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Sensing electric and magnetic components of microwave fields using Rydberg and ground-state atoms TOBIAS THIELE, JILA, Univ of Colorado - Boulder and ETH Zurich, JOANNIS KOEPSELL, ETH Zurich, YI-HENG LIN, JILA, Univ of Colorado - Boulder, JOHANNES DEIGLMAYR, ETH Zurich, MARK O. BROWN, CINDY REGAL, JILA, Univ of Colorado - Boulder, ANDREAS WALLRAFF, FREDERIC MERKT, ETH Zurich — Precise sensing of electromagnetic fields has many applications ranging from definition of frequency standards to magnetic field sensing in magnetic resonance imaging. Atoms as sensors are particularly attractive due to the quantum nature of their interaction with electromagnetic fields. We present two different experiments that exploit sensitive Rabi-rate measurements in atoms to determine the magnetic or electric components of microwave fields. First, we show measurements of two-dimensional spatial distributions of an electric field amplitude and its direction with respect to a bias field using a supersonic beam of Rydberg atoms in a cryogenic environment. Rydberg atoms are ideally suited to measure small variations in electric fields because of their large polarizability. We then present how we use a complete measurement of the polarization of the magnetic component of a microwave field to sense small changes in the polarization axis of single ground-state atoms in optical tweezers. This platform has recently attracted much attention because of the possibility to control the position and state of the atom. A combination of both techniques opens perspectives to precisely and non-invasively detect very small changes in electromagnetic fields in free space or close to surfaces.

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