Força N-N

Forma geral, com base em simetrias

$$V(\vec{r}, \vec{p}, \vec{\sigma}_1, \vec{\sigma}_2, \vec{\tau}_1, \vec{\tau}_2) = V_c(r) + V_\sigma(r)\,(\vec{\sigma}_1.\vec{\sigma}_2) + V_\tau(r)\,(\vec{\tau}_1.\vec{\tau}_2) + V_{\sigma\tau}(r)\,(\vec{\sigma}_1.\vec{\sigma}_2)\,(\vec{\tau}_1.\vec{\tau}_2)$$

$$+V_{ls}(r)(\vec{\tau}_1.\vec{\tau}_2) + V_{ls\tau}(r)\left(\vec{L}.\vec{S}\right)(\vec{\tau}_1.\vec{\tau}_2)$$

$$+V_t(r)S_{12} + V_{t\tau}(r)S_{12}\,(\vec{\tau}_1.\vec{\tau}_2)$$

$$+V_q(r)Q_{12} + V_{q\tau}(r)Q_{12}\,(\vec{\tau}_1.\vec{\tau}_2)$$

$$+V_{pp}(r)\,(\vec{\sigma}_1.\vec{p})\,(\vec{\sigma}_2.\vec{p}) + V_{pp\tau}(r)\,(\vec{\sigma}_1.\vec{p})\,(\vec{\sigma}_2.\vec{p})\,(\vec{\tau}_1.\vec{\tau}_2),$$

Troca de mésons

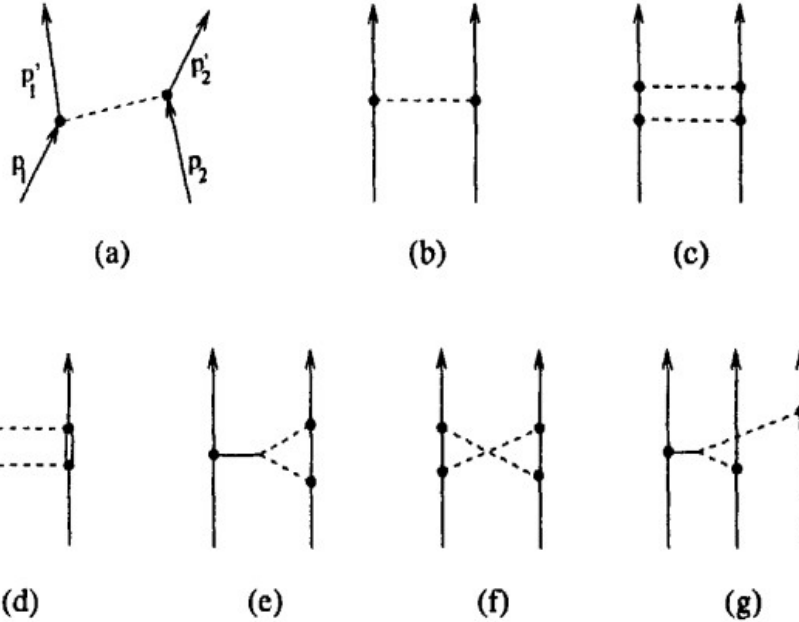- Descrição das regiões de distâncias longas e intermediárias

Figure 3-8: Diagrammatic representation of meson exchange between two nucleons: (*a*, *b*) one-pion exchange, (*c*) two-pion exchange, (*d*) two-pion exchange with intermediate state involving a Δ-particle, (*e*) ρ-meson exchange, and (*f*) another type of two-pion exchange term with both pions emitted before either one reabsorbed. An example of three-body force is shown by (*g*).
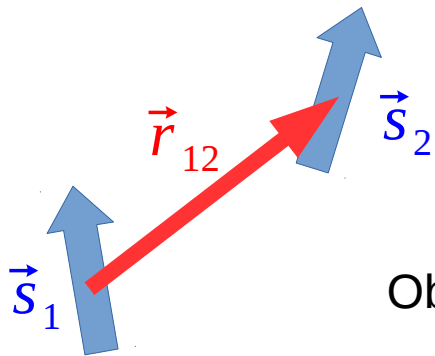
Regiões da Força Central
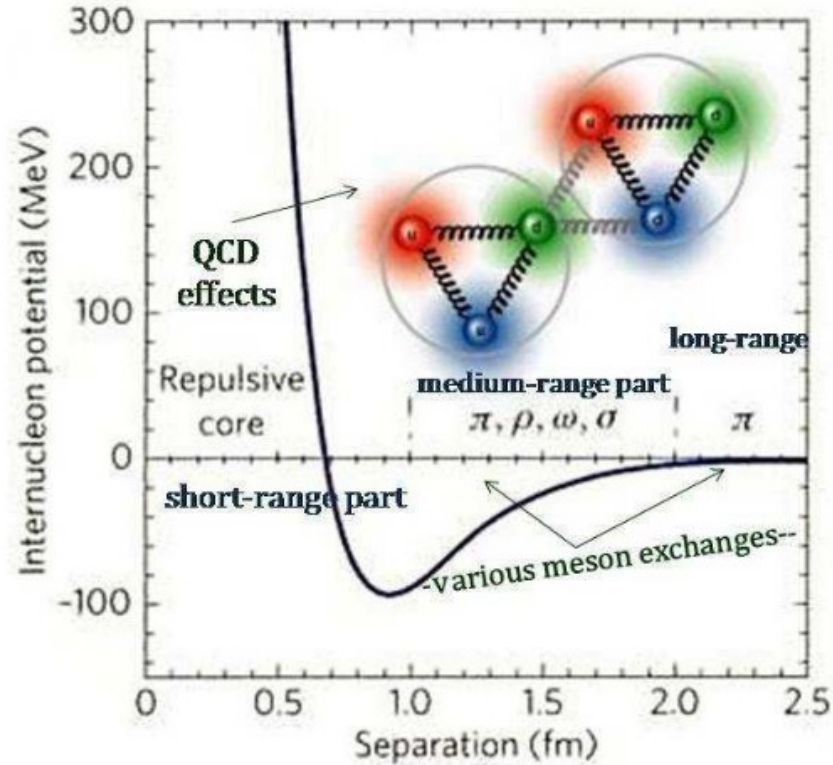
Força tensorial (S_{12})
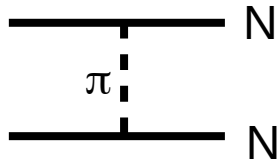
$$V_{OPEP}^{(1)}(r) = \frac{g_{pi}^2}{3}(\vec{\tau}_1.\vec{\tau}_2)\left[\frac{e^{-\mu r}}{r}(\vec{\sigma}_1.\vec{\sigma}_2) + \left(1 + \frac{3}{\mu r} + \frac{3}{(\mu r)^2}\right)\frac{e^{-\mu r}}{r}S_{12}\right]$$

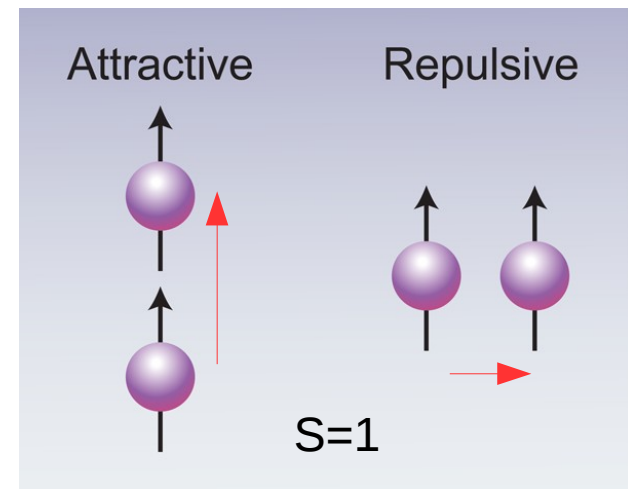$$S_{12} = \frac{3}{r^2}(\vec{\sigma}_1.\vec{r})(\vec{\sigma}_2.\vec{r}) - \vec{\sigma}_1.\vec{\sigma}_2 = 2\left[3\left(\vec{S}.\frac{\vec{r}}{r}\right)^2 - \vec{S}^2\right]$$

Análoga à interação entre dois imãs

$$R_d \approx 2.1\,fm$$

$\vec{r}_{12}$ $\vec{s}_2$

$\vec{s}_1$

Obs.: $\langle S=0|S_{12}|S=0\rangle = 0$

(por quê?!)

Attractive   Repulsive

S=1

Q>0   Q<0

Dêuteron: Q=0.29efm²

Força N-N Paris potential

$\pi=+$, L=0,2…

SE $\underline{S=0, T=1}$

TE $\underline{S=1, T=0}$

$R_d \approx 2.1\,fm$

$\pi=-$, L=1,3...

SO $\underline{S=0, T=0}$

TO $\underline{S=1, T=1}$

V[MeV]

400

200

0

−200

0

1

2

r[fm]

0

1

2

r[fm]