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X-ray-atom scattering in presence of a laser field

D. B. Milosevic[1], F. Ehlotzky[2],

[1]Department of Physics, University of Sarajevo
[2]Institut für Theoretische Physik, Universität Innsbruck

We consider x-ray-hydrogen atom scattering in the presence of a monochromatic linearly polarized laser field. The S-matrix of this process is presented and an expression for the differential cross section (DCS) is derived. The presented numerical results for the DCS as a function of the number n of photons exchanged with the laser field show a characeristic behaviour. The number n can only be even. For $n = 0, \pm 2$ we have pronounced maxima in the DCS, followed by sharp minima at $n = \pm 4$. After that we have a plateau which is different for negative and positive values of n. The plateau for the negative values of n is much more extended than for positive ones. We also analyze the dependence of the matrix elements of the x-ray spectra on the incident x-ray photon energies and we show that the shape and position of the plateau is determined by the simple relation $n\hbar\omega = I_0 - \hbar\omega_k$. This condition connects the number of absorbed or emitted photons n, the laser field photon energy $\hbar\omega$, the atomic ionization potential I_0 and the energy of the incident x-ray photon $\hbar\omega_k$.

Supported by ÖNB project Nr. 6211/1 and by a ÖAD scholarship Nr. 798-1/97.

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Redistribution of electron energies at the interface between laser radiation filled space and vacuum

S. Varro[1], F. Ehlotzky[2]

[1]Research Institute for Solid State Physics, Budapest
[2]Institut für Theoretische Physik, Universität Innsbruck

Using a simple one-dimensional model, we show that at the interface between a half-space filled by laser radiation and vacuum a considerable redistribution of the energies of electrons, either scattered or ionized in the laser field, takes place. This indicates that electron spectra evaluated by using electromagnetic plane wave fields for the description of a laser pulse, cannot reliably be compared with those data observed experimentally.

Supported by the Scientific-Technical Agreement between Austria and Hungary 1997/98, project Nr. A47 and OTKA project Nr. T016140.