TRR 142
Tailored Nonlinear Photonics

TRR Guest Scientist Lecture / Seminar

Date/Time: 17.06.2021 / 15:00 o'clock
Location: Online - Zoom

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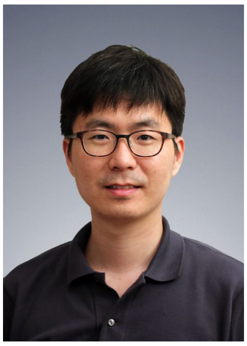


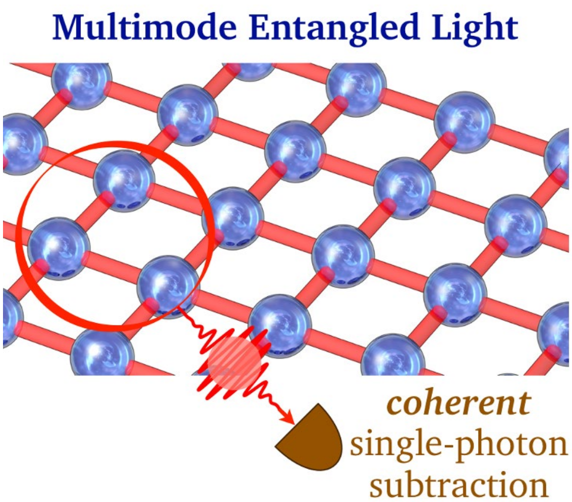
Non-Gaussian quantum states of multimode light fields

Abstract:

Continuous-variable quantum information encoded on the electromagnetic fields of light plays a pivotal role in quantum technologies [1]. It enables to build a large-scale entangled quantum state for quantum computing and quantum communication based on standard optical resources: a squeezed vacuum state of light, linear optics, and homodyne detection. However, a quantum state produced by those resources always exhibits a Gaussian distribution, which is generally insufficient for quantum technologies [2]. Subtracting a single photon from a squeezed vacuum state can introduce a non-Gaussian distribution, but the conventional method of photon subtraction works only for a single-mode quantum state, which significantly limits the range of application.

Here we generate non-Gaussian quantum states of multimode light by employing a single-photon subtractor compatible with multimode light [3,4]. We first prepare a multimode squeezed vacuum state and then subtract a single photon at a desired mode or at a superposition of desired modes; the resultant multimode quantum state exhibits a non-Gaussian distribution (negativity of the Wigner function in many cases) when measured at the mode(s) of photon subtraction. Furthermore, when a single photon is subtracted from a multimode entangled state, we observe that the induced non-Gaussianity is distributed to other modes via entanglement between modes. Such non-Gaussian multimode quantum states will have broad applications for universal quantum computing, entanglement distillation, and nonlocality test.

References
[1] U. L. Andersen et. al., Nat. Phys. 11, 713–719 (2015).
[2] A. Mari et. al., Phys. Rev. Lett. 109, 230503 (2012).
[3] Y.-S. Ra et. al., Phys. Rev. X 7, 031012 (2017).
[4] Y.-S. Ra et. al., Nature Physics 16, 144–147 (2020).



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