

Tarefa 22: BHZ model

$$\mathcal{H}(k_x, k_y) = \begin{pmatrix} \epsilon(k) + \mathcal{M}(k) & Ak_- & 0 & 0 \\ Ak_+ & \epsilon(k) - \mathcal{M}(k) & 0 & 0 \\ 0 & 0 & \epsilon(k) + \mathcal{M}(k) & -Ak_+ \\ 0 & 0 & -Ak_- & \epsilon(k) - \mathcal{M}(k) \end{pmatrix}$$

$$\begin{cases} \epsilon(k) & = & C - Dk^2 \\ \mathcal{M}(k) & = & M - Bk^2 \\ k_{\pm} & = & k_x \pm ik_y \end{cases}$$

d (Å)	A (eV)	B (eV)	C (eV)	D (eV)	M (eV)
58	-3.62	-18.0	-0.0180	-0.594	0.00922
70	-3.42	-16.9	-0.0263	0.514	-0.00686

$d < d_c$
 $d > d_c$

Table 1: Parameters for $\text{Hg}_{0.32}\text{Cd}_{0.68}\text{Te}/\text{HgTe}$ quantum wells.

- 1) Show that 2 of the 4 bands are always degenerate independently of the parameters.
- 2) Calculate the value of M such that the energy gap *vanishes* at $\mathbf{k}=(0,0)$.