The Photon Statistics of Squeezed Number States

S Varro[1]

[1] *Quantum Optics and Quantum Information, Wigner Research Centre for Physics, Budapest, Hungary*
Contact Email: varro.sandor@wigner.hu

The coherent [1] and squeezed [2] states of a quantum-mechanical harmonic oscillator have already been constructed by Schrödinger (1926) and Kennard (1927), respectively, immediately after the invention of wave mechanics. From the sixties of the last century, these states have played an important role in quantum optics and quantum information, for instance, in the theory and experiments on lasers and parametric processes [3-4]. The squeezed (coherent) states also naturally appear in the non-perturbative description of the interaction of strong quantized radiation fields with electrons (*e.g.* in the high-harmonic generations process [5]), so they have significance also in attosecond physics.

The photon number distribution of squeezed (generalized) coherent states is well known [3], n the meantime it has become a textbook material, say. The probability amplitudes are determined by the matrix elements of the type <m|SD|n> (where S is the squeezing operator and D is a displacement operator), and they are expressed by classical Hermite or Laguerre polynomials. However, for the matrix element of the type <m|S|n>, referring to the squeezed number states, no compact expression of a similar structure has been published in the enormous literature on squeezed states, which appeared in the last more than 90 years.

Recently we have shown [6] that the probability amplitudes <m|S|n> for the squeezed number states can be expressed in a simple closed form in terms of the classical Gegenbauer polynomials. After discussing the photon number distribution, we shall also apply this result to describing parametric processes taking place in a spectral component of black-body radiation. Finally, we also mention the connection of the amplitudes <m|S|n> [6] with the irreducible representations of the 2+1 parameter Lorentz group.

References

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