

Symmetry and universality in mesoscopic physics

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The title of the talk is the title of the research project SFB-Tr 12 of the German National Science Foundation (Deutsche Forschungsgemeinschaft) which involves mathematicians and physicists from the universities of Bochum, Essen and Köln as well as the Polish Academy of Sciences. The goal of the talk is to indicate the type of mathematics that is involved in the project and to encourage participants of the conference to consider interdisciplinary work as a possibility for their future research.

After explaining the notions in the title and some of the basic concepts of mesoscopic physics, we will sketch our recent work with Annett Püttmann, a complex geometer, and Martin Zirnbauer, a physicist from Köln who is director of the SFB. Our work, which is entitled *Haar expectations of ratios of random characteristic polynomials*, amounts to deriving explicit formulas for bosonic-fermionic autocorrelation functions which are defined as integrals over classical compact groups. A key conceptual step for this is the realization that such integrals are numerical parts of certain superfunctions which are characters of partially integrated representations of Howe dual partners (Lie superalgebras) of physically motivated representations of the compact groups. These are uniquely defined by a number of their properties which are derived from the supersymmetry at hand. Using these properties, the formula can be derived as a Weyl-group average of a natural meromorphic function whose poles cancel in a somewhat subtle way. Complex analysis plays an important role at a number of points in the project.