Analysis of mean squared displacement of microparticles using two- and three-dimensional methods for diagnosing their spatial position

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Active Brownian particles are considered as particles that can convert the energy of the environment into the energy of their own motion [1, 2]. The active Brownian motion of single dust particle in a three-dimensional dc discharge trap under the influence of laser radiation was experimentally studied. The experiment used spherical melamine formaldehyde (MF) particles, part of the surface of which had a copper coating (Janus particle). A comparison was made of the analysis of the mean squared displacement (MSD) of microparticles using two- and three-dimensional methods for diagnosing their spatial position. The average kinetic energy of motion of dust particles at different laser irradiation intensities was determined. As a result of the analysis, it was revealed that for a qualitative assessment of MSD, analysis techniques can be used, as for the two-dimensional case, when video recording of the movement of particles by one video camera is used for visualization and analysis, and the image of the trajectory of the particle is obtained in projection onto the plane of the matrix of this video camera. The quantitative difference in this case, in contrast to three-dimensional motion diagnostics, differs depending on the time period being studied; in our case, up to $t \approx 0.1$ s, the error is no more than 5%. At long times the difference reaches 10%.

[1] Aranson I S 2013 *Phys.-Usp* **56** 79–92

[2] Bechinger C, Leonardo R D, Löwen H, Reichhardt C, Volpe G and Volpe G 2016 *Rev. Mod. Phys.* **88** 045006