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# Study of Photoemissive Dusty Plasma

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Text [1] of the contribution.

A series of experiments were carried out on a specially designed experimental set-up to study photoemission charging of macroparicles under the effect of light. Scheme of the experiment is shown in fig. 1(a). Dusty macroparticles were put into a vacuum chamber in argon atmosphere under the pressure of 1 bar. The vacuum chamber was a glass cylinder 75 mm in diameter and 20 mm in height. One of its sides was made as a quartz window and was meant to let the light in the working area of the vacuum chamber. A sunlight simulator based on a high pressure xenon lamp was used as the source of light. This simulators emission spectrum (which is similar to the sunlight spectrum in the Earths top atmosphere) is shown in fig. 1(b). A filter was used to cut the long wavelength part of the radiation spectrum and thus neutralize the effects of particles and the vacuum chamber heating. The diagnostics of a charge gained by macroparticles due to electrons photoemission was made by registering the changes in particles dynamic behaviour in external electric fields. In order to do it two electrodes were placed inside the working area of photoemissive cell and a dc voltage U = 200 V was given to the electrodes. The experiments were carried out for two different electrodes configurations: the electrodes' planes were placed horizontally (as shown in fig.1(a)) or vertically.

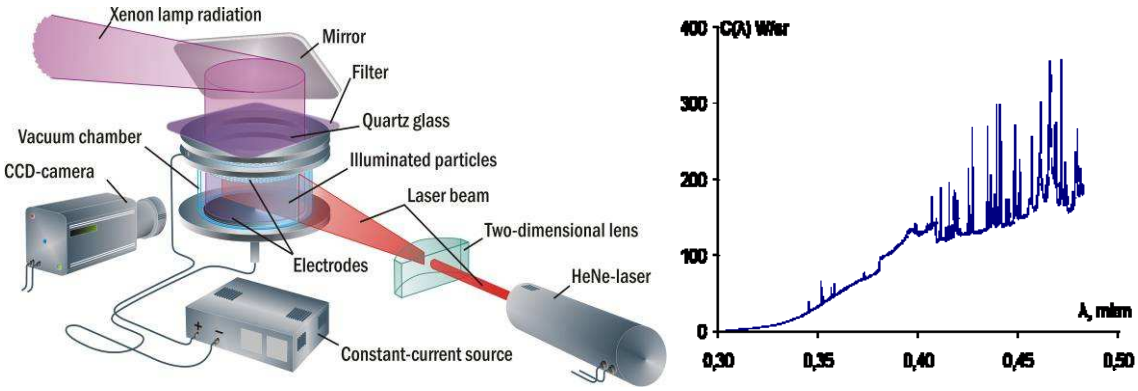


FIGURE 1. (a) Experimental setup; (b) Sunlight simulator emission spectrum.

A He-Ne laser ($\lambda$ = 633 nm) was used to illuminate the particles; its beam had the shape of so-called "laser sheet" 2.5 cm wide and 200 μm thick in the thinnest region. A camera with the recording speed of 20 frames/sec was used to detect the scattered by the dusty particles radiation. It is necessary to denote that the "laser sheet" plane was situated vertically. We used polydisperse particles with the typical size smaller than 40 μm. These particles were made of lanthanum hexaborid, baryta, silicium covered with cesium, metal covered with cesium, yttrium and so on.

The using of an original program package allowed us to determine from a series of video shots such dusty system parameters as the total number of particles in a selected region, their velocities, time dependences of the number of macroparticles moving along a selected direction and time dependences of average velocities of the particles' ordered motion in these directions.

Time dependence of the number of macroparticles moving along the positive direction shows that the sunlight simulator radiation makes almost all dusty particles in the working area of the vacuum chamber (more than 90%) gain positive electric charge. In order to estimate this charge we write down the balance equation for forces acting on a single macroparticle along this direction for the stationary case:

$$0 = E\,Q - \beta\,V_{av} \qquad (*)$$

E is the electric field due to dc voltage given to the electrodes, Q is the macroparticle charge, $V_{av}$ is the average speed of the positively charged particles, $\beta$ is the constant of a neutral gas friction. For instance, the charge of a single yttrium macroparticle (average radius 15 μm) found from balance equation for experimental parameters was $Q \approx 8000$ elementary charges.

In conclusion it is necessary to denote once again that we are the first to experimentally demonstrate the possibility of positive charging of dusty particles' ensemble under the light radiation influence. The positive charge gained by a micron-sized particle was about 500 elementary charges.

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