On the vacua of new SO(8) gauged supergravity

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in collaboration w/ A. Borghese, G. Dibitetto, D. Roest & O. Varela

Outlook

1) The old SO(8) gauged SUGRA

2) The embedding tensor & the new SO(8) gauged SUGRA

3) Invariant sectors of new SO(8) gauged SUGRA

    3.2) The SU(3) invariant sector

    3.3) The SO(4) invariant sector

4) Collecting results & final remarks

Outlook

1) The old SO(8) gauged SUGRA

Top-down approach

[Cremmer & Julia '79]
[de Wit & Nicolai '82, '87]
[Englert '82]

11d supergravity on the 7-sphere : SO(8) gauged SUGRA with N=8 SUSY

Always believed to be unique !!

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11d supergravity on the 7-sphere : SO(8) gauged SUGRA with N=8 SUSY

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The theory

- Field content : metric + 70 real scalars + 28 electric vectors + fermions
- Global E_7 symmetry & local SO(8) gauge symmetry
- R-symmetry group SU(8) rotating the **8** gravitini $\psi_{I=1,...,8}$
- The **70 = 35** (SD) + i **35** (ASD) scalars ϕ_{IJKL} serve as coordinates in $E_7/SU(8)$ coset space
- Unique non-trivial scalar potential

The goal : Find critical points of the scalar potential and investigate the Physics associated : vacuum energy , residual symmetry , mass spectra , preserved SUSY . . .

The problem : It depends on 70 scalar fields !!

The alternatives :

I) Numerical methods to explore certain energy ranges [Fischbacher, '11]

II) Look at simpler (smaller) & consistent subsets of fields [truncations]

[Warner, '83 '84]
[Bobev, Halmagyi, Pilch & Warner, '10]
[Fischbacher, Pilch & Warner, '10]

Smaller sectors

Truncation = Retain fields invariant under the action of a residual group

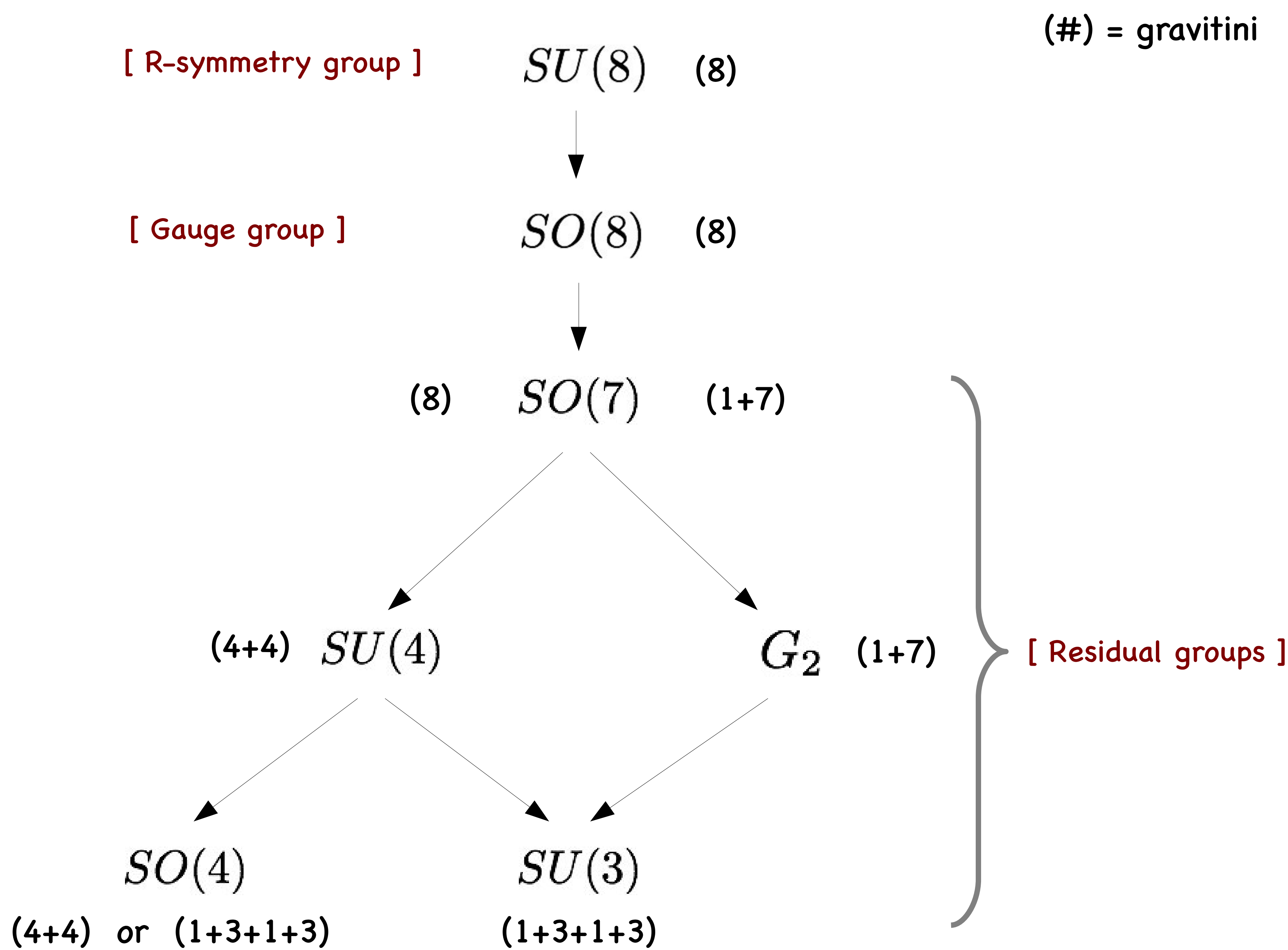
$$G_{res} \subset SU(8)$$

1) G_{res} = SU(3) : N=2 description (gravity + 1 vector + 1 hyper)

$$\mathcal{M}_{SK} = \frac{SL(2)}{SO(2)} \qquad \text{and} \qquad \mathcal{M}_{QK} = \frac{SU(2,1)}{SU(2) \times U(1)}$$

2) G_{res} = SO(4) : N=2 (gravity + 1 hyper) or N=0 descriptions

[different embeddings inside SU(8)]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(4+4) $SU(4)$
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(4+4) or (1+3+1+3)
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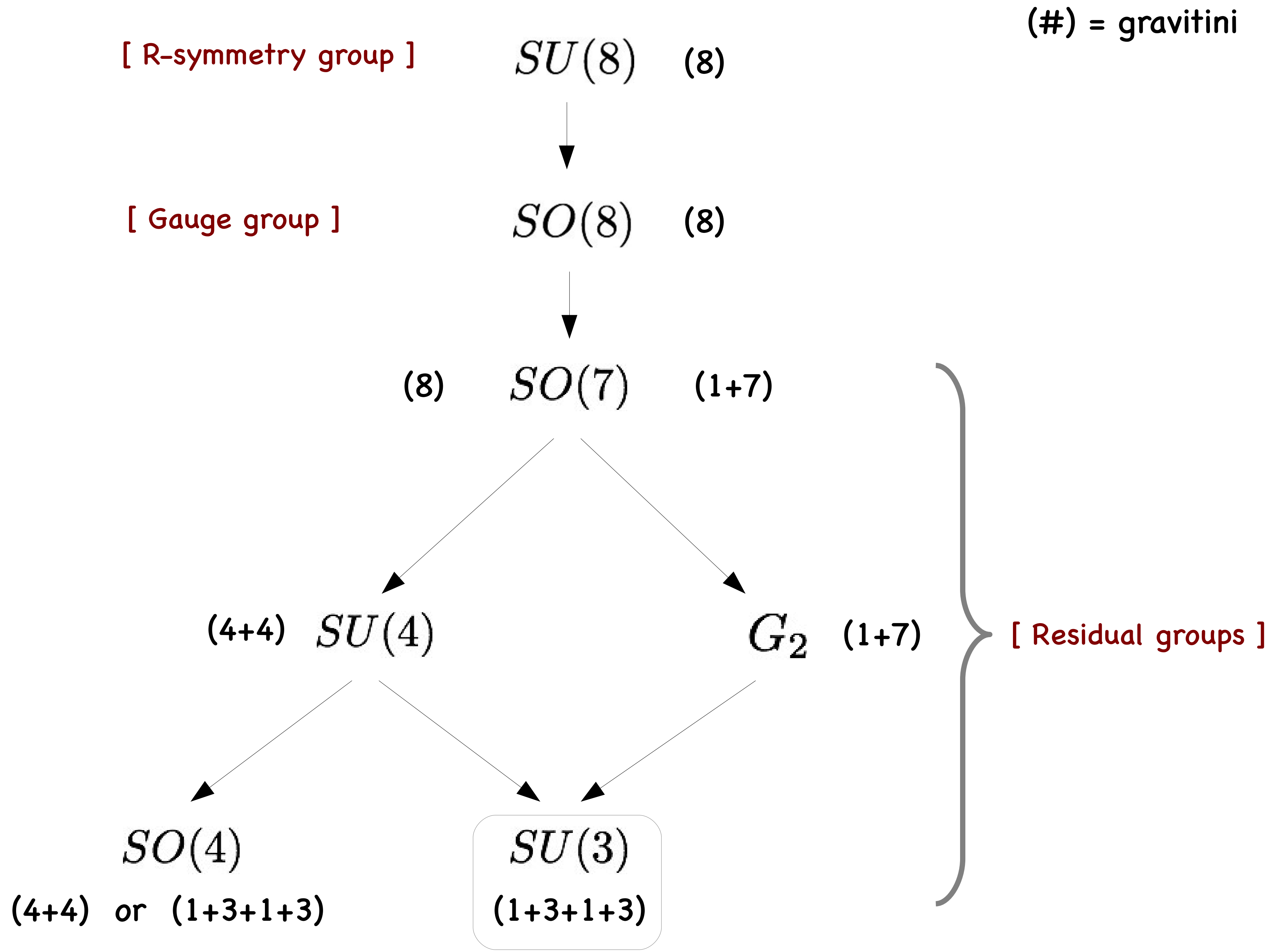
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SU(3) invariant critical points

[Warner '83, '84]
[Bobev, Halmagyi, Pilch & Warner '10]

SUSY	Symmetry	Cosm. constant	Stability
$\mathcal{N}=8$	SO(8)	$-6\ (\times 1)$	✓
$\mathcal{N}=2$	$\mathrm{SU}(3)\times\mathrm{U}(1)$	$-\frac{9}{2}\sqrt{3}\ (\times 1)$	✓
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They all are consistent truncations of 11d supergravity on $Ads_4 \times S^7$ with a round , squashed, stretched or warped 7-sphere (SE_7) and 4-form flux [Nicolai & Pilch '12]

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Domain walls
&
RG-flows

[Gauntlett, Sonner & Wiseman '09]

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AdS/CMT applications : Holographic superconductivity

[Gauntlett, Sonner & Wiseman '09, '09]
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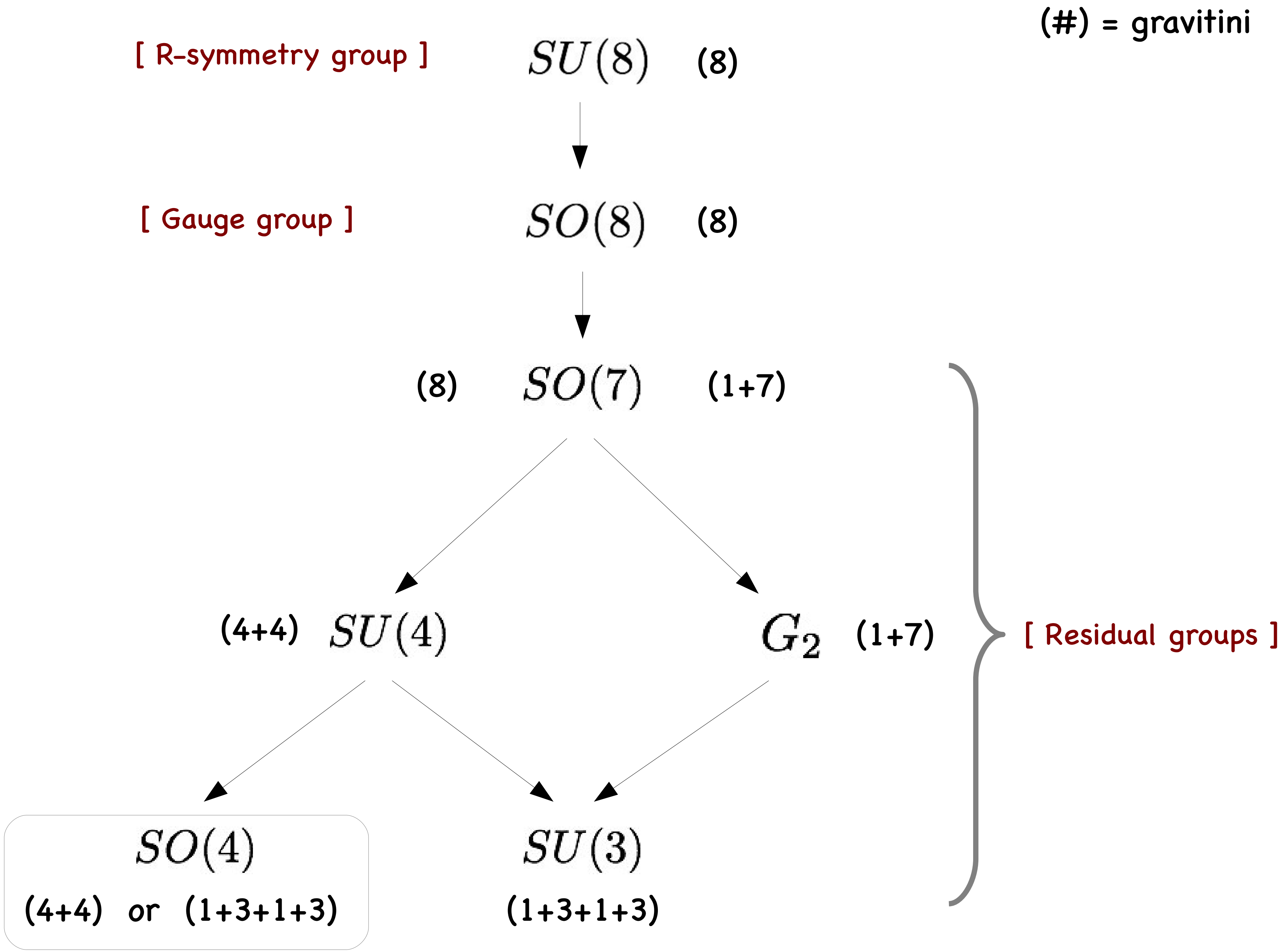
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AdS/CMT applications : Holographic superconductivity [Bobev, Kundu, Pilch & Warner '11]

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The embedding tensor

[de Wit, Samtleben & Trigiante '07]

Most general SUGRA with N=8 SUSY in 4D : Embedding Tensor (ET) Formalism

Gauging = Promote part of the E_7 global symmetry to a local gauge symmetry

$$A_M = \Theta_M{}^{\alpha} t_{\alpha}$$

- A_M → 4d elec&mag vectors (M=1,...56)
- $\Theta_M{}^{\alpha}$ → Emb. Tensor (selector)
- t_{α} → $E_{7(7)}$ generators (global symmetry)

Indices : M = 1,...,56 [fundamental index of E_7 with $\underbrace{56 = 28 + 28'}_{\text{elec\&mag}}$]

α = 1,...,133 [adjoint index of E_7]

elec&mag Sp(56)

Supersymmetry imposes linear constraints (LC) ==> ET lives in the **912** of E_7

Gauge algebra & scalar potential

Gauge algebra : Building the charges $X_{MN}{}^{P} = \Theta_{M}{}^{\alpha}\,[t_{\alpha}]_{N}{}^{P}$, the gauge algebra is given by

$$[A_M, A_N] = -X_{MN}{}^{P}\, A_P$$

Closure imposes quadratic constrains (QC) ==> Only 28 independent vectors

$$\Omega^{MN}\, \Theta_{M}{}^{\alpha}\, \Theta_{M}{}^{\beta} = 0$$

Scalar potential : The charges also induce a non-trivial scalar potential for the 70 scalars in the theory

$$V = \frac{g^2}{672} X_{MNP} X_{QRS} \left(M^{MQ} M^{NR} M^{PS} + 7\, M^{MQ} \Omega^{NR} \Omega^{PS} \right)$$

where $M = LL^t$ and $L = \exp[\,\vec{\phi}\;\vec{t}\,]$ is an $E_7/SU(8)$ element

The new SO(8) gauged SUGRA

[Dall'Agata, Inverso & Trigiante '12]

- Group theory

ET decomp : $\mathbf{912} = 2 \times (\mathbf{1} + \mathbf{35}_v + \mathbf{35}_s + \mathbf{35}_c + \mathbf{350})$ [under SO(8)]

ω-parameter family of new SO(8) gauged SUGRA's !!

The new SO(8) gauged SUGRA

[Dall'Agata, Inverso & Trigiante '12]

- Group theory

ET decomp : **912 = 2 x (1 + 35_v + 35_s + 35_c + 350)** [under SO(8)]

ω-parameter family of new SO(8) gauged SUGRA's !!

- ω-parameter : Electric (28) vs magnetic (28') vectors spanning the SO(8)

$$\Theta_{\text{elec}}{}^{\alpha} \propto \cos(\omega)$$
$$\Theta_{\text{mag}}{}^{\alpha} \propto \sin(\omega)$$

$$V(\Theta, \phi) = V(\omega, \phi)$$

ω-dependent scalar potential !!

This is a U(1) outside E_7 but inside Sp(56)

- phase set to ω = 0 purely electric vectors
- phase set to ω = Pi/2 purely magnetic vectors
- phase set to 0 < ω < Pi/2 dyonic combination of vectors

The new electromagnetic phase raises some questions...

I) Do the known critical points of the standard SO(8) gauged SUGRA evolve with the new phase? If so, how?

II) Do Physics (CC, mass spectra, SUSY) depends on the new phase?

III) Are there genuine critical points associated to non-vanishing values of the electromagnetic phase?

IV) Is the periodicity of the electromagnetic rotations Pi/2 or smaller?

V) Is there an embedding of the ω-phase into string/M-theory?

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The SU(3) group theoretical truncation

- Embedding of SU(3) inside the global & R-symmetry groups

E_7 ==> SL(2) x F_4 ==> SL(2) x SU(2,1) x SU(3)

SU(8) ==> SU(4) x SU(4) ==> SU(3) x SU(3) ==> SU(3)

- SU(3) invariant fields

  - gravitini : 8 ==> 1 + 3 + 1 + 3 ===> N=2 SUSY
  - scalars : 2 [SK] + 4 [QK] real scalars ==> $z + (\zeta_1 \, , \zeta_2) \in \mathbb{C}$
  - vectors : 4 vectors (2 elec & 2 mag) in the fundam. of Sp(4) ==> $(A^{0,1} \, , A_{0,1})$

- N=2 theory with 1 vector + 1 hyper : $\mathcal{M}_{SK} = \dfrac{SL(2)}{SO(2)}$ $\quad \mathcal{M}_{QK} = \dfrac{SU(2,1)}{SU(2) \times U(1)}$

$U(1)_1$ x $U(1)_2$ gauging along QK isometries

The N=2 canonical formulation

[de Wit, Samtleben & Trigiante '05]
[Halmagyi, Petrini & Zaffaroni '11]

- The scalar potential with a dyonic gauging in the hypermultiplet sector

$$V = \underbrace{\Theta_M{}^a \Theta_N{}^b}_{\text{emb tens}} \Big[4 \underbrace{e^{\mathcal{K}} X^M \overline{X}^N}_{\text{SK}} \underbrace{h_{uv} k^u{}_a \bar{k}^v{}_b}_{\text{QK}} + \underbrace{P^x_a P^x_b}_{\text{QK}} \underbrace{\left(g^{i\bar{j}} f_i{}^M \bar{f}_{\bar{j}}{}^N - 3 e^{\mathcal{K}} X^M \overline{X}^N \right)}_{\text{SK}} \Big]$$

SK : data associated to the SK manifold ==> ω-independent
QK : data associated to the QK manifold ==> ω-independent

[N=8 truncation]

emb tens : ω-dependent vectors gauging the $U(1)_1$ x $U(1)_2$ isometries dyonically

- Gauge covariant derivatives

$$Dq^u = dq^u - \Big(\left(A^0 \cos\omega - A_0 \sin\omega\right) k_1^u + \left(A^1 \cos\omega - A_1 \sin\omega\right) k_2^u \Big)$$

involving electric (ω = 0) , magnetic (ω = Pi/2) or dyonic (0 < ω < Pi/2) vectors

- The scalar potential depends on the neutral fields z and $\zeta_{12} = \dfrac{|\zeta_1| + i|\zeta_2|}{1 + \sqrt{1 - |\zeta_1|^2 - |\zeta_2|^2}}$

The superpotential formulation

- The same scalar potential can be obtained as

$$V = 2\left[\frac{4}{3}(1-|z|^2)^2\left|\frac{\partial \mathcal{W}}{\partial z}\right|^2 + (1-|\zeta_{12}|^2)^2\left|\frac{\partial \mathcal{W}}{\partial \zeta_{12}}\right|^2 - 3\mathcal{W}^2\right]$$

from any of the two ω-dependent superpotentials

$$\mathcal{W}_+ = (1-|z|^2)^{-3/2}\,(1-|\zeta_{12}|^2)^{-2}\left[(e^{2i\omega}+z^3)\,(1+\zeta_{12}^4) + 6\,z\,(1+e^{2i\omega}z)\,\zeta_{12}^2\right]$$

$$\mathcal{W}_- = (1-|z|^2)^{-3/2}\,(1-|\zeta_{12}|^2)^{-2}\left[(e^{2i\omega}+z^3)\,(1+\bar{\zeta}_{12}^4) + 6\,z\,(1+e^{2i\omega}z)\,\bar{\zeta}_{12}^2\right]$$

- Setting $\omega = 0$ boils down to the standard SU(3) invariant superpotentials

[Bobev, Halmagyi, Pilch & Warner '10]

- Supersymmetric critical points can be extrema of only one or both superpotentials corresponding to N=1,2 respectively

Recalling the SU(3) invariant critical points at $\omega = 0$

[Warner '83, '84]
[Bobev, Halmagyi, Pilch & Warner '10]

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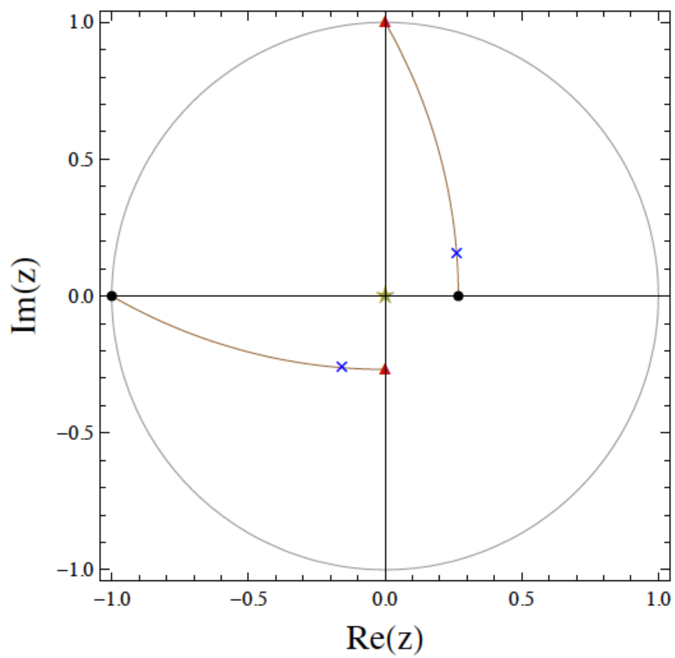
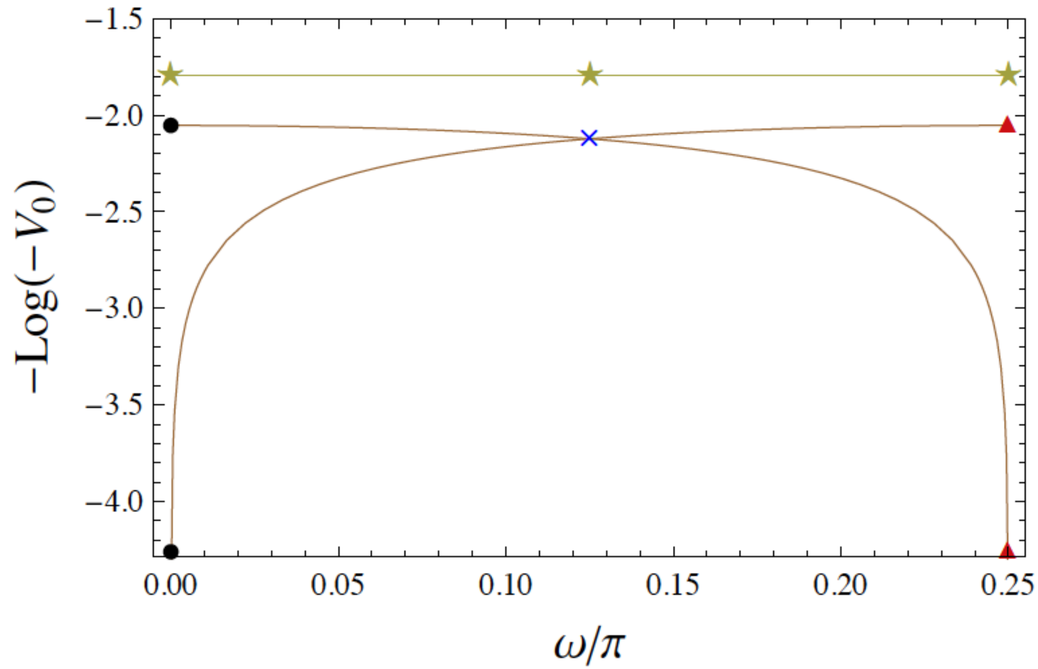
. . . what happens when turning on ω ?

The ω-story of the old critical points

EXAMPLE : the N=8 SO(8) & N=2 SU(3)xU(1) critical points

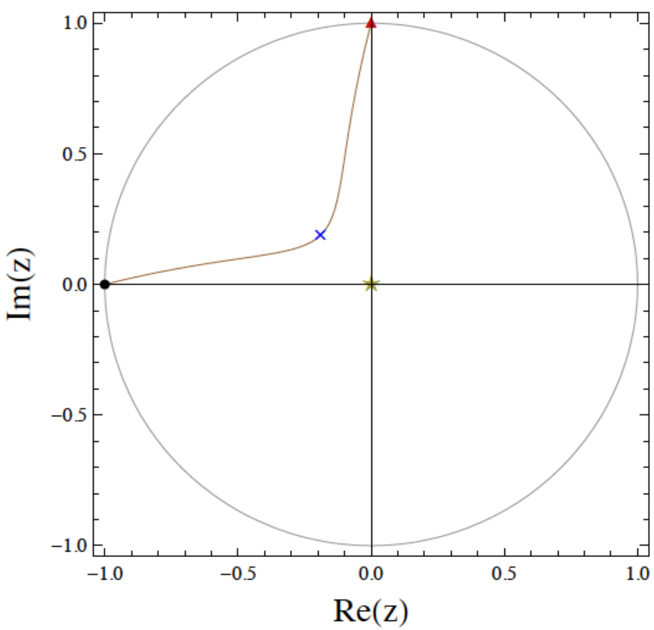


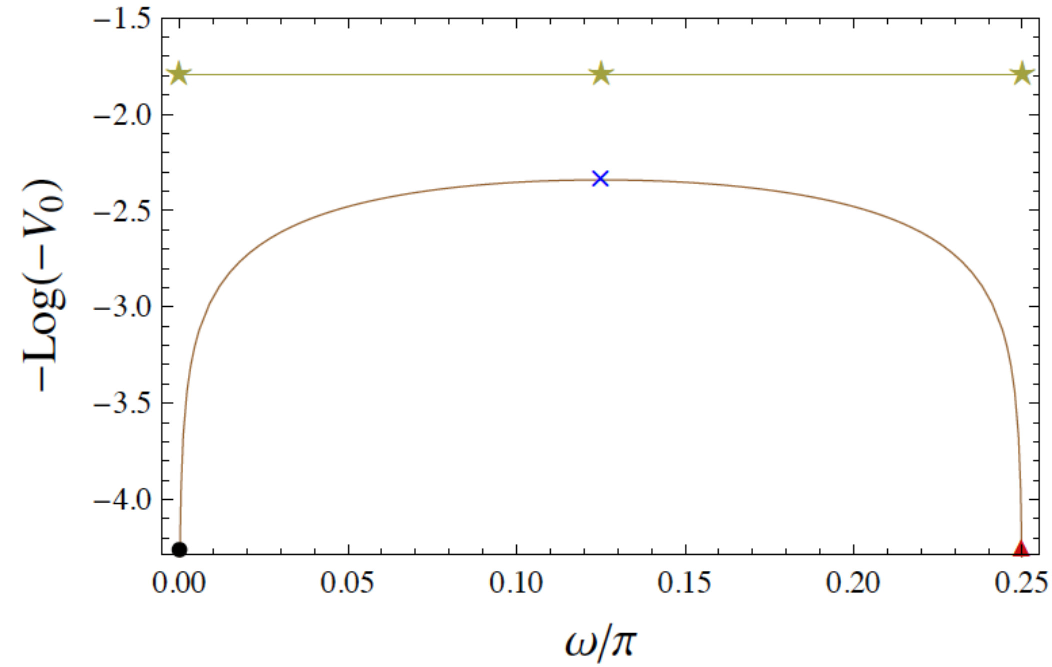


- The normalised mass spectra are insensitive to the ω-phase ==> is G_{res} crucial ?
- There are new solutions which move to the field-boundary at ω = n pi/4
- Analogous ω-stories : N=1 G2-inv , N=0 SO(7)-inv [unstable] , N=0 SU(4)-inv [unstable]

Genuine new critical points

EXAMPLE : novel N=1 SU(3)-invariant critical points





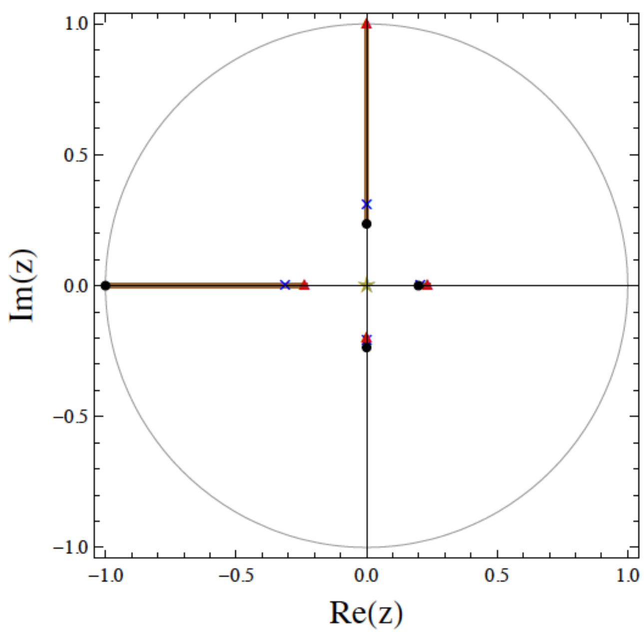
- These are genuine solutions which move to the boundary at ω = n pi/4
- Analogous ω-stories : novel N=0 G2-inv [stable] and N=0 SU(3)-inv [stable]
- Mass spectra of the N=0 SU(3)-inv sols sensitive to the ω-phase ==> G_{res} is not all !!

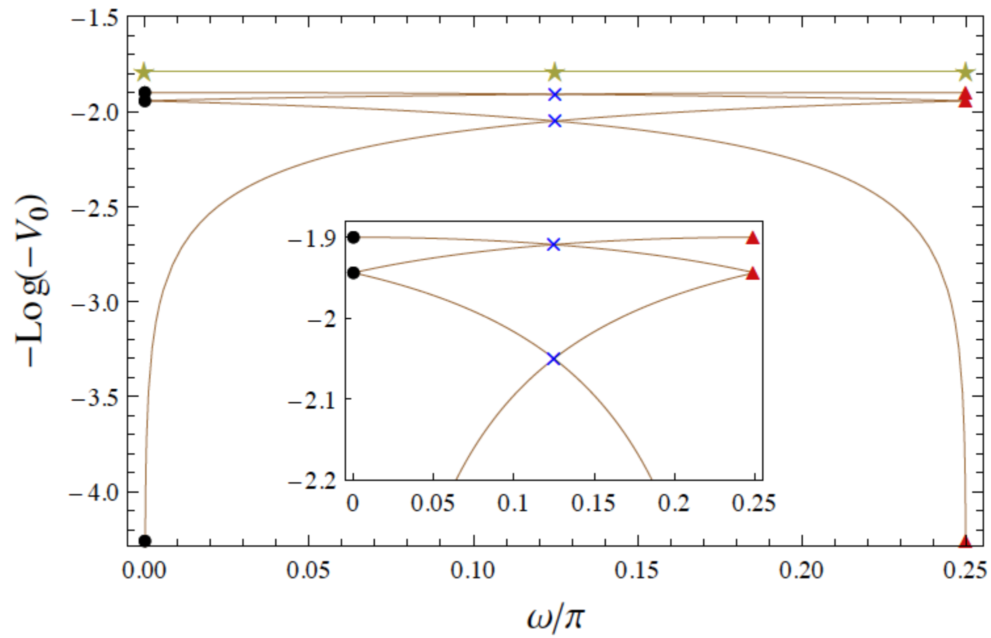
A comment on the Pi/4 periodicity of the ω-phase

[Dall'Agata, Inverso & Trigiante '12]

- Argument based on the quartic E_7-invariant ==> the period cannot be less than Pi/4

EXAMPLE : Transmutation of $SO(7)_+$ [x1] and $SO(7)_-$ [x2] critical points





- Scalars : **70 = 35** (SD) + i **35** (ASD) with SD <=> ASD under SO(8) triality

- What is the interrelation between ω-periodicity and triality ? ⟹ SO(4) sectors

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Recalling the SO(4) invariant critical points at ω = 0

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[Warner '84]

[Fischbacher, Pilch & Warner, '10]

Triality and the three embeddings $SO(4)_{v,s,c}$

- Let us take (without loss of generality) the 8 gravitini of the theory to transform as $\mathbf{8} = \mathbf{8}_v$ of SO(8). Then, the 70 scalars will transform as

$$\mathbf{70} = \mathbf{35}_s \text{ (SD)} + i\, \mathbf{35}_c \text{ (ASD)}$$

- There are three triality-related embeddings of $SO(4) = SO(3)_1 \times SO(3)_2$

N = 2	N = 0	New N = 0
$SO(8)_v$	$SO(8)_s$	$SO(8)_c$
$8_v \Rightarrow 1 + 3_1 + 1 + 3_2$	$8_v \Rightarrow 4 + 4$	$8_v \Rightarrow 4 + 4$
$8_s \Rightarrow 4 + 4$	$8_s \Rightarrow 1 + 3_1 + 1 + 3_2$	$8_s \Rightarrow 4 + 4$
$8_c \Rightarrow 4 + 4$	$8_c \Rightarrow 4 + 4$	$8_c \Rightarrow 1 + 3_1 + 1 + 3_2$
$\mathbf{35}_s$ ==> 2 SD scalars	$\mathbf{35}_s$ ==> 4 SD scalars	$\mathbf{35}_s$ ==> 2 SD scalars
$\mathbf{35}_c$ ==> 2 ASD scalars	$\mathbf{35}_c$ ==> 2 ASD scalars	$\mathbf{35}_c$ ==> 4 ASD scalars

- 3 = 1 + 2 splitting of the SO(4) invariant sectors of SO(8) gauged SUGRA

The vectorial SO(4)$_v$ embedding [$8_v = 1 + 3_1 + 1 + 3_2$]

$$\quad\quad\quad\quad\quad\quad\quad\quad\quad (1) \quad (a) \quad (\hat{1}) \quad (\hat{a})$$

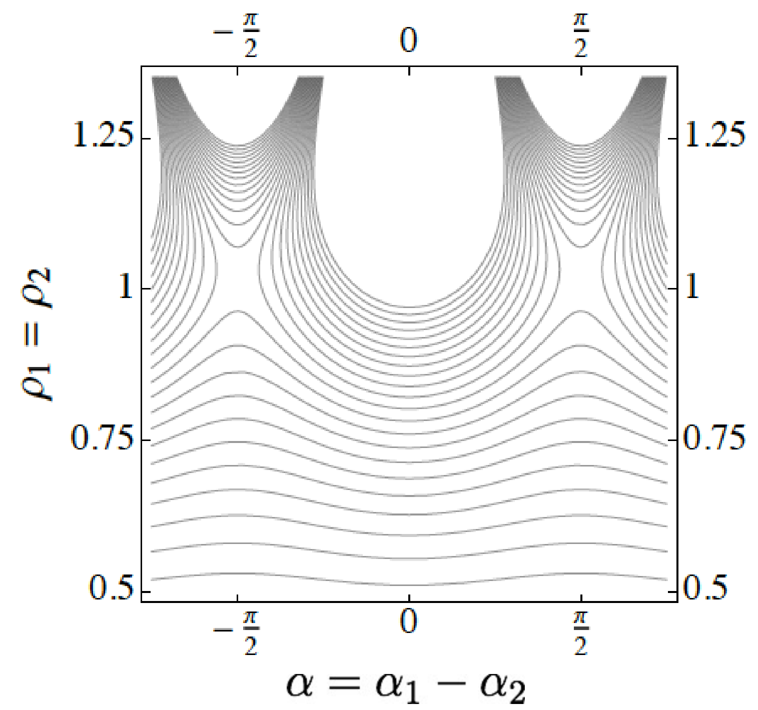
- 2 [SD] + 2 [ASD] invariant scalars

$$\phi_{1abc} = (\phi_{\hat{1}\hat{a}\hat{b}\hat{c}})^* = \rho_1 e^{i\alpha_1}\, \epsilon_{abc}$$

$$\phi_{\hat{1}abc} = -(\phi_{1\hat{a}\hat{b}\hat{c}})^* = \rho_2 e^{i\alpha_2}\, \epsilon_{abc}$$

- Scalar potential is ω-independent !!

$$\begin{aligned} V^v \; = \; & -\frac{1}{8\rho^4}\Big(32\rho_1^4 + 61\rho_1^2\rho_2^2 + 32\rho_2^4 \\ & + \; 4\cosh(2\rho)\left(4\rho_1^4 + 9\rho_1^2\rho_2^2 + 4\rho_2^4\right) \\ & - \; \rho_1^2\rho_2^2\left(\cosh(4\rho) - 8\cos(2\alpha)\sinh^4(\rho)\right)\Big) \end{aligned}$$



- Stable critical points at $\alpha = \pm\frac{\pi}{2}$ and $\rho_1 = \rho_2 = \frac{1}{\sqrt{2}}\cosh^{-1}(\sqrt{5})$ with $V = -14$

- The SO(4)$_v$ solutions are not affected by the ω-phase !!

The spinorial $SO(4)_s$ embedding [$8_v = 4 + 4$]

(i) $(\hat{i})$

[standard SUGRA]

- 4 [SD] + 2 [ASD] invariant scalars

$$\begin{aligned} \phi_{ijkl} &= (\phi_{\hat{i}\hat{j}\hat{k}\hat{l}})^* = (x_1 + i y_1)\, \epsilon_{ijkl} \\ \phi_{\hat{i}jkl} &= -(\phi_{i\hat{j}\hat{k}\hat{l}})^* = \tfrac{1}{2}(x_2 + i y_2)\, \epsilon_{\hat{i}jkl} \\ \phi_{i\hat{j}k\hat{l}} &= x_3\, \epsilon_{i\hat{j}k\hat{l}} + x_4\, \delta_{[i\hat{j}}\delta_{k\hat{l}]} \end{aligned}$$

- Scalar potential [modding out by a discrete D_4]

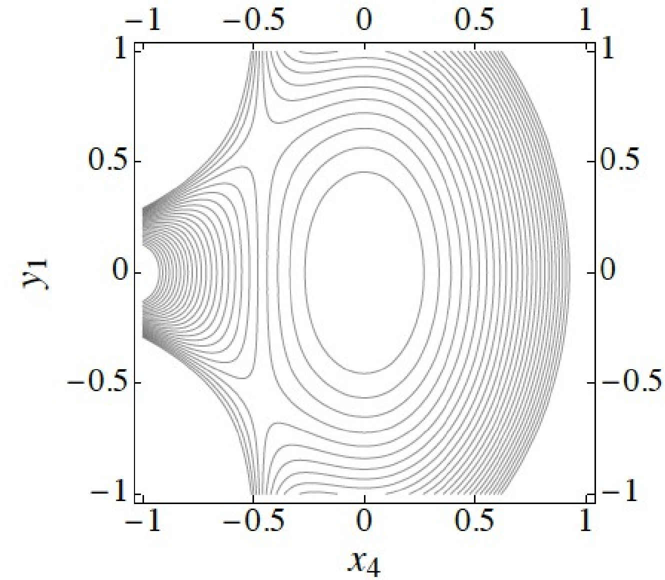
$$V^s = \cos^2(\omega)\, V_0^s(x_4, y_1) + \sin^2(\omega)\, V_0^s(-x_4, y_1)$$

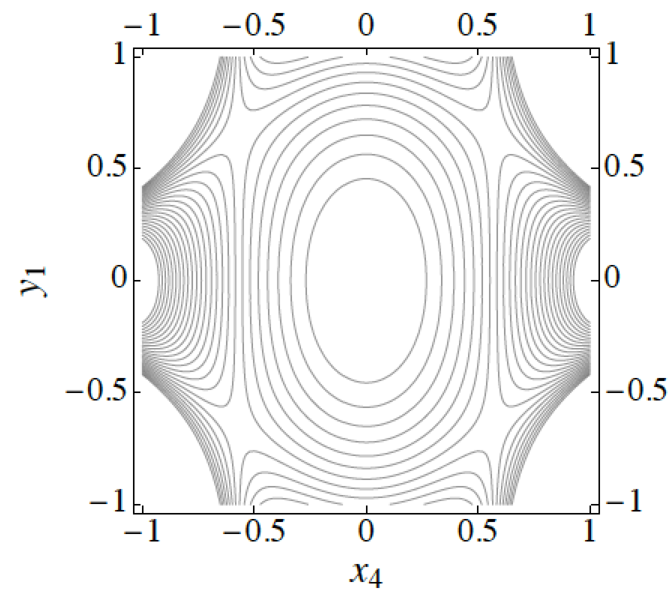
with the $\omega = 0$ potential

$$\begin{aligned} V_0^s &= \tfrac{1}{2}\sinh^2(y_1)\left(\cosh(6x_4) - 4\sinh^3(2x_4)\right) \\ &\quad - \tfrac{3}{4}\cosh(2x_4)(3\cosh(2y_1) + 5)\,. \end{aligned}$$

i) $\omega = 0$ ==> 2 unstable sols with $V = -2\sqrt{9 + 6\sqrt{3}}$

ii) $\omega = Pi/4$ ==> 4 unstable sols with $V = -6\sqrt{3}$





- Pi/4 periodicity is broken unless a new SO(4) sector comes to the rescue

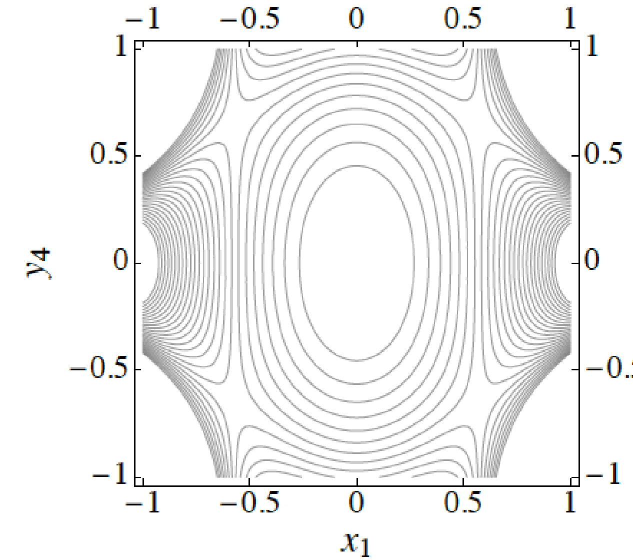
The new $SO(4)_c$ embedding [8_v = 4 + 4]

$(i) \quad (\hat{i})$

[standard SUGRA]

- 2 [SD] + 4 [ASD] invariant scalars

$$\phi_{ijkl} = (\phi_{\hat{i}\hat{j}\hat{k}\hat{l}})^* = (x_1 + iy_1)\,\epsilon_{ijkl}$$
$$\phi_{\hat{i}jkl} = -(\phi_{i\hat{j}\hat{k}\hat{l}})^* = \tfrac{1}{2}\,(x_2 + iy_2)\,\epsilon_{\hat{i}jkl}$$
$$\phi_{i\hat{j}k\hat{l}} = i\,y_3\,\epsilon_{i\hat{j}k\hat{l}} + i\,y_4\,\delta_{[i\hat{j}}\,\delta_{k\hat{l}]}$$



- Scalar potential [modding out by a discrete D_4]

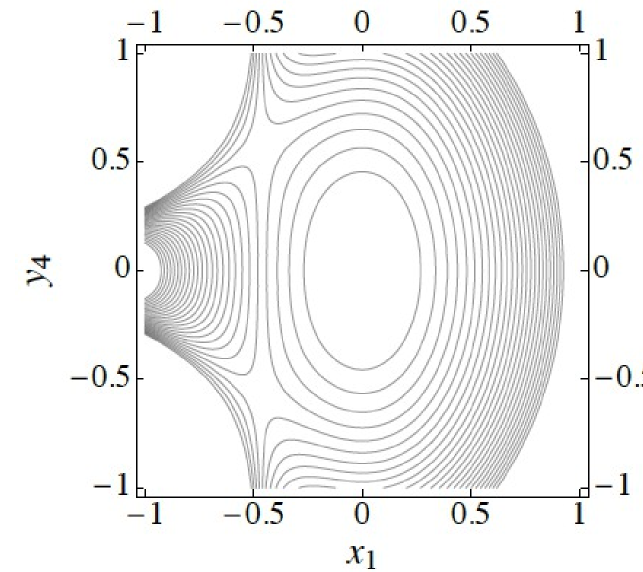
$$V^c = V_0^c + 4\,\sin\omega\cos\omega\,\sinh^2(x_1)\sinh^3(2y_4)$$

with the ω = 0 potential

$$V_0^c = \tfrac{1}{2}\sinh^2(x_1)\cosh(6y_4) - \tfrac{3}{4}\cosh(2y_4)\,(3\cosh(2x_1)+5)$$

i) ω = 0 ==> 4 unstable sols with $V = -6\sqrt{3}$

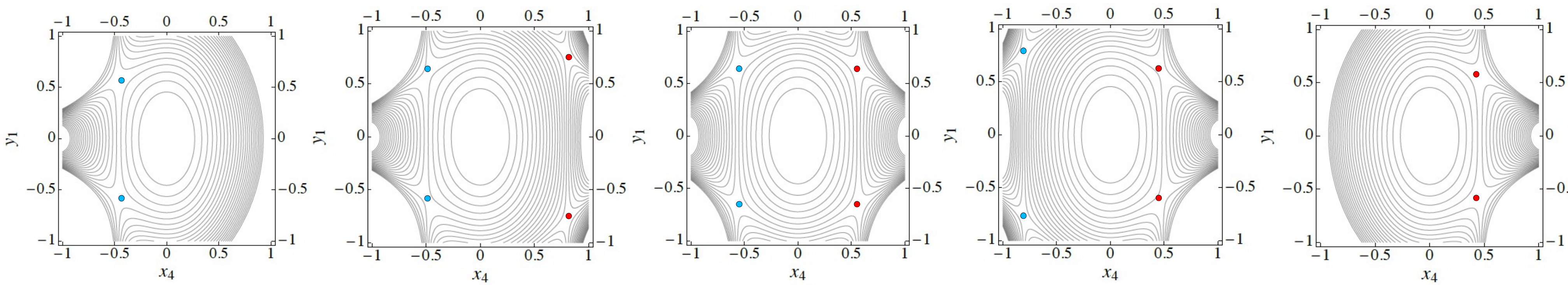
ii) ω = Pi/4 ==> 2 unstable sols with $V = -2\sqrt{9+6\sqrt{3}}$



- The combination of the $SO(4)_s$ & $SO(4)_c$ sectors restores Pi/4 periodicity !!

Singular limits in the $SO(4)_s$ sector [analogous for $SO(4)_c$]

- One pair of solutions runs away when ω approaches 0 and Pi/2



ω = 0 $\quad$ ω = Pi/8 $\quad$ ω = Pi/4 $\quad$ ω = 3Pi/8 $\quad$ ω = Pi/2

- What happens to these solutions? Do they abandon the SO(8) theory and that's why we see them disappearing? If so, where do they go to?

- Fortunately, there is a way of sitting on top of a solution and travel with it along the different theories (gaugings) which are compatible with it . . .

. . . the so-called "Go To The Origin" (GTTO) approach [Dibitetto, A.G, Roest '11 '12]

The GTTO approach

Idea : Looking for the theories (gaugings) compatible with a given critical point instead of looking for the critical points compatible with a given theory

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Going To The Origin : If a critical point is found at $\phi = \phi_0$ with a residual symmetry G_{res} , it can always be brought to $\phi = 0$ via an E_7 transformation. After this, the quantities in the theory (*e.g.* fermion mass terms) will adopt a form compatible with G_{res}

[$E_7/SU(8)$ is an homogeneous space]

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[$E_7/SU(8)$ is an homogeneous space]

Applicability : Ansatz for the fermion masses compatible with $G_{res} = SO(4)_s \times D_4$

- gravitino-gravitino mass terms : $\mathcal{A}^{ij} = \alpha\ \delta^{ij}$, $\mathcal{A}^{\hat{i}\hat{j}} = \alpha\ \delta^{\hat{i}\hat{j}}$

- gravitino-dilatino mass terms :

$$\mathcal{A}_i{}^{jkl} = \beta\ \epsilon_i{}^{jkl} \ , \ \mathcal{A}_i{}^{\hat{j}\hat{k}l} = -\delta\ \epsilon_i{}^{\hat{j}\hat{k}l} + \gamma\ \delta_i^{[\hat{j}}\delta^{\hat{k}]l}$$

$$\mathcal{A}_{\hat{i}}{}^{\hat{j}\hat{k}\hat{l}} = -\beta\ \epsilon_{\hat{i}}{}^{\hat{j}\hat{k}\hat{l}} \ , \ \mathcal{A}_{\hat{i}}{}^{jk\hat{l}} = \delta\ \epsilon_{\hat{i}}{}^{jk\hat{l}} + \gamma\ \delta_{\hat{i}}^{[j}\delta^{k]\hat{l}}$$

It allows for four free parameters $\alpha, \beta, \delta, \gamma \in \mathbb{C}$

Fermion masses for G_{res} = $SO(4)_s$ x D_4

- Solve the QC & EOM in order to find all the theories compatible with a critical point preserving G_{res} = $SO(4)_s$ x D_4 ==> There is a one-parameter family of theories !!

- gravitino-gravitino mass terms :

$$\begin{aligned} \mathrm{Re}[\alpha(\theta)] &= A\,\sin(\theta)\,(2\sqrt{2}\,\cos^2(\theta)+B) \\ \mathrm{Im}[\alpha(\theta)] &= A\,\cos(\theta)\,(2\sqrt{2}\,\sin^2(\theta)-B) \end{aligned}$$

- gravitino-dilatino mass terms :

$$\begin{aligned} \mathrm{Re}[\beta(\theta)] &= \cos(\theta)\left(1-\cos(2\theta)-\tfrac{B}{\sqrt{2}}\right) \\ \mathrm{Im}[\beta(\theta)] &= \sin(\theta)\left(1+\cos(2\theta)+\tfrac{B}{\sqrt{2}}\right) \end{aligned}$$

$$\delta(\theta)=e^{i\theta} \qquad \gamma(\theta)=-i\,2\,\sqrt{2}\,A\,e^{-i\theta}$$

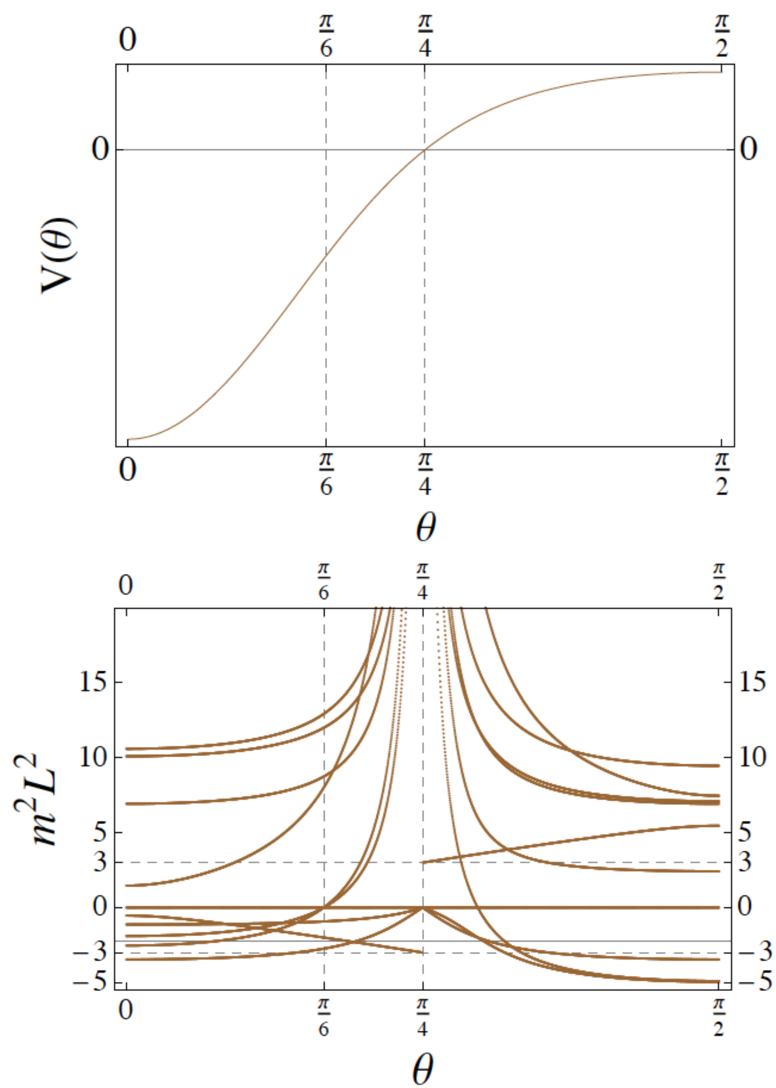
with $A=\frac{1}{2}(\sqrt{2}\cos(2\theta)B+\cos(4\theta)+3)^{1/2}$ and $B=(\cos(4\theta)+5)^{1/2}$

- The scalar potential interpolates between AdS and dS solutions for θ = [0,Pi/2]

$$V(\theta)=-6\,\left(\,1+\cos(4\theta)+\sqrt{2}\,\cos(2\theta)\,B\,\right)$$

Gauge group & AdS/Mkw/dS transitions

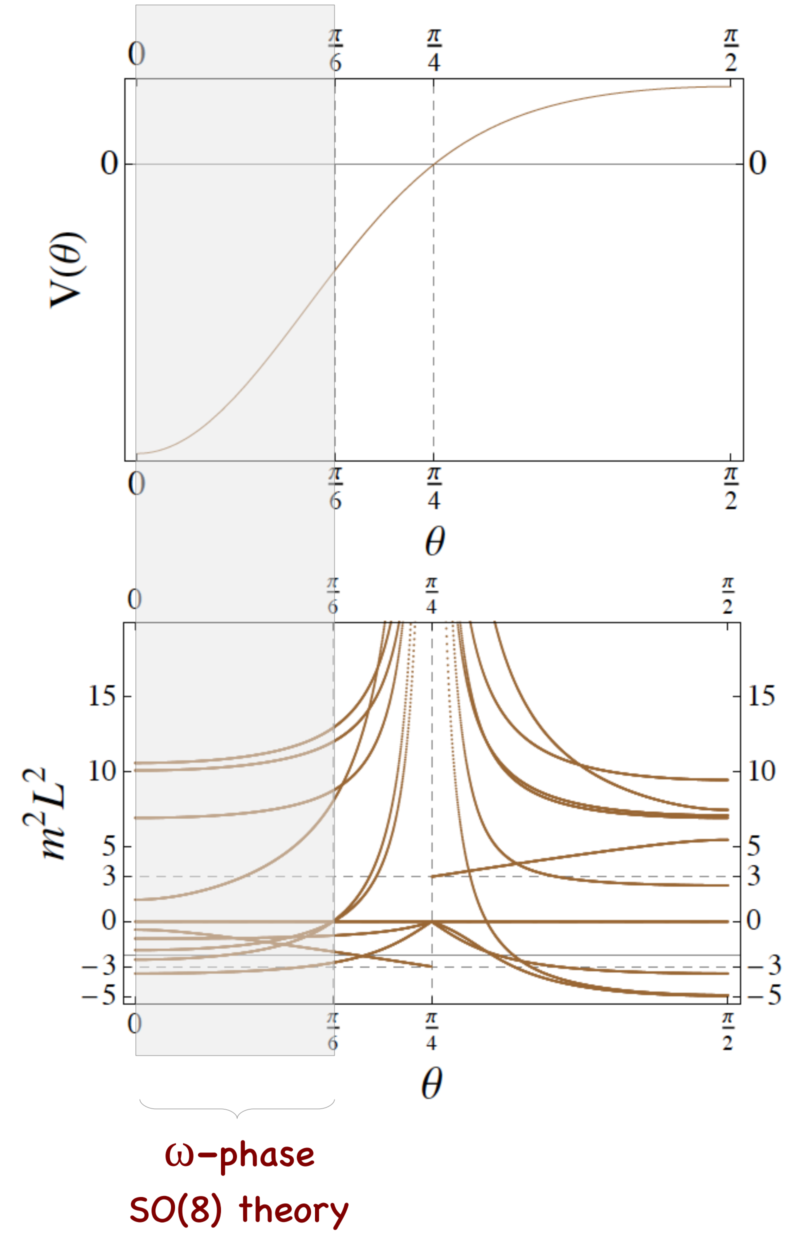
- The whole story of the solution preserving $G_{res} = SO(4)_s \times D_4$ can be tracked



Gauge group & AdS/Mkw/dS transitions

- The whole story of the solution preserving $G_{res} = SO(4)_s \times D_4$ can be tracked

i) θ = [0 , Pi/6) ==> SO(8) gauging
[unstable AdS solutions]

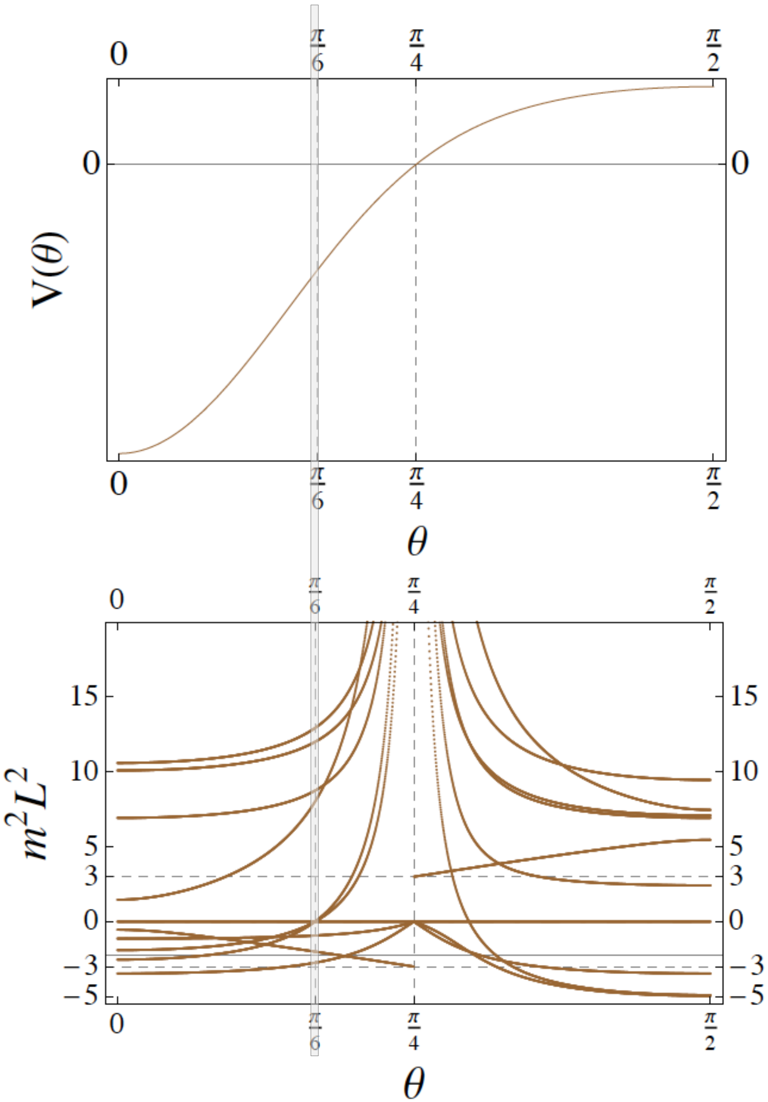


Gauge group & AdS/Mkw/dS transitions

- The whole story of the solution preserving $G_{res} = SO(4)_s \times D_4$ can be tracked

ii) θ = Pi/6 ==> $SO(2) \times SO(6) \times_s T^{12}$ gauging

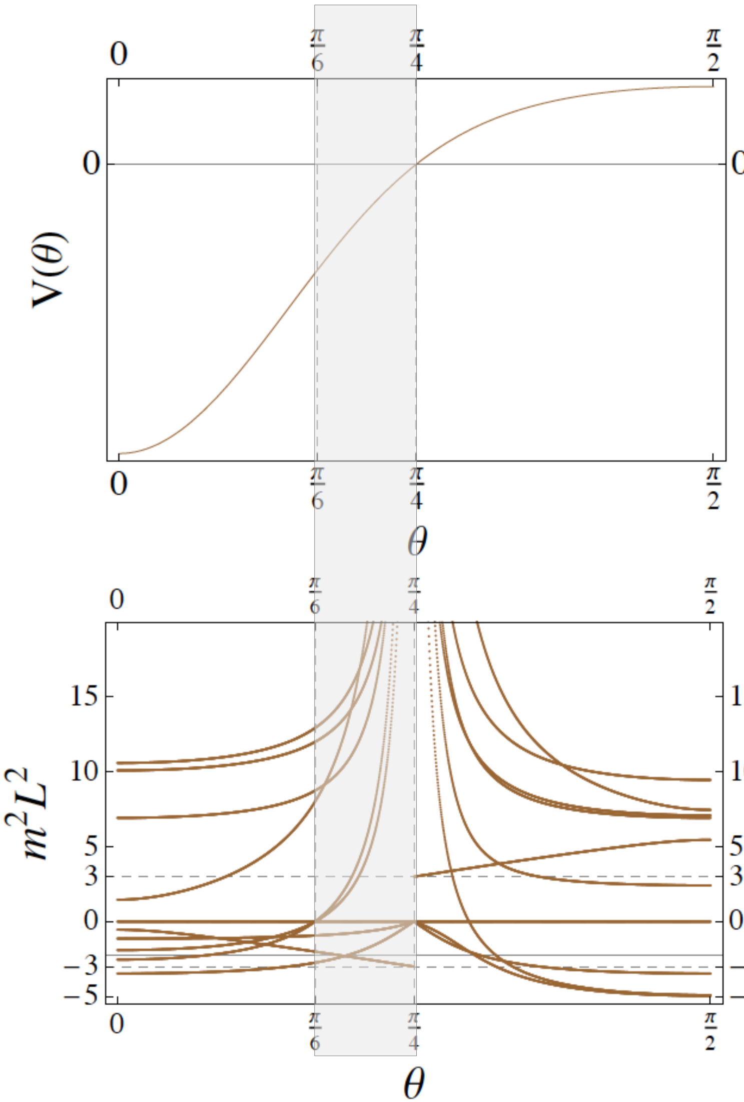
[unstable AdS solution]



Gauge group & AdS/Mkw/dS transitions

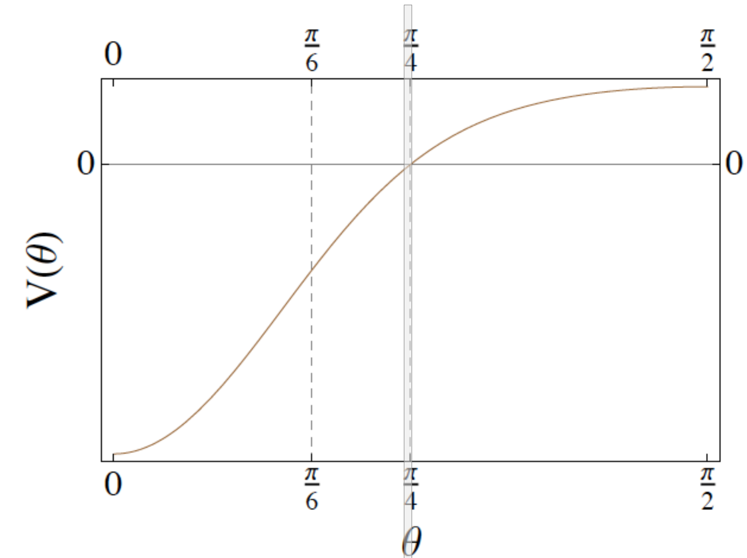
- The whole story of the solution preserving $G_{res} = SO(4)_s \times D_4$ can be tracked

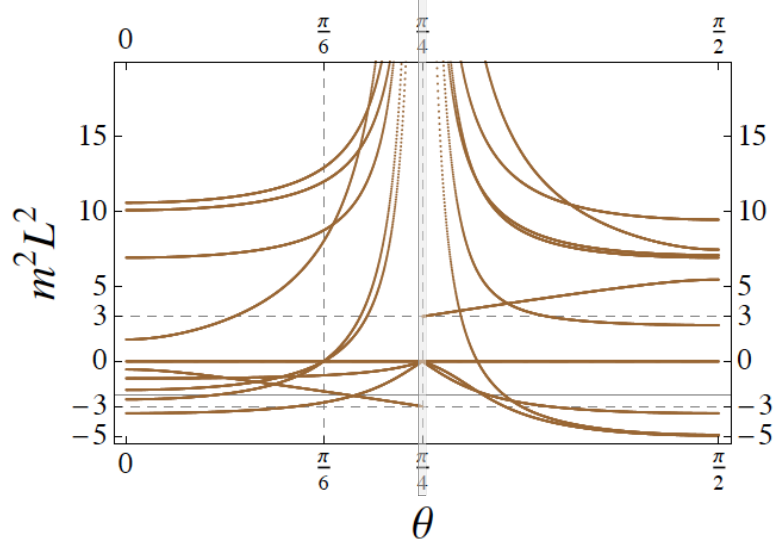
iii) θ = (Pi/6,Pi/4) ==> SO(6,2) gauging
[unstable AdS solutions]



Gauge group & AdS/Mkw/dS transitions

- The whole story of the solution preserving $G_{res} = SO(4)_s \times D_4$ can be tracked



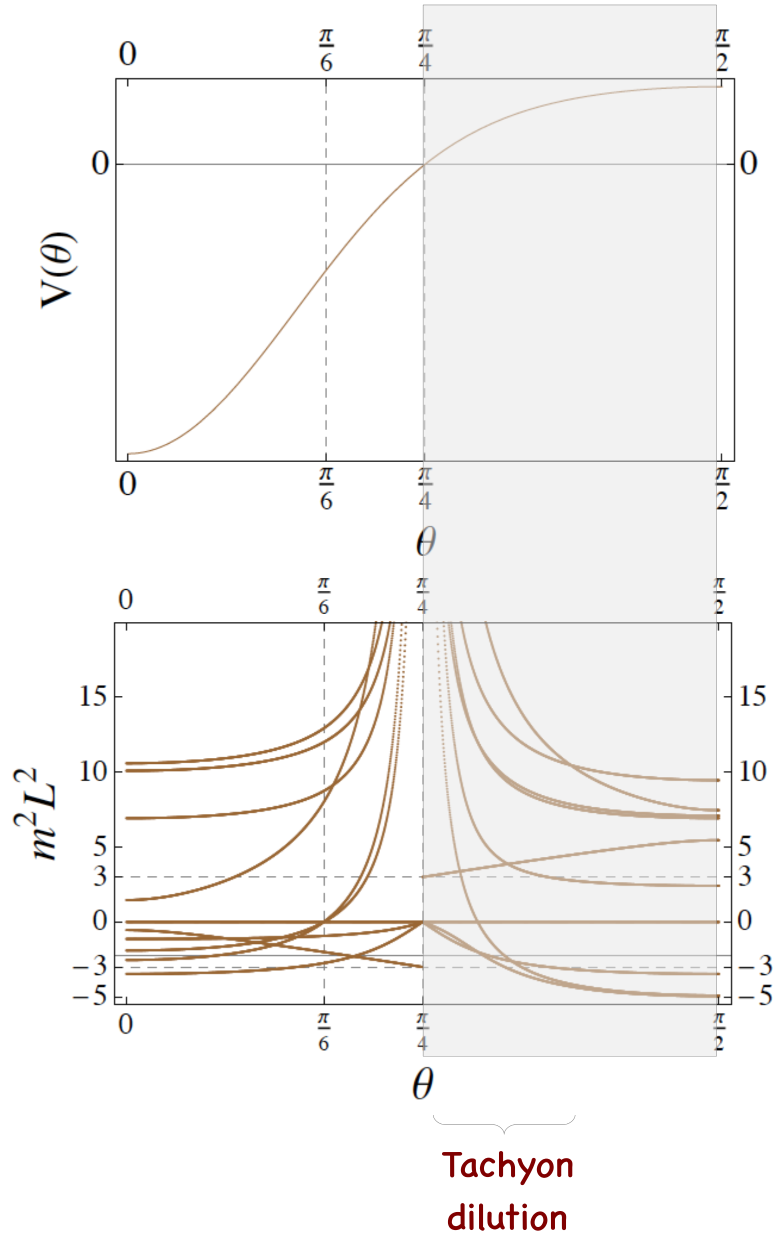


iv) θ = Pi/4 ==> $SO(3,1)^2 \times_s T^{16}$ gauging

[Mkw solution without tachyons]

Gauge group & AdS/Mkw/dS transitions

- The whole story of the solution preserving $G_{res} = SO(4)_s \times D_4$ can be tracked



v) θ = (Pi/4,Pi/2] ==> SO(4,4) gauging
[unstable dS solutions]

[Dall'Agata & Inverso '12]

Outlook

1) The old SO(8) gauged SUGRA

2) The embedding tensor & the new SO(8) gauged SUGRA

3) Invariant sectors of new SO(8) gauged SUGRA :

    3.2) The SU(3) invariant sector

    3.3) The SO(4) invariant sector

4) Collecting results & final remarks

SU(3) & SO(4) invariant critical points of new SO(8) gauged SUGRA

SUSY	Symmetry	CC ($\omega = 0$)	Stability	CC ($\omega = \pi/8$)	Stability	ω-dep masses
$\mathcal{N} = 8$	SO(8)	-6 ($\times 1$)	✓	-6 ($\times 1$)	✓	×
$\mathcal{N} = 2$	SU(3) × U(1)	-7.794 ($\times 1$)	✓	-8.354 ($\times 2$)	✓	×
$\mathcal{N} = 1$	G_2	-7.192 ($\times 2$)	✓	-7.943 ($\times 2$)	✓	×
		–	–	-7.040 ($\times 1$)	✓	×
$\mathcal{N} = 1$	SU(3)	–	–	-10.392 ($\times 1$)	✓	×
$\mathcal{N} = 0$	SO(7)	-6.687 ($\times 1$)	×	-6.748 ($\times 2$)	×	×
		-6.988 ($\times 2$)	×	-7.771 ($\times 2$)	×	×
$\mathcal{N} = 0$	SU(4)	-8 ($\times 1$)	×	-8.581 ($\times 2$)	×	×
$\mathcal{N} = 0$	G_2	–	–	-10.170 ($\times 1$)	✓	×
$\mathcal{N} = 0$	SU(3)	–	–	-10.237 ($\times 2$)	✓	✓
$\mathcal{N} = 0$	SO(4)	-14 ($\times 2$)	✓	-14 ($\times 2$)	✓	×
		-8.807 ($\times 2$)	×	-9.110 ($\times 2$)	×	✓
				-15.599 ($\times 2$)	×	✓
		-10.392 ($\times 4$)	×	-15.599 ($\times 2$)	×	✓
				-9.110 ($\times 2$)	×	✓

Standard supergravity

New supergravity

SU(3) & SO(4) invariant critical points of new SO(8) gauged SUGRA

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				-9.110 ($\times 2$)	×	✓
		-8.807 ($\times 2$)	×	-15.599 ($\times 2$)	×	✓
				-15.599 ($\times 2$)	×	✓
		-10.392 ($\times 4$)	×	-9.110 ($\times 2$)	×	✓

[genuine]

Standard supergravity

New supergravity

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$\mathcal{N}=0$	SO(4)	-14 ($\times2$)	✓	-14 ($\times2$)	✓	×
		-8.807 ($\times2$)	×	-9.110 ($\times2$)	×	✓
				-15.599 ($\times2$)	×	✓
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				-9.110 ($\times2$)	×	✓

[ω-dep]

Standard supergravity

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$\mathcal{N} = 0$	SO(4)	-14 ($\times 2$)	✓	-14 ($\times 2$)	✓	×
		-8.807 ($\times 2$)	×	-9.110 ($\times 2$)	×	✓
				-15.599 ($\times 2$)	×	✓
	[standard]	-10.392 ($\times 4$)	×	-15.599 ($\times 2$)	×	✓
				-9.110 ($\times 2$)	×	✓

Standard supergravity

New supergravity

Final remarks

Mass spectra

- One has to go to small SU(3) & SO(4) residual groups to start seeing ω-dependent mass spectra ==> The residual symmetry does not uniquely determine masses !!

Periodicity

- Triality enters the game to restore Pi/4 periodicity

Tachyon amelioration

- Tachyons can get diluted around AdS/Mkw/dS transitions ==> stable dS in N=8?

Domain-walls and RG flows

- ω-dependent N=2 superpotential for the SU(3)-inv sector ==> New domain-wall solutions at $\omega \neq 0$ ==> Prediction of the free energy F_{IR}/F_{UV}

[rely on M-theory embedding]

Lifting to 11d SUGRA?

- It seems to require vectors from dimensional reduction of A_3 and A_6 , so . . .

[de Wit & Nicolai '13]

… thank you all !!