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ICD and its exploration by short, intense and coherent light pulses

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How does a microscopic system like an atom or a small molecule get rid of the excess electronic energy it has acquired, for instance, by absorbing a photon? If this microscopic system is isolated, the issue has been much investigated and the answer to this question is more or less well known. But what happens if our system has neighbors as is usually the case in nature or in the laboratory? In a human society, if our stress is large, we would like to pass it over to our neighbors. Indeed, this is in brief what happens also to the sufficiently excited microscopic system. A new mechanism of energy transfer has been theoretically predicted and verified in several exciting experiments. This mechanism seems to prevail "everywhere" from the extreme quantum system of the He dimer to water and even to quantum dots. The transfer is ultrafast and typically dominates other relaxation pathways. To exploit the high intensity of laser radiation, we propose to select frequencies at which single-photon absorption is of too low energy and two or more photons are needed to produce states of an atom that can undergo interatomic Coulombic decay (ICD) with its neighbors. ICD is an extremely efficient decay mechanism for excited systems which are embedded in environment. For the Ne2 dimer it is explicitly demonstrated that the proposed multiphoton absorption scheme is much more efficient than schemes used until now, which rely on single-photon absorption. Extensive calculations on Ne2 show how the low-energy ICD electrons and Ne+ pairs are produced for different laser intensities and pulse durations. At higher intensities the production of Ne+ pairs by successive ionization of the two atoms becomes competitive and the respective emitted electrons interfere with the ICD electrons. It is also shown that a measurement after a time delay can be used to determine the contribution of ICD even at high laser intensity. The study can provide a hint how the energy deposited by a FEL on one site in a medium can be transferred fast to the surrounding. Work on ICD can be found on the ICD Bibliography: http://www.pci.uni-heidelberg.de/tc/usr/icd/ICD.refbase.html