Discrete Symmetries

1 Parity Ti spatial inversion

classical = - - =

 $\hat{\pi}^*\hat{\mathbf{x}}\hat{\mathbf{f}} = -\hat{\mathbf{x}}$

Hen & Tilx>=-x(Tilx)

so file? = e (-X) & by convention = 0

17 /x > = /x> 20 TT = TT

IT is hermitian.

Parity of momentum &. Translation operator
Tx(a)(b)=(x+a)

 $T_X(-a) \widehat{\pi} |x\rangle = T_X(-c) |-x\rangle = |\pm x-a\rangle = \widehat{\pi} |x+a\rangle$

= Ffallx>

or $T_{\chi}(-a)$ $\overrightarrow{T} = \overrightarrow{\Pi} \overrightarrow{T}(a)$ infinitescinally,

(1+12Px) == == (1-12P)

Br = -TB

77 Po TI = - Po in verts operator P -> -P orbited T=rxp -> T o TITT = P Similarly for spen, TTS W=5 If IT, HI = 0 energy eigenstate one state of definite points. TT /4 = ± /4) for YEZINEMY Parity is property of spherical harmonica! P-7 0-7 17-0, Ø-70+1T Ym(00) -> (-1) / m(0,0) filnews = Eight nems

Time reversal f Em change & -> 8; Curvet] -> -j E-1 = 1 3 -7 - B Schrödungen equation first order in time 1 + + + = H4 of 4(x,+) is solution, 4(x,-+) is not due to 2. However 44(x,-+) is solution. So Pinchider complex conjugation. I operator acting on arbitrary ket 1/d> -> f(d) Consider time evolution over in finitessimil time E.

/ x, E) = (1 -: EH) (a, 0)

Consider two physically equivalent state evolutions. (Sakurais)

I. take
$$\vec{p}^2 - \vec{p}' = -\vec{p}'$$
 then evolves to $x - X_0$ in time \vec{z}
 $\vec{p}' = -\vec{p}'$
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 $\vec{z} = \vec{z} = \vec{p}' = -\vec{p}' =$

then -iEHT = TIEH

We cannot have

be course
$$\tilde{z}' + \tilde{r} = -\tilde{r}$$
 would give for free particle $\frac{\tilde{p}^2}{\tilde{z}^m} - \frac{\tilde{p}^2}{\tilde{z}^m}$ which is wrong.

and complex conjugation operator

Preserves commutators,

Time reversal of spinor State & (R) in +1 eigenvalue of Fin operator. On Hw, you show 27(n) = -ioz x(n) 2 2 (-ri) blipped spin classically votatory sphere \$ \frac{1}{2} \quad \quad \frac{1}{2} \quad \frac{1}{2} \quad \frac{1}{2} \quad \qua $\left(-i\,\mathcal{T}_{2}\right)^{2}=\left(0^{-1}\right)\left(0^{-1}\right)^{2}=-\left(0^{1}\right)^{2}-\tilde{\mathcal{I}}$ AS 72 N(B) = - 2(B) where as for spino state 22/0/=+10) generally, 72 /2 integer) = - 1/2 integer) P2 | integer > = + linteger)

Parity Violation in B-decay Wu et al. 1957 Cobalt source at 0.01 k polarized in magnetic field

60 Co -> 60 N; + e Ve

- 4 ½ ½ Observed: dNe = 1 - V cord Sonci Pe - Pe, this preferred direction Violate Parity. Structure of weat interactioni. Weak decay produces left-handed "chiral" electron, Spin anti-aligned with

we will discuss chirality next semester. For ultra-relativistic particle v≈c chirality is equal to helicity.

Montante .

Electric Dipole Moment of neutron	Makeum er endig yek i ilektik konst di niglegentet i give vant en landiji atteste delik di steksionet di nigle
neutron (U3, d-1/3, d-1/3) quartes	
$\frac{3}{-3} \oplus \int d = 0.1 r_n = 0.1 x f_m$	
· ·	
$d_1 = 9l = 4 \times 10^{-4} e - cm$	
experimentally dn 4 3×10 e-cm	Sidda acces griffigh a alleg filter and a defection of a citation of situation of situation of situation is grant
of proportional to neutron spin	
	дом у на 2000 година водина то постори в село на 2000 година в село на 2000 година в село село на 2000 година Дирина пред пред пред село на 2000 година в село
under time reversal, 57-5° so 57-3 electric field does not charge:	l - d' igne promise mensionement per part magnet remain
	ing ang ang ang ang ang ang ang ang ang a
	eg myrifir fallan en skall garrag mellen skall garrag egge men kan skall en
H= J.E > - J.E + violation	dia di santan di salam di sepiman di sebahan makan melakan menanda kenara menanda menenda menenda menenda men Menenda sebahan sebahan menenda menend
compare to magnetic moment; in = 1 3	Marien and the state of the s
but (-B) (-B)	ika antara mengangka hipupa menanganah didahan hipupa mengangkan ika menungan perungan sebagai sebagai pengan Miliputan katalah didah didah didah pengangan pengangan pengangan pengangan pengangan pengangan pengangan penga Miliputan katalah didah didah didah pengangan pengangan pengangan pengangan pengangan pengangan pengangan pengan
6-30 5	
So H = Q.B -> Q.B	
also violates Parity on 57 = +57	axial-vector
also violatin faity on S->+5 d. E -> - d. E; D. B - R. B E -> = E	vector:

and the second s	Note, many moleculus have
	large EDM 15, for example
popular y no proportion and a second annual annual and one of the second and one of the second annual annual a	$NH_3 d = 0.3 \times 10^{-8} e \cdot cm$
	but edm vot proportional to spin. but statu exist
	1+ 2) (- 2)
	note, grow state has zone electric dipole moment.
an again tha an	note QCD con explain neutron Eom, O parametr.
	8 paramets "naturally" 1)
	but limit on neutron EDM 0<10-10
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