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Interferometry in a Strong Light

Optical interferometry is at the heart of many precise measurements from gravitational wave searches to microscopy. Generally one improves interferometer precision by increasing the light intensity, as well as by calming the many technical sources of noise that can perturb the mirrors or optical path. However, at extreme levels of light strength where radiation forces are significant, a new and interesting disturbance should appear – the quantum shaking associated with random arrival of individual photons at a mirror of the interferometer. This quantum backaction of light has been long foreseen and played a formative role in quantum optics theory. In this talk I will discuss an experiment in which we used a particularly compliant micro-scale drum to observe backaction in an interferometer, and demonstrate how quantum correlations can improve measurement in the presence of backaction. In this strong-light limit, interferometer mirrors can also be used as a nonlinear medium to manipulate light – for example to make squeezed light. We may even be able to extract more complex quantum states from our interferometer by coupling superconducting microwave circuits to the moving mirror.