

## Improved Quantum Magnetometry beyond the Standard Quantum Limit

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### Reference:

Phys. Rev. X 5, 031010 (2015) <http://arxiv.org/abs/1411.0716> [2]

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<http://dx.doi.org/10.1103/PhysRevX.5.031010> [3]

Under ideal conditions, quantum metrology promises a precision gain over classical techniques scaling quadratically with the number of probe particles. At the same time, no-go results have shown that generic, uncorrelated noise limits the quantum advantage to a constant factor. In frequency estimation scenarios, however, there are exceptions to this rule and, in particular, it has been found that transversal dephasing does allow for a scaling quantum advantage. Yet, it has remained unclear whether such exemptions can be exploited in practical scenarios. Here, we argue that the transversal-noise model applies to the setting of recent magnetometry experiments and show that a scaling advantage can be maintained with one-axis-twisted spin-squeezed states and Ramsey-interferometry-like measurements. This is achieved by exploiting the geometry of the setup that, as we demonstrate, has a strong influence on the achievable quantum enhancement for experimentally feasible parameter settings. When, in addition to the dominant transversal noise, other sources of decoherence are present, the quantum advantage is asymptotically bounded by a constant, but this constant may be significantly improved by exploring the geometry.

- [41.95.+m Quantum magnetometry](#) [4]
- [QIPC](#) [5]
- [FP7](#) [6]
- [Result](#) [7]
- [SIQS](#) [8]

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