$$S(R_f) = \int_0^{R_{match}} K_{fi}(R_f, R_i) u(R_i) dR_i$$

$K_{fi}(R_f, R_i)$

$$D_{fi} = R_f - R_i$$

R_f

D_{fi}

$u(R_i)$

$$\ell_f + \ell_i$$

R_i

10^{-15}

R_f

$$\ell = L_{in}$$

$R_{\min}$

> 0

J

$J + .1$

$L(L+1)$

$$L = J$$

$L = L_{in}$

$k = 0$

L

< 0

2

k

-1

S

$\hbar^2 k^2 / 2m$

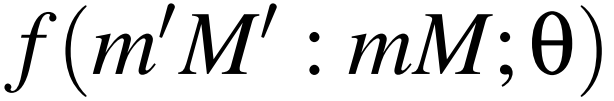
$k = f' / f$

S_{el}

$$0.05 < Re(S_{el}) < 0.95$$

$$K_{fi}(R_f, D_{fi})$$

$$((G - iF) - S.(G + iF)).i/2$$



θ

A

$L = 0$

$\exp i(\sigma_L - \sigma_0))$

$S_\ell < 0.1$

$J - L$

total

$r = h$

$\sin(\delta(k))\exp(-i\delta(k))$

$k \exp(-i\delta(k))$

$$k \sin(\delta(k)) \exp(-i\delta(k))$$

≥ 0

-1

$180 - \theta$

$1/3$

r_0

T

sin

3

$\hbar^2 / (m_\pi^2 c^2)$

$$j(j+1) - l(l+1) - s(s+1) = 2\mathbf{l}.\mathbf{s}$$

S

J_T

$int(J)+1$

$^3S - ^3D$

K

$$Mn(Ek) = \langle I' || Ek || I \rangle / (\sqrt{2I+1} \langle IKk0 | I'K \rangle) \ .$$

$$Mn(Ek) = \langle k||Ek||0\rangle$$

$$Mn(Ek) = Q_0 \sqrt{5/16\pi}$$

R

$$Mn(Ek) = \frac{3\,Z\,\beta_k\,R^k}{4\pi}\ .$$

Q_0

$M(Ek)$

$$i^{I-I'+|I-I'|}\ \langle I'||Ek||I\rangle$$

$$\pm\sqrt{(2I+1)\ B(Ek, I \to I')}\ ,$$

$I \leftrightarrow I'$

$$Q_2 = \sqrt{16\pi/5}\,(2I+1)^{-1/2}\,\langle II20|II\rangle\,\langle I||E2||I\rangle\ .$$

$$M(Ek) = Mn(Ek)\ (-1)^{[I-I'+|I-I'|]/2}\ \sqrt{2I+1}\langle IKk0|I'K\rangle$$

I, I'

$\beta_k \times R$

$$B(Ek, 0 \to k)$$

$K = 0$

$$< IB|M(Ek)|IA >$$

$RDEF(k, I \rightarrow I')$

$$DEF(k)(-1)^{[I-I'+|I-I'|]/2}\sqrt{2I+1}\ \langle IKk0|I'K\rangle$$

$$M(Ek) * 4\pi / [3ZR^{k-1}]$$

$$F(r) = M(Ek)\ e^2\ \frac{\sqrt{4\pi}}{(2k+1)}\ r^{-k-1}$$

$e^2 = 1.440$

$-1/\sqrt{4\pi}$

$$F(r) = -DEF(k)\ \frac{1}{\sqrt{4\pi}}\ \frac{dU(r)}{dr}$$

$$(-1)^{[I-I'+|I-I'|]/2}$$

$$\left|L_n,(SN,J_{core})S;J_{com}\right\rangle$$

$$|(LN, SN)Jn, J_{core}; J_{com}\rangle$$

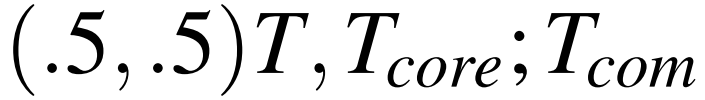
$$\left|L_{nn},(\ell,S_{12})j_{12};J_{12}\right\rangle$$

$(.5, .5)T$

$$|(L_{nn},\ell)L_t,(S_{12},J_{core})S_t;J_{com}\rangle$$

$$|(.5,.5)T, T_{core}; T_{com}\rangle$$

$\left(L_{nn},(\ell,S_{12})j_{12}\right)J_{12},J_{core};J_{com}\rangle$



J_{core}

J_{com}

T_{com}

core

$L_{nn} + \ell$

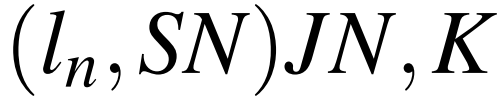
$T(k)$

$5 \times |NAM|$

$L_n, (SN, J_{core})S; J_{com}$

L_n

n



com

$$K = K_{com} - K_{core}$$

n

$l + s$

min

12

max

$u_{12}(r)$

$u(R) =< u_{12}(r)|U(r,R) >$

$$U\left(r,R\right)\times$$

l_{max}

S_{min}

$$\left|(l_1,s_1)j_1,(l_2,s_2)j_2;J_{12},T\right\rangle$$

$(l_1, s_1) j_1$

nn

$u_1(r_1) \times u_2(r_2)$

$L_{nn}, ((\ell, (s_1, s_2)S_{12})j_{12}; J_{12}, T\rangle$

D_0

D_0

(R, R')

$1/\sqrt{4\pi}$

g

$Q > 0$

$$\theta = \pi$$

$$\theta = 0$$

p

C

v

$$\langle c | c + v = t \rangle$$

$$\langle c | c + p = t' \rangle$$

h

$$\Gamma = 2\gamma^2 P$$

$1/2$

$P_{\mathrm{leff}}(E - \mathtt{energy}) / P_{\mathrm{leff}}(e_{\mathrm{pole}} - \mathtt{energy})$

$\sigma(\theta)$

19

28

16

31

$$\mathbf{S}\big([\ell, s_p]s_t, s_t\big)$$

s_p

s_t

I_t

$$(F_{\lambda_1} G_{\lambda_2})_{\lambda\mu} = \sum_{\mu_1\mu_2} \langle \lambda_1\mu_1, \lambda_2\mu_2 | \lambda\mu \rangle F_{\lambda_1\mu_1} G_{\lambda_2\mu_2} \ ,$$

$$F_{s_t} = [\ell, s_p] s_t$$

$$G_{s_t} = s_t$$

S

$$(F_\lambda G_\lambda)_{00} = (2\lambda+1)^{-1/2} \sum_\mu (-1)^{\lambda-\mu} F_{\lambda\mu} G_{\lambda-\mu} \, .$$

$(-1)^{\lambda}(2\lambda+1)^{-1/2}$

$$\langle j_f m_f | \hat{O}_{\lambda\mu} | J_i m_i \rangle = (2j_f + 1)^{-1/2} \, \langle j_i m_i, \lambda\mu | j_f m_f \rangle \, \langle j_f || \hat{O}_{\lambda} || j_i \rangle$$

$$\left\langle (LI_p)J, I_t; J_T M_T \right| \mathbf{S}([\ell, s_p]s_t, s_t) \left| (L'I'_p)J', I'_t; J_T M_T \right\rangle$$

$$(-1)^{s_t+J_T+J'+I_t} \begin{Bmatrix} J' & I'_t & J_T \\ I_t & J & s_t \end{Bmatrix} \hat{J}\hat{J}' \begin{Bmatrix} L' & I'_p & J' \\ \ell & s_p & s_t \\ L & I_p & J' \end{Bmatrix} \frac{1}{\sqrt{4\pi}} \hat{\ell}\hat{L}\langle L0\ \ell 0|L'0\rangle$$

$$\times \left\langle I_p \middle|\middle| s_p \middle|\middle| I'_p \right\rangle \left\langle I_t \middle|\middle| s_t \middle|\middle| I'_t \right\rangle$$

$$\left\langle I_p \middle|\middle| s_p \middle|\middle| I'_p \right\rangle \left\langle I_t \middle|\middle| s_t \middle|\middle| I'_t \right\rangle$$

$$\langle I_p || s_p = 0 || I_p \rangle = \hat{I}_p$$

$$((2I'_t+1)(2I_t+1))^{1/4}$$

$$\left\langle I_t \middle| \middle| s_t = 0 \middle| \middle| I_t \right\rangle = \hat{I}_t$$