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PREFACE

This volume presents results obtained by the participants of the V Baltic-Nordic workshop "Algebra, Geometry and Mathematical Physics" held at the Będlewo Conference Center on October 12–16, 2009. The workshop was organized and sponsored by the Stefan Banach International Mathematical Center. This was the fifth conference in a series of workshops aimed at stimulating exchange of scientific ideas and disseminating research results obtained by mathematicians from the region of Baltic Sea and Scandinavia. Thus among the participants there were representatives of Germany, Estonia, Norway, Poland, Russia, Sweden, but also from other countries: Belgium, Czech Republic, Greece, France, Luxembourg and Ukraine.

The aim of the AGMP workshops is to foster the understanding of algebraic and geometric structures in physics. The main emphasis is on the interplay between them. The workshop series is an outcome of the initiatives of several universities:

- AGMP-5, Stefan Banach International Mathematical Center, 12–16 October 2009,
- AGMP-4, University of Tartu, 9–11 October 2008,
- AGMP-3, Chalmers University of Technology and University of Göteborg, 11–13 October 2007,
- AGMP-2, Lund University, 12–14 October 2006,
- AGMP-1, Tallinn University of Technology, 8 October 2005.

The research articles selected for this volume focus on questions in algebra and geometry which are of importance in physics. All papers were reviewed. The Editors take this opportunity to thank all the referees for their work.

The articles cover a wide range of topics, divided into the following parts:

- algebraic structures in physics,
- applications of Lie theory,
- various aspects of quantization,
- applications of differential geometry.

The articles of Abramov–Shitov, Fløystad–Vatne, Kamiya–Mondoc–Okubo and Stoilova–Van der Jeugt are devoted to various algebras used in physical models. The work of Gustavsen and Ile describes some properties of Cohen–Macaulay modules on a quotient surface singularity. Eriksen and Siqveland analyze the possibility of constructing a version of "noncommutative algebraic geometry". In a more direct physical vein, Kerner shows that the Lorentz and $SU(3)$ groups can be derived from the covariance principle conserv-

ing a $\mathbb{Z}_3$-graded three-form on a $\mathbb{Z}_3$-graded cubic algebra representing quarks endowed with nonstandard commutation laws.

Various applications of Lie theory are presented in the articles by Cherniha–Kovalenko, Cherniha–Pliukhin, Nizhnikov–Shilin, and Schlichenmaier. The works of Cherniha and collaborators are devoted to nonlinear boundary value problems modeling the processes of melting and evaporation of solid materials as well as reaction-diffusion equations. These problems are analyzed using Lie symmetry methods. Nizhnikov and Shilin use matrix elements of basis transformations in a representation space of the unimodular pseudo-orthogonal group to derive some formulas for special functions. Schlichenmaier investigates a new class of infinite-dimensional Lie algebras of geometric origin, that is, the Lax operator algebras and their central extensions.

Various aspects of quantization are presented. Gurevich and Saponov realize a quantization of some Poisson pencils in the framework of braided affine geometry. Yang–Baxter map systems (or set-theoretic analogs of entwining Yang–Baxter structures) are presented by Kouloukas and Papageorgiou. Krähmer and Wagner show that Connes–Moscovici "twisted" spectral triples (A, H, D) yield representations of arbitrary covariant differential calculi over Hopf algebras in the sense of Woronowicz. The n-dimensional (isotropic and nonisotropic) harmonic oscillator is studied as a Wigner quantum system by Lievens and Van der Jeugt. Paal and Virkepu use operadic Lax representations for the harmonic oscillator to construct the quantum counterparts of three-dimensional real Lie algebras. It is shown by Stigner how some properties of the rational conformal field theories can be obtained from the representation theory of classifying algebras. Wagner's article proves that the isospectral bi-equivariant spectral triple on quantum $SU(2)$ and the isospectral equivariant spectral triples on the Podleś spheres are related by restriction.

Several aspects of differential geometry ranging from planar curves to harmonic maps are presented in the papers by Hrdina, Kureš, Szczepkowska et al., Vašík, and Ianuş, Vîlcu and Voicu.

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The Editors