A New Geant4 based Simulation Framework for ANKE

A. Mussgiller

The ROOT[1] based analysis framework RootSorter[2] provides an easy to use database interface that allows the storage and retrieval of any kind of parameter. A new Geant4[3] based Simulation has been developed that takes advantage of this parameter interface to construct the simulation geometry. The main aim of the development is to hide the internal structure of Geant4 as much as possible and only provide a simple interface to the Geant4 core. The control of the simulation is done in a similar way as in RootSorter which allows a quick start to the users who are already familiar with RootSorter.

Detector Components
The different ANKE detectors may be added to the simulation by calling a function with the name of the detector. Currently the following detectors are known to the simulation:

- Positive Side Detector - Pd (No MWPC)
- Negative Side Detector - Nd
- Forward Detector - Fd
- Spectator Detector - Vd
- D2 Vacuum Chamber
- New Target Chamber

A picture of the implemented detectors and passive geometries is shown in figure 1.

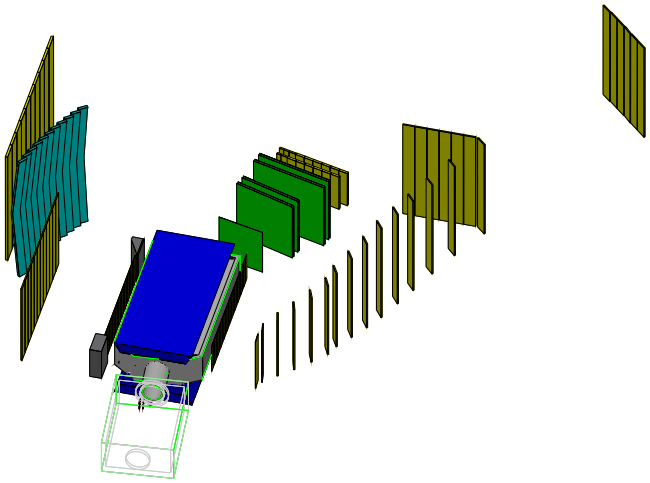

Fig. 1: Picture of the detectors and passive geometries implemented in the simulation

Particle Generator
At the moment the main source for primary particles is a ROOT file containing a Pluto++[4] generated event tree. Again, the type of the particle generator is selected by its name. The name of the used root file may be specified from within the user code, the Geant4 session or a Geant4 macro. The type of vertex at which the primary particles are generated may also be specified. It can be a point like or extended vertex with various shapes. The extended vertices give the opportunity to take the real target extension into account.

Physics Processes
The simulation framework offers the possibility to use any of the by Geant4 supplied physics processes lists. Since the available physics lists are mostly specialised on dealing with high energy particle physics it is possible to specify own physics processes that suit the users need. At the moment one additional physics list is implemented which is able to deal with all processes involved in the physics at ANKE.

Magnetic Field
Two different types of magnetic fields are implemented in the software, a ”box” field and a field map based on Mafia calculations. Both magnetic field classes are based on the fields available in RootSorter. The field strength is controlled via the parameter interface but may be overridden on the Geant4 command line or a macro.

Output
The output of the simulation is a ROOT file with a tree. Each in a simulation run used detector adds a branch to the tree which holds the detector specific results for each simulated event. For the Forward detection system for instance the branch will contain a list of hits in the hodoscope counters as well as the hits in the wire chambers. Each hit carries the information about the particle that produced the hit (type and momentum), its position and the time since the start of the event. In addition the list of generated particles and the position of each particles vertex is written to the tree. The output file does not contain any Geant4 related data which means that the analysis of the output file can be done without the use of Geant4.

Summary
The newly developed simulation framework provides an easy to use interface to the Geant4 core. All above listed key components are activated via the name of the component. The size of a full featured simulation of ANKE is as low as 20 lines of source code. The interface allows to extend the simulation by additional detectors, particle generators or field classes in a simple way. For developing extensions only a limited knowledge of Geant4 is required.
In the near future the implementation of all detectors will be finished. Up to this point the simulation framework has been used for several simulations involving the spectator detector.

References:

[1] Rene Brun and Fons Rademakers, ”ROOT - An Object Oriented Data Analysis Framework”, Proceedings AIHENP’96 Workshop, Lausanne, Sep. 1996, NIM A 389 (1997) 81-86.
[2] V. Hejny, M. Hartmann, A. Mussgiller, ”RootSorter: A New Analysis Framework for ANKE”, IKP Annual Report 2002
[3] S. Agostinelli et al, ”GEANT4: A Simulation Toolkit”, NIM A 506 (2003), 250-303
[4] Marios A. Kagarlis, ”Pluto++ - A Monte Carlo simulation tool for hadronic physics”, GSI Report 3, July 2000