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Techniques for Characterizing Light Source Emission Statistics at Single-Photon Level

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Characterizing the underlying processes contributing to a light field has wide ranging applications throughout physics. For instance, knowledge of the mode structure is vital for engineering sources of nonclassical light that minimize loss and decoherence of quantum information due to coupling to unwanted modes. Photon-number statistics are used to characterize a variety of optical systems including single-photon sources [1–3], cavity QED [4,5], and lasers [6,7].
The aim of this talk is to review the techniques, in particular the ones investigated in INRIM (Italy), for characterizing the statistical emission of single-photon or low-light sources [8-11] and eventually their mode structure reconstructions [12]. This is very important in the context of photon detection efficiency (PDE) characterization of single-photon sensitive detector like, SPADs and silicon photomultipliers (SiPM). The PDE measurements of SiPM are generally based on light sources that are assumed presenting Poissonian statistics in the photon emission, but this has to be properly tested.
Furthermore, a validation of the measurement techniques is on going thanks to pilot comparisons lead by INRIM between European national metrological institutions on the measurement of the second-order Glauber auto-correlation function in the VIS-NIR and at telecom wavelength for both pulsed and CW sources. These comparisons are carried on under the European metrological project EMPIR 14IND05 "MIQC2" [13], from the skills developed and results obtained in the previous project on metrology at single photon level, namely IMERA+ qu-Candela [14], EMRP IND06 "MIQC" [15], and EMRP EXL05 "SIQUTE" [16].

[1] C. Kurtsiefer, S. Mayer, P. Zarda, and H. Weinfurter, Phys. Rev. Lett. 85, 290 (2000).

[2] D. Press, S. Gotzinger, S. Reitzenstein, C. Hofmann, A. Loffler, M. Kamp, A. Forchel, and Y. Yamamoto, Phys. Rev. Lett. 98, 117402 (2007).

[3] W. Schmunk, M. Gramegna, G. Brida, I. P. Degiovanni, M. Genovese, H. Hofer, S. Kuck, L. Lolli, M. G. A. Paris, S. Peters, M. Rajteri, A. M. Racu, A. Ruschhaupt, E. Taralli, and P. Traina, Metrologia 49, S156 (2012).

[4] M. Aßmann, F. Veit, M. Bayer, M. van der Poel, and J. M. Hvam, Science 325, 297 (2009).

[5] M. Hennrich, A. Kuhn, and G. Rempe, Phys. Rev. Lett. 94, 053604 (2005).

[6] D. Elvira, X. Hachair, V. B. Verma, R. Braive, G. Beaudoin, I. Robert-Philip, I. Sagnes, B. Baek, S. W. Nam, E. A. Dauler, I. Abram, M. J. Stevens, and A. Beveratos, Phys. Rev. A 84, 061802 (2011).

[7] M. Aßmann, F. Veit, M. Bayer, C. Gies, F. Jahnke, S. Reitzenstein, S. Hofling, L. Worschech, and A. Forchel, Phys. Rev. B 81, 165314 (2010).

[8] C.J. Chunnilall, I. P. Degiovanni, S. Kück, I. Müller, A. G. Sinclair, Optical Engineering 53 (8), 081910 (2014)

[9] E. Moreva, P. Traina, J. Forneris, I.P. Degiovanni, et al., Physical Review B 96 (19), 195209 (2017)

[10] I.P. Degiovanni, S. Polyakov, A. Migdall, H.B. Coldenstrodt-Ronge, I. A. Walmsley, F. N. C. Wong, "Single-Photon Generation and Detection" (Chapter 7: "Hybrid Detectors"), Elsevier Inc. 2013.

[11] D.G. Monticone, K. Katamadze, P. Traina, E. Moreva, J. Forneris, I. P. Degiovanni et al. Physical review letters 113 (14), 143602 (2014)

[12] E.A. Goldschmidt, F. Piacentini, I.R. Berchera, S.V. Polyakov, S. Peters, S. Kück, I.P. Degiovanni et al. Phys. Rev. A. 88 (1), 013822 (2013)

[13] http://empir.npl.co.uk/miqc2/

[14] http://www.quantumcandela.org/

[15] http://projects.npl.co.uk/MIQC/

[16] https://www.ptb.de/emrp/siqute-home.html

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