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Improving the precision of weak measurement by nonclassical states SHENGSHI PANG, University of Rochester, TODD A. BRUN, University of Southern California — Weak value amplification is a useful protocol to amplify tiny physical effects by postselecting the system in a weak measurement. However, there has been controversy over its precision advantage in parameter estimation recently, since it discards unselected results of the postselection measurement on the system, which may take away useful information. While it is now clear that retaining failed postselections can yield more Fisher information than discarding them, the advantage of postselection measurement itself still remains to be clarified. If a weak measurement with postselection measurement cannot not produce higher precision than without postselection measurement, it would be meaningless to discuss the use of postselection results. In this work, we address this problem by studying the optimal signal-to-noise ratio (SNR) of postselected weak measurement. We find a surprising result that when the probe is initially prepared in a proper squeezed coherent state, the postselected weak measurement can give a higher SNR than the standard weak measurement, while such an advantage vanishes when the probe is prepared in a normal coherent state. This suggests that raising the precision of weak measurement by postselection calls for the presence of nonclassicality in the probe state.

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