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**Symmetry and bandwidth constrained deep reinforcement machine learning for quantum control of atomic and superconducting systems** PHILIP JOHNSON, ANTHONY SANTANA, DENNIS LUCARELLI, Department of Physics, American University — Machine learning techniques are becoming an important tool in quantum information science, particularly for quantum control and quantum state and process tomography. There is a tension, however, between taking advantage of the highly optimized performance offered by the use of machine learning techniques, and the desire to gain insights into basic physical principles useful for guiding future experimental and theoretical investigations. We will describe our recent work applying deep reinforcement learning techniques, including modified versions of Q-learning, to the optimal quantum control of ultracold atomic and superconducting systems in the presence of leakage dynamics. We use a basis of bandlimited functions to constrain the learning to physically realistic control fields, and investigate the impact of exploiting additional dynamical symmetries to reduce simulation size and complexity, with the goal of trading away a modest degree of optimization for more efficient algorithm performance and greater insight into system dynamics.

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