Revisiting quantum superpositions: Insights from the Generalized Lorentz Transformation

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Abstract

The quantum description of reality is still an intriguing and bizarre topic for many scientists because of its rich structure. In tackling the most fundamental questions within this domain, researchers often try to incorporate unconventional methods to explain some essential features acquired by quantum systems. Recently, Dragan and Ekert [2] postulated that considering the generalized Lorentz transformation, including a valid description of superluminal observers, may imply the emergence of multiple quantum mechanical trajectories. As a counterargument, we show that rigorous analysis of the generalized Lorentz transformation does not imply any correspondence between the classical concept of a definite path and the multiple paths of quantum mechanics. Furthermore, we point out that a comprehensive analysis of the structure of subluminal and superluminal reference frames leads to the conclusion that the absorption process is indistinguishable from the emission process as far as the superluminal reference frame is concerned. We indicate the preceding argument as the major cause of the illusory emergence of multiple quantum trajectories.

References

[1] Grudka, A., Stempin, J., Wójcik, J., & Wójcik, A. (2023). Superluminal observers do not explain quantum superpositions. *Physics Letters A*, *487*, 129127.

[2] Dragan, A., & Ekert, A. (2020). Quantum principle of relativity. *New Journal of Physics*, *22*(3), 033038.

Figures

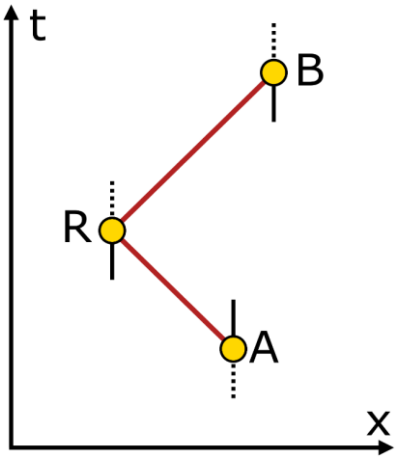

Figure 1: Minkowski diagram presents an experiment in which a single photon is emitted by a source A, reflected by a mirror R, and absorbed by an atom B as seen from a subluminal reference frame

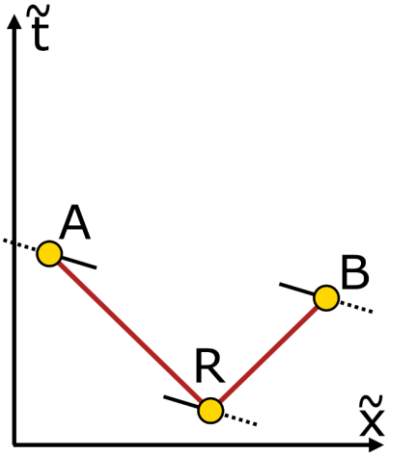

Figure 2: The experiment from Fig.1 seen from the superluminal reference frame