Optimal phase estimation for a Mach-Zehnder interferometer.
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fornia, Santa Barbara, California 93106, USA — We study a Mach-Zehnder inter-
ferometer fed by a coherent state in one input port and vacuum in the other. We
explore a Bayesian phase estimation strategy to demonstrate that it is possible to
achieve the standard quantum limit *independently* from the true value of the phase
shift and specific assumptions on the noise of the interferometer. We have been able
to implement the protocol using parallel operation of two photon-number-resolving
detectors and multiphoton coincidence logic electronics at the output ports of a
weakly-illuminated Mach-Zehnder interferometer. This protocol is unbiased and
saturates the Cramer-Rao phase uncertainty bound and, therefore, is an optimal
phase estimation strategy.

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