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During 2016, the research of the group focused on several themes related to the gauge/gravity and the AGT correspondences, covering hot problems in integrability, conformal filed theory and supersymmetric filed theories. The group also started a new research line focused on the statistical mechanics properties of epidemic models exploiting methods from the quantum field theory of critical phenomena.

Here we present a brief summary of the published works.

1. Conformal anomaly c-coefficients of superconformal 6d theories [1]

We propose general relations between the conformal anomaly and the chiral (R-symmetry and gravitational) anomaly coefficients in 6d (1,0) superconformal theories. The suggested expressions for the three type B conformal anomaly c-coefficients complement the expression for the type A anomaly a-coefficient. In particular, we prove that (2,0) 6d conformal supergravity coupled to 26 tensor multiplets is free of all chiral and conformal anomalies. We discuss some interacting (1,0) superconformal theories, predicting the c-coefficients for the "E-string" theory on multiple M5-branes at E_8 9-brane and for the theory describing M5-branes at an orbifold singularity. Finally, we elaborate on holographic computation of subleading corrections to conformal anomaly coefficients coming from $R^2 + R^3$ terms in 7d effective action.

2. Virasoro vacuum block at next-to-leading order in the heavy-light limit [2]

In this work we consider the semiclassical limit of the vacuum Virasoro block describing the diagonal 4-point correlation functions on the sphere. The semiclassical block may be expanded in powers of the light ratio h_L/c and the leading nontrivial (linear) order is known. Here, we compute for the first time the next-to-leading quadratic correction $O((h_L/c)^2)$, for generic heavy operator ratio h_H/c. The result is a highly non-trivial extension of the leading order and may be relevant for further refined AdS_3/CFT_2 tests.

3. Iterating free-field AdS/CFT: higher spin partition function relations [3]

We find a simple relation between a free higher spin field partition function on thermal quotient of AdS_{d+1} and the partition function of the associated $d-$dimensional conformal higher spin field on thermal quotient of AdS_d. Starting with a conformal higher spin field defined on AdS_d one may also associate to it another conformal field in $d-1$ dimensions, thus "iterating" AdS/CFT. We observe that in the case of $d = 4$ this iteration leads to a "trivial" $3d$ higher spin conformal theory with parity-even non-local action: it describes zero total number of dynamical degrees of freedom and the corresponding partition function on thermal AdS_3 is equal to 1.

4. The ground state of long-range Schrodinger equations and static $q\bar{q}$ potential [4]

We reconsider the problem of computing the asymptotic weak-coupling expansion of the ground state energy of a certain class of 1d Schrödinger operators $-\frac{d^2}{dx^2} + \lambda V(x)$ with long-range even potential obeying $\int_{\mathbb{R}} dx\, V(x) < 0$ and large x asymptotics $V \sim -a/x^2 - b/x^3 + \cdots$. The operator is known to admit a bound state for $\lambda \to 0^+$, but the binding energy is rigorously non-analytic at $\lambda = 0$. Its asymptotic expansion starts at order $\mathcal{O}(\lambda)$, but contains higher corrections $\lambda^n \log^m \lambda$ with all $0 \le m \le n-1$. We discuss various analytical tools to tame this problem and provide the general expansion of the binding energy at $\mathcal{O}(\lambda^3)$ in terms of quadratures.

5. On the cusp anomalous dimension in the ladder limit of $\mathcal{N} = 4$ SYM [5]

We analyze the cusp anomalous dimension in the (leading) ladder limit of $\mathcal{N} = 4$ SYM and present new results for its higher-order pertur-

bative expansion. We study two different limits with respect to the cusp angle ϕ. The first is the light-like regime where $x = e^{i\,\phi} \to 0$, while the second limit is the regime of small cusp angle. Our results provide several non-trivial tests, useful to check the application of Quantum Spectral Curve methods to the ladder approximation at non zero ϕ, in the two limits we studied.

6. On triviality of S-matrix in conformal higher spin theory [6]

We consider the conformal higher spin (CHS) theory in $d = 4$ that contains the $s = 1$ Maxwell vector, $s = 2$ Weyl graviton and their higher spin $s = 3, 4, \ldots$ counterparts with higher-derivative kinetic terms. The interacting action for such theory can be found as the coefficient of the logarithmically divergent part in the induced action for sources coupled to higher spin currents in a free complex scalar field model. We explicitly determine some cubic and quartic interaction vertices in the CHS action from scalar loop integrals. We then compute the simplest tree-level 4-particle scattering amplitudes $11 \to 11$, $22 \to 22$ and $11 \to 22$ and find that after summing up all the intermediate CHS exchanges they vanish.

7. On the large Ω-deformations in the Nekrasov-Shatashvili limit of $\mathcal{N} = 2^*$ SYM [7]

8. Exact partition functions for the Ω-deformed $\mathcal{N} = 2^*$ $SU(2)$ gauge theory [8]

9. Exact partition functions for deformed $\mathcal{N} = 2$ theories with $N_f = 4$ flavours [9]

In this series of paper we consider Ω-deformed $\mathcal{N} = 2$ $SU(2)$ gauge theories in four dimensions and their low energy effective actions. We explore several cases where the theories are characterized by special relations among the parameters such that the instanton partition function and the full prepotential, including the perturbative part, may be obtained in closed form. The resulting partition functions are related by AGT correspondence to conformal blocks of the Virasoro algebra, providing several new exact results in CFT.

10. Critical behavior in a stochastic model of vector mediated epidemics [10]

11. Fisica ed epidemiologia: nuovi metodi per nuove emergenze [11]

The extreme vulnerability of humans to new and old pathogens is constantly highlighted by unbound outbreaks of epidemics. This vulnerability is both direct, producing illness in humans (dengue, malaria), and also indirect, affecting its supplies (bird and swine flu, Pierce disease, and olive quick decline syndrome). In most cases, the pathogens responsible for an illness spread through vectors. In general, disease evolution may be an uncontrollable propagation or a transient outbreak with limited diffusion. This depends on the physiological parameters of hosts and vectors (susceptibility to the illness, virulence, chronicity of the disease, lifetime of the vectors, etc.). In this perspective and with these motivations, we analyzed a stochastic lattice model able to capture the critical behavior of such epidemics over a limited time horizon and with a finite amount of resources. The model exhibits a critical line of transition that separates spreading and non-spreading phases. The critical line is studied with new analytical methods and direct simulations. Critical exponents are found to be the same as those of dynamical percolation.

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