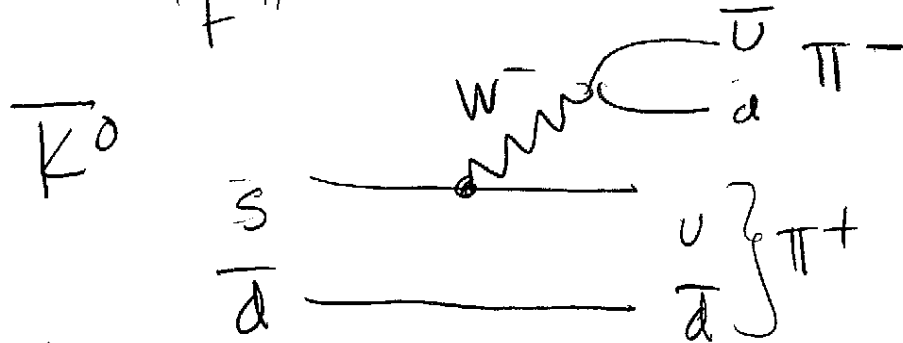
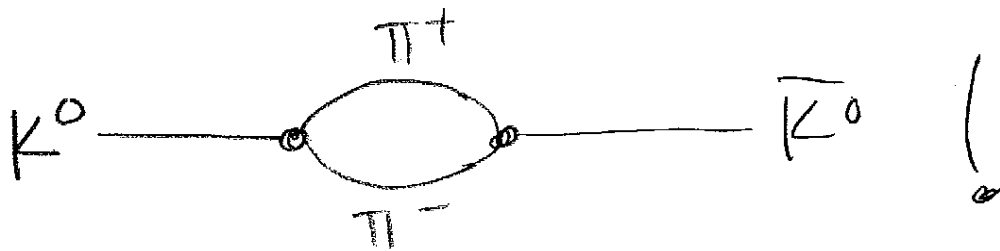


OR: $K^0 \rightarrow \pi^+ \pi^-$... rate $\propto F^2$
 all factors "F"



Look at this

rate $\propto F^2$ too!



$$i\hbar \frac{d}{dt} \begin{pmatrix} |K^0\rangle \\ |\bar{K}^0\rangle \end{pmatrix} = \begin{pmatrix} m_{K^0} c^2 & \alpha F^2 \\ \alpha F^2 & m_{\bar{K}^0} c^2 \end{pmatrix} \begin{pmatrix} |K^0\rangle \\ |\bar{K}^0\rangle \end{pmatrix}$$

Eigenvalues: $m_{K^0} c^2 = m_{\bar{K}^0} c^2$ (CPT)

$$m_{K^0} c^2 \pm \alpha F^2$$

$$|K_1^0\rangle = \frac{1}{\sqrt{2}} [|K^0\rangle - |\bar{K}^0\rangle] \quad |K_2^0\rangle = \frac{1}{\sqrt{2}} [|K^0\rangle + |\bar{K}^0\rangle]$$

"Lighter"

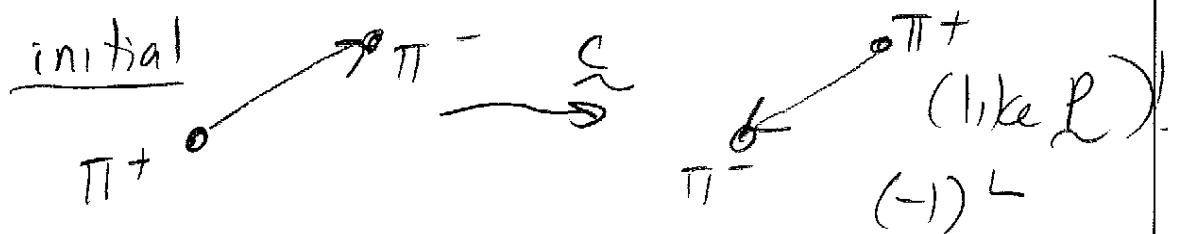
"Heavier"

$$CP |K_1^0\rangle = C \left(\frac{1}{\sqrt{2}} [|K^0\rangle - |\bar{K}^0\rangle] \right) = |K_1^0\rangle \quad \text{ev. +1}$$

$$\begin{aligned} \underline{\underline{C}} \underline{\underline{P}} |K_2^0\rangle &= \underline{\underline{C}} \left(\frac{-1}{\sqrt{2}} \right) [|K^0\rangle + |\bar{K}^0\rangle] \\ &= -|K_2^0\rangle \quad \text{e.v. } -1 \end{aligned}$$

Fun Chapter #1

$$\begin{aligned} \underline{\underline{C}} \underline{\underline{P}} [\underbrace{|\pi^+\pi^-\rangle}_{L=0}] &= \underline{\underline{C}} (-1)^2 (-1)^0 |\pi^+\pi^-\rangle \\ &= \underbrace{|\pi^-\pi^+\rangle} \end{aligned}$$



$$\underline{\underline{C}} \underline{\underline{P}} |\pi^+\pi^-\rangle = (+1) |\pi^+\pi^-\rangle$$

$$\begin{aligned} \underline{\underline{C}} \underline{\underline{P}} [\underbrace{|\pi^+\pi^-\pi^0\rangle}_{L=0}] &= \underline{\underline{C}} (-1)^3 (-1)^0 |\pi^+\pi^-\pi^0\rangle \\ &\quad \text{(a bit of work)} \\ &= (-1) |\pi^+\pi^-\pi^0\rangle \end{aligned}$$

If weak interaction conserves CP then

}	{	$K_1^0 \rightarrow \pi^+\pi^-$	allowed	}	<u>IF</u> <u>CP</u> conserved.
		$K_2^0 \rightarrow \pi^+\pi^-$	forbidden		
		$K_1^0 \rightarrow \pi^+\pi^-\pi^0$	forbidden		
		$K_2^0 \rightarrow \pi^+\pi^-\pi^0$	allowed		

GREAT EXPERIMENTAL STORIES

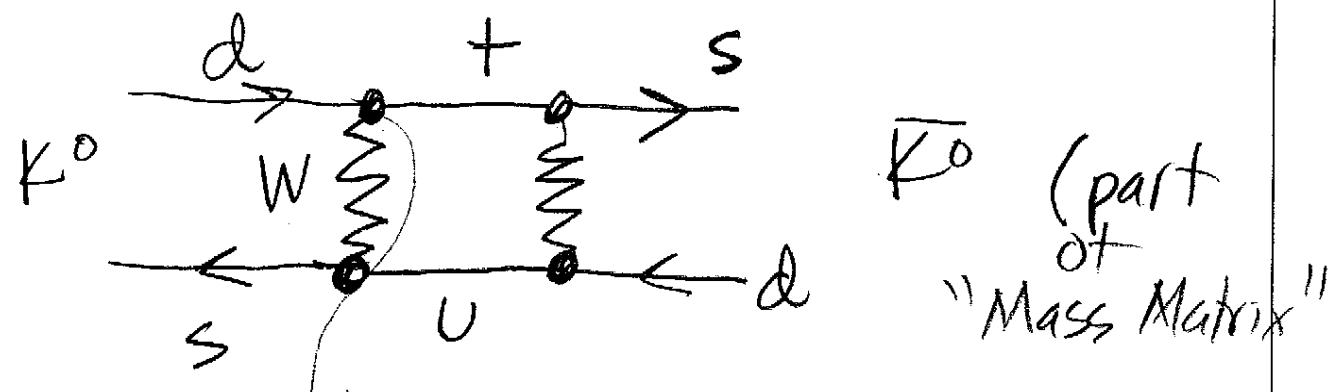
Chapter #3 : K^0 decays $\rightarrow \pi^+ \pi^-$] 1964

Branching Ratio $\approx 2 \cdot 10^{-3}$] 1978 Nobel Prize

CP NOT Conserved by weak interactions.

(!!!)

Mechanism Complicated...
INVOLVES TOP QUARK



non-trivial complex #

$M_{top} \approx 174,000 \text{ MeV}$... not made directly until 1995

"First hint" \rightarrow 1964

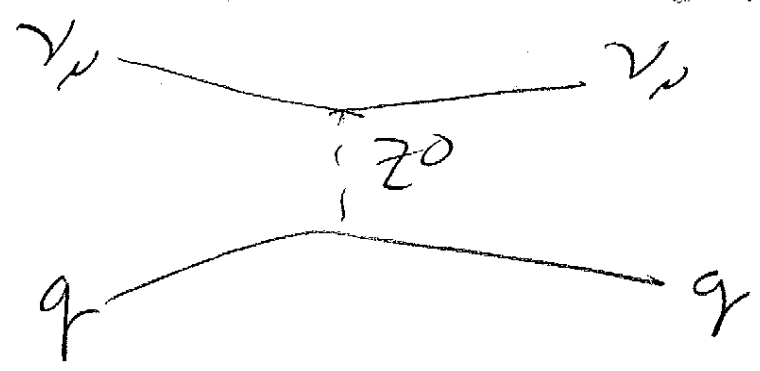
"TUNNELING" ... where else?

W± themselves : $n \rightarrow p e^- \bar{\nu}_e$

proceeds via a 80 GeV particle
observed ~1915

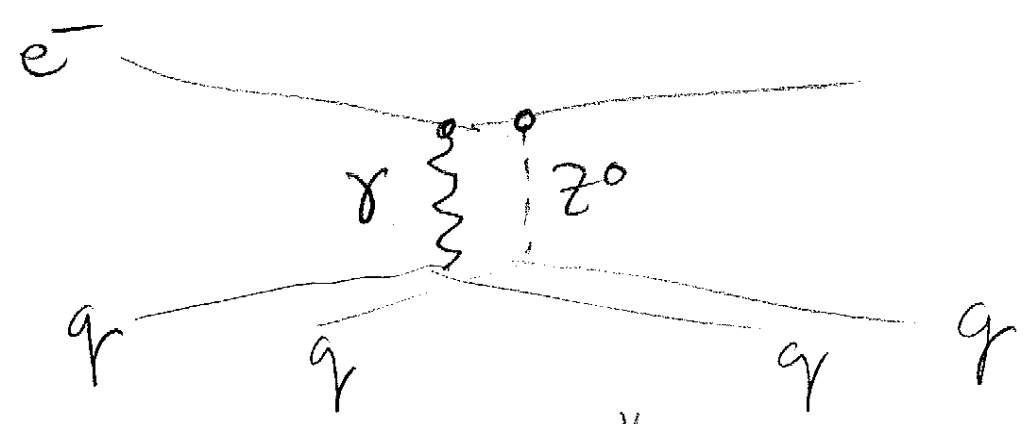
Z⁰ MUCH harder, looks so much like a photon!

→ early 1970's ("Neutral Currents")



Didn't convince people.
(neutron background)

→ 1978 great experiment detected interference between



→ "Handedness" ⇒ 1990 LEP

H⁰ : A lot of evidence ...

$$144 \text{ GeV} > M_{H^0} > 114 \text{ GeV}$$

Supersymmetry :

every fermion \leftrightarrow boson (spin 0)

$e^- \longrightarrow \tilde{e}^-$
selectron.

$u \longrightarrow \tilde{u}$
squark
"scalar"

\rightarrow SAME CHARGES"

boson \rightarrow Different Masses

$W^\pm \longrightarrow \tilde{W}^\pm$ fermion
spin $-\frac{1}{2}$
"Wino"

EXTREMELY STRONG CONSTRAINTS
AGAINST SUSP

STRONG Theory in favor.