Improving the Dipole Trap: The Way to Ultracold Gas

Khitrin, Dmitrii (School: Lyceum #40)

Studying the distribution of the intensity of laser radiation at the focus of the aberration lens allows advancement in the creation of an optical trap system for ultracold gas. Local intensity maxima lead to the heating of atoms inside the trap, which is an undesirable effect. So, my scientific tutor and I take the reduction of this effect on our shoulders. The objective of my work is to study the aberrations of the trap's optical system and to develop a method for eliminating local maxima which leads to the increase in average kinetic energy of atomic motion inside the trap cavity. In other words, the goal of my research is to reduce the negative effect of spherical lens aberration, leading to the heating of atoms inside an atomic trap, due to coma-type aberration. This effect is manifested when a laser beam reaches the lens at an angle other than 90 degrees. Therefore, the main result me and my scientific advisor wanted to achieve is to find the optimal angle of incidence of the beam which provides the compensation of the spherical aberration's undesirable influence. As a result of this work, we practically observed the change of intensity distribution at the focus of an aberrational cylindrical lens. Using experimental data, we estimated the optimal angle. Then we obtained Taylor series decompositions of the previously derived functions, which allowed us to study the relationship between various types of aberrations. Substituting the numerical values of the known parameters of the lens, we managed to find the optimal angle of the lens theoretically.

Awards Won: