

Quantum computing and simulation with high-dimensional systems

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Today's quantum computers are almost exclusively built for binary information processing, inherited from classical computers. Yet, the underlying quantum systems, in particular trapped ions, are inherently multilevel systems. Similarly, a wide range of target applications for quantum computers and simulators are naturally formulated in high-dimensional Hilbert spaces. I will discuss how to construct a universal toolbox for quantum information processing in trapped-ion qudits and how to use it for improved quantum information processing. We demonstrate that the performance of the quantum processor does not degrade with qudit dimension, making this a promising way to scale the computational power of existing quantum hardware.