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The Role of Computer Modelling in the Extraction of Experimental Observables in Nuclear Physics

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Abstract

Experimental study of the atomic nucleus and its constituent particles is most often carried out by colliding an energetic probe (photon, hadron neutrino etc.) with the nuclear system under study and detecting the sub-atomic particles produced by the interaction of the probe with the nucleus. From an analysis of the distributions in energy, direction and species of sub-atomic particle(s) produced in the final state, the properties of the nuclear system under study can be inferred. However no particle detection system is perfect and in general the information which it produces will be skewed significantly by finite size and resolution effects, as well as unavoidable gaps in coverage. Quantitative correction for these distortions is usually difficult or impossible to calculate analytically and, ever since the dawning of the age of practical electronic computers, nuclear physicists have employed computer models of their experiments to make these calculations. Naturally such computer models have also become indispensible to the design of new experimental systems. Thus “virtual reality” has been an essential part of sub-atomic physics since the 1950's. Here the basic computation methods are described, the progress in the sophistication of modelling charted, and illustrative examples from the current hadron-physics research given.

Keywords: Nuclear physics, computer modelling, Monte Carlo methods.

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