Contribution ID: **716** Type: **Oral (Student, In Competition) / Orale (Étudiant(e), inscrit à la compétition)**

Direct reconstruction - a new event reconstruction algorithm for the IceCube Neutrino Observatory

Wednesday 17 June 2015 14:30 (15 minutes)

The IceCube detector is designed to detect very high-energy neutrino events (exceeding 1 PeV) from astrophysical sources. DeepCore, a low-energy array, was designed to extend the reach of IceCube down to ˜10 GeV. Data analyses at the low energies have unique challenges compared to their high-energy counterparts, including achieving robust reconstructions of the energy and angular properties in the sparsely instrumented detector volume. The traditional reconstruction algorithms are also reliant on large-memory tabulated representations of the photon probabilities in the instrumented ice that are technically difficult to produce. Here a new algorithm is described that takes advantage of parallelizing the simulation of event hypotheses across general purpose graphics processing units (GPUs), and directly propagating the resulting photons. In this way, events may be reconstructed in real-time with a full detector simulation, removing the need to approximate models of the detector medium and ultimately providing the best possible description of the neutrino interactions in the deep Antarctic glacier.

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Session Classification: W2-7 Cosmic Frontier: Astrophysics and Neutrinos (PPD) / Frontière cosmique : astrophysique et neutrinos (PPD)

Track Classification: Particle Physics / Physique des particules (PPD)