Dynamics of Neon Ions after Neon Gas Seeding and Puffing into Tokamak Plasma

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- High Z impurity seeding/puffing is an important topic as it is capable to provide radiative improvement of confinement and disruption mitigation in future tokamaks. A number of authors have studied experimentally and numerically using sophisticated code.
- Here in this work a two dimensional (2D) interchange turbulence has been used to describe neon ions in the presence of the neon gas seeding/puffing in the edge and SOL regions. Ionization and recombination processes have been included.
- In the simulation a multispecies description has been used where the neon and hydrogen ions are assumed to be lost in the limiter plates by a common sound speed instead of assuming Bohm sheath criteria for each species of the ions. BOUT++ code has been used for the modeling.
- Main results:

  (a) A specific attention has been given to understand the dynamics of the neon gas. It is found that homogeneous neon gas becomes inhomogeneous in the presence of interchange turbulence, ionization, and recombination processes. The strong inhomogeneity of the neon ions drives its motion so that the ions can moves towards the core even in the absence of stochastic magnetic field. Both experimentally and numerically, we find the presence of neon ions sufficiently inside in the edge region. Numerical simulation indicates that the ions can move at 1/30th of sound speed. Presence of neon ion polarization drift helps for its movements.

  (b) A small modification of radially outward particle flux has been obtained. It is found that the neutral friction with the ions, electron impact ionization, and recombinations is responsible for this effect. Frequency spectrum indicates that the gas can shift the frequency spectrum towards the lower frequency.

  (c) This study hints a noble limiter biasing scheme (for small tokamaks) for the impurity seeding so that impurity transport into the core will be minimized at the same time it will improve the confinement by the radiative cooling process in the boundary region.