Contribution ID: **15** Type: **Oral Presentation**

Comparative Theoretical Analysis of Entangled Quantum States for Enhanced Sensing Application

Tuesday 8 July 2025 09:20 (20 minutes)

Quantum sensing leverages the distinct characteristics of quantum states to surpass classical measurement precision limits. We propose a theoretical study which provides a comparative analysis of various entangled quantum states, specifically NOON states, twisted NOON states, entangled coherent states, and BAT states, for advanced sensing applications. We evaluate each state's phase estimation precision, and robustness to noise and decoherence. NOON states offer remarkable phase sensitivity but face significant challenges with photon loss and decoherence. Twisted NOON states introduce angular momentum modes, potentially enhancing sensitivity and noise resistance in structured sensing scenarios. Entangled coherent states provide flexibility with adjustable amplitudes and resilience to photon loss, while BAT states balance enhanced sensitivity with improved noise tolerance through hybrid quantum states. The comparative assessment includes theoretical noise modeling and considers losses to the environment.

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Session Classification: Photonics

Track Classification: Track C - Photonics