

Non-equilibrium energy losses at intermediate to high energies

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The slowing down of fast ions in matter is dominated by electronic processes namely target ionization/excitation, projectile ionization/excitation and electron capture. The basic physical quantities that are used to describe such electronic processes are single-event probabilities, mean energy loss and energy-loss fluctuation. For gas targets or amorphous materials the related cross-sections are more meaningful. However, for crystalline targets as well as for the description of processes related to ion track formation the determination of the probabilities and energy loss as a function of the impact parameter are also required. All these quantities will depend on the projectile speed and nuclear charge but also on the projectile charge-state for experiments under non-equilibrium charge conditions. The determination of the impact parameter dependence of the ionization probability, mean energy loss and straggling is in general a very complex task, and even in the framework of the first-order Born and independent particle model ends up in a large-scale calculation. In this work we describe a model for the ionization probability, energy loss and straggling as a function of the impact parameter for swift ions. We propose a general schema to add contributions from distant and close collisions. In this way, physical processes arising from large and small impact-parameters can be easily included into a single expression valid for all impact parameters. The physical inputs of the model are the electron density and oscillator strengths of the target as well as the screening function of the projectile and are realized by the CasP program [1]. Simple formulas for these quantities are derived and the results are compared to other more sophisticated calculations and experimental data.

[1] P.L. Grande and G Schiwietz, *CasP – Convolution Approximation for Swift Particles*, <http://www.hmi.de/people/schiwietz/casp.html>.