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A Quantum Simulator From Trapped Ions KENDRA VANT, DANA BERKELAND, MALCOLM BOSHIER, JOHN CHIAVERINI, DAVID LIZON, WARREN LYBARGER, ROBERT SCARLETT, ROLANDO SOMMA, LANL, MATTHEW BLAIN, BERNIE JOKIEL, CHRISTOPHER TIGGES, SNL — Many quantum systems cannot be simulated efficiently on a classical computer due to the large Hilbert space they inhabit. They may instead be investigated using a quantum simulator - a device which uses a number of more-easily controllable quantum bits to mimic the quantum spins in the system to be studied. The states of the simulator follow the nearly same equations of motion as the real system, yet are directly accessible to the experimenter. Trapped ions may make this kind of simulation possible. We will describe the experimental status of the proposed LANL trapped-ion quantum simulator including our ideas for the generation of spin-dependent optical forces to produce ion-ion interactions that mimic interactions in Ising-like model Hamiltonians. Prospects for using this interaction as the basis of a few-ion simulator for this model and others will also be described. In addition, recent collaboration between LANL and SNL has led to the construction of microfabricated ion traps; development of their use for quantum simulations will also be a major focus in the near future. These multizoned traps should be more suitable for quantum simulation than single well traps. We will discuss the trap development and testing.

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