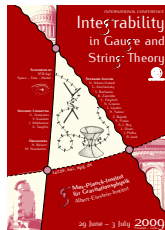


# Workshop Summary

**Gleb Arutyunov**

*Institute for Theoretical Physics, Utrecht University*

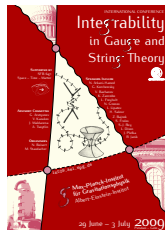
*Integrability in Gauge and String Theory,  
Potsdam 29 June - 3 July 2009*



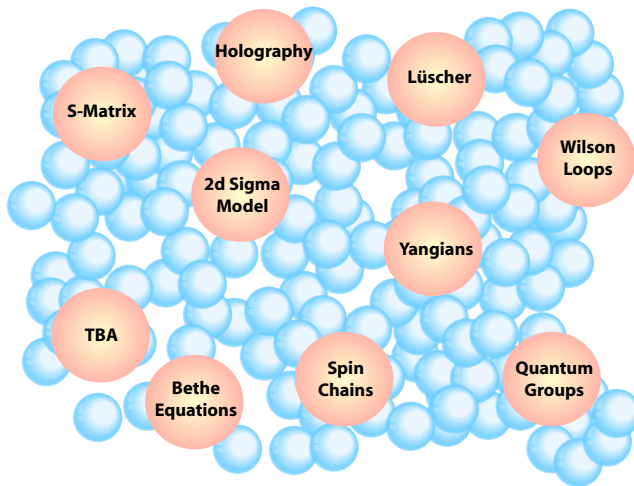
# Integrability in Gauge and String Theory

The conference is a very exciting annual event!

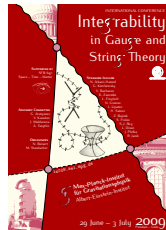
- 2005: Paris (ENS Summer Institute)
- 2006: Potsdam
- 2007: Paris (Itzykson conference, Saclay and ENS)
- 2008: Utrecht
- 2009: Potsdam
- 2010 – TBA



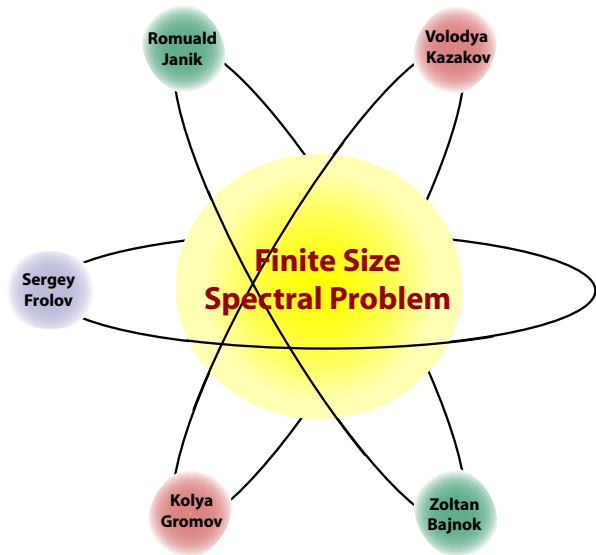
*Development and application of beautiful methods of integrable models with the goal to understand the dynamics of gauge and string theories*



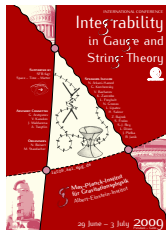
AdS/CFT  $\stackrel{?}{=} 0.99999(9)$







related talk by Radu Roiban on Konishi from strings



- *Sergey Frolov*: string hypothesis  $\implies$  TBA equations  $\implies$  Y-system and its analytic properties  $\implies$  Ground state
- *Volodya Kazakov*: Y-system  $\implies$  Large  $L$  solution  $\implies$  discrete Hirota dynamics  $\implies$  a proposal to describe excited states
- *Romuald Janik*: 5-loop Konishi  $\implies$  an extremely sensitive test of the dressing phase  $\implies$  a new future test for TBA and AdS/CFT

$$\Delta = 4 + 12g^2 - 48g^4 + 336g^6 + 96[-26 + 6\zeta(3) - 15\zeta(5)]g^8 - 96[-158 - 72\zeta(3) + 54\zeta(3)^2 + 90\zeta(5) - 315\zeta(7)]g^{10}$$

- *Zoltan Bajnok*: finite-size effects in integrable QFTs: exact S-matrix  $\implies$  Bethe-Yang equation  $\implies$  Lüscher corrections  $\implies$  TBA  $\implies$  Y  $\implies$  lattice  $\implies$  NLIE. Analyticity is a key to the solution!

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- *Kolya Gromov*: impressive numerical solution of the TBA/Y-system proposed to correspond to the Konishi operator

$$E_{TBA/Y} \approx 2.0004 \lambda^{1/4} + \frac{1.988}{\lambda^{1/4}} + \mathcal{O}(\lambda^{-3/4})$$

≈20 computers, 1000 hours of computer time!

- *Radu Roiban*: quantum strings in  $AdS_5 \times S^5$  and dimension of Konishi at strong coupling

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## Just for fun?!

In [hep-th/0510208](#) (with Sergey Frolov) we identified a consistent truncation of the full classical string sigma model to the  $su(1|1)$  sector

$$\text{tr}(\Psi^M Z^{J-\frac{M}{2}}), \quad \Delta = J + M, \quad [0, J - \frac{M}{2}, M]$$

A theory of two-dimensional Dirac fermion

$$E - J = \sum_{i=1}^M \sqrt{1 + \frac{4\lambda n_i^2}{(E + J)^2}}$$

Konishi descendent  $J = 2, M = 2$ :  $[0, 1, 2]_{(1,0)}$  of dimension 4.

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## Open problems

- Carry out comparison of predictions of TBA/Y to known results
- Increase precision of numerics. Konishi on your laptop!
- Develop analytic strong and weak coupling expansions
- Understand analytic properties of the Y-system on an infinite genus Riemann surface
- NLIE, lattice?

## Algebraic structures, large spins

- *Alessandro Torrielli*: Yangian (cf. talk by Vladimir Bazhanov) and construction of the world-sheet scattering matrix for string bound states.
- *Lisa Freyhult*: Scaling functions for AdS/CFT at strong and weak coupling and in the large spin expansion – subleading correction from the integral equation, agreement with perturbative computations is found. Spiky strings and the Bethe ansatz.
- *Nick Dorey*: "Giant Holes" in the large spin spectrum.

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 $\beta = 0$  and  $c \leq 26$
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**Amplitudes**

Lev  
Lipatov

(Integrability, multi-Regge)

Juan  
Maldacena

(Amplitudes, Wilson Loops)

Tristan  
McLoughlin

(Dual conformal symmetry)

Jan  
Plefka

(Yangian)

Nima  
Arkani-Hamed

(Weak-weak holography)

Gregory  
Korchemsky

(Hidden symmetries)

Beautiful Models  
and  
Fundamentals  
of Integrability

- *Samson Shatashvili*: Mysteriously, vacua of supersymmetric gauge theories (topological theories) are classified by solutions of the Bethe Ansatz!
- *Hubert Saleur*: CFTs on supertargets and lattice models (exactly solvable but not integrable).
- *Davide Gaiotto*: Wall-crossing in  $\mathcal{N} = 2$  gauge theories and integrability. Applications to Wilson loops and minimal surface problem
- *Jos Vermaseren*: Euler and Z-sums: how to organize?
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## Perfect organization

- 1 Niklas Beisert
- 2 Matthias Staudacher
- 3 Christine Gottschalkson

Christine, Matthias and Niklas invested a lot of energy, enthusiasm and creativity to carry out this wonderful conference with an outstanding and up-to-date scientific programme!

# Thank you!



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28 June - 2 July 2010

*Stockholm*

Organizers: Lisa Freyhult, Joe Minahan and Kostya Zarembo

NORDITA program  
"Integrability in String and Gauge Theories;  
AdS/CFT Duality and its Applications"  
(Stockholm, 31 May - 9 July)







