Bourjaily

$$\text{geom} \begin{cases} D4 \\ N1 \end{cases} \begin{cases} \text{F } / 4^0_{\mathbb{C}} \\ \text{M } / 7^0_{\mathbb{R}} \end{cases}$$

chiral matter: charge: gauge forces

IIA Dbra = M geom

IIB Dbra = F geom

$$\text{HE38 } / T^3 = \text{ M } / Y_2$$

$$\text{H } / Y_3 \left(T^3\right) = \text{ M } / G_2 \left(Y_2\right) \text{ geom}$$

$$Y_3 \sim Y_3^{\text{mirr}} \Rightarrow Y_3 \left(T^3\right)$$

F/8=triple intersection 2-cycles/matter curves=cubic operators superpotential

M/7=M2 instantons wrapping SUSY 3-cycles

M/7 gauge=rank 7 subgroups E8 one U(1)

F/8 gauge=rank 6 subgroups E8 two U(1)

M(ALE)

$$\Gamma_k = E_k \text{ root lattice } = \text{ SUSY 2-cycle basis}$$

$$\mathbb{C}^2 / \Gamma_k \text{ orbifold}$$

$$1^0_{\mathbb{H}} \text{ hyperKahler}$$

$$C \cap C' \neq \varnothing \Leftrightarrow C|C' \neq 0$$

$$E_k \text{ roots } \subset \mathbb{R}^{1:k}$$

$$C|C = 2$$

pos roots

$$e_i - e_j$$

$$e_i + e_j + e_k - e_0$$

$$k \geqslant 6: \quad e_{i_1} + \cdots + e_{i_6} - 2\, e_0$$

$$k = 8: \quad e_i + e_1 + \cdots + e_8 - 3\, e_0$$

$$\text{MF } / \text{ shrinking roots } \Rightarrow E_k \text{ gauge}$$

$$\text{ad } E_7 = 133 \begin{cases} b_2 = 7 \text{ basic 2-cycles } + \not{3} \text{ KK reduction } \Rightarrow 7 \text{ KK ab vector fields/Sugra} \\ \text{massless M2 wrap sizeless roots } \Rightarrow 126 \text{ non-ab vector fields/Subra} \end{cases}$$

$$M/7 = \text{ ALE} \times \mathbb{S}^3 = \mathbb{C}^2/\Gamma_k \times \mathbb{S}^3 = 1^0_{\mathbb{H}} \times \mathbb{S}^3$$

$$E_8 \supset E_6 \times SU_3$$

$$248 = 78{:}1 + 1{:}8 + 27{:}\bar{3} + \overline{27}{:}3$$