CONICET

The cusp anomalous dimension of ABJM from a TBA approach

D. H. Correa [1] V. I. Giraldo-Rivera [1] M. Lagares [1]

[1]Instituto de Física La Plata (Argentina)

Based on arXix:2304.01924

DAAD

Motivation

TBA equations for Γ_{cusp} — **We focused on this step**

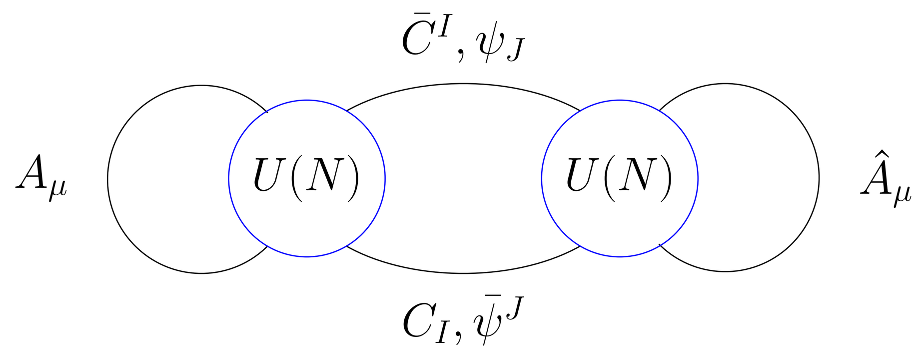
↓ Exact solution for small angles

TBA computation of Bremmstrahlung function

↓ Comparison with localization result

Derivation of interpolating function $h(\lambda)$

ABJM theory



One can construct 1/2 BPS Wilson loops as

$$W := \frac{1}{2N}\text{Tr}\left[\mathcal{P}\exp\left(i\int_{\substack{\text{straight}\\\text{line}}} \mathcal{L}(\tau)\,d\tau\right)\right],$$

where $\mathcal{L}$ is a superconnection covariant under $SU(1,1|3)$.

Wilson loop's integrable open spin chain

Anomalous dimensions of insertions in 1/2 BPS Wilson loop ⟷ Energies of integrable open spin chain

Vacuum state: insertion of

$$\mathcal{V}_\ell = \begin{pmatrix} 0 & (C_1\bar{C}^2)^\ell C_1 \\ 0 & 0 \end{pmatrix}.$$

$\implies$ $SU(2|1)$ symmetry (consistent with string theory expectations).

Impurities: replacing C_1 or $\bar{C}^2$ by

type A magnons: $(C_3, C_4|\bar{\psi}^2_+, \bar{\psi}^2_-)$,

type B magnons: $(\bar{C}^3, \bar{C}^4|\psi^+_1, \psi^-_1)$.

Scattering matrix: same $SU(2|2)$ invariant matrix as for single-trace operators.

Reflection matrix:

$$\mathbf{R} = \begin{pmatrix} R^0_A\,\hat{R} & 0 \\ 0 & R^0_B\,\hat{R} \end{pmatrix},$$

with

$$\hat{R} = \text{diag}(1, 1, e^{-ip/2}, -e^{ip/2}),$$

and where R^0_A and R^0_B are dressing phases (not fixed by symmetry).

The above matrix is compatible with the $SU(2|1)$ symmetry, the boundary Yang-Baxter equations and weak-coupling expansions.

Dressing phases

Crossing equation:

$$R^0_A(p)R^0_B(\bar{p}) = -\frac{\frac{1}{x^+}+x^+}{\frac{1}{x^-}+x^-}\frac{1}{\sigma(p,-\bar{p})}.$$

where σ is the BES phase.

All loop solutions:

$$R^0_A(p) = -\frac{1}{R_0(p)}\left(\frac{\frac{1}{x^+}+x^+}{\frac{1}{x^-}+x^-}\right)\left(\frac{x^-}{x^+}\right),$$

$$R^0_B(p) = \frac{1}{R_0(p)}\left(\frac{x^-}{x^+}\right),$$

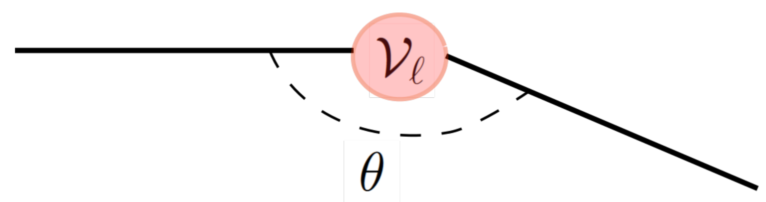
where R_0 is the square root of the dressing phase proposed in [1] for the $\mathcal{N}=4$ sYM case.

Consistent with **weak** and **strong coupling** expectations.

Perturbative **boundary bound states** only for **type A** particles.

Γ_{cusp} from a TBA approach

The anomalous dimension of



can be computed with a TBA formula for small ℓ. The limit with no insertions ($\ell=-1/2$) gives Γ_{cusp}.

$$E_0(\ell) = -\frac{1}{4\pi}\sum_{a=1}^{\infty}\int_0^\infty dq\,\log[1+Y^I_{a,0}(q)] - \frac{1}{4\pi}\sum_{a=1}^{\infty}\int_0^\infty dq\,\log[1+Y^{II}_{a,0}(q)].$$

We propose the **same Y system** as for the **periodic spin chain**.

Asymptotic solution to the Y-system

$$Y^I_{a,0} = Y^{II}_{a,0} \sim \left(\frac{z^{[-a]}}{z^{[+a]}}\right)^{2L}\frac{\varphi\left(u-\frac{ia}{2}\right)}{\varphi\left(u+\frac{ia}{2}\right)}T_{a,1}.$$

T functions are constrained by **symmetry**:
$$T^{SU(1|2)}_{a,1} \equiv T^{SU(2|1)}_{1,a}.$$

φ is obtained from the **leading Lüscher correction**.

With this we recover

$$\Gamma_{\text{cusp}} = -2\lambda\sin^2\frac{\theta}{2}\sum_{k=0}^{\infty}P^{(0,1)}_k(-\cos\theta) + \mathcal{O}(\lambda^2) =$$

$$= -\lambda\left(\frac{1}{\cos\frac{\theta}{2}} - 1\right) + \mathcal{O}(\lambda^2).$$

as computed in [2] with an expansion in Feynman diagrams.

References

[1] D. Correa, J. Maldacena and A. Sever, JHEP **08** (2012), 134.

[2] L. Griguolo, D. Marmiroli, G. Martelloni and D. Seminara, JHEP **05** (2013), 113.