Empirical modeling of heavy impurity particle transport based on imaging diagnostics in fusion plasmas

Wonho Choe[1], Inwoo Song[1], D.–H. Kwon[2], Y. H. An[3], C. R. Seon[4], J. Jang[3], H. Shin[1], J. Hong[1], R. Guirlet[5]

[1] *Korea Advanced Institute of Science and Technology (KAIST), Daejeon 34141, Korea*
[2] *Korea Atomic Energy Research Institute, Daejeon 34057, Korea*
[3] *National Fusion Research Institute, Daejeon 34133, Korea*
[4] *ITER Organization, 13115 Saint Paul lez Durance, France*
[5] *CEA-IRFM, Cadarache, 13108 Saint Paul lez Durance, France*

The transport of heavy metal impurities such as W and gas impurities such as Kr shows strong poloidal variation in a rapidly rotating plasma due to the high centrifugal effect. Recently we have developed a two-dimensional impurity transport code which can deal with poloidally asymmetric particle distribution. In order to cope with the unavailability of full atomic database for line transitions of high-Z impurities, this code calculates the brightness of spectral lines and the radiation power density of impurities by solving the coupled continuity and momentum equations of all charge states of the impurities based on the inferred values of transport coefficients and corona approximation. Firstly, the W transport and its strong poloidal asymmetry due to W powder injection to the KSTAR plasma was simulated. The result shows that the overall spectral structure of the quasi-continuum line emission from the W ions is in good agreement with the spectra measured by the Compact Advanced EUV Spectrometer (CAES) within 0.2 nm error in wavelength. The relationship between the toroidal rotation speed and the W distribution was numerically scanned and the geometrical factor of the distribution shows strong dependence on the toroidal rotation speed, implying that the neoclassical transport dominates the transport. Secondly, the Kr injection for ELM control was studied. Due to the unavailability of sufficient photon emission coefficients for Kr, the new scheme for comparison with the InfraRed Imaging Video Bolometer (IRVB) data was developed, which calculates radiation power density from impurities with the continuum and line power coefficients. In this way, the transport coefficients D and V for Kr were empirically obtained, which will be analyzed and compared with the neoclassical calculation for further physics study.