Quantum enhanced sensing with optimized particle numbers

Morgan Mitchell
ICFO Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels, Barcelona, Spain

Discussions of quantum enhanced sensing typically describe an optimization problem with the particle number as a fixed resource. In fact, for many practical scenarios, including gravitational-wave detection, optical probing of material, and atomic sensing, the particle number is a parameter that can be freely chosen to optimize the sensitivity. Due to the statistical advantage of using more particles, this optimization is achieved when statistical advantage is balanced by some other effect, generally leading to a nonlinear interferometry scenario. Is quantum enhanced sensing possible or effective in this scenario ? We describe three experiments in optimized, nonlinear interferometry, including low-damage probing of a material system, nonlinear interferometry with a cold atomic ensemble, and number-and-photon-flux-optimized spin noise spectroscopy with squeezed light.