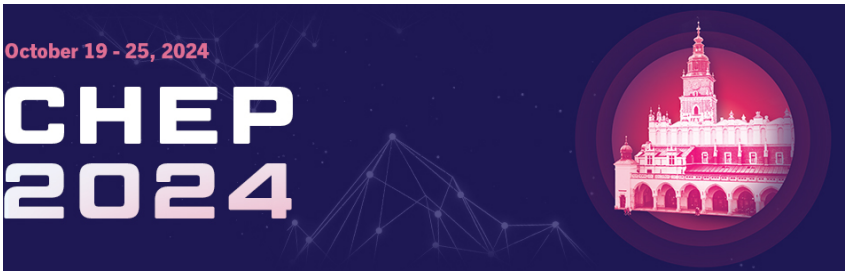

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Parallel Photon Simulation for IceCube In C++

Monday 21 October 2024 14:42 (18 minutes)

The IceCube Neutrino Observatory instruments one cubic kilometer of glacial ice at the geographic South Pole. Cherenkov light emitted by charged particles is detected by 5160 photomultiplier tubes embedded in the ice. Deep antarctic ice is extremely transparent, resulting in absorption lengths exceeding 100m. However, yearly variations in snow deposition rates on the glacier over the last 100 thousand years have created roughly horizontal layers which vary significantly in scattering and absorption coefficients. Theses variations must be taking into account when simulating IceCube events. In addition, anisotropies in photon propagation have been observed and recently described by deflection by birefringent polycrystals. Modeling of ice properties remains one of the largest sources of systematic uncertainties in IceCube analyses, requiring intensive studies of the ice. Despite the fact that photon tracking is highly parallelizable and is an ideal case for GPUs, the limiting constraint for these studies is time spent simulating photon propagation. In order to efficiently and accurately perform these simulations, custom software has been developed and optimized for our specific use case. IceCube's current production simulation code CLSim is based on OpenCL and is tightly coupled to the IceCube's simulation stack and is in need of modernization. This talk will discuss the current requirements for Photon tracking code in IceCube and the effort to transition the code to new C++ frameworks which uses std::par.

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