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Topological limit shape phase transitions: melting of Arctic Circles (ONSITE presentation)

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A limit shape phenomenon in statistical mechanics is the appearance of a most probable macroscopic state. An iconic example of this phenomenon is given by Arctic Circle Theorem [2] of random tilings which in certain scaling limit can be mapped to imaginary time evolution of free fermions. A limit shape is usually characterized by a well-defined boundary separating frozen and liquid spatial regions. The earliest studies related to this phenomenon in the context of crystal
shapes are in works by Pokrovsky and Talapov [1].

In this talk I will present a phase transition of limit shape, which can be visualized as merging two melted regions (Arctic circles). By mapping onto a free fermionic problem and calculating corrspondent correlation functions we identify the transition as the third order transition known in lattice QCD [3]. We make connection to algebraic geometry, stressing the topological nature of the transition and identify universal features of the limiting shape. Relations with impurity problem in one-dimensional quantum liquids will be discussed.

[1] W. Jockusch, J. Propp and P. Shor, arXiv preprint math/9801068 (1998). “Random domino tilings and the arctic circle theorem.”

[2] V. L. Pokrovsky and A. L. Talapov, Phys. Rev. Lett. 42, 65 (1979). “Ground State, Spectrum, and Phase Diagram of Two-Dimensional Incommensurate Crystals.”

[3] D. J. Gross and E. Witten, Phys. Rev. D, 21 (2): 446, 1980. “Possible third-order phase transition in the large-n lattice gauge theory.”; S. R. Wadia, , Phys. Lett. 93, 403 (1980) “N = ∞ phase transition in a class of exactly soluble model lattice gauge theories”

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