Partners and Quantum Information Capsule

Koji Yamaguchi

Dept. of Phys., Tohoku Univ.

A quantum field is capable of playing a role of quantum information storage. However, it is nontrivial where the field store information in a total pure state. This question is important in the context of black hole information loss problem. So far, a common picture is that of a mode and its purification partner sharing the information quantum mechanically [1, 2]. In this talk, we first review these results. In addition, we introduce the concept of quantum information capsule (QIC), a single mode storing information in a pure state, as a new class of information carrier [3, 4]. Partners and QICs enable us to track information scrambled by unitary evolution. We analyze the time-evolution of a QIC in a discretized scalar field to demonstrate the diffusion of information in entangled pure states.

References

[1] M. Hotta, R. Schützhold, and W. G. Unruh, *Partner particles for moving mirror radiation and black hole evaporation*, Phys. Rev. D **91**, 124060 (2015).

[2] J. Trevison, K. Yamaguchi, and M. Hotta, *Spatially Overlapped Partners in Quantum Field Theory*, J. Phys. A: Math. Theor. **52**, 12 (2019).

[3] K. Yamaguchi, N. Watamura, and M. Hotta, *Quantum Information Capsule and Information Delocalization by Entanglement in Multiple-qubit Systems*, Phys. Lett. A. **383**, 1255 (2019).

[4] K. Yamaguchi, and M. Hotta, *Quantum Information Capsule in Multiple-Qudit Systems and Continuous-Variable Systems*, arXiv:1902.05675 [quant-ph].