Who is "c" Scaling weight

$$\Delta = \frac{d}{2} + c$$

$$c = \sqrt{\frac{d^2}{4} - \frac{m^2}{H^2}} \quad \begin{cases} c = i\rho \\ c \in \mathbb{R} \end{cases}$$

Inter-twining operators

invertible, normalizable maps

$$\chi = (\ell, c) \longrightarrow \tilde{\chi} = (\ell, -c)$$

$$\Delta + \tilde{\Delta} = d$$

$G =$ (normalization) ([illegible])

The late-time boundary of de Sitter

- with C. Skordis

ISO(d,1)

isometry of Mink

SO(d+1,1)

Goal: UNITARITY & the

3 ways to build reps

1) from generators I_g^χ structure preserving maps

Sun

2) for $g\in G$

Sun, $\boxed{\text{Dobrev et al}}$

working with function spaces act on C_χ

3) analytic cont. from the plus

Higuchi, Letsios

$C_\chi = \{f : \text{Domain} \to V_\rho\}$, properties related to how they transform under stability subgroup

$f(g) \longleftrightarrow f(\vec{x})$ $\quad \vec{x}\in\mathbb{R}^d$

(f_1, f_2)

Unitary rep: $(I_g^\chi f_1, I_g^\chi f_2) \overset{!}{=} (f_1, f_2)$

momenta

$\int |a|^{-(k+c)''}$

In momentum space

$$\mathcal{O}(\vec{x}) = \int \frac{d^dk}{(2\pi)^d}\, e^{i\vec{k}\cdot\vec{x}}\, \mathcal{O}(\vec{k}) \qquad \mathcal{O}(\vec{k}) \sim k^c$$

$$\phi(\vec{x},\eta) = \int \frac{d^dk}{(2\pi)^d}\, e^{i\vec{k}\cdot\vec{x}} \left[\phi_k(\eta)\, a_{\vec{k}} + \phi_k^*(\eta)\, a^\dagger_{-\vec{k}}\right]$$

$\langle \vec{k}|\vec{k}'\rangle = (2\pi)^d \delta^{(d)}(\vec{k}-\vec{k}')$

$e^{i\vec{k}\cdot\vec{x}}\phi_k \leftarrow$ VKG

$$\lim_{\eta\to 0}\phi(\vec{x},\eta) = \int \frac{d^dk}{(2\pi)^d}\, e^{i\vec{k}\cdot\vec{x}} \left[|\eta|^{\frac{d}{2}+\{-i\rho,\,-\nu\}}\alpha(\vec{k}) + |\eta|^{\frac{d}{2}+\{i\rho,\,\nu\}}\beta(\vec{k})\right]$$

states: $|\mathcal{O}(\vec{k})\rangle \equiv \mathcal{O}(\vec{k})|0\rangle = k^c|-\vec{k}\rangle$

¿ Normalization ?

$(\mathcal{O},\mathcal{O}) = \int \frac{d^dk}{(2\pi)^d} \langle \mathcal{O}(\vec{k})|\mathcal{O}(\vec{k})\rangle$ $\quad \sqrt{}\ c = i\rho$

$c=0$, $d+1=4$

$c = i\rho$ $\quad (\mathcal{O},\mathcal{O})$ $\quad \rho\in\mathbb{R}$ $\quad$ Principal Series

$\left(\frac{k}{2}\right)^c$

$-\frac{3}{2} < c < \frac{3}{2}$ $\quad$ Compl. $\quad$ for $c>0$ applies for β^L $\quad \tilde{\mathcal{O}} = G_\chi^\dagger\, \mathcal{O}$

for $c<0$ app α^L $\quad \mathcal{O} = G_\chi^\dagger\, \tilde{\mathcal{O}}$

$c\in\mathbb{R}$ $\quad (\mathcal{O},\tilde{\mathcal{O}})$

$\Delta\in\mathbb{Z}\cup\{0\}$ $\quad$ Discrete $\quad c = -\frac{3}{2}$ $\quad \tilde{\mathcal{O}} = G^\dagger_{\chi_{01}}\, \mathcal{O}$ $\quad \left(\frac{k^2}{2}\right)^{3/2}$ $\quad \alpha^M$

Symmetric traceless tensor (type-I) SO(2,1), SO(4,1)

who is

$\Delta =$

$C =$

$\alpha_N^H(\vec{k}) =$

$\beta_N^H(\vec{k}) =$

$\beta_N^L(\vec{k}) =$

$\alpha_N^L(\vec{k}) =$

$\alpha_N^M(\vec{k})$

$\checkmark\ c = i\rho$

do sth

$$\sqrt{\frac{\ }{4} - \frac{m}{H^2}} \Big\} \quad c \in \mathbb{R}$$

normalizable maps

$$\chi = (\rho, c) \longrightarrow \tilde{\chi} = (\rho, -c)$$

$$\Delta + \tilde{\Delta} = d$$

G = (normalisation) (projection)

$$\alpha_N^H(\vec{k}) = \sqrt{\rho\pi \sinh(\rho\pi)} \left[-\frac{i}{\pi}\Gamma(i\rho)\, e^{-\rho\pi} a_{\vec{k}} + \frac{1}{\sinh(\rho\pi)\,\Gamma(1-i\rho)} a^{+}_{-\vec{k}} \right] \left(\frac{k}{2}\right)^{-i\rho}$$

$$\beta_N^M(\vec{k}) =$$

$$\beta_N^L(\vec{k}) = 2^{-\nu/2} \left[\frac{1+i\cot(\pi\nu)}{1-i\cot(\pi\nu)} a_{\vec{k}} + a^{+}_{-\vec{k}} \right] k^{\nu}$$

$$\alpha_N^L(\vec{k}) = -i\, 2^{\nu/2} \left[a_{\vec{k}} - a^{+}_{-\vec{k}} \right] k^{-\nu}$$

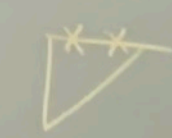
$$\tilde{\alpha}_N^L(\vec{k}) = -i\, 2^{-\nu/2} \left[a_{\vec{k}} - a^{+}_{-\vec{k}} \right] k^{\nu}$$

$$[\alpha_N, \beta_N] \neq 0$$

$$\alpha_N^M(\vec{k}) = -i\, 2^{3/4} \left[a_{\vec{k}} - a^{+}_{-\vec{k}} \right] k^{-3/2}$$

Scalar Particles at the late-time boundary of de Sitter

– with C. Skordis

Set up: free $ds^2 = \frac{-d\eta^2 + d\vec{x}^2}{H^2|\eta|^2}$ 

Wigner Particles $\longrightarrow$ UIR ISO(d,1)

isometry of Mink

spatial boundary

(dS_{d+1} $\Lambda > 0$ No global ∂_t SO(d+1,1)

Mink $\Lambda = 0$

AdS $\Lambda < 0$

↳ a timelike boundary

Goal: UNITARITY & the inner product

SO(d+1,1) ISO(d,1)

dS_{d+1} $Mink_{d+1}$

t – transl

$\vec{x}$–transl $\tilde{N}$ $\vec{x}$–transl

dilatations $A = SO(1,1)$ boosts

SCT N

rotations $M = SO(d)$ rotations

maximally compact $K = SO(d+1)$

Casimir $\chi = \{\ell, c\}$

Invariant / stability subgroup NAM, K

Translations

categorization → ref momenta

3 ways to build reps

1) from generators

Sun

2) for $g \in G$ working with function spaces

Sun, $\boxed{\text{Dobrev et al}}$

3) analytic cont. from the plane

Higuchi, Letsios

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$SO(d+1,1)$		$ISO(d,1)$
dS_{d+1}		$Mink_{d+1}$
		t-transl
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Principal & Comp

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$\int |a|^{-\ell + c\,\ell'}$

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