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# Simulating Potentials and Shuttling Protocols on an X-Junction Surface Trap

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Trapped ion qubits achieve excellent coherence times and gate fidelities, well beyond the threshold for fault tolerant quantum error correction. One route towards scalability is the coherent control and shuttling of ions between different zones on a microfabricated surface trap. A current challenge in shuttling is speed and fidelity. The shuttling operations should be as fast as possible to speed up quantum computation, as well as slow (adiabatic) in order to preserve the internal qubit state. Through simulation of trapping potentials and ion dynamics, we can observe the effects of static and dynamic potentials on the ions motional state and investigate various shuttling protocols on an X-junction surface trap. We introduce a new software called 'Realpot'which is easy to use and specifically designed to simulate BEM potentials, and also import and visualize FEM potentials. The software package is designed for ease of use and can calculate voltage solutions subject to specific constraints that are then applied to the simulated electrodes. The software package also provides detailed visualization and interactive plotting of potentials and ion dynamics.

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