E4/1

most 16SC theories
are dim. reductions of 10D SYM

10D: A^μ, MWG, no scalars

$d<10$: $A^\mu + (10-d)$ scalars
+ fermions

~~Flat directions~~ of V scalars

: all 10-d Pi commute as matrices
→ may diagonalize all of them.

Generic eigenvalues → Coulomb branch
where G is broken to $U(1)^{\text{rank}(G)}$.

Special points or sub-manifolds where
~~symmetries~~ gauge group has U.t factors.
→ Singularities in the moduli space.

But 16SC → no singularities of the
mod. space where only in the higher
derivative operators.

Moduli space is locally flat $\mathbb{R}^{10-d) \times \text{rank}}$
Globally $\mathbb{R}^{(10-d) \text{ times}}$ / discrete symmetry.

10/2 Exotic Theory w 16 SC in 6D.

Regular 6D SYM has $\mathcal{N} = 2A = (1,1)$
8 SC in 1 Weyl spinor + another 8 in the anti Weyl spinor.

Type 2B or (2,0) has both all 16 SC
in 2 ⊕ CH Weyl spinors.

Massless SM is tensor rather than vector.

1 Tensor SM ⊃ 5 real scalars
2 LH Weyl Spinors
1 self-dual tensor $B_{\mu\nu}$
$H_{\lambda\mu\nu} = \frac{1}{6} \epsilon_{\lambda\mu\nu\rho\sigma\tau} H^{\rho\sigma\tau}$

$\mathcal{N} = 2B$: ∃ interacting theories
of several tensor multi, but they
are non-Lagrangian.

Under DR dim red 6D → 5D
interacting theories become SYM theories
$G_0 = SU(N)$, $SO(2N)$, $E_{6,7,8}$

[4/3] Rigid SUSY in $d=3$

$N=1$	2 SC
$N=2$	4 SC
$N=3$	6 SC
$N=4$	8 SC
? $N=5$?	10 SC
$N=6$	12 SC
$N=8$	16 SC

$N=8$: SYM, Simple
to $N=4$ in $d=4$, etc.
Also. rel Free 10d SYM.

On the Coulomb branch where G is spont. broken to $U(1)^r$.
free vectors are dual to scalars
Matter → Free SM: 8 real scalars
+8 Maj spinors.
Moduli space $\mathbb{R}^{8r}$ / discrete symmetry.

$N=6$: several types of SCFTs.
interactions: gauge + Chern-Simons

[E4/4]

$\mathcal{N}=4$ in 3D

is dim red from $\mathcal{N}=2$ in 4D.

→ vector SM + Hyper SM

del regions. but one gauge + susy partners

Hyper Mod space $\mathcal{M} = \mathcal{M}_{HM} \otimes \mathcal{M}_{VM}$

$\mathcal{M}_{HM}$: real scalars + 4 Maj. spinors

$\mathcal{M}_{VM}$ is Hyper Kähler.

VM: A_μ + 3 real scalars
+ 4 majorana.

different IR effects from 4D.

3d "instantons" are magnetic.
not YM instantons.

vortices are particles.

Coulomb branch $G \to U(1)^r$

Free A^μ → scalars.

→ 4r massless scalars

Moduli space geometry is Hyper Kähler

$\mathcal{M} = \mathcal{M}_{HM} \times \mathcal{M}_{HM}$ both Hyper Kähler.

Mirror symmetry

$(\mathcal{M}_{HM}, \mathcal{M}_{HM})$ (theory A) $\leftrightarrow$ $(\mathcal{M}_{HM}, \mathcal{M}_{HM})$ of theory B.

E4/5] $\mathcal{N}=3$: has CS terms + superpartners.

$\mathcal{N}=2$: diff Rep of $\mathcal{N}=1$ in 4D.

→ ~~Vector & Scalar Multiplets~~

Scalar mult : complex Φ
+ Dirac 4

$\mathcal{L}_{\mathcal{N}=2} = \int d^4\theta\, K(\Phi,\bar{\Phi}) + \int d^2\theta\, W + h.c.$

→ ~~Kähler geometry~~

$W(\Phi)$ holomorphic.

but gauge coupling $\frac{1}{g^2}(\Phi,\bar{\Phi})$
is real & non-holomorphic.