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Thesis: " THEORETICAL STUDY OF QUANTUM NON-LOCAL CORRELATIONS IN INCE GAUSS BEAMS"

Summary:

In recent years, structured beams have had a great development, facilitating progress in their applications, including areas like quantum mechanics, more specifically in quantum information. For example, the applications of structured light in quantum mechanics contribute significantly in high-dimensional entanglement since these beams have more degrees of freedom due to the orbital angular momentum. In this thesis, Ince Gauss beams, the solution to the paraxial wave equation in elliptic coordinates with periodic boundary conditions, are studied. These structured beams are relevant and they are characterized by an important parameter, the ellipticity , this parameter is of interest because it replicates the limiting cases of other families of structured beams. When the IGBs become the Laguerre Gauss Beams (LGB), while for the IGBs become the Hermite Gauss Beams (HGB). On consideration of these characteristics of the IGBs, and taking into account that it is a continuous basis of the SU(2), according to the similarities with the representation of the Poincaré sphere between families of structured beams, a representation of the Wigner function for the IGBs, that will depend on the quadrature operators already known from group theory and on the coefficients between IGBs and LGBs, is obtained.

When an expression for the Wigner function was gotten, a representation for a Bell inequality, Clauser Horne Shimony Holt (CHSH) is proposed. These two representations were validated in the limit reproducing the results for LGBs. The main result of this thesis, is the value for the CHSH Bell-type inequality, for different order of the IGBs, and for different values of the ellipticity. In all the cases, the Bell inequality is violated, this shows that for the families of Ince Gauss under investigation, non-locality behaviour is presented.

This is a very important characteristic, related to entanglements, which may give some clues for future research.