Measuring the scattering phases of ion-atom collisions via two-center interference effects

S F Zhang[1] *, Y Gao[1], X L Zhu[1], D L Guo[1], M Schulz[2], A B Voitkiv[3] and X Ma[1†]

[1]Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou 730000, China
[2]Department of Physics and LAMOR, Missouri University of Science & Technology, Rolla, Missouri 65409, USA
[3]Theoretische Physik I, Heinrich Heine Universität Düsseldorf, Universitätsstraße 1, 40225, Düsseldorf, Germany

Synopsis Phases of quantum transition amplitudes contain very important information about physical processes. However, as a rule, they may not be accessed experimentally. This is, in particular, the case when collisions of ions and atoms are studied. We will report on the new method with which the relative scattering phase of ion-atom collisions can be read out via two-center interference effects.

We explore double electron capture in collisions of alpha particles with the hetero-diatomic molecule CO[1]. By regarding the atomic cores of the molecule as two "slits", the interference effects in molecular orientation spectrum can be identified (see figure 1).

It is known that the interference effects in collisions between ions and homo-diatomic molecules (for instance, H_2) will present symmetric distributions about 90 degrees in the orientation spectra [2,3]. However, with the hetero-diatomic molecule CO as "double slits", the spectra of figure 1 exhibit very asymmetric orientation distributions. It is found the asymmetries arise due to non-zero relative scattering phase of the alpha particle scattering on different atomic cores of the CO.

Such a phase can be obtained via a fitting procedure. Experimentally extracting the scattering phase not only can provide the most stringent test for theory but may also open the prelude to new areas of atomic collision studies.

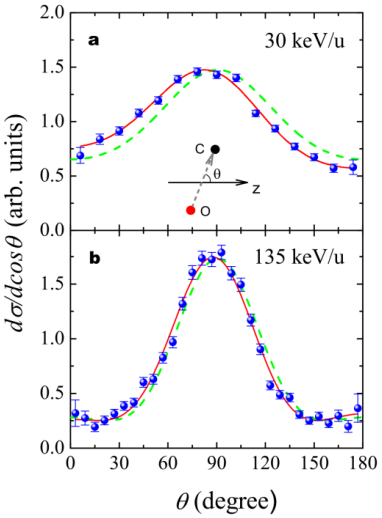

Figure 1. Interference effects in collisions between He2+ on CO.

References

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* E-mail: zhangshf@impcas.ac.cn
† E-mail: x.ma@impcas.ac.cn