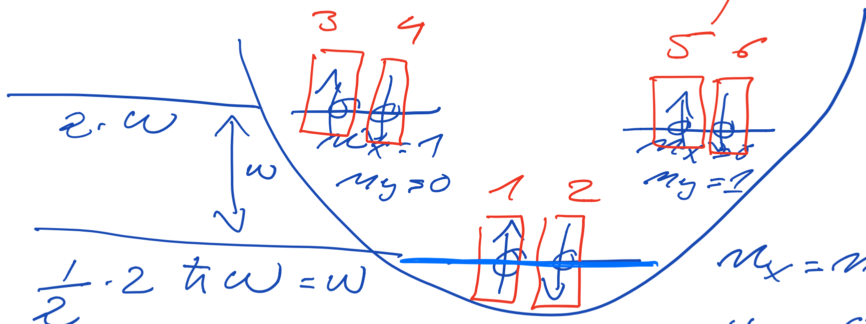
$N=6$ $\qquad$ $d=2$



$H_{n_x=0}(x)\,H_{n_y=1}(x)$
$\times\, e^{-\omega(x^2+y^2)}$
$\times\, \xi_{1/2}(\uparrow)$

$n_x=n_y=0$

$H_{n_x=0}(x)=\underline{1}$

$$E_{n_x n_y}=\hbar\omega\left(n_x+n_y+\frac{d}{2}\right)$$

In code

- 1) set up various basis functions (6) → 3 different spatial wf
  1) $H_{n_x=0}\,H_{n_y=0}\,\underline{e^{-(x^2+y^2)}}$
  2) $H_{n_x=1}\,H_{n_y=0}$ — " —
  3) $H_{n_x=0}\,H_{n_y=1}$ — " —
- 2) set up various 1st derivatives
  - quantum force
  - local energy
- 3) set up various 2nd derivatives
  - local energy

use these functions,

<u>$N=2$</u>

$\uparrow\downarrow$ $m_x=0$ $m_y=0$

$\vec{r}_1, \vec{s}_1$ $\quad$ $\vec{r}_2\ \vec{s}_2$

$$\psi(\vec{r}_1\vec{r}_2, \vec{s}_1, \vec{s}_2) = \frac{1}{\sqrt{2!}} \begin{vmatrix} \varphi_1 \chi_\uparrow(1) & \boxed{\varphi_1} \chi_\uparrow(2) \\ \varphi_1 \chi_\downarrow(1) & \varphi_1 \chi_\downarrow(2) \end{vmatrix}$$

$$\varphi_1(\vec{r}_2) = H_{m_x=0}(x_2)\, H_{m_x=0}(y_2) \times e^{-\alpha(x_2^2+y_2^2)}$$

$$= \frac{1}{\sqrt{2}} \left[\varphi_1 \chi_\uparrow(1) \varphi_1 \chi_\downarrow(2) - \varphi_1 \chi_\downarrow(1) \varphi_1 \chi_\uparrow(2) \right]$$

$$\langle \psi | H | \psi \rangle$$

$$H = \sum_{i=1}^{2} \left(\underline{-\tfrac{1}{2}\nabla_i^2 + \tfrac{1}{2}k(x_i^2+y_i^2)} \right) + \sum_{i<j}^{2} v(r_{ij})$$

$$\hat{h}_0(\vec{r}_i)\, \varphi_\alpha(\vec{r}_i) = \varepsilon_\alpha \varphi_\alpha(\vec{r}_i)$$

$$\langle \beta | \hat{h}_0 | \alpha \rangle = \int d\vec{r}\, \varphi_\beta^*(\vec{r}_1)\, \hat{h}_0(\vec{r})\, \varphi_\alpha(\vec{r}) = \varepsilon_\alpha \cdot \delta_{\alpha\beta}$$

$$\langle \tilde{\beta} | \hat{h}_0 | \tilde{\alpha} \rangle =$$

$$|\tilde{\alpha}\rangle = \varphi_\alpha(\vec{r}_i)\, \chi_{m_{s_i}}(s_i) \qquad \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \uparrow$$

$$|\tilde{\beta}\rangle = \varphi_\beta(\vec{r}_i)\, \chi_{\tilde{m}_{s_i}}(s_i) \qquad \begin{pmatrix} 0 \\ 1 \end{pmatrix} = \downarrow$$

$$\varepsilon_\alpha \delta_{\alpha\beta} \cdot (0 \;\; 1) \begin{pmatrix} 1 \\ 0 \end{pmatrix} = 0$$

$$\langle \Psi | \hat{H}_0 | \Psi \rangle =$$

$$\frac{1}{2} \sum_{s_1 s_2} \int d\vec{r}_1 \int d\vec{r}_2 \left[\varphi_1^* \chi_\uparrow^*(1)\, \varphi_2^* \chi_\downarrow^*(2) - \varphi_1^* \chi_\downarrow^*(1)\, \varphi_1^* \chi_\uparrow^*(2) \right]$$

$$\left(\hat{h}_0(\vec{r}_1) + h_0(\vec{r}_2) \right) \left[\varphi_1 \chi_\uparrow(1)\, \varphi_2 \chi_\downarrow(2) - \varphi_1 \chi_\downarrow(1)\, \varphi_1 \chi_\uparrow(2) \right]$$

$$\underset{1}{\varepsilon_1} + \underset{2}{0} + \underset{3}{0} \qquad \underset{4}{\varepsilon_1} + \ldots \; \varepsilon_2$$

$$= \frac{1}{2}\left(2\varepsilon_1 + 2\varepsilon_2 \right)$$

$$= \varepsilon_1 + \varepsilon_2$$

2

$$\langle \psi \,|\, \sum_{i<j} v(r_i, r_j) \,|\, \psi \rangle$$

$$= \langle 12 | v | 12 \rangle - \langle 12 | v | 21 \rangle$$

$$= \dots$$