Photoelectric Effect with Linearly Polarized High Energy Photons

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Spatial distributions of photoelectrons ejected from K-shells of Ta, Au and Pb by linearly polarized high energy photons have been investigated. The reactions ^{24}Mg (p, p'γ) $^{24}Mg^*$ and ^{28}Si (p,p'γ) $^{28}Si^*$ have been used as the sources of linearly polarized 1368 keV and 1779 keV photons. Magnesium and silicon targets were bombarded with 3.07 MeV and 3.10 MeV protons, respectively, obtained from the 4 MV Van de Graaff accelerator of the NRC. After being collimated, photons emitted at 90^o with respect to the direction of the incoming proton beam, entered an evacuated apparatus containing the photoelectric target. Photoelectrons were detected in a pair of cooled 2 cm^2 Si (Li) detectors. A fast coincidence was required between photoelectrons and subsequently emitted K-X rays. Spectra from both Si (Li) counters were recorded simultaneously.

The ratio R (Θ) of the number of photoelectrons ejected in the polarization plane to the number emitted in a plane perpendicular to this was measured for various values of the photoelectron emission angle Θ. Our experimental results support the validity of existing theoretical predictions [1]. At forward emission angles the photoelectrons are predicted to be emitted predominantly in the plane of polarization of the photons. This tendency is less pronounced as the emission angle increases and a crossover is expected to occur and the emission in a plane orthogonal to the polarization plane to be favoured. In our experiment crossover is observed and also, within the experimental accuracy, the absolute values of R (Θ) are in good agreement with the theoretical calculation.

1) S.Hultberg, B.Nagel and P. Olsson,
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