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Towards Qudit-Based Quantum Computing[1] PEI JIANG LOW, BRENDAN WHITE, MATTHEW DAY, USMAN KHAN, MIA SHI, COLIN PARKYN, CRYSTAL SENKO, University of Waterloo — We present recent progresses in realizing qudit-based quantum computing with barium ions. Quantum state manipulations and measurements are paramount to quantum computation. In our proposed qudit measurement scheme, high fidelity is achieved by shelving computational qudit states in the $6S_{1/2}$ level to the meta-stable $5D_{5/2}$ level, which has transition wavelength of approximately 1762 nm. Therefore, spectroscopy of $6S_{1/2}$ to $5D_{5/2}$ states is a crucial preparatory data for our qudit-based computing scheme, and we report on our recent progress on this experiment. From our prior theoretical investigation, qudit manipulation can be done practically with either direct transitions with microwave or Raman transition. As a preliminary experiment, we have chosen microwave-driven control. To have sufficient control on qudit manipulation, phase, frequency and amplitude control of microwave radiation are required. We report on the architecture of this infrastructure and our progress on this experiment.

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