

Title: Talk 5

Speakers:

Collection: Simplicity III

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$$\frac{SU(3) \times SU(2) \times U(1)}{\mathbb{Z}_6} = S(U(3) \times U(2))$$

$$\left( \begin{smallmatrix} 3 \\ 2 \end{smallmatrix} \right)_{\frac{1}{3}} \oplus \left( \begin{smallmatrix} 1 \\ 2 \end{smallmatrix} \right)_{-1} \quad \mathbb{Z}_6$$

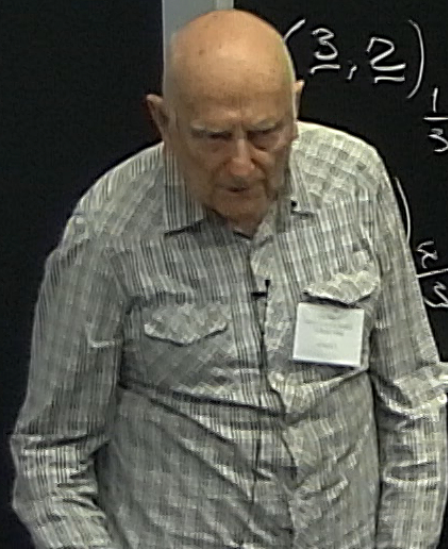
$$\left( \begin{smallmatrix} 3 \\ 1 \end{smallmatrix} \right)$$

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$$\frac{SU(3) \times SU(2) \times U(1)}{\mathbb{Z}_6} = S(U(3) \times U(2))$$

$$\left(\frac{3}{3}, 2\right)_{\frac{1}{3}} \oplus \left(1, 2\right)_{-1} \quad L$$

$$\left(\frac{4}{3}, 1\right)_{\frac{2}{3}} \times \dots$$



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$$\frac{SU(3) \times SU(2) \times U(1)}{\mathbb{Z}_6} = S(U(3) \times U(2))$$

$$\left(\frac{3}{-}, \frac{2}{-}\right)_{\frac{1}{3}} \oplus (1, \frac{2}{-})_{-1} \quad L$$

$$\left(\frac{3}{-}, 1\right)_{\frac{2}{3}} \oplus (3, 1)_{\frac{1}{3}} + \dots \quad -2$$

GUT

SU(5)  
 SO(10)  
 SU(4) × SU(2) × SU(2)

$$\bigoplus_{\nu=0}^5 \wedge^{\nu} \mathbb{C}^5 \quad \underline{24} \quad (\underline{8,1})_0 \oplus (\underline{1,3})_0 \oplus (\underline{1,1})_0$$

$$\underline{16}_L \oplus \underline{16}_R \quad + (\underline{3,2})_{\frac{1}{3}} \oplus (\underline{3,2})_{\frac{2}{3}}$$

1988 NCG

Commas

$$A_F = \mathbb{C} \oplus H \oplus \mathbb{C}[\mathbb{Z}]$$



$$\bigoplus_{\nu=0}^5 \wedge^{\nu} \mathbb{C}^5 \quad \underline{24} \quad (8,1)_0 \oplus (1,3)_0 \oplus (1,1)_0$$

$$\underline{16}_L \oplus \underline{16}_R + (3,2)_{\frac{1}{3}} \oplus (3,2)_{\frac{2}{3}} \quad \text{Commes}$$

1988 NCG p Jordan

$$A_F = \mathbb{C} \oplus H \oplus \mathbb{C} [3]$$

$$X \circ Y = \frac{1}{2}(XY + YX) = Y \circ X$$

$$L_X Y = X \circ Y \quad [L_X, L_X] = 0$$

$$\bigoplus_{\nu=0}^5 \wedge^\nu \mathbb{C}^5 \quad \underline{24} \quad (8,1)_0 \oplus (1,3)_0 \oplus (1,1)_0$$

$$\underline{16}_L \oplus \underline{16}_R + (3,2)_{\frac{2}{3}} \oplus (3,2)_{\frac{1}{3}} \quad \text{Commas}$$

$$1988 \quad \text{NCG} \quad p \text{ Jordan} \quad A_F = \mathbb{C} \oplus H \oplus ([3])$$

$$X \circ Y = \frac{1}{2}(XY + YX) = Y \circ X \quad \text{tr } X^2 > 0$$

$$L_X Y = X \circ Y \quad [L_X, L_{X^2}] = 0 \quad X^2 + Y^2 = 0 \Rightarrow X = Y = 0$$

$$|\psi\rangle\langle\psi|$$

$$d \sum_i |d^i\rangle\langle d^i|$$

J. v. Neumann 1934

Peirce

$$J_3^8 = H_3(\mathbb{O})$$

$$X = \begin{pmatrix} x_3 & x_2 & x_1 \\ x_3^* & x_2^* & x_1^* \\ x_2 & x_1 & x_3 \end{pmatrix} \quad 27$$

$$J_r^d \quad E_{ij} \quad E_{ii}$$

$$\downarrow$$

$$\dim J_r^d = \binom{r}{2} d + r$$

$$J_2^d \quad X = \sum \lambda_i + \hat{x} \quad \text{tr } \hat{x} = 0$$

$$X^2 = N(X) = \sum_{\mu=0}^d x_\mu^2 \quad X^2 - 2\sum X + \det X$$

$$\sum_{\mu=0}^d x_\mu^2 = N(X)$$

Albert



$$|\psi\rangle\langle\psi|$$

$$d \sum_i |d^i\rangle\langle d^i|$$

J. v. Neumann 1934

Peirce

$$J_3^8 = H_3(\mathbb{O})$$

$$X_{(\sum_i x_i)} = \begin{pmatrix} \sum_1 x_3 & x_3 & x_2^x \\ x_3^x & \sum_2 & x_1 \\ x_2 & x_4^x & \sum_3 \end{pmatrix} \quad 27$$

$$\begin{matrix} J^d \\ J_r \\ \downarrow \\ \dim J_r^d = \binom{r}{2}d + r \end{matrix} \quad \begin{matrix} E_{ij} \\ d_{ij} \end{matrix} \quad E_{ii}$$

$$J_2^d X = \sum 1 + \hat{X} \quad \text{tr} X = 0$$

$$X^2 = N(X) = \sum_{m=0}^d x_m^2 \quad X^2 - 2\sum X + \det X = \sum^2 - N(X)$$

Albert

$$\mathbb{D} = \mathbb{C} \oplus \mathbb{C}^3$$

$$\frac{SU(3)_c \times G_{12}}{\mathbb{Z}_3}$$

$$X(\xi, x) = X(\xi, z) + (Z_r)$$

$$|xy|^2 = |x|^2 |y|^2$$

$$x = z + Z$$

$$\frac{SU(3)_c \times SU(3)_{EW}}{\mathbb{Z}_3}$$

$F_4$

$X_{\mathbb{C}} \subset \mathbb{C}^3$   $\mathbb{Z}_3$

$$\mathbb{O} = \mathbb{C} \oplus \mathbb{C}^3 \quad \underline{SU(3)} \subset G_2 \quad X_{(\mathbb{Z}_3, X)} = X_{(\mathbb{Z}_3, Z)} + (\mathbb{Z}_3)$$

$$|xy|^2 = |x|^2 |y|^2 \quad x = z + Z$$

$$\frac{SU(3) \times SU(3)}{\mathbb{Z}_3} = F_4^{\omega} \subset F_4$$

$$F_4 \quad J_2^8 \subset \mathcal{O}_g \quad Spin(9) \quad (U, V)$$

$$\mathbb{Z}_3 \quad V X_{(\mathbb{Z}_3, Z)} V^* + U Z V^*$$

$$F_4^{\omega} \cap Spin(9)$$

CAUTION

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$$G_{SM} = \frac{SU(3) \times SU(2) \times U(1)}{\mathbb{Z}_6} = S(U(3) \times U(2))$$

$(\underline{3}, \underline{2})_{\frac{1}{3}} \oplus (\underline{1}, \underline{2})_{-1} \quad L \quad 6$   
 $(\underline{3}, \underline{1})_{\frac{2}{3}} \oplus (\underline{3}, \underline{1})_{-1} \quad + \dots \quad 0 \quad -2$

$G_{UT} \quad SU(5)$   
 $SO(10)$   
 $SU(4) \times SU(2) \times SU(2)$

