XXIX International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC2015) IOP Publishing
Journal of Physics: Conference Series **635** (2015) 052043 doi:10.1088/1742-6596/635/5/052043

Parity violation in the resonance elastic electron scattering on He-like uranium

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Synopsis Parity violation on the cross section of the resonance elastic electron scattering by He-like uranium ion is studied. It is assumed that the incident electron is polarized and tuned in resonance with one of the close-lying opposite-parity states.

Investigations of the parity nonconservaion (PNC) effects in atomic systems play a very important role in tests of the Standard Model at low-energy regime [1]. From the theoretical side, the heavy few-electron ions are the most appropriate candidates for these studies. This is due to a simple electronic structure that allows high-precision calculations of these systems. For the last years a vast number of different scenarios offering the detection of the PNC effects in heavy highly-charged ions were proposed (see, e.g., Refs. [2, 3, 4] and references therein). However, the breaking of the space symmetry in the process of electron scattering by heavy ions has not yet been discussed in the domain of atomic physics.

In the present contribution we study the PNC effect on the cross section of the elastic scattering of the polarized electrons by He-like uranium ion ($Z = 92$) being initially in the ground state. The energy of the incident electron is assumed to be tuned in resonance with one of the quasidegenerate $d_1 \equiv \left[\left(1s\ 2p_{1/2}\right)_0\ 6s\right]_{1/2}$ or $d_2 \equiv \left[(1s\ 2s)_0\ 6s\right]_{1/2}$ states [4], thus providing the enhancement of the parity violation. In order to investigate the PNC effect, we introduce the asymmetry parameter $\mathcal{A} = \left(\sigma_{1/2} - \sigma_{-1/2}\right) / \left(\sigma_{1/2} + \sigma_{-1/2}\right)$ where σ_{μ_i} is the differential cross section with μ_i designating the helicity of the incident electron. The deviation of this parameter from zero indicates the breaking of the spatial symmetry. In figure 1 it is depicted as a function of the scattering angle θ. From this figure one can see that the maximum value of $|\mathcal{A}|$ is expected for $\theta \sim 70^\circ$ at the energy of the incident electron being tuned in resonance with any of d_1 or d_2 state and amounts to about 8×10^{-8}. Though this asymmetry is too small to make possible performing the corresponding experiment it is worth to mention that one can expected the increase of the PNC effect by few orders of magnitude for the inelastic electron scattering.

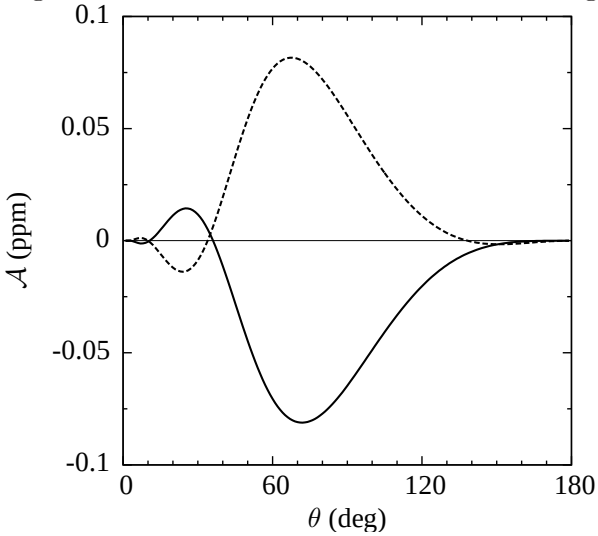

Figure 1. The solid and dashed lines are correspond to the energies of the incident electron being tuned in resonance with d_1 and d_2 states, respectively.

This work was supported by SPbSU (Grants No. 11.38.269.2014 and No. 11.38.237.2015).

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