On HS symmetries, cubic interactions, AdS & CFT

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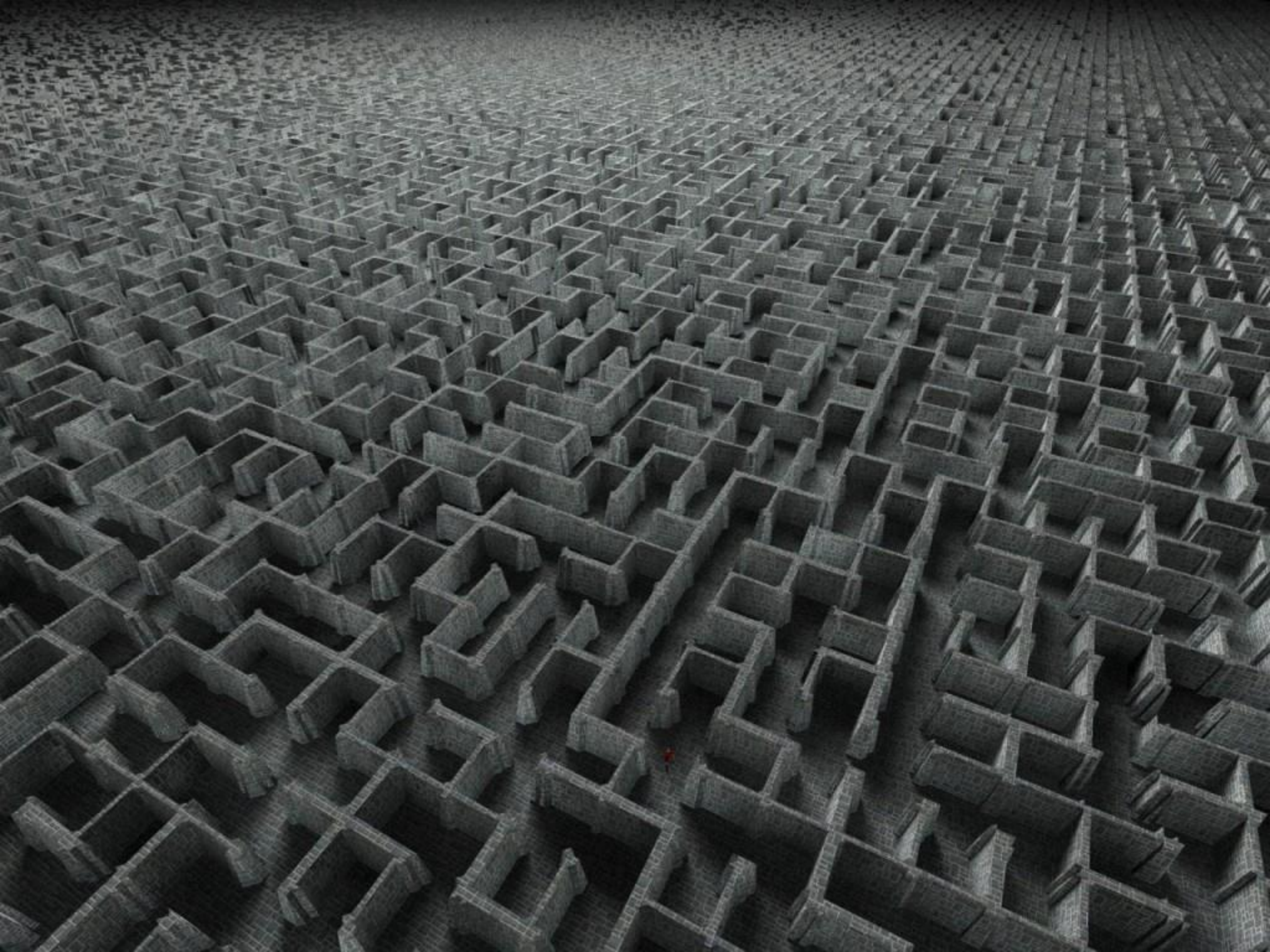
MAX-PLANCK-GESELLSCHAFT

based on arXiv:1311.0242 w. E.Joung and arXiv:1305.5180 w. N.Boulanger, D.Ponomarev, E.Skvortsov

Desired Goals!

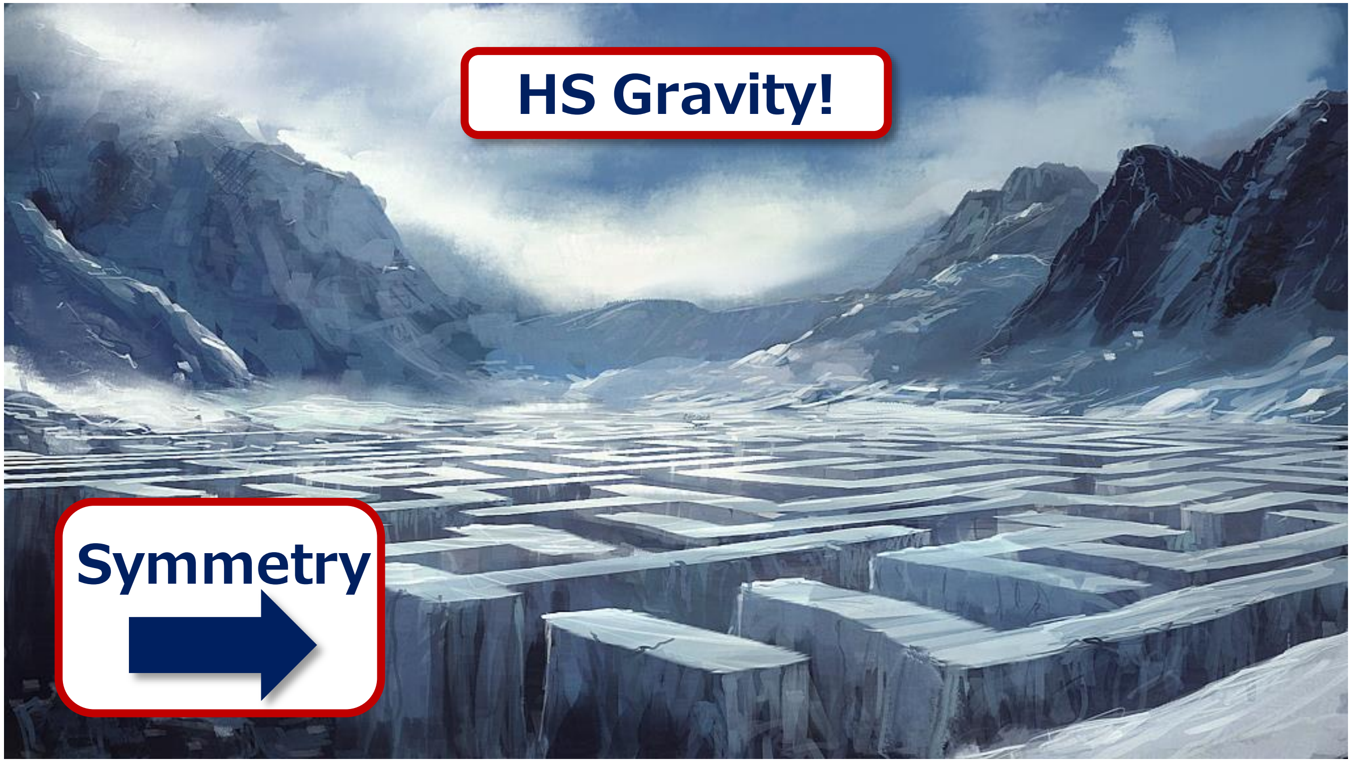
- **Uncover the symmetries behind String Theory**
- **Shed light on holography and Quantum Gravity**



...topology matters!!

History teaches us:

Symmetry has always paid off!



What is the "maximal" symmetry of Quantum Gravity?

Fradkin & Vasiliev ('80s): Higher-Spin Symmetry!

Cons:

too big symmetry => too simple theory...

Pros:

- Deformation (gauging) of symmetries (Algebroid, field dependent structure constants)
- Almost all checks of AdS/CFT driven by symmetry (maximal symmetry => proof of Holography?)

To do List

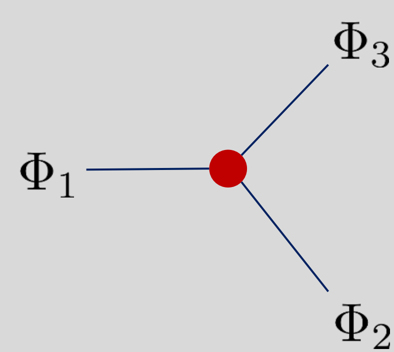
- HS systematics
- HS holography

Some of this today

- HS on non-trivial backgrounds (black-holes!)
- …

Cubic Couplings Classification

$$s_1 \geq s_2 \geq s_3$$

	n	$\#_\partial$	$\delta^{(1)}_{E_1}$	$\delta^{(1)}_{E_2}$	$\delta^{(1)}_{E_3}$	$C^{(3)}$
Class I	0 $\vdots$ $\frac{s_2+s_3-s_1}{2}$	$s_1+s_2+s_3$ $\vdots$ $2\,s_1$	$=0$ $\vdots$ $=0$	$=0$ $\vdots$ $\vdots$	$=0$ $\vdots$ $\vdots$	$\approx \tilde{K}(Y_\ell, H_{12}, H_{23}, H_{31})$ $\ell = 2$ or 3
Class II	$\vdots$ $\vdots$ $\frac{s_3+s_1-s_2}{2}$	$\vdots$ $\vdots$ $2\,s_2$	$\neq 0$ $\vdots$ $\vdots$	$\vdots$ $\vdots$ $=0$	$\vdots$ $\vdots$ $=0$	$\approx \tilde{K}(Y_1, H_{12}, H_{23}, H_{31})$
Class III	$\vdots$ $\vdots$ $\frac{s_1+s_2-s_3}{2}$	$\vdots$ $\vdots$ $2s_3$	$\vdots$ $\vdots$ $\vdots$	$\neq 0$ $\vdots$ $\vdots$	Λ $\vdots$ Λ	
Class IV	$\vdots$ $\vdots$ s_3	$\vdots$ $\vdots$ $s_1+s_2-s_3$	$\vdots$ $\vdots$ $\neq 0$	$\vdots$ $\vdots$ $\neq 0$	$\neq 0$ $\vdots$ $\neq 0$	

$$[\![E_1 \,,\, E_2]\!]^{(0)}_3 = 0 \quad \Longleftrightarrow \quad \delta^{(1)}_{E_1} = 0 \quad \text{or} \quad \delta^{(1)}_{E_2} = 0$$

E.Joung and M.T. '13

Coleman-Mandula in AdS/CFT!

Assumptions: symmetric tensors + one HS generator + no colour (+ Gravity)!

Boulanger, Ponomarev, Skvortsov, M.T. '13

	Algebra:	**UIR**
AdS_3/CFT_2 (Virasoro!!)	$\mathrm{hs}_3(\lambda) = \dfrac{U[sl(2)]}{C_2 - \lambda\,1}$	$(\Box - m_\lambda^2)\phi(x) = 0$
AdS_4/CFT_3	**Moyal (unique)**	**Scalar & Spinor Singletons** Fradkin, Vasiliev '86; Konstein, Vasiliev '90; Maldacena, Zhiboedov 2011
AdS_5/CFT_4	$\mathrm{hs}_5(\lambda) = \dfrac{U[su(2,2)]}{C_2 - \lambda\,1}$	**One parameter family (doubletons)** Gunaydin et all; Boulanger, Skvortsov; Manvelyan, Mkrtcyan, Mkrtcyan, Theisen
AdS_{6+n}/CFT_{5+n}	$\mathrm{hs}_d = \dfrac{U[so(d-1,2)]}{\square\square \oplus \begin{smallmatrix}\square\\\square\\\square\\\square\end{smallmatrix}}$	**Scalar singleton**

$$\langle J \cdots J \rangle = \mathrm{Tr}[\psi \star \cdots \star \psi]$$

Outlook

- Admissibility will put further constraints
- Deformation (Lie Algebroids!)
- More general backgrounds (Black-Holes!)