Quantum Light: Coherence, Photon Statistics and Phase Space

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The three topics coherence, photon statistics and phase space distribution are intimately related and closely connected to the properties of the quantum vacuum. Here we will pick three different scenarios which underline this relation: two experimental results and one speculative consideration. The first one [1] is about the nature of spontaneous emission. Wigner and Weisskopf treated spontaneous emission perturbatively as an irreversible process, which raises the question whether or not there coherence between the light emitted by a single atom spontaneously into different direction: the experiment gives the answer. The second scenario [2] is a simultaneous measurement of the phase space distribution function and the intensity correlation in a light field which can be tuned between from a squeezed state to a thermal State. The intensity correlation is determined in two different ways and the results are compared: one way is to measure the intensity correlation directly and the other way is to calculate the intensity correlation from the measured Wigner function. We focus on weak squeezing for which the $g(2)$ function diverges. The third scenario, the speculative consideration [3] is to treat the modern vacuum as a dielectric and show that this provides a phenomenological approach to determining the speed of light, the permittivitty of the vacuum and the fine structure constant.

References

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