Journal of Physics:
Conference Series

(e,2e) and (γ,2e) experiments on C_{60}

Journal of Physics: Conference Series **488** (2014) 022018 doi:10.1088/1742-6596/488/2/022018

(e,2e) and (γ,2e) experiments on C_{60}

P. Bolognesi[†1], Y Pavlyukh*, M. Schüler, J. Berakdar* and L.Avaldi[† 2]

[†] CNR-IMIP, Area della Ricerca di Roma 1 , 00015 Monterotondo Scalo, Italy
[*] Institute für Physik, Martin-Luther-Universität Halle-Wittenberg, 06120 Halle, Germany

Synopsis The single and double ionization of C60 in gas phase has been studied by (e,2e) and (γ,2e) experiments. Both the energy distribution of the singly and doubly charged ions and the coincidence angular correlation have been measured. The experimental results have been compared with calculations explicitly accounting for the two-electron correlations.

Fullerene, one of the carbon allotropic forms, discovered in 1985 by Kroto and Smalley [1] is attracting significant interest for its amazing properties [2]. Fullerene can be considered as an intermediate form between atoms and clusters. This makes it a very special target for the investigation of the electron-electron interactions. Its highly symmetric and stable structure shows, already at the single molecule level, both atomic and collective behaviors.

In order to investigate these behaviors in gas phase C_{60} we have undertaken an extensive set of measurements using both an electron beam of tunable energy in the laboratory in Rome and the synchrotron radiation at Elettra.

The ionization of C_{60} has been studied by (e2e) experiments at about 1000 eV in asymmetric kinematics and 0.6 a.u. momentum transfer. The binding energy spectrum (figure 1) has been compared with previous photoemission data and theoretical calculations, while the measured coincidence angular distributions corresponding to the ionization of the HOMO and HOMO-1 have been compared with calculations that account for ionic symmetry and electronic structure of C_{60} [3].

The double photoionization of C_{60} has been studied at the Gas Phase beamline at Elettra. In a first experiment the binding energy spectrum of C_{60}^{2+} has been measured by detecting in coincidence two photoelectrons of about 10 eV as a function of the photon energy. The spectrum has been compared with the Auger spectrum which populates the same final states via inner shell ionization. At two selected binding energies the correlated angular distribution has been also measured.

A theory based on the Kohn-Sham potential for C60 has been developed [6]. We study the role of the electronic correlation by computing the bound states in the vicinity of the HOMO along with the scattering wave functions for two electrons. Our approach treats the electron-electron interaction exactly and thus allows for the clarification of its effect on the 2e emission properties.

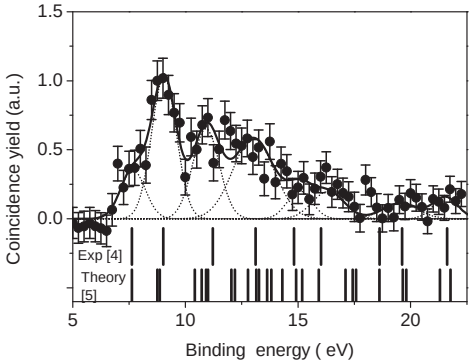

Figure 1. (e,2e) binding energy spectrum of C_{60} measured at E_a=1000 eV, E_b=20 eV, θ_a=4° and θ_b=80°. The bars below the spectrum are the positions of the electronic bands measured in [4] and calculated in [5];

References

[1] H W Kroto *et al* 1985 *Nature* **318** 162
[2] A F Hebard *et al* 1991 *Nature* **350** 600
[3] P Bolognesi *et al* 2011 *J. Phys.: Conf. Series* **288** 012006
[4] J H Weaver *et al* 1991 *Phys. Rev. Lett.* **66** 1741
[5] P Colavita *et al* 2001 *Phys. Chem. Chem. Phys.* **3** 4481
[6] Y Pavlyukh *et al* 2010 *Phys. Rev.* A **81** 042515

[1] E-mail: Paola.Bolognesi@imip.cnr.it
[2] E-mail: Lorenzo.Avaldi@imip.cnr.it