ABSTRACT

Hydrogen neutral beam injection into plasma is widely use in charge-exchange emission spectroscopy as a powerful diagnostic tool in tokamaks for determination of ion temperatures, densities, and rotational velocities. On the DIII-D tokamak it has been observed that the ion carbon impurity densities obtained from the toroidal and vertical spectral viewchords do not agree. These differences have been attributed to plume emission contributions. In this work, an analytic solution is derived from first principles to solve the full collisional radiative kinetic equation including the main atomic physics interactions to predict plume densities and emissivities along the local magnetic field lines. This model is used to calculate plume emissivities for both carbon and helium, the first is of interest since is the main impurity ion present on the DIII-D tokamak, and the second one is important for future helium ash studies. This analysis shows that the plume emissivities for helium are significantly higher in comparison to those calculated from carbon, that and plume effects must be taken into account for helium Charge-Exchange Recombination (CER) Spectroscopy.