

**Lecture Series 76 — May 8, 2025, 15:00-17:00 Moscow time.**

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**Lecture 1 —  $\Phi^4_3$  Theory from many-body quantum Gibbs states**

**Speaker:** Rongchan Zhu (Beijing Institute of Technology)

**Time:** 15:00-16:00 Moscow time

**Abstract:** We derive the  $\Phi^4_3$  measure on the torus as a rigorous limit of the quantum Gibbs state of an interacting Bose gas, where the limiting classical measure describes the critical behavior of the Bose gas just above the Bose–Einstein phase transition. Since the quantum problem is typically formulated using a nonlocal interaction potential, a key challenge is to approximate the local  $\Phi^4_3$  theory by a Hartree measure with a nonlocal interaction. This requires uniform estimates on the Hartree measure, which are achieved using techniques from recent development on stochastic quantization and paracontrolled calculus. The connection to the quantum problem is then established by applying the variational approach and deriving a quantitative convergence of the quantum correlation functions to those of the Hartree classical field.

**Bio:** Rongchan Zhu is a Professor at Beijing Institute of Technology. She earned her Ph.D. in 2012 from both the Academy of Mathematics and Systems Science, Chinese Academy of Sciences, and Bielefeld University in Germany. Her research focuses on Stochastic Partial Differential Equations (SPDEs), with particular emphasis on singular SPDEs, stochastic fluid equations, and the study of quantum field models via stochastic quantization methods.

**Lecture 2 — Quantization of the theory of topological insulators**

**Speaker:** Armen Sergeev (Steklov Mathematical Institute of Russian Academy of Sciences)

**Time:** 16:00-17:00 Moscow time

**Abstract:** Topological insulators are the solid bodies having a broad energy gap stable under small deformations. This motivates the usage of topological methods for their study.

A key role in the theory of solid states is played by their symmetry groups. Kitaev has pointed out that there is a relation between the symmetries of solid bodies and Clifford algebras. According to this observation the quantization of topological insulators should reduce to the theory of irreducible representations of Clifford algebras.

The next important step was done by Kennedy and Zirnbauer who introduced the notion of pseudosymmetries. While the algebra of observables of a topological insulator is generated by Hamiltonians satisfying commutation relations with symmetry operators, the quantum observables are given by the complex structures on the Nambu space satisfying anticommutation relations with pseudosymmetries. This correspondence determines the quantization of topological insulators.

**Bio:** Armen Glebovich Sergeev is an outstanding Russian mathematician whose interests include complex analysis and complex geometry of tubular domains, pseudoholomorphic curves, matrix domains of holomorphy, geometric quantization, Seiberg-Witten equations, vortex equations, infinite-dimensional Kähler manifolds and harmonic mappings of compact Riemann surfaces into Kähler manifolds. Besides, studies the universal Teichmüller space, which contains the classical Teichmüller spaces of compact Riemann surfaces of finite genus as complex submanifolds.

Prof. Sergeev graduated from the Faculty of Mechanics and Mathematics of Moscow State University in 1971. Four years later, he defended his PhD thesis on the topic "Multidimensional factorization problem and multiplicative theory of hyperfunctions" being supervised by Prof. A. G. Kostyuchenko.

Since 1982, he has been working at the Steklov Mathematical Institute (MIAN), now being Deputy Director of the institute.

In 1989, Armen Sergeev became Doctor of Physical and Mathematical Sciences. He teaches at the Faculty of Mechanics and Mathematics, as a professor of the Department of Function Theory and Functional Analysis (1994).

Besides, Prof. Sergeev is a Member of the Board of the Moscow Mathematical Society (MMS), Editor of the MMS Proceedings, Deputy Editor-in-Chief of the journal "Izvestiya RAS. Mathematical Series". Honorary Doctor of Heñañ University (Heñañ, China) and foreign Member of the National Academy of Sciences of the Republic of Armenia (2014).