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Towards the next generation RIB facility using the ISOL Method: radiological protection and shielding challenges

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Over the last decade, the importance of evolving towards the construction of Radioactive Ion Beam (RIB) facilities gained considerable interest and support from the Nuclear Physics community (at large). Projects like the EURISOL (EURopean Isotope Separation On-Line Radioactive Ion Beam) Design Study paved the way to the investigation of scientific, technological and engineering studies of the next generation facility for the production of RIBs using the ISOL (Isotope Separation On-Line) method, two to three orders of magnitude more intense than the ones currently available at other facilities. At the same time, upgrade studies were undertaken at the existing facilities such as SPIRAL-2 at GANIL and ISOLDE at CERN, among others, in order to fill the gap between the existing facilities and the future EURISOL facility. The HIE-ISOLDE project stands for the ongoing High Intensity and Energy upgrade of the ISOLDE facility at CERN.
Computational studies with the state-of-the-art Monte Carlo codes FLUKA and MCNPX pinpointed severe constrains in the shielding design and in the dose rate assessment of these facilities, due to activation of the structural materials and the high intensity of the proton beams impinging on the spallation targets. These translate in dose-rate values that impose careful shielding assessment and consideration of radiation safety issues, should a technical intervention be needed, in a routine situation/maintenance or following an accident with the need to replace or fix damaged components.
In this paper the dose-rate mapping, activation studies of structural components and the shielding design of the aforementioned installations HIE-ISOLDE and EURISOL will be described. Discrepancies between the Monte Carlo simulation results and the experimental data (measurements) obtained at ISOLDE will be presented and pinpointed. The analysis of eventual limitations in the Monte Carlo modelling and simulation of these complex and sophisticated installations will be performed, from the geometry, materials and available cross-sections data viewpoints.

Summary

In this paper, radiological protection and shielding issues associated to the next generation or upgrade of existing RIB facilities are discussed, with emphasis in dosimetry (dose-rate distributions), activation of structural components, shielding design and radiation safety issues.
Shortcomings of the Monte Carlo simulations in order to accurately model and predict the aforementioned distributions and to obtain a correct shielding assessment are discussed.

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