

MULTIPLE IONISATION OF ATOMS AND MOLECULES EXPOSED TO STRONG AND WEAK X-RAY FIELDS

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Albert Einstein's explanation of the photoelectric effect in form of his photoelectric law from 1905 opened up the development of electron spectroscopy, which intensively took place in Sweden and other countries in the mid 1950's and onwards, and which in particular has a longstanding tradition at Oulu University. Conventional electron spectroscopy, which is widely used today in many different scientific contexts and industrial applications, reveals primarily the electronic structure of singly ionized systems.

Absorption of a single photon can also lead to the emission of two or more electrons by a single atom or molecule. If all the electrons emitted by a specific process can be detected simultaneously and their energies analysed, one can access the energy levels of multiply charged systems. This type of experiment implies in reality multi-dimensional correlation spectroscopy, offering an exceptional opportunity to investigate many-particle dynamics of Coulomb systems, which govern the building up of matter in all forms. A highly efficient measuring technique, which is based on a time-of-flight magnetic bottle electron spectrometer, is known to us since some years [1], and allows, for instance, the studies of double vacancies involving valence and/or core levels and their decay (see e.g. Refs. [2,3] and references therein).

Double core vacancies are especially of great interest, because they potentially have a higher chemical sensitivity compared to conventional core level electron spectroscopy. Such vacancies can be created in different ways. A highly efficient way is utilizing a non-linear few X-ray photon absorption process (see e.g. Refs. [4,5] and references therein), which just became possible at the world's first X-ray Free Electron Laser sources.

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