

Contribution ID: 19

Type: Talk

The Riemann Zeta Function and Quantum Mechanics

Friday, 27 May 2022 09:30 (1 hour)

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. We also analyze the Newton flows [3, 4] of ζ as well as of the closely related function ξ . Both provide additional insight [5] into the Riemann hypothesis.

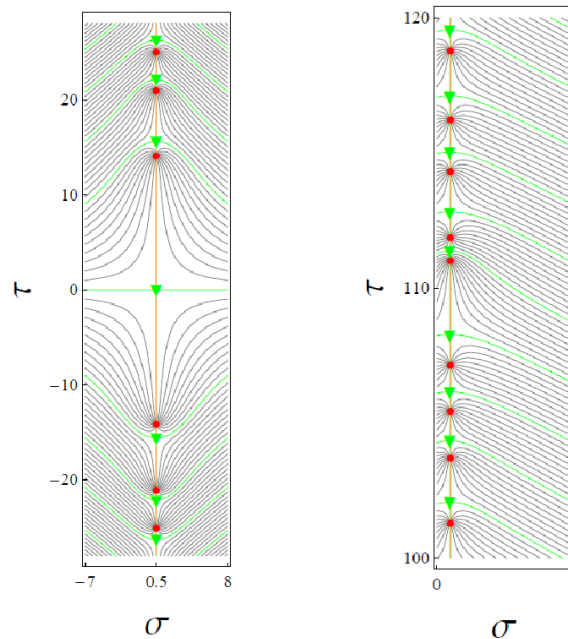


Figure 1: Lines of constant phase of the function ξ

- [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).
- [3] J. Neuberger, C. Feiler, H. Maier, and W.P. Schleich, Newton flow of the Riemann zeta function: Separatrices control the appearance of zeros, *New J. Phys.* 16, 103023 (2014).
- [4] J.W. Neuberger, C. Feiler, H. Maier, and W.P. Schleich, The Riemann hypothesis illuminated by the Newton

flow of ζ Phys. Scr. 90, 108015 (2015).

[5] W.P. Schleich, I. Bezděková, M.B. Kim, P.C. Abbott, H. Maier, H. Montgomery, and J.W. Neuberger, Equivalent formulations of the Riemann hypothesis based on lines of constant phase, Phys. Scr. 93, 065201 (2018).

Primary author: Prof. SCHLEICH, Wolfgang P. (Institut für Quantenphysik and Center for Integrated Quantum Science and Technology (IQST), Universität Ulm)

Presenter: Prof. SCHLEICH, Wolfgang P. (Institut für Quantenphysik and Center for Integrated Quantum Science and Technology (IQST), Universität Ulm)

Session Classification: Talk