The present thesis is focused on study of dust grain charging. The experimental part covers interaction between dust grains and high-energy electrons and self-discharging of grains by both field electron emission and field ionization. The second part of the thesis describes construction and evaluation of a linear electrodynamic trap of the novel design.

We have observed charging of small dust grains towards high positive electric potentials when bombarded by the high-energy electron beam. We have described an increase of the secondary electron-electron emission yield from negatively charged grains due to the surface field. Further, self-discharging characteristics for both positively and negatively charged grains were measured. The relationship between discharging rate and the rate of the flow of atoms leaving the grain surface due to diffusion was observed for positively charged grains. This suggests significantly lower surface field necessary for ionizing such atoms compared to the ionization of atoms of surrounding gas and compared to the typically published field ionization thresholds.

Based on the design published in the master thesis, a linear quadrupole trap of novel design was constructed. Testing measurements confirmed functionality and expected characteristics of the trap. In addition, effects of possible mechanical imperfections of the trap construction was analyzed utilizing the numerical model of the electric field inside the trap.