

Prof. Dr. Wolfgang P. Schleich

Institut für Quantenphysik und Center for Integrated Quantum Science and Technology
(IQST), Universität Ulm

The Riemann Zeta Function and Quantum Mechanics

The Riemann zeta function ζ plays a crucial role in number theory as well as physics. Indeed, the distribution of primes is intimately connected to the non-trivial zeros of this function. We briefly summarize the essential properties of the Riemann zeta function and then present a quantum mechanical system which when measured appropriately yields ζ . We emphasize that for the representation in terms of a Dirichlet series interference [1] suffices to obtain ζ . However, in order to create ζ along the critical line where the non-trivial zeros are located we need two entangled quantum systems [2]. In this way entanglement may be considered the quantum analogue of the analytical continuation of complex analysis.

[1] R. Mack, J. P. Dahl, H. Moya-Cessa, W.T. Strunz, R. Walser and W. P. Schleich, *Riemann ζ -function from wave packet dynamics*, Phys. Rev. A. **82**, 032119 (2010).

[2] C. Feiler and W.P. Schleich, *Entanglement and analytical continuation: an intimate relation told by the Riemann zeta function*, New J. Phys. **15**, 063009 (2013).