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Probe incompatibility in multiparameter noisy quantum metrology

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We derive fundamental bounds on the maximal achievable precision in multiparameter noisy quantum metrology, tighter than a direct use of single-parameter results. This allows us to study the effect of incompatibility of optimal probe states for simultaneous estimation of multiple parameters in generic channels, so far studied mostly in noiseless scenarios. We apply our results to several paradigmatic example, such as lossy multiple-phase interferometry. Going beyond the multiparameter estimation paradigm, we introduce the concept of random quantum sensing and show how the tools developed may be applied to multiple-channel discrimination. As an illustration, we prove the loss of the quadratic advantage of time-continuous Grover algorithm in presence of dephasing or erasure noise.

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