

Preface

This is a proceedings volume from the String-Math conference which took place at the University of Warsaw in 2022. In the past years the interactions between mathematics and high energy theoretical physics have been rapidly developing. Among others, they resulted in the rise of a new subfield, which is often referred to as physical mathematics. Quantum field theory and string theory play an important role in these developments, in particular as a source of often unexpected conjectures at the frontier of mathematics. Without a physical insight, many of these conjectures would not exist. The series of String-Math conferences is the natural and most prestigious venue, where such developments can be presented and discussed altogether by both physicists and mathematicians.

The String-Math conference in 2022 focused on several research areas actively developing these days. They included generalized (categorical) symmetries in quantum field theory and their relation to topological phases of matter; formal aspects of quantum field theory, in particular twisted holography; various developments in supersymmetric gauge theories, BPS counting and Donaldson-Thomas invariants. Other topics discussed included new advances in Gromov-Witten theory, curve counting, and Calabi-Yau manifolds. Another broad topic concerned algebraic aspects of conformal field theory, vertex operator algebras, and quantum groups. Furthermore, several other recent developments were presented during the conference, such as understanding the role of operator algebras in the presence of gravity, derivation of gauge-string duality, complexity of black holes, or mathematical aspects of the amplituhedron. We expect that all these topics will be actively developed also in the forthcoming future. This proceedings volume contains articles summarizing 14 conference lectures, devoted to some of the above topics.

The conference in Warsaw was the 12th conference in the String-Math series. These conferences take place annually, and previously were hosted by: University of Pennsylvania, University of Bonn, Simons Center for Geometry and Physics (Stony Brook), University of Alberta, Tsinghua University, College de France, University of Hamburg, Tohoku University, Uppsala Univeristy, Universities of Stellenbosch and Cape Town, IMPA (Rio de Janeiro); the next two meetings are taking place in Melbourne (2023) and Trieste (2024). Over the last decade the series of String-Math conferences has developed into a central event on the interface between mathematics and physics related to string theory, quantum field theory and related topics. The conference in Warsaw provided a special opportunity for community members to convene in person following two prior online conferences held during the Covid pandemic.