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SCATTERING OF ELECTRON LAGUERRE – GAUSS WAVE PACKETS BY ATOMIC TARGETS

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Introduction. Vortex beams have been known for a long time [1]. However, studies of such beams are actively being pursued. This study is a continuation of the work on the scattering of Gaussian [2] and Bessel [3] twisted beams on atomic targets. It studied the scattering of twisted electron beams in the Laguerre-Gauss model by atomic targets. These beams have a certain projection of the orbital angular momentum. They differ from Bessel beams in that they are square integrable, they have a certain radial quantum number, which is responsible for the number of rings.

Solving the problem of scattering of Laguerre-Gauss beams will make it possible to find new practical applications of such beams and create new methods for their generation on electron microscopes and particle accelerators. Basic applications of Laguerre-Gauss beams are optical micromanipulation of particles, light fluorescence microscopy and quantum information.

Main part. We used quantum non-relativistic mechanics and optics tools and numerical simulation methods. The study has been carried out within the framework of the generalized Born approximation. The following problems have been solved:
1) The number of events of the Laguerre-Gauss beam scattered by a single hydrogen atom is calculated;
2) The averaged cross section of the Laguerre-Gauss beam scattered by a macroscopic (infinite) target, which is described as incoherent ensembles of potential centers is calculated;
3) The influence of the impact parameter, the width and shape of the Laguerre-Gauss packet on scattering processes is evaluated. The sensitivity of the normalized number of scattering events (for scattering by a single atom) to a change in the azimuthal angle is also found.

Conclusion. The scattering of the Laguerre-Gauss electron beam by a single hydrogen atom and by a macroscopic target has been studied. We found out the dependence of the scattering of such beams on the impact parameter, width, and shape of the packet.

A special result is the dependence of the average cross section of the Laguerre-Gauss electron beam scattered on a macroscopic target on the projection of the orbital angular momentum. This effect is not observed for previously studied twisted Bessel beams [3].

References:

1. Durnin J., Miceli Jr J. J, Eberly J. H. J. H. Diffraction–Free Beams // Physical review Letters. – 1987. – Vol. 58, is. 15. – P. 1499–1501.
2. Karlovets D. V. Scattering of wave packets on atoms in the Born approximation // Physical Review A. – 2015. – V. 92. No. 5. – P. 052703.
3. Karlovets D. V. Scattering of twisted electron wave packets by atoms in the Born approximation // Physical Review A. – 2017. – V. 95, No. 3. – P. 032703.