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Radio-frequency Electrometry Using Rydberg Atoms in Vapor Cells: Towards the Shot Noise Limit[1] SANTOSH KUMAR, HAOQUAN FAN, AKBAR JAHANGIRI, University of Oklahoma, Oklahoma, USA, HARALD KUEBLER, 5. Physikalisches Institut, Universitat Stuttgart, Germany, JAMES P. SHAFFER, University of Oklahoma, Oklahoma, 5. PHYSIKALISCHES INSTITUT, UNIVERSITAT STUTTGART, GERMANY COLLABORATION — Rydberg atoms are a promising candidate for radio frequency (RF) electric field sensing. Our method uses electromagnetically induced transparency with Rydberg atoms in vapor cells to read out the effect that the RF electric field has on the Rydberg atoms. The method has the potential for high sensitivity (pV cm^{-1} $Hz^{-1/2}$) and can be self-calibrated. Some of the main factors limiting the sensitivity of RF electric field sensing from reaching the shot noise limit are the residual Doppler effect and the sensitivity of the optical read-out using the probe laser. We present progress on overcoming the residual Doppler effect by using a new multi-photon scheme and reaching the shot noise detection limit using frequency modulated spectroscopy. Our experiments also show promise for studying quantum optical effects such as superradiance in vapor cells using Rydberg atoms.

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