Department of Physics Colloquium

Factorization of numbers, Schrödinger cats and the Riemann hypothesis

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Abstract

In this talk we connect the three different topics of factorization of numbers, Schrödinger cats and the Riemann hypothesis. The bridge between these areas is the concept of a Gauss sum.

Gauss sums manifest themselves in various phenomena such as the Talbot effect, wave packet dynamics or quantum carpets. Moreover, Gauss sums can be used to efficiently factor numbers. The talk summarizes these activities and discusses a new approach based on a potential with a logarithmic energy spectrum.

Moreover, we propose an elementary quantum system which provides us with the Riemann zeta function. We show that its zeroes are a consequence of the interference of two quantum systems with opposite phases. However, the preparation of such a superposition state (Schrödinger cat) is impossible unless one takes advantage of entangled quantum systems. In this sense analytic continuation familiar from complex analysis finds entanglement as its analogue in quantum mechanics.

We conclude by introducing a geometrical approach towards the Riemann hypothesis based on the lines of constant phase.
Biography

**Wolfgang P. Schleich** is engaged in research on quantum optics ranging from the foundations of quantum physics via general relativity to number theory. He was educated at the Ludwig Maximilians-Universität (LMU) in Munich and studied with Marlan O. Scully at the University of New Mexico, Albuquerque, and the Max-Planck Institute for Quantum Optics, Garching. Moreover, he was also a post-doctoral fellow with John Archibald Wheeler at the University of Texas at Austin. Professor Schleich is a member of several national and international academies and has received numerous prizes and honors for his scientific work such as the Gottfried Wilhelm Leibniz Prize, the Max Planck Research Award, and the Willis E. Lamb Award for Laser Science and Quantum Optics. He is also a Faculty Fellow at the Hagler Institute for Advanced Study at Texas A&M University. His textbook, *Quantum Optics in Phase Space*, has been translated into Russian, and a Chinese edition was published in 2010.