SMSS Distinguished Colloquium

UTRGV

School of Mathematical & Statistical Sciences

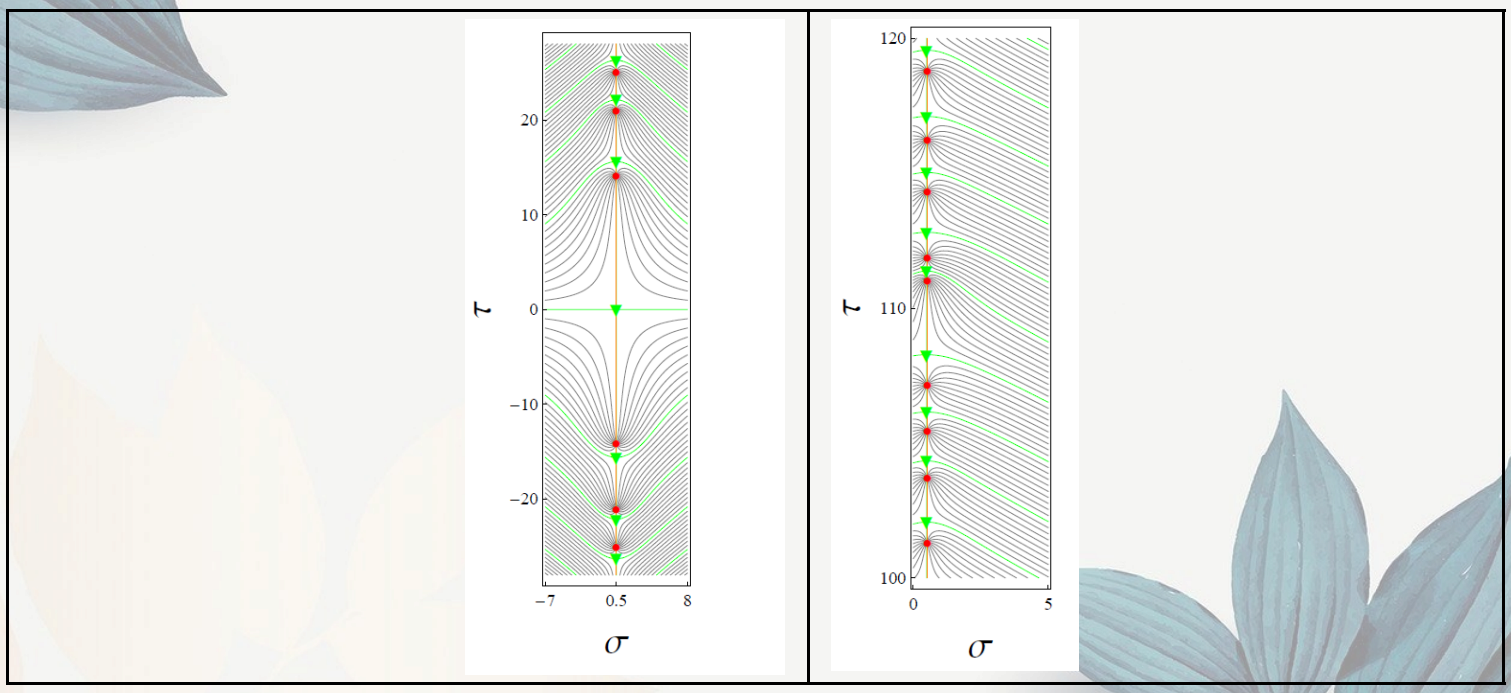
Guest Speaker: Dr. Wolfgang P. Schleich

Institute of Quantum Physics, University of Ulm,
Germany & German Aerospace Center (DLR),
Institute of Quantum Technologies

The Riemann Zeta Function and Quantum Mechanics

Abstract:

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.



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* z, 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).

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About Speaker:

Dr. Wolfgang Schleich is a Chair-Professor of Theoretical Physics, University of Ulm and Acting Director of German Aerospace Center (DLR), Institute of Quantum Technologies. During his 40 year career of demonstrated leadership and groundbreaking research, Dr. Schleich has been holding broad areas of research interests which include theoretical quantum optics, physics of cold atoms and analogies to solid state physics, fundamental questions of quantum mechanics, general relativity, number theory, statistical physics and nonlinear dynamics.

Dr. Wolfgang Schleich was selected as Fellows of the Optical Society of America (OSA,1997), the Institute of Physics (IOP,1999), the American Physical Society(APS,2000) and the European Society of Optics (2007). In 2013, he was awarded as Texas A&M University Institute for Advanced Study (TIAS) Faculty Fellow.

Dr. Wolfgang Schleich was elected to the German Academy of Sciences Leopoldina (2002), Heidelberg Academy of Sciences (2005), Royal Danish Academy of Sciences and Letters and the Austrian Academy of Sciences (Corresponding Members), Academia Europaea (2008) and the Hungarian Academy of Sciences (Honorary Member, 2019). He received many awards, prizes and medals such as Max Planck Research award (2002), Willis E. Lamb Award (2008), Gottfried Wilhelm Leibniz Prize from German Research Foundation (1995) and Prize of the German Physical Society (1991), Otto Hahn Medal (1983) and Ernst Abbe Medal (1991).

Most recently, Dr. Schleich is recognized "for pioneering contributions to topics including gyroscopes and general relativity, Schleich-Wheeler oscillations, quantum state engineering, quantum optics in phase space, Gauss-sum factorization and wave packet dynamics and the red shift controversy resolution in atom interferometry" and received 2021 Herbert Walther Award from the Optical Society (OSA) and the Deutsche Physikalische Gesellschaft (DPG).

Date: Friday, February 26, 2021

Time: 1:30 – 2:30 PM CST

Zoom link: https://utrgv.zoom.us/j/9082139008

If you have any questions please contact Dr. Sergey Grigorian sergey.grigorian@utrgv.edu or Dr. Baofeng Feng baofeng.feng@utrgv.edu