

Using the Wigner function to calculate expectation values

Gerd Leuchs^{1,2,3}, Birgit Stiller^{1,2}

¹*Max Planck Institute for the Science of Light, Erlangen, Germany*

²*Department of Physics, University Erlangen-Nürnberg, Germany*

³*Department of Physics, University of Ottawa, Canada*

The quantum state of a light mode can be described in different ways, one way is by the Wigner function of the state. This representation is effectively a continuous variable description and has the advantage of describing both pure and mixed states. Using the Wigner function of a state it is straight forward to predict the outcome of homodyne measurements, because the field operators composing the corresponding measurement operator are symmetrically ordered and the Wigner function likewise corresponds to symmetric ordering. Other measurements may be described by operators in which the field operators are normally or anti-normally ordered. Direct detection e.g. corresponds to normal ordering and eight port homodyning to anti-normal ordering. In these cases the transition from one type of ordering to another has to be taken into account.

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- [1] B. Stiller, U. Seyfarth, and G. Leuchs, "Temporal and spectral properties of quantum light", Les Houches lectures 2013, arXiv:1411.xxxx