Compression of metrological quantum information in the presence of noise

Flavio SALVATI

University of Cambridge, Cavendish Laboratory

fs483@cam.ac.uk

Post-selected quantum metrology allows detectors to operate at lower intensities without reducing the input rate of quantum information [3, 2, 1]. Until now, the effect of noise on such metrology has not been investigated. In my talk I will prove that post-selection can always increase the (Fisher) information per output state, even in the presence of strong depolarising noise [4]. The extent of the possible information compression depends on the strength of the noise. I present analytical formulae pinning down this relation. My derivation holds in the case of multi-parameter quantum metrology and post-selection by a general filter (i.e., POVM). Finally, I design the optimal filter to use in noisy post-selected quantum metrology.

References

[1] D. R. M. Arvidsson-Shukur, N. Yunger Halpern, H. V. Lepage, A. A. Lasek, C. H. W. Barnes, and S. Lloyd. Quantum advantage in postselected metrology. *Nature Communications*, 11(1):3775, Jul 2020.

[2] J. H. Jenne and D. R. M. Arvidsson-Shukur. Unbounded and lossless compression of multiparameter quantum information. *Phys. Rev. A*, 106:042404, Oct 2022.

[3] N. Lupu-Gladstein, Y. B. Yilmaz, D. R. M. Arvidsson-Shukur, A. Brodutch, A. O. T. Pang, A. M. Steinberg, and N. Y. Halpern. Negative quasiprobabilities enhance phase estimation in quantum-optics experiment. *Phys. Rev. Lett.*, 128:220504, Jun 2022.

[4] F. Salvati, W. Salmon, C. H. W. Barnes, and D. R. M. Arvidsson-Shukur. Compression of metrological quantum information in the presence of noise, 2023.