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Compressed Sensing for Reconstructing Sparse Quantum States[1]
KENNETH RUDINGER, ROBERT JOYNT, University of Wisconsin-Madison Physics Department — Compressed sensing techniques have been successfully applied to quantum state tomography, enabling the efficient determination of states that are nearly pure, i.e, of low rank. We show how compressed sensing may be used even when the states to be reconstructed are full rank. Instead, the necessary requirement is that the states be sparse in some known basis (e.g. the Pauli basis). Physical systems at high temperatures in thermal equilibrium are important examples of such states. Using this method, we are able to demonstrate that, like for classical signals, compressed sensing for quantum states exhibits the Donoho-Tanner phase transition. This method will be useful for the determination of the Hamiltonians of artificially constructed quantum systems whose purpose is to simulate condensed-matter models, as it requires many fewer measurements than demanded by standard tomographic procedures.

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