Universal scaling of the electronic stopping cross section for swift heavy projectiles colliding with atoms and molecules

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The electronic stopping cross section and mean excitation energy for heavy ions collinding with atoms and molecules --- within the first Born approximation --- have been calculated in terms of an orbital decomposition. The harmonic oscillator approach and the virial theorem are implemented to describe the atomic target electronic structure through the mean excitation energy [1]. For molecular targets, we use the core and bonds decomposition [3]. In this work, we show that, within the Bethe theory, there is a universal scaling when the electronic stopping cross sections and projectile kinetic energy are scaled properly in terms of the target mean excitation energy for all projectile–target combinations. We provide an analytic expression for the stopping cross section that depends only in terms of the target properties [2]. Finally, we verify the universal scaling law by comparison to atomic and molecular experimental data available in the literature. The scaling rule is useful to describe the electronic stopping cross section for projectile-target systems that have not been experimentally measured yet [3].

References

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