

$$\begin{aligned}
H = \sum_{x,a} & \left[-t_a c_{x+a}^\dagger c_x + \frac{J_a}{8} c_{x+a}^\dagger \vec{\sigma} c_{x+a} \cdot c_x^\dagger \vec{\sigma} c_x \right. \\
& \left. + \frac{V_a}{2} c_{x+a}^\dagger c_{x+a} c_x^\dagger c_x \right] + H_U ,
\end{aligned}$$