Weak measurement and quantum gravity

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PhD Studentship in Theoretical Physics.

The idea that a particle trajectory has no meaning in quantum mechanics has been called into question by the experimental work of Kocsis et al [1] based on weak values [2]. The conventional view has been unambiguously stated by Landau and Lifshitz [3] :- "In quantum mechanics there is no such concept as the path of a particle". In contrast, a basic concept in General Relativity is the geodesic. Reconciling these two views has been one of the stumbling blocks to producing a quantum theory of gravity.

A theoretical PhD research project is planned to examine the relation between the weak value of momentum and the transition probability applitude used in the Schwinger-Feynman approach to QM and QFT [4] with the ultimate view to shining more light onto quantum-gravitational path integral techniques. This work would explore these connections with the aim of producing an extensive set of "table top" experiments as proposed by Bekenstein [5] at sub-Planckian length scales [6]. Gaining further insight into the problem of quantum gravity will have world wide impact on the physics community.

The candidate must have a good background in theoretical physics and willing to learn new mathematical techniques involving non-commutative algebras. Some familiarity with Clifford algebras will be an advantage.

Funding

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References

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[4] Flack, R., Hiley, B. J., Entropy, 20
[5] May 2018. doi:10.3390/e20050367. [5] Bekenstein, J., arXiv 1211.3816v2.
[6] Oliva, M., Steuernagel, O., Phys. Rev. A 95, 052112 (2017).