Universität Bielefeld

Fakultät für Physik & Fakultät für Mathematik

Kolloquium Mathematische Physik

Alexander Its

Indiana University Purdue University Indianapolis

The Riemann-Hilbert method

The Riemann-Hilbert method is a powerful analytic apparatus for solving a vast variety of problems in pure and applied mathematics. The method has its origin in Hilbert's 21st problem concerning the inversion of the monodromy map in the theory of linear differential equations, and it consists in reducing a problem at hand to the problem of analytical factorization of a given matrix valued function. A classical example of the use of analytic factorization techniques is the Wiener-Hopf method in linear elasticity, hydrodynamics, and diffraction.

Another array of problems that have fallen under the Riemann-Hilbert formalism over the last twenty - twenty five years came from modern theory of integrable systems. In this new area, the Riemann-Hilbert approach exploits ideas which go beyond both the usual Wiener-Hopf scheme and the theory of singular integral equations, and they have their roots in the inverse scattering method of soliton theory and in the theory of isomonodromy deformations. The main "beneficiaryöf this, latest version of the Riemann-Hilbert method, is the global asymptotic analysis of nonlinear systems. Indeed, many long-standing asymptotic problems in the diverse areas of pure and applied math have been recently solved with the help of the Riemann-Hilbert technique.

In this talk a general overview of the Riemann-Hilbert method will be given. The most recent applications of the Riemann-Hilbert approach to asymptotic problems arising in the theory of matrix models, orthogonal polynomials, and statistical mechanics will be outlined. The talk is based on the works of many authors spanned over a number of years.

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