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Advances in quantum dynamics of photons in curved spacetime

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General relativity and quantum mechanics are the two frameworks through which we understand Nature. To date, they have been successful at providing accurate predictions of natural phenomena in their respective domains of validity. Many attempts to find a unified theory of Nature that can describe all of observable phenomena have been tried with varying degrees of success. Regardless, the quest for unification remains open, and therefore continues.

One avenue for investigating the overlap of general relativity and quantum mechanics that is less ambitious but can still provide potentially observable and measurable predictions is that of (low energy) quantum field theory in curved spacetime viewed through the lens of quantum information. In recent years, a great deal of attention has been given to this approach, which has provided novel and intriguing insights into phenomena that can be tested in the laboratory.

We present updates on the investigation into the quantum nature of the gravitational redshift, seeking to understand which are the quantum dynamics that lead to the effective classical observable effect. We present the current state-of-the-art and discuss novel discoveries. We also discuss the place that this avenue of research has in the broader context of relativistic and quantum physics.

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