.8 – 2.0 ms time resolution enable studying transport processes and radiation distribution associated to ELMs across the pedestal region. The specific aim of this work was to determine the dependence of Ar transport and radiation on f_{ELM} by measuring the difference in Ar line radiation inside and outside the pedestal and testing whether diffusion and convective velocity transport coefficients (D, v) in the ETB could be determined. Different values of f_{ELM} between 30 – 100 Hz were achieved in three discharges which scanned varying levels of plasma triangularity, δ, deuterium (D) puffing and auxiliary heating. Cross-checking with CXRS data and considerations on the effects of charge exchange (CX) contributions necessary for the transport studies will be discussed.

[1] A. Kallenbach et al., Plasma Physics and Controlled Fusion 55, 12 (2013)

[2] R. Dux et al., Plasma Physics and Controlled Fusion 56, 12 (2014)

[3] T. Pütterich et al., Journal of Nuclear Materials 415, 5334 (2011)