The 1s Lamb Shift in hydrogen-like Gold by X-Ray Spectrometry with FOCAL

T. Gassner[1,2], M.Trassinelli [3], R. Heß[2], U. Spillmann[1,2], D. Banaś[4], K.-H. Blumenhagen[1], F. Bosch[2], C. Brandau[5,2], W. Chen[2], Chr. Dimopoulou[2], E. Förster[1,6], R.E. Grisenti[7,2], A. Gumberidze[2], S. Hagmann[2,7], P.-M. Hillenbrand[2], P. Indelicato[8], P. Jagodzinski[4], T. Kämpfer[1], Ch. Kozhuharov[2], M. Lestinsky[2], D. Liesen[2], Yu. A. Litvinov[2], R. Loetzsch[1], B. Manil[9], R.Märtin[1], F. Nolden[2], N.Petridis[2,7], M. S. Sanjari[2], K.S. Schulze[1], M. Schwemlein[1], A. Simionovici[10], M. Steck[2], Th. Stöhlker[1,2,6], C. I. Szabo[11], S.Trotsenko[1], I. Uschmann[1,6], G.Weber[1,6], O.Wehrhan[1], N. Winckler[2] D.F.A. Winters[2], N. Winters[2], E. Ziegler[1,2], and H.F. Beyer[2]

[1]Helmholtz-Institut Jena, Jena, Germany; [2]GSI Helmholtzzentrum, Darmstadt, Germany; [3]Institut des NanoSciences de Paris, CNRS-UMR 7588, Sorbonne Universités, UPMC Univ Paris 06, 75005, Paris, France; [4]Institute of Physics, Jan Kochanowski University, PL-25-406 Kielce, Poland; [5]Institut für Atom und Molekülphysik, Justus-Liebig-Universität, Gießen, Germany; [6]Inst. für Optik und Quantenelektronik, Friedrich-Schiller-Universität, Jena, Germany; [7]Institut für Kernphysik, Goethe-Universität, Frankfurt am Main, Germany; [8]Laboratoire Kastler Brossel, CNRS-UMR 8552, Collège de France, ENS-PSL Research University, Sorbonne Universités, UPMC Univ Paris 06, 75005, Paris, France; [9]Laboratoire de Physique des Lasers (LPL) UMR 7538 CNRS - Université Paris 13, Villetaneuse, France; [10]ISTerre, Observatoire des Sciences de l'Univers, BP 53, 38041 Grenoble, France; [11]Laboratoire Kastler Brossel, Sorbonne Universités, UPMC Univ. Paris 06, Case 74; 4, place Jussieu, 75005 Paris, France; [12]ESRF, Grenoble, France

Synopsis We have measured the 1s Lamb shift in hydrogen-like gold Au^{78+} in the experimental storage ring (ESR) by high-resolution spectroscopy of the Lyman x rays using a dedicated twin crystal-spectrometer assembly. This is the first result obtained for high-Z hydrogen-like ion with high-resolution wavelength-dispersive spectroscopy at a storage ring. The result is compared with the state-of-the-art QED calculations as well as with other measurements.

Aiming for an accurate testing of the QED effects on the ground state binding energy in high-Z, H-like ions, novel high resolution x-ray spectrometer setup has been developed for experiments at the Experimental Storage Ring (ESR) at GSI, Darmstadt. Namely, the twin crystal-spectrometer assembly, Bi-FOCAL, operated in the FOcusing Compensated Asymmetric Laue geometry has been arranged for accurate x-ray spectroscopy at the ESR gas jet as schematically depicted in figure 1 [1]. Each spectrometer was equipped with one 2D position-sensitive Ge strip detector. In a dedicated beamtime at the ESR, Lyman-α transitions of H-like Au^{78+} were measured in high resolution via spectroscopy of the corresponding x rays located near 63 keV in the laboratory system. Bare gold ions were stored in the ESR at a velocity corresponding to $\beta \approx 0.47$ and the x rays were measured in coincidence with ions undergoing single-electron capture in the argon gas target and being deflected onto a particle detector by the bending magnet downstream the gas jet. It could be demonstrated that the newly developed crystal optics together with the position sensitive detector can cope with the low count-rate situation encountered. Background could be effectively reduced, by proper shielding facilitated by the existence of a polychromatic focus and by making use of the time and energy resolving capabilities of our Ge strip detectors. This setup has allowed us to obtain an experimental value for the 1s Lamb shift in H-like Gold with high statistical accuracy which will be compared with the state-of-the-art theoretical predictions and the results of other measurements [2, 3, 4].

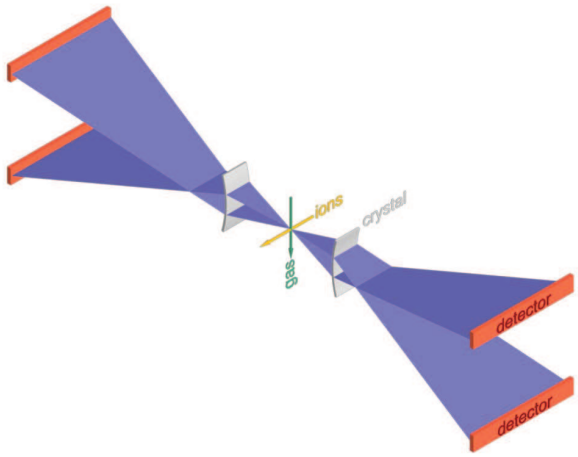

Figure 1. The Bi-FOCAL crystal-spectrometer arrangement at the ESR gas jet.

References

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