STIMaRT 2020
String Theory, Integrable Models and Representation Theory
Winter School-Conference

- **ALEXANDER ZAMOLODCHIKOV // SOLVABLE UV DEFORMATIONS OF 2D QUANTUM FIELD THEORIES**

The lectures will discuss some recent methods of studying the "irrelevant" perturbations of 2D quantum field theories. Typically, these perturbations give rise to a non-renormalizable perturbation theory and determine the IR effective infrared theories only. 2D cases exhibit the sort of deformations for which the theory is defined in a unique manner, with precise theories deduced for S-matrix and energy spectrum deformations. A short-wave behavior pattern arises, which does not affect causality but appears to break up the standard local structure of the field theory (as manifested by the specific phenomena outside the light cones).

Background knowledge requirements: quantum field theory, including re-normalization and diagram techniques. The knowledge of the basics of 2D conformal field theory is also desirable.

- **NIKOLAY RESHETIKHIN //**
  LIMIT SHAPES IN STATISTICAL MECHANICS /

The limit shape formation in statistical mechanics is a special behavior of the system in thermodynamic limit. When it occurs, any configuration that is significantly away from the most probable one is exponentially improbable. Such most probably configuration is called the limit shape. Configurations in a small vicinity of the limit shape are Gaussian distributed. Counterparts of this phenomenon in probability theory are large deviations and central limit theorem.

These lectures will focus on the limit shape phenomenon in integrable models in statistical mechanics. After an introduction into the nature of the phenomenon and presenting example of integrable models, the focus will be on dimer models and on the 6-vertex model. At the end there will be a discussion of some open problems

- In the first lecture I will introduce the dimer models, the Ising model, and the 6-vertex model. We will discuss boundary conditions and some interesting particular cases.
- The second lecture will be focused on the exact solution of dimer models and we will start the discussion of the limit shape phenomenon in dimer models.
- In the third lecture will continue the discussion of limit shape phenomenon. The plan is to have the description of limit shapes as solutions of the variational principle and conformally invariant fluctuations at the end of this lecture.
- The fourth lecture will be an introduction into the Bethe ansatz diagonalization of the raw-to-raw transfer-matrix. Algebraic Bethe ansatz will be explained, we will briefly discuss properties of Bethe vectors and solutions to the Bethe equations.
- The plan is to have the description of limit shapes and fluctuations for the 6-vertex model at the end of the fifth lecture.
- I also hope to find time for the discussion of some related problems, such as ASEP, the stochastic 6-vertex model and the 5-vertex model

- **LEONID RYBNIKOV //**
  GAUDIN MODEL AND CRYSTALS

1. **Warmup. Universal enveloping algebra center and integrability of the Toda system**
   key source:
   = = = B.Kostant, Quantization and Representation Theory

- **Critical-level center and Gaudin model quantization**
  key sources:
  = = = E. Frenkel, Affine Algebras, Langlands Duality and Bethe Ansatz, arXiv:q-alg/9506003;
  = = = B. Feigin, E. Frenkel, N. Reshetikhin, Gaudin Model, Bethe Ansatz and Critical Level arXiv:hep-th/9402022;
  = = = B. Feigin, E. Frenkel, V. Toledano-Laredo, Gaudin models with irregular singularities arXiv:math/0612798

- **Bethe Ansatz in Gaudin model**
  key sources:
  = = = E. Frenkel, Affine Algebras, Langlands Duality and Bethe Ansatz, arXiv:q-alg/9506003;
  = = = B. Feigin, E. Frenkel, N. Reshetikhin, Gaudin Model, Bethe Ansatz and Critical Level arXiv:hep-th/9402022;
  = = = B. Feigin, E. Frenkel, L. Rybnikov, Opers with irregular singularity and spectra of the shift of argument subalgebra arXiv:0712.1183;
  = = = Leonid Rybnikov, A proof of the Gaudin Bethe Ansatz conjecture arXiv:1608.04625

- **Deligne-Mumford compactification of stable rational curves' modulus space as the Gaudin model parameter space**

- key sources:

  = = = L. Aguirre, G. Felder, A. Veselov, Gaudinsubalgebras and stable rational curves, arXiv:1004.3253;

  = = = L. Rybnikov, Cactus group and monodromy of Bethe vectors, arXiv:1409.0131

- **Crystals and commutors**

  key source:

  = = = A. Henriques, J. Kamnitzer, Crystals and coboundary categories, arXiv:math/0406478;

  = = = J. Kamnitzer, P. Tingley, The crystal commutor and Drinfeld'sunitarized R-matrix, arXiv:0707.2248)

- **Bethe-vector crystalline structure and cactus group**

  key sources:

  = = = L. Rybnikov, Cactus group and monodromy of Bethe vectors, arXiv:1409.0131;

  = = = I. Halacheva, J. Kamnitzer, L. Rybnikov, A. Weekes, Crystals and monodromy of Bethe vectors, arXiv:1708.05105)

Contact the **Organizing Committee** at:
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