Contribution ID: **280** Type: **Parallel Talk short**

Methodology trends on gamma and electron radiation damage simulations studies in solids under high fluency irradiation environments

Thursday 26 October 2017 15:50 (25 minutes)

The present work deals with the numerical simulation of gamma and electron radiation damage processes under high brightness and radiation particle fluency on regard to two new radiation induced atom displacement processes, which concern with both, the Monte Carlo Method based numerical simulation of the occurrence of atom displacement process as a result of gamma and electron interactions and transport in a solid matrix and the atom displacement threshold energies calculations based on Molecular Dynamic methodologies.
The two new radiation damage processes here considered in the framework of high brightness and particle fluency irradiation conditions are: 1) The radiation induced atom displacement processes due to a single primary knockout atom excitation in a defective target crystal matrix increasing its defect concentrations (vacancies, interstitials and Frenkel pairs) as a result of a severe and progressive material radiation damage and 2) The occurrence of atom displacements related to multiple primary knockout atom excitations for the same or different atomic species in an perfect target crystal matrix due to subsequent electron elastic atomic scattering in the same atomic neighborhood during a crystal lattice relaxation time.
In the present work a review of numeral simulation attempts of these two new radiation damage processes are presented, starting from the former developed algorithms and codes for Monte Carlo simulation of atom displacements induced by electron and gamma in irradiated materials and, in addition, the Molecular Dynamics calculations atom displacement threshold energies for defective crystalline materials as well as for the cases of multiple primary knockout atomic excitations.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei