Accelerated neutrino oscillation probability calculations and reweighting on GPUs

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Neutrino oscillation experiments are reaching high levels of precision in measurements, which are critical for the search for CP violation in the neutrino sector. Inclusion of matter effects increases the computational burden of oscillation probability calculations. The independency of reweighting individual events in a Monte Carlo sample lends itself to parallel implementation on a Graphics Processing Unit. The library Prob3++ was ported to the GPU using the CUDA C API, allowing for large scale parallelized calculations of neutrino oscillation probabilities through matter of constant density, decreasing the execution time by 2 orders of magnitude, when compared to performance on a single CPU. Additionally, benefit can be realized by porting some systematic uncertainty calculations to GPU, especially non-linear uncertainties evaluated on splines. The implementation of a fast, parallel spline evaluation on a GPU is discussed.

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