

Angular-averaged Ewald potential for a Yukawa one-component plasma

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The Yukawa potential, also known as the Debye or screened Coulomb potential, can be used to describe interactions between mesoscopic particles [1]; also, it is often used to represent the strong nuclear force in atomic nuclei. The Debye potential is a linearized solution for Boltzmann-Poisson systems.

When modeling the Yukawa one-component plasma (YOCP) in the weak screening limit, the Yukawa potential becomes very close to the Coulomb one, and the problem of long-range interaction arises. Commonly, it is solved by taking into account additional terms when summing over particle images, which leads to an increase in simulation time. We propose to consider the Ewald procedure for the YOCP [2], and then average this Ewald potential over all directions. This approach has already shown its merits in modeling the conventional one-component plasma (OCP) [3], as well as advantages in the analytical derivation of the pseudopotential, which takes into account both quantum and long-range effects [4]. In this paper, we present the derivation of the angular averaged YOCP Ewald potential (YOCP AAEP). We also analyze the obtained result from a physical point of view and show that the angular averaged potential tends to the usual OCP AAEP in the weak screening limit.

- [1] Farouki R T and Hamaguchi S 1994 *The Journal of Chemical Physics* **101** 9885–9893
- [2] Hamaguchi S and Farouki R T 1994 *The Journal of Chemical Physics* **101** 9876–9884
- [3] Demyanov G S and Levashov P R 2022 *Phys. Rev. E* **106** 015204
- [4] Demyanov G S and Levashov P R 2022 *Contributions to Plasma Physics* **62** e202200100