MAR17-2016-000584

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Quantum Theory of Superresolution for Incoherent Optical Imaging[1]

MANKEI TSANG, National University of Singapore

Rayleigh's criterion for resolving two incoherent point sources has been the most influential measure of optical imaging resolution for over a century. In the context of statistical image processing, violation of the criterion is especially detrimental to the estimation of the separation between the sources, and modern far-field superresolution techniques rely on suppressing the emission of close sources to enhance the localization precision. Using quantum optics, quantum metrology, and statistical analysis, here we show that, even if two close incoherent sources emit simultaneously, measurements with linear optics and photon counting can estimate their separation from the far field almost as precisely as conventional methods do for isolated sources, rendering Rayleigh's criterion irrelevant to the problem. Our results demonstrate that superresolution can be achieved not only for fluorophores but also for stars. Recent progress in generalizing our theory for multiple sources and spectroscopy will also be discussed.

[1]This work is supported by the Singapore National Research Foundation under NRF Grant No. NRF-NRFF2011-07 and the Singapore Ministry of Education Academic Research Fund Tier 1 Project R-263-000-C06-112.