The physical processes of dust particle charging have been studied in various fields [1-3]. In magnetic fusion devices, maintaining the reliable and safe operation of a tokamak is a major challenge, as dust contamination can significantly affect its performance. This dust may originate from intentionally introduced sources, such as lithium pellets, or from intense plasma-wall interactions. Since these dust grains can become charged, they may disperse across various regions of the tokamak. Liu et al. [4] point out that dust particles in fusion cause a significant risks due to their possible radioactivity, toxic properties, and ability to disrupt discharges by entering the core plasma. This highligts the need to study their charging behaviour under tokamak conditions. P.C. Stangeby [5] clearly indicates that the electron distribution in the edge plasma of tokamaks often deviates from a Maxwellian distribution. This deviation complicates the measurement of electron temperature by Langmuir probes, as the probes primarily detect the hot component, leading to an overestimation of the electron temperature. It is stated that "except in highly collisional regimes, there is a possibility for non-Maxwellian electron distributions to arise. Specifically, in the "high recycling" regime of divertor tokamaks, large temperature gradients can develop, and fast electrons (the high-energy tail) can reach the target plate nearly without collisions, while slower electrons undergo frequent collisions. As a result, the electron distribution at the target becomes significantly non-Maxwellian [5]. The family of κ (kappa)-distributions represents one of the possible mathematical descriptions of such behavior [6].

Understanding the charging mechanisms of dust particles in tokamak plasmas is therefore essential. This study investigates the charging processes of carbon dust particles in fusion plasmas. The Orbital Motion Limited (OML) theory, a widely used approach for modeling dust particle charging, is applied to study the charging of dust particles by collection of plasma ions and electrons. Additionally, thermionic electron emission (TEE) is incorporated into the developed model. This work was supported by the Grant No. AP19679536 of the Ministry of Science and Higher Education of the Republic of Kazakhstan.

[1] J. Goree, Plasma Sources Sci. T., 400-406 (1993)

[2] D. B. Weingartner JC, Astrophys. J. Suppl. S., 263-281 (2001)

[3] G. V. Miloshevsky, A. Hassanein, Phys. Rev. E 85 (2012)

[4] Z. Liu, D. Wang, G. Miloshevsky, Nuclear Materials and Energy (2017)

[5] P. C. Stangeby, JET-P (95)14 (1995)

[6] G. Livadiotis, Journal of Geophysical Research: Space Physics, 120,1607 (2015).