RELATIVISTIC KINEMATICS OF ELECTRONS EMITTED FROM FAST PROJECTILES: KINEMATIC BROADENING AND HIGH RESOLUTION MEASUREMENTS

T.J.M. Zouros[1,2], Rido Mann[3] and S. Hagmann[3,4]

1) Department of Physics, University of Crete, Heraklion, Crete, Greece
2) Inst. of Electronic Structure and Laser, FORTH, P.O. Box 1527, 71110 Heraklion, Crete, Greece
3) Gesellschaft für Schwerionenforschung, Planckstrasse 1, 64291 Darmstadt, Germany
4) Institut für Kernphysik, August-Euler-Strasse 6, 60486 Frankfurt, Germany

We have investigated the kinematic effects influencing the spectroscopy of electrons emitted from relativistic ion emitters. These effects, well known from the case of non-relativistic emitters [1, 2] are re-derived using a relativistic formulation, for fast emitters for which $\gamma >> 1$. Interest in these results arise from possible new applications of zero-degree Auger electron spectroscopy in storage rings using relativistic highly charged ions in collision with gas targets, as for example in the New Experimental Storage Ring (NESR) planned to be built at GSI within the SPARC collaboration.

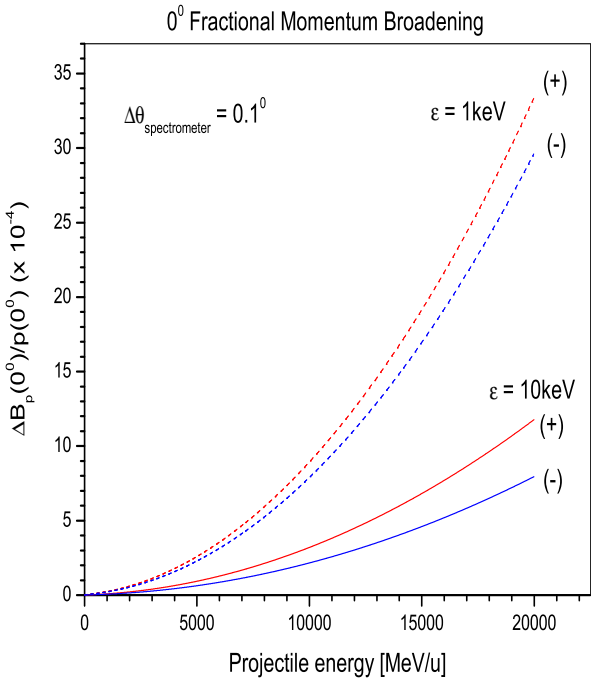

Fig. 1. Exact fractional electron momentum kinematic broadening plotted as a function of projectile energy for both the forward (+) and backward (−) emitted electrons. The rest frame electron energies ε used for this calculation are 1 and 10 keV.

Of particular concern are the limits imposed by the kinematic broadening[1, 2] on the momentum resolution of the envisioned magnetic spectrometer. Our calculations for the exact laboratory fractional momentum broadening in the forward direction ($\theta = 0^0$), $\Delta B_p(0^0)/p(0^0)$ are shown in Fig. 1 for a spectrometer full acceptance angle $\Delta\theta_{spectrometer} = 0.1°$. Both the forward emitted (+) and the backward emitted (−) electron broadenings are shown. The envisioned magnetic spectrometer's electron momentum resolution $\Delta p/p$ will be better than 1×10^{-4}. Clearly, as shown in Fig. 1 for this spectrometer to be effective in the entire energy range up to 20 GeV/u the overall acceptance angle will have to be smaller than 0.1°. Furthermore, the smaller the electron rest frame energy the more restricted the acceptance angle.

These and other points relating to the inherent kinematic limitations of such a magnetic spectrometer will be presented.

References

[1] N. Stolterfoht, Physics Reports **146**, 315 (1987).

[2] T J M Zouros and D H Lee, in *Accelerator-based atomic physics techniques and applications*, ed. by S M Shafroth and J C Austin, (AIP Press, Woodbury, NY), p. 426-479 (1997).

[3] For more information please see http://www.gsi.de/zukunftsprojekt/experimente/sparc.

E-mail : tzouros@physics.uoc.gr