Young-type Electron Interferences in Autoionization of He Atoms colliding with H_2: A Projectile Energy Dependence

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In the present work we provide experimental evidence for Young-type interferences caused by one single electron acting on a given double-center scatterer which is analogous to an atomic-size double-slit apparatus [1-3]. The interfering electron originates from autoionization of a doubly-excited helium atom following the capture of the two H_2 target electrons by a He^{2+} incoming projectile ion. In the backward direction, the autoionized electron scatters on the two H^+ centers of the fully ionized target molecule. Here, the autoionizing projectile plays the role of a single-electron source, independent of the interferometer provided by the residual two-center target. The present experiment resembles the famous "thought experiment" imagined by Feynman in 1963, in which the quantum nature of the electron is illustrated from a Young-like double-slit experiment.

The experiment has been performed at projectile energies of 30 keV and 8 keV. Similarly to the case of Young's experiment with light, the interference effects manifest themselves in well defined oscillations in the angular distribution of the scattered electrons. The presence of these oscillations is an unprecedented experimental demonstration that a single electron interferes with itself while passing through a Young-like apparatus.

When the projectile energy is divided by a factor of ~ 4, the oscillations remain with about the same angular period, but a phase shift of ~ π is observed. These results will be discussed during the conference.

[1] J.-Y. Chesnel, A. Hajaji, R. O. Barrachina and F. Frémont, *Phys. Rev. Lett.* **98** (2007) 100403

[2] J.-Y. Chesnel *et al.*, *Journal of Physics: Conference Series* **58** (2007) 185

[3] F. Frémont *et al.*, *Journal of Physics: Conference Series* **88** (2007) 012020