

Characteristic X-ray radiation and Auger electrons production from resonant coherently excited highly charged ions under planar channeling

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Density-matrix approach of papers [1-3] to treat the resonant coherent excitation (RCE) process in oriented crystals is applied for unified theoretical description of charge state distribution of relativistic resonant coherently excited ions, their characteristic X-ray radiation and, for the first time, Auger electron production from doubly excited states. The work was stimulated by recent RCE experiments including unambiguous observation of azimuthal anisotropy of characteristic X-ray radiation from excited planar-channeled ions [4], double RCE experiments [5], and trajectory dependent measurements of the survival fraction of the emergent ions [6].

We adapt main idea of the experiment [6] to understand better regularities of ion alignment in the RCE process. Angular distributions of characteristic X-rays from resonant coherently excited ions under planar channeling are calculated being resolved over transverse entrance coordinate z_{in} of the incoming ion. Tuning in on certain harmonics (k,l) of the in-crystal electric field makes it possible to relate the anisotropy of the radiation yield to specific symmetry properties of this field.

Experiment [5] points to new directions in physics of autoionization phenomena. In present work we deal with two aspects of this subject. a) Considering the dynamical (via fast oscillating lattice field) coupling between intermediate $1s2p:1P_1$ and autoionizing $2p^2:1D_1$ states of helium-like ions, we come to close agreement with measurements [5] on survival fraction of relativistic Ar^{16+} ions in both cases of single resonance and cascade double RCE process. Investigating further the role of this coupling, we look at its influence upon alignment of the intermediate state $1s2p:1P_1$ and, hence, on angular distribution of X-ray radiation from it. b) Our calculations predict (in the double resonance regime) large yield of Auger electrons from the produced autoionizing state, and, due to its alignment, clear anisotropy of their angular distribution.

The work is supported by Russian Foundation for Basic Research (grant 06-02-17367).

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