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Quantum Mechanics and Riemann Hypothesis

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The cerebrated Riemann Hypothesis asserts that the nontrivial zeros of the Riemann zeta function lie on a critical line parallel to the imaginary axis, whose real part is 1/2. If it holds true, then the values of the nontrivial zeros minus 1/2 would constitute a discrete set of purely imaginary numbers, giving rise to the speculation that they may correspond to the eigenvalues of a self-adjoint (Hermitian) operator multiplied by the imaginary number. Finding such an operator as a way of proving the Riemann Hypothesis is the essence of the Hilbert-Pólya programme. In this talk I will illustrate an example in which techniques of PT-symmetric quantum mechanics can be applied to examine this problem. In particular, I will identify the operator which "does the trick"for the Hilbert-Pólya programme, i.e. an operator whose eigenvalues correspond exactly to the nontrivial zeros, and show, perhaps surprisingly, that the reality of the eigenvalues in itself is insufficient to establish the Riemann Hypothesis. (Based on joint work with Carl Bender & Markus Müller.)

Content of the contribution

Theory

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