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Optimising Lattice QCD for GPUs

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The University of Adelaide has invested several million dollars in the Phoenix HPC facility. Phoenix features a large number of GPUs, which were
critical to its entry in the June 2016 Top500 supercomputing list. The status of high performance computing in Australia relative to other nations
poses a unique challenge to researchers, in particular those involved in computationally intensive fields such as Lattice QCD.

Quantum chromodynamics (QCD) is the fundamental theory that describes the strong interaction. Lattice QCD provides a computational framework to study
the highly non-perturbative phenomena that arise in QCD. Lattice QCD calculations demand the most powerful HPC resources available. Their highly
parallel nature makes GPUs an ideal hardware platform for Lattice QCD. The technological power offered by GPUs has transformed the Centre for the
Subatomic Structure of Matter's research program at the University of Adelaide, using high performance computing to solve the fundamental equations
that describe the interactions of subatomic particles and reveal their internal structure. The quark propagator code is a key piece of software in
these calculations, and we discuss how this code has been optimised to run within the CUDA framework.

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