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Precision Spectroscopy in engineered subspaces

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Noise limits the coherence of quantum superpositions thus compromising the precision with which spectroscopy can be performed. In the field of quantum information processing several methods were developed that mitigate the effect of noise on quantum coherence. Examples include, dynamic decoupling (DD), decoherence-free-subspaces (DFS) and quantum error-correction codes. In this talk I will describe the use of Hilbert space engineering and dynamic modulation schemes to improve on the precision of spectroscopy in trapped-ion experiments. Specifically I'll show how the sensitivity of force measurements [1] and the measurement accuracy of an atomic quadrupole moment [2] were improved using DD techniques. I'll also show the use of correlated spin Hamiltonians can lead to Heisenberg limited optical clock spectroscopy. Finally I'll discuss how the use of entangled subspaces can improve the accuracy of optical clocks. 1. R. Shaniv and R. Ozeri, arXiv:1602.08645 (2016), Nature Comm., In Press. 2. R. Shaniv, N. Akerman and R. Ozeri, Phys. Rev. Lett. 116, 140801 (2016)