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Simulation of Channeling and Radiation of Ultra-Relativistic Projectiles in Linear, Bent and Periodically Bent Crystals by Means of MBN Explorer

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The multi-purpose computer package MBN (Meso-Bio-Nano) Explorer that is being developed by MBN Research Center allows modeling of molecular systems of varied level of complexity with the sizes ranging from the atomic to the mesoscopic scales. It is suited to optimize the structure of a system as well as to run MD simulations. In specific application to the channeling phenomenon, the package allows one to modelling various crystalline structures, both straight and bent, to perform analysis of periodic bending in superlattices, to simulate the structure modification due to the surface deformations. The channeling module of the package provides efficient and reliable simulations of channeling of ultra-relativistic projectiles and for calculation of spectral and angular distributions of the emitted radiation. The predictive power of this software resides at the level of accuracy comparable or even higher than in current experiments.

In the talk we will review the general and unique features of the computer package as well as report on the results obtained by means of the MBN Explorer during the last years in the field of channeling. The efficient algorithms of particle trajectories simulation implemented in MBN Explorer has allowed us to describe planar and axial channeling and radiation processes for different type of charged particles and crystals (of different kind and shape) occurring at different energies and at various crystal thicknesses including macroscopic (up to the cm range). In these simulations we have analyzed the particle dechanneling lengths, spectral and angular distributions of radiation emitted in the straight, bent and periodically bent crystals. These simulations elucidate all the elementary events of particle propagation through the crystal that contribute to the overall beam propagation and radiation effects. Many of these results are highly relevant in connection with the ongoing and planned experiments concerning the investigation of the properties of Crystalline Undulators.

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