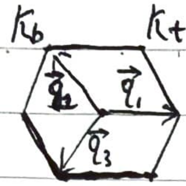
NO.

Date

①



$$H_\tau = \begin{pmatrix} -\frac{\hbar^2(\vec{k}-\tau\vec{K}_b)^2}{2m_b} + \Delta_b(\vec{r}) & \Delta_{T,\tau}(\vec{r}) \\ \Delta^\dagger_{T,\tau}(\vec{r}) & -\frac{\hbar^2(\vec{k}-\tau\vec{K}_t)^2}{2m_t} + \Delta_t(\vec{r}) \end{pmatrix}$$

$$\Delta_{b,t}(\vec{r}) = 2V_{b,t}\sum_{j=1,3,5}\cos(\vec{g}_j\cdot\vec{r} + \psi_{b,t}) + V^{(0)}_{b,t}$$

$$\Delta_{T,\tau}(\vec{r}) = w\left(1 + e^{i\frac{2\pi}{3}\tau}\, e^{i\tau\vec{g}_2\cdot\vec{r}} + e^{i\frac{4\pi}{3}}\, e^{i\tau\vec{g}_3\cdot\vec{r}}\right)$$

② valley dependent gauge transformation:

$$\begin{pmatrix} e^{-i\tau\vec{K}_b\cdot\vec{r}} & 0 \\ 0 & e^{-i\tau\vec{K}_b\cdot\vec{r}} \end{pmatrix} H_\tau \begin{pmatrix} e^{i\tau\vec{K}_b\cdot\vec{r}} & 0 \\ 0 & e^{i\tau\vec{K}_b\cdot\vec{r}} \end{pmatrix}$$

$$= \begin{pmatrix} -\frac{\hbar^2\vec{k}^2}{2m_b} + \Delta_b(\vec{r}) & \Delta_{T,\tau}(\vec{r}) \\ \Delta^\dagger_{T,\tau}(\vec{r}) & -\frac{\hbar^2[\vec{k}-\tau(\vec{K}_t-\vec{K}_b)]^2}{2m_t} + \Delta_t(\vec{r}) \end{pmatrix}$$

$$= \widetilde{H}_\tau$$

$$H_\tau = e^{i\tau\vec{K}_b\cdot\vec{r}}\,\widetilde{H}_\tau\, e^{-i\tau\vec{K}_b\cdot\vec{r}}$$

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SDW

$$\cos\vec{q}_j\cdot\vec{r}\ \tau_x + \chi \sin\vec{q}_j\cdot\vec{r}\ \tau_y$$

$$= \begin{pmatrix} 0 & e^{-i\chi\vec{q}_j\cdot\vec{r}} \\ e^{i\chi\vec{q}_j\cdot\vec{r}} & 0 \end{pmatrix}, \quad \chi = \pm 1$$

$$-\frac{\hbar^2\vec{k}^2}{2m^*} + \Delta(\vec{r}) + \lambda\begin{pmatrix} 0 & \sum\exp(-i\chi\vec{q}_j\cdot\vec{r}) \\ \sum_{j=1,2,3}\exp(i\chi\vec{q}_j\cdot\vec{r}) & 0 \end{pmatrix}$$

$$\begin{pmatrix} e^{i\vec{k}_b\cdot\vec{r}} & \\ & e^{-i\vec{k}_b\cdot\vec{r}} \end{pmatrix}\begin{pmatrix} -\frac{\hbar^2\vec{k}^2}{2m^*} + \Delta(\vec{r}) & \lambda\sum\exp(-i\chi\vec{q}_j\cdot\vec{r}) \\ \lambda\sum_{j=1,2,3}\exp(i\chi\vec{q}_j\cdot\vec{r}) & -\frac{\hbar^2\vec{k}^2}{2m^*} + \Delta(\vec{r}) \end{pmatrix}\begin{pmatrix} e^{-i\vec{k}_b\cdot\vec{r}} & \\ & e^{i\vec{k}_b\cdot\vec{r}} \end{pmatrix}$$

$$= \begin{pmatrix} -\frac{\hbar^2(\vec{k}-\vec{k}_b)^2}{2m^*} + \Delta(\vec{r}) & \lambda M_\chi(\vec{r}) \\ \lambda M_\chi^+(\vec{r}) & -\frac{\hbar^2(\vec{k}+\vec{k}_b)^2}{2m^*} + \Delta(\vec{r}) \end{pmatrix}$$

$$M_\chi(\vec{r}) = e^{i2\vec{k}_b\cdot\vec{r}}\sum_{j=1,3,5}\exp(-i\chi\vec{q}_j\cdot\vec{r})$$

$$\vec{k}_b = \vec{q}_2$$

① $\chi = +1$

$$M_{+1}(\vec{r}) = e^{i(2\vec{q}_2-\vec{q}_1)\cdot\vec{r}} + e^{i\vec{q}_2\cdot\vec{r}} + e^{i(2\vec{q}_2-\vec{q}_3)\cdot\vec{r}}$$

$$= e^{i(\vec{q}_2+\vec{g}_2)\cdot\vec{r}} + e^{i\vec{q}_2\cdot\vec{r}} + e^{i(\vec{q}_2+\vec{g}_1)\cdot\vec{r}}$$

② $\chi = -1$

$$M_{-1}(\vec{r}) = e^{i(2\vec{q}_2+\vec{q}_1)\cdot\vec{r}} + e^{i3\vec{q}_2\cdot\vec{r}} + e^{i(2\vec{q}_2+\vec{q}_3)\cdot\vec{r}}$$

$$= e^{i\vec{g}_1\cdot\vec{r}} + e^{i(\vec{g}_1+\vec{g}_2)\cdot\vec{r}} + e^{i\vec{g}_2\cdot\vec{r}}$$

NO.

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