Detector-Physics (simulation versus experiment)

Introduction

Modern physics experiments (both at high energy physics experiments like CMS at CERN and many-body nuclear physics like R^3B at GSI/FAIR) rely strongly on computer simulations. Those simulations are used to design new detector systems as well as interpret the data recorded from a huge number of signals received during the experiment from different detector types.

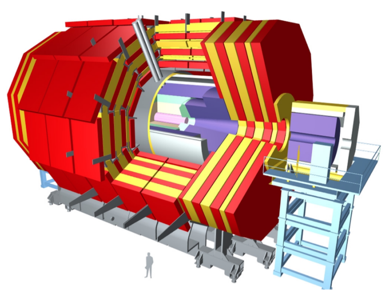
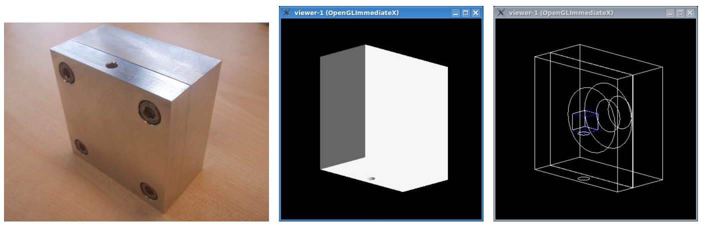


Figure 1: CMS

Physics studied

The simulation has the big advantage that it could be quite flexible in choosing different simple physics cases, e.g. from the lectures. In general, a projectile will hit a target and several particles and γ-rays could be emitted from the vertex. One simple example might be the decay of the Coulomb-excited ^{58}Ni(γ,nγ)^{57}Ni.



(a) (b) (c)

Exercise

The exercise is composed of three parts. Firstly, after an introduction to the data acquisition and readout electronics, you will realise a simple experiment of detecting γ-rays from a radioactive source using CsI crystals-based detectors. More complex setup will be obtained by the combination of those two detectors (see (a) in the figure). You will analyse the detected energy spectra in order to extract the most important values: resolution and efficiency.

Secondly, you will modify a C++-program in order to reproduce the experiments in a computer simulation (see (b) and (c)). The simulated spectra will be compared to the acquired one in order to interpret the different elements.

Finally, using the similar C++ environment, you will simulate a more complex detection system with variable geometry and material. The new detector system will be optimised to detect a γ emitted from a moving target (you will produce the corresponding event generator).

Key-words

Computer simulation, C++ programming, neutron and γ detection, detector optimisation.