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Optical methods for detection of nuclear magnetic resonance.

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Nuclear magnetic resonance is commonly detected with inductive pick-up coils or, less commonly, with SQUID magnetometers. I will discuss recent work in our group on optical detection of NMR using two separate techniques. In one approach, optically-pumped alkali-metal atoms are used to detect the magnetic fields generated by nuclear magnetic moments. Such atomic magnetometers reach sensitivity similar to low-T_c SQUID magnetometers without requiring cryogenic cooling. We recently demonstrated atomic magnetometer detection of NMR and NQR signals at frequencies ranging from 20 Hz to 423 kHz. In the other approach, NMR signals from a transparent substance are obtained by direct optical detection. In this technique the plane of polarization of a linearly polarized light transmitted through the sample is rotated by interaction with nuclear spins. We detected NMR signals from water and liquid ^{129}Xe using this method. Such nuclear spin optical rotation (NSOR) signals do not rely on measurement of long range dipolar fields and allow new modalities of imaging and spectroscopy.