17th European Fusion Theory Conference

9 - 12 October 2017, Athens - Greece

EFTC 2017

Numerical modeling of dust transport in a tokamak plasma

C. D. Dritselis[1], and I. E. Sarris[2]

[1] *University of Thessaly, Athens Avenue, Volos 38334, Greece*
[2] *TEI of Athens, Agiou Spyridona 17, Egaleo 12210, Greece*

One of the most serious challenges faced by the fusion community at present is addressing the material related issues in the next generation of fusion experiments. The discussion on the role of dust in magnetic fusion devices started long time ago, but it is still not clear what is the impact of dust on the edge plasma parameters and plasma contamination by impurities [1]. More recently, several studies have clearly indicated the occurrence of transient impurity events in plasma discharges following a disruption [2]. These events result in intense radiation spikes in the JET plasma discharges that can be explained by a possible injection of tungsten (W) ions as an outcome of full ablation of W dust particles. Consequently, the problem of dust production, mobilization and interaction both with the plasma and the vessel plasma-facing components is of great importance, and requires the development of accurate numerical tools. In this frame, dedicated tools for the calculation of dust trajectories are useful for predicting the transport and dynamics of dust grains in tokamaks. The present work describes the physical and numerical models implemented in a recently developed dust dynamics code SOLPDUST. The new code is robust, flexible, and computationally inexpensive, which includes the essential physics of modeling the trajectories of dust grains in realistic tokamak plasma environments (see Figure 1). It implements several high-level algorithms for the computation of dust orbits, dust charging, inter-collisions and breakup, dust collisions with micro-turbulence, and dust-chamber wall interactions. Several approaches for modeling dust micro-turbulence collisions and for reconstructing dust trajectory from mean plasma backgrounds are also presented. The main features of the present and previous dust transport codes, such as DUSTT [3], DTOKS [4], DUSTTRACK [5], MIGRAINe [6] are outlined and compared. Finally, representative results are shown from comparisons of the numerical predictions of the new code with the aforementioned codes in selected examples.

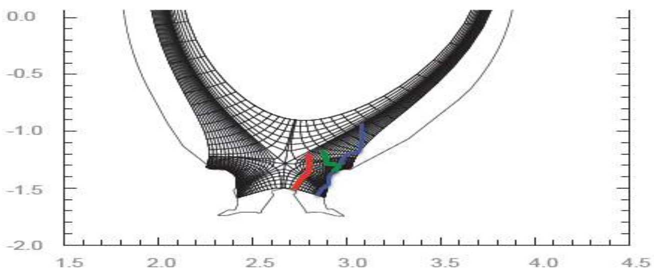

Figure 1: *Representative trajectories of carbon dust predicted by using the new dust transport code.*

Financial support from the Association EUROFUSION–Hellenic Republic during 2008–2016 is gratefully acknowledged. The content of this paper is the sole responsibility of its author and it does not necessarily represent the views of the European Commission or its services.

References

[1] A. Loarte, et al. Nucl. Fusion, 47, S203 (2007); G. Federici et al., Nucl. Fusion 41, 1967–2137 (2001)
[2] G. F. Matthews, J. Nucl. Mater. 438, Supplement, S2 (2013); M. Sertoli, et al., J. Nucl. Mater. 463, 837 (2015); J. C. Flanagan et al., Plasma Phys. Contr. F. 57, 014037 (2015)
[3] A. Pigarov et al., Phys. Plasmas 12, 122508 (2005)
[4] M. Bacharis, M. Coppins, and J. E. Allen, Phys. Rev. E 82, 026403 (2010)
[5] E. Lazzaro et al., Plasma Phys. Contr. F. 54, 124043 (2012)
[6] L.Vignitchouk, P. Tolias, and S. Ratynskaia, Plasma Phys. Contr. F. 56, 095005 (2014)