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Eletron-helium laser-assisted free-free scattering for incident energies from 30 - 200 eV: effects of polarization direction

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Synopsis We report on experiments that examine electron-helium scattering in the presence of an Nd:YAG laser field of 1.17 eV photons. At each incident electron energy (30, 60, and 200 eV), the laser polarization direction is varied within a plane perpendicular to the scattering plane. We compare our results with Kroll-Watson approximation calculations.

We are examining electron-helium elastic scattering in the presence of an Nd:YAG laser field ($h\nu = 1.17\,\mathrm{eV}$). The first such laser-assisted free-free (LAFF) experiments were reported by Andrick and Langhans in 1976 [1], and Weingartshofer et al in 1977 [2]. Previously, we have reported results on such processes for incident energies from 50 – 350 eV for a fixed laser polarization direction [3].

Here, we report on experiments at three incident electron energies (30, 60, and 200 eV), where the laser polarization direction is varied within a plane perpendicular to the scattering plane. Specifically, we vary the polarization from being approximately parallel to the momentum transfer direction, to being perpendicular to it, in 30° increments. We compare our results with Kroll-Watson approximation (KWA)[4] calculations.

Of particular interest is the case where the polarization is perpendicular to the scattering plane, for which the KWA predicts vanishing cross section; other workers have found that the KWA tends to be inaccurate for those cases where it predicts small cross sections (e.g., [5, 6]). However, the KWA describes our results within the experimental uncertainties. A representive plot of our data and associated calculations is shown in figure 1.

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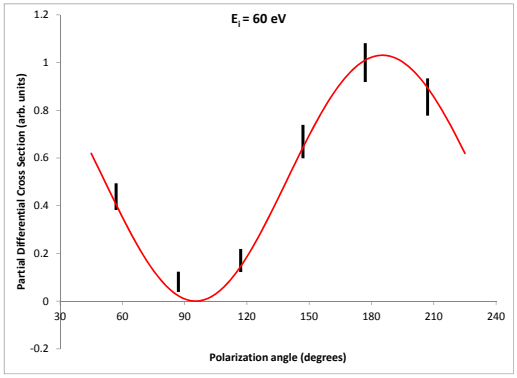

Figure 1. Angular distribution of electrons elastically scattered from helium that have emitted a single photon as a function of laser polarization direction (measured relative to the momentum transfer direction). Bars indicate experimental measurements (plus or minus one standard deviation). The solid line is a KWA calculation fitted to the data.

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