YOUNG-TYPE INTERFERENCES, SINGLE-ELECTRON SOURCES AND AN ATOMIC-SIZE TWO-CENTER INTERFEROMETER

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Recently, interferences caused by a single electron impacting on an independent double-center scatterer, which plays the role of an atomic-size double-slit system, were experimentally evidenced for the first time [1,2]. The electron originates from the autoionization of doubly excited 2*l*n*l*' (n ≥ 2) configurations of He following a double charge exchange process by 30 keV He^{2+} ions impinging on H_2 molecules. Well-defined oscillations were visible in the angular distribution of the electrons emitted towards the receding H protons. The presence of these oscillations was shown to be a clear demonstration that a single electron interferes with itself. The period of the oscillations was found to be ~17°, in agreement with the predictions of the model developed recently [3].

In the present work, we discuss the dependence of the interference pattern with interference parameters. It is well known that, when light passes through two slits, the distance *i* between two maxima on a screen strongly depends on the light wavelength λ and on the distance *d* between the slits. Consequently, the angular period, defined by $T \sim \lambda/d$, varies also with these two parameters. Similarly, by modifying the electron wavelength and the distance between the protons, the interference pattern is expected to change. This can be easily done by changing the projectile velocity, or the projectile itself.

We performed a Young-type experiment using 30 keV He^{2+} and 105 keV N^{6+} projectile ions. In the case of He^{2+} ions, the period *T* is found to be practically the same as that found at 30 keV, within the uncertainties. However, the shape of the interference pattern changes strongly, since a phase shift of nearly π in the angular distribution of autoionizing electrons is observed. For N^{6+} projectile ions, no oscillation is found. We will show that all these results can be interpreted using the simple model developed previously [3].

References

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