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Charge changing cross sections of heavy ions and its applications in high Z cosmic rays and hadron therapy

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The interaction of energetic nuclei through various materials is a subject of experimental and theoretical investigations for several decades for the applications of space radiation problems and hadron therapy. In most of the experimental activities, hydrogenated materials such as water, polyethylene, CR39 etc. are used to study physical and biological effects of the radiations. The energy deposition by light nuclei (in particular, 12C ion) in living tissues or tissue-like media is of primary importance for ion-beam cancer therapy. The main objective of the present research is to study heavy ions fragmentations in various targets at high energies. The availability of relativistic heavy ion beams at BNL USA and HIMAC Japan facilities have made it possible to investigate the projectile fragmentation on different targets and at different energies. It is well known that the reduced etch rate p of CR39 track etch detectors is a unique function of the particle restricted energy loss (REL). The identification of a high energy charged fragment with the help of a SSNTD relies on two sources of information: firstly, a good knowledge of how a charged particle loses its energy while propagating in a stopping medium of well-known physical and chemical properties and secondly, the experimental observation of ion trajectory leaving a physically observable signature with a high degree of accuracy. Response functions present the resolution capability of the CR39 detector and the reliability of measurement accuracy of the experiment. The calibration curves are important for the purpose of identification of unknown charged particles in the galactic cosmic rays (GCR). The present study will also cover the simulation study for Si^{14+} and Fe^{26+} ions interactions and calculation of partial charge changing cross section using Geant4. The work reports the performance of available Geant4 nuclear models for the study of hadronic interactions by calculating the fragmentation production cross section (FPXS) for Si^{14+} and Fe^{26+} in various elemental targets. The models employed in the present calculations are binary cascade (BIC), abrasion-ablation (AA) and quantum molecular dynamics (QMD). The calculated fragmentation production cross sections are compared with the experimental data. This comparative study will also be supportive for Geant4 users to choose the appropriate model for further improvement.

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