Tuesday March 18 watch out when passing pointers $S' = S \pm \frac{1}{2}$

Diagonalization of H_N: Have the $\langle \bar{Q}^{old}\bar{S}^{old} | f_N | \bar{Q}'^{old}\bar{S}'^{old} \rangle_N = \langle S^{old} S^{old} \tfrac{1}{2}\sigma | S^{old'} S^{old'} \rangle \langle \bar{Q}^{old} | f_{N\sigma} | \bar{Q}'^{old} \rangle$ (full)

$\bar{Q}^{old} \in \bar{Q}^{old}$

I.H. Need: $\langle QS | f^{+}_{N+1} f_{N\sigma} | Q'S' \rangle_{N+1}$

$$\sum_{\substack{\alpha=1,2 \\ \sigma=\uparrow,\downarrow}} f^{+}_{\alpha\sigma} f_{-1\sigma} + h.c. = \sum_{\alpha} \sum_{\sigma} \underbrace{\langle Q^{old} S^{old} | f_{-1\sigma} | Q'^{old} S'^{old} \rangle}_{= (\text{fermi. factor}) \langle \bar{Q}\bar{S}\bar{S}_z | f^{+}_{\alpha\sigma} | \bar{Q}'\bar{S}'\bar{S}'_z \rangle}$$

Remember this ALWAYS!

$$|Q\,S\,(S_z = S)\rangle_{N+1} = \sum_{S_z^{old}\,\tilde{S}_z} \langle S^{old}\, S_z^{old}, \tfrac{1}{2}, \tilde{S}_z \,|\, S\, S \rangle \; |\, Q^{old}\, S^{old}\, S_z^{old} \rangle_N \otimes |\bar{Q}\,\bar{S}\,\bar{S}_z\rangle_s$$

A problem: what if more than one site share the same quantum number?

Phonons

$N=16$ $\begin{cases} \alpha = 0.4 & V_S = -0.5\ -0.4\ -0.3\ -0.2\ -0.1\ 0.0 \\ \alpha = 0.0 & V_S = -0.5 \end{cases}$

Triangle inequality:

$$J_1 + J_2 \leq J \leq |J_1 - J_2|$$

Wednesday March 19 order: $|\uparrow\downarrow\ \uparrow\downarrow\rangle \leftarrow f^{+}_{1\uparrow} f^{+}_{1\downarrow} f^{+}_{2\uparrow} f^{+}_{2\downarrow} |0\rangle$

Re-arranging basis.

	ist	$\bar{Q}$	$\bar{S}$	$\bar{S}_z$	(ist old)	
Bl 0	0	-2	0	0	(0)	$\|0\ 0\rangle$
Bl 1	1	-1	½	½	(1)	$\|0\ 1\rangle$
	2	-1	½	½	(4)	$\|1\ 0\rangle$
Bl 2	3	-1	½	-½	(2)	$\|0\ \downarrow\rangle$
	4	-1	½	-½	(8)	$\|\downarrow\ 0\rangle$

(old)

	ist	$\bar{Q}$	$\bar{S}$	$\bar{S}_z$	old	
Bl 0	5	0	0	0	(9)	$\frac{\|\uparrow\downarrow\rangle - \|\downarrow\uparrow\rangle}{\sqrt{2}}$
Bl 3	6	0	0	0	(3)	$\|0\ \uparrow\downarrow\rangle$
	7	0	0	0	(12)	$\|\uparrow\downarrow\ 0\rangle$
Bl 4	8	0	1	-1	(10)	$\|\downarrow\ \downarrow\rangle$
Bl 5	9	0	1	0	(6)	$\frac{\|\uparrow\downarrow\rangle + \|\downarrow\uparrow\rangle}{\sqrt{2}}$
Bl 6	10	0	1	1	(5)	$\|\uparrow\ \uparrow\rangle$

(ist)

	ist	$\bar{Q}$	$\bar{S}$	$\bar{S}_z$		
Bl 7	11	+1	½	½	(7)	$\|\uparrow\ \uparrow\downarrow\rangle$
	12	+1	½	½	(13)	$\|\uparrow\downarrow\ \uparrow\rangle$
Bl 8	13	+1	½	-½	(11)	$\|\downarrow\ \uparrow\downarrow\rangle$
	14	+1	½	-½	(14)	$\|\uparrow\downarrow\ \downarrow\rangle$
Bl 9	15	2	0	0	(15)	$\|\uparrow\downarrow\ \uparrow\downarrow\rangle$

Switcher (new) (old) (new)

2 → 3		8 → 4	
3 → 6		9 → 5	
4 → 2		10 → 8	
5 → 10		11 → 13	
6 → 9		12 → 7	
7 → 11		13 → 12	