·		137 A
unitary operator with small parturbation:	0=	Hermitian Operators (Megni: def)
Q=Î+12F/ 4 1111 NA	0 7	i) < X 1 (A4) > = (LA6) 14> iii) At = A.
F=2 > translation, H= time evolution. 12 > rotation		$i) < X   (A \psi) \rangle = \langle (A \psi)   \psi \rangle$ $iii) A^{\dagger} = A$ $ii) \Leftrightarrow \langle \psi   (A \psi) \rangle = \langle (A \psi)   \psi \rangle$
Uz (Sa) = I-1 = Sa [z		=> <41A14>13 real . 11.11, 1002 11.11.11.11.11.11.11.11.11.11.11.11.11.
Ingeneral I Un(sx)=z= = sanil		A has real eigenvalues. :!!!!!
Fin terretations univx) = exp(= xtpin):		Adjoint (Hérmitian conjugate:
Isolated system: [î, A]=0; then i) is concerved	0-3	< X 1 A+ 147 = < (A) X ) 147 = < 41 A 1, X > * 1 12
1.3/1 3.1/3/		$\langle \phi   := \langle X   A^{\dagger} \Rightarrow     \phi \rangle =   A   x \rangle$
	0-1	· Unitary: U-1=U+. U:=eiA ~> U+=(eiA)+=e-iA (A+=A)
	0-)	· f(z) := Z cizi ~> f(A) := Z ciAi
		[fcm]t = & G*A*)t = Sci* At)i = f* (At)
		Projection Operator:
- the state of the	0-)	$1 dempotent: \Lambda^2 = \Lambda.$
	0-1	If A is Hermitiant and idempotent, then !!!
1 1	0	it is a projection operator.
		-> Decomposition = A4+(I+A)4.
1 1.511+ (64 611) 11 6.1 5.41. 11		< > < < < > < < < > < < < < > < < < <
21 1/11/11/11/11/11/11/11/11/11/11/11/11/		4= 8cn4n -> cm = <4m14>
		・ 4(ア, サニア) 「「リストアンリレア」、も) カア (ルハイア) コー
		= [ [ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
		) [ a the strain of the strain
i i i i i i i i i i i i i i i i i i i		ラスサポレアンサル(アンテムをアーアン)
b (c) (i' i		ン なりゃ(アバーアン) りにアバーアン = S(アルーアン) ·· S(アルーアン)
1 >1 · \$1 · \$1 · \$1 · \$1 · \$1 · \$1 · \$1	9=1	< X 1 4 > = \( \text{X*(P,+)} \( \text{P,+)} \def \( \text{P',+} \) \( \text{P',+} \
	0-3	= 「「X*(アル) S(ア・・アウナ(アジャ) dアイア
	<b>6</b> -3	= 2 (X*(F)+).4n(F)dF)(+)(F)+)dF)
Charles of English to the control of	0-3	= 2 < X   4n> < 4n  4>
	0-1	> 2 14n>< 4n = 1.
	677	
		1

- 2A7 = < 41A14> = 2 2 cm Cr < 4ml A14n> = En cinchan childring - El cal an = 7 2 cm cn Cum Millen + En da cm cla) clan Alla) = El colzant/ Iccar/2ada cn=<4n(4>, c(a)=<4a14> Chosure relation for a "ono-particle system: 54\*(F') 4n(F) + 54\*(F') Yatt) da = 8(F-F') · Observable A, B, B, B, are compatible of they poisess a common set of eigenfunctions. · AByn=anbnyn=bwanyn=BAYnulling => (AB-BA) 4 = Stenic ABLBA) 4n = 104111111 · If [A,B] =0 : 1 A(Byn) = BA(4) = an(Byn) 11 · where an non-degenerated: then By a = bnya · where an 113 degenerater 12: Bynt E Crouns BZ, dr fnr = PZ Z dr Crs fns = bn Z dr fnr = 2 di Cristbudgi +3

· [AIB] = -ZB,A] [A B+c] = [A B]+ [A G]: [A, [B, c]] + [B, [C,A]], + [C,[A,B]] = 0 1 · AA:=[<(A-<A>)}7]=[ CA2>-(CA)]]=1. 11 AR ARISISIS CEAMBER LINE A B'age observables ·Prf: A:=A- (A > B:=B- (B) (Vinear Hermitian) => (AB)= (AB) = AB2, (AB) [A, 13] = [A-)<AD, (B-KB>) = [A|R] : C:= A+INB, ACIR, Ct=(A+INB <cc+>= < 4 1 qct 14> = < c+ + 11c+4> >>> € 1818\_ 1(x) := <cct>11/1/1/ 1/1/VERABJ>ER 11 (1, y1) = < (A+1XB)(A+1XB)> = < A2> + ~2 < B3~山入([本, B])> 5( - (AB) - FW/mn= (AA) + A/ (AB) 7 - 1 / (AB) > > > = 5( AB) - FW/mn= (AA) + A/ (AB) > 7,0 //// WANTCABITY TELEBRITY · The minimam works training holds when !! D= [(A1B)]/[2AB)2]11 (Ct4)=01: =11) Comider x, px 1: x = 0 - ti/[26p3] 1 ··· ct y=0= 2 (APX) (β- (Px>) + (x) + (Px>) + (x) 1-1-00 4 (x) = ( exp ( + (Pxbx)) (xxp [- (xpx)2 (x- (xx)2/+2-Gaussian Wave parket. AT' + 1 = 1 -( ALCA MESTALLERACE) - Jana Mar Dan Coll & All Charles

· Matrix representation · Unitary transformation  $\frac{1}{U} \xrightarrow{A} X \qquad A'U = UA : 1 \qquad (1)$   $U \downarrow O \downarrow U \qquad \Rightarrow A' = UAUt : M : A' \qquad . \qquad .$ 147= & 14n>cn, 1x= & 14m>dm, Amn = <4m 1 A14n> X=A4 => dm=<4m1x>=<4m1A14>= ZAmncn ⇒ガ=Aご · A B Hermittan = A' is Hermitian < X14> = < X | Z14n>< 4n1 14> 11/10 @ porator equations remain uncharged in form = & (< 4,1x>)\* < 4,14> = Idn cn = at. 2 If the complete set of orthonormal eigenfunctions 15 THE A FEN B+CLED ICTIONS 1' 1. Eling of anobservable A is used as a basis, then [AIB] AC => [A', B'] = C A - I SI A I A is represented by a diagonal matrix. · LHO:  $\hat{M} = \frac{1}{2} \frac{1}{2} \frac{mw^2}{2}$ · (an, 46) = eig (A) :1... ât:= JE[ Max x 7 of mhax > (and vun) = eig(A') 10 CXIAI4> = < X'IA'I4'> : ((1)  $\Rightarrow [a_{1}, a_{1}] = 1$   $A = \frac{hw}{2} (\hat{a} \hat{a}_{1} + \hat{a}_{1} \hat{a}_{2})$ · Fourier transform +(x+t) = O(px+t) is unitary: Φ(px, t) = 0 H(x, t); (+ (x, t) dx = hw (a-a+-1) = hw(a+a+1) = tw (+++) · L'and Lz form a complete set for the specification · Intinitesimal unitary transformation of angular momentum states. U= 1-18/5/1864 - 5-12 Hermitian 11 11 I=U+U=(Iにを中)(I+以下) 1111 y= rsino simp ~ ) Ly = -it (cozy - cotosino 3) = Imist + 12 F + 2 (E) 12= rano 1/2 = -it fo 1 = Ft=F=> Fis Hermitlan (1) IF is called a the generator of the enf. un.t. U 111(4) = U4) = 4+ 125 F4 = 4+ 54 Where & d = 12 F4 = A+STA = WAUTY BULL 1 ... SILVE => A+8A = A+12[F,A] + U(E) => 8A=iZ[F,A] to first order in 2.