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How a noisy signal can be a useful spectroscopic tool: understanding noise from quantum interference

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Naively one might assume that unavoidable fluctuations in laser frequency, intensity, and phase always diminishes the precision of spectroscopic applications. But light-matter interactions sensitive to laser fluctuations encode useful information about the medium in the transmitted light's fluctuations, and analysis of these fluctuations can enhance measurement precision. Diode lasers in particular have significant phase noise and a resonant atomic vapor converts this phase noise into transmitted intensity noise. Further, intensity noise from two orthogonally polarized fields originating from the same laser can be either correlated or anti-correlated, depending very sensitively on detuning from a resonance. In this talk I will present a noise correlation technique using a single "noisy" diode laser interacting with rubidium vapor on a sharp resonance feature from quantum interference, Electromagnetically Induced Transparency (EIT). Of particular interest is a narrow band of correlation that coincides with the quantum interference. The linewidth of this noise correlation peak has been shown in earlier work to be power-broadening resistant at low laser powers. I will present recent experimental noise correlation studies, including power broadening of this correlation peak at higher powers. This noise correlation technique holds promise in high-resolution applications such as atomic EIT-noise magnetometry.