EuroGDR Supersymmetry 2004

Minimal $\mathcal{N} = 4$ no-scale model

from generalised dimensional reduction

Giovanni Villadoro

Univ. di Roma "La Sapienza" and INFN

26 November 2004

in collaboration with Fabio Zwirner

JHEP 0407 (2004), 055 - arXiv:hep-th/0406185

INTRODUCTION

Study of SUSY breaking mechanisms
from higher dimensional SUGRAs
via Scherk–Schwarz

in higher dimensions SS is a flux
interplay with RR, NSNS fluxes and with
D-branes via dualities

Important in order to understand:
effective SUGRAs,
string vacua, soft terms . . .

Also a first step towards an extended
supersymmetric RS construction.

No-Scale Models

E.Cremmer, S.Ferrara, C.Kounnas, D.V.Nanopoulos

Phys.Lett.B133 (1983) 61

in $\mathcal{N}$ =1:

$$\mathcal{G} = K + \log |w|^2$$

$$V = e^{\mathcal{G}} \left(\mathcal{G}^{I\overline{J}} \mathcal{G}_I \mathcal{G}_{\overline{J}} - 3 \right) + \frac{1}{2} (Ref^{-1})^{ab} D_a D_b$$

$$\langle V \rangle = 0 \qquad \langle V_I \rangle = 0$$

simple solution:

$$\langle D_a \rangle = 0$$

$$K = -3 \log \left(T + \overline{T} \right) \qquad w = const$$

$$m^2_{3/2} = e^{\mathcal{G}} = \frac{|w|^2}{(T+\overline{T})^3}$$

Analogous for generic $\mathcal{N}$

$$V \propto \delta\psi^{\Sigma} \delta\psi_{\Sigma} - 3\, \overline{S}^{AB} S_{AB}$$

$\mathcal{N}=4,\ D=5$ (ungauged) pure SUGRA

E.Cremmer, (1980) LPTENS 80/17

Field Content:

1 - graviton (g_{MN})
4 - gravitini (ψ_{Ma}, $a=1..4$)
6 - vectors ($V^i_M + v_M$, $i=1..5$)
4 - dilatini (χ_a)
1 - dilaton ($X = e^{-\phi/\sqrt{6}}$)

in short notation:

$$_{D=5}[1,4,5+1,4,1]^{\mathcal{N}=4}_{m=0}$$

Global Symmetries, U-Duality group:
$SO(1,1)\times USp(4)$

$$USp(4)\sim SO(5)\sim Spin(5)$$

The action of $SO(1,1)$ on the fields is:

$$V^i_M \to e^{-\lambda}\ V^i_M\,,\ \ v_M \to e^{2\lambda}\ v_M\,,\ \ \phi\to\phi+\sqrt{6}\lambda$$

Reduction on $\mathcal{M}_4 \times S_1$

The kinetic Lagrangian:

(ungauged SUGRA=No cosmological constant)

$$e_5^{-1}\mathcal{L}_5^{kin} =$$

$$-R_5 - \frac{1}{2}\partial_M\phi\,\partial^M\phi - \frac{1}{4}X^4 v_{MN}v^{MN} - \frac{1}{4}X^{-2}V^i_{MN}V_i^{MN}$$

$$-\frac{1}{8}e_5^{-1}\varepsilon^{MNRST}V^i_{MN}V^i_{RS}v_T - \frac{i}{2}\overline{\psi}^a_M\gamma^{MNR}D_N\psi_{Ra} + \frac{i}{2}\overline{\chi}^a\gamma^M D_M\chi_a$$

Field decomposition

$$E_M{}^A = \begin{pmatrix} \rho^{-1/2}e_\mu^\alpha & \rho A_\mu \\ 0 & \rho \end{pmatrix},\ \psi_{Ma} = \begin{pmatrix} \psi_{\mu a} \\ \psi_{y a} \end{pmatrix},$$

$$V^i_M = \begin{pmatrix} V^i_\mu \\ V^i_5 \end{pmatrix},\ v_M = \begin{pmatrix} v_\mu \\ v_5 \end{pmatrix}$$

Field redefinition

$$\psi^a_\mu = \rho^{-1/4}\eta^a_\mu + \left(A_\mu + \tfrac{i}{2}\rho^{-3/2}\widehat{\gamma}\gamma_\mu\right)\psi^a_y\,,$$

$$\psi_{ya} = \rho^{5/4}\psi'_{ya}\,, \qquad \chi_a = \rho^{1/4}\chi'_a\,,$$

$$V^i_\mu = B^i_\mu + V^i_5 A_\mu\,, \qquad v_\mu = b_\mu + v_5 A_\mu\,,$$

$$t = \rho\,X^{-2}\,, \qquad \tau = v_5\,, \qquad \varphi_0 = \sqrt{2}\,\rho\,X\,, \qquad \varphi^i = V^i_5$$

Matter coupled $\mathcal{N}=4$ $D=4$ SUGRA

M.de Roo and P.Wagemans Nucl.Phys.B262 (1985) 644

$${}_{D=4}[1,4,5+1,4,2]^{\mathcal{N}=4}_{m=0} \;+\; {}_{D=4}[0,0,1,4,6]^{\mathcal{N}=4}_{m=0}\,.$$

$$\begin{aligned}
&e_4^{-1}\mathcal{L} = \\
&-R_4 - \frac{1}{2}\frac{\partial_\mu t\partial^\mu t + \partial_\mu\tau\partial^\mu\tau}{t^2} - \frac{\partial_\mu\varphi_0\partial^\mu\varphi_0 + \partial_\mu\varphi_i\partial^\mu\varphi^i}{\varphi_0^2} \\
&-\frac{1}{4}g_{IJ}\,F^I_{\mu\nu}F^{J\ \mu\nu} - \frac{1}{8}e_4^{-1}\theta_{IJ}\,\varepsilon^{\mu\nu\rho\sigma}F^I_{\mu\nu}F^J_{\rho\sigma} \\
&-\frac{i}{2}\overline{\eta}^a_\mu\gamma^{\mu\nu\rho}D_\nu\eta_{\rho\,a} + \frac{i}{2}\overline{\chi}^a\gamma^\mu D_\mu\chi_a + \frac{3}{4}i\,\overline{\psi}^a_y\gamma^\mu D_\mu\psi_{y\,a} + \dots\,,
\end{aligned}$$

$$\frac{SU(1,1)}{U(1)}\times\frac{SO(6,1)}{SO(6)}$$

U-duality group:

$$SO(6,1)\times SU(1,1)\subset Sp(14,\mathbb{R})$$

Maximal compact subgroup:

$$SO(6)\times U(1)\sim SU(4)\times U(1)$$

(R-symmetry in $D=4$)

$$\begin{aligned}
\mathfrak{su}(1,1) &= \mathfrak{so}(1,1) + \mathbf{1}^+ + \mathbf{1}^- \\
\mathfrak{so}(6,1) &= \mathfrak{so}(1,1) + \mathfrak{so}(5) + \mathbf{5}^+ + \mathbf{5}^-
\end{aligned}$$

Matter coupled $\mathcal{N}=4$ $D=4$ SUGRA

$$ {}_{D=4}[1,4,5+1,4,2]^{\mathcal{N}=4}_{m=0} \;+\; {}_{D=4}[0,0,1,4,6]^{\mathcal{N}=4}_{m=0} \,. $$

vector-scalar coupling

$$
\begin{aligned}
&e_4^{-1}\mathcal{L} = \\
&-R_4 - \frac{1}{2}\frac{\partial_\mu t \partial^\mu t + \partial_\mu \tau \partial^\mu \tau}{t^2} - \frac{\partial_\mu \varphi_0 \partial^\mu \varphi_0 + \partial_\mu \varphi_i \partial^\mu \varphi^i}{\varphi_0^2} \\
&-\frac{1}{4} g_{IJ}\, F^I_{\mu\nu} F^{J\ \mu\nu} - \frac{1}{8} e_4^{-1} \theta_{IJ}\, \varepsilon^{\mu\nu\rho\sigma} F^I_{\mu\nu} F^J_{\rho\sigma} \\
&-\frac{i}{2}\overline{\eta}^a_\mu \gamma^{\mu\nu\rho} D_\nu \eta_{\rho\, a} + \frac{i}{2}\overline{\chi}^a \gamma^\mu D_\mu \chi_a + \frac{3}{4} i\, \overline{\psi}^a_y \gamma^\mu D_\mu \psi_{y\, a} + \dots \,,
\end{aligned}
$$

$$ F^I_{\mu\nu} = 2\,\partial_{[\mu} B^I_{\nu]}\,, \qquad B^I_\mu = (B^i_\mu,\, b_\mu,\, A_\mu)\,, $$

$$ g_{IJ} = \begin{pmatrix} t\,\delta_{ij} & 0 & t\,\varphi_i \\ 0 & \frac{\varphi_0^2}{2\,t} & \frac{\tau\,\varphi_0^2}{2\,t} \\ t\,\varphi_j & \frac{\tau\,\varphi_0^2}{2\,t} & t\,\varphi_i\,\varphi^i + \frac{\tau^2\,\varphi_0^2}{2\,t} + \frac{t\,\varphi_0^2}{2} \end{pmatrix} $$

$$ \theta_{IJ} = \begin{pmatrix} \tau\,\delta_{ij} & \varphi_i & \tau\,\varphi_i \\ \varphi_j & 0 & \frac{\varphi_i\,\varphi^i}{2} \\ \tau\,\varphi_j & \frac{\varphi_i\,\varphi^i}{2} & \tau\,\varphi_i\,\varphi^i \end{pmatrix} $$

R-symmetry in $D = 4$: $SU(4) \sim SO(6)$

but the reduced Lagrangian is only invariant under the $D = 5$ R-symmetry $USp(4) \sim SO(5)$

$SU(4)$ only a symmetry of the *e.o.m.*

$Sp(14, \mathbb{R})$ duality connects "ungauged" $SU(4)$ and $USp(4)$ theories ($SO(6,1) \times SU(1,1) \subset Sp(14, \mathbb{R})$)

$$\begin{aligned} \mathfrak{su}(1,1) &= \mathfrak{so}(1,1) + \mathbf{1}^+ + \mathbf{1}^- \\ & \quad\; t \quad\;\; + \tau + \begin{matrix} \textit{magnetic} \\ \textit{embedding} \end{matrix} \end{aligned}$$

$$\begin{aligned} \mathfrak{so}(6,1) &= \mathfrak{so}(1,1) + \mathfrak{so}(5) + \mathbf{5}^+ + \mathbf{5}^- \\ & \quad\; \varphi_0 + \mathfrak{usp}(4) + \varphi_i + \begin{matrix} \textit{magnetic} \\ \textit{embedding} \end{matrix} \end{aligned}$$

$$t, \varphi_0 \to \phi, \rho \qquad \tau, \varphi_i = v_5, V_5^i$$
$$\mathfrak{so}(5) + \mathbf{5}^- = \mathfrak{su}(4)$$

see:

Gaillard and Zumino - Nucl.Phys.B193 (1981) 221
Andrianopoli, D'Auria, Ferrara and Lledo - JHEP0207 (2002) 010
& Nucl.Phys.B640 (2002) 63

and refs. therein

Scherk-Schwarz – $\mathcal{N} = 4$ SUGRA

Scherk and Schwarz (1979)

$$U \in USp(4) \times SO(1,1)$$

---

compact $USp(4) \Rightarrow$ no-scale model

only charged fields are affected

$${}_{D=5}[1, 4, 5 + 1, 4, 1]^{\mathcal{N}=4}_{m=0}$$

$USp(4)$ rank-2 $\Rightarrow$ 2 mass parameters

the twist $U(y) = \exp(i\, y\, M)$

$$M_4 = \text{diag}\,[m_1\,\sigma_3\,, m_2\,\sigma_3]$$

mass matrix for gravitini and dilatini

(super-Higgs effect)

$$M_5 = \text{diag}\,[(m_1 + m_2)\,\sigma_2\,, (m_1 - m_2)\,\sigma_2\,, 0]$$

mass matrix for vectors (Higgs effect)

gauging of shift symmetries

$$\begin{aligned} \widehat{D}_\mu \varphi^i &= \partial_\mu \varphi^i - i (M_5)^i{}_j \; (B^j_\mu + \varphi^j \; A_\mu) \\ \widehat{B}^i_{\mu\nu} &= (\partial_\mu B^i_\nu - \partial_\nu B^i_\mu) - i (M_5)^i{}_j \; (A_\mu B^j_\nu - B^j_\mu \; A_\nu) \end{aligned}$$

Gauged group:

$$[X_{\hat{\imath}}, X_7] = f^{\hat{\jmath}}{}_{\hat{\imath}7} X_{\hat{\jmath}}\,, \qquad [X_{\hat{\imath}}, X_{\hat{\jmath}}] = 0\,,$$

$$f^{\hat{\jmath}}{}_{\hat{\imath}7} = i M^{\hat{\jmath}}{}_{\hat{\imath}}\,,$$

$$\mathbf{U(1)} \ltimes \mathcal{T}^{\mathbf{4}}$$

The minimal $\mathcal{N} = 4$ NO-SCALE model

$$e_4^{-1} \mathcal{L}^{SS}_{\text{bos}} = -R_4 + (V = 0)$$

$$-\frac{1}{2} \frac{\partial_\mu t \partial^\mu t + \partial_\mu \tau \partial^\mu \tau}{t^2} - \frac{\partial_\mu \varphi_0 \partial^\mu \varphi_0 + \widehat{D}_\mu \varphi_i \widehat{D}^\mu \varphi^i}{\varphi_0^2}$$

$$-\frac{1}{4} g_{IJ}\, \widehat{F}^I_{\mu\nu} \widehat{F}^{J\ \mu\nu} - \frac{1}{8} e_4^{-1} \theta_{IJ}\, \varepsilon^{\mu\nu\rho\sigma} \widehat{F}^I_{\mu\nu} \widehat{F}^J_{\rho\sigma}$$

$$-\frac{2}{3} i\ d_{\hat{\imath}\hat{\jmath}\hat{k}} M^{\hat{k}}{}_{\hat{l}} e_4^{-1} \varepsilon^{\mu\nu\rho\sigma} B^{\hat{\imath}}_\mu B^{\hat{l}}_\nu B^{\hat{\jmath}}_{\rho\sigma}$$

extra-CS term from inhomogeneous transformation of θ_{IJ} under shift symmetries

see:

L.Andrianopoli, S.Ferrara, M.A.Lledo JHEP 0404 (2004) 005

...continued

$$m_1 \neq m_2 = 0$$

$$[1,2,1,0,0]^{\mathcal{N}=2}_{m=0} + \left\{2 \times [0,1,2,1,0]^{\mathcal{N}=2}_{m\neq 0}\right\}$$

$$+2 \times [0,0,1,2,2]^{\mathcal{N}=2}_{m=0}$$

$$|m_1| \neq |m_2|, m_1 m_2 \neq 0$$

$$[1_{m=0}, 4_{m\neq 0}, 4_{m\neq 0} + 3_{m=0}, 4_{m\neq 0}, 4_{m=0}]^{\mathcal{N}=0}$$

$$|m_1| = |m_2| \neq 0$$

$$[1_{m=0}, 4_{m\neq 0}, 2_{m\neq 0} + 5_{m=0}, 4_{m\neq 0}, 6_{m=0}]^{\mathcal{N}=0}$$

$\frac{1}{2}$BPS multiplet

Central Charges given by the twist U saturate the bound: $z_i = m_i$

Spectrum (twice degenerate) (because of CPT)

spin 3/2	$(\eta^{1\ldots 4}_\mu)$	:	$\frac{2}{t\varphi_0^2} m^2_{1,2}$
spin 1	$(V^{1\ldots 4}_\mu)$	:	$\frac{2}{t\varphi_0^2}(m_1 \pm m_2)^2$
spin 1/2	$(\chi^{1\ldots 4})$	:	$\frac{2}{t\varphi_0^2} m^2_{1,2}$

$$str\, M^2 = 0 \quad \textit{(from } str\, Z^2 = 0\textit{)}$$

HIGHER DIMENSIONS

(new no-scale models)

$D = 6$ (2,2) $\to D = 5$:

R-symm: $USp(2) \times USp(2)$ U-duality: $SO(1,1) \times SO(4)$

$${}_{D=6}[1, (2,1) + (1,2), (2,2) + (1,1)_2, (2,1) + (1,2), 1]^{\mathcal{N}=4}_{m=0}$$

$$U(1) \ltimes \mathcal{T}^4$$

$$\mathfrak{so}(1,1) + \mathfrak{so}(5,1) \to \mathfrak{so}(1,1) + \mathfrak{so}(1,1) + \mathfrak{so}(4) + \mathbf{4}^+ + \mathbf{4}^-$$

$D = 6$ (4,0) $\to D = 5$:

L.J.Romans Nucl.Phys.B267 (1986) 433

R-symm: $USp(4)$ Scalar Manifold: $\frac{SO(5,21)}{USp(4) \times SO(21)}$

$${}_{D=6}[1, 4, 5^-, 0, 0]^{\mathcal{N}=4}_{m=0} \; + \; 21 \times \; {}_{D=6}[0, 0, 1^+, 4, 5]^{\mathcal{N}=4}_{m=0}$$

$D = 7 \to D = 6$:

R-symm: $USp(2)$ U-duality: $SO(1,1) \times USp(2)$

$${}_{D=7}[1, 2, 1_2 + 3, 2, 1]^{\mathcal{N}=4}_{m=0}$$

$$U(1) \ltimes \mathcal{T}^2$$

$$\mathfrak{so}(1,1) + \mathfrak{so}(1,1) + \mathfrak{usp}(2) + \mathbf{3}^+ + \mathbf{3}^-$$

$D = 8 \to D = 7$:

R-symm: $SO(2)$ U-duality: $SO(1,1) \times SO(2)$

$${}_{D=8}[1, 1^+, 1_2 + 2, 1^-, 1]^{\mathcal{N}=4}_{m=0}$$

$$U(1) \ltimes \mathcal{T}^2$$

$$\mathfrak{so}(1,1) + \mathfrak{so}(1,1) + \mathfrak{so}(2) + \mathbf{2}^+ + \mathbf{2}^-$$

NON-COMPACT SO(1,1) TWIST

$$V_M^i \to e^{\Lambda y}\ V_M^i\,,\ \ v_M \to e^{-2\Lambda y}\ v_M\,,\ \ X \to e^{\Lambda y}\ X$$

$$\begin{aligned}
e_4^{-1}\mathcal{L}_{\text{bos}}^{SO(1,1)} &= -R_4 \\
&-\frac{1}{2}\frac{D_\mu t D^\mu t + D_\mu \tau D^\mu \tau}{t^2} - \frac{D_\mu \varphi_0 D^\mu \varphi_0 + D_\mu \varphi_i D^\mu \varphi_i}{\varphi_0^2} \\
&-\frac{1}{4} g_{IJ} \widehat{F}^I_{\mu\nu} \widehat{F}^{J\ \mu\nu} - \frac{1}{8} e_4^{-1} \theta_{IJ} \varepsilon^{\mu\nu\rho\sigma} \widehat{F}^I_{\mu\nu} \widehat{F}^J_{\rho\sigma} \\
&-\frac{1}{6} e_4^{-1} \Lambda \mathcal{C}_{IJK}\, \varepsilon^{\mu\nu\rho\sigma} B^I_\mu B^J_\nu \widehat{F}^K_{\rho\sigma} - \frac{6\Lambda^2}{t\varphi_0^2}
\end{aligned}$$

stabilisation of all moduli but one
with a runaway positive potential

$$\begin{aligned}
&D_\mu \varphi_0 = (\partial_\mu - \Lambda A_\mu)\,\varphi_0\,,\ \ D_\mu \varphi^i = \partial_\mu \varphi^i - \Lambda\left(B^i_\mu + \varphi^i A_\mu\right)\,, \\
&D_\mu t = (\partial_\mu + 2\Lambda A_\mu)\,t\,,\ \ D_\mu \tau = \partial_\mu \tau + 2\Lambda\,(b_\mu + \tau A_\mu) \\
&\widehat{F}^i_{\mu\nu} = B^i_{\mu\nu} - \Lambda\left(A_\mu B^i_\nu - B^i_\mu A_\nu\right)\,, \\
&\widehat{F}^6_{\mu\nu} = b_{\mu\nu} + 2\Lambda\,(A_\mu b_\nu - b_\mu A_\nu)\,, \\
&\widehat{F}^7_{\mu\nu} = A_{\mu\nu}\,.
\end{aligned}$$

$$SO(1,1) \ltimes \mathcal{T}^6$$

Fermion Masses $\qquad -\dfrac{1}{2}\left(\dfrac{6\Lambda^2}{t\varphi_0^2}\right)^{1/2} \bar{\eta}^a_\mu \widehat{\gamma}\gamma^\mu \chi_a$

see also

E.Bergshoeff, M.de Roo, E.Eyras Phys.Lett.B413 (1997) 70

$S_1/\mathcal{Z}_2$ ORBIFOLD REDUCTION

$$y \to -y: \ \Phi(x^\mu, -y) = \mathcal{Z}_2 \ \Phi(x^\mu, y)$$

$$(\mathcal{Z}_2)^2 = 1$$

$$\begin{array}{rcl} e_\mu^\alpha & : & + \\ \rho\,,\phi\,,v_5 & : & + \\ A_\mu\,,v_\mu & : & - \\ V_\mu^i & : & (+,+,-,-,-) \\ V_5^i & : & (-,-,+,+,+) \\ \psi_{\mu_a} & : & (+,-,+,-) \\ \psi_{y_a}\,,\chi_a & : & (-,+,-,+)\,. \end{array}$$

$$[1,2,1,0,0]^{\mathcal{N}=2}_{m=0} \ + \ [0,0,1,2,2]^{\mathcal{N}=2}_{m=0} \ + \ [0,0,0,2,4]^{\mathcal{N}=2}_{m=0}\,.$$

see also: *R.Altendorfer Phys.Lett.B476 (2000) 172*

Scherk–Schwarz + Orbifold

Consistency condition: $\mathcal{Z}_2\,U\,\mathcal{Z}_2\,U = 1$

$$\mathcal{Z}_2\, U\, \mathcal{Z}_2\, U = 1, \quad U = exp(iT)$$

CASE $[T, \mathcal{Z}_2] = 0$:

$$\Rightarrow U^2 = 1 \Rightarrow m_{1,2} = 0, \pm\frac{1}{2r}$$

$$\Leftrightarrow S_1/\mathcal{Z}_2 \times \mathcal{Z}_2'$$

with radius$= 2r$ and $U = \mathcal{Z}_2 \cdot \mathcal{Z}_2'$

$e_\mu^\alpha\,,\rho\,,\phi\,,v_5$	ψ_{μ_a}	$\psi_{y_a}\,,\chi_A$	$A_\mu\,,v_\mu$	V_μ^i	V_5^i
$(+,+)$	$\begin{pmatrix} +,+ \\ -,- \\ +,- \\ -,+ \end{pmatrix}$	$\begin{pmatrix} -,- \\ +,+ \\ -,+ \\ +,- \end{pmatrix}$	$(-,-)$	$\begin{pmatrix} +,- \\ +,- \\ -,+ \\ -,+ \\ -,- \end{pmatrix}$	$\begin{pmatrix} -,+ \\ -,+ \\ +,- \\ +,- \\ +,+ \end{pmatrix}$

$$[1,1,0,0,0]^{\mathcal{N}=1}_{m=0} \quad + \quad 2 \;\times [0,0,0,1,2]^{\mathcal{N}=1}_{m=0}$$

CASE $\{T, \mathcal{Z}_2\} = 0$:

$$\Rightarrow U \in \frac{USp(4)}{SU(2)\times U(1)}$$

$$M_4^2 = \text{diag}\left[m_1^2\,, \cancel{m_1^2}\,, m_2^2\,, \cancel{m_2^2}\right]$$
$$M_5^2 = \text{diag}\left[(m_1+m_2)^2\,, (m_1-m_2)^2\,, \cancel{(m_1+m_2)^2}\,, \cancel{(m_1-m_2)^2}\,, \cancel{0}\right]$$

$$\mathcal{N} = \mathbf{4},\ D = \mathbf{5}$$
$$\Downarrow \qquad \mathcal{Z}_2$$

$$[1,2,1,0,0]^{\mathcal{N}=2}_{m=0} + [0,0,1,2,2]^{\mathcal{N}=2}_{m=0} + [0,0,0,2,4]^{\mathcal{N}=2}_{m=0}$$

$$\Downarrow \qquad SS\ (m_1 \neq 0, m_2 = 0)$$

$$[1,1,0,0,0]^{\mathcal{N}=1}_{m=0} + [0,1,2,1,0]^{\mathcal{N}=1}_{m\neq 0} + 2\times[0,0,0,1,2]^{\mathcal{N}=1}_{m=0}$$

$$\Downarrow \qquad SS\ (m_1 m_2 \neq 0)$$

$$[1_{m=0}, 2_{m\neq 0}, 2_{m\neq 0}, 2_{m\neq 0}, 4_{m=0}]^{\mathcal{N}=0}$$

long-multiplet = half BPS multiplet
no central charge ($z_i = 0$) (orbifold cut)

$\mathcal{N} = 2$ with $str(M^2) = 0$

analogous to:
$str(M^4) = 0$ in $\mathcal{N} = 3$ *GV Phys.Lett.B602 (2004) 123*
and to $str(M^6) = 0$ in $\mathcal{N} = 4$ *D'Auria, Ferrara et al. JHEP 0306 (2003) 045 and hep-th/0409184*

CONCLUSIONS

Generalised reduction with U-duality twists produces a richer and new structure for spontaneous SUSY breaking in extended SUGRAs.

- Allow for partial and total SUSY breaking + compatibility with orbifold

- New type of gaugings with vanishing c.c.

- Nice properties of the spectrum (for the stabilisation of the scales)