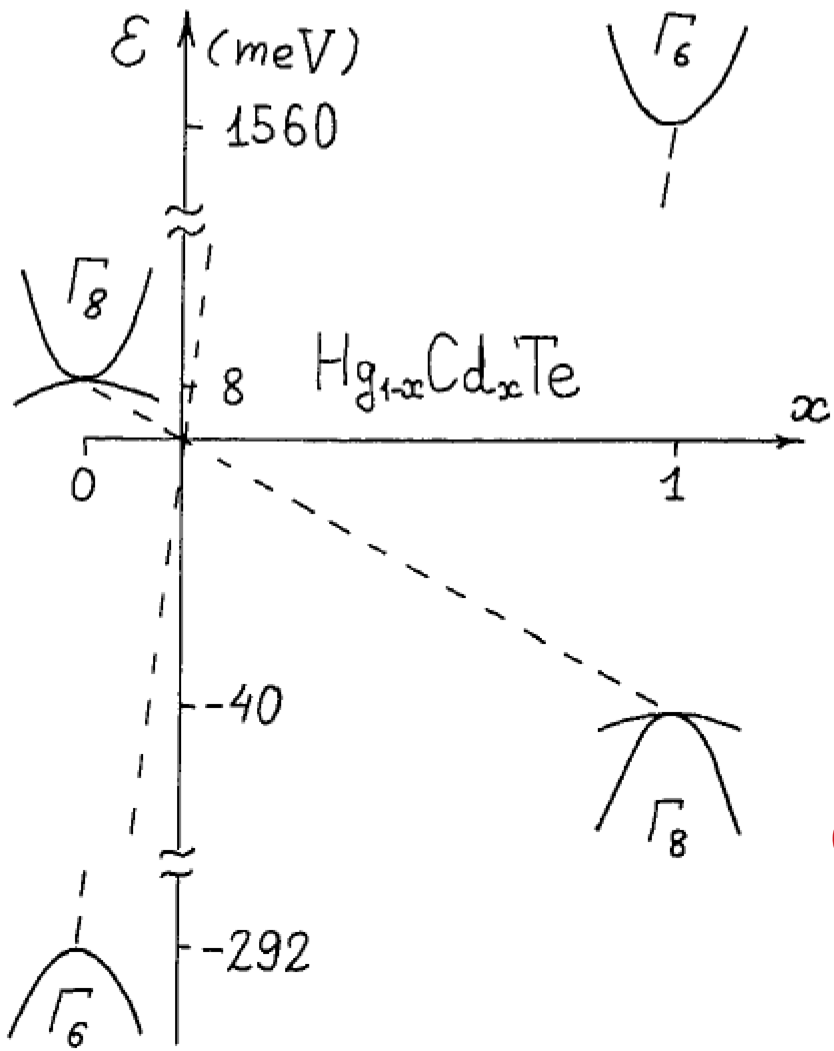
Modelo BHZ



Volkov, Pankratov: 1985

[JETP Lett. 42, 178 ('85)]
[Solid State Comm. 61, 93 ('87)]
[Landau Level Spectroscopy, Chap. 14 ('91)]

Bernevig, Hughes, Zhang: 2006

[Science 314, 1757 (2006)]

Bandas de condução/valência do HgTe (x=0), não podem ser continuamente deformadas nas bandas do CdTe (x=1)

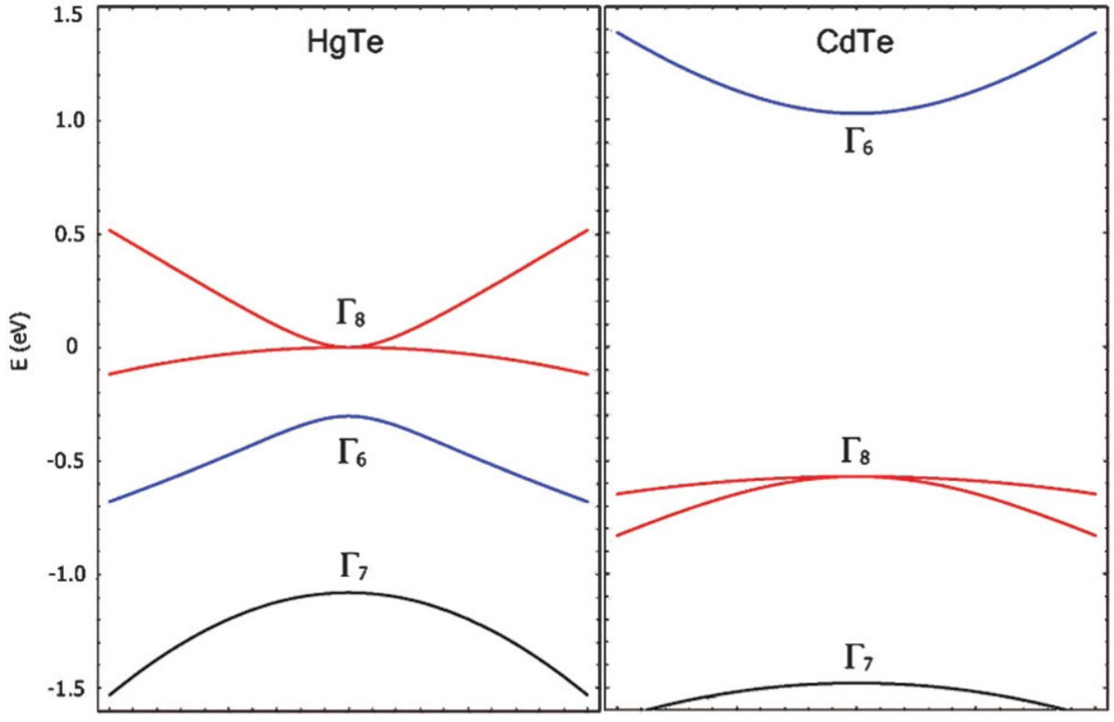
Inversão de bandas em bulk

$$\Gamma_6$$

Banda tipo S

$$\Gamma_8$$

Banda tipo P



Inversão de bandas em bulk

$$\Gamma_6$$

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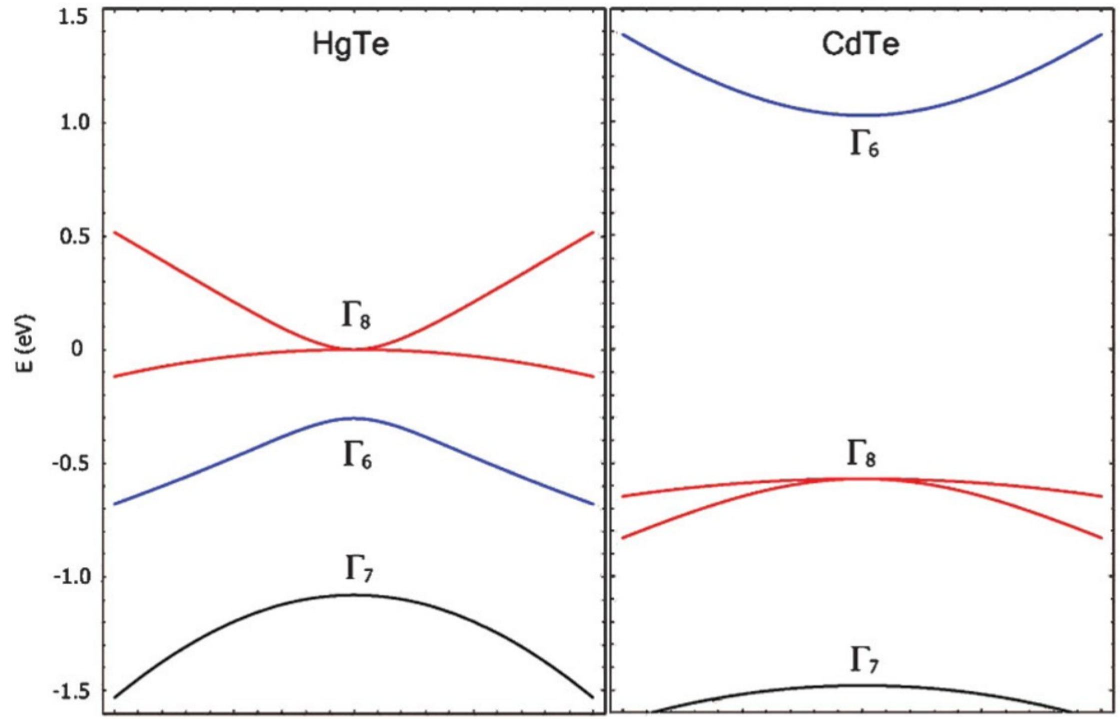
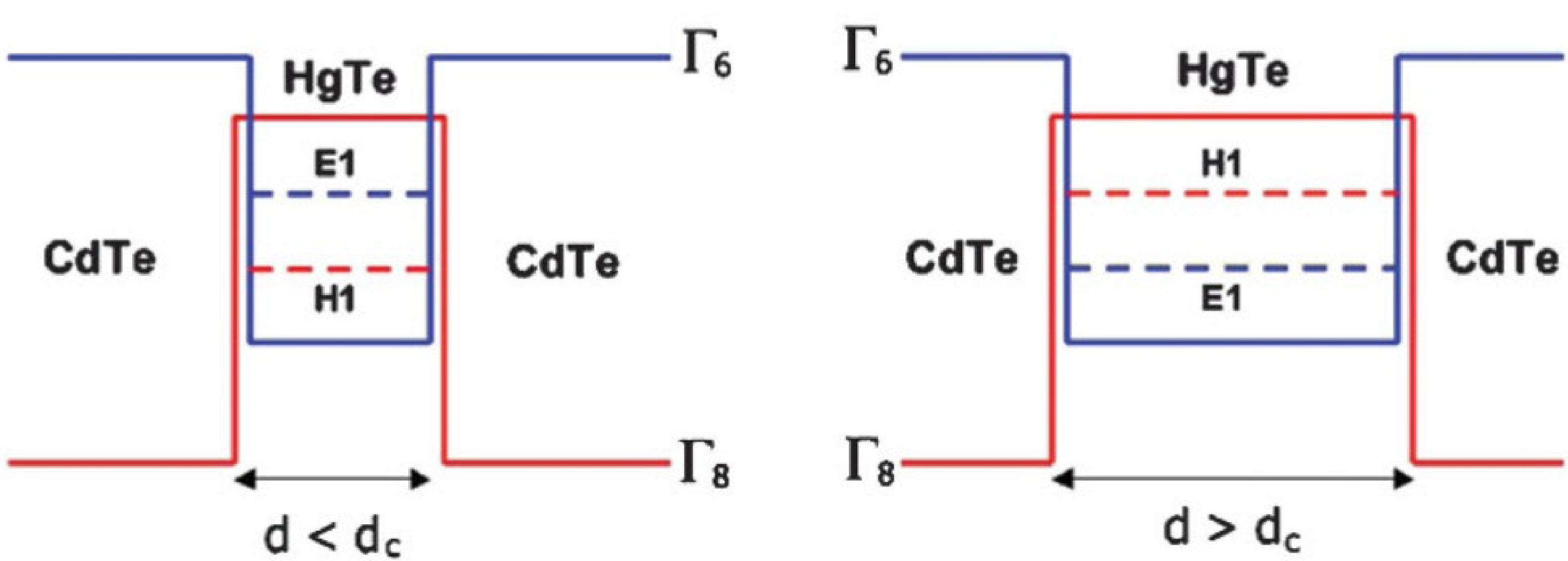
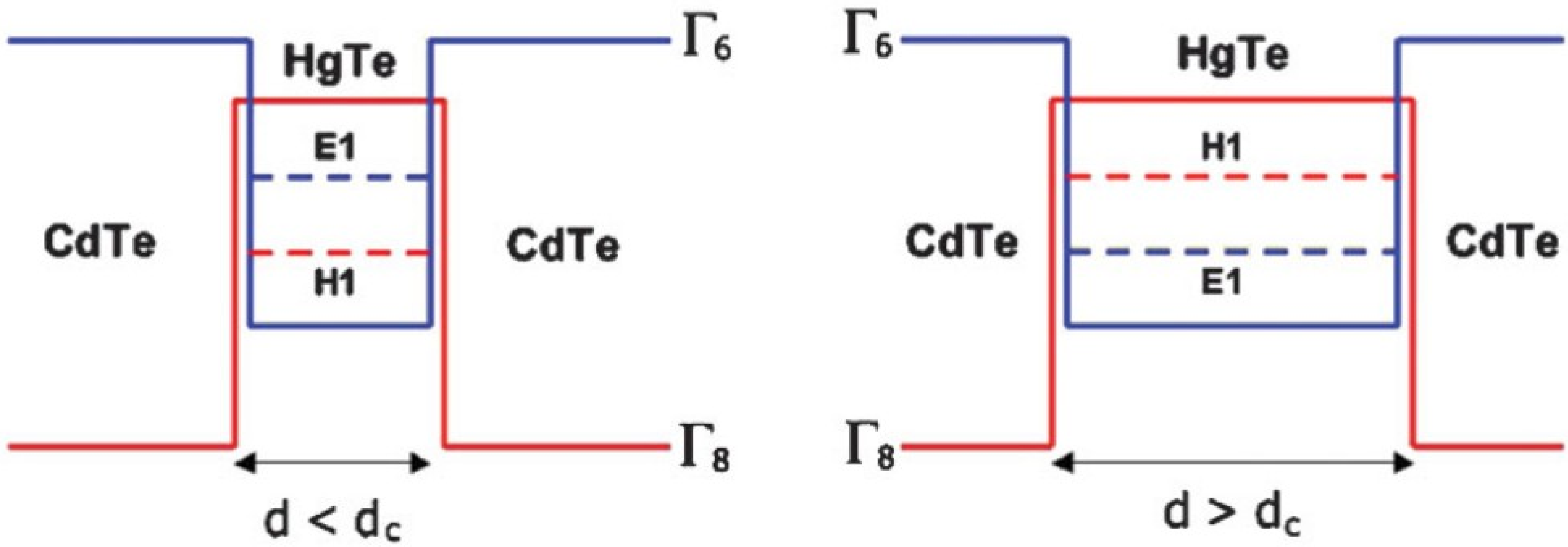
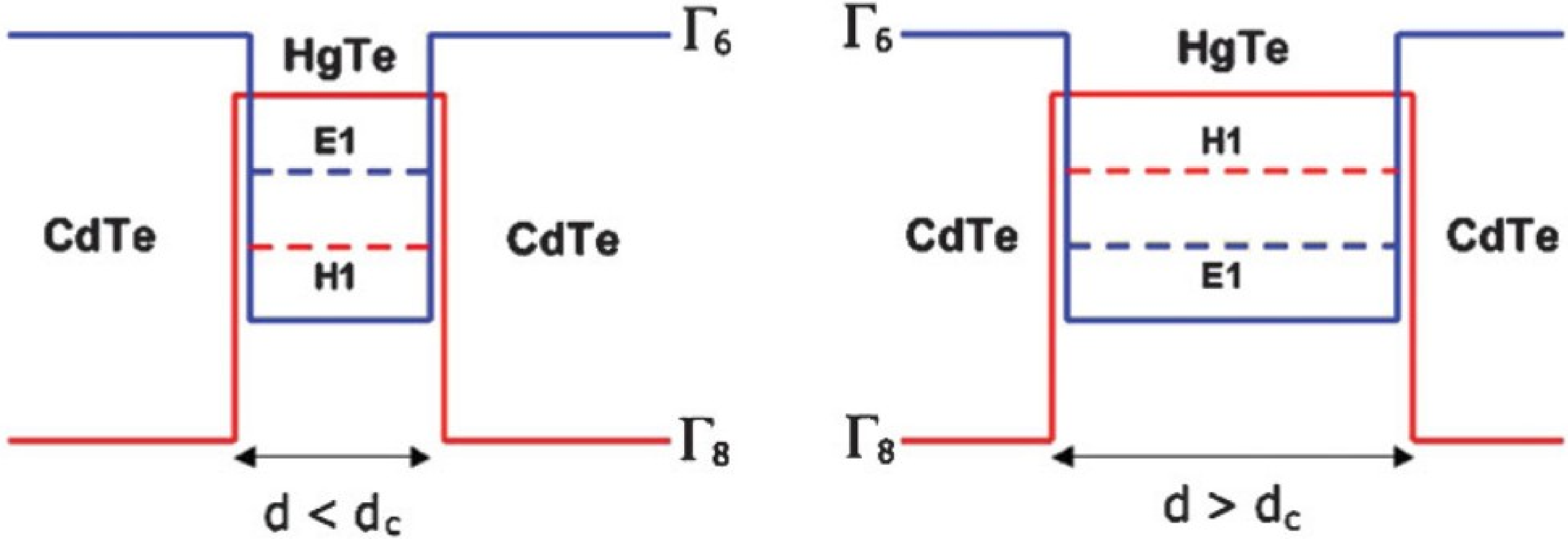


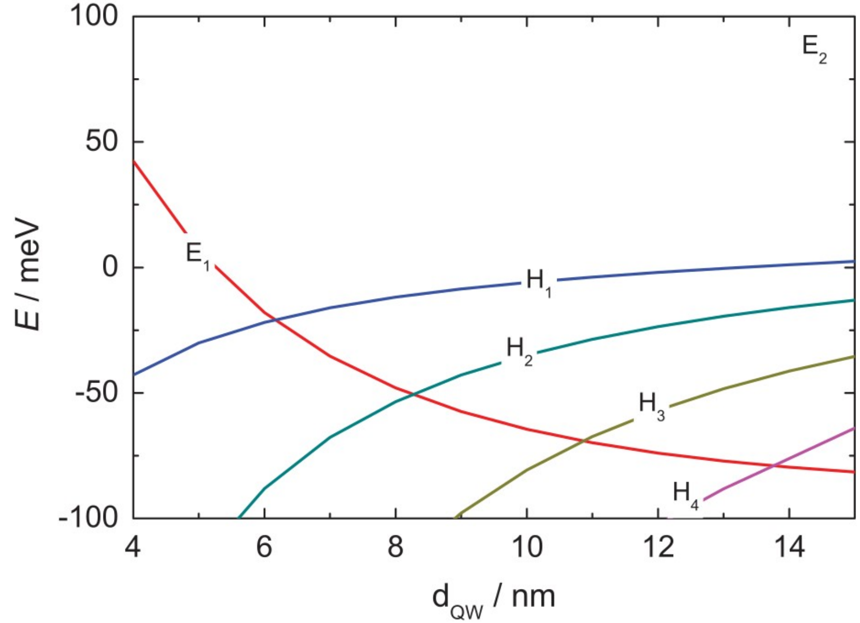
Heteroestrutura

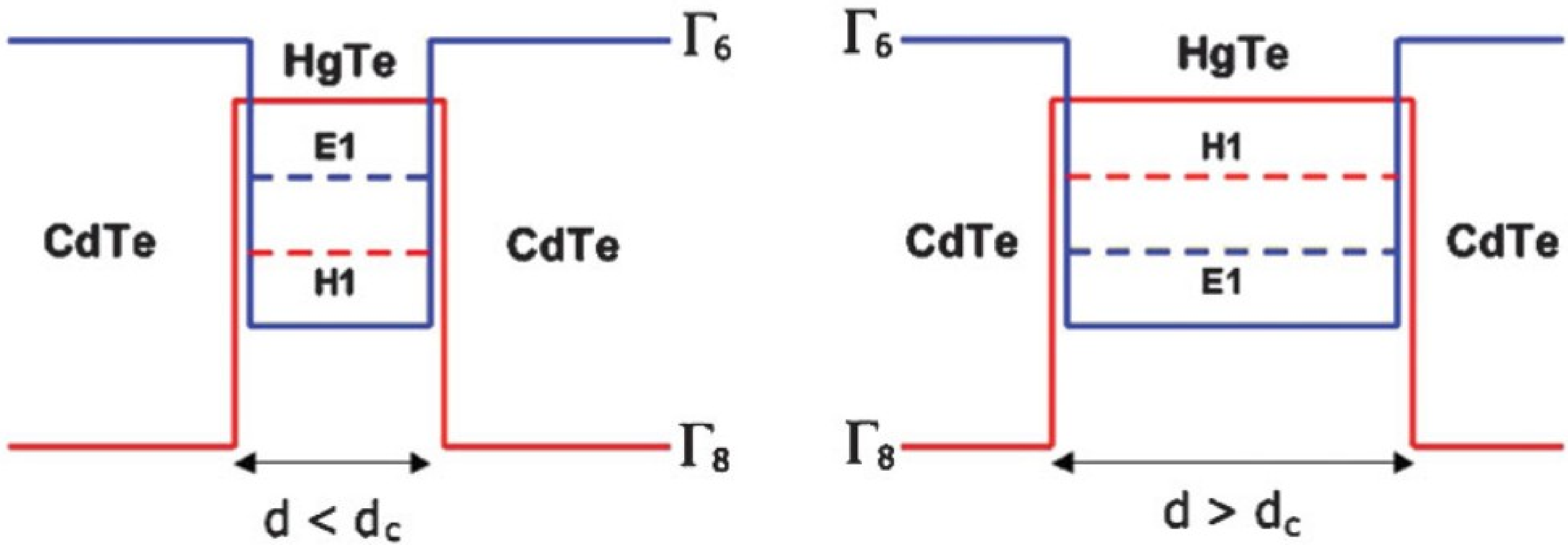


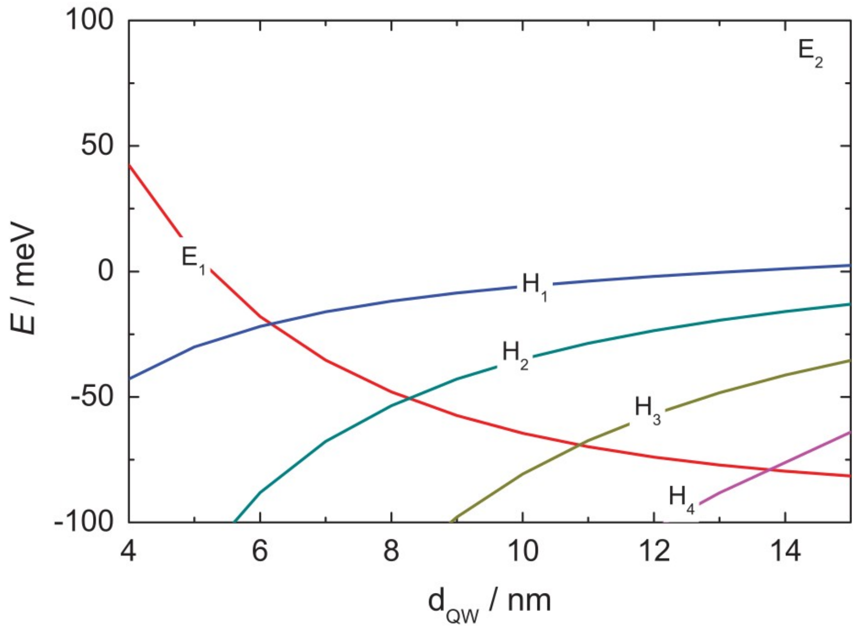


HgTe
Γ_6
E1
H1
CdTe
CdTe
Γ_8
$d < d_c$
Γ_6
HgTe
H1
E1
CdTe
CdTe
Γ_8
$d > d_c$

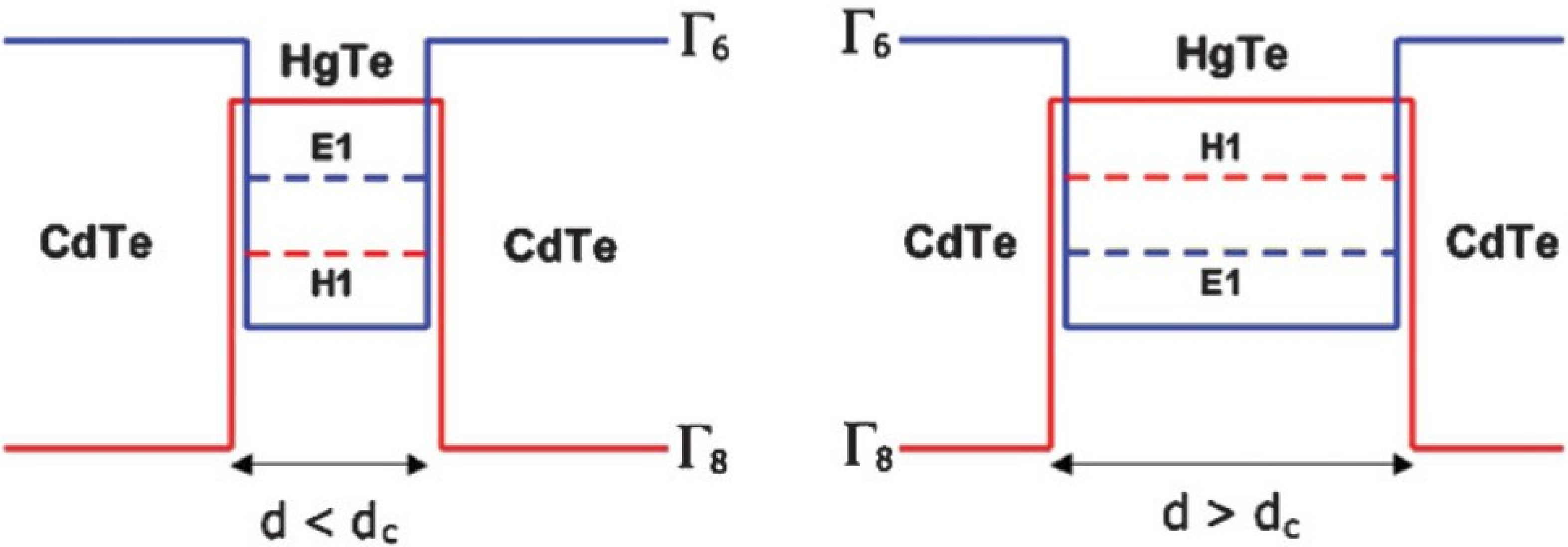

Γ6
HgTe
E1
H1
CdTe
CdTe
Γ8
d < dc
Γ6
HgTe
H1
E1
CdTe
CdTe
Γ8
d > dc

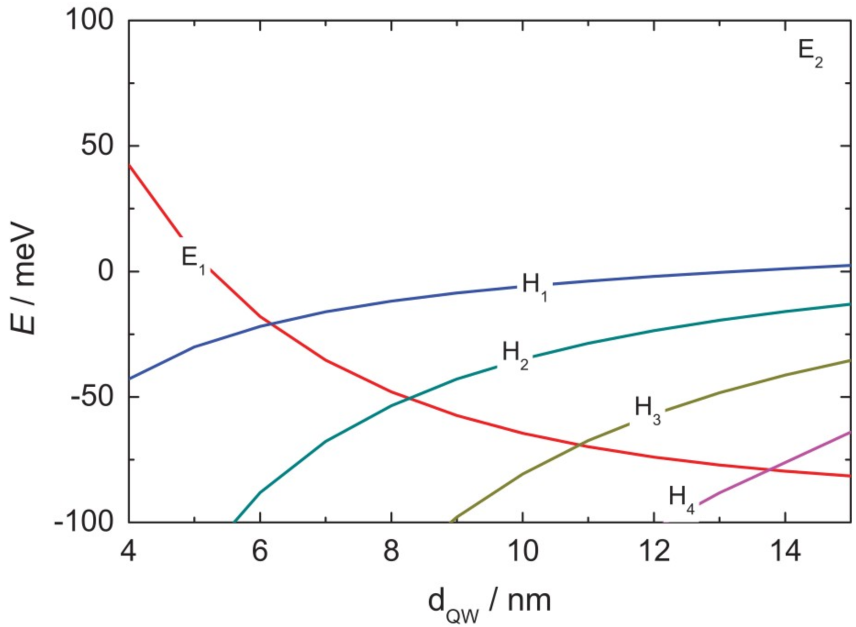

100
50
0
-50
-100
E / meV
4
6
8
10
12
14
dQW / nm
E2
E1
H1
H2
H3
H4





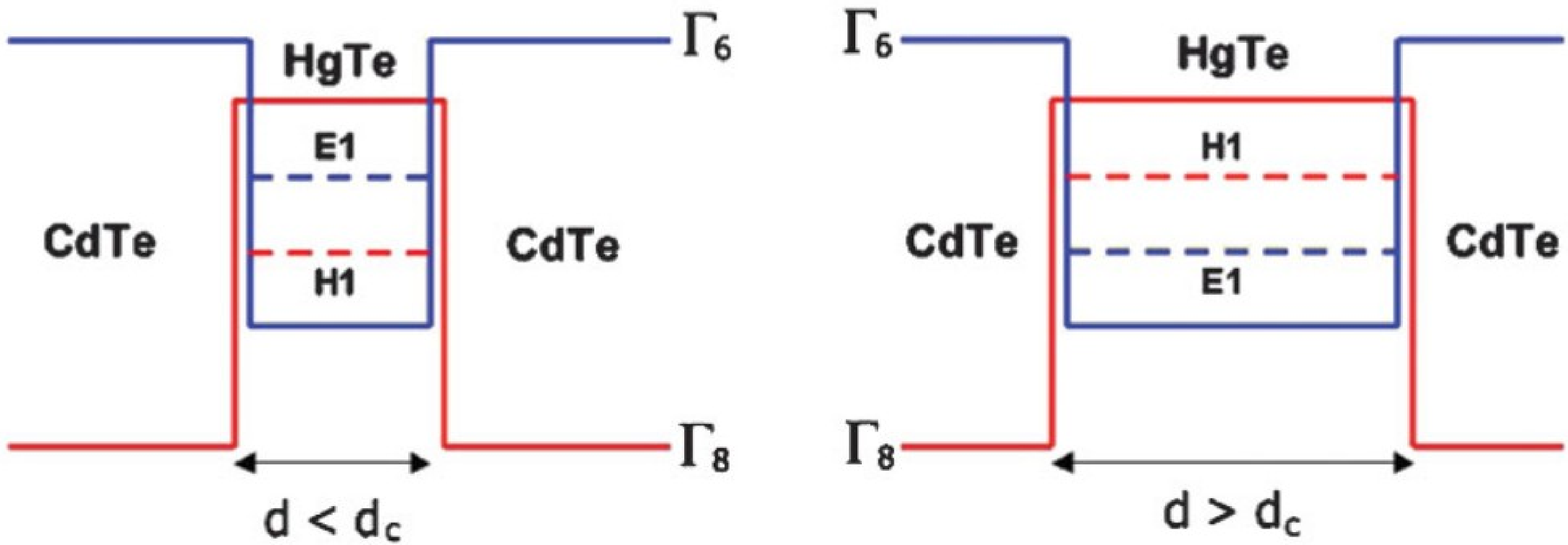
Estados confinados

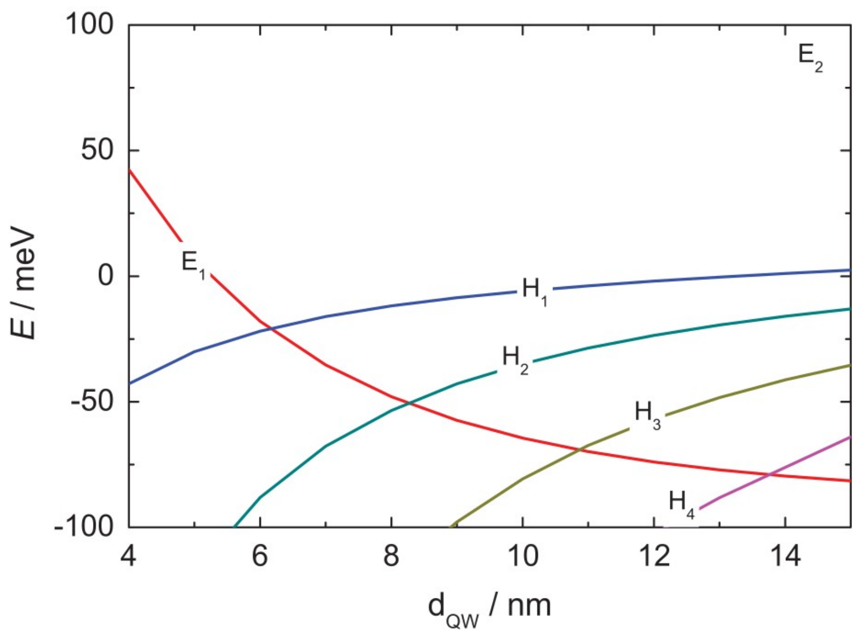




Estados confinados

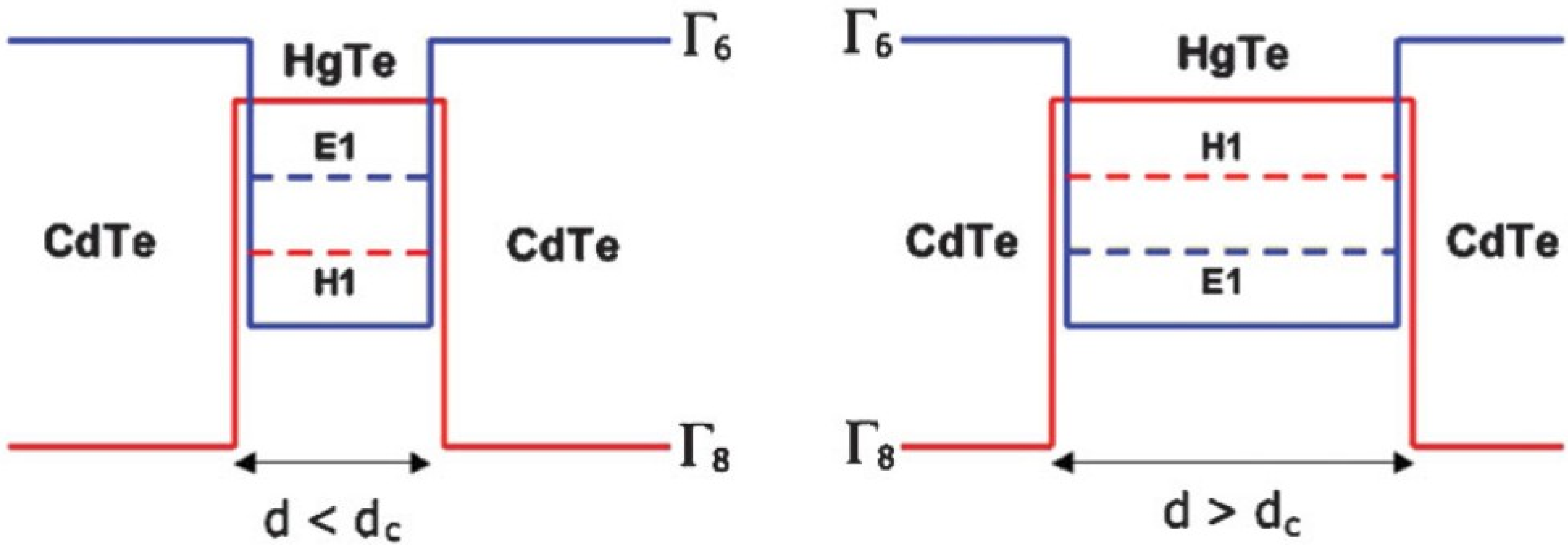
Trocam de ordem como função

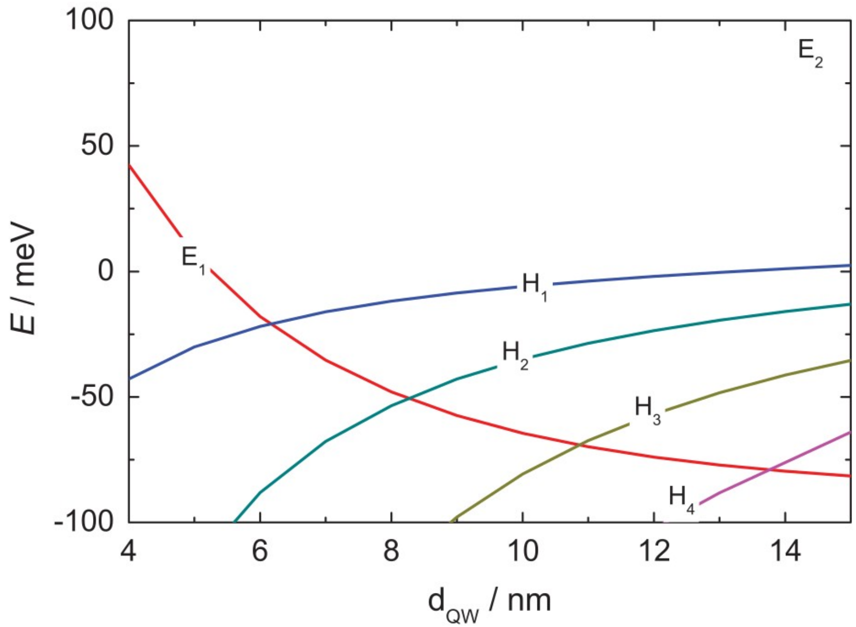




Estados confinados

Trocam de ordem como função
da largura do poço quântico

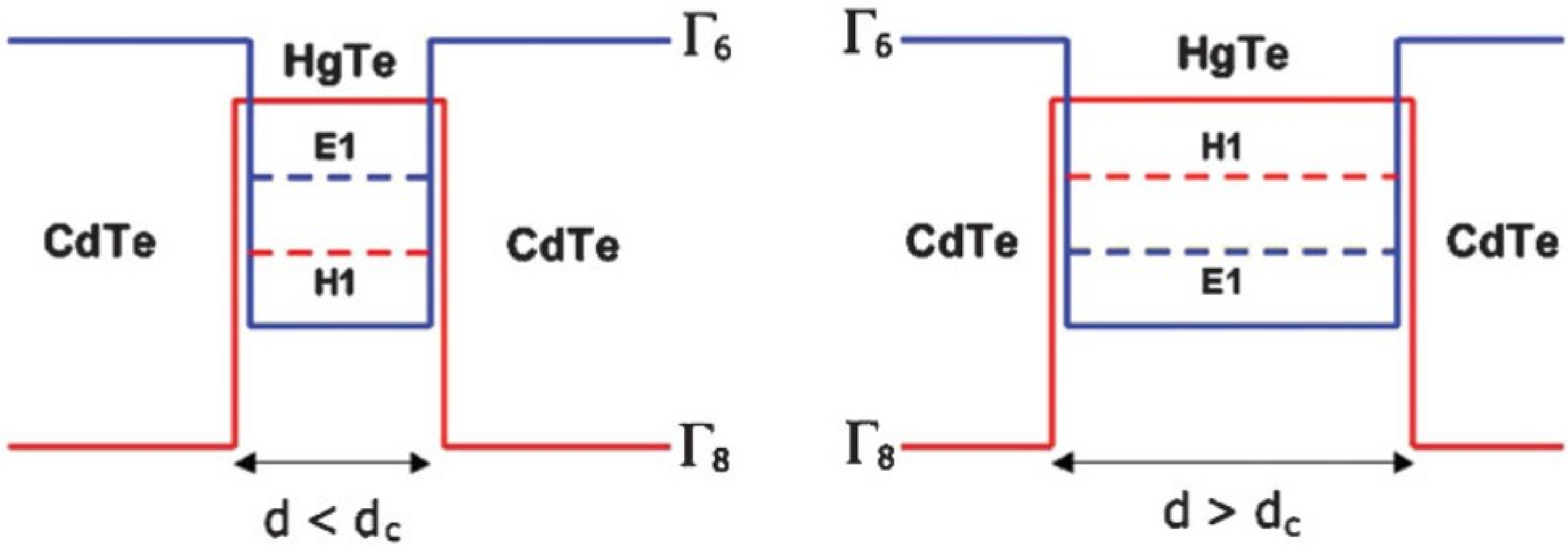


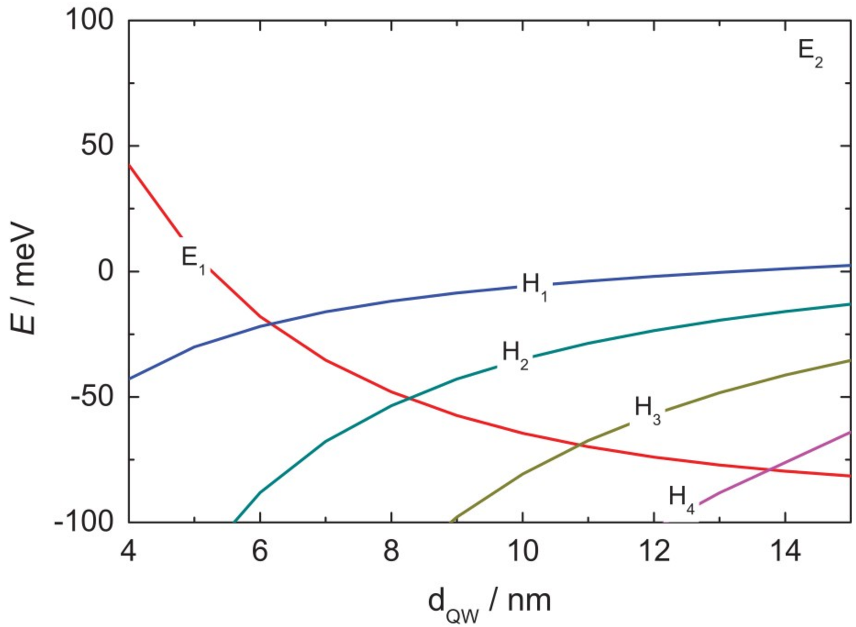


Estados confinados

Trocam de ordem como função
da largura do poço quântico

"massa": $M = E1\text{-}H1$





Estados confinados

Trocam de ordem como função da largura do poço quântico

“massa”: $M = E1\text{-}H1$

$$h(\boldsymbol{k}_{\|}) = C - D\boldsymbol{k}_{\|}^2 + A(\sigma_x k_x - \sigma_y k_y) + (M - B\boldsymbol{k}_{\|}^2)\sigma_z$$

Massa M??

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$$H = A(\sigma_x k_x - \sigma_y k_y) + M\sigma_z$$

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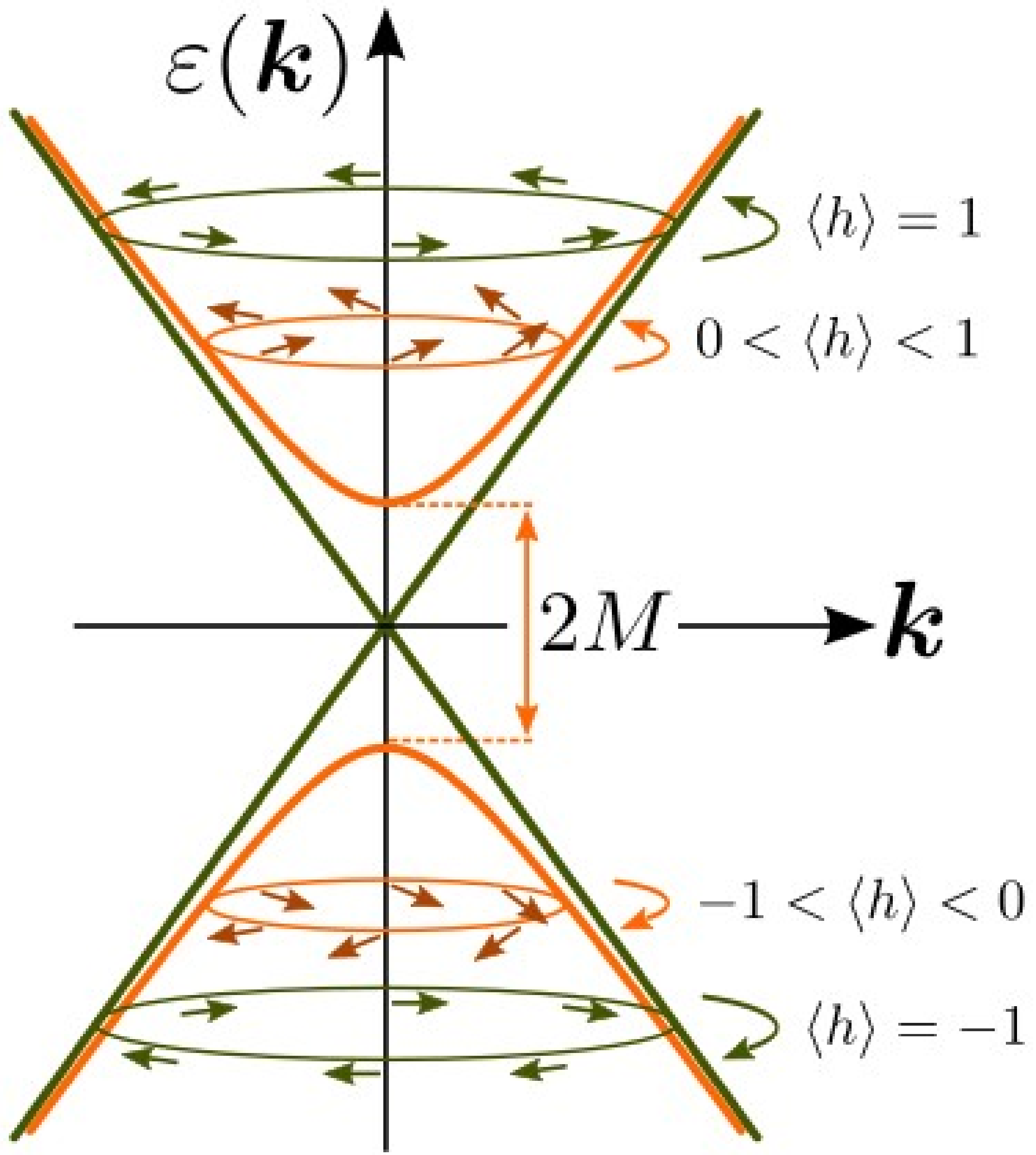

Estados de borda: bulk-boundary correspondence

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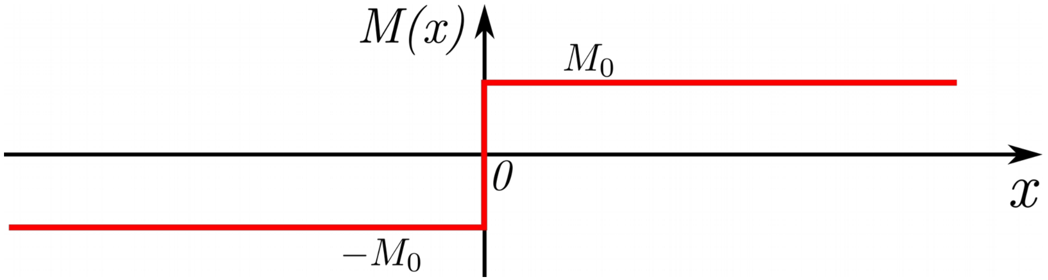

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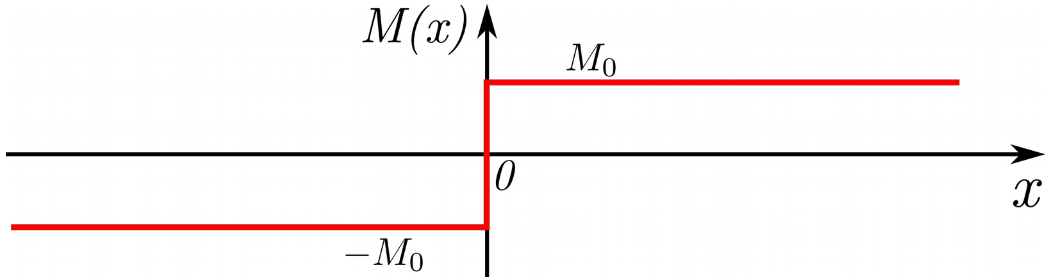
$$H = A(\sigma_x k_x - \sigma_y k_y) + M(x)\sigma_z$$

$$M(x) = M_0 \mathrm{sgn}(x)$$



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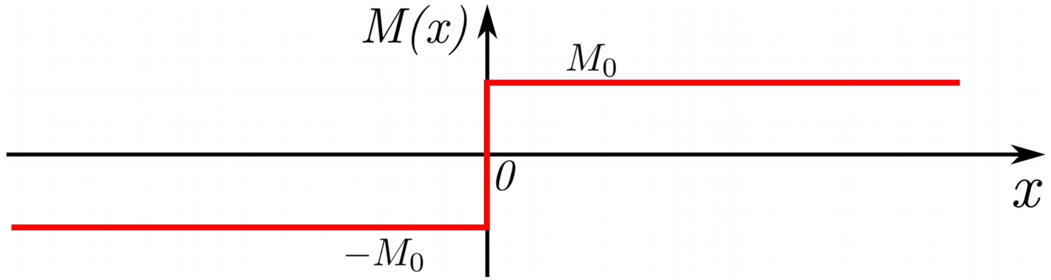

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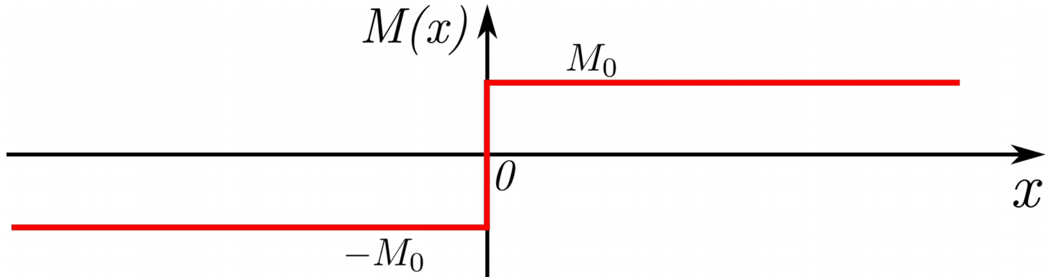

Para x $<$ 0

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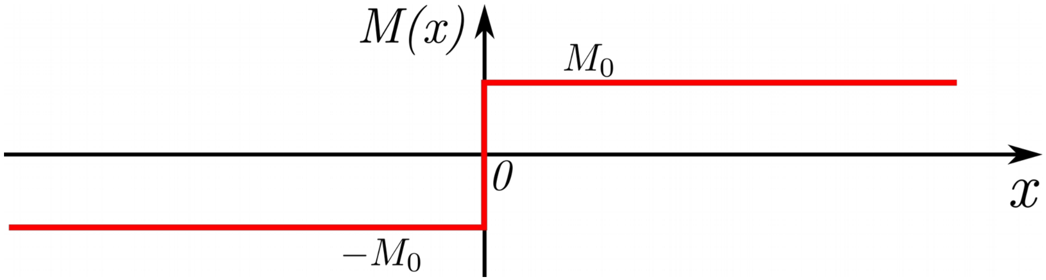

Para x < 0

$$\varphi_L(x) = N e^{\lambda x} \phi_L$$

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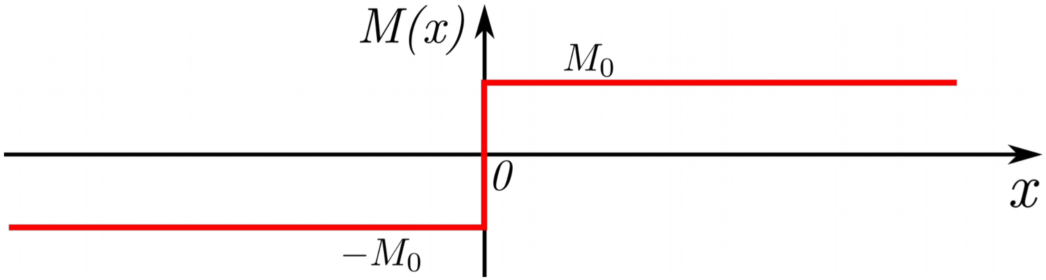

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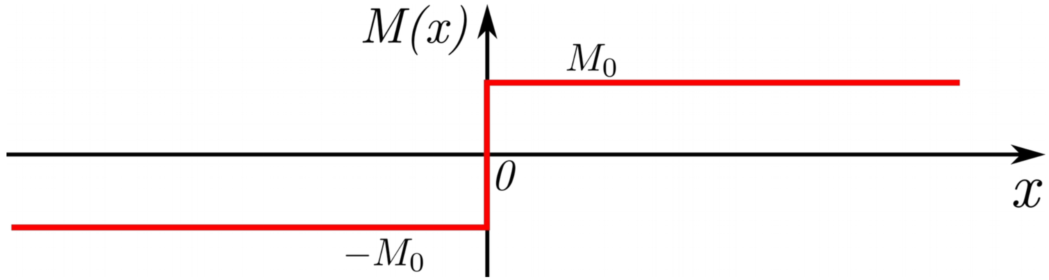

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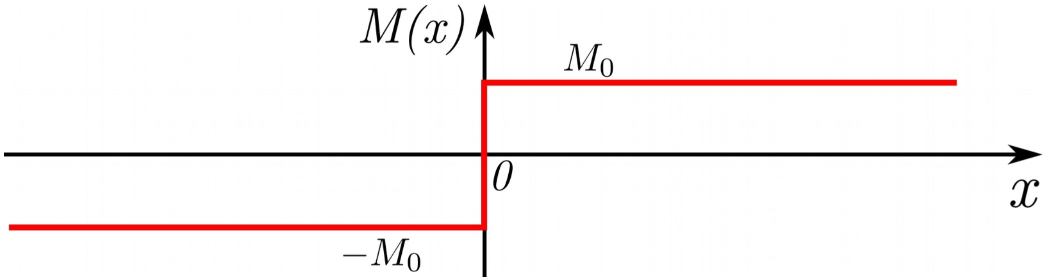

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Para x > 0

$$\varphi_R(x) = N e^{-\lambda x} \phi_R$$

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Estados de borda: bulk-boundary correspondence

$$H = A(\sigma_x k_x - \sigma_y k_y) + M(x)\sigma_z$$

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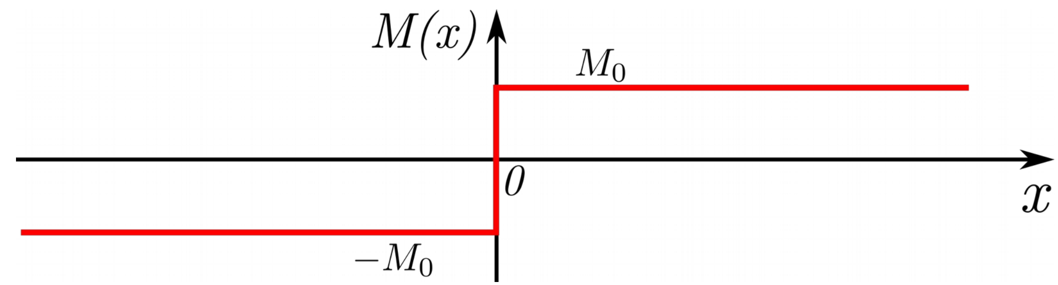
Considerar ky=0 por simplicidade



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Continuidade na interface $\rightarrow$ $\lambda = M_0/A$

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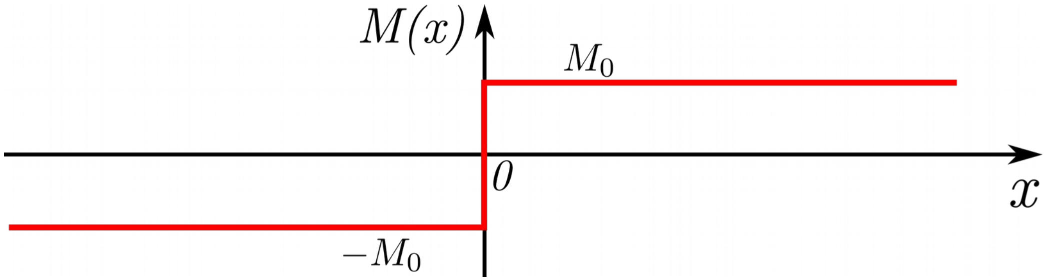

Considerar ky=0 por simplicidade

Para x $<$ 0

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Para x $>$ 0

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Continuidade na interface $\rightarrow$ $\lambda = M_0/A$

Para ky $\neq$ 0

$$\varphi(x,y) = Ne^{ik_y y}e^{-\lambda|x|}\phi$$

Estados de borda: bulk-boundary correspondence

$$H = A(\sigma_x k_x - \sigma_y k_y) + M(x)\sigma_z$$

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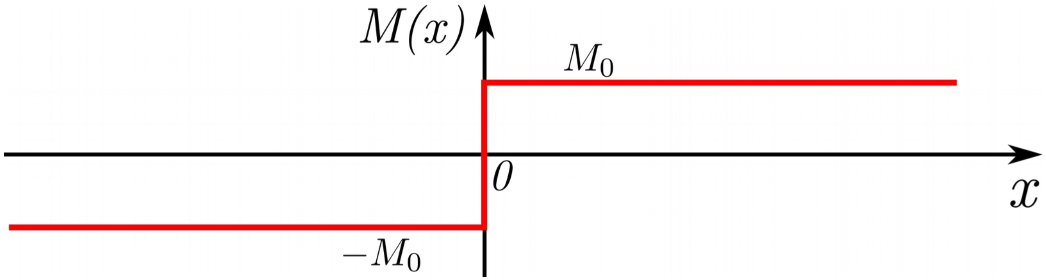

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Continuidade na interface $\rightarrow \lambda = M_0/A$

Para ky $\neq 0$

$$\varphi(x,y) = N e^{ik_y y} e^{-\lambda|x|} \phi$$

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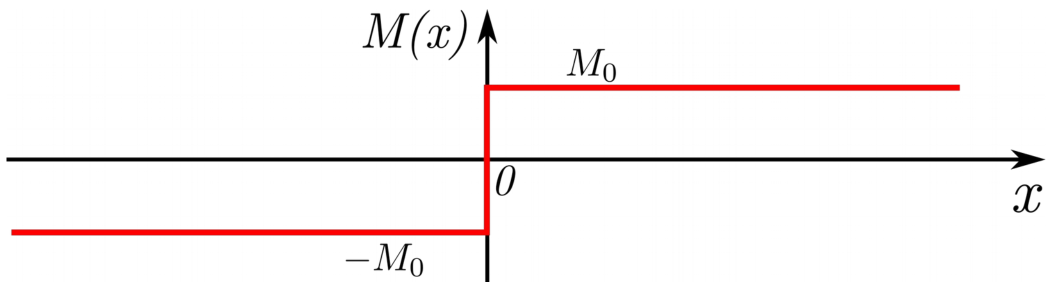

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