3 - 7 Observation of Indirect (e, 3e) of CO Induced by Electron Impact*

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We report an experimental investigation of ionization dissociation of CO^{2+} induced by electron impact at incident energy of 380 eV. The fragment ions (C^+/O^+) and the emitted electron were measured in coincidence by utilizing COLTRIMS technique. The kinetic-energy-release (KER) of the fragment ions and the energy of the outgoing electrons are obtained. Based on the characters of the KER distribution and the energy spectrum of the emitted electrons (see Fig. 1), the direct and indirect double ionization ((e, 3e)) including an auto-ionization process were identified respectively.

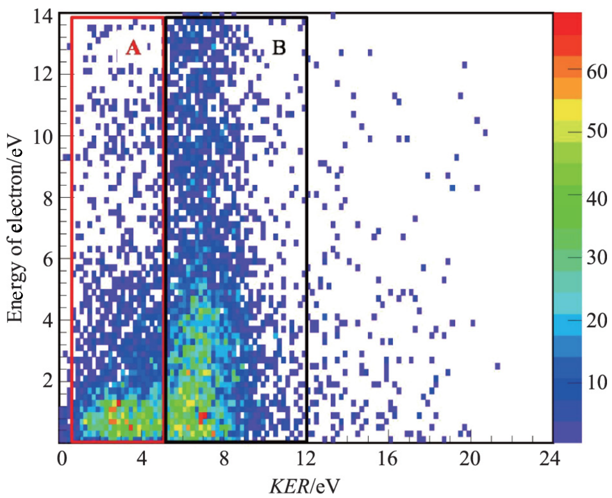

Fig. 1 (color online) Two-dimensional diagram of the kinetic energy of one of the emitted electrons (vertical) versus the KER of the ionic fragments (horizontal).

Two apparent features are found as marked in Fig. 1. In the area A (marked by the red square), most of the emitted electrons distribute in the region with the electron kinetic energy less than 2 eV and the KER from 0 to 5 eV. In the area B (marked by the black square), the electrons distribute in the energy range of 0 to 14 eV and the intensity shows a monotonous decrease with the electron energy increase, and most of the electrons locate below 6 eV. The corresponding KER exhibits a broader distribution from 5 to 12 eV with a maximum around 7 eV. For the area A, the lower KER and the concentrated energy distribution of the emitted electron reveal the indirect (e, 3e) including an auto-ionization process[1]. For the area B, the higher KER value and the continuous energy distribution of the outgoing electron indicate the direct (e, 3e) process.

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3 - 8 Unambiguous Detection of Interatomic Coulombic Decay of Ne Dimer*

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A famous energy transfer mechanism is termed Interatomic Coulombic Decay (ICD)[1,2], in which an initial vacancy is firstly created in an inner shell of atom A, then the excess energy from the drop of an outer shell electron into the vacancy can be transferred to the neighboring atom B via virtual photons.

In contrast with numerous X ray and heavy ion experiments, the ICD investigation by electron impact is very scare. And the corresponding evidence is only obtained based on electron energy spectrum subtraction[3]. Now, in order to get the ICD evidence more directly, we performed the fragmentation experiment of Ne dimers by 380 eV electron impact at the Reaction Microscope in the Institute of Modern Physics, CAS[4].

By detecting the Ne^+/Ne^+ ions and the emitted electron in coincidence, the momenta and energy of all charged products, as well as the Kinetic Energy Release (KER), are obtained. As shown in Fig. 1, the relationship of the

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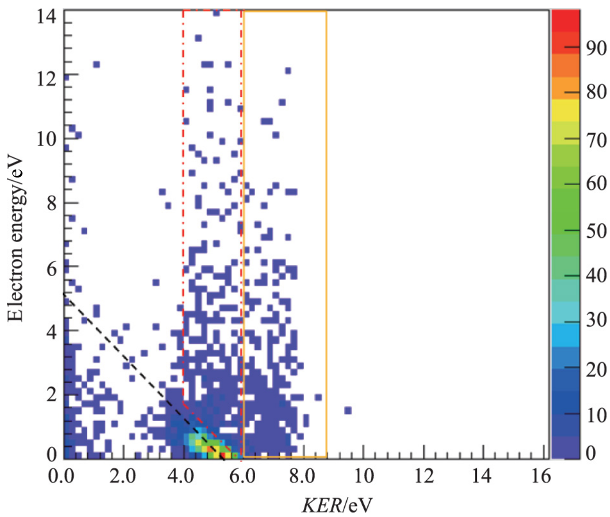

Fig. 1 (color online) Correlation map between electron energy and KER. Black dashed line: position of ICD initial states: Ne($2s^{-1}$)-Ne($2p^6$).

electron energy and the KER is presented in a two dimensional map, in which a diagonal island at electron energy from 0 to 2 eV and KER from 4 to 6 eV is observed.

According to the energy conservation law, if a $2s$ electron of one Ne atom is ionized, and the transition energy from $2p$ to $2s$ is used to ionize the electron of another Ne atom, the sum energy of ICD electron and KER will be a constant (5.5 eV). In Fig. 1, this constant is presented as a dashed line. Obviously, most events in the diagonals island locate around this line. This means that we detected ICD arises from initial states Ne($2s^{-1}$)-Ne($2p^6$). Because we do not apply the electron energy spectrum subtraction in the offline analysis, our result provides the most direct evidence of ICD in (e, 2e) experiment so far.

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3 - 9 Calculations about the Production Rate of H- and Li-like Uranium for DR Experiments on HIAF

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A new project, High Intensity heavy ion Accelerator Facility (HIAF) is under design now in China, which will provide stable and unstable ion beams with high energy, high intensity and high quality[1]. Dielectronic recombination (DR) experiments of very heavy highly charged ions and radioactive ions are considered as the main motivation for atomic physics at HIAF[2]. The spectroscopy of very heavy H- and Li-like ions is a powerful tool to test quantum electrodynamics (QED) in strong fields and to investigate the generalized Breit interaction (GBI)[3,4]. In addition, the isotope shift and the hyperfine splitting can be researched with DR experiments of Li-like ions.

In order to prepare the DR experiments with an electron-cooler and a dedicated electron target at SRing on HIAF, the calculations about the percentage and output energy of H-like $^{238}U^{91+}$ and Li-like $^{238}U^{89+}$, $^{235}U^{89+}$, $^{237}U^{89+}$ with program Lise++ have been performed by using $^{238}U^{34+}$ as a projectile. The results of the calculation are presented in Fig. 1. Therewith, the energy of electron-cooler and the required detuning voltage of the electron target corresponding to the ion beam energy and excitation energy of KLM-DR process of H-like $^{238}U^{91+}$ have also been calculated, respectively. The combination of an electron cooler and a dedicated electron target at the SRing will provide a unique opportunity for DR spectroscopy of highly charged ions to test the strong field QED and investigate the interface of atomic physics and nuclear physics.