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INFLUENCE OF CATASTROPHES AND HIDDEN DYNAMICAL SYMMETRIES ON ULTRAFAST BACKSCATTERED PHOTOELECTRONS

T. ROOK, L. CRUZ RODRIGUEZ and C. FIGUEIRA DE MORISSON FARIA

Department of Physics and Astronomy, University College London, Gower Street, London, WC1E 6BT, UK
E-mail thomas.rook.20@ucl.ac.uk

Abstract. We discuss the effect of using potentials with a Coulomb tail and different degrees of softening in the photoelectron momentum distributions (PMDs) using the recently implemented hybrid forward-boundary CQSFA (H-CQSFA). We show that introducing a softening in the Coulomb interaction influences the ridges observed in the PMDs associated with backscattered electron trajectories. In the limit of a hard-core Coulomb interaction, the re-scattering ridges close along the polarization axis, while for a soft-core potential, they are interrupted at ridge-specific angles. We analyze the momentum mapping of the different orbits leading to the ridges. For the hard-core potential, there exist two types of saddle-point solutions that coalesce at the ridge. By increasing the softening, we show that two additional solutions emerge as the result of breaking a hidden dynamical symmetry associated exclusively with the Coulomb potential. Further signatures of this symmetry breaking are encountered in subsets of momentum-space trajectories. Finally, we use scattering theory to show how the softening affects the maximal scattering angle and provide estimates that agree with our observations from the CQSFA. This implies that, in the presence of residual binding potentials in the electron's continuum propagation, the distinction between purely kinematic and dynamic caustics becomes blurred (see Rook et al. 2024).

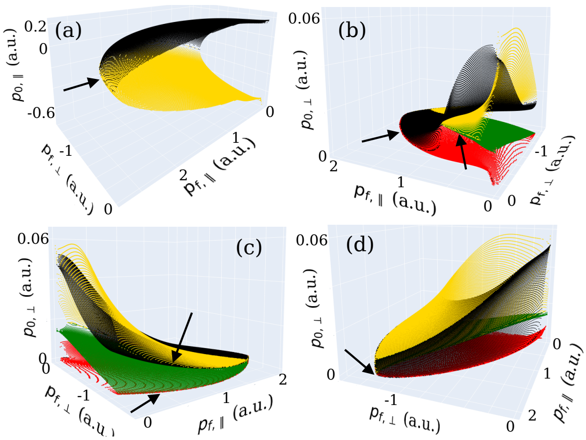

Figure 1: Three dimensional representation of the saddle point trajectories which correspond to the backscattered photoelectrons for a hard-core potential (a) and a soft-core potential (b-d). When a Coulomb softening is introduced, the number of sheets of solutions increases from two to four. The four distinct folds which connect these sheets all intersect at the singular point indicated by the black arrow in panel (d). The folds are indicated by the arrows in panels (a-c).

References

Rook, T., Cruz Rodriguez, L., Faria, CfdM.: 2024, **arXiv:2403.02264** [*physics.atom-ph*]