Technique for three-dimensional diagnostics of microparticles in colloidal plasmas

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In studies of active systems, diagnostics of microparticle dynamics plays an important role. In some cases, such as two-dimensional melting studies [1], it is often sufficient to use simple two- dimensional diagnostics. In this case, the system of microparticles is simply recorded by a video camera located perpendicular to the plane of the monolayer. In more complicated cases, such as investigation of the dynamics of three-dimensional systems of active particles levitating in the strata of the DC discharge [2], it is necessary to use three-dimensional diagnostics.

This work provides a review of known methods for two-dimensional and three-dimensional diagnostics of microparticles. The recent results on the study of active colloidal plasma using these techniques are presented, such as an analysis of the root-mean-square displacements of active Brownian particles, phonon spectra in a two-layer structure consisting of particles of different sizes, and structural instability accompanied by a transition to a square lattice in a quasi-two-dimensional plasma crystal [3].

[1] Vasilieva E, Petrov O and Vasiliev M 2021 *Scientific Reports* **11** 523

[2] Vasiliev M, Antipov S and Petrov O 2006 *Journal of Physics A: Mathematical and General* **39** 4539

[3] Syrovatka R A, Lipaev A, Naumkin V N and Klumov B A 2022 *JETP Letters* **116** 869–874