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Director de tesis: Dr. Roberto Ramírez Alarcón

Sinodales:

Dra.Laura Cassandra Rosales Zárate
(Sinodal Interna, Presidenta del Jurado)

Dr. Carlos Herman Wiechers Medina
(Sinodal Externo, UG Secretario)

Dra. Lorena Berenice Velázquez Ibarra
(Sinodal externa, UG Vocal )

Tesis: "STUDY OF THE PROPAGATION OF ENTANGLED PHOTONS IN ORBITAL ANGULAR MOMENTUM WITH LAGUERRE AND INCE-GAUSS MODES THROUGH A TURBULENT ATMOSPHERE"

Resumen:

In free space optical communication, atmospheric turbulence is a significant challenge due to the random fluctuations in the refractive index caused by temperature variations in the atmosphere. This research focuses on the impact of atmospheric turbulence on entangled photons with Orbital Angular Momentum (OAM) using Laguerre and Helicoidal Ince Gauss modes. To measure the entanglement we use the concurrence, obtained by reconstructing the density matrix with quantum state tomography techniques.

In this work, we extend the investigation of Laguerre Gauss modes by considering nonzero radial indices, a novel approach that has not been studied in the literature. Furthermore, we studied the concurrence of Helicoidal Ince-Gauss modes against atmospheric turbulence. These modes, characterized by their ellipticity dependency and helicoidal phase, had not been extensively studied before.

Our findings reveal that modes with higher cylindrical symmetry exhibit greater resilience in preserving the entanglement against scintillation induced by turbulence. Our results also contribute to the existing knowledge by emphasizing that the effect of the turbulence on the entanglement is basis dependent.

The outcomes of this study have implications for practical applications. The observed resilience of higher cylindrical symmetry modes against turbulence-induced scintillation could be useful in free space optical communication systems. This includes applications in Quantum Key Distribution (QKD) and other secure communication protocols relying on entanglement preservation.