## LEC 21: REPRESENTATIONS

11/8

LAST TIME: GROUPS: ABSTRACT MATCHEMATICAL

DESCRIPTIONS OF SYMMETRIES

LIE GROUPS: containeds Groups

(hove of parameters

characterizing the

symmetry transform.)

GROUPS THAT ARE MANIFOURS

WE AUGURATION: COMMUTATION.

contains all of the board information about the group

contlink of this as set of lelocities e e = 1 ; que trajectories to reach Calmost any group element

| Address and the special part of the special special special special special special special special special sp   | REPRESENTATION SET OF MCEBRA)  |
|--|--|
|  | REPRESENTATION: MATERICES  |
| en alventississen en en anno en  | MAP BETWEEN GROUP EVENENTS ?   |
| and the second s | MATRICES THAT PRESERVES MULTIPULATION.   |
|  | eg $\begin{pmatrix} \cos \Theta & \sin \Theta \end{pmatrix}$ is the defining (fundamental $-\sin \Theta & \cos \Theta \end{pmatrix}$ rep. of so(2) |
|  | D(g(0)) D'is the rep. CAN MUSS IMPRINE   |
|  | for small parameter 0=8  |
|  | $D[g(e)] = 4 + i \epsilon d(T) + \cdots$   |
|  | Taylor exp crossed 11 REPREDENTATION   |
|  | OF THE ALBERTA   |
|  | $D[g(\theta)] = \lim_{k \to \infty} (1 + i \frac{\theta}{k} + 1)^k = e^{i\theta + 1}$  |
|  | a(T) (EXPONDITIVE)   |
|  | 80 SETEN, WE SAM NEED TO UNDERSTAND  |
|  | BUGGBRA.   |
|  |  |
|  |  |

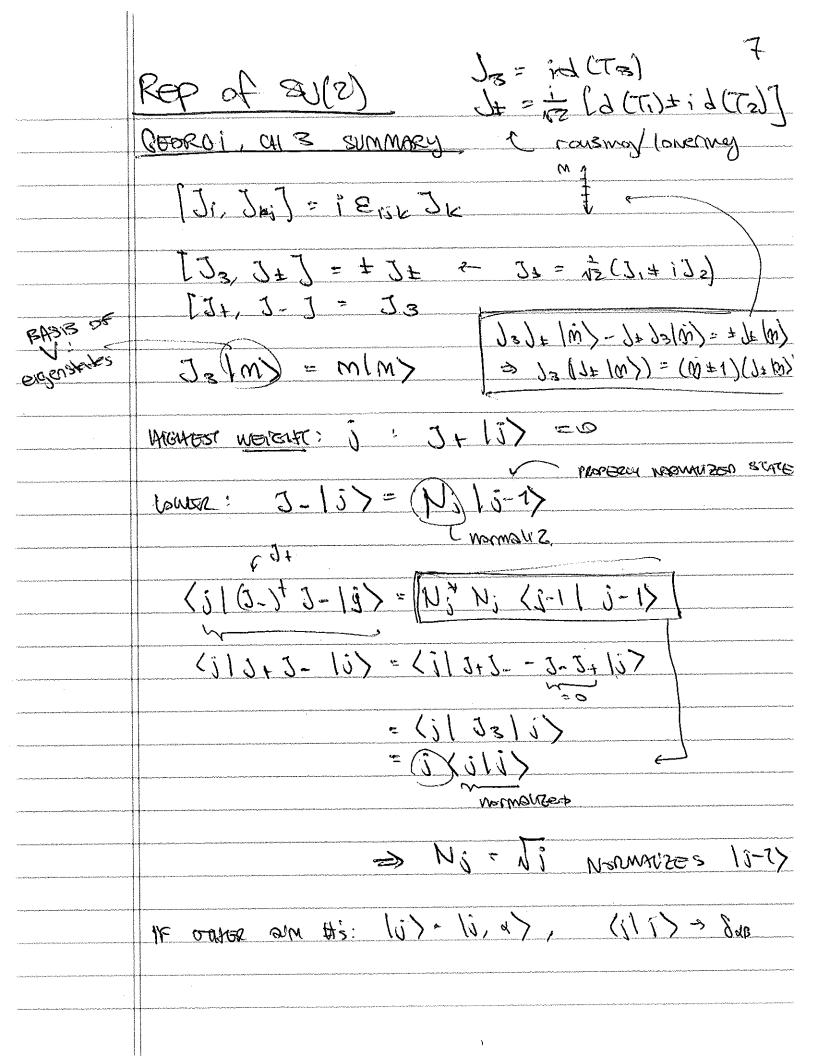
compare to 'over rep"

ONE STEP MORE COMPUCACED: ROTATIONS SC(S): L(80(S)) is given by  $T_1 = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ ROT ABOUT  $\chi$   $T_2 = \begin{pmatrix} -1 & 0 \\ -1 & 0 \end{pmatrix}$ ROT ABOUT  $\chi$ 

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| and the second  |   |
|   | BCH FRANCE: exp(x+y+ \frac{1}{2}(x,1x))+ \frac{1}{12}(x,1x) |
|   | 7 + 12/8,43,43.   |
|   | you can look it up.   |
|   | Commutator!   |
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| $P(f_i)^* P^* F_{i,i} \mid \text{core}(i)  V(G_{i,i})^*  (i)  V(G_{i,i})^*  (i)  V(G_{i,i})^*  V(G_{i,$   |   |
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chumbted w ow sound on 5-state ons; EXAMPLE: SU(2) - special unitary 2x2 matrices det v=1 Tutu=1 WHAT IS THE ALGEBRA? det U = 1 - 2 Eab Ecd Vac Ubd Le det U = 0 + ¿ EabEca (Vac Ubd + Vac Uba) end up w) [tr(0)=0 v+U = 11 までしばっつこでかかまる = [ 2+ + 2 = 0] cf 80(2) 80: ALGEBRA: traceless, Conti) hermition 2x2 HOW MANY ARE THERE? 8 IR comp. fracedoss: Carti) Normitian :

YOU PROBABLY ALPEADY KNOW A MICE BASIS OF SUCH CHATRICES: PAUL MATRICES [oi, oi] = Einkok exact some commutation relation as six3)! Ner [7; = - 20; ] L(30(2)) = L(50(3)) NB: |SU(E) # SO(3) BUT ONE THING WE CAN GLEAN FROM THIS IS THAT SU(2) HAS SOMETHING TO BO WITH POTATIONS MOCKE A NET OF ELEMENTS OF SU(2) ARE EXPONDINTIATION OF pres of L(SU(2)) IMPORTANT: 5% IS DIAGONAL. 80, eg, if WEIDE IN A BASIS WHERE H 15 DIAGONAL "THEN ACTING WI dOS) SO D(CIOSAD) WILL NOT CHANGE YOUR EXCENSIBLE



UKI)Y)GIZ

WHAT AROUT 
$$3 + 10 - 1$$
?

=  $\frac{1}{N_0} 3^{\dagger} 3 - 10$ 

=  $\frac{1}{N_0} [3 + 3 - 10]$ 

=  $\frac{1}{N_0} [3 + 3 - 31]$ 

=  $\frac{1}{N_0} [3 + 3 - 31]$ 

=  $\frac{1}{N_0} [3 + 3 - 31]$ 

can continue this proxess

CHECIANG NOONBLIZATIONS:

BUT: ALSO EXISTS A BISTROM OF LADDER

Nj-e = vs N(2i-e)(e+1) =0 = [l=2]

| noonselectuur (1941 – 1842) kan talainen kan talainen kan talainen kan talainen kan talainen kan talainen kan t | THE STANDARD NOTATION  |
|---|--|
|   | Upsel states by Max 13 (i)  Co encodes total # of states  (size of representation)   |
|   | AND BY J3 (W)  |
|   | $(3, m'   3= 13, m) = 8mm m$ $(3, m'   3+ 13, m) = \sqrt{(3+M+1)(3-1)}$ $(3, m'   3+ 13, m) = \sqrt{(3+M+1)(3-1)}$ $(3, m'   3-13, m) = \sqrt{(3+M+1)(3-1)}$ $(3, m'   3-13, m) = \sqrt{(3+M+1)(3-1)}$ $(3, m'   3-13, m) = \sqrt{(3+M+1)(3-1)}$ |
|   | $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$   |
|   | or writing by m names  |

$$J_{1}^{(1/2)} = \frac{1}{2} \begin{pmatrix} 0 & 1 \\ 1 & n \end{pmatrix}^{2} = \frac{1}{2} \sigma_{1}$$

$$J_{2}^{(1/2)} = \frac{1}{2} \begin{pmatrix} 1 & -1 \\ 1 & -1 \end{pmatrix}^{2} = \frac{1}{2} \sigma_{2}$$

$$J_{3}^{(1/2)} = \frac{1}{2} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}^{2} = \frac{1}{2} \sigma_{3}$$

## SPIN-1:

$$\vec{J} = \frac{1}{\sqrt{z}} \left\{ \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix} \right\}$$

Call traceless. Nermitian matrices

|  | THESE TWO ARE SPECIAL PERS  |
|--|---|
|  | SPIN- Z: DEFINING REP (PUNDAMENTUL)   |
| A de come de la colonia del Prima de la colonia de la colo | t what we ween by "80(2)"   |
|  | SAM - 2: MOJOINT REP , EXMINACENT TO  |
|  |   |
|  | A REPRESENTATION PURNISHED BY   |
| العالمية المراجعة ال   | GENERATORY  |
|  | $\left[\frac{1}{d^{(Ad)}}\left(T_{a}\right)\right]_{bc}=2^{\frac{1}{2}}C_{abc}$ |
| r and should see the order to see the section of th | 1d Cla) bc=21 Cabo  |
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| and the second of the second o | LTa. Tb] = i Caba Ta  |
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| Court description as in the second  |   |
|  | 8pm-2: 12,2>, 12,-2>  |
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