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Scalar Mesons on the Lattice Using Stochastic Sources on GPU Architecture.

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We describe our studies of multi-pion correlation functions computed using stochastic propagators in quenched lattice QCD, harnessing GPUs for acceleration. We find that projecting onto momentum states for the pions becomes enormously expensive and has a poor scaling with the linear extent of the lattice. It is also found that correlations between stochastic propagators appearing in the same diagram, when a single set of random source vectors is used, lead to much larger errors than if separate random sources are used for each propagator.

We use L¨uscher's method and look for the σ in the $\pi\pi \longrightarrow \pi\pi$ channel. The result is that multi-pion correlation functions must be considered, which inevitably involve all-to-all propagators, which are quite expensive and require many inversions. For this reason, GPUs are ideally suited to accelerating the calculation. For this work we have integrated the Columbia Physics System (CPS) and QUDA GPU inversion library, in the case of clover fermions.

We describe some other challenges that we have uncovered, in particular getting hit with Amdahl's law for the tying together and tracing of propagators in our calculations, as well as momentum projections. We have also accelerated these parts of our calculation using GPUs and show some benchmarks.

Summary

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Primary authors: Mr HOWARTH, Dean (Rensselaer Polytechnic Institute); GIEDT, Joel (Rensselaer Polytechnic Institute)

Presenter: Mr HOWARTH, Dean (Rensselaer Polytechnic Institute)

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