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Quantifying coherence and entanglement in trapped ions using the multiple quantum spectrum MARTIN GAERTTNER, ARGHAVAN SAFAVI-NAINI, MICHAEL WALL, JILA, NIST and the University of Colorado, Boulder, JUSTIN BOHNET, NIST - Boulder, BRIAN SAWYER, GTRI - Atlanta, JOSEPH BRITTON, JOHN BOLLINGER, NIST - Boulder, ANA MARIA REY, JILA, NIST and the University of Colorado, Boulder — The multiple quantum coherence (MQC) spectrum of a quantum state, originally introduced for highly mixed states in the context of NMR, quantifies coherence between different magnetization sectors. The MQC spectrum of a spin system is measurable by a sequence of rotations and evolution under an interaction Hamiltonian, provided that the evolution can be time reversed. Such a many-body echo can be realized in systems of trapped ions. We study the relation of the multiple quantum intensities with entanglement measures and witnesses such as Fisher information and concurrence and discuss the impact of decoherence mechanisms present in current trapped ion experiments on the proposed scheme for measuring the MQC spectrum. Supported by: JILA-NSF-PFC-1125844, NSF-PHY-1521080, ARO, AFOSR, AFOSR-MURI

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