Einstein Synchronization by Quantum Teleportation

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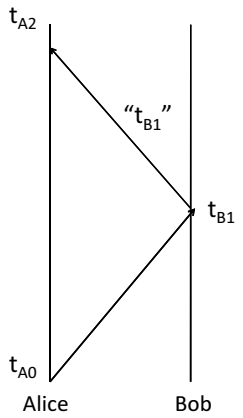
In the seminal paper on the special relativity published in 1905 [1], Einstein considered a thought experiment for two spatially separated clocks to synchronize by exchanging light signals back and forth between them. The first light signal starts from one of the observers Alice at the time t_{A0} as her clock indicates, reaches the other observer Bob at the time t_{B1} measured by his clock and then the information of the numerical value t_{B1} is sent back to Alice by the light signal, who receives the information of t_{B1} at the time t_{A2} by her clock. By this communication Alice obtains all of the necessary data t_{A0}, t_{B1} and t_{A2} to check the synchronization criterion

$$\frac{t_{A0}+t_{A2}}{2}=t_{B1}. \tag{1}$$

In this paper we present a protocol of Einstein's synchronization of two spatially separated clocks



on the basis of quantum teleportation. Our scheme does not contain the frame defining problem nor the phase contamination problem in the quantum clock synchronization by Jozsa et.al [2]. We show that the synchronization criterion in our protocol is relativistically invariant.

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[1] A. Einstein, " On the electrodynamics of moving bodies,"(English translation) Annalen der Physik **17**,891 (1905).
[2] R. Jozsa, D. S. Abrams, J. P. Dowling, and C. P. Williams, Phys. Rev. Lett. **85**, 129802 (2010).

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