

$$\begin{aligned}
& \hat{H} = \hat{H}_S + \hat{H}_E + \hat{H}_{SE}, \quad (1) \\
& \hat{H}_{SE} = \chi(t) \boldsymbol{\alpha} \cdot \hat{\boldsymbol{\sigma}} \otimes \hat{O}. \quad (2)
\end{aligned}$$