Abstract for an Invited Paper
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**Quantum simulations with trapped ions**

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The basic tool box of the Innsbruck quantum computer based on a string of trapped $Ca^+$ ions will be reviewed. The quantum toolbox is applied to carry out both analog and digital quantum simulations. In this talk, the basic simulation procedure will be presented and its application will be discussed for a variety of spin Hamiltonians. Including a carefully controlled dissipation mechanism, the toolbox allows for the quantum simulation of open systems. A string of ions is used to implement a quantum system that interacts by means of quantum gate operations with an additional ancilla ion which in turn is coupled to the environment in a well-controlled way. Thus, entangled states, such as Bell and GHZ states can be generated by dissipative processes and can be used as part of a quantum simulator. Recent experimental results on the simulation of competing coherent and dissipative processes will be discussed.