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First observation of correlated photons emitted by heavy highly charged ions in the process of radiative recombination

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Synopsis Dynamics of the electron spin in the Photoelectric Effect was studied in time-reversal via the process of Radiative Recombination. For this the photorecombination into an excited state of an ion and its subsequent radiative decay was observed. Pairs of correlated photons were detected in conicidence. Such an observation is the first of its kind for the initial ion as heavy as bare uranium.

Two correlated photons emitted in the process of Radiative Recombination into an excited state of a bare uranium ion followed by its radiative decay have been detected in coincidence. For this a relativistic beam of bare uranium ions, stored in the GSI storage ring ESR, collided with a gas target of N_2 atoms. The photons were detected by a setup of segmented large area high purity germanium detectors, arranged around the target.

The recombination channels, proceeding through the intermediate excited states of H-like uranium: $2s_{1/2}+2p_{1/2}$ and $2p_{3/2}$, were separated by the energies of the decay photons: $Ly\alpha_2$ or $Ly\alpha_1$, see the Fig. To accomplish this, a strong Doppler broadening, caused by the angle variation of the photon emission from the relativistic projectile, has been compensated by the granularity of the photon detectors and by a large number of readout channels. The experiment for the first time allows to study alignment of the excited states produced by RR where the photon emission direction is observed[1, 2]. Thus it represents a significant step towards the complete experiment of RR as well as of the photoelectric effect in time reversal. Dynamics of the electron spin in this process is evident from the measured photon correlation. Although correlated hard x-rays were routinely observed in other strongly coupled systems like atomic nuclei, our observation is fundamentally different, as it involves transitions with very high multipolarities.

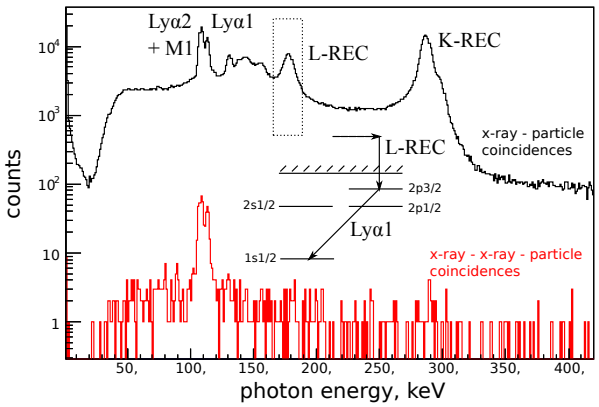

Figure 1. Typical observed spectra.

References

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