Spectroscopic measurement of molecular deuterium fluxes in the DIII-D plasma edge

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Abstract. Molecular deuterium fluxes into the edge of deuterium-fueled L-mode discharges are measured using passive visible spectroscopy of D_2 emission lines. Comparison with the atomic deuterium influx measured using D_α emission suggests that a significant fraction of the plasma edge fueling from the walls is in the form of D_2. Molecular deuterium flux is observed in both the divertor and main chamber regions, but is roughly a factor 100 smaller near the inner main chamber wall and roughly a factor 1000 smaller near the outer main chamber wall, when compared with the divertor region. Very high levels of molecular D_2 excitation are measured, with ground state D_2 rotational population temperatures T_{rot} up to 10,000 K, and vibrational population temperatures T_{vib} up to 30,000 K. Comparisons between rotational population temperatures and the local electron density suggest that T_{rot} can be used as a reasonably good indicator of electron density in the D_2 line emission region. In recombining, detached divertor operation, estimates of the enhanced volume recombination rate due to the presence of vibrationally-excited D_2 suggest that the effect of

molecular-assisted volume recombination (MAR) could be comparable in magnitude to that of normal D^+ volume recombination (EIR).

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