Bright and Quantum: Toward Intense and Non-Gaussian Quantum Light

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Non-Gaussian quantum states of light are related to quantum enhancements in quantum metrology, quantum computation, and quantum error correction. However, generating such states—and especially characterizing their nonclassical properties—remains an active challenge, particularly in the high-photon-number regime where full state reconstruction becomes impractical.

In this talk, I will present our theoretical work on how to generate a specific family of non-Gaussian states: the generalized coherent states (GCS), which arise from the nonlinear evolution of coherent light [PRR2023]. These states retain a classical Poissonian photon-number distribution while exhibiting non-Gaussian features in their Wigner representation. While this generation mechanism is well understood, identifying experimental observables that can reveal the nonclassical features of such states—without relying on complete quantum tomography—remains a key challenge.

I will discuss current strategies for addressing this problem, including the use of intensity-field correlation functions and displacement-based diagnostics of non-Gaussianity through differential current measurements. As a complementary perspective, I will briefly mention the entanglement potential upon beam splitter interaction, which—while theoretically informative—requires full state reconstruction and is thus less practical in the intense-light regime.