Title: Three point functions in N=4 SYM from integrability

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Abstract: <p>The talk will review the computation of the three point function of gauge-invariant operators in the planar N=4 SYM theory using integrability-based methods. The structure constant can be decomposed, as proposed by Basso, Komatsu and Vieira, in terms of two form-factor-like objects (hexagons). The multiple sums and integrals implied by the hexagon decomposition can be performed in the large-charge limit, and be compared to the results obtained by semiclassics. I will discuss a method to perform these sums and the contributions currently accessible by this approach.</p>

Three point functions in $\mathcal{N}=4$ SYM from integrability

w/ Y. Jiang, S. Komatsu, I. Kostov 2016

w/ I. Kostov (in progress)

Basso, Gonçalves, Komatsu 2017

Three point functions in $\mathcal{N}=4$ SYM f

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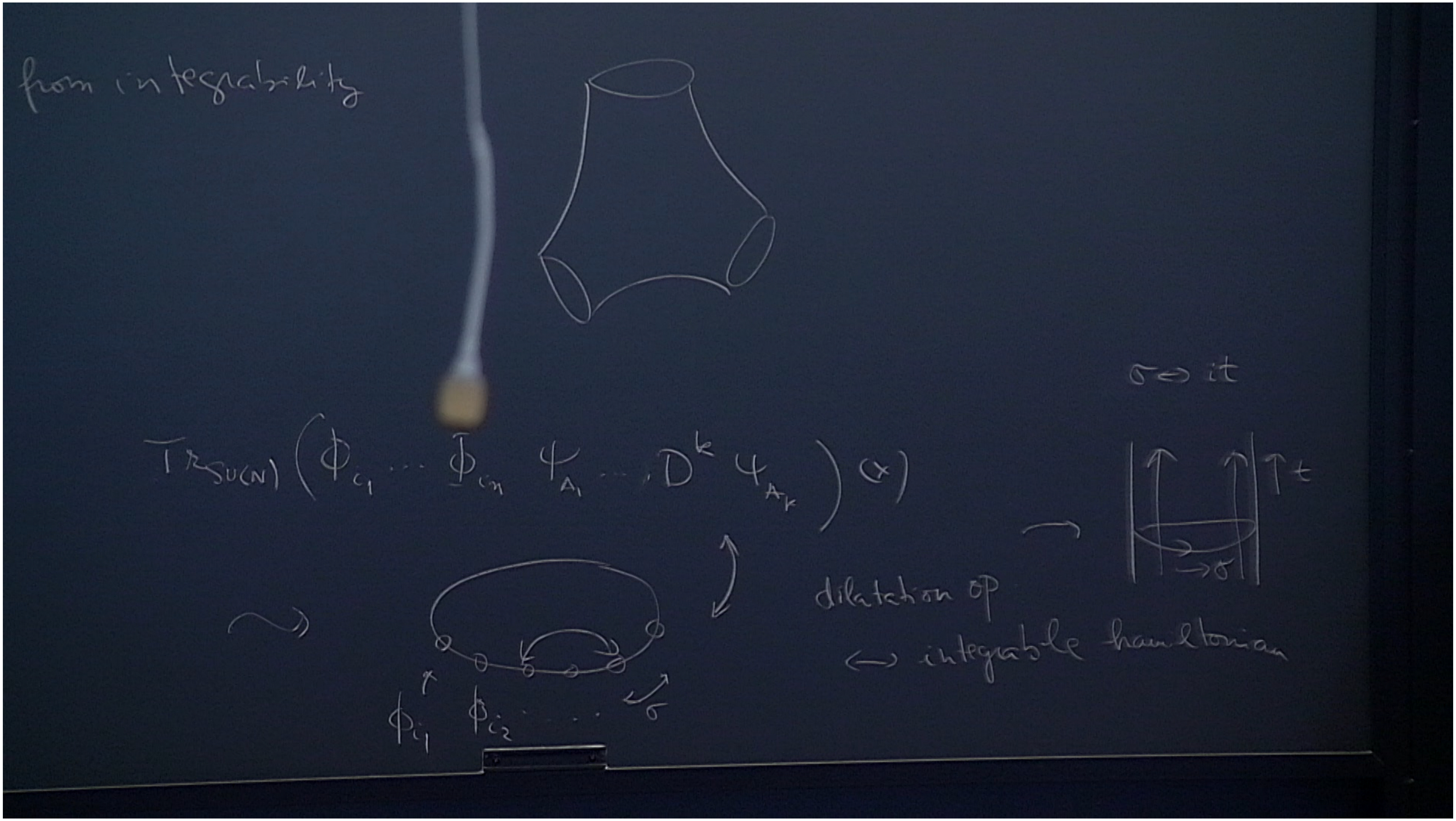
planar $\mathcal{N}=4$ SYM w/ gauge group $SU(N)$

$$g^2 = \frac{\lambda}{16\pi^2} = g_{YM}^2 N \rightsquigarrow \text{finite}$$

$$PSU(2,2|4) \supset SO(4,2), \quad SO(6) \text{ R-symmetry}$$

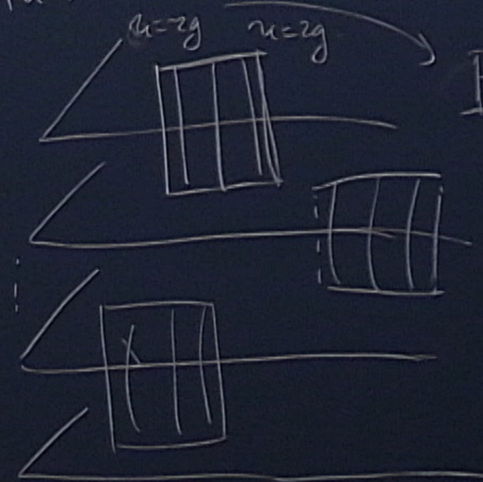

from integrability
$\mathrm{Tr}_{SU(N)}\left(\Phi_{i_1}\cdots\Phi_{i_n}\,\psi_{A_1}\cdots D^k\psi_{A_k}\right)(x)$
dilatation op
⟷ integrable hamiltonian
$\sigma \leftrightarrow it$
t
σ
$\phi_{i_1}\ \phi_{i_2}\ \cdots$
σ

$$E_n \longleftrightarrow \Delta_n(g) \longleftrightarrow \{u\} \equiv \{p\}$$

TBA $\rightsquigarrow$ quantum spectral curve

$Q_a(u)$ $\quad a = 1, \dots, 8$ $\quad$ Baxter functions

$L \to \infty$ $\rightsquigarrow$

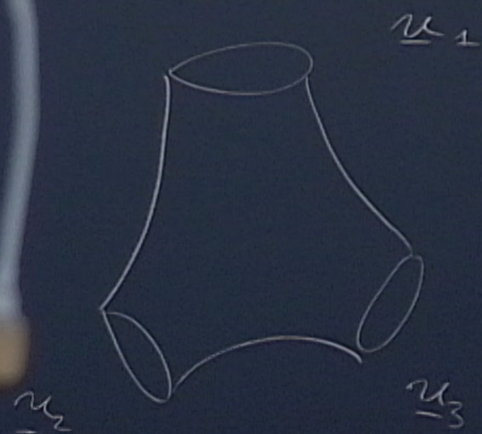


$\to P^a(u) \to$ quasimomentum

$$\frac{u}{g} = x + \frac{1}{x} \qquad \text{Zhukovsky}$$

1 from integrability

16



$$\langle O_1(x_1)\, O_2(x_2)\, O_3(x_3) \rangle \sim \frac{C_{123}(g^2)}{|x_{12}|^{\Delta_{12}}\, |x_{13}|^{\Delta_{13}}\, |x_{23}|^{\Delta_{23}}}$$

$\Delta_{ij} = \Delta_i + \Delta_j - \Delta_k$

$\{ijk\} = \{1,2,3\}$

$$\langle \bar{O}_1(x)\, O_1(0) \rangle = \frac{1}{|x|^{2\Delta_1}}$$

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w/ I. Kostov (in progress)

Basso, Gonçalves, Komatsu 2017

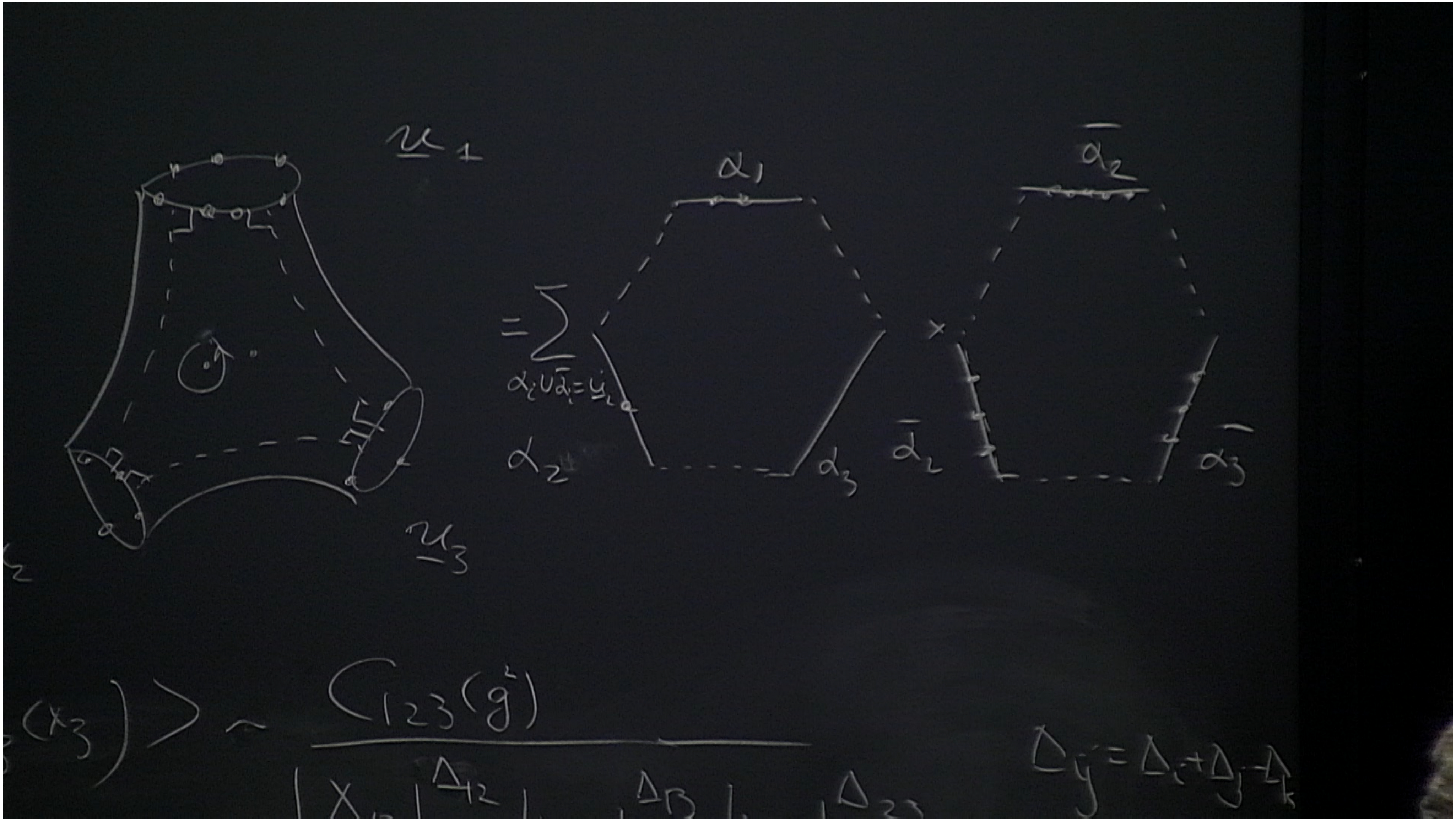
$\langle \mathcal{O}_1(x_1)\, \mathcal{O}_2(x_2)\, \mathcal{O}_3$

$g \to 0 \quad \rightsquigarrow \quad$ EGSV 2010

$\langle \bar{\mathcal{O}}_1(x)\, \mathcal{O}_1(0) \rangle$

$g \to \infty \quad \rightsquigarrow \quad$ Janik et al 2010 - 2011

KK(N) $\quad$ 2011 → 2016


u1
u3
α1
ᾱ2
α2
α3
ᾱ2
ᾱ3
C123(g²)
Δij=Δi+Δj−Δk

g finite

Basso, Komatsu, Vieira 2015

$$C_{123}(g) \sim \sum_{\alpha_i \cup \bar{\alpha}_i = \bar{u}_i} \underbrace{H(\alpha_1|\alpha_2|\alpha_3) \times H(\bar{\alpha}_1|\bar{\alpha}_2|\bar{\alpha}_3)}\ \underbrace{w(\alpha_1,\bar{\alpha}_1)}\ w(\alpha_2,\bar{\alpha}_2)\ w($$

$$\ln C_{123}(g) = \sum_{*} (-1)^{|*|} \oint_{\Gamma_*} \mathrm{Li}_2\left(e^{i P_*(z)}\right)$$

$$P_*(z) : \begin{cases} P_{ij}(z) = (P_i + P_j + P_k)(z) & \{i,j,k\} = \{1,2,3\} \\ 2P_i(z) & i = 1,2,3 \\ (P_1 + P_2 + P_3)(z) & \end{cases}$$

2015

$$\underbrace{H(\alpha_1|\alpha_2|\alpha_3)}\times H(\bar{\alpha}_1|\bar{\alpha}_2|\bar{\alpha}_3)\ \underbrace{w(\alpha_1,\bar{\alpha}_1)}\ w(\alpha_2,\bar{\alpha}_2)\ w(\alpha_3,\bar{\alpha}_3)$$ $\times$ mirror particles

$$-1)^{|*|} \oint_{\Gamma_*} Li_2\left(e^{i P_*(z)}\right)$$

$$P_i + P_j + P_k)(z) \quad \{i,j,k\}=\{1,2,3\}$$

$$i=1,2,3$$

$$P_3)(z)$$

$$\frac{1}{n!}\int_{\Gamma_k} \frac{dz_1 \dots dz_n}{(2\pi)^n\,\varepsilon^n} \underbrace{\prod_{i=1}^{n} f_i(z_i)\, \frac{e^{-ip(z_i)\,l_{13}}}{h(z_i,u)}}_{\prod_i f(z_i)} \prod_{i<j} h(z_i,z_j)\,h(z_j,z_i)$$

$$z_i = z_j + i\varepsilon$$

$$f(z_i)\,f(z_i+i\varepsilon).$$

$$\underbrace{\prod_{i<j} \Delta^2(z_i,z_j)}_{\approx 1} \quad \frac{(z_i-z_j)^2}{(z_i-z_j)^2+\varepsilon^2}$$

$$1-\varepsilon\,\delta(z_i-z_j)$$

$$\mathrm{Det}_{(ij)}\,\frac{1}{z_i-z_j+i\varepsilon}$$

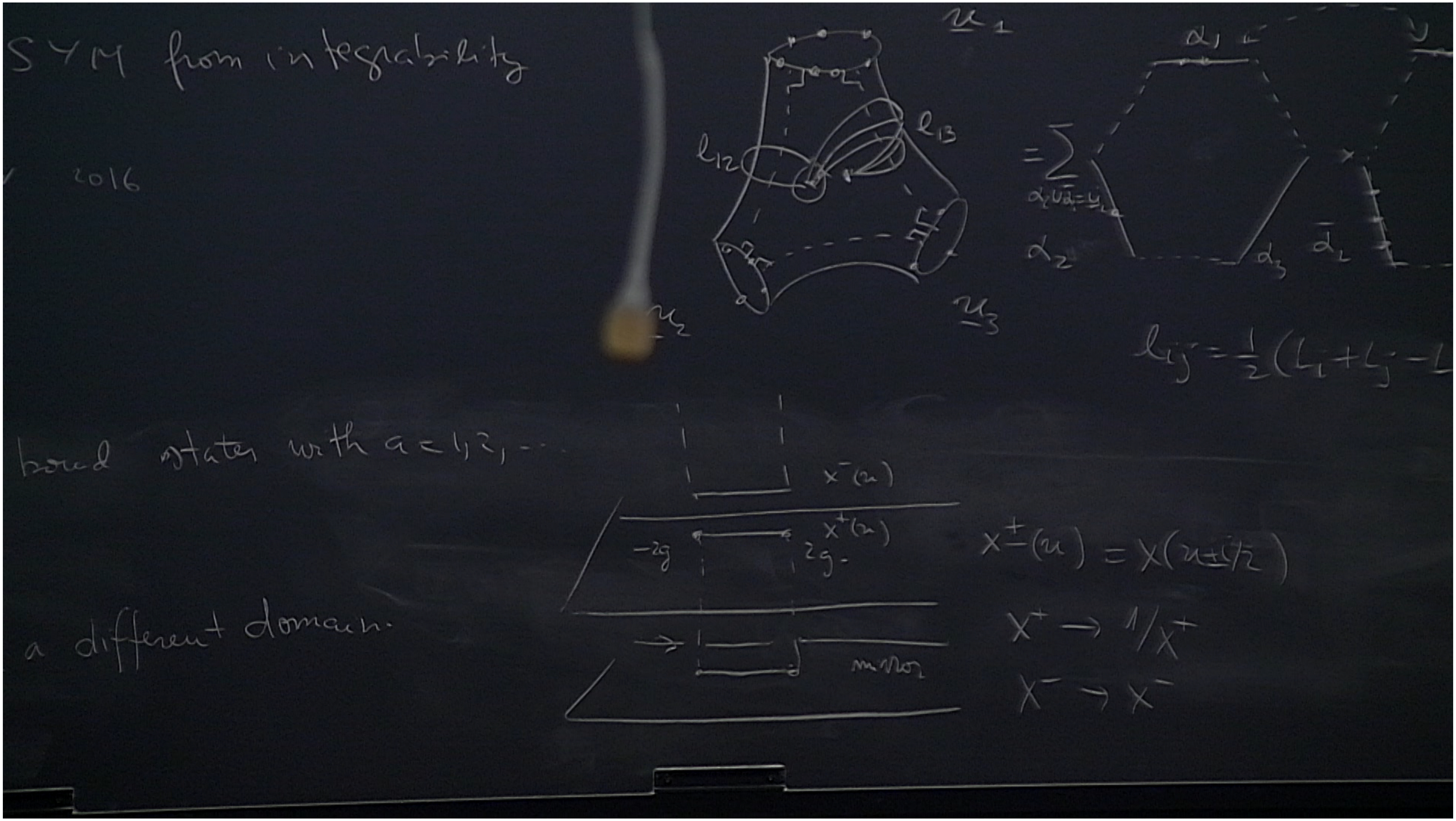
Bettelheim, Kostov 2014

$$\ldots|\alpha_3) \times H(\bar\alpha_1|\bar\alpha_2|\bar\alpha_3)\ \underbrace{w(\alpha_1,\bar\alpha_1)}\ w(\alpha_2,\bar\alpha_2)\ w(\alpha_3,\bar\alpha_3)$$

* mirror particles

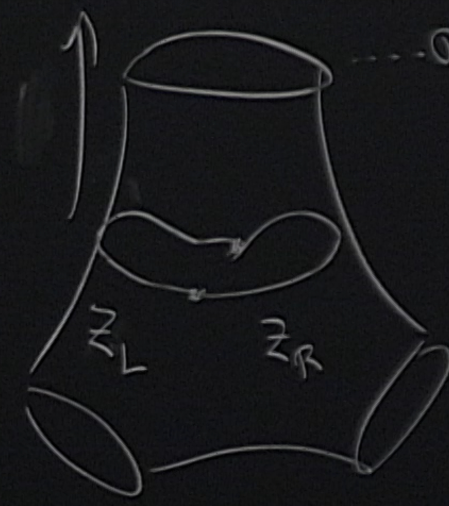
$$\ldots \mathrm{Li}_2\left(e^{iP_*(z)}\right)$$

$$\ldots z) \quad \{i,j,k\}=\{1,2,3\} \quad \checkmark$$


SYM from integrability
2016
ℓ_{12}
ℓ_{13}
u_1
u_2
u_3
α_1
α_2
α_3
$\bar{\alpha}_2$
bound states with a = 1, 2, ...
$x^-(u)$
$x^+(u)$
$-2g$
$2g$
$x^{\pm}(u) = x(u \pm i/2)$
a different domain.
$x^+ \to 1/x^+$
mirror
$x^- \to x^-$

$$\underbrace{w(\alpha_1, \bar{\alpha}_1)}\; w(\alpha_2, \bar{\alpha}_2)\; w(\alpha_3, \bar{\alpha}_3) \quad \times \text{ mirror particles}$$

$\checkmark \quad \Gamma_{\underline{u}} \qquad \Gamma_{[-2g,2g]}$



$\sigma = R$

$$1 \over h(z_L, z_R)\, h(z_R, z_L)$$

$$\sim \frac{1}{(z_L - z_R)^2}$$