Investigating the Poloidal Structure of Impurity Density in Tokamak Plasmas using a 2D Fluid Transport Model

Hyojong Lee[1], E.A. Belli[2], J. Dominski,J[3]. Candy[2], Jungpyo Lee[1],

[1]Hanyang University, Nuclear Engineering Dept. Seoul, South Korea
[2]General Atomics, PO Box 85608, San Diego, California 92186-5608, USA
[3]Princeton Plasma Physics Laboratory, 100 Stellarator Road, Princeton, New Jersey 08543, USA

High-Z heavy impurities such as tungsten can be sputtered from the ITER-like wall. The tungsten accumulation in the core region of tokamak plasmas poses a significant challenge, as it leads to radiative cooling and dilution of main plasma species. Previous studies [1,2,3] have also found that poloidal inhomogeneity of impurities can amplify neoclassical impurity influx. Therefore, we are developing a 2D impurity transport fluid code. This code incorporates the fitting model of the friction (FACIT) [4,5] to solve the nonlinear parallel momentum fluid equation [2] for impurity neoclassical transport across the entire plasma domain. It is considered self-consistently with various tokamak environments. This approach allows us to understand the relationship between centrifugal force, pressure, and friction by examining the poloidal impurity density structure, with results comparable to NEO and XGC codes [6,7].

References

[1] C Angioni and P Helander, Plasma Phys. Control. Fusion 56 124001 (2014)
[2] T. Fulop and P. Helander Physics of Plasmas 6, 3066 (1999)
[3] H. Lee at al Physics of Plasmas 29, 022504 (2022)
[4] D Fajardo et al Plasma Phys. Control. Fusion 65 035021 (2023)
[5] Patrick Maget et al, Plasma Phys. Control. Fusion 62 025001 (2020)
[6] E A Belli and J Candy, Plasma Phys. Control. Fusion 51 075018 (2009)
[7] S. Ku, R. Hager, C. Chang, J. Kwon, and S. Parker, J. Comput. Phys. 315, 467 (2016).