# PHYSICS DEPARTMENT COLLOQUIUM

## " Towards Single-Spin Detection Using Magnetic Resonance Force Microscopy"

BY

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We have recently demonstrated spin detection using Magnetic Resonance Force Microscopy (MRFM) with a sensitivity approaching the single-spin level. Achieving this high sensitivity has been possible by overcoming numerous technical challenges as well as developing a detailed understanding of the spin dynamics. In the first part of my talk, I will review the fundamentals of MRFM and discuss the key advances that have enabled us to realize our current detection sensitivity.

One of these key advances has been the development of a novel spin manipulation protocol that allows us to detect the sqrt(N) statistical fluctuations in small spin ensembles. Using this technique, we have shown that we can follow the fluctuations in real-time and apply feedback on the spin system to control the time evolution of the spin orientation. Through the use of active feedback, we have demonstrated that spins can be hyperpolarized or “cooled” in the rotating frame, transferred and stored in the lab frame and then read out at some later time. One potential application of this technique could be for state initialization and readout in quantum computing.

In the last part of my talk, I will present our most recent results on our progress towards single-spin imaging and discuss future experiments beyond single-spin detection.

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