

Isomorphic issues about the CTCs in Quantum Physics

Enzo Bonacci

(The Physics Unit of ATINER, Athens, Greece)

E-mail: enzo.bonacci@physics.org

The main solutions to the Polchinski's paradox [7] are Novikov's self-consistent causal loops [5] referring to a Reciprocity Principle (RP) in physics ([2, 3, 4]) whereby the past determines the future as well as the future determines the past. The recent proposal of a quantum circuit formulation of the famous wormhole billiard ball paradox [1] has renovated the interest for closed time-like curves (CTCs) applied to elementary particles. We wish to enrich such discussion by focusing on an electron entering in a time-travel tunnel so that it can collide with its past self at low energy. We investigate the graph isomorphism (GI) of two alternative cases about the exiting particle: 1) If it is still an *electron*, then the collision deflects the trajectory of the incoming particle just towards the tunnel entrance (within a stable time loop). 2) If it is a *positron*, i.e., matter going backwards in time [6], then the interaction with the incoming electron is a process of pair production which is reversed inside the tunnel (as annihilation) according to the RP. Our GI analysis raises open questions ranging from the role of a preferential arrow of time to the validity of the law of inertia in chronology violations.

REFERENCES

- [1] Lachlan Bishop et al. Time-travelling billiard ball clocks: a quantum model. *arXiv*, e-Print : 2007.12677v2 [quant-ph], 2021.
- [2] Enzo Bonacci. *Absolute Relativity*. Turin : Carta e Penna, 2007.
- [3] Enzo Bonacci. *Extension of Einstein's Relativity*, volume 42 of *Physical Sciences*. Rome : Aracne Editrice, 2007.
- [4] Enzo Bonacci. *Beyond Relativity*, volume 43 of *Physical Sciences*. Rome : Aracne Editrice, 2007.
- [5] Fernando Echeverria et al. Billiard balls in wormhole spacetimes with closed timelike curves: Classical theory *Physical Review D*, 44(4) : 1077–1099, 1991.
- [6] Richard P. Feynman. The theory of positrons. *Physical Review*, 76(6) : 749–759, 1949.
- [7] John L. Friedman et al. Cauchy problem in spacetimes with closed timelike curves. *Physical Review D*, 42(6) : 1915–1930, 1990.