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”Nuclear Reactions within Time Dependent Superfluid Local Density Approximation”

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Time-dependent density functional theory can be viewed as an exact reformulation of time-dependent quantum mechanical problem, where the fundamental variable is no longer the many-body wave-function but the density. For systems like atomic nuclei and quantum atomic gases this approach has to be extended in order to deal with superfluid fermionic systems. Within the framework of the unrestricted time-dependent density functional theory, we present
for the first time an analysis of the relativistic Coulomb excitation of the heavy deformed open shell nucleus 238U. The approach is based on Superfluid Local Density Approximation (SLDA) formulated on a spatial lattice that can take into account coupling to the continuum, enabling self-consistent studies of superfluid dynamics of any nuclear shape. We have computed the energy deposited in the target nucleus as a function of the impact parameter, finding it to be signicantly larger than the estimate using the Goldhaber-Teller model. The isovector giant dipole resonance, the dipole pygmy resonance and giant quadrupole modes were excited during the process. The one body dissipation of collective dipole modes is shown to lead a damping width of about 0.4 MeV and the number of pre-equilibrium neutrons emitted has been quantified.

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