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Assessment of the role of molecules in divertor plasma detachment for tokamak devices using the multi-fluid code UEDGE[1] A. HOLM, T. D. ROGNLIEN, W. H. MEYER, Lawrence Livermore National Lab — The importance of molecules for onset and degree of plasma detachment is demonstrated for a one-dimensional and a two-dimensional slab geometry. Plasma detachment, experimentally observed for $T < 3$ eV [1], decreases the particle and heat fluxes incident on the divertor due to volumetric recombination. Molecular processes become relevant at temperatures relevant to detachment [2], and may result in sub-eV plasma temperatures, when electron-ion recombination become large. Equipartition of hydrogen ions and atoms with molecules cools the ions and atoms, and the decreased ion temperature diminishes the electron heating due to electron-ion thermal coupling. When the collisionality becomes sufficiently high, the ion temperature decreases below the electron temperature due to ion-molecule equipartition and ion-electron equipartition becomes an electron energy sink. It is shown that this electron energy sink results in sub-eV electron temperatures, yielding high electron-ion recombination rates and, subsequently, high degrees of plasma detachment not observed in simulations without molecules.

[1] D. Eldon, et al., *Nucl. Fusion* **57**, 066039 (2017).
[2] U. Fantz, et al., *J. Nucl. Mat.* **290**, 367 (2001).

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