COMPTON IONIZATION OF POSITRONIUM BY TWISTED PHOTONS.

Yu.V.Popov[1,2], I.P.Volobuev[1], K.A.Bornikov[3]

[1]*Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, Russia, popov@srd.sinp.msu.ru*

[2]*Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Dubna, Russia*

[3] *Physics Faculty, Lomonosov Moscow State University, Moscow, Russia*

The process of Compton decay of positronium by a twisted photon is considered in the A^2 approximation. In the case of an incoming Bessel cylindrical wave and an outgoing photon plane wave, the matrix element of such decay is closely related to a similar matrix element for an incoming plane electromagnetic wave. Within the framework of standard scattering theory taking into account the momentum conservation law, it is shown that in the expression for the probability of this process almost all the most important characteristics of the cylindrical wave of a twisted photon are lost. Moreover, it is shown that the differential probability of positronium decay by a twisted photon is equal to the probability of decay by a plane-wave photon with a certain momentum moving at a certain angle to the z axis, averaged over the azimuthal angle of the incident photon [1].

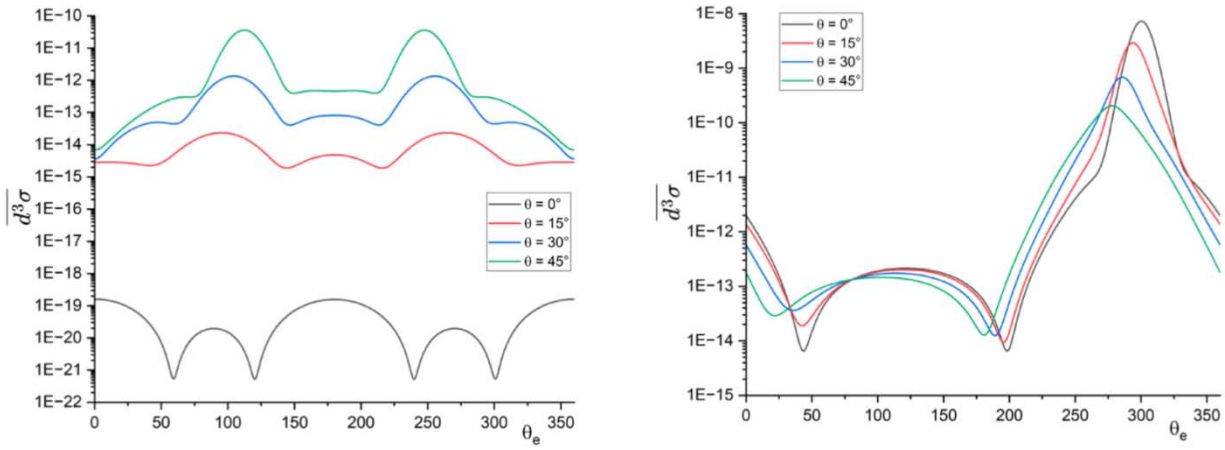

Fig. 1. Averaged differential cross section in atomic units as a function of the electron scattering angle θe. ω= 5 keV, electron energy Ee= 27.2 eV, coplanar kinematics. The opening angles $\theta$and the corresponding curves are shown in the figures. Left panel: scattering photon angle $\theta 1 = 0^\circ$, right panel: $\theta 1 = 60^\circ$.

As an example, in Fig. 1, the differential cross sections are displayed for the cases of different opening angles of twisted photons. This study demonstrates that incorporating the momentum conservation law into the plane-wave matrix element removes the dependence of the matrix element (probability, cross section) on the projection m of the orbital angular momentum and the impact parameter, which, from a physical standpoint, should play an important role in the case of a cylindrical wave. This conclusion is also supported by papers of other authors.

References

[1]. Bornikov K. A., Volobuev I. P., Popov Yu. V. *Moscow University PhysicsBulletin* **80(**1), (2025)