IOPscience iopscience.iop.org

Home Search Collections Journals About Contact us My IOPscience

Effect of coulomb confinement resonances on time delay in $Ne@C_{60}^{-5}$

This content has been downloaded from IOPscience. Please scroll down to see the full text.

2015 J. Phys.: Conf. Ser. 635 092042

(http://iopscience.iop.org/1742-6596/635/9/092042)

View the table of contents for this issue, or go to the journal homepage for more

Download details:

IP Address: 130.56.97.171
This content was downloaded on 18/07/2016 at 04:07

Please note that terms and conditions apply.

Effect of coulomb confinement resonances on time delay in Ne@C_{60}^{-5}

Ashish Kumar[*] [1], H. R. Varma[*] [2], P. C. Deshmukh[*,†] [3], S. T. Manson[#] [4], V. K. Dolmatov [$] [5] and A. S. Kheifets[!] [6]

[*] School of Basic Science, Indian Institute of Technology Mandi, 175001, India
[†] Department of Physics, Indian Institute of Technology Madras, 600049, India
[#]Department of Physics and Astronomy, Georgia State University, Atlanta, GA 30303, USA
[$]Department of Physics and Earth Science, University of North Alabama, Florence, Alabama 35632, USA
[!]Research School of Physics and Engineering, Australian National University, Canberra, Australian Capital Territories 0200, Australia

Synopsis Wigner time delay for inner and outer shells of Ne@C_{60}^{-5} have been studied using relativistic random phase approximation (RRPA) [1]. Coulomb confinement resonances (CCR) due to the charged nature of fullerene cause prominent effects on the photoionization time delay of 1s subshell. These CCRs in 1s also results in significant modifications of the time delay in 2s and 2p ionization channels through interchannel coupling at energies far above their thresholds.

Sophisticated experimental techniques such as attosecond streaking and Reconstruction of Attosecond Bursts by Ionization of Two-photon Transitions (RABITT) [2] have opened up a new domain in photoionization experiments; it is now possible to measure the difference in delay time for the ejection of photoelectrons from different subshells of an atom with attosecond precision. A number of theoretical and experimental works have been reported in the recent past along this direction [3-6].

Dolmatov *et al.* [7] has predicted the re-emergence of confinement resonances at very high energies far away from the 2p threshold in Ne@C_{60}^{-5}. This revivification of confinement resonances was attributed to the presence of CCRs in the 1s subshell of Ne@C_{60}^{-5}. The present work reports the Wigner time delay in 2s ionization channels due to the presence of these CCRs in 1s subshell. The effect of these CCRs on the time delays of 2s and 2p subshells of Ne@C_{60}^{-5} are also studied in the region far above respective thresholds.

A model potential is used to simulate the effect of charged fullerene [7]. Wigner time delay is determined in the photon energy range of 880 to 920 eV within the frame work of relativistic random phase approximation (RRPA) which takes into account the important many electron correlations.

As an example, the time delay and phase shift for $2s \rightarrow \varepsilon p_{3/2}$ are shown in Fig. 1 ($2s \rightarrow \varepsilon p_{1/2}$ is essentially identical). In the region of CCRs (~ 882 -894 eV) the phase changes significantly. In each CCR region the phase shift initially increases and then decreases. As a result a flip in the sign of time delay profile is observed.

These rapid changes of phase shift in the region of CCRs are seen to enhance the time delay significantly.

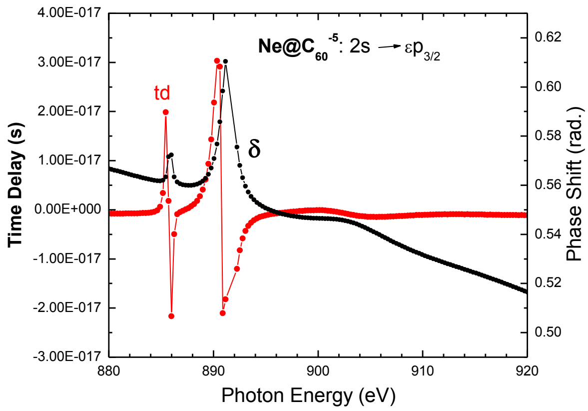

Figure 1. Wigner time delay (td) and phase shift (δ) for $2s \rightarrow \varepsilon p_{3/2}$ photoionization of Ne@C_{60}^{-5}.

The abrupt changes, which are observed above 895 eV, are absent in the region of ordinary confinement resonances (OCR).

In conclusion, CCRs play a major role in the time delay of electron from 1s subshell and also results in significant enhancement of time delay in 2s and 2p ionization channels.

References

[1] W R Johnson *et al* 1979 *Phys. Rev. A* **20** 978
[2] J M Dahlstrom *et al* 2012 *J. Phys. B.* **45** 183001
[3] M Schultze *et al* 2010 *Science* **328** 1658
[4] G Dixit *et al* 2013 *Phys. Rev. Lett.* **111** 203003
[5] P C Deshmukh *et al* 2014 *Phys. Rev. A* **89** 053424
[6] S Saha *et al* 2014 *Phy. Rev. A* **90** 053406
[7] V K Dolmatov *et al* 2009 *Phys. Rev. A* **80** 035401

[1]E-mail: ashishyadav002@gmail.com
[2] E-mail: hari@iitmandi.ac.in [3]E-mail: pcd@physics.iitm.ac.in [4]E-mail: smanson@gsu.edu
[5] E-mail: vkdolmatov@una.edu [6]E-mail: A.Kheifets@anu.edu.au

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd