YOUNG-TYPE INTERFERENCE WITH SINGLE ELECTRONS IN THE AUTOIONIZATION OF ATOMS BY THE IMPACT OF MOLECULES: AN INDEPENDENT MEASUREMENT IN THE BACKWARD DIRECTION

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In a recent article [1] we provided an unprecedented experimental evidence of a single electron interfering with itself in a set-up that was analogous to an atomic-size double-slit apparatus [2]. In that version of the famous gedanken experiment proposed by Feynman in 1963 [3] to illustrate the wave-like nature of matter, the electron originates from the autoionization of a doubly-excited helium atom following a double capture process in a 30 keV He^{2+} + H_2 collision. The autoionizing He atom plays the role of a single-electron source, that is independent of the two-center target interferometer. In that experiment, performed at GANIL (Grand Accélérateur National d'Ions Lourds), in Caen (France), at least three distinctive oscillations were observed in the angular distribution of the electron emission cross section, in a range from 95 to 160 degrees. Here, we report the first results of an independent measurement performed at the Cockroft–Walton accelerator of the Centro Atómico Bariloche, with 40 keV He^{2+} projectiles. The electron emission was observed from 155 to 180 degrees, overlapping with the previous experiment in a small region of angles and extending its range all the way to the backward direction. The H_2 gas target was provided by a needle of 0.3 mm bore located at the focus of the cylindrical mirror electron spectrometer [4] to reduce partially the extended gas target effect and increase the counting rate. The results are consistent with the oscillations observed with the Caen equipment. The prominent increase of the electron intensity at 180 degrees, despite of no corrections due to gas target extension, can be ascribed to a backward Glory effect [5, 6].

Keywords: Young interference; Autoionization; Atom-molecule collision

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