INCLUDING BARYONS

$\rightsquigarrow$ huge work ☺

Still, the aim is to answer: where does M_p come from?

$$\Psi = \begin{pmatrix} p \\ n \end{pmatrix} = \begin{pmatrix} [u,d]u \\ [u,d]d \end{pmatrix}$$

($N_f = 2$)
(For $N_f = 3$ one has a "3x3" matrix... so, intrinsically $\neq$).

$$\Psi = P_R \Psi + P_L \Psi = \Psi_R + \Psi_L$$

$$\begin{cases} \Psi_R \mapsto U_R \Psi_R \\ \Psi_L \mapsto U_L \Psi_L \end{cases}$$

How do we couple it to the mesons? Where does the mass come from?

Note: No mass term is (self-linear) possible!

Namely:

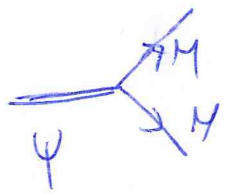
$$m_N \bar{\psi}\psi = m_n\left(\bar{\psi}_R \psi_L + \bar{\psi}_L \psi_R\right)$$

breaks C.i.

(You might add this term, but a $\delta \bar{\psi}\psi$ with $\delta \propto 3 m_u \ldots$
very small
↓
(For strangeness: relevant!!!))

$$\phi \mapsto U_L \phi U_R^{\dagger}$$

$$\mathcal{L}_{int} = g\left(\bar{\psi}_R \phi^{\dagger} \psi_L + \bar{\psi}_L \phi \psi_R\right)$$



But then $\phi = \sigma = F \ldots$ and we get:

$$\boxed{M_N \sim g F}$$

The condensation of σ generates the mass of the proton.

This is surely a possibility... but it is unique?

Suppose we start now with 2 baryonic doublets

ψ_1 and ψ_2

$\psi_1 \equiv \begin{pmatrix} \\ \end{pmatrix}$ "positive parity"

$\psi_2 \equiv \begin{pmatrix} \\ \end{pmatrix}$ "negative parity"

Then MIRROR

$\psi_{2,L} \mapsto U_R \psi_{2,L}$

$\psi_{2,R} \mapsto U_L \psi_2$

MIRROR

STANDARD

$\psi_{1,R} \mapsto U_R \psi_{1,R}$

$\psi_{1,L} \mapsto U_L \psi_{1,L}$

Remark: these are "composite" fields... they can transform in a $\neq$ way than the underlying quarks.

Then, a mass term is possible:

$$\mathcal{L}_{m_0} = m_0 \big(\bar{\psi}_{1,R} \psi_{2,L} + \dots$$

is now chirally invariant because $\psi_{2,L}$ transforms mirror-like!

... $\rightarrow$ TALK.