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2015 J. Phys.: Conf. Ser. 635 052063

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Investigation of the dependence of the energy resolution of a hemispherical deflection analyzer on the distance of the position sensitive detector from the focal plane

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Synopsis We investigate the energy resolution and line shape of a biased paracentric hemispherical deflector analyzer considering the distance between the exit focal plane and the detection plane. Equipped with a piezo-electrically controlled location of a 2D position sensitive detector we were able to accurately determine the optimum conditions for best energy resolution. The voltages of the injection lens of the spectrometer were also optimized for each location.

Most modern hemispherical deflector analyzers (HDAs) are equipped with an electrostatic injection zoom lens and a position sensitive detector (PSD). Practical geometrical constraints (fringing field correctors, grids, their mountings etc.) does not always allow the PSD placement at the optimal position, i.e. the first-order focal plane following 180° deflection. Page and Read [1] have shown in simulations that an optimal choice on the distance h between the focal plane and the detection plane might exist for which non-linearities in the energy of the electrons across the PSD become minimized.

Here, we present a study on the h dependence of the energy resolution and line shape in a biased paracentric HDA. The HDA is equipped with a 4-element entry zoom lens and a 2-dimensional PSD in operation with a doubly-differentially pumped gas target. It is a part of the experimental station at the 5.5MV TANDEM of the NCSR “Demokritos” in Athens developed in the new research initiative APAPES [2] funded by THALES. The setup is primarily dedicated to zero-degree Auger projectile spectroscopy, performing high resolution studies of electrons emitted in ion-atom collisions.

Recently, a piezo-electric motor on the shaft on which the PSD is supported has been installed (see Figure 1). This allows us to electronically control the distance h of the PSD with respect to the HDA exit focal plane thus enabling an experimental study of its effect on the measured line shape. Moreover, at different values of the distance h of the PSD, the injection

lens voltages are optimized appropriately including this vital parameter in the study as well [3]. Cold cathode electron gun beams are mostly utilized while electrons resulting from ion-atom collisions at zero-degrees with respect to the ionic beam are complementing the study. In order to understand in detail our findings we also included simulations utilizing the SIMION 8.1 ion optics simulation package.

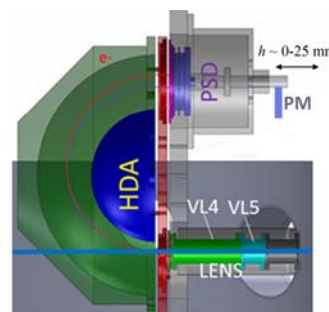


Figure 1. Schematic view of an HDA spectrometer. The PSD is placed a distance h from the focusing plane of the HDA.

This research has been co-financed by the European Union and Greek national funds through OP: Education and Lifelong Learning, Research Program: THALES.

References

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