Title: Magnetic Quivers and Phase Diagrams in 6 dimensions

Speakers: Amihay Hanany

Collection/Series: Mathematical Physics

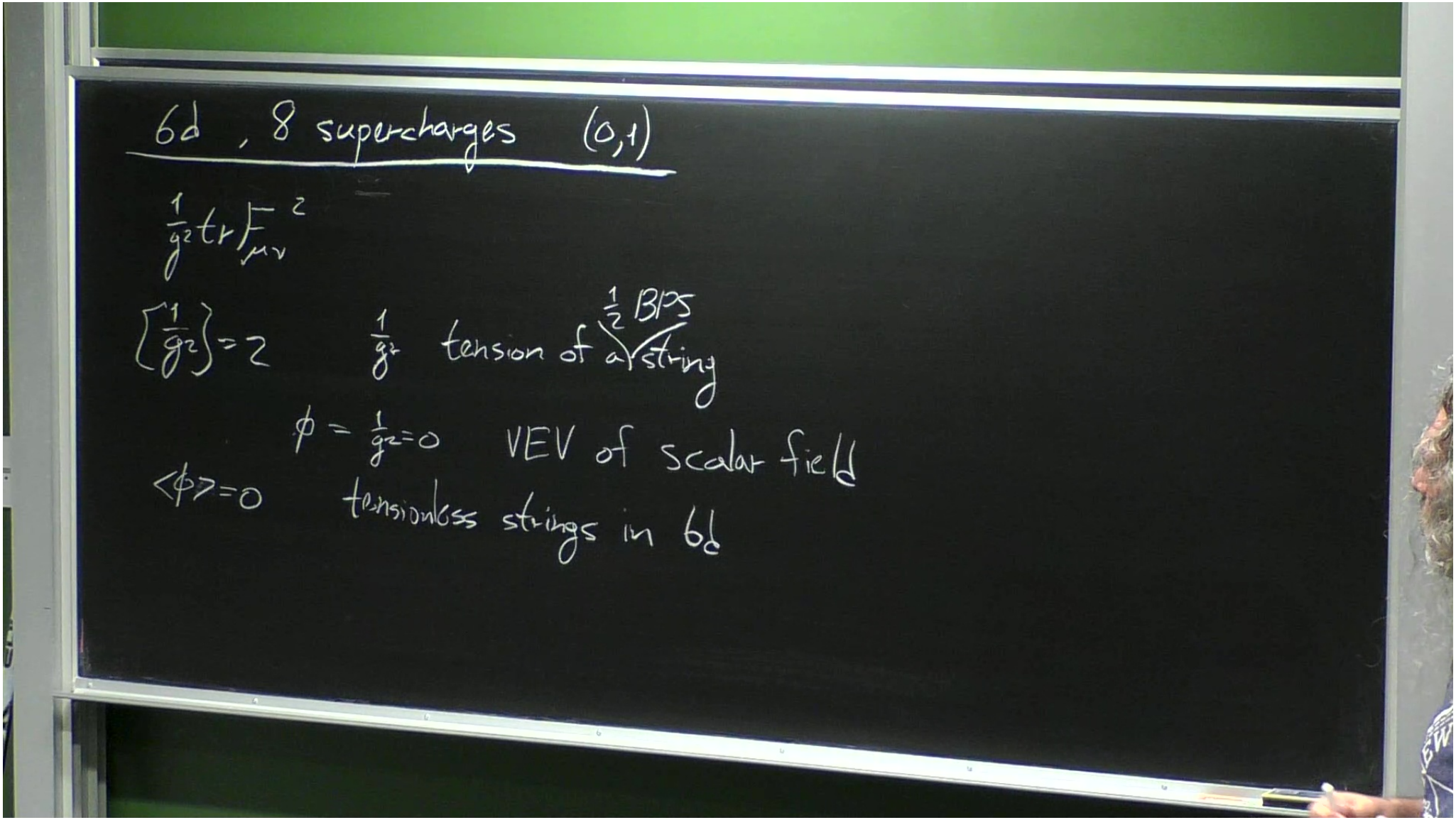
Subject: Mathematical physics

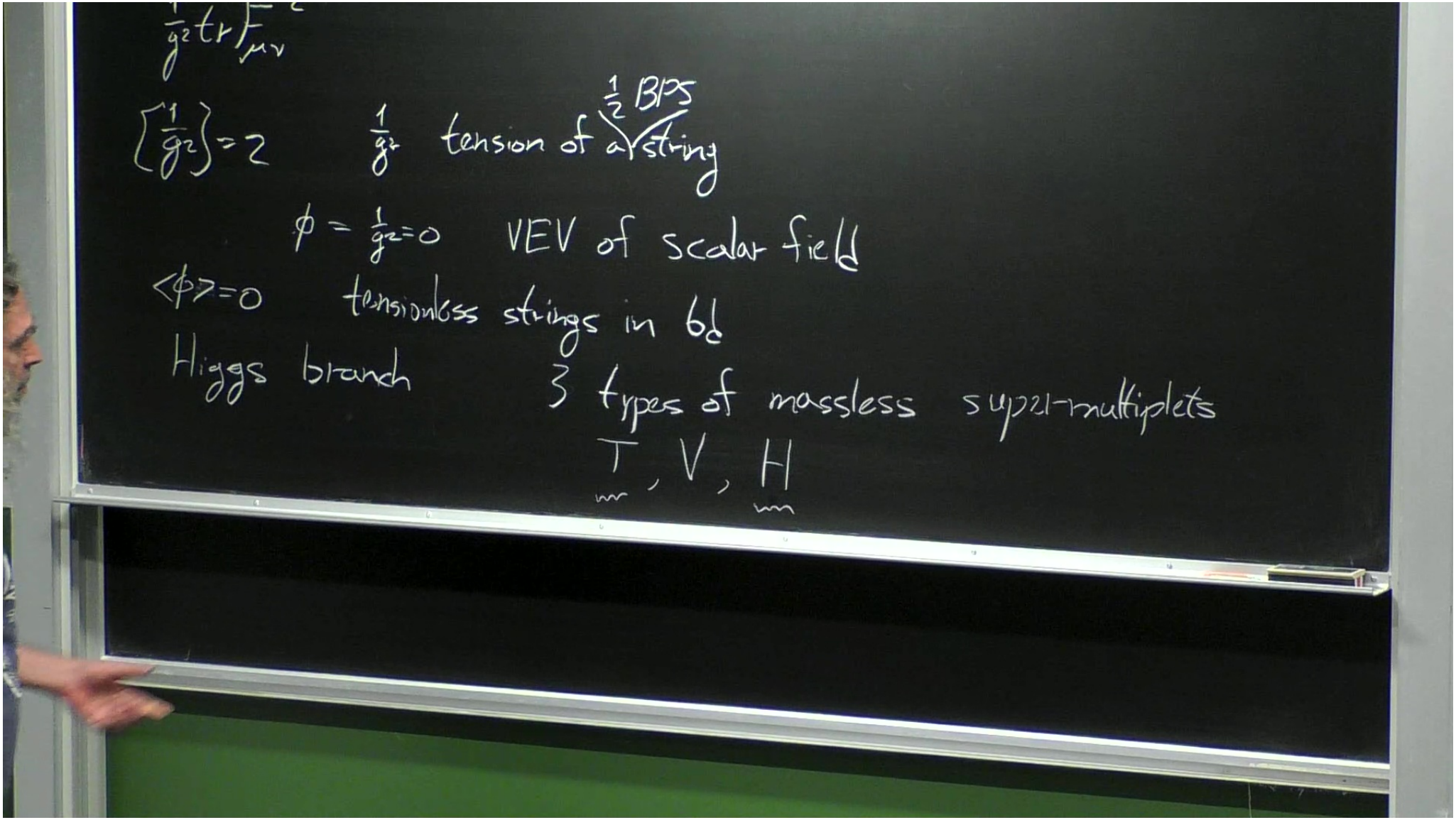
Date: December 02, 2024 - 1:00 PM

URL: https://pirsa.org/24120028

Abstract:

Higgs branches in theories with 8 supercharges change as one tunes the gauge coupling to critical values. This talk will focus on six dimensional (0,1) supersymmetric theories in studying the different phenomena associated with such a change. Based on a Type IIA brane system, involving NS5 branes, D6 branes and D8 branes, one can derive a "magnetic quiver" which enables the construction of the Higgs branch using a “magnetic construction” or as a more commonly known object “3d N=4 Coulomb branch”. Interestingly enough, the magnetic construction opens a window to a new set of Higgs branches which were not available using the well studied method of hyperkähler quotient. It turns out that exceptional global symmetries are fairly common in the magnetic construction, and few examples will be shown. In all such cases there are strongly coupled theories where Lagrangian description fails, and the magnetic construction is helpful in finding properties of the theory. Each Higgs branch can be characterized by a phase diagram which describes the different sets of massless fields around vacua. We will use such diagrams to study how Higgs branches change. If time permits we will show an interesting exceptional sequence consisting of SU(3) — G2 — SO(7).


6d , 8 supercharges (0,1)
$\frac{1}{g^2} tr F_{\mu\nu}^2$
$\left[\frac{1}{g^2}\right] = 2$
$\frac{1}{g^2}$ tension of a string
$\frac{1}{2}$ BPS
$\phi = \frac{1}{g^2} = 0$ VEV of scalar field
$\langle\phi\rangle = 0$ tensionless strings in 6d


$\frac{1}{g^2} tr F_{\mu\nu}^2$
$\left[\frac{1}{g^2}\right] = 2$
$\frac{1}{g^2}$ tension of a string
$\frac{1}{2}$ BPS
$\phi = \frac{1}{g^2} = 0$ VEV of scalar field
$\langle\phi\rangle = 0$ tensionless strings in 6d
Higgs branch
3 types of massless supermultiplets
T, V, H

Symplectic singularity

how does the Higgs branch change

SU(2) with 4 flavors $\square$ SO(8)

↓ Sp(1)

1T, 1V, 4H

$M_H = \mathbb{C}^{16} /\!\!/_{SU(2)} = \overline{\min SO(8)}$

$\dim_{\mathbb{Q}} M_H = 8 - 3 = 5$ $= \{M_{8\times 8} : M + M^T = 0, M^2 = 0, r(M) \leq 2\}$

in 6d gauge anomalies

which restrict the matter

$N_f = 4 \bmod 6$

$SU(3)$, $N_f = 0, 6, 12, (18)$

G_2 $N_f = 1, 4, 7, (10)$

Hyper multiplet moduli space $\underline{\underline{T}}, V, \underline{\underline{H}}$

Symplectic singularity

how does the Higgs branch change

$SU(2)$ with 4 flavors $\supset SO(8)$
$\supset Sp(1)$

$1T, 1V, 4H$

$M_H = \mathbb{C}^{16} /\!\!/_{SU(2)} = \overline{\min SO(8)}$

$\dim_{\mathbb{Q}} M_H = 8 - 3 = 5$

$= \{ M_{8\times 8} : M + M^T = 0, M^2 = 0, r(M) \leq 2 \}$

in 6d gauge anomalies which test the matter

$N_f = 4 \bmod 6$

$SU(3)$, $N_f = 0, 6, 12, (18)$

G_2 $N_f = 1, 4, 7, (10)$

Hyper multiplet moduli space $\underline{T}, V, \underline{H}$

Symplectic singularity

how does the Higgs branch change

$SU(2)$ with 4 flavors $\begin{matrix} \square \\ | \\ \square \end{matrix}$ $\begin{matrix} SO(8) \\ | \\ Usp(4) \end{matrix}$

$1T, 1V, 4H$

$M_H = \mathbb{C}^{16} /\!\!/_{SU(2)} = \overline{\min SO(8)}$

$\dim_{\mathbb{Q}} M_H = 8 - 3 = 5$ $= \{ M_{8\times 8} : M + M^T = 0, M^2 = 0, r(M) \leq 2 \}$

in 6d gauge anomalies which restrict the matter

$N_f = 4 \bmod 6$

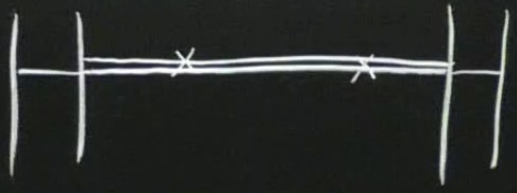
$SU(3)$, $N_f = 0, 6, 12, (18)$

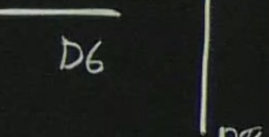
G_2 $N_f = 1, 4, 7, (10)$

$\frac{1}{g^2} = 0$ $\quad \overline{n.\min SO(7)} = \{M_{7\times 7} : M + M^T = 0,\ M^3 = 0,\ r(M) \leq 2\} = \overline{\min SO(8)}/\mathbb{Z}_2$

magnetic quivers, branes

Type IIA D6, NS5, D8



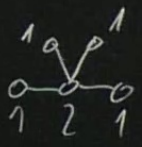


electric quiver: D6 branes between NS branes

magnetic " " " D8 "

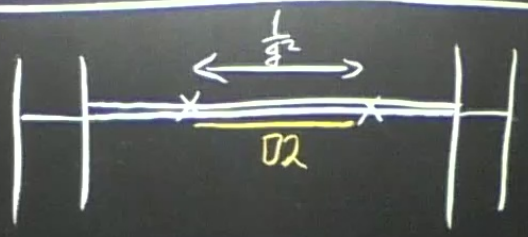
□ SO(8)

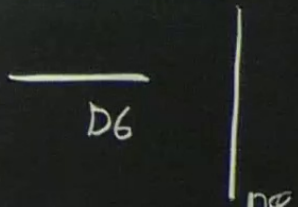
○ SU(2)



magnetic quivers, branes

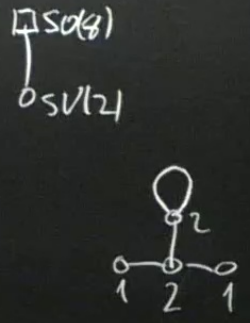
Type IIA D6, NS5, D8

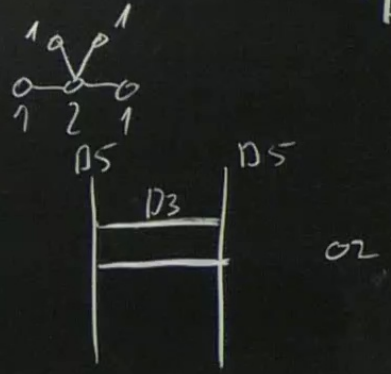




electric quiver: D6 branes between NS branes

magnetic " " " D8 "





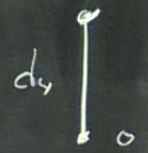
phase diagram

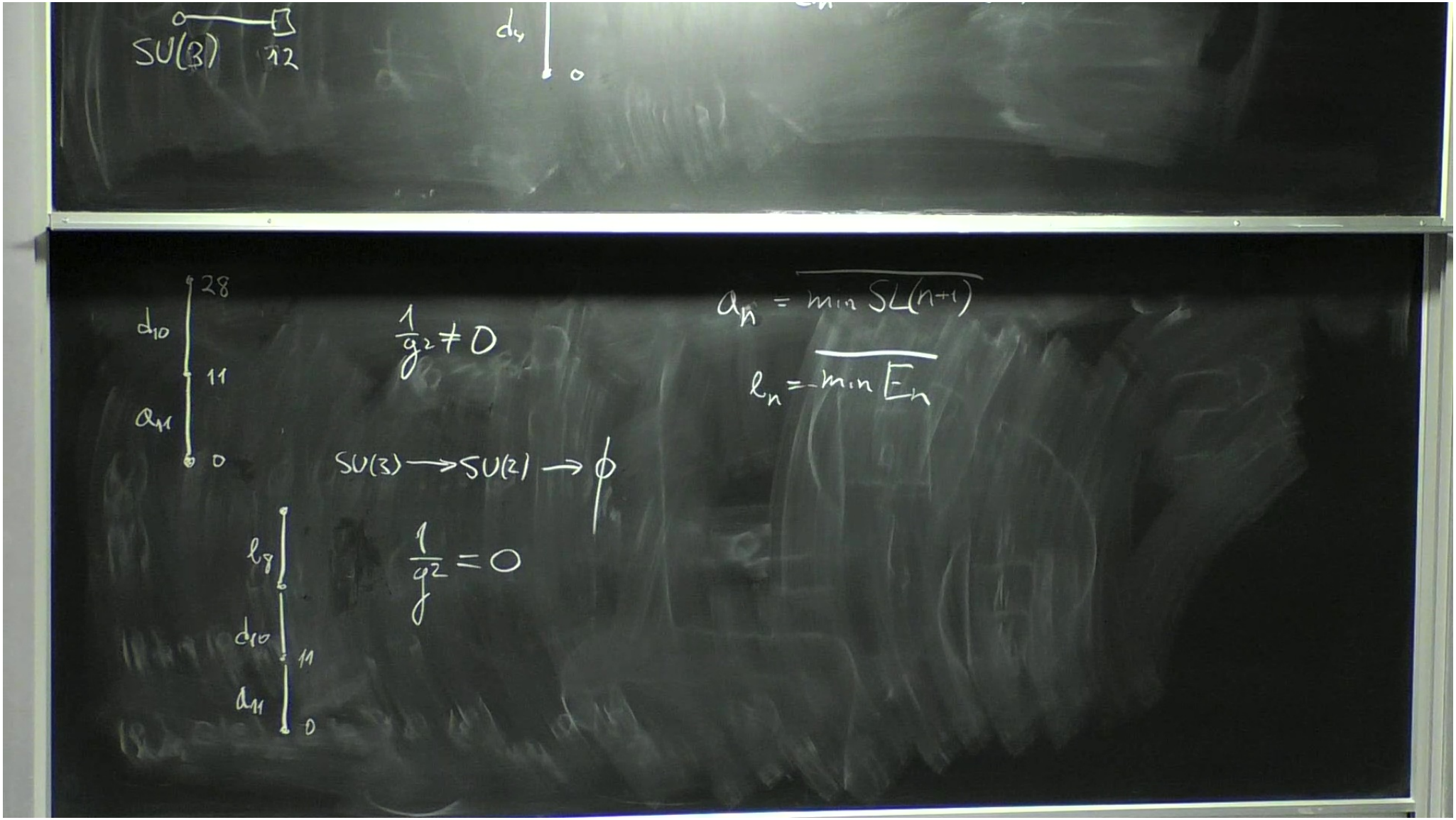
$\mathcal{M}_H$, disjoint union of sets of vacua

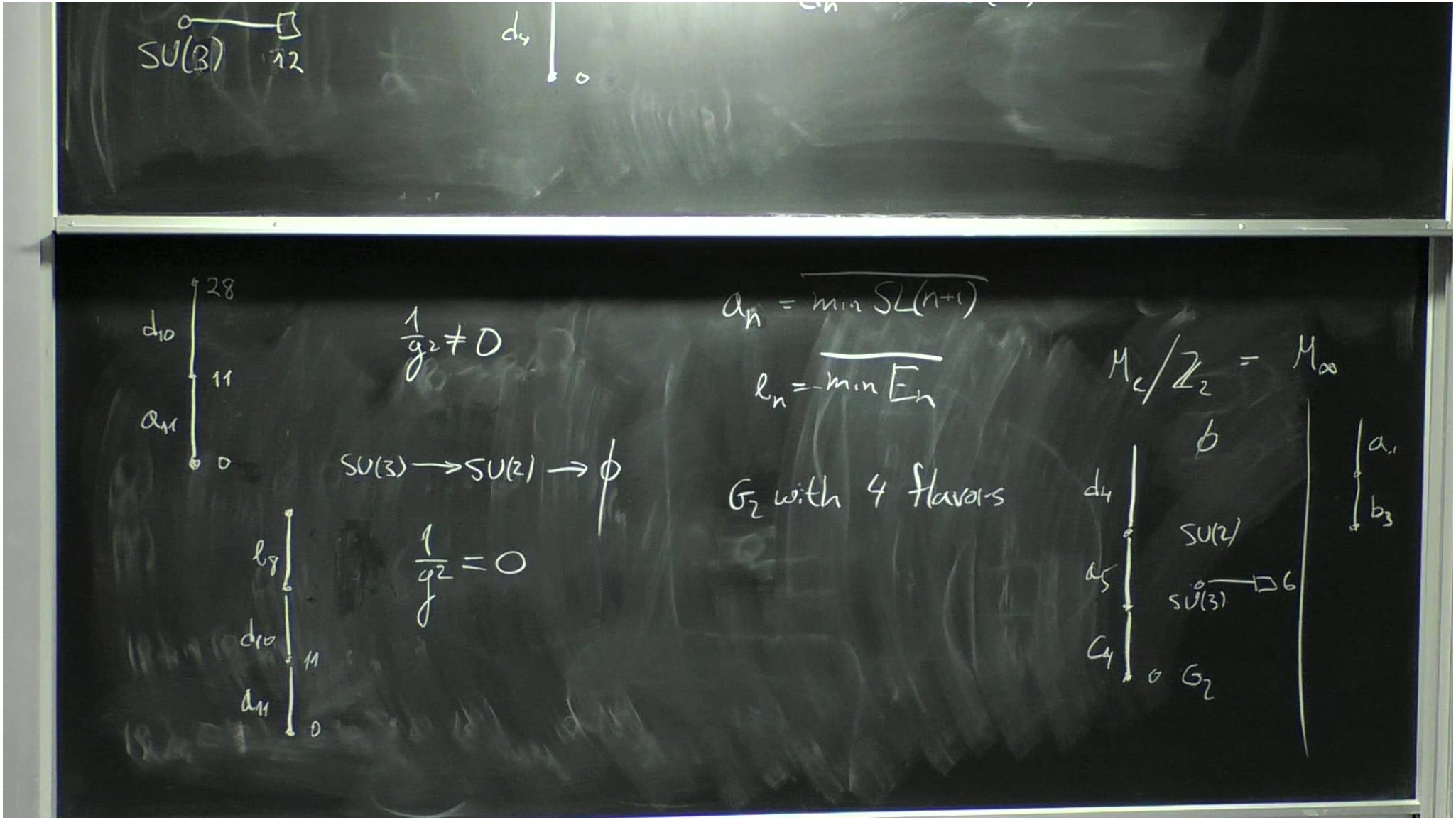
characterized by set of massless states

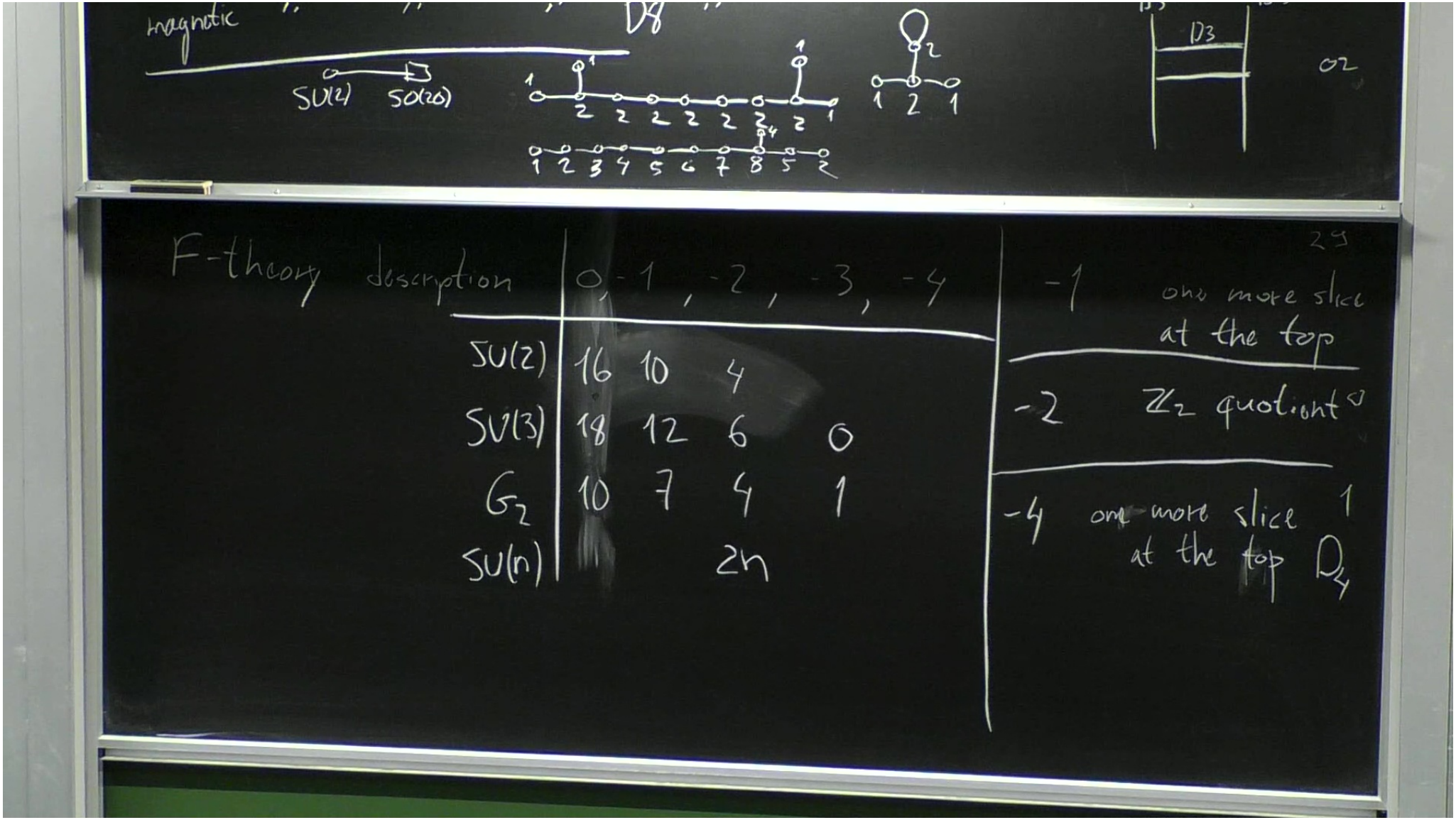
← cone , symplectic singularity

$d_n = \overline{\text{min } SO(2n)}$




SU(3)
12
d_4
0
28
d_{10}
11
d_{11}
0
$\frac{1}{g^2} \neq 0$
$a_n = \overline{\min SL(n+1)}$
$\ell_n = \overline{-\min E_n}$
$SU(3) \longrightarrow SU(2) \longrightarrow \phi$
$\frac{1}{g^2} = 0$
ℓ_9
d_{10}
11
d_{11}
0


SU(3)
12
d_4
0
28
d_{10}
11
a_{11}
0
$\frac{1}{g_2} \neq 0$
$SU(3) \longrightarrow SU(2) \longrightarrow \phi$
$\frac{1}{g^2} = 0$
e_7
d_{10}
11
a_{11}
0
$a_n = \overline{\min SL(n+1)}$
$e_n = \overline{-\min E_n}$
G_2 with 4 flavors
$M_c/\mathbb{Z}_2 = M_\infty$
b
d_4
SU(2)
d_5
SU(3)
6
C_4
0 G_2
a_1
b_3


magnetic
D8
SU(2) SO(20)
D3
O2
F-theory description | 0, -1, -2, -3, -4
SU(2) | 16 10 4
SU(3) | 18 12 6 0
G_2 | 10 7 4 1
SU(n) | 2n
-1 one more slice at the top
-2 $\mathbb{Z}_2$ quotient
-4 one more slice at the top D_4