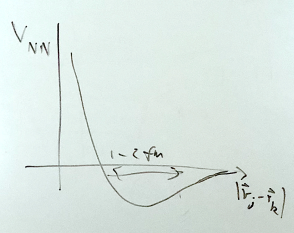


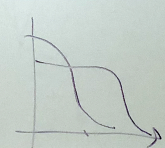
NR QM

$$H = \sum_{i=1}^A \frac{\vec{p}_i^2}{2M_i} + \left[\sum_{\substack{j,k=1 \\ j < k}}^A \frac{e^2}{r_{jk}} \right] + \sum_{\substack{j,k=1 \\ j < k}}^A V_{NN}(\vec{r}_j, \vec{r}_k, I_{jk}, \vec{\sigma}_j, \vec{\sigma}_k, \dots) + \sum V_{NNN}$$

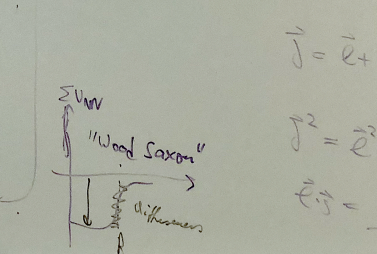


$H|\psi\rangle = E|\psi\rangle$ $|\psi\rangle = \begin{pmatrix} \psi_{11} \\ \psi_{12} \\ \vdots \\ \psi_{A1} \end{pmatrix}$

Assume solved $\rightarrow \rho(\vec{r})$
 one-nucleon approximation
 $H_{1N} = \frac{\vec{p}^2}{2M} + \sum_{i=1}^A V_{Ni} =$



Find all $\rightarrow |\psi_E\rangle \rightarrow \begin{pmatrix} \psi_{11} \\ \psi_{12} \\ \vdots \\ \psi_{A1} \end{pmatrix}$



$\vec{j} = \vec{l} + \vec{s}$
 $j^2 = l^2 + s^2 + 2\vec{l} \cdot \vec{s}$
 $\vec{l} \cdot \vec{s} = \frac{j^2 - l^2 - s^2}{2}$

Harree-Fock

$l = \frac{3}{2}, s = \frac{1}{2}$
 $n=1, l=2$

\rightarrow Shell Model

$\begin{pmatrix} \psi_{11} & \psi_{12} & \dots & \psi_{A1} \\ \vdots & \vdots & \ddots & \vdots \\ \vdots & \vdots & \ddots & \vdots \end{pmatrix}$

1) Nuclei \sim spherical

$\vec{j} = \vec{l} + \vec{s}$

$|\psi_E\rangle = |n, l, m_l, s, m_s\rangle$

$= |n, l, j, m_j\rangle$

Spin-Orbit: $\vec{l} \cdot \vec{s}$

$j^2 = l^2 + s^2 + 2\vec{l} \cdot \vec{s}$

$V_{SO} = M_{SO} \vec{l} \cdot \vec{s}$

$J = l + \frac{1}{2}$

$\vec{l} \cdot \vec{s} = \frac{j^2 - l^2 - s^2}{2} = \frac{j(j+1) - l(l+1) - 3/4}{2}$