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Arby, a general purpose, low-energy spectroscopy simulation tool

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Measurements of radioactive sources, in order to reach an optimum level of accuracy, require an accurate determination of the detection efficiency of the experimental setup. In gamma ray spectroscopy, in particular, the high level of sensitivity reached nowadays implies a correct evaluation of the detection capability of source emitted photons. The standard approach, based

on an analytical extension of calibrated source measurements usually introduces large uncertainties related to shapes, geometrical setup, compositions and details of the nuclear decay emissions. To overcome the limitations intrinsic in the standard approach a different and more appropriate methodology is needed, specifically the possibility to simulate a virtual experiment featuring the same characteristics as the real measurements (geometry, materials, physical process involved). The GEANT4 toolkit offers all the ingredients needed to build such a simulator: the standard approach is to write specialized code to simulate a specific problem using the toolkit components and assembling them in a compiled program that contains the full specification of the experimental setup. Our approach, at INFN Milano-Bicocca has been, instead, to build a general purpose program capable of tackling a wide range of use-cases by reading the complete specification of the experiment to simulate from external files. This decoupling between simulation algorithm and experimental setup description allows to maintain and validate a single program, making it easy to add features and components by leveraging on an already existing body of functionality. This code, called Arby, was designed based on our experience in very low-background experiments: it's generality stems from the complete decoupling between its simulation capabilities and the actual specification of the experiment's setup. Different materials in different geometries (source and detector) can be specified externally, as well as a wide variety of different physical process to describe the interaction of radiation with matter. Even pile-up phenomena are correctly taken into account by the code, allowing for a fine-tuning and an arbitrary level of accuracy in determining the efficiency of the experimental setup. In this talk we will describe the architecture of the system and show some applications to real radioactive data analysis.

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