A broadband magnetic resonance spectrometer based on optomechanical detection will be described. Demonstrations of inductive detection of spin precession in the early 1940s launched magnetic resonance spectroscopy as a general-purpose tool. As an easily miniaturizable complement to this, the transverse RF moment arising from dipole precession can be choreographed (via frequency mixing) to yield resonant AC torque on a mechanical torsion sensor that then can be detected through optical interferometry [1].

Comprehensive electron spin resonance spectra of a single-crystal, mesoscopic yttrium iron garnet disk at room temperature will be presented to illustrate the approach. A key feature of the method is that it is broadband to DC, enabling measurements of the intricate magnetostatics of individual mesoscopic magnetic objects [2] to be performed simultaneously with the spin resonance studies, all using the same optomechanical readout.

References

Biographical Sketch
Degrees: BSc (Honours in Physics), University of Alberta, 1981
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PhD (Physics), Cornell, 1988
Mark Freeman obtained his PhD in Low Temperature Physics from Cornell University under the supervision of Bob Richardson (1996 Physics Nobel Laureate). He then worked for six years at the IBM TJ Watson Research Center, Yorktown Heights, NY, initially as a postdoc with David Awschalom. In 1994 he joined the faculty of his undergraduate alma mater, the University of Alberta, where he is now a Canada Research Chair in Condensed Matter Physics, and cross-appointed to the National Institute for Nanotechnology. Freeman’s research concentrates on nonequilibrium physics in nanosystems, with an emphasis on magnetic phenomena. His group has worked extensively on the development and application of ultrafast stroboscopic scanning probe techniques for the elucidation of spatiotemporal nanodynamics. Their primary current focus is on optomechanical methods for ultrasensitive studies of nanostructures.