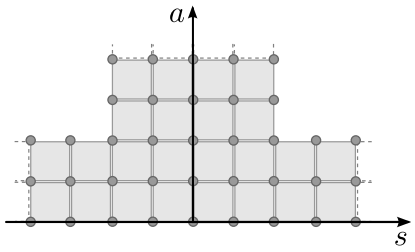
EXACT SPECTRUM OF 4D CONFORMAL GAUGE THEORIES FROM INTEGRABILITY

N. Gromov
King's College London

The spectrum of $\mathcal{N}=4$ super Yang-Mills theory can be studied using methods of integrability in the planar limit. We show that the exact spectrum is governed by a set of functional equations (Hirota equations) [1]

$$T_{a,s}(u+\tfrac{i}{2})T_{a,s}(u-\tfrac{i}{2}) = T_{a+1,s}(u)T_{a-1,s}(u) + T_{a,s+1}(u)T_{a,s-1}(u)\ . \qquad (1)$$

The set of functions $T_{a,s}$ of the spectral parameter u belongs to an infinite lattice of a very particular shape called T-hook



The Hirota equations by itself describe a classical integrable system. This allows further simplification of the solution. We describe how the infinite set of functional equations (1) can be recast into a finite set of nonlinear integral equations [2] (FiNLIE) which can be solved numerically or analyzed analytically in various limits. This new FiNLIE is in the perfect agreement with the previously obtained numerical results [2] based on the Thermodynamic Bethe Ansatz (TBA) approach.

The presented solution of the spectral problem passes various very nontrivial tests. It agrees with extremely involved perturbative calculations in the gauge theory (up to five loops) as well as with the predictions of the string theory for the strong coupling limit (up two two loops).

Keywords: Quantum Gauge Theories, Integrability

[1] N. Gromov, V. Kazakov and P. Vieira, "Exact Spectrum of Anomalous Dimensions of Planar N=4 Supersymmetric Yang-Mills Theory," Phys. Rev. Lett. **103** (2009) 131601

[2] N. Gromov, V. Kazakov and P. Vieira, "Exact Spectrum of Planar $\mathcal{N}=4$ Supersymmetric Yang-Mills Theory: Konishi Dimension at Any Coupling," Phys. Rev. Lett. **104** (2010) 211601

[3] N. Gromov, V. Kazakov, S. Leurent and D. Volin, "Solving the AdS/CFT Y-system," arXiv:1110.0562 [hep-th].