PREFACE

Quantum Topology originated in the mid eighties with the discovery of the Jones polynomial by V. Jones, and its quantum field theory interpretation as a 3-dimensional gauge theory by E. Witten.

The Jones polynomial is a powerful knot invariant that keeps tightly locked key information about the geometry and topology of the knot complement. The Jones polynomial, which originally arose in the index theory of von Neumann algebras, is clearly connected to statistical mechanics state sums in one and two dimensions, and can be described by a deformation of the representation theory of classical Lie algebras. The algebra underlying the representation theory and its deformation leads to deep connections with associators, non-abelian algebraic geometry and motivic cohomology, as was discovered by V. Drinfeld and M. Kontsevich.

Understanding associators and the Kontsevich integral of the simplest knots is a difficult problem that has motivated a lot of research in the theory of finite-type invariants. The latter are axiomatic abstractions of the perturbative gauge theory underlying the Jones polynomial and the corresponding 3-manifold invariants.

An axiomatization of the 3-manifold invariants was proposed by M. Atiyah under the name of Topological Quantum Field Theory (in short TQFT) in 3+1 dimensions. The TQFT invariants of closed 3-manifolds are powerful invariants that carry a lot of information about the topology and the differential geometry of the underlying manifold. In dimension three, the differential geometry is mostly the hyperbolic geometry and its few other exceptions, as follows from W. Thurston's Geometrization Conjecture. The TQFT invariants of knotted 3-dimensional objects lead, under suitable asymptotic limits, to a recovery of the corresponding hyperbolic invariants. An example of this principle is the Volume Conjecture of R. Kashaev for knots.

A parallel aspect of Quantum Topology is the idea of Categorification of M. Khovanov which merges state-sums and homological algebra into a homological refinement of the Jones polynomial, the so-called Khovanov Homology. Understanding the underlying geometry of Khovanov Homology is a major challenge.

The collection of the papers in the present volume arose from an International Conference on Quantum Topology in Ha Noi, Vietnam, in August 6-19, 2007. The aim of the conference was to bring together young and seasoned researchers in the area, and to expose the algebraic, topological and geometric aspects of it to a diverse audience.

It remains for the editor to thank the people who worked so hard to make this possible. First of all, I wish to thank the Vietnamese Academy of Science and Technology, and the local organizers Do Ngoc Diep, Nguyen Viet Dung and Vu The Khoi for their tireless effort and their wonderful hospitality. I wish to thank Thang Le, who conceived the idea of the conference, and the organizing committee, C. Gordon, V. Jones and V. Turaev. I would like to thank the sponsors: National Science Foundation, Institute of Mathematics (VAST, Hanoi), The International Center for Theoretical Physics, Saigon CTT, FPT corp, and Georgia Institute of Technology, whose generous contributions have helped to make the conference successful.

I would like to particularly thank the authors themselves, whose original talks made the conference such an exciting time and whose contributions show so much thought and care. Finally, I wish to thank Acta Mathematica Vietnamica for dedicating a special volume of the journal to the articles of the conference.

December, 2008

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