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Adaptive phase estimation with two-mode squeezed-vacuum and parity measurement ZIXIN HUANG, University of Sydney, Sydney, NSW 2006, Australia, KEITH R. MOTES, Department of Physics and Astronomy, Macquarie University, Sydney NSW 2113, Australia, PETR M. ANISIMOV, Los Alamos National Laboratory, New Mexico 87545, JONATHAN P. DOWLING, Hearne Institute for Theoretical Physics and Department of Physics & Astronomy, Louisiana State University, Baton Rouge, LA 70803, DOMINIC W. BERRY, Department of Physics and Astronomy, Macquarie University, Sydney NSW 2113, Australia — A proposed phase-estimation protocol based on measuring the parity of a two-mode squeezed-vacuum state at the output of a Mach-Zehnder interferometer shows that the Cramer-Rao sensitivity is sub-Heisenberg [Phys. Rev. Lett. 104, 103602 (2010)]. However, these measurements are problematic, making it unclear if this sensitivity can be obtained with a finite number of measurements. This sensitivity is only for phase near zero, and in this region there is a problem with ambiguity because measurements cannot distinguish the sign of the phase. Here, we consider a finite number of parity measurements, and show that an adaptive technique gives a highly accurate phase estimate regardless of the phase. We show that the Heisenberg limit is reachable, where the number of trials needed for mean photon number $\bar{n} = 1$ is approximately one hundred. We show that the Cramer-Rao sensitivity can be achieved approximately, and the estimation is unambiguous in the interval $(-\pi/2, \pi/2)$.

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