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BEC magnetometry as a probe of hybrid quantum systems¹ COLLIN REYNOLDS, CHANDLER KEMP, ELI FOX, KELVIN BLASER, MUKUND VENGALATTORE, Cornell University — We describe our progress towards realization of a hybrid quantum system consisting of a Bose Condensate magnetically coupled to a micromechanical oscillator. Due to the presence of a magnetic domain on the oscillator, the micromotion of the oscillator results in a periodically varying Zeeman shift that we measure using non-destructive imaging [1]. We estimate the sensitivity of the position readout to be comparable to the zero-point motion of the oscillator. We also outline prospects of achieving the strong-coupling limit of this BEC-membrane system to enable sympathetic cooling and the creation of non-classical states of this mechanical device [2]. In order to achieve this strongcoupling limit, we are investigating both cavity-enhanced schemes as well as coupling the BEC to a graphene membrane whose mass is comparable to that of the atomic gas.

[1] M. Vengalattore *et al*, Phys. Rev. Lett. **98**, 200801 (2007);

[2] S. Singh *et al*, "Quantifying measurement back-action on a macroscopic object: BEC magnetometry on mechanical oscillators." Phys. Rev. A **84**, 023841 (2011).

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Mukund Vengalattore Cornell University

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