Metal-Insulator transitions in infinitesimally weakly disordered flatbands

arXiv: 2107.11365

Tilen Čadež

tilencadez@ibs.re.kr

Center for Theoretical Physics of Complex Systems

virtual, August 18, 2021

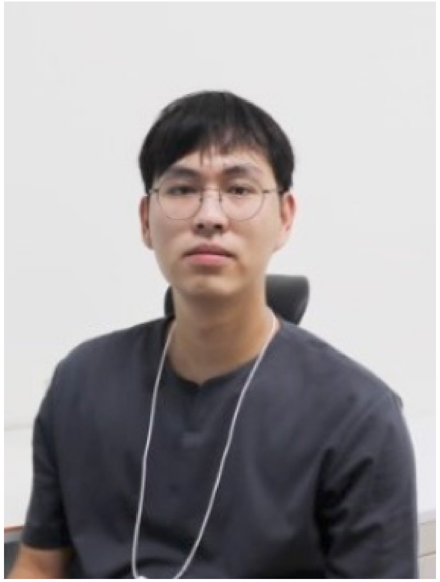
Institute for Basic Science

Aim:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

with

Yeongjun Kim



Alexei Andreanov

Sergej Flach

Outline:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

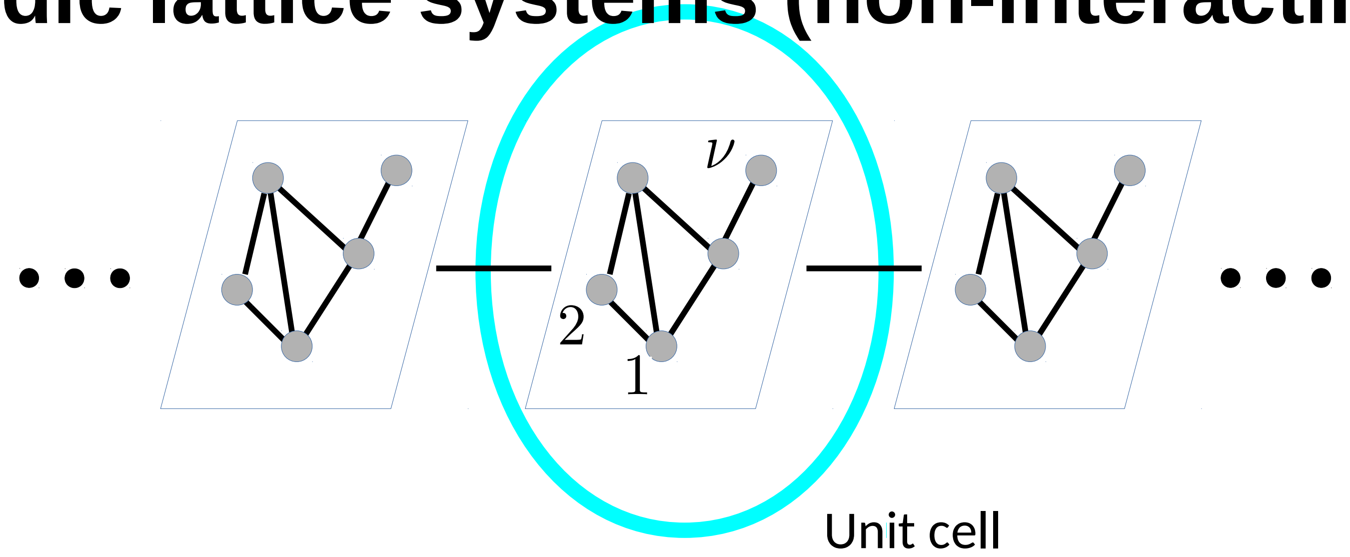
a) ABF construction, 2 bands, d = 1,2,3

b) Scale free model

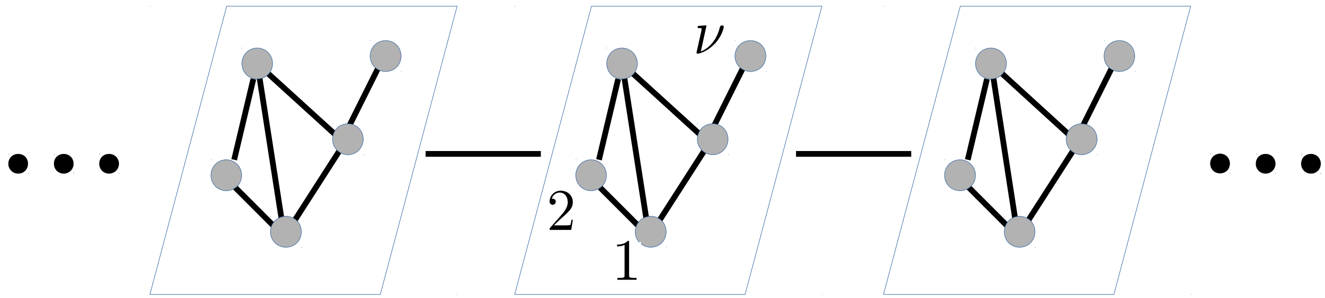
c) Localization in d = 1,2

d) Metal-insulator transition in d = 3

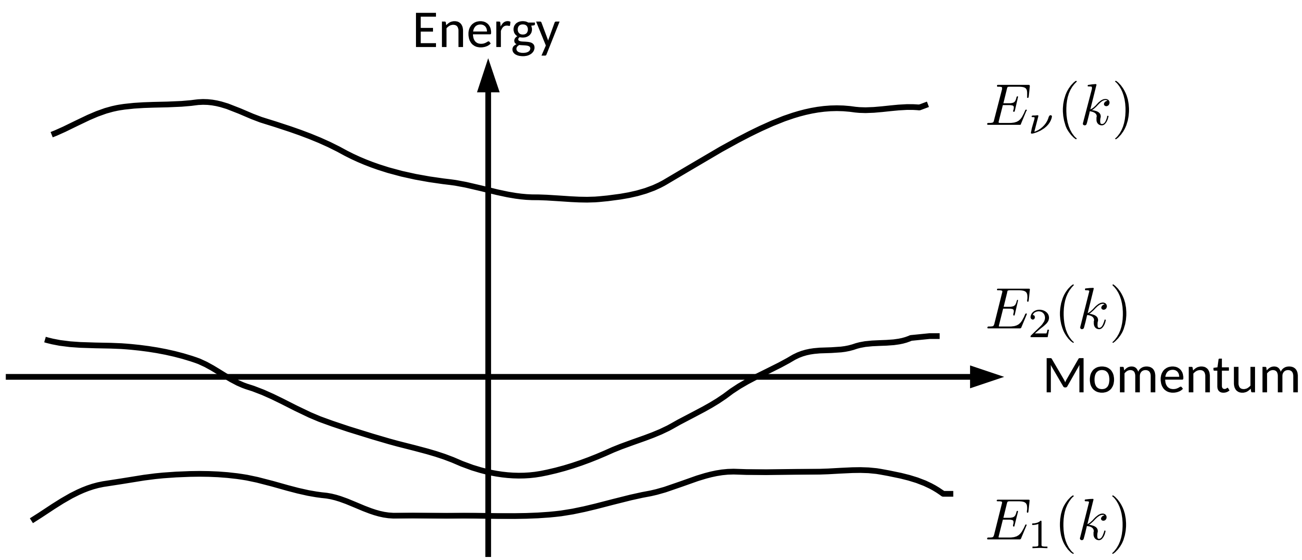
Periodic lattice systems (non-interacting):



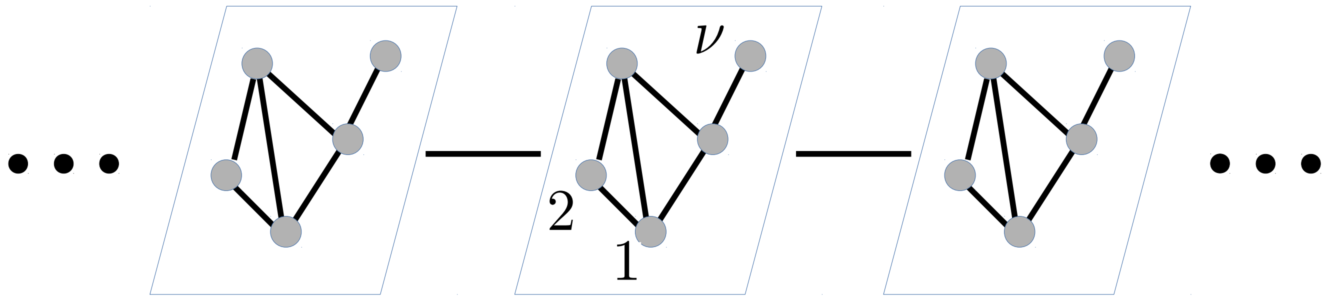
Periodic lattice systems:



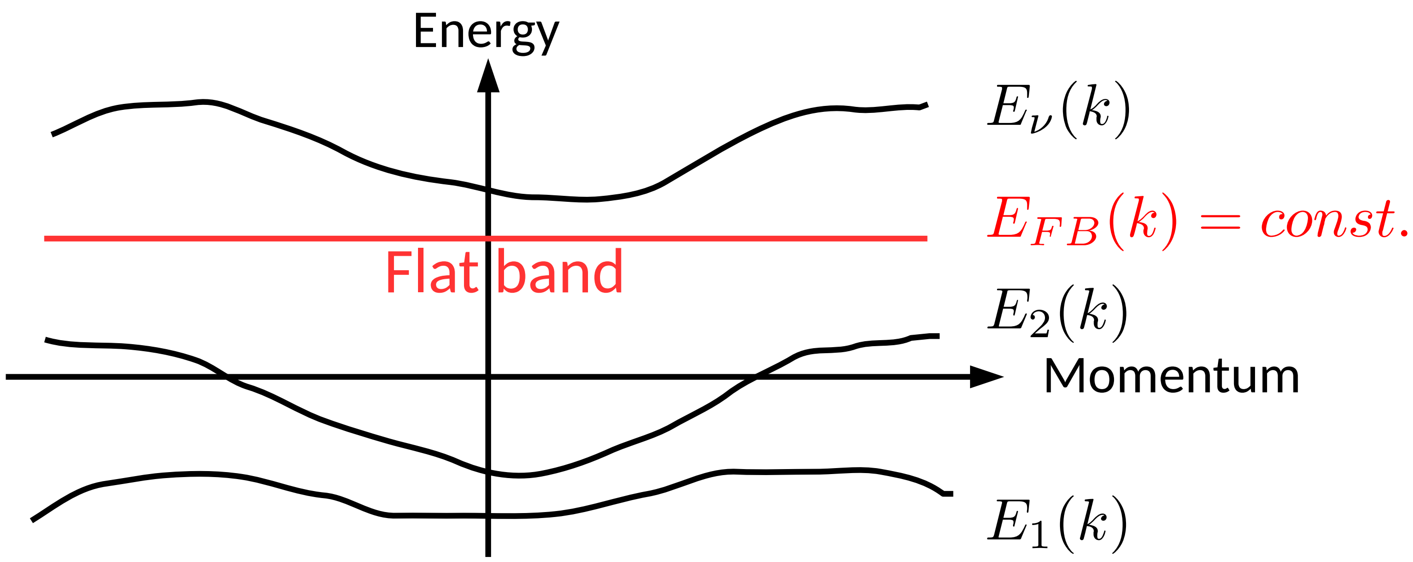
Band structure



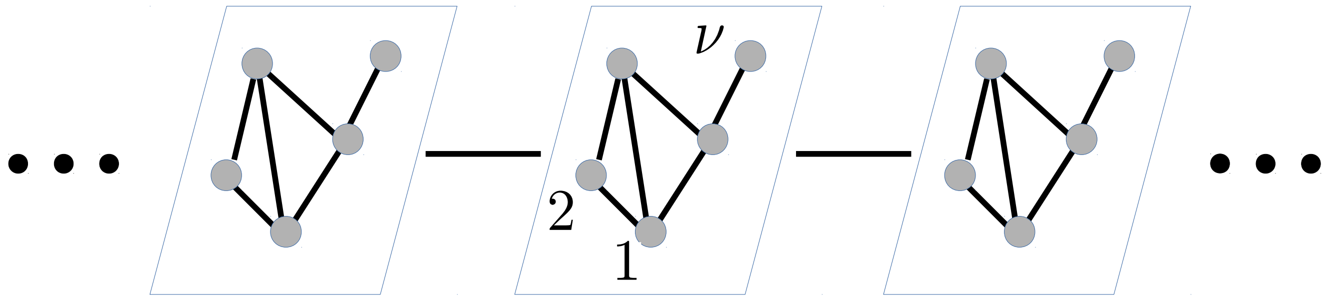
Periodic lattice systems:



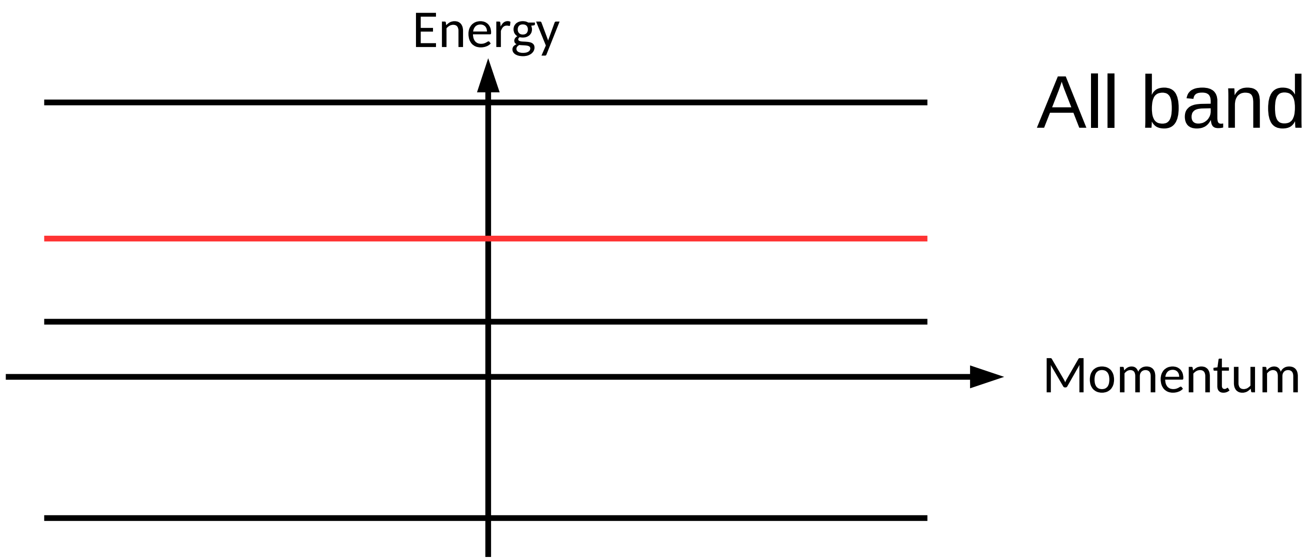
Band structure



Periodic lattice systems:

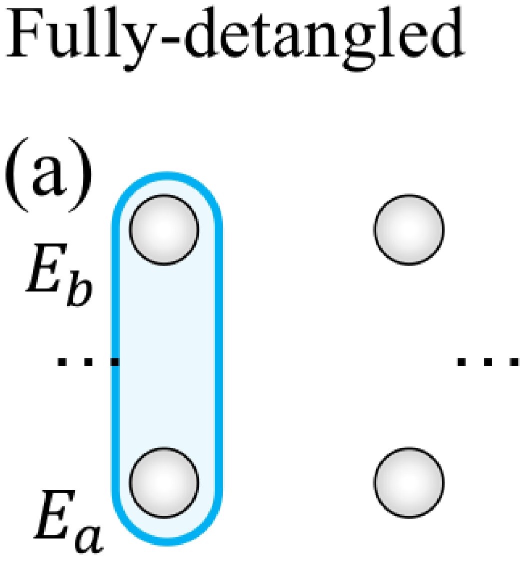


Band structure

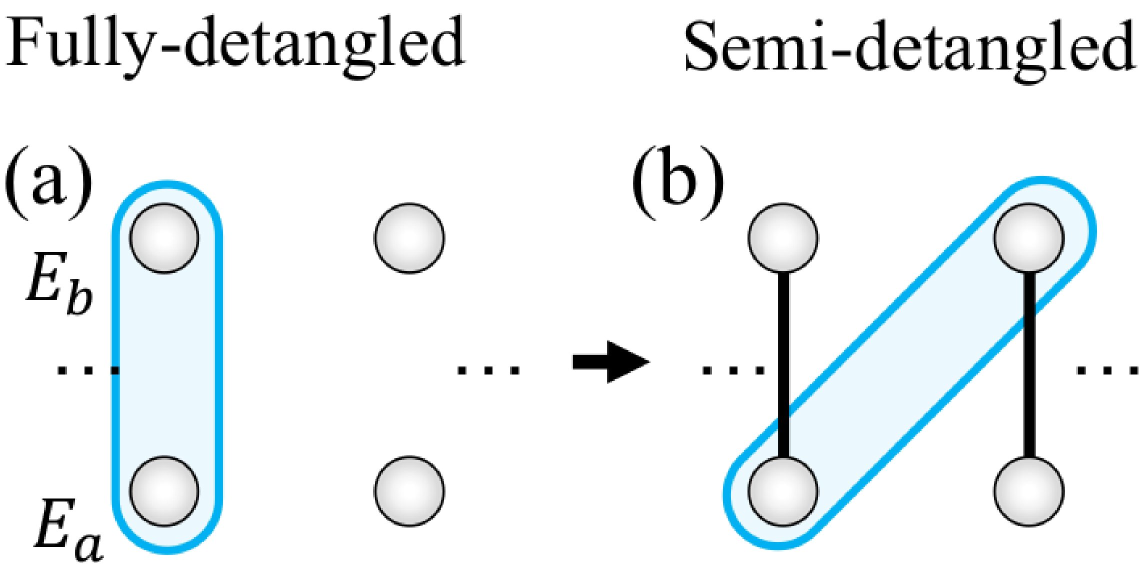


All bands flat

a) ABF construction, 2 bands, d = 1



a) ABF construction, 2 bands, d = 1



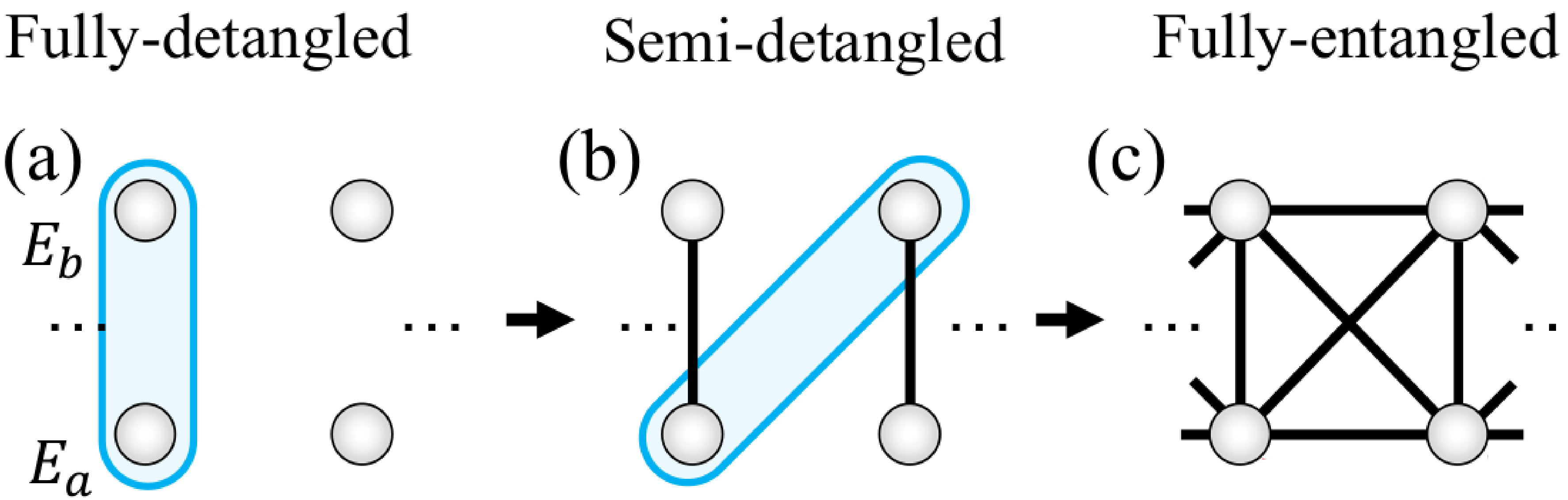
$$U_1 = \begin{pmatrix} z_1 & w_1 \\ -w_1^* & z_1^* \end{pmatrix}$$

Local unitary transformation (LUT)

$$z_1 = \cos(\theta_1) e^{i\varphi_1}$$

$$w_1 = \sin(\theta_1) e^{i\bar{\varphi}_1}$$

a) ABF construction, 2 bands, d = 1

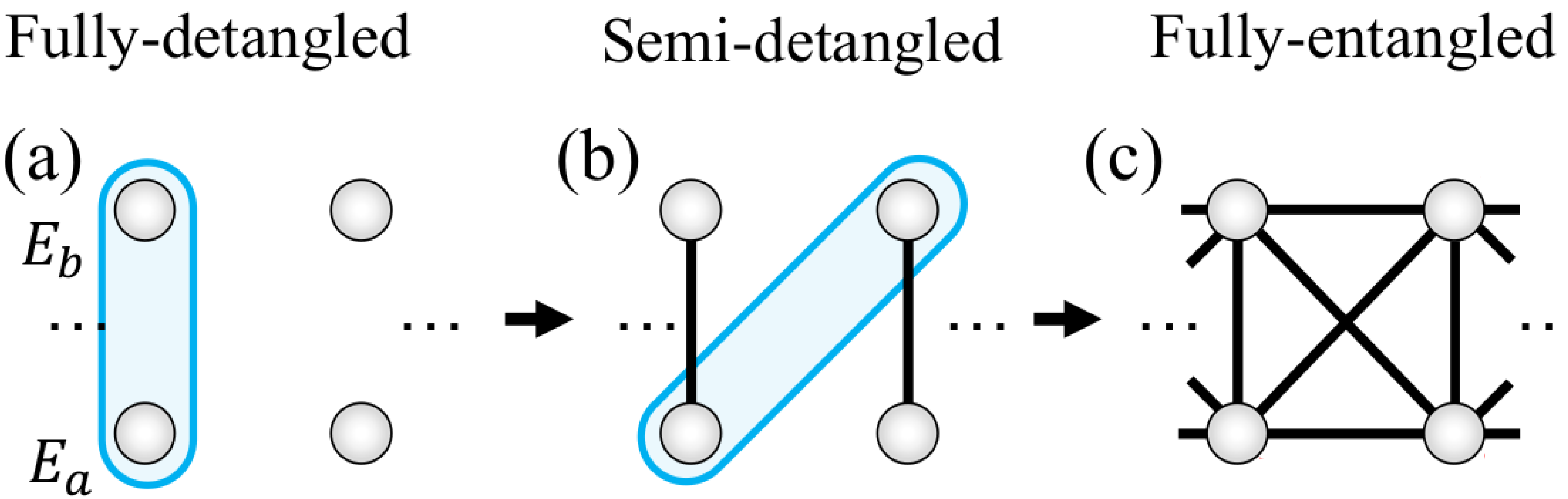


$$U_1 = \begin{pmatrix} z_1 & w_1 \\ -w_1^* & z_1^* \end{pmatrix} \qquad U_2 = \begin{pmatrix} z_2 & w_2 \\ -w_2^* & z_2^* \end{pmatrix}$$

$$z_1 = \cos(\theta_1) e^{i\varphi_1} \qquad z_2 = \cos(\theta_2) e^{i\varphi_2}$$

$$w_1 = \sin(\theta_1) e^{i\bar{\varphi}_1} \qquad w_2 = \sin(\theta_2) e^{i\bar{\varphi}_2}$$

a) ABF construction, 2 bands, d = 1

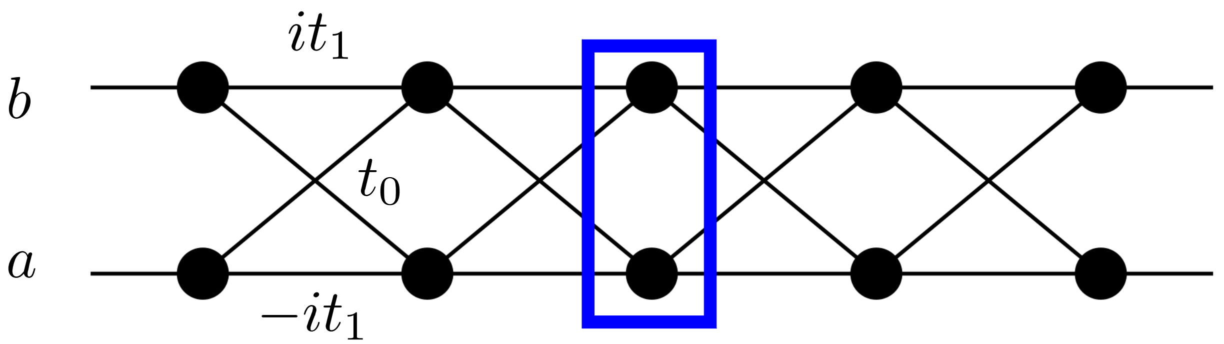


$$U_1 = \begin{pmatrix} z_1 & w_1 \\ -w_1^* & z_1^* \end{pmatrix} \qquad U_2 = \begin{pmatrix} z_2 & w_2 \\ -w_2^* & z_2^* \end{pmatrix}$$

A manifold of equivalent ABF systems!

example: Creutz ladder (FE basis)

Creutz M., **PRL 83**, 2636 (1999)



$$H_{1C} = \begin{pmatrix} -it_1 & -t_0 \\ -t_0 & it_1 \end{pmatrix}$$

$$E_C(k) = \pm 2\sqrt{t_0^2 \cos^2(k) + t_1^2 \sin^2(k)}$$

$t_0 = t_1$ ABF

Local unitary
transformations (LUT)

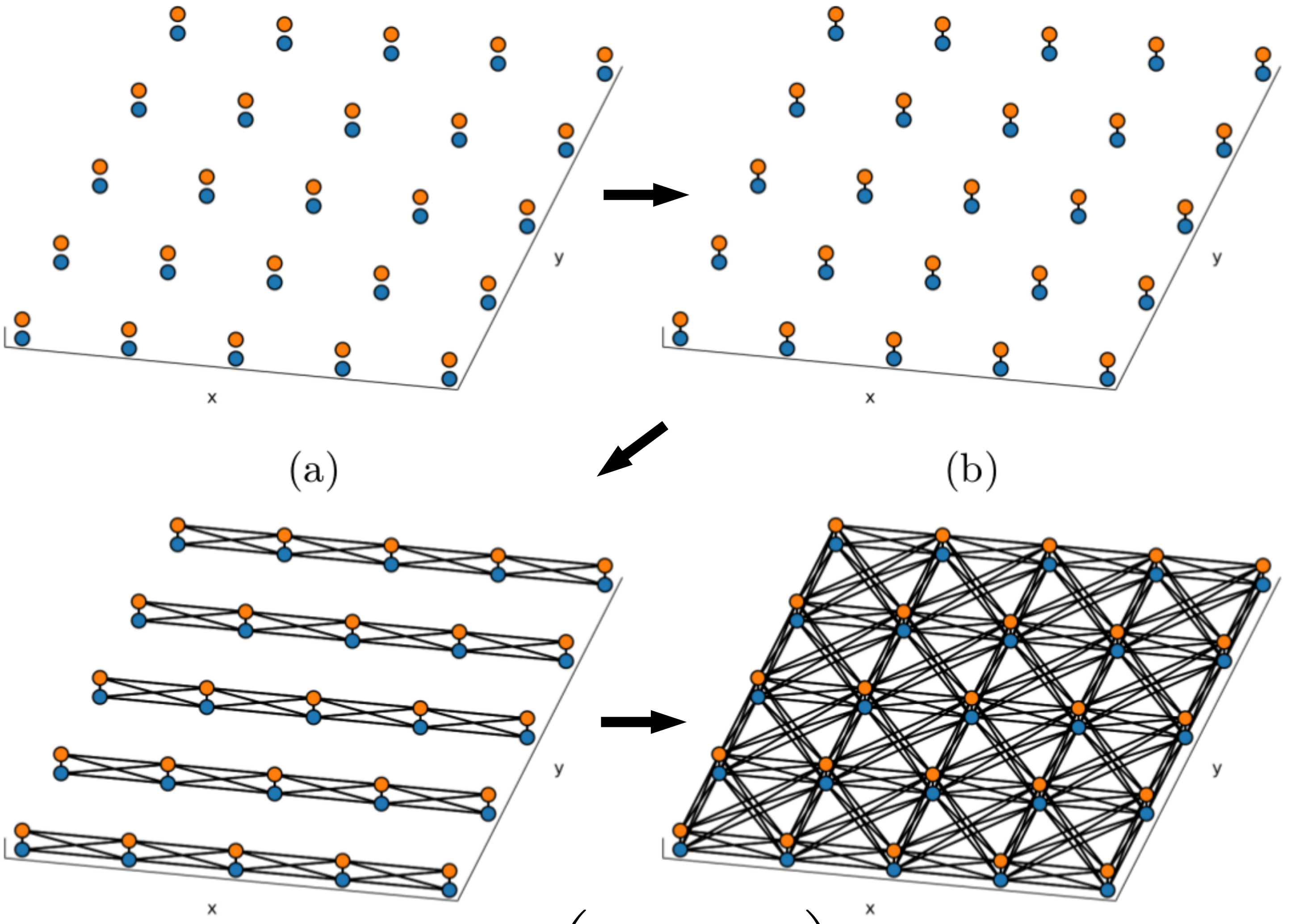
Danieli C. et al., **arXiv** 2004.11871 (2020)

$$\theta_1 = \theta_2 = \pi/4 \qquad E_a = -E_b = 2t_0$$

$$\varphi_1 = -\bar{\varphi}_1$$

$$\varphi_2 = 2\bar{\varphi}_2 = \pi$$

a) ABF construction, 2 bands, d = 2



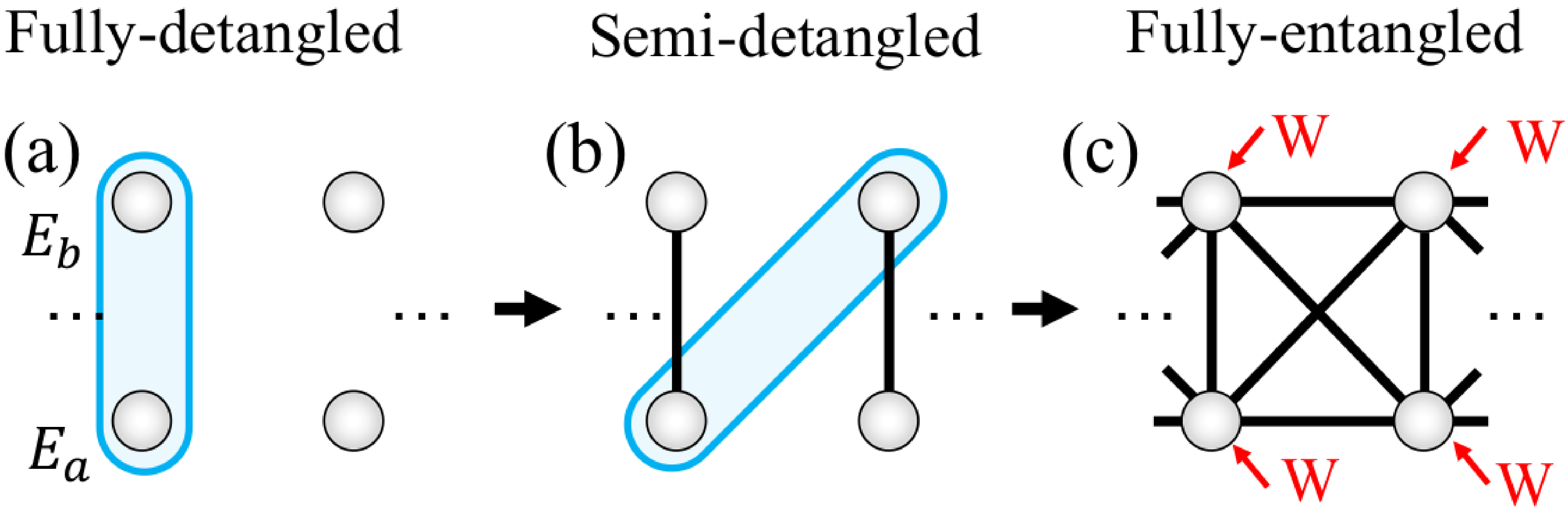
(a) (b)

(c) $U_3 = \begin{pmatrix} z_3 & w_3 \\ -w_3^* & z_3^* \end{pmatrix}$ (d)

U_4

d = 3

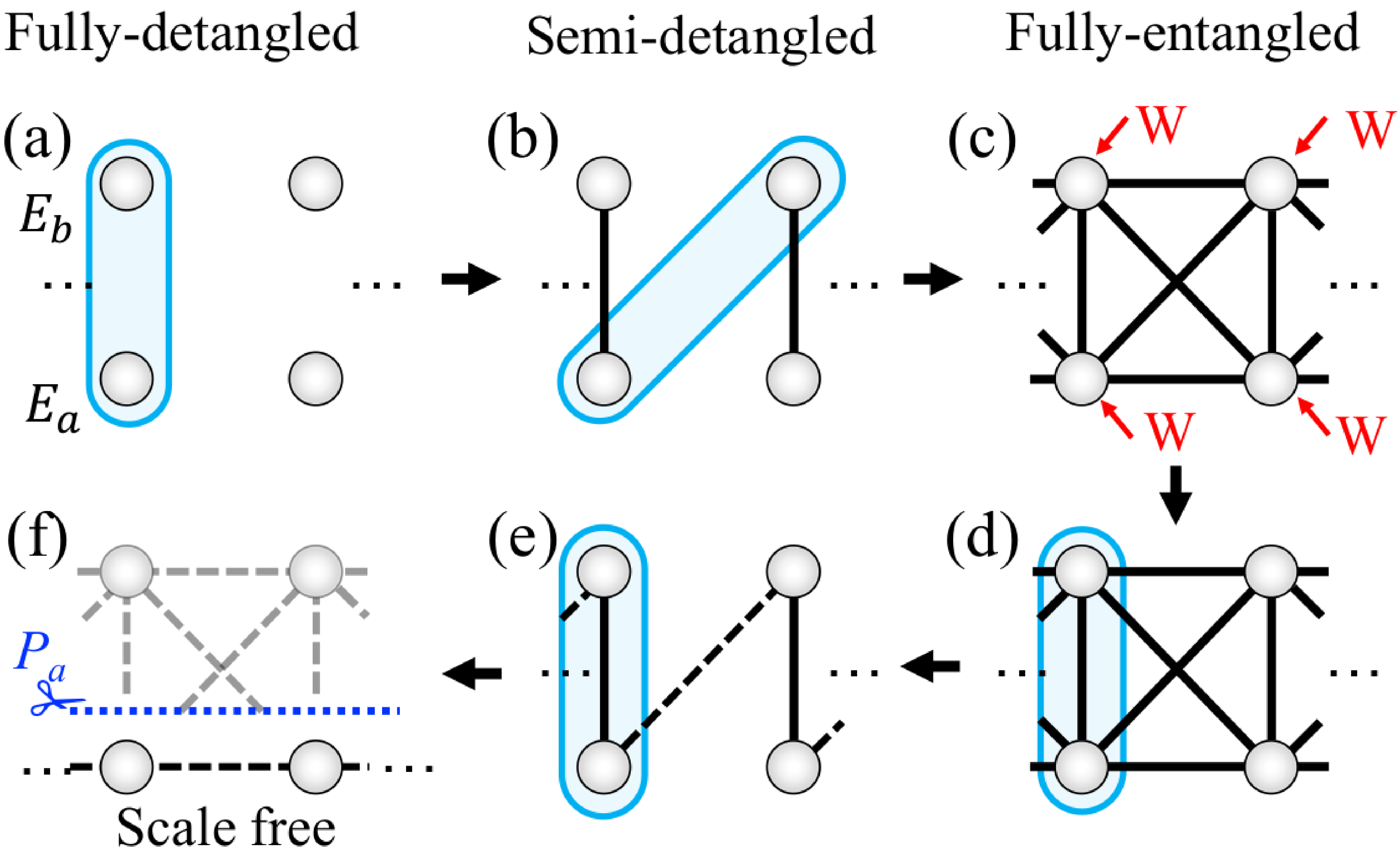
Disorder



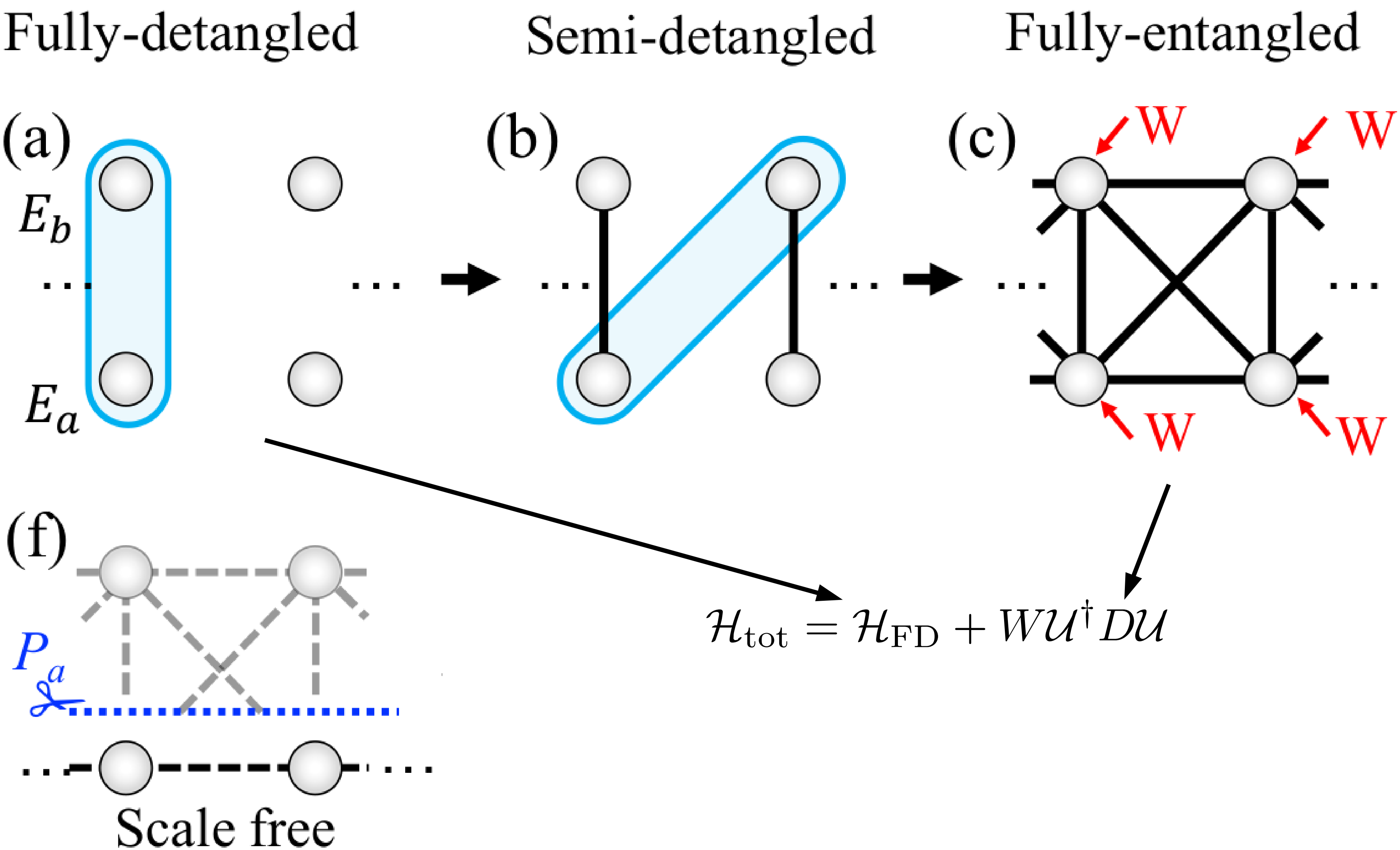
Adding potential (onsite) disorder

$$\varepsilon_n \in [-W/2, W/2]$$

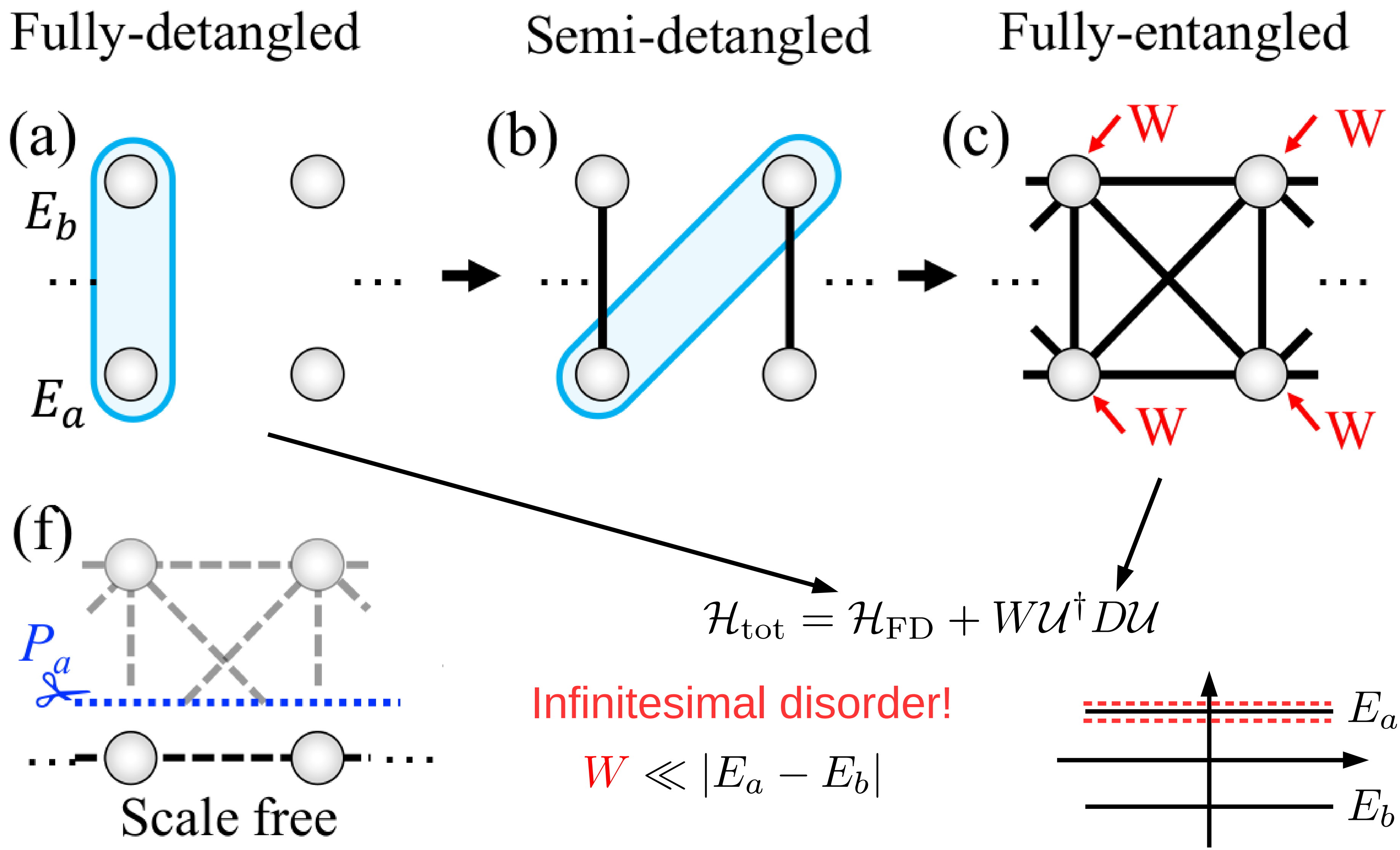
b) Scale free model, 2 bands, d = 1



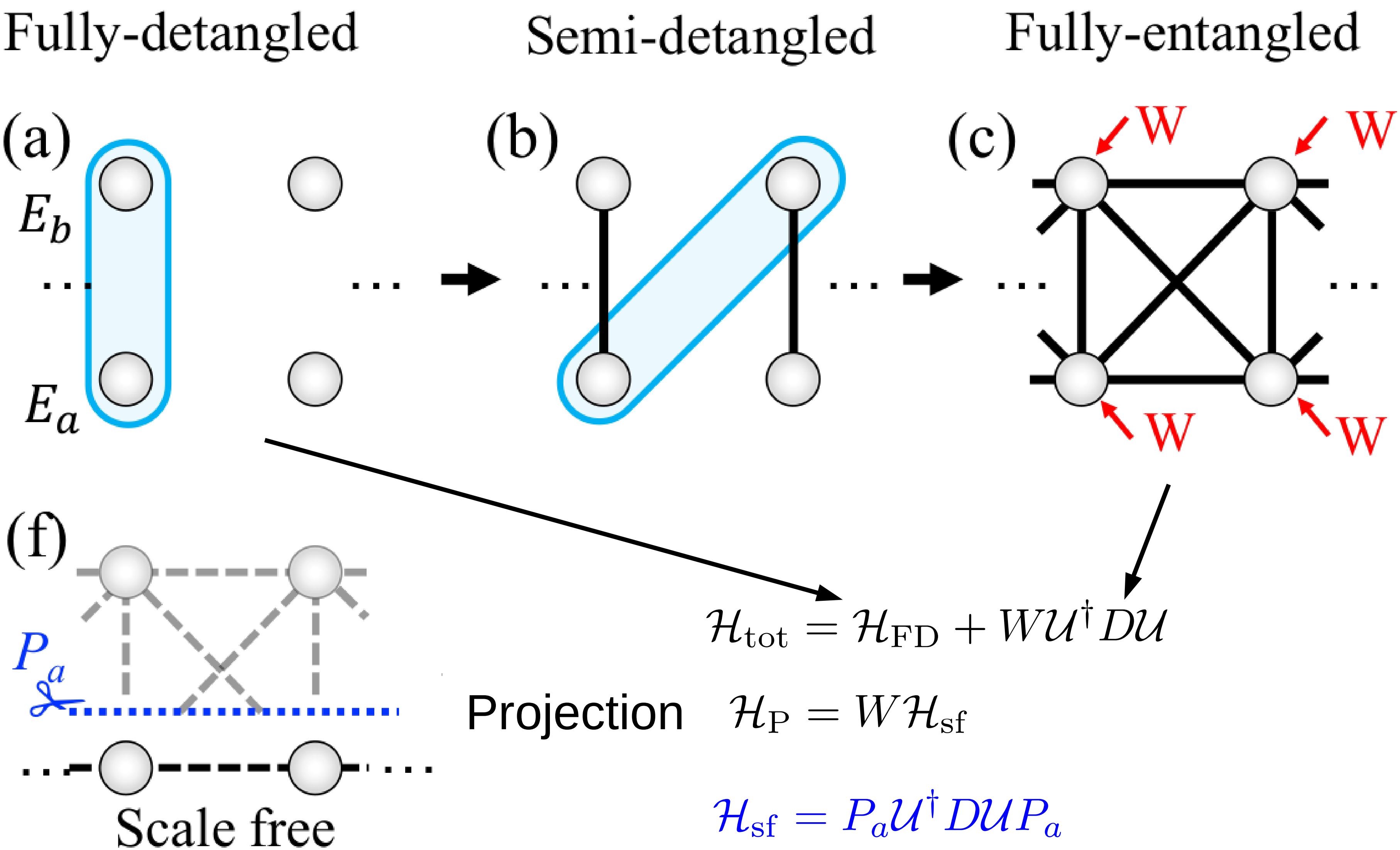
b) Scale free model



b) Scale free model



b) Scale free model



$$\mathcal{H}_{\rm tot} = \mathcal{H}_{\rm FD} + W\mathcal{U}^\dagger D\mathcal{U}$$

Projection $\quad \mathcal{H}_{\rm P} = W\mathcal{H}_{\rm sf}$

$$\mathcal{H}_{\rm sf} = P_a\mathcal{U}^\dagger D\mathcal{U}P_a$$

c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\text{sf}} = \sum_n (V_n |a_n\rangle\langle a_n| + t_n |a_{n+1}\rangle\langle a_n| + h.c.)$$

c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\rm sf} = \sum_n \left(V_n |a_n\rangle\langle a_n| + t_n |a_{n+1}\rangle\langle a_n| + h.c. \right)$$

$$V_n = \left[\varepsilon_{p,n} \cos^2(\theta_2) + \varepsilon_{f,n} \sin^2(\theta_2)\right] \cos^2(\theta_1) + \\ + \left[\varepsilon_{p,n+1} \sin^2(\theta_2) + \varepsilon_{f,n+1} \cos^2(\theta_2)\right] \sin^2(\theta_1)$$

$$t_n = 1/4 \left(\varepsilon_{f,n+1} - \varepsilon_{p,n+1}\right) \sin(2\theta_1) \sin(2\theta_2) e^{i(\varphi_1 + \bar{\varphi}_1 - \varphi_2 + \bar{\varphi}_2)}$$

Only two parameters!

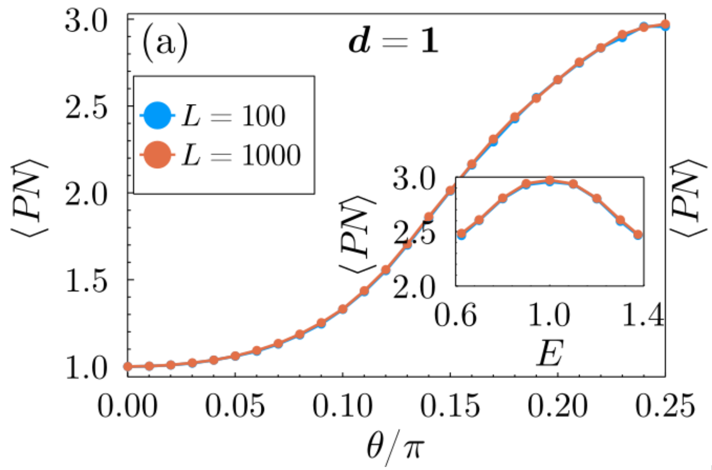
$$\theta_1, \theta_2 \in [0, \pi/4]$$

c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\rm sf} = \sum_n \left(V_n|a_n\rangle\langle a_n| + t_n|a_{n+1}\rangle\langle a_n| + h.c.\right)$$

Exact diagonalization (ED) and transfer matrix (TM)

$$\theta_1 = \theta_2 = \theta$$



Participation number

$$\mathrm{PN}_\mu = \Big(\sum_n |\psi_{\mu,n}|^4\Big)^{-1}$$

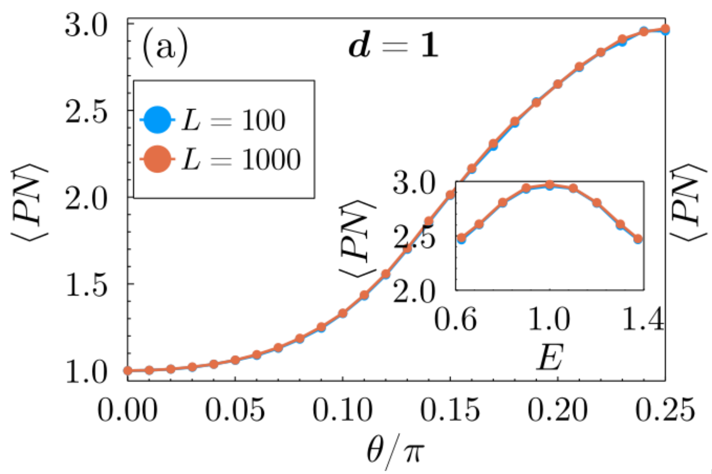
Localization!

c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\rm sf} = \sum_n \left(V_n |a_n\rangle\langle a_n| + t_n |a_{n+1}\rangle\langle a_n| + h.c. \right)$$

Exact diagonalization (ED)

$$\theta_1 = \theta_2 = \theta$$



$$\text{ABF} \neq \text{ABF}$$

Localization!

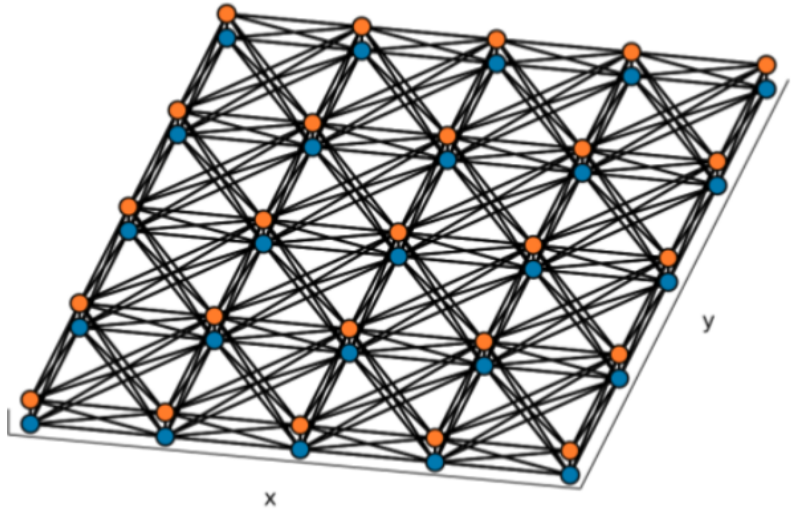
Participation number

$$\mathrm{PN}_\mu = \Big(\sum_n |\psi_{\mu,n}|^4 \Big)^{-1}$$

c) d = 2, square lattice + diagonal hoppings

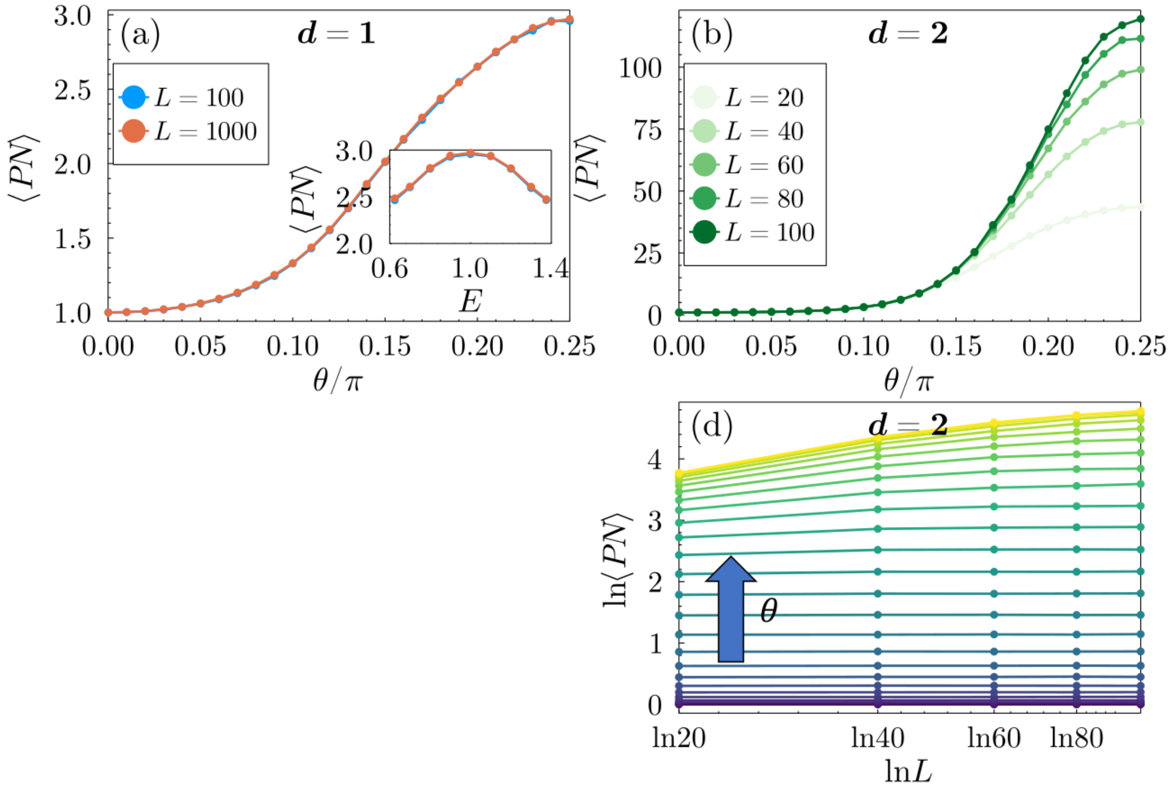
Exact diagonalization (ED)

$$\theta_1 = \theta_2 = \theta_3 = \theta$$



c) d = 2, square lattice + diagonal hoppings

Exact diagonalization (ED)

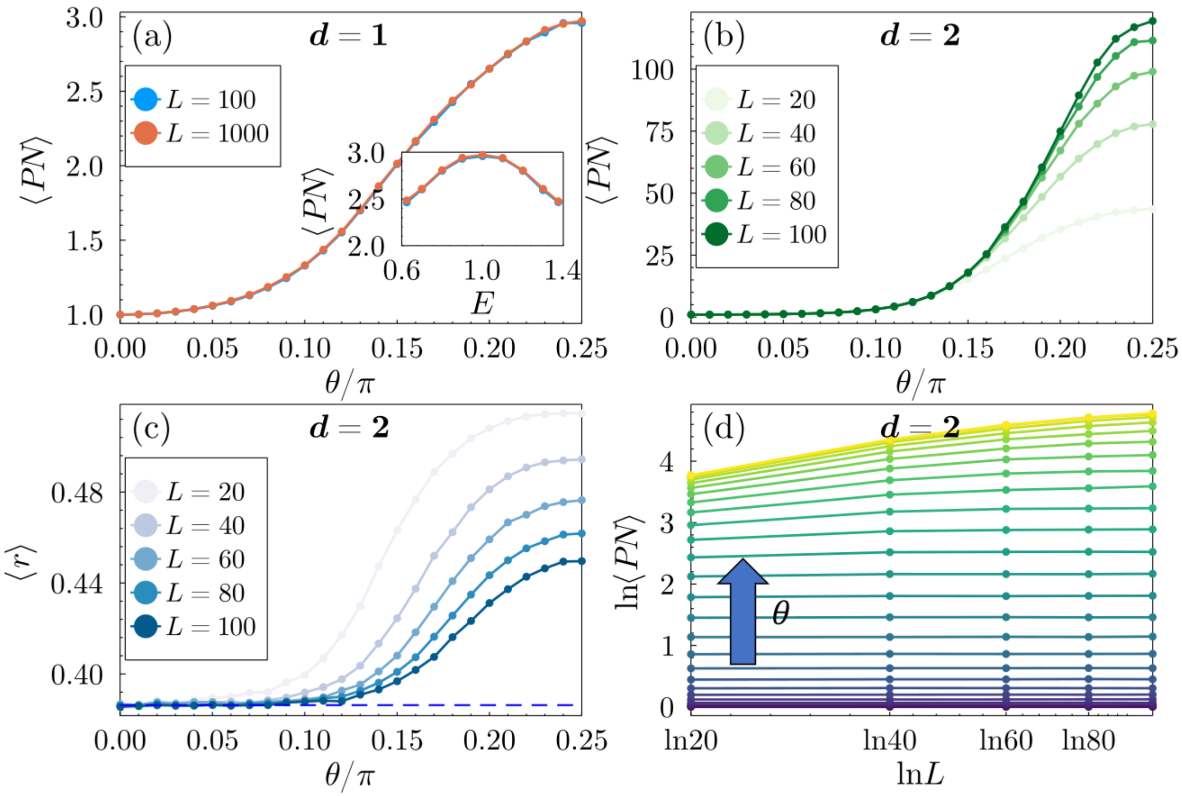


$$\langle \mathrm{PN} \rangle \sim L^{\alpha}$$

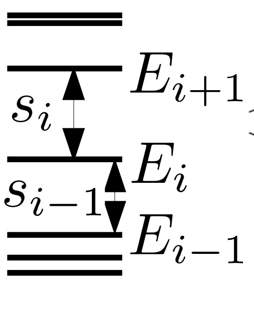
$$\alpha \to 0$$

c) d = 2, square lattice + diagonal hoppings

Exact diagonalization (ED)



ROAG



$$\langle \mathrm{PN} \rangle \sim L^{\alpha}$$

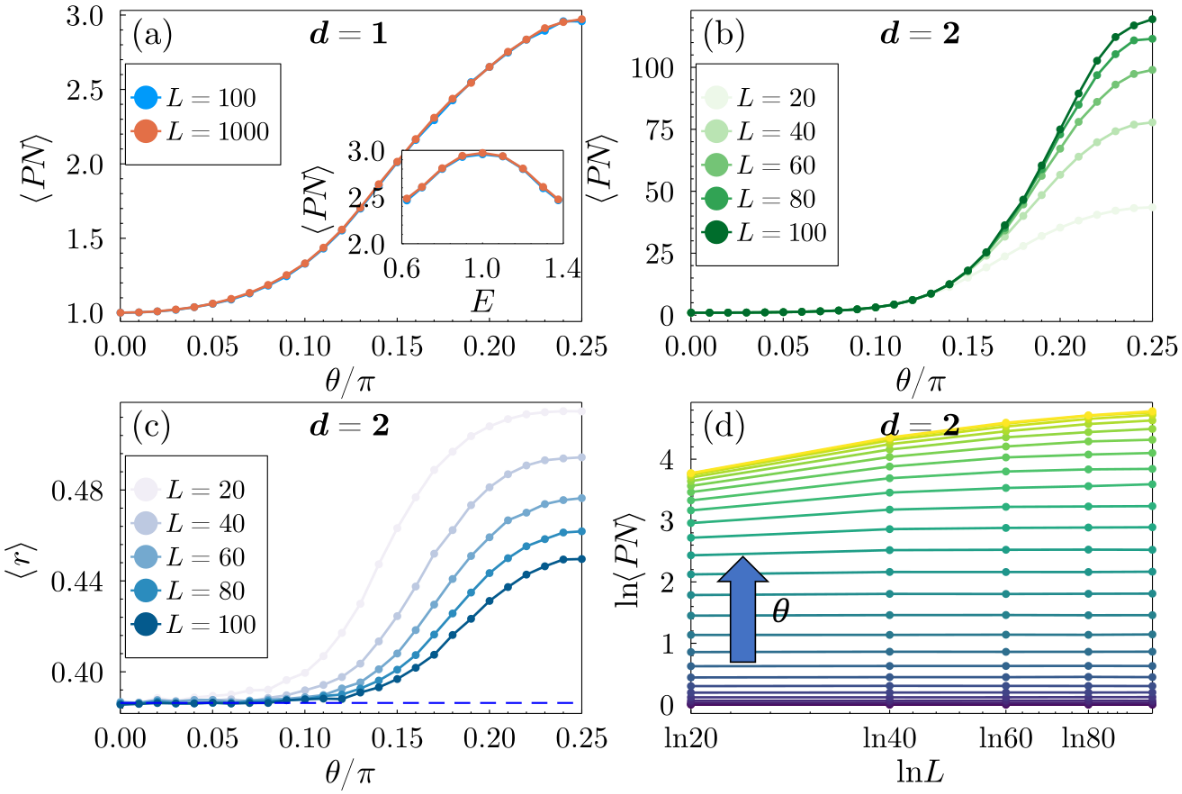
$$\alpha \to 0$$

$$r_i = \frac{\min(s_i, s_{i-1})}{\max(s_i, s_{i-1})}$$

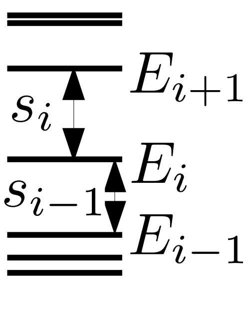
Oganesyan V. & Huse D. A., **PRB 75**, 155111 (2007)

c) d = 2, square lattice + diagonal hoppings

Exact diagonalization (ED)



ROAG



$$\langle \mathrm{PN} \rangle \sim L^{\alpha}$$

$$\alpha \to 0$$

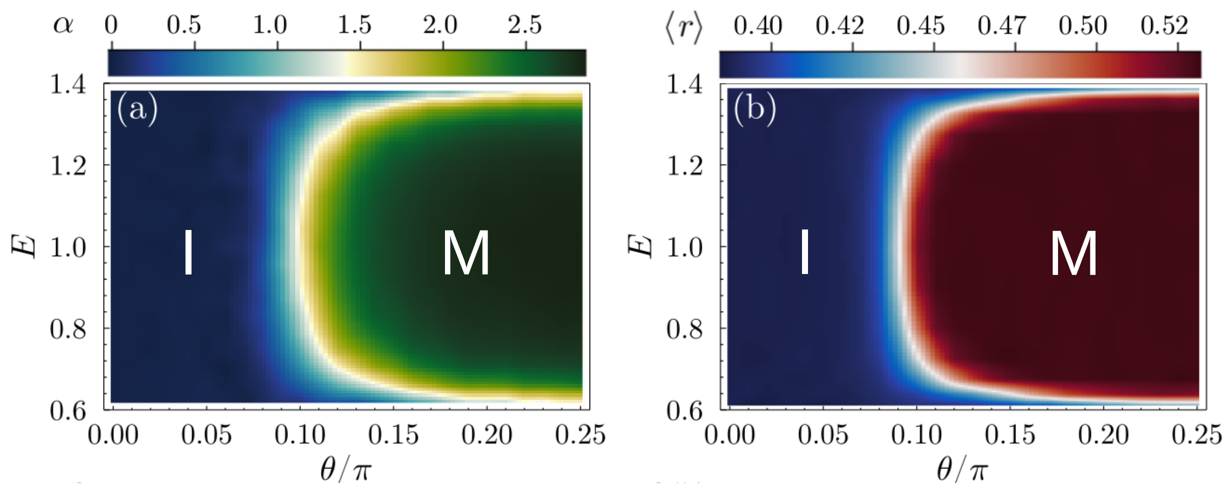
$$r_i = \frac{\min(s_i, s_{i-1})}{\max(s_i, s_{i-1})}$$

Localization!

d) d = 3, cubic lattice + diagonal hoppings

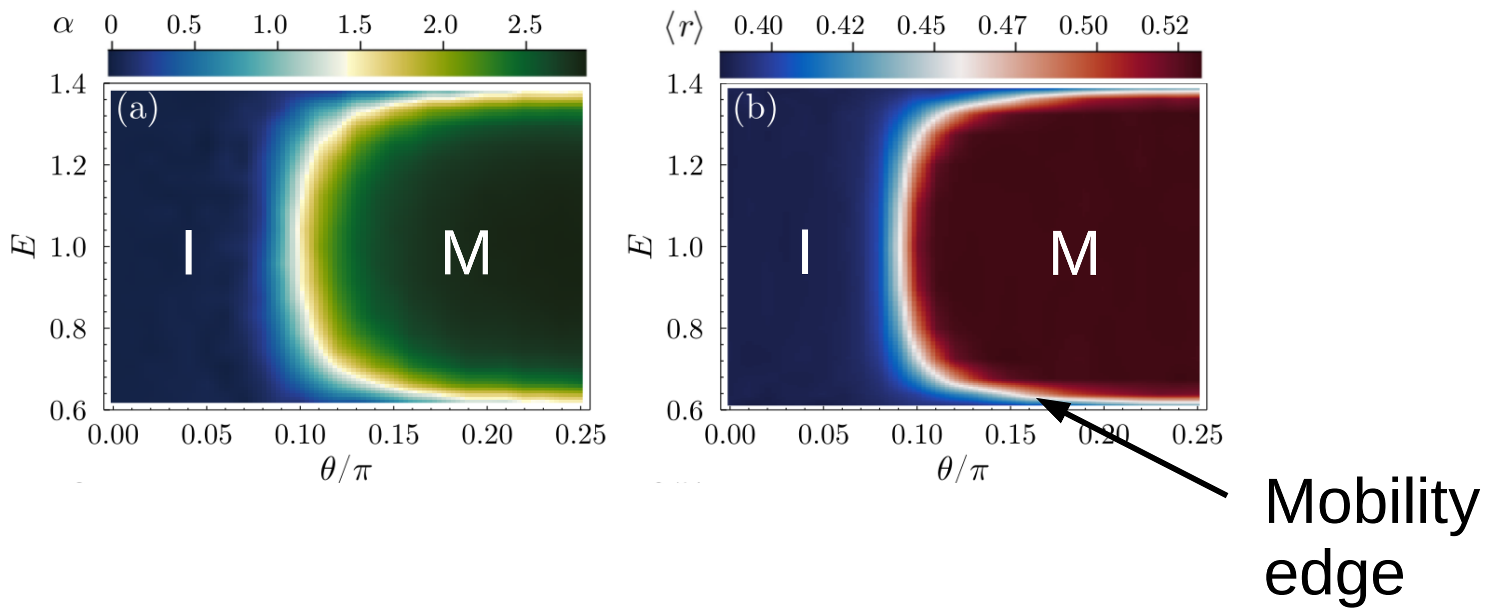
Exact diagonalization (ED)

$$\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta$$



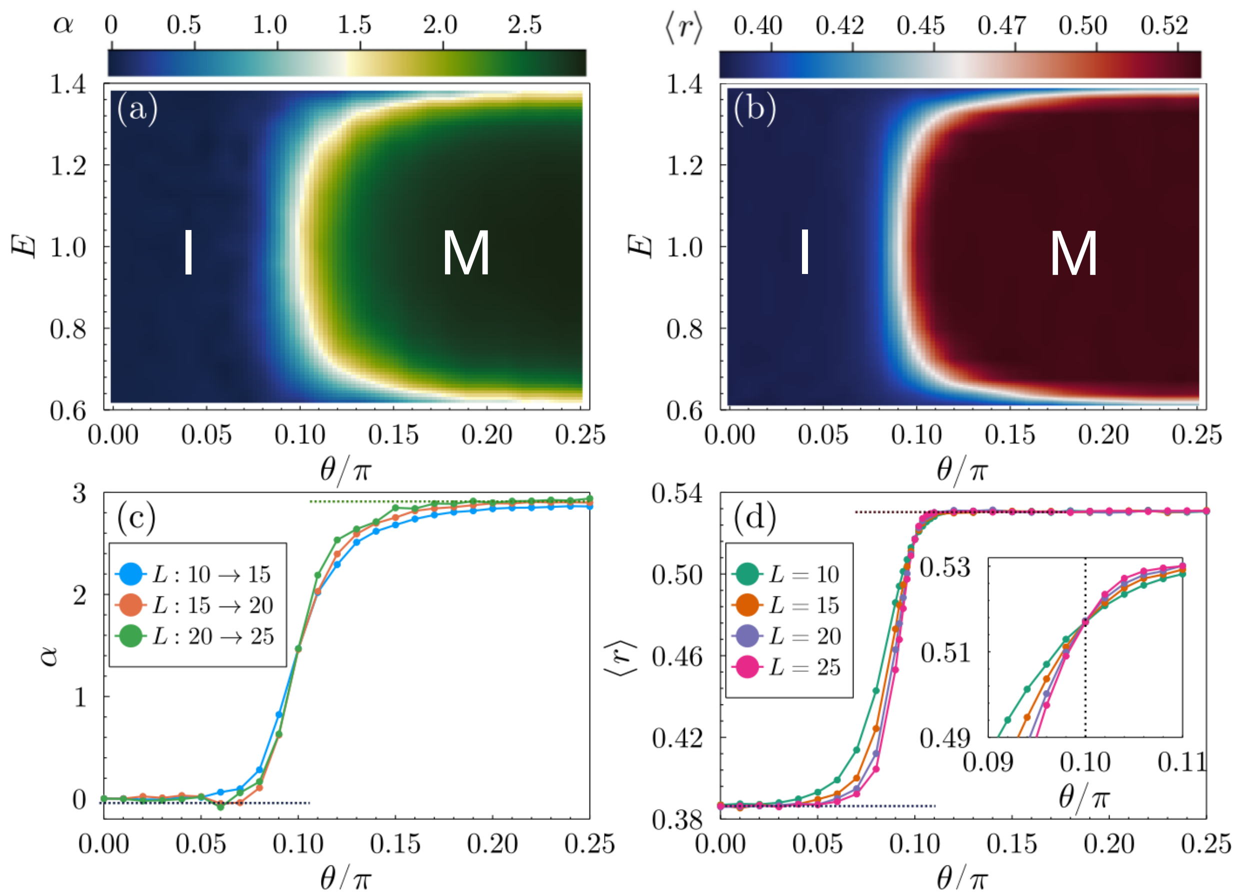
d) d = 3, cubic lattice + diagonal hoppings

Exact diagonalization (ED)



d) d = 3, cubic lattice + diagonal hoppings

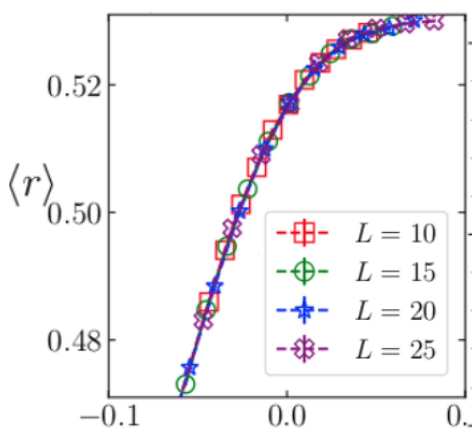
Exact diagonalization (ED)



d) d = 3, cubic lattice + diagonal hoppings

Finite size scaling

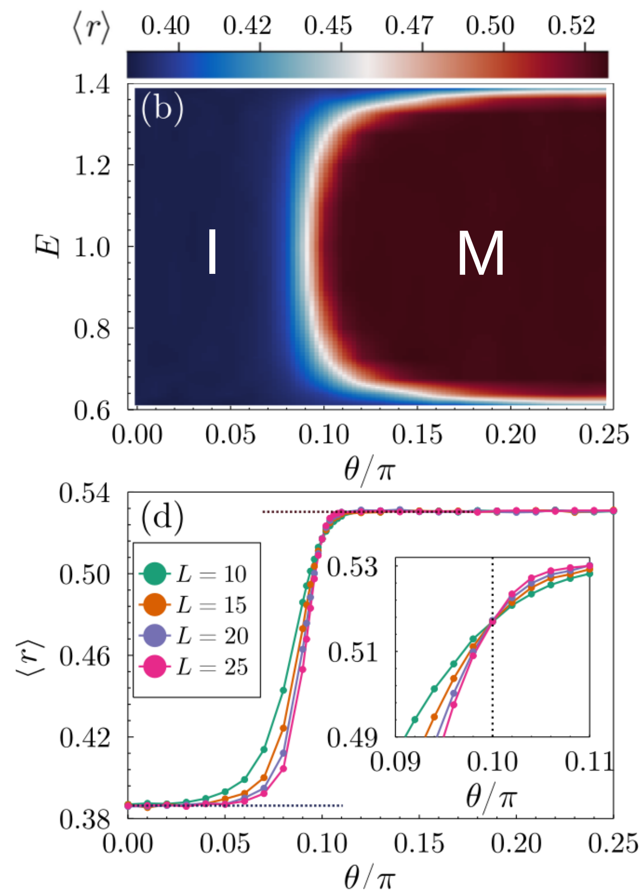
$$\langle r \rangle \sim f(x)$$



$$x = (\theta - \theta_c)L^{1/\nu}$$

$$\nu = 1.54$$

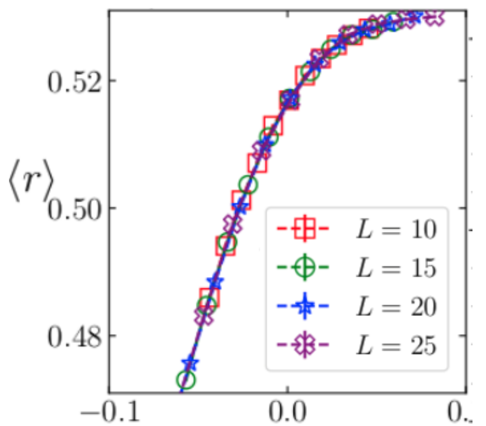
$$\theta_c = 0.10\pi$$



d) d = 3, cubic lattice + diagonal hoppings

Finite size scaling

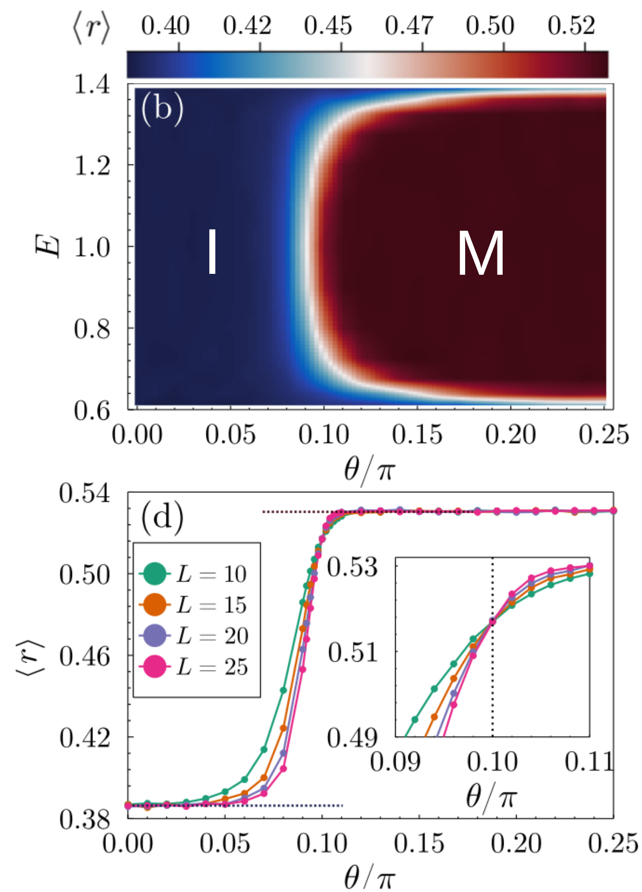
$$\langle r \rangle \sim f(x)$$



$$x = (\theta - \theta_c)L^{1/\nu}$$

$$\nu = 1.54$$

$$\theta_c = 0.10\pi$$



3D Anderson model

$$\nu = 1.57$$

Slevin K. & Ohtsuki T., **NJP 16**, 015012 (2014)

2) Generalizations

- $\nu\,\mathrm{bands, LUT\,SU}(\nu)\mathrm{matrices}, \nu^2 - 1\,\mathrm{real\,parameters}$

  $$W \ll |E_a - E_b| \to \mathrm{scale\,free\,model}$$

2) Generalizations

- $\nu\,\mathrm{bands},\mathrm{LUT}\,\mathrm{SU}(\nu)\mathrm{matrices},\nu^2-1\,\mathrm{real\,parameters}$

$$W \ll |E_a - E_b| \rightarrow \mathrm{scale\,free\,model}$$

- $\mathrm{Other\,symmetry\,classes}:\ \mathrm{GUE},\ \mathrm{GSE}$

2) Generalizations

- $\nu\,\mathrm{bands, LUT\,SU}(\nu)\mathrm{matrices}, \nu^2-1\,\mathrm{real\,parameters}$

$$W \ll |E_a - E_b| \rightarrow \mathrm{scale\,free\,model}$$

- $\mathrm{Other\,symmetry\,classes:\ GUE,\ GSE}$
- $\mathrm{Other\,potentials}$

Conclusions:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

arXiv: 2107.11365

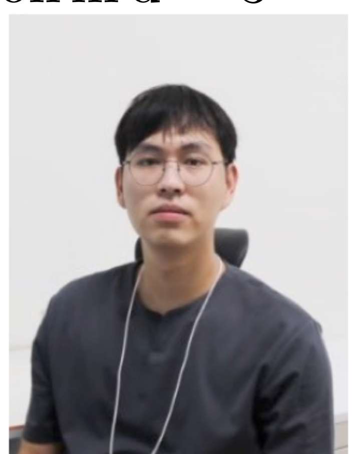
- $\mathrm{ABF} \neq \mathrm{ABF}$
- $\mathrm{Localization\,in\,d} = 1, 2$
- $\mathrm{Metal - Insulator\,transition\,in\,d} = 3$

Conclusions:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

arXiv: 2107.11365

- $\mathrm{ABF} \neq \mathrm{ABF}$
- $\mathrm{Localization\,in\,d} = 1, 2$
- $\mathrm{Metal} - \mathrm{Insulator\,transition\,in\,d} = 3$



Thursday, August 19

Chairperson: Dario Rosa

16:00 – 17:00	*IBS Physics Colloquium @ Daejeon* Daniel Leykam, National University of Singapore, Singapore *Flat bands, sharp physics*
17:00 – 17:40	Liqin Tang, Nankai University, China *Novel phenomena in photonic flatband lattices*
17:40 – 18:20	Clemens Gneiting, RIKEN, Japan *Lifetime of flatband states*
18:20 – 19:00	*Break*

Chairperson: Barbara Dietz

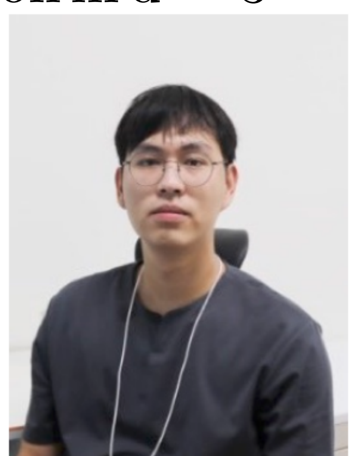
19:00 – 19:15	Anupam Bhattacharya, University of Manchester, UK *Identification of flat bands in 2D materials using neural network*
19:15 – 19:30	Ihor Vakulchyk, IBS PCS *Percolation Transitions in Interacting Many-Body Flatband Systems*
19:30 – 19:45	Yeongjun Kim, IBS PCS *Metal-insulator transitions for weakly disordered flatbands: Additional details*
19:45 – 20:00	Arindam Mallick, IBS PCS *Wannier-Stark Flatbands*

Conclusions:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

arXiv: 2107.11365

- $\mathrm{ABF} \neq \mathrm{ABF}$
- $\mathrm{Localization\ in\ d} = 1, 2$
- $\mathrm{Metal - Insulator\ transition\ in\ d} = 3$



Thursday, August 19

Chairperson: Dario Rosa

16:00 – 17:00 *IBS Physics Colloquium @ Daejeon*
Daniel Leykam, National University of Singapore, Singapore
Flat bands, sharp physics

17:00 – 17:40 Liqin Tang, Nankai University, China
Novel phenomena in photonic flatband lattices

17:40 – 18:20 Clemens Gneiting, RIKEN, Japan
Lifetime of flatband states

18:20 – 19:00 *Break*

Chairperson: Barbara Dietz

19:00 – 19:15 Anupam Bhattacharya, University of Manchester, UK
Identification of flat bands in 2D materials using neural network

19:15 – 19:30 Ihor Vakulchyk, IBS PCS
Percolation Transitions in Interacting Many-Body Flatband Systems

19:30 – 19:45 Yeongjun Kim, IBS PCS
Metal-insulator transitions for weakly disordered flatbands: Additional details

19:45 – 20:00 Arindam Mallick, IBS PCS
Wannier-Stark Flatbands

Metal-Insulator transitions in infinitesimally weakly disordered flatbands

arXiv: 2107.11365

Tilen Čadež

tilencadez@ibs.re.kr

PCS Center for Theoretical Physics of Complex Systems

virtual, August 18, 2021

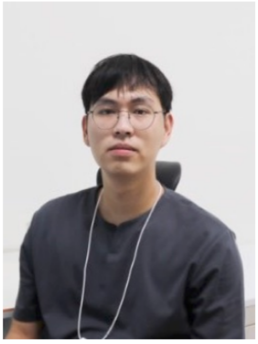
IBS Institute for Basic Science

Aim:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

with

Yeongjun Kim



Alexei Andreanov

Sergej Flach

Outline:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

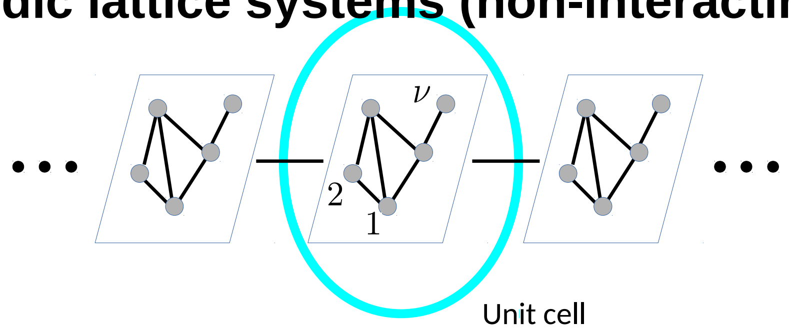
a) ABF construction, 2 bands, d = 1,2,3

b) Scale free model

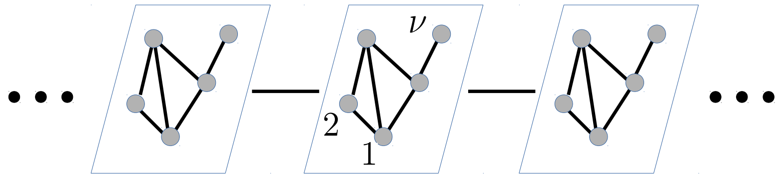
c) Localization in d = 1,2

d) Metal-insulator transition in d = 3

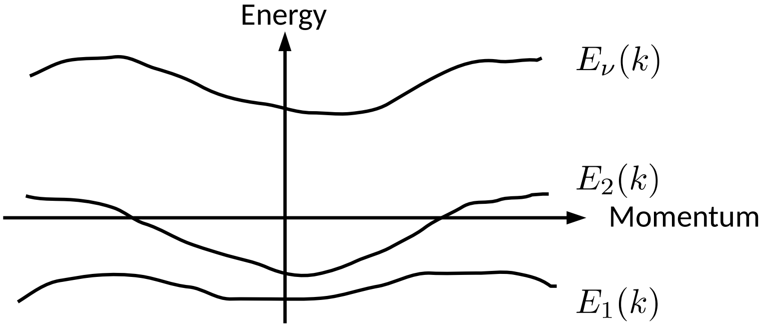
Periodic lattice systems (non-interacting):



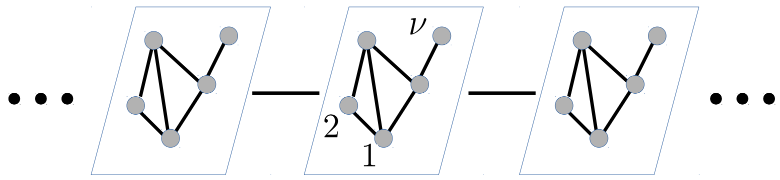
Periodic lattice systems:



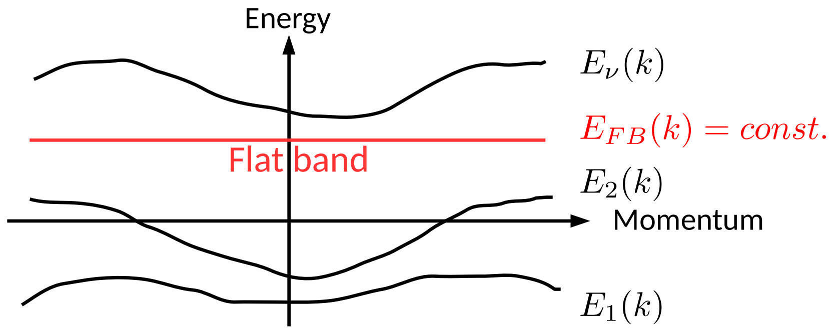
Band structure



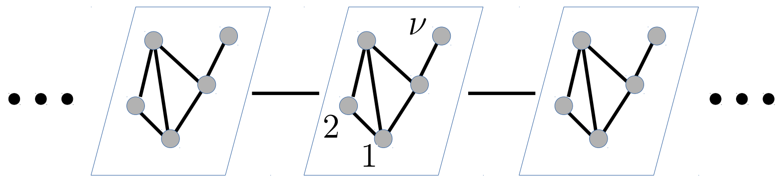
Periodic lattice systems:



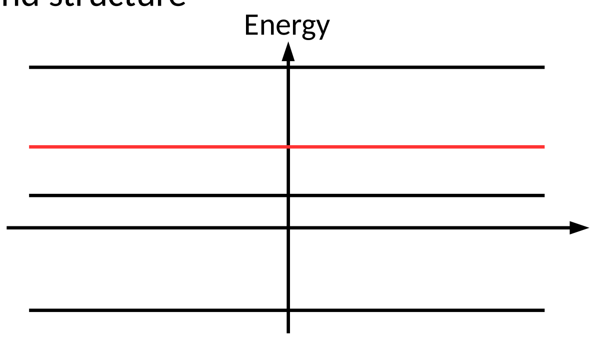
Band structure



Periodic lattice systems:



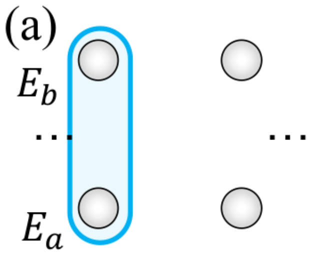
Band structure



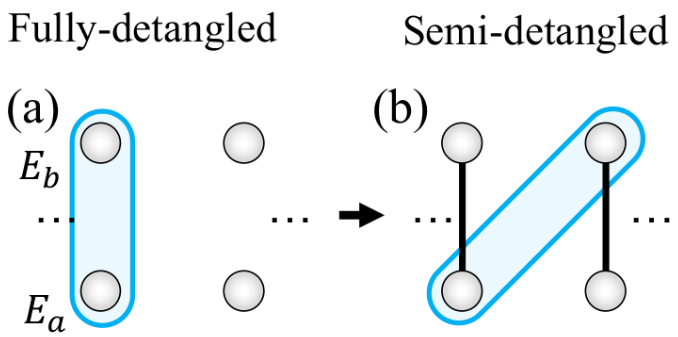
All bands flat

a) ABF construction, 2 bands, d = 1

Fully-detangled



a) ABF construction, 2 bands, d = 1

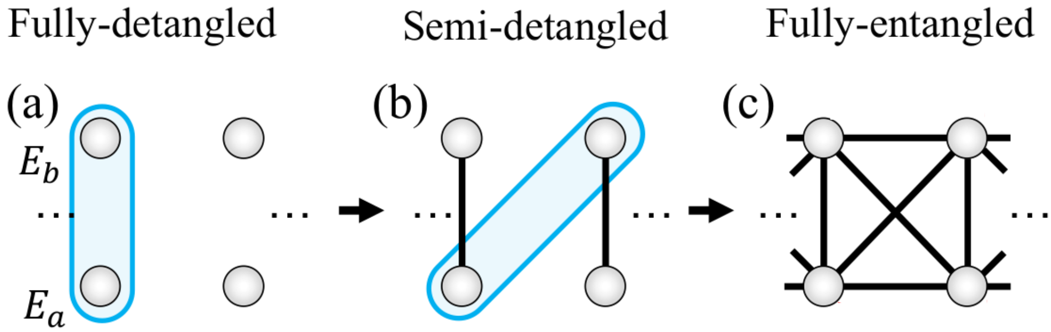


$$U_1 = \begin{pmatrix} z_1 & w_1 \\ -w_1^* & z_1^* \end{pmatrix}$$

Local unitary transformation (LUT)

$$z_1 = \cos(\theta_1) e^{i\varphi_1}$$
$$w_1 = \sin(\theta_1) e^{i\bar{\varphi}_1}$$

a) ABF construction, 2 bands, d = 1

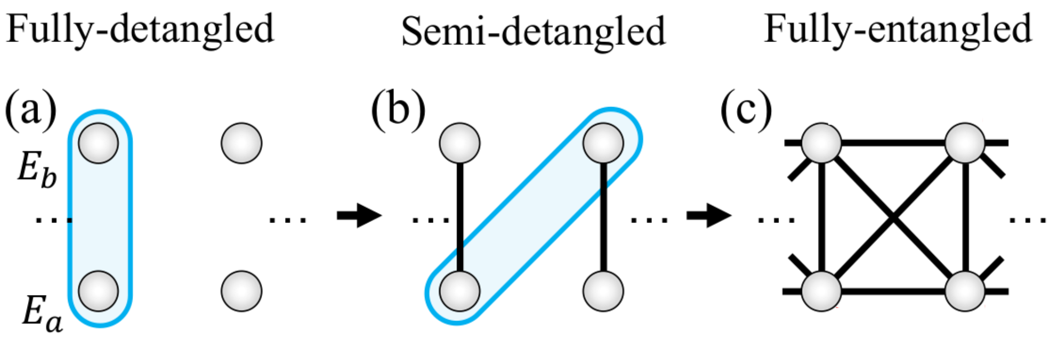


$$U_1 = \begin{pmatrix} z_1 & w_1 \\ -w_1^* & z_1^* \end{pmatrix} \qquad U_2 = \begin{pmatrix} z_2 & w_2 \\ -w_2^* & z_2^* \end{pmatrix}$$

$$z_1 = \cos(\theta_1) e^{i\varphi_1} \qquad z_2 = \cos(\theta_2) e^{i\varphi_2}$$

$$w_1 = \sin(\theta_1) e^{i\bar{\varphi}_1} \qquad w_2 = \sin(\theta_2) e^{i\bar{\varphi}_2}$$

a) ABF construction, 2 bands, d = 1

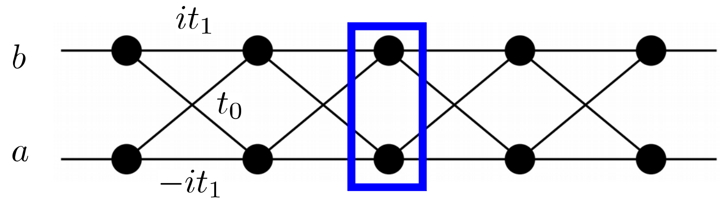


$$U_1 = \begin{pmatrix} z_1 & w_1 \\ -w_1^* & z_1^* \end{pmatrix} \qquad U_2 = \begin{pmatrix} z_2 & w_2 \\ -w_2^* & z_2^* \end{pmatrix}$$

A manifold of equivalent ABF systems!

example: Creutz ladder (FE basis)

Creutz M., **PRL 83**, 2636 (1999)



$$H_{1C} = \begin{pmatrix} -it_1 & -t_0 \\ -t_0 & it_1 \end{pmatrix}$$

$$E_C(k) = \pm 2\sqrt{t_0^2 \cos^2(k) + t_1^2 \sin^2(k)}$$

$$t_0 = t_1 \qquad \text{ABF}$$

Local unitary
transformations (LUT)

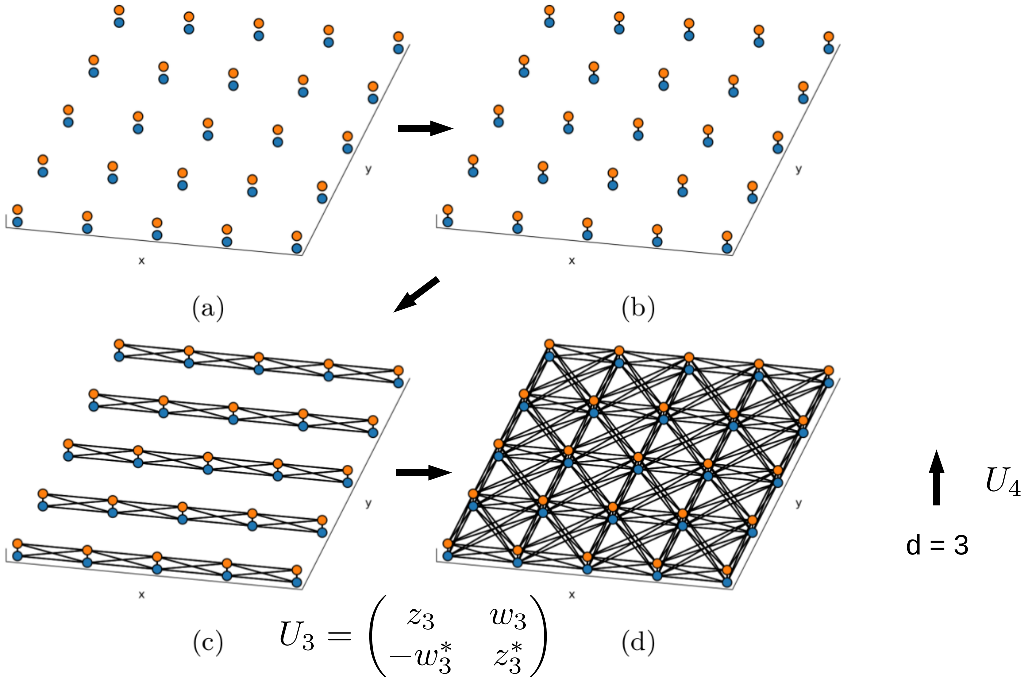
Danieli C. et al., **arXiv** 2004.11871 (2020)

$$\theta_1 = \theta_2 = \pi/4 \qquad E_a = -E_b = 2t_0$$

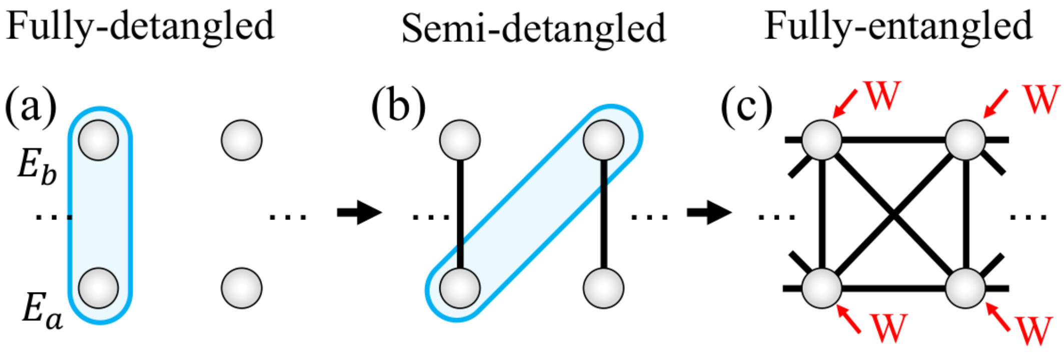
$$\varphi_1 = -\bar{\varphi}_1$$

$$\varphi_2 = 2\bar{\varphi}_2 = \pi$$

a) ABF construction, 2 bands, d = 2

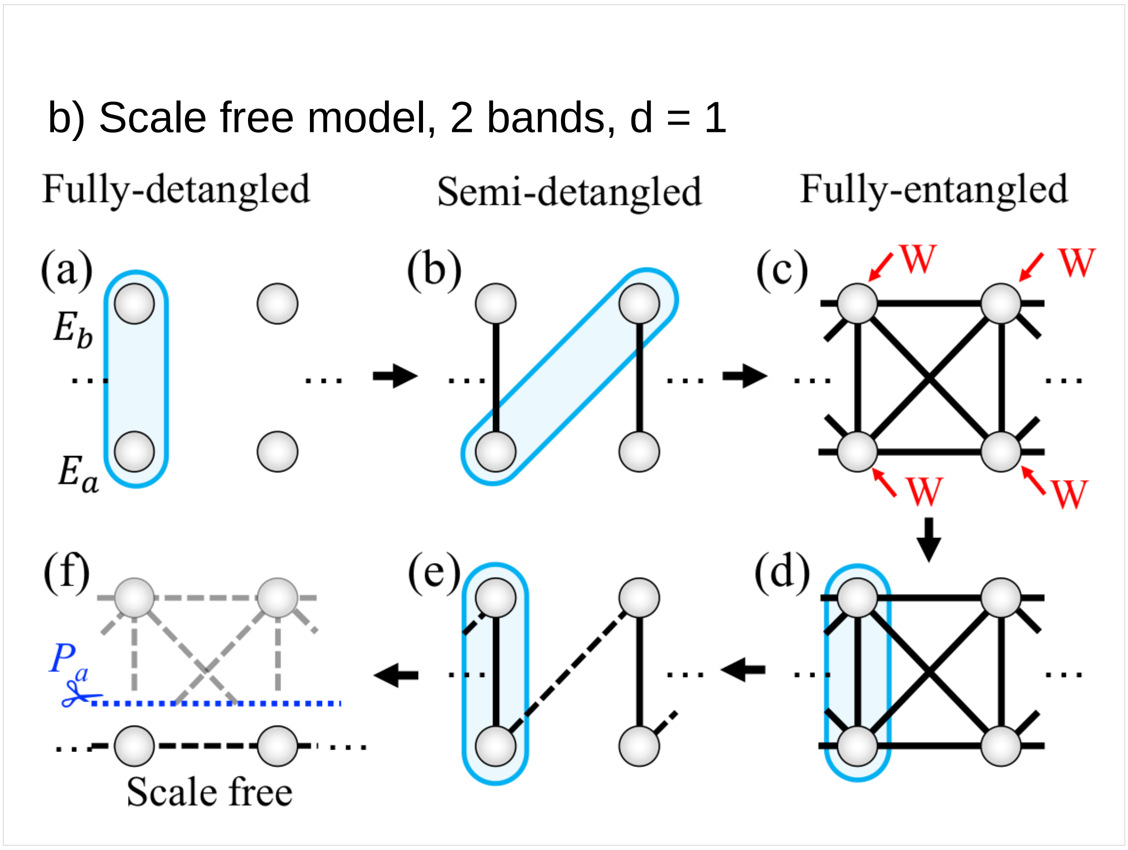


Disorder



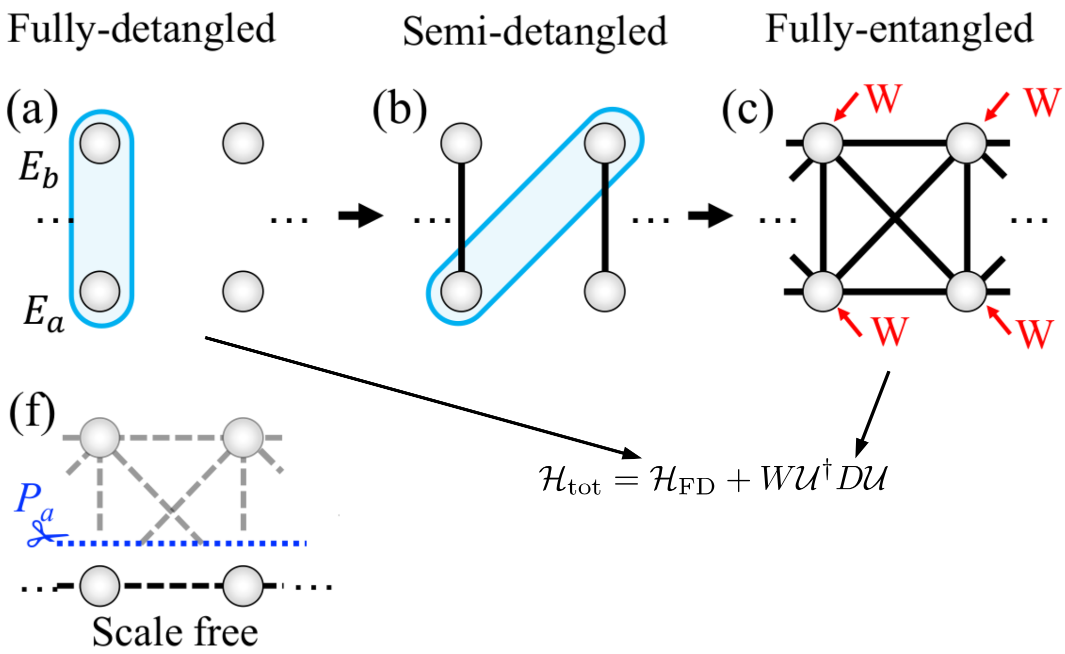
Adding potential (onsite) disorder

$$\varepsilon_n \in [-W/2, W/2]$$

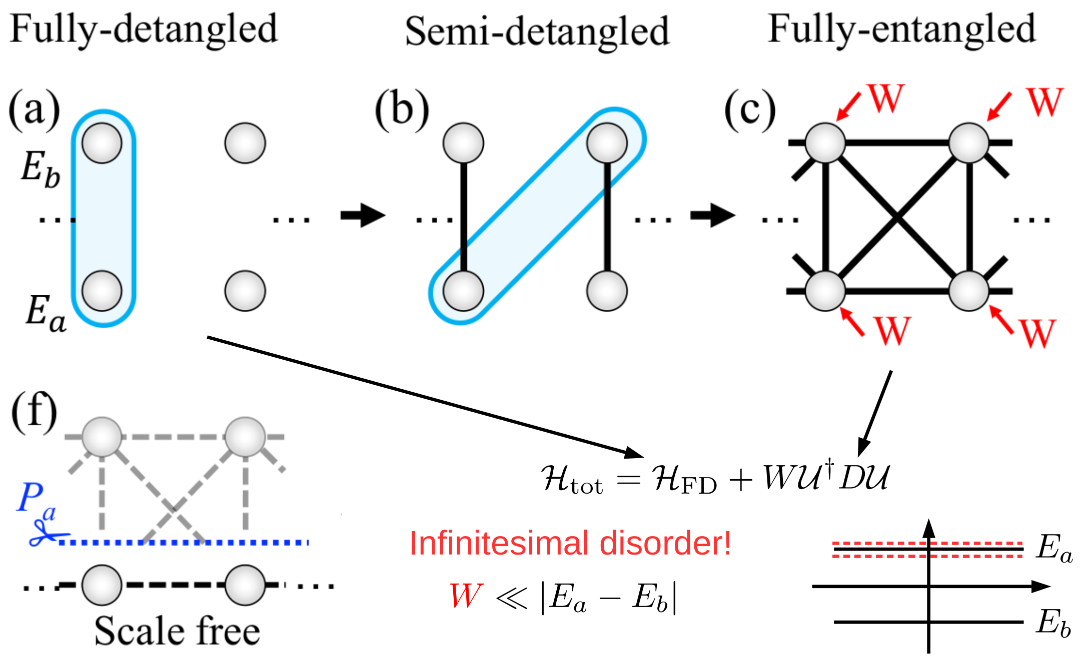


b) Scale free model, 2 bands, d = 1
Fully-detangled
Semi-detangled
Fully-entangled
(a)
(b)
(c)
(d)
(e)
(f)
E_b
E_a
W
W
W
W
P_a
Scale free

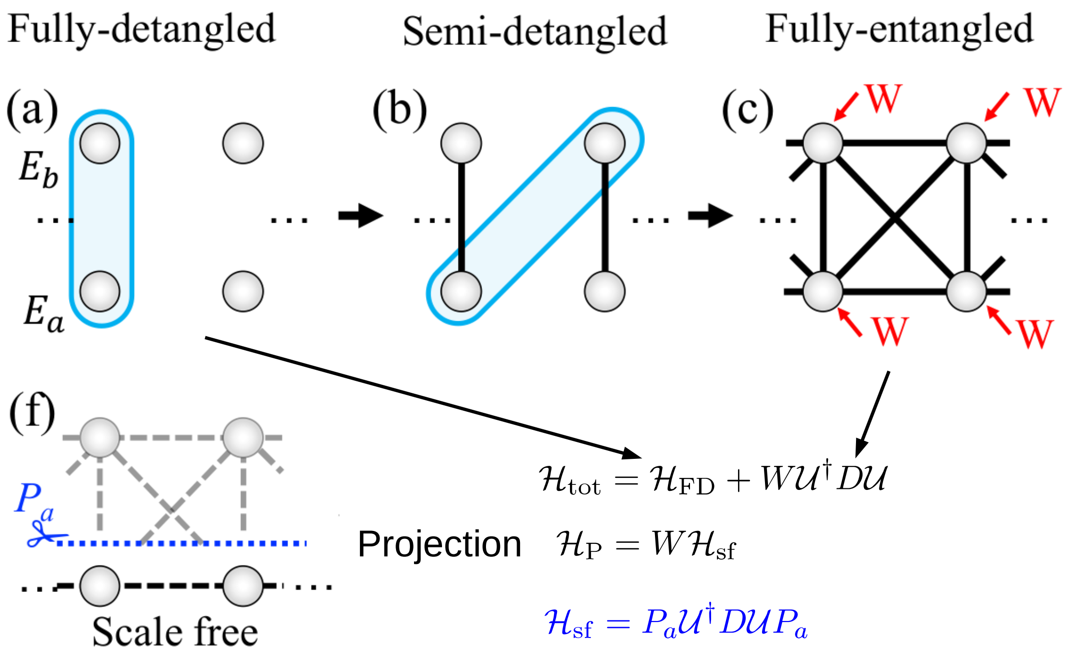
b) Scale free model



b) Scale free model



b) Scale free model



c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\mathrm{sf}} = \sum_n (V_n |a_n\rangle\langle a_n| + t_n |a_{n+1}\rangle\langle a_n| + h.c.)$$

c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\mathrm{sf}} = \sum_n \left(V_n|a_n\rangle\langle a_n| + t_n|a_{n+1}\rangle\langle a_n| + h.c.\right)$$

$$V_n = \left[\varepsilon_{p,n}\cos^2(\theta_2) + \varepsilon_{f,n}\sin^2(\theta_2)\right]\cos^2(\theta_1) +$$
$$+\left[\varepsilon_{p,n+1}\sin^2(\theta_2) + \varepsilon_{f,n+1}\cos^2(\theta_2)\right]\sin^2(\theta_1)$$

$$t_n = 1/4\left(\varepsilon_{f,n+1} - \varepsilon_{p,n+1}\right)\sin(2\theta_1)\sin(2\theta_2)e^{i(\varphi_1+\bar{\varphi}_1-\varphi_2+\bar{\varphi}_2)}$$

Only two parameters!

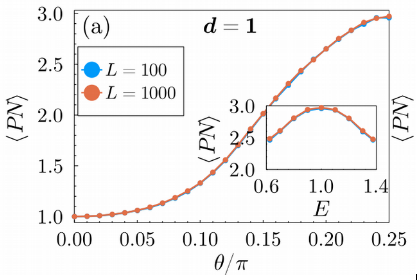
$$\theta_1, \theta_2 \in [0, \pi/4]$$

c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\rm sf} = \sum_n \left(V_n |a_n\rangle\langle a_n| + t_n |a_{n+1}\rangle\langle a_n| + h.c.\right)$$

Exact diagonalization (ED) and transfer matrix (TM)

$\theta_1 = \theta_2 = \theta$



Participation number

$$\mathrm{PN}_\mu = \Big(\sum_n |\psi_{\mu,n}|^4\Big)^{-1}$$

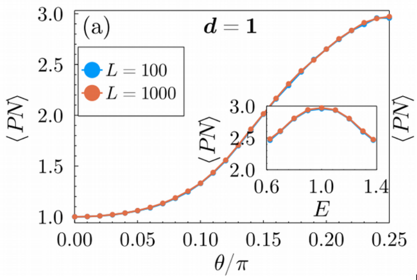
Localization!

c) d = 1, nearest neighbor hopping model

$$\mathcal{H}_{\rm sf} = \sum_n (V_n|a_n\rangle\langle a_n| + t_n|a_{n+1}\rangle\langle a_n| + h.c.)$$

Exact diagonalization (ED)

$\theta_1 = \theta_2 = \theta$



$\mathrm{ABF} \neq \mathrm{ABF}$

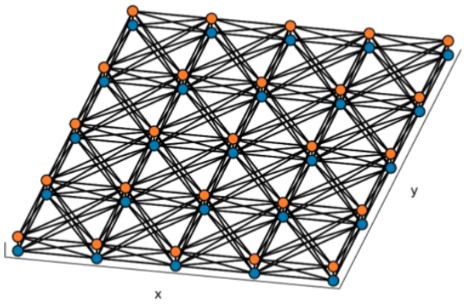
Participation number

$$\mathrm{PN}_\mu = \Big(\sum_n |\psi_{\mu,n}|^4\Big)^{-1}$$

Localization!

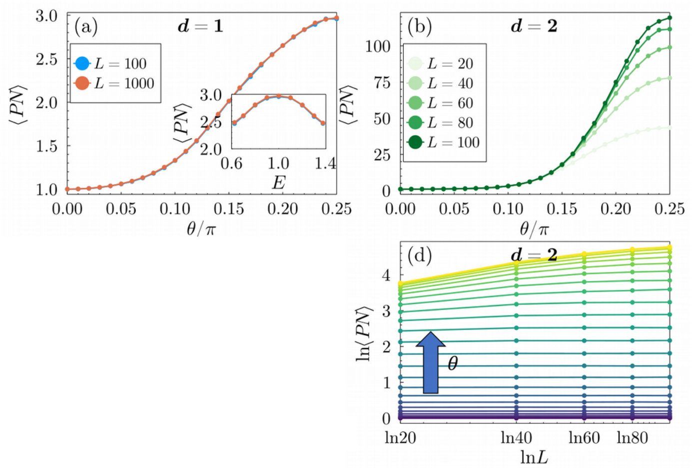
c) d = 2, square lattice + diagonal hoppings

Exact diagonalization (ED) $\theta_1 = \theta_2 = \theta_3 = \theta$



c) d = 2, square lattice + diagonal hoppings

Exact diagonalization (ED)

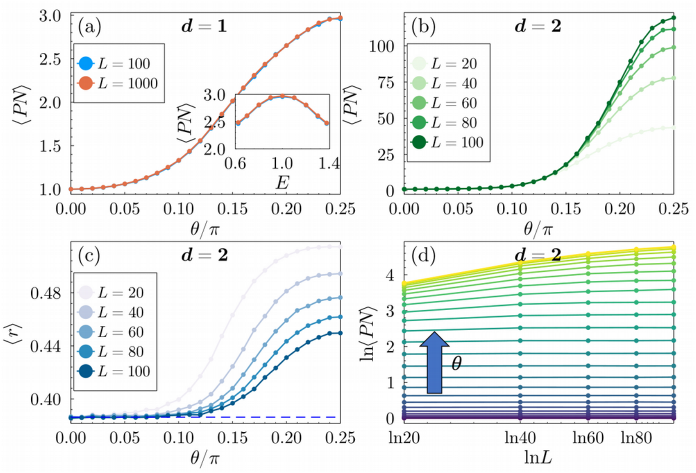


$$\langle \mathrm{PN} \rangle \sim L^{\alpha}$$

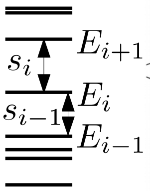
$$\alpha \to 0$$

c) d = 2, square lattice + diagonal hoppings

Exact diagonalization (ED)



ROAG



$$\langle \mathrm{PN} \rangle \sim L^{\alpha}$$

$$\alpha \to 0$$

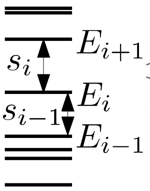
$$r_i = \frac{\min(s_i, s_{i-1})}{\max(s_i, s_{i-1})}$$

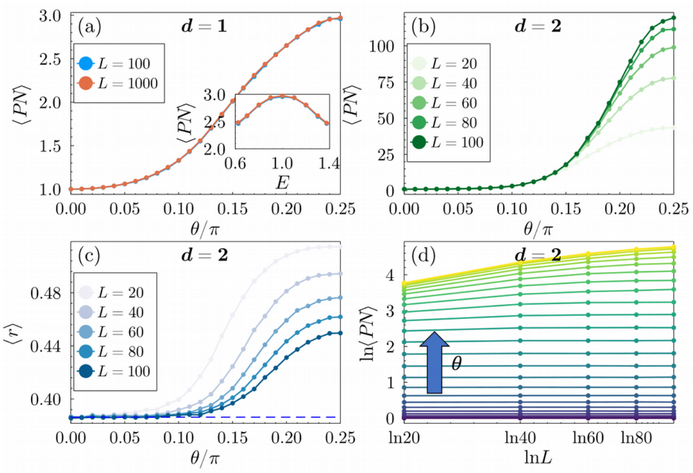
Oganesyan V. & Huse D. A., **PRB 75**, 155111 (2007)

c) d = 2, square lattice + diagonal hoppings

Exact diagonalization (ED)

ROAG





$$\langle \mathrm{PN} \rangle \sim L^{\alpha}$$

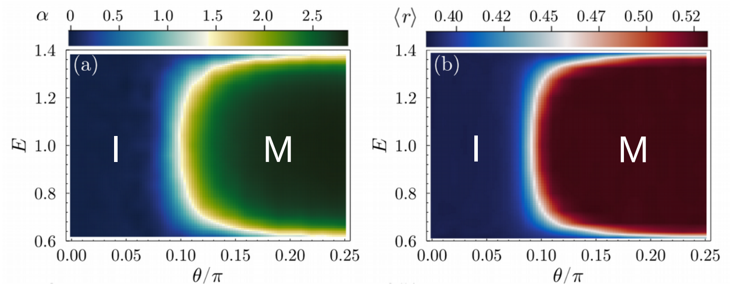
$$\alpha \to 0$$

$$r_i = \frac{\min(s_i, s_{i-1})}{\max(s_i, s_{i-1})}$$

Localization!

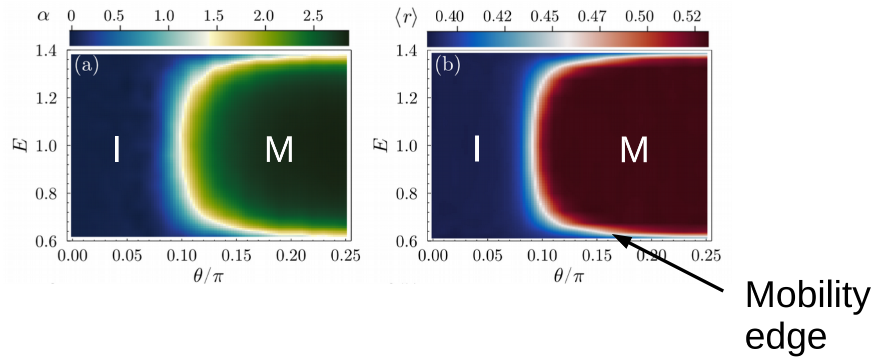
d) d = 3, cubic lattice + diagonal hoppings

Exact diagonalization (ED) $\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta$



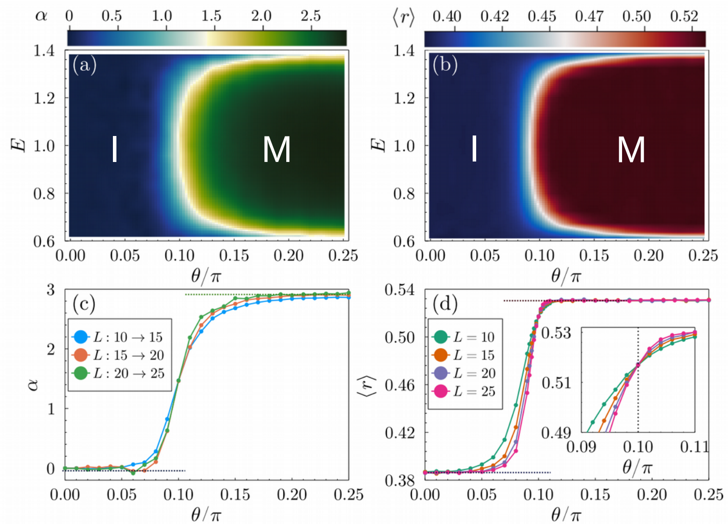
d) d = 3, cubic lattice + diagonal hoppings

Exact diagonalization (ED)



d) d = 3, cubic lattice + diagonal hoppings

Exact diagonalization (ED)



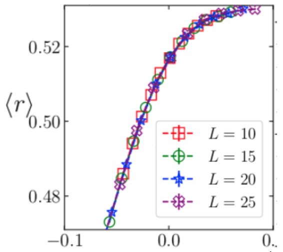
d) d = 3, cubic lattice + diagonal hoppings

Finite size scaling

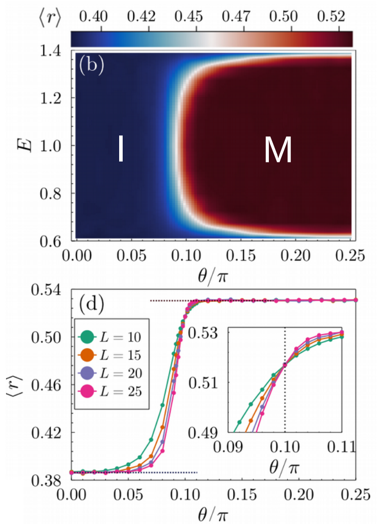
$\langle r \rangle \sim f(x)$

$\nu = 1.54$

$\theta_c = 0.10\pi$



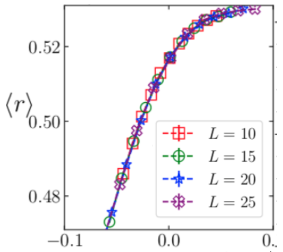
$x = (\theta - \theta_c)L^{1/\nu}$



d) d = 3, cubic lattice + diagonal hoppings

Finite size scaling

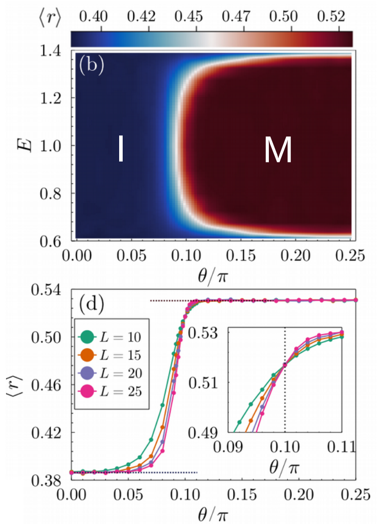
$\langle r \rangle \sim f(x)$



$x = (\theta - \theta_c) L^{1/\nu}$

$\nu = 1.54$

$\theta_c = 0.10\pi$



3D Anderson model

$\nu = 1.57$

Slevin K. & Ohtsuki T., **NJP 16**, 015012 (2014)

2) Generalizations

- $\nu\,\mathrm{bands}, \mathrm{LUT\,SU}(\nu)\mathrm{matrices}, \nu^2-1\,\mathrm{real\,parameters}$

$$W \ll |E_a - E_b| \to \mathrm{scale\,free\,model}$$

2) Generalizations

- $\nu\,\mathrm{bands}, \mathrm{LUT}\,\mathrm{SU}(\nu)\mathrm{matrices}, \nu^2 - 1\,\mathrm{real\,parameters}$

  $$W \ll |E_a - E_b| \to \mathrm{scale\,free\,model}$$

- $\mathrm{Other\,symmetry\,classes:\ GUE,\ GSE}$

2) Generalizations

- $\nu\,\mathrm{bands, LUT\,SU}(\nu)\mathrm{matrices}, \nu^2 - 1\,\mathrm{real\,parameters}$

  $$W \ll |E_a - E_b| \to \mathrm{scale\,free\,model}$$

- $\mathrm{Other\,symmetry\,classes:\ GUE,\ GSE}$

- $\mathrm{Other\,potentials}$

Conclusions:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

arXiv: 2107.11365

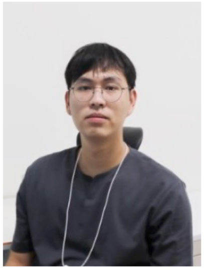
- $\mathrm{ABF} \neq \mathrm{ABF}$
- $\mathrm{Localization\,in\,d} = 1, 2$
- $\mathrm{Metal - Insulator\,transition\,in\,d} = 3$

Conclusions:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

arXiv: 2107.11365

- $\mathrm{ABF} \neq \mathrm{ABF}$
- $\mathrm{Localization\,in\,d} = 1, 2$
- $\mathrm{Metal - Insulator\,transition\,in\,d} = 3$



Thursday, August 19

Chairperson: Dario Rosa

16:00 – 17:00 *IBS Physics Colloquium @ Daejeon*
Daniel Leykam, National University of Singapore, Singapore
Flat bands, sharp physics

17:00 – 17:40 Liqin Tang, Nankai University, China
Novel phenomena in photonic flatband lattices

17:40 – 18:20 Clemens Gneiting, RIKEN, Japan
Lifetime of flatband states

18:20 – 19:00 *Break*

Chairperson: Barbara Dietz

19:00 – 19:15 Anupam Bhattacharya, University of Manchester, UK
Identification of flat bands in 2D materials using neural network

19:15 – 19:30 Ihor Vakulchyk, IBS PCS
Percolation Transitions in Interacting Many-Body Flatband Systems

19:30 – 19:45 Yeongjun Kim, IBS PCS
Metal-insulator transitions for weakly disordered flatbands: Additional details

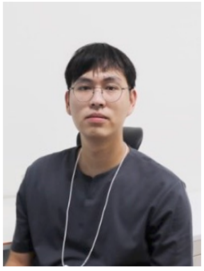
19:45 – 20:00 Arindam Mallick, IBS PCS
Wannier-Stark Flatbands

Conclusions:

Systematic study of all bands flat (ABF) systems in the presence of (infinitesimally) weak disorder.

arXiv: 2107.11365

- $\mathrm{ABF} \neq \mathrm{ABF}$
- $\mathrm{Localization\,in\,d} = 1, 2$
- $\mathrm{Metal - Insulator\,transition\,in\,d} = 3$



Thursday, August 19

Chairperson: Dario Rosa

16:00 – 17:00 *IBS Physics Colloquium @ Daejeon*
Daniel Leykam, National University of Singapore, Singapore
Flat bands, sharp physics

17:00 – 17:40 Liqin Tang, Nankai University, China
Novel phenomena in photonic flatband lattices

17:40 – 18:20 Clemens Gneiting, RIKEN, Japan
Lifetime of flatband states

18:20 – 19:00 *Break*

Chairperson: Barbara Dietz

19:00 – 19:15 Anupam Bhattacharya, University of Manchester, UK
Identification of flat bands in 2D materials using neural network

19:15 – 19:30 Ihor Vakulchyk, IBS PCS
Percolation Transitions in Interacting Many-Body Flatband Systems

19:30 – 19:45 Yeongjun Kim, IBS PCS
Metal-insulator transitions for weakly disordered flatbands: Additional details

19:45 – 20:00 Arindam Mallick, IBS PCS
Wannier-Stark Flatbands