Angular and polarization correlations in the sequential two-electron radiative recombination as a tool for production and diagnostics of spin-polarized heavy ion beam

A.V. Maiorova[1], A. Surzhykov[2,3], S. Tashenov[2], V. M. Shabaev[1]

[1]*Department of Physics, St. Petersburg State University, Ulianovskaya 1, 198504 Petrodvorets, St. Petersburg, Russia*
[2]*Physics Institute, Philosophenweg 12, 69120 Heidelberg, Germany*
[3]*Helmholtz–Institut Jena, Fröbelstieg 3, 07743 Jena, Germany*
maiorova@pcqnt1.phys.spbu.ru

The Radiative Recombination (RR) is the dominating process in ion-electron collisions. In recent years, RR of highly charged heavy ions is the subject of intense theoretical as well as experimental research (see [1] and references therein). RR is an effective tool for investigations of the photoionization in large-energy and strong-field regimes. On the other hand, strong interest to this process is due to the fact that the radiative recombination is very sensitive to the spin, relativistic and QED effects in the structure and dynamics of heavy atomic systems (see, e.g. [2,3]).

In the last few years several experiments on studying of the RR with polarized ion beams were proposed [4-7]. Furthermore, it was proposed to use RR into polarized H-like ions as the tool for beam spin diagnostic [8]. Information about the polarization properties of heavy ions beams is required for studying, for example, the parity nonconservation effects in highly charged ions or in heavy-ion collisions. Up to the present, however, all of proposed experiments are hampered owing to the lack of techniques capable of production and preservation of heavy-ion polarization.

In the present work we propose a method which allows one to study production and diagnostics of spin polarization of heavy H-like ions. We consider subsequent captures of electrons from two spatially separated targets into the K shell of an initially bare ion having zero nuclear spin. We suppose that two K-RR photons, emitted in such a process, are measured in coincidence. If the emission direction of the first K-RR photon is fixed, the resulting H-like ion is polarized. The polarization of such intermediate ion beam will be affect on the angular and polarization properties of the photon emitted in the collision with the second target. Thereby investigations of the angular and polarization correlation between two subsequently emitted photons give us an opportunity to produce the polarized ion beam and to study its properties.

References:
[1] J. Eichler, Th. Stöhlkler, Phys. Rep. **439**, 1 (2007).
[2] Th. Stöhlkler *et al.*, Phys. Rev. Lett. **82**, 3232 (1999).
[3] S. Tashenov *et al.,* Phys. Rev. Lett. **97**, 223202 (2006)
[4] A. Surzhykov, S. Fritzsche, Th. Stöhlker, Phys. Lett. A **289**, 213 (2001).
[5] A. Surzhykov, S. Fritzsche, Th. Stöhlker, NIMB **205**, 391 (2003).
[6] A. Surzhykov, S. Fritzsche, Th. Stöhlker, S. Tashenov, Phys. Rev. A **68**, 022710 (2003).
[7] A. E. Klasnikov *et al*., NIMB **235**, 284 (2005).
[8] A. Surzhykov, S. Fritzsche, Th. Stöhlker and S. Tashenov, Phys. Rev. Lett. **94**, 203202 (2005).