Dynamical properties of dust particles in a background gas and external magnetic field

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In this work, we investigate the simultaneous effects of a static homogeneous external magnetic field and the background gas environment on the dynamical properties of dust particles in strongly coupled two-dimensional Yukawa systems. We use the Langevin dynamics computer simulation method. The equations of motion of the particles with taking into account both effects mentioned above, can be written as:

$$m\ddot{\mathbf{r}}_i(t) = \sum_{i \neq j} \mathbf{F}_{ij}(r_{ij}) + Q[\mathbf{v}_i \times \mathbf{B}] - vm\mathbf{v}_i(t) + \mathbf{F}_{Br}, \quad (1)$$

where the first term on the right hand side gives the sum of inter-particle interaction forces, the second is the Lorentz force, the third term represents the friction force (proportional to the particle velocity), is due to of the presence of the background gaseous environment, while the fourth term accounts for a randomly fluctuating “Brownian” force that is caused by the random kicks of the gas atoms on the dust particles. To integrate the equations of motion (1), a new numerical scheme is used, in which the time step is not limited by the magnitude of the magnetic field [1]. This scheme was obtained similarly to the scheme proposed in Ref. [2], but takes into account the friction force as well.

REFERENCES

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