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# Towards Microwave-Frequency Spin Mechanics

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Torque magnetometry using torsional resonators provides a highly sensitive platform for resolving magnetic signatures in single meso-scale elements. In the static case, sample magnetizations are biased using a DC field while an AC excitation is applied at a frequency equal to the mechanical resonance of the torsional device. The resulting torque is then measured using an interferometric technique. One challenge in probing dynamics is that the interferometric signal must be demodulated at this fixed mechanical resonance; however, early studies in spin mechanics have met this challenge and produced a technique for simultaneously acquiring static and dynamic magnetization in the audio-frequency regime [1]. This approach has since been extended by orders of magnitude (up to several hundred megahertz), where spin resonances and other dynamic phenomena have been observed [2].

Pushing this frequency limit further still requires innovative new demodulation techniques. Here we discuss current methodologies to probe a single yttrium iron garnet microdisk for pinned resonant modes, higher order spin waves, and the Einstein-de Haas effect up to frequencies of a few gigahertz.

[1] J. E. Losby *et al.*, Solid State Communications, **198** (2014), 3-6.
[2] J. E. Losby *et al.*, Manuscript in prep.

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