Relaxation of solid target after its excitation by single fast heavy ion.

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Interaction of fast heavy ions with solids leads to creation of latent tracks and is accompanied by radiation of the X-ray spectral lines caused by radiative decay of autoionizing states of multicharged target ions (so called inner shall K_α satellites). This radiation carries in itself the information on a condition of substance in the region of interaction and can be used for diagnostics of an initial stage of defect creation.

Till now interpretation of emission spectra is based on the so called "atomic" model of multiple ionization of target atoms by projectile ion impact. In this model relaxation of excited ion levels is caused by only non-collisional processes (autoionization and radiative decay), and emission X-ray spectra are not connected with parameters of plasma formed in ion track. Thus, the "atomic" model completely ignores the fact that in the plasma a relaxation processes can be much more various. For example, due to collisions with free plasma electrons, originally excited ion Z can be ionized/recombined before emission of X-ray photon. It means, that initial excitation of ion Z can lead actually to radiation of a spectral line of ion $Z' \neq Z$, and the observable X-ray spectrum will reflect not only characteristics of interaction of projectile ion with atoms of targets, but also parameters (temperature, density) of the created plasma.

In the present work more general plasma model of a relaxation of matter in the region of heavy ion tracks is suggested. This “plasma” relaxation model is based on the solution of the time-dependent radiative-collision kinetic equations with initial conditions defined by both “atomic” model and MD-calculations. The validity of approach developed is tested by comparison of calculation results with available data observed in the experiments [1-3] carried out on the linear heavy ion accelerator UNILAC (GSI, Darmstadt, Germany).

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