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Title: Nuclear Physics from lattice QCD

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While the theory of Quantum Chromodynamics (QCD) predicts that quarks and gluons are the basic building blocks of nuclear matter, the complex and rich structure exhibited by matter suggests there are underlying collective degrees of freedom. Experiments at Nuclear and High Energy physics labs around the world measure the properties of matter with the aim to determine its underlying structure. Several such new experiments worldwide are under construction, such as the $310M upgrade of the Jefferson Lab electron accelerator and its new experimental measurement facility, Hall D. To provide a theoretical determination of how matter binds, ab initio computations within lattice QCD are used. While these calculations predict what is seen in experiments, they also guide experimental measurements, and future plans for new facilities. This talk will focus on the techniques used in these lattice QCD calculations, in which the development of the software infrastructure has been supported through the US SciDAC initiative. In particular, calculations at both capacity and capability scale of computers are required. The arrival of GPUs has significantly altered how capacity scale computations are performed. The extension of these successful methods to the capability scale of computing, in particular machines like Cray's XK6, is requiring the development of new algorithmic techniques as well as new software infrastructure.