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The Application of SNiPER to the JUNO Simulation

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The JUNO (Jiangmen Underground Neutrino Observatory) is a multipurpose neutrino experiment which is mainly designed to determine neutrino mass hierarchy and precisely measure oscillation parameters. As one of the most important systems, the JUNO offline software is being developed using the SNiPER software. In this presentation, we focus on the requirements of JUNO simulation and present the working solution based on the SNiPER.

The JUNO simulation framework is in charge of managing event data, detector geometries and materials, physics processes, simulation truth information etc. It glues physics generator, detector simulation and electronics simulation modules together to achieve a full simulation chain. In the implementation of the framework, many attractive characteristics of the SNiPER have been used, such as dynamic loading, flexible flow control, multiple event management and Python binding. Furthermore, additional efforts have been made to make both detector and electronics simulation flexible enough to accommodate and optimize different detector designs.

For the Geant4-based detector simulation, each subdetector component is implemented as a SNiPER tool which is a dynamically loadable and configurable plugin. So it is possible to select the detector configuration in runtime. The framework provides the event loop to drive the detector simulation and interacts with the Geant4 which is implemented as a passive service. All levels of user actions are wrapped into different customizable tools, so that user functions can be easily extended by just adding new tools. The electronics simulation has been implemented by following an event driven scheme. The SNiPER task component is used to simulate data processing steps in the electronics modules. The electronics and trigger are synchronized by triggered events containing possible physics signals.

Now the JUNO simulation software has been released and is being used by the JUNO collaboration to do detector design optimization, event reconstruction algorithm development and physics sensitivity studies. The concurrent computing using GPU and phi-coprocessor is being studied in order to speed up the simulation of light propagation in the large liquid scintillator detector.

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