

Localization vs. decoherence in noisy Floquet topological chains

M.-T Rieder, L. M. Sieberer, M. H. Fischer,
and I. C. Fulga

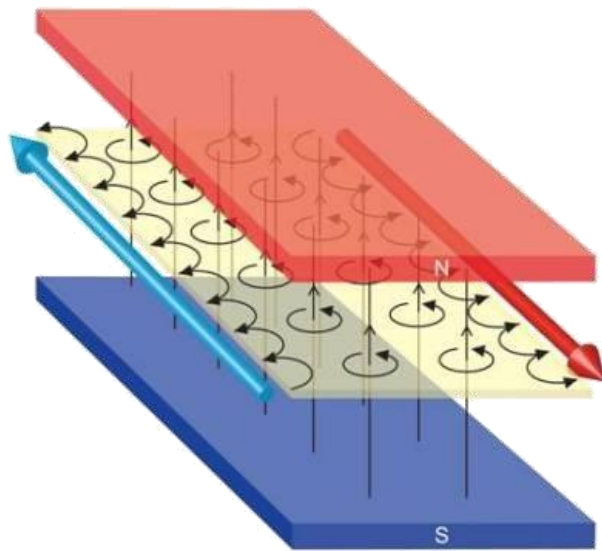
arXiv:1711.06188 (PRL)

arXiv:1809.03833 (PRB)

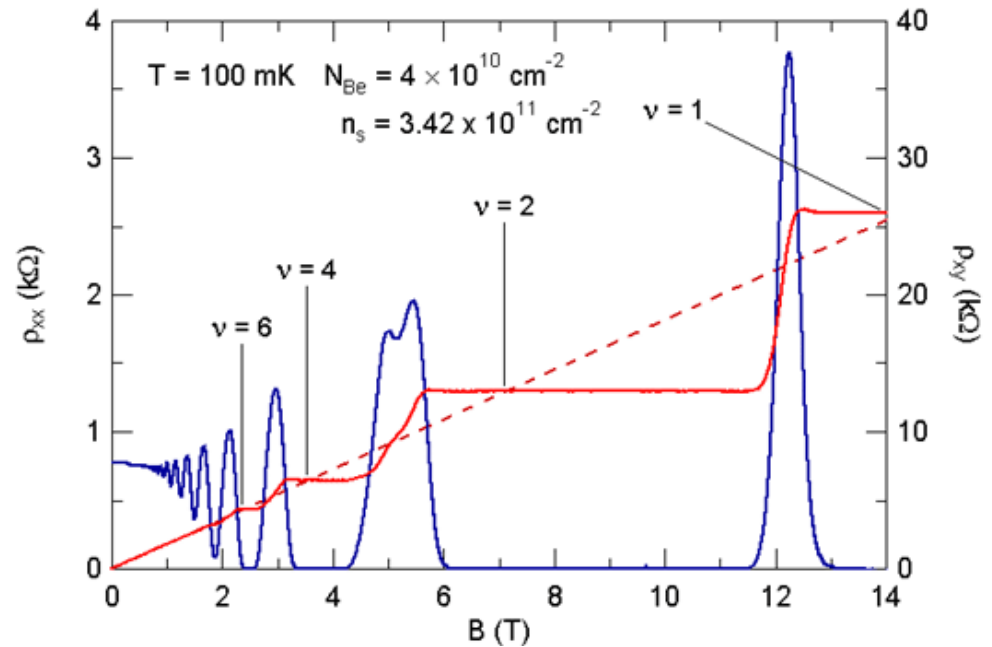
UKRATOP, December 4 2018

Topological protection

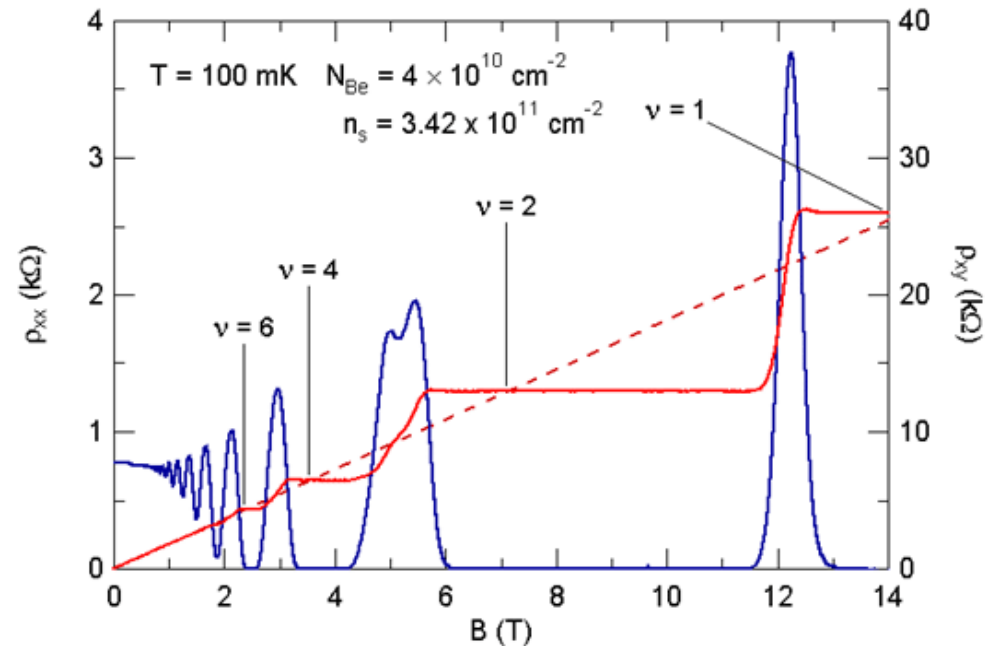
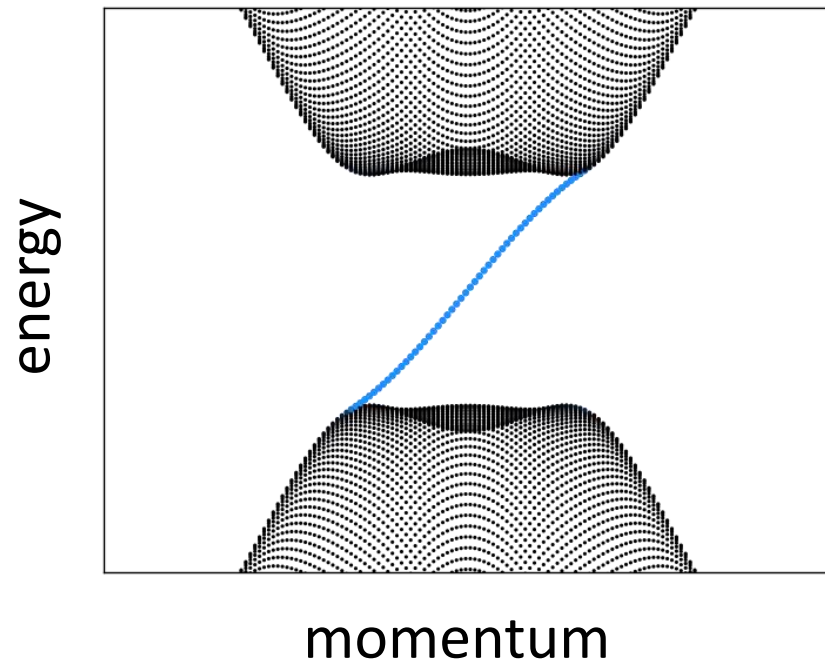
Topological protection



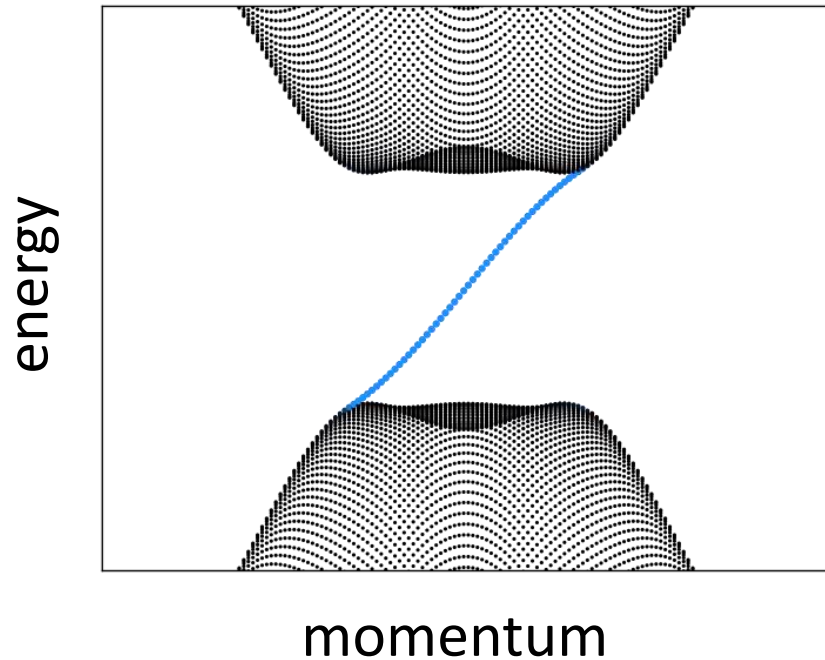
Quantum Hall effect



Topological protection

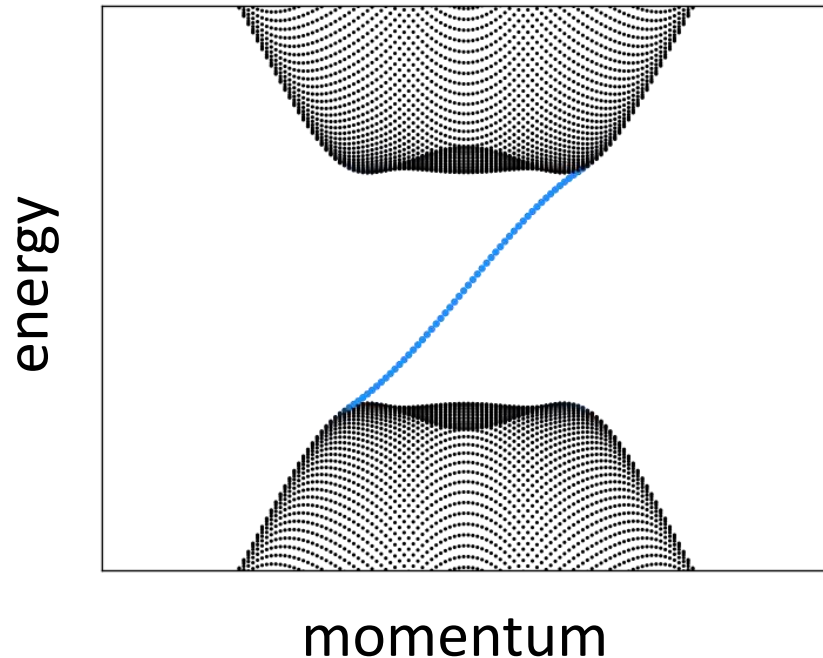


Floquet topological insulators



$$H(t) = H(t + T)$$

Floquet topological insulators

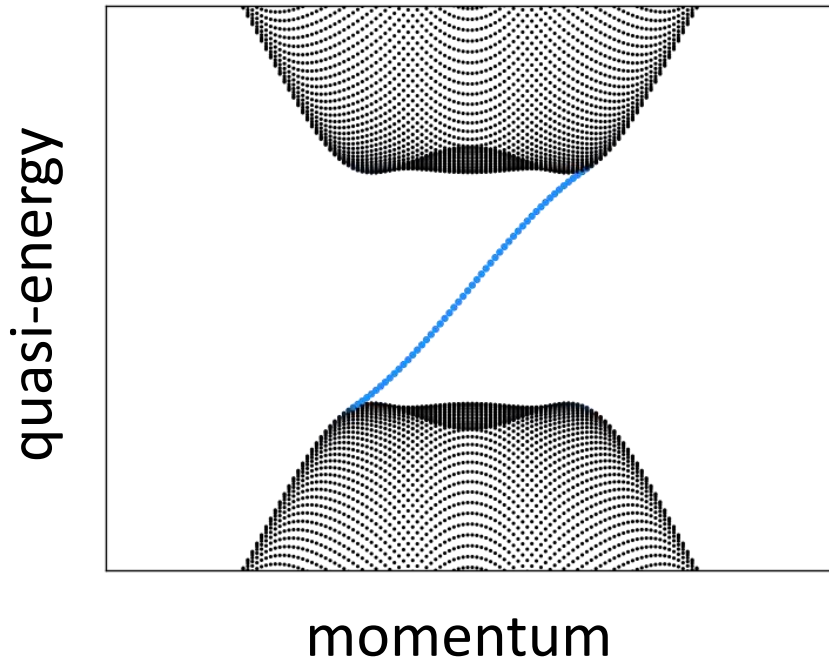


$$H(t) = H(t + T)$$

$$F = \mathcal{T} \exp \left(-\frac{i}{\hbar} \int_0^T H(t) dt \right)$$

$$F|\psi\rangle = \exp(-i\varepsilon T/\hbar)|\psi\rangle$$

Floquet topological insulators

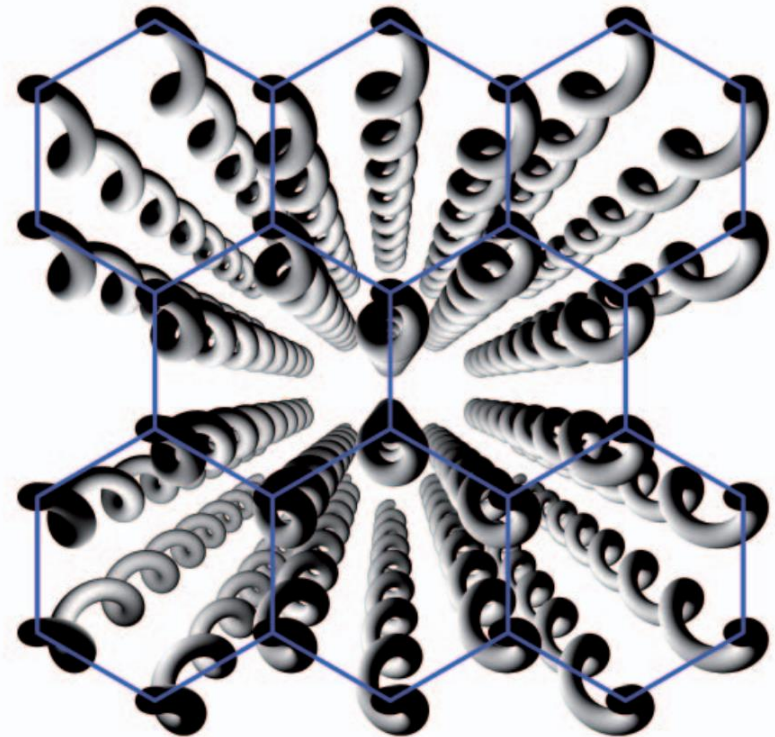
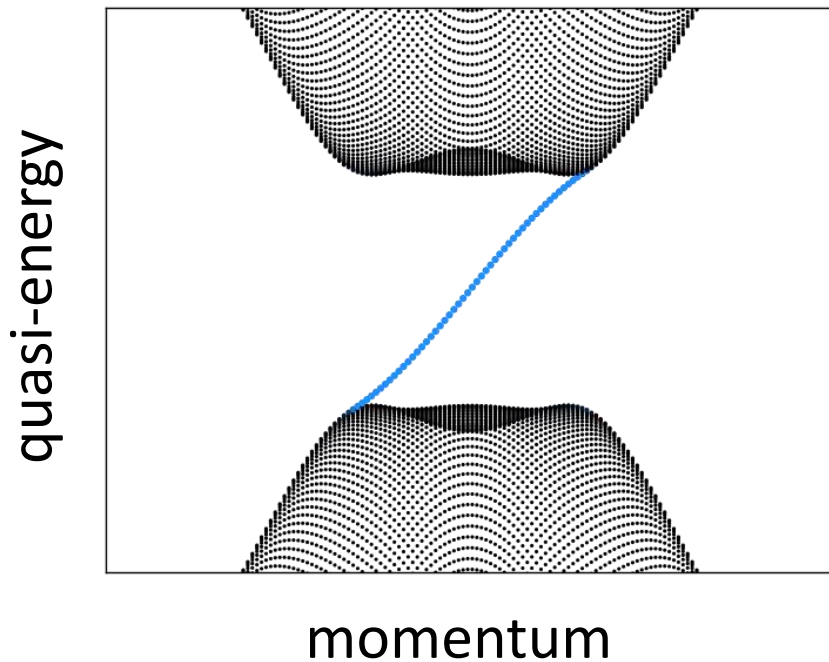


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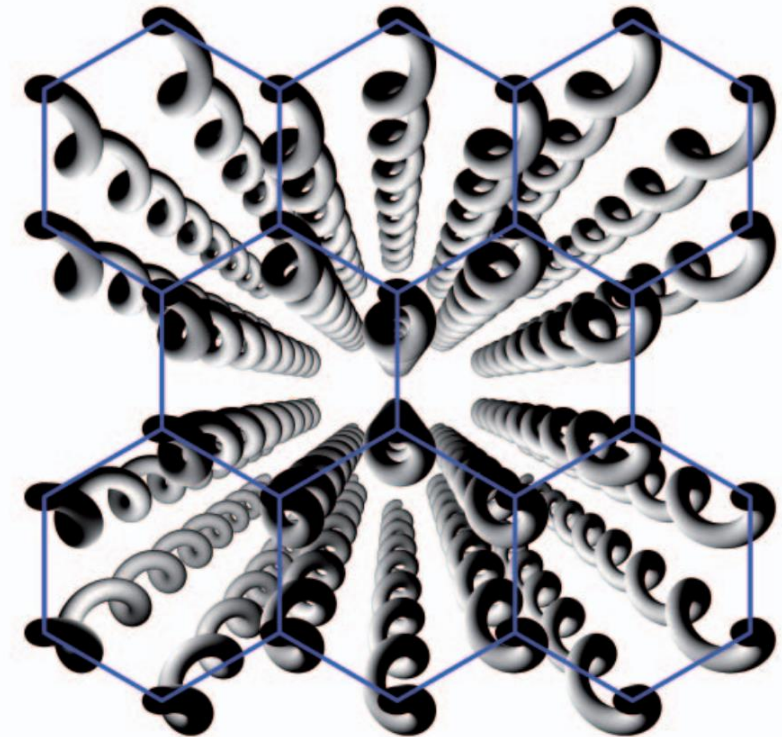
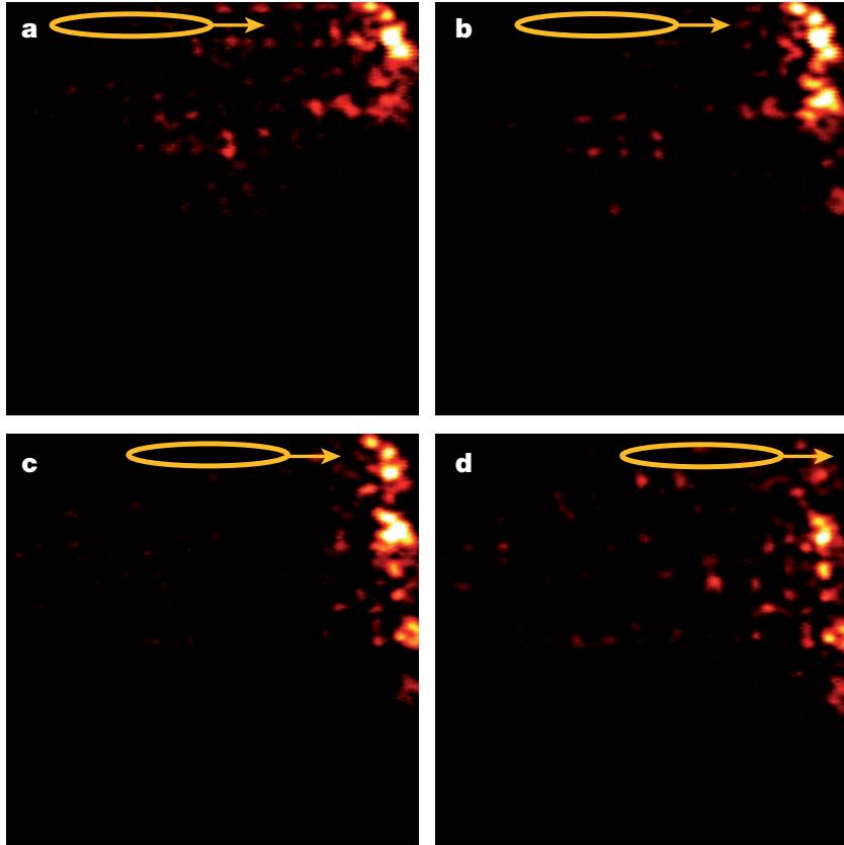
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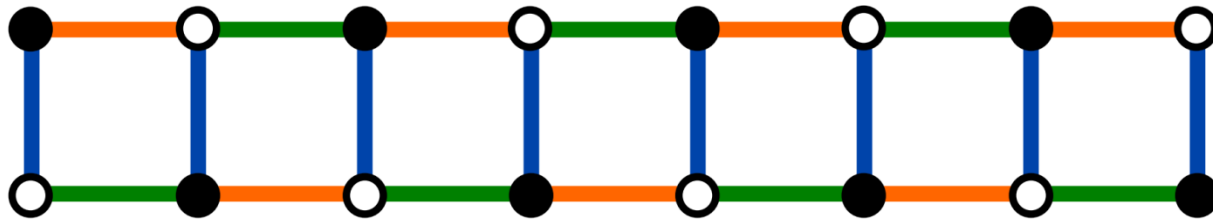
Photonic crystals



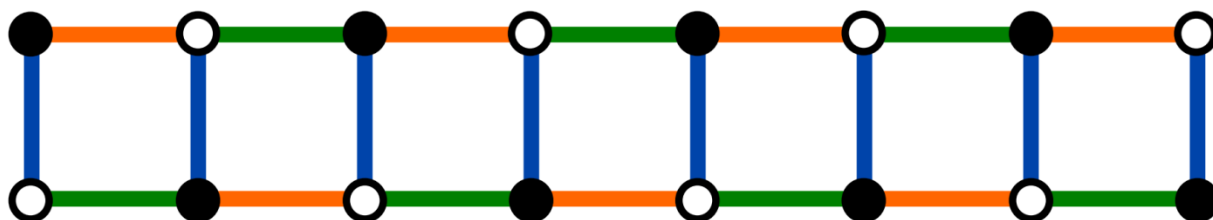
Floquet quantum Hall effect



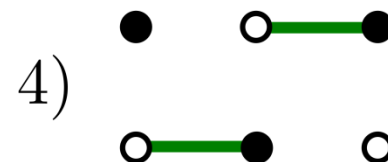
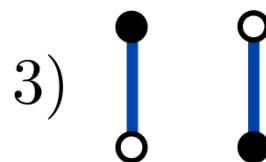
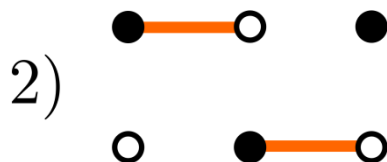
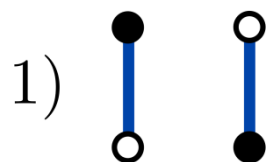
Floquet ladder



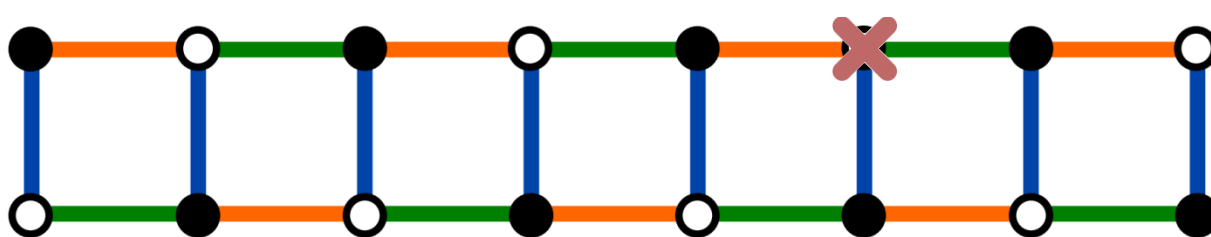
Floquet ladder



Four step driving:



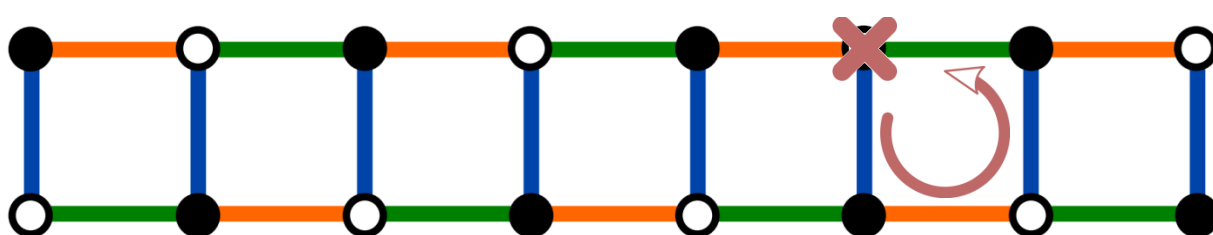
Floquet ladder



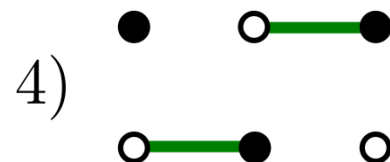
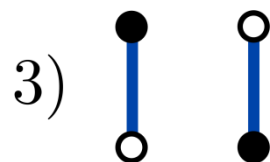
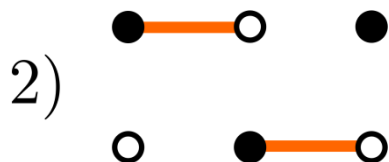
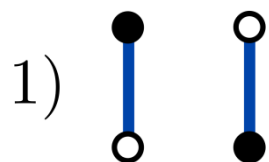
Four step driving:



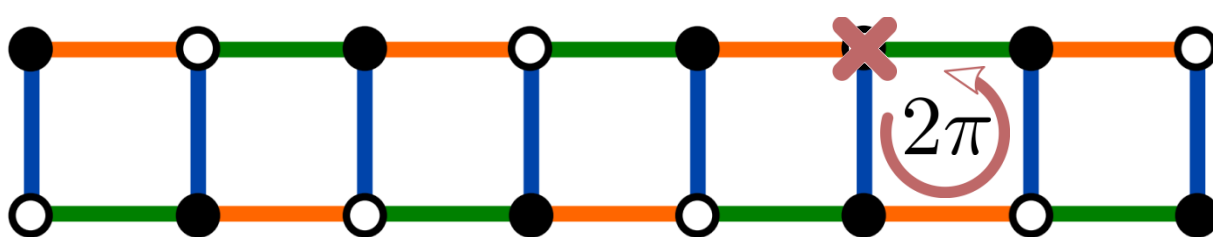
Floquet ladder



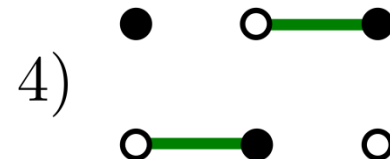
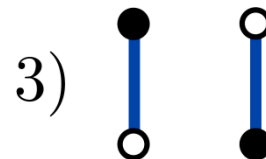
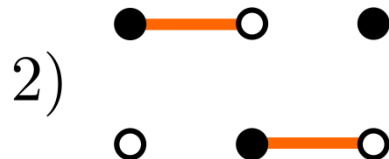
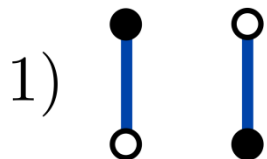
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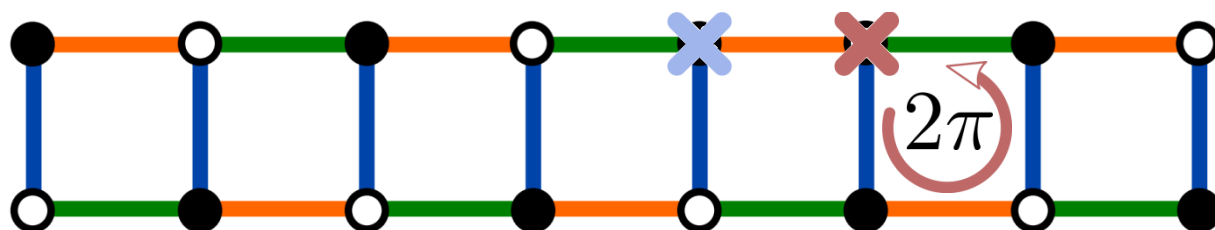
Floquet ladder



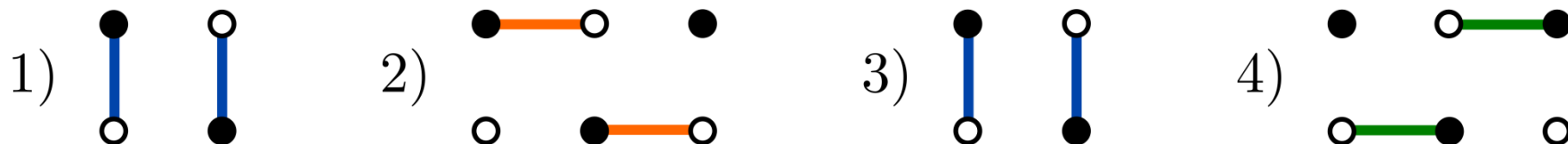
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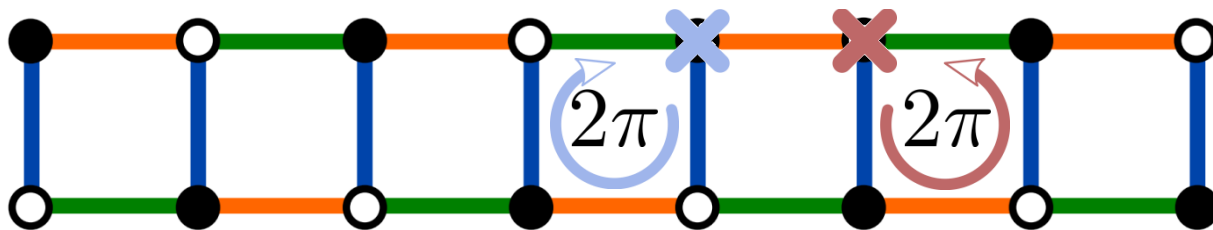
Floquet ladder



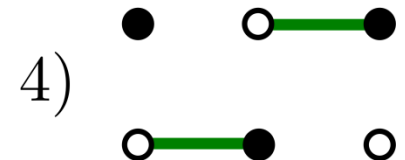
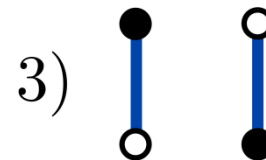
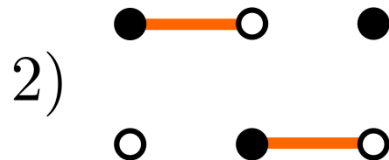
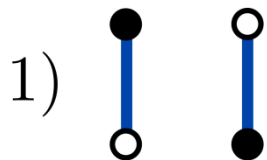
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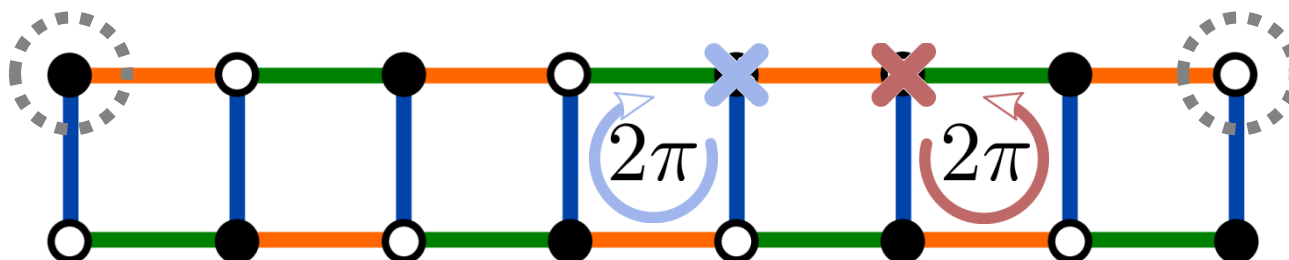
Floquet ladder



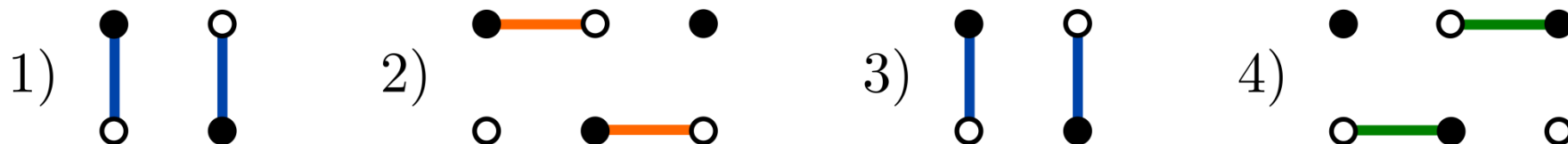
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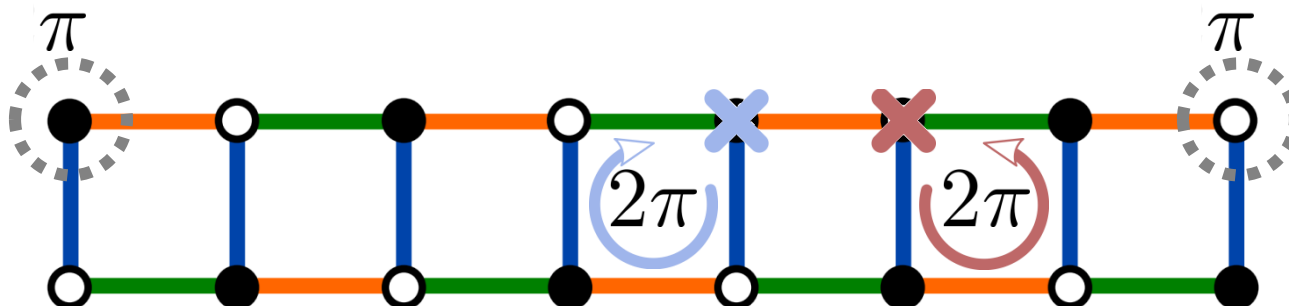
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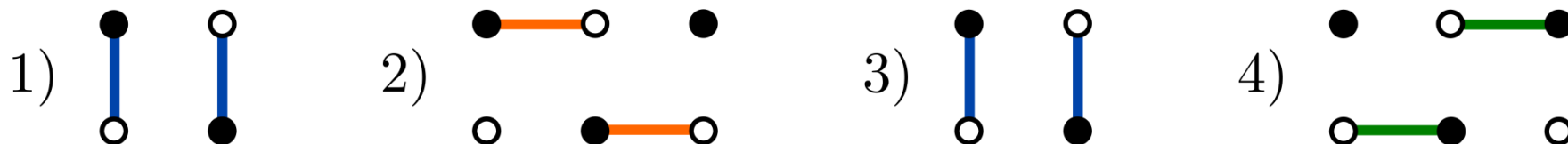
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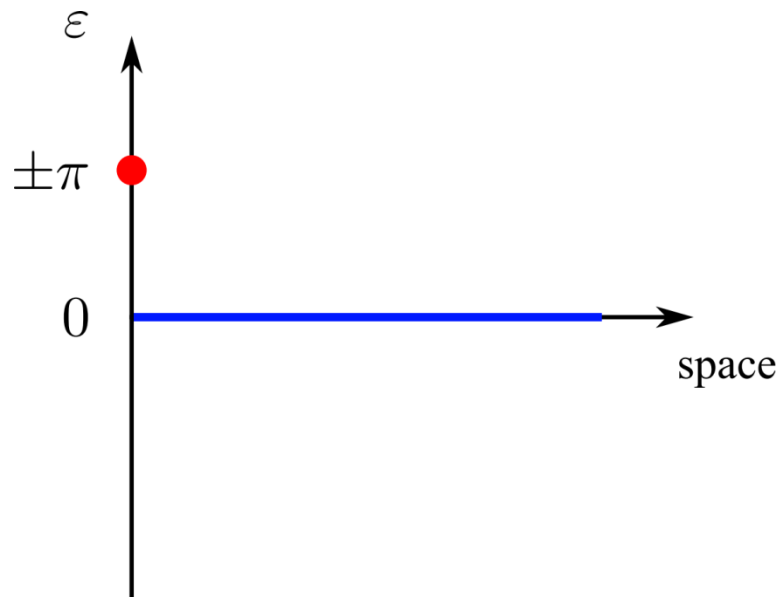
Floquet ladder



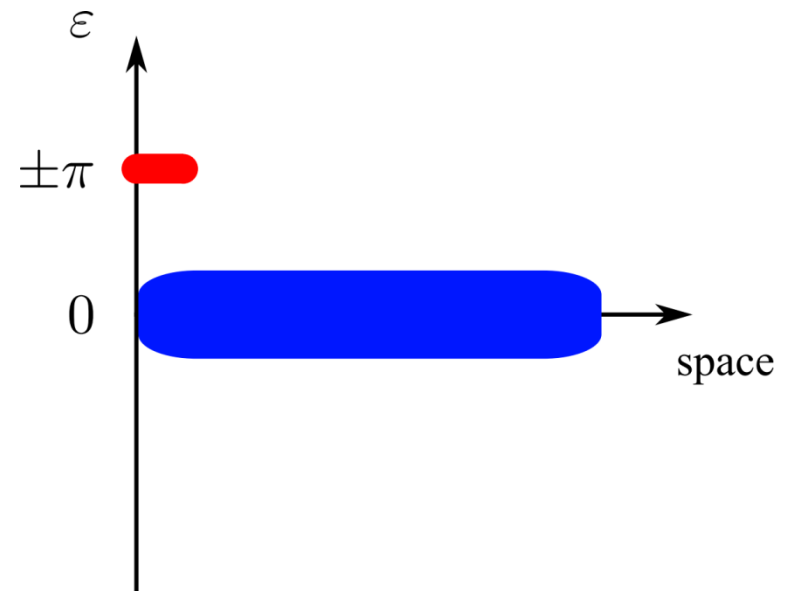
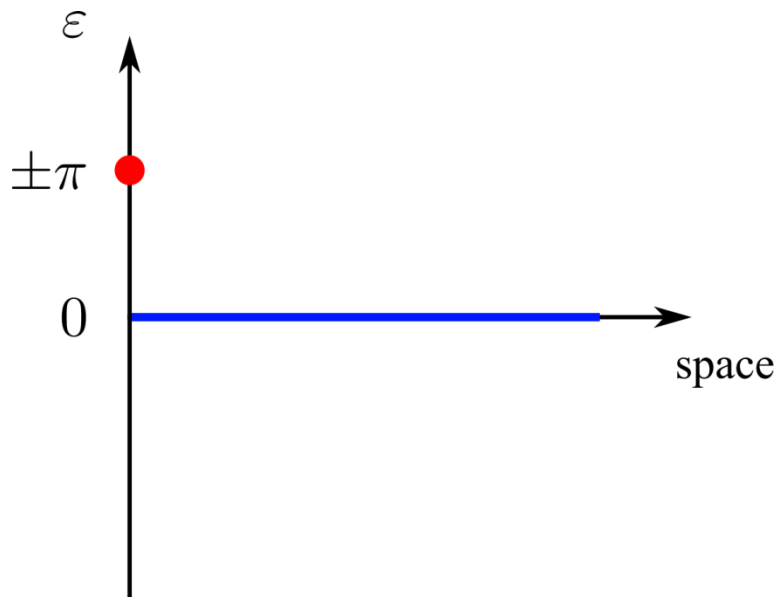
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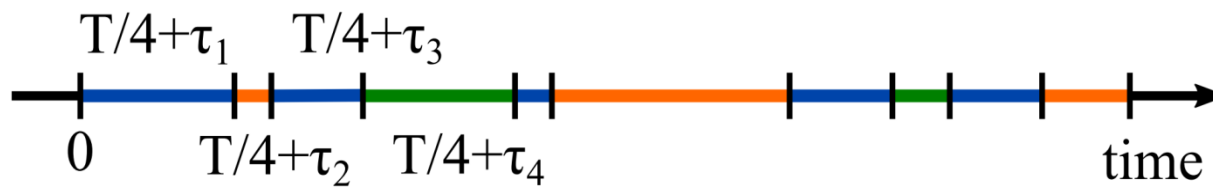
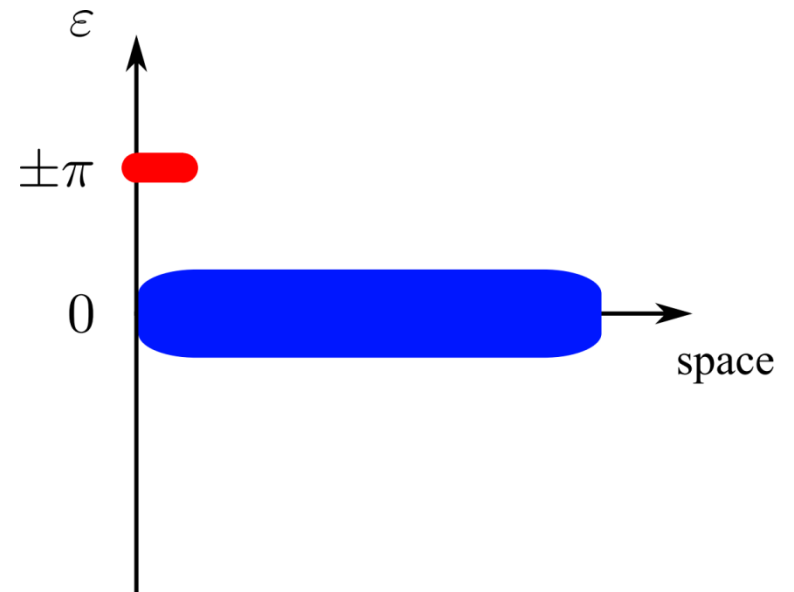
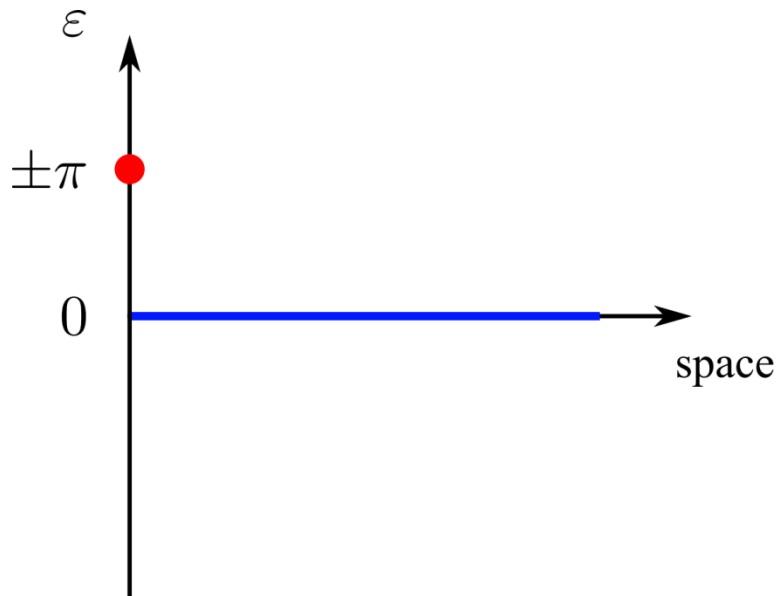
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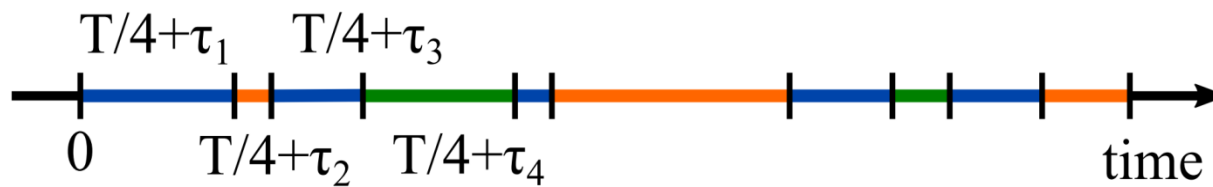
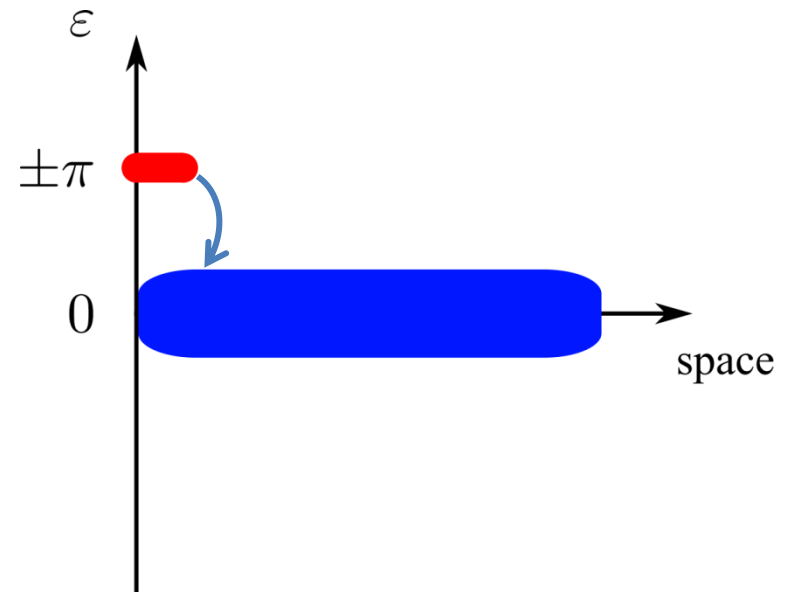
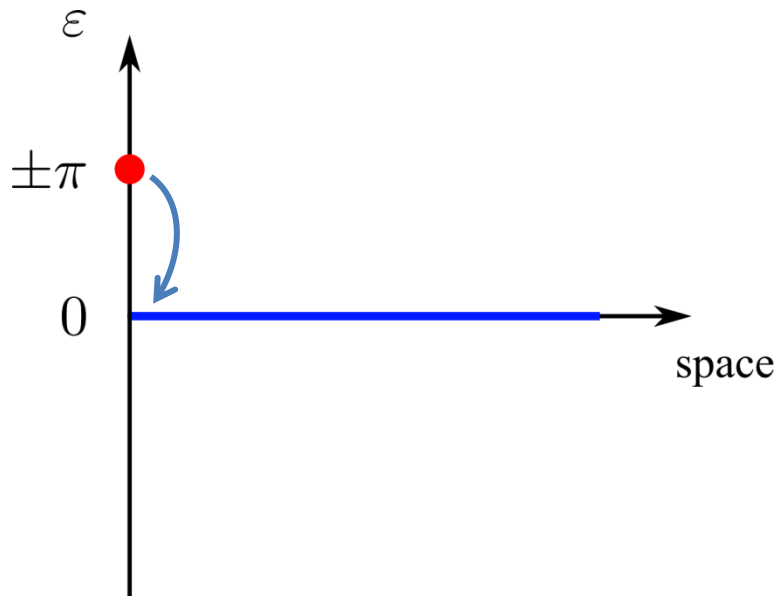
Floquet ladder



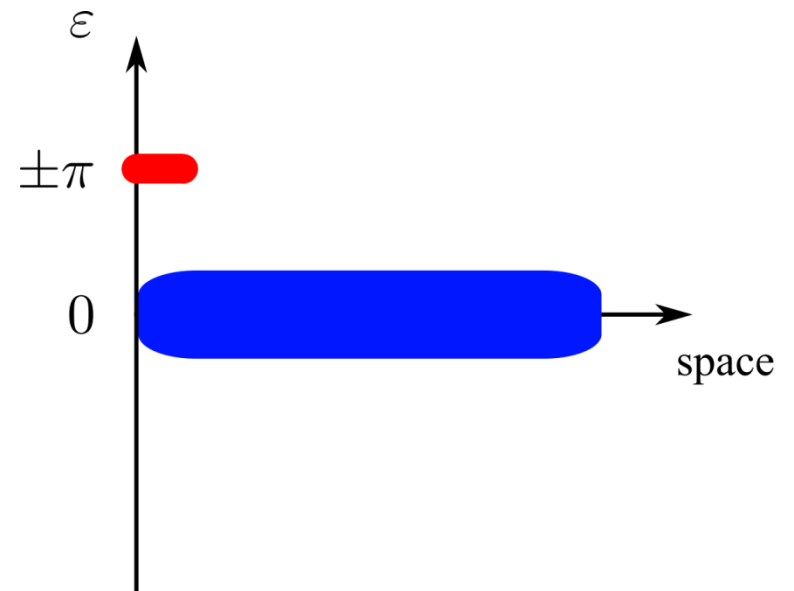
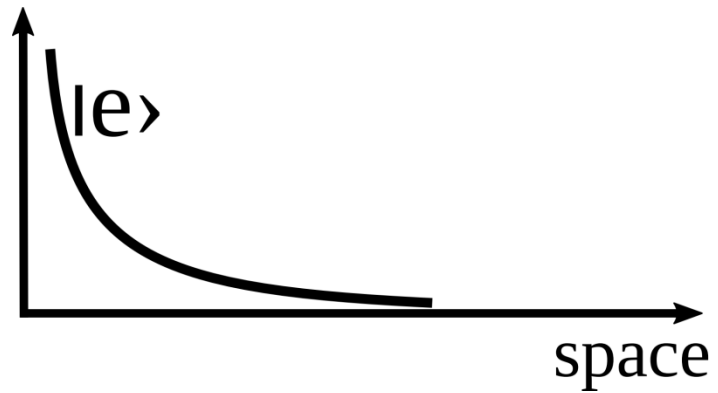
Noisy driving



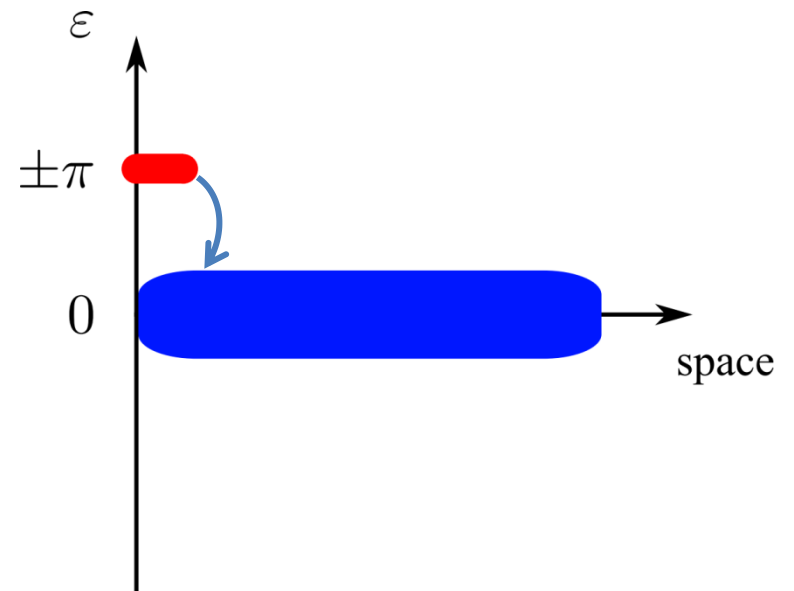
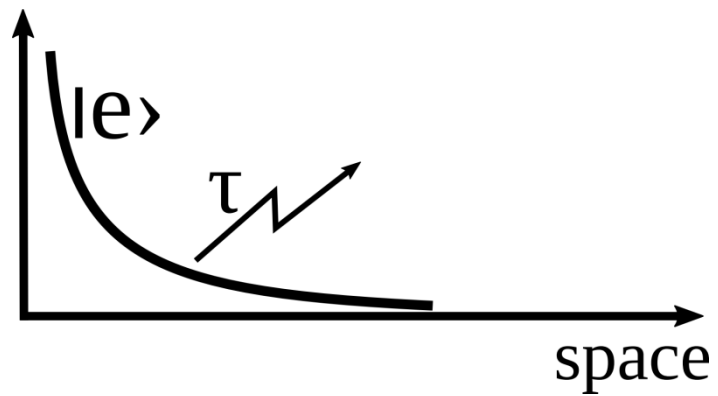
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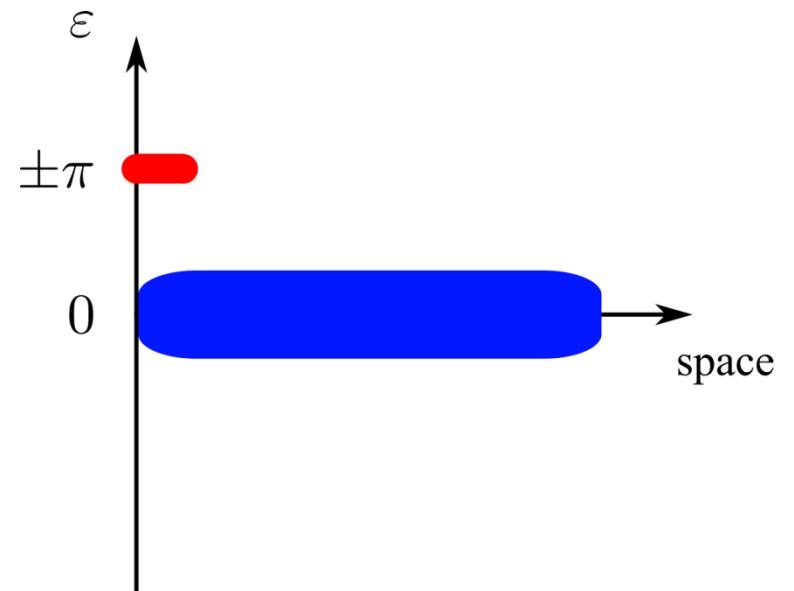
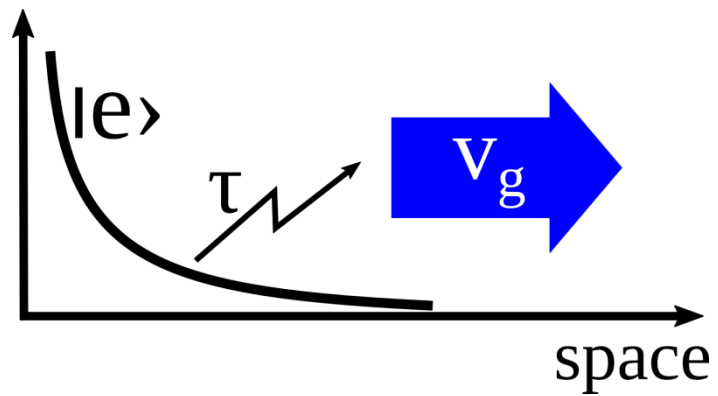
End mode decay



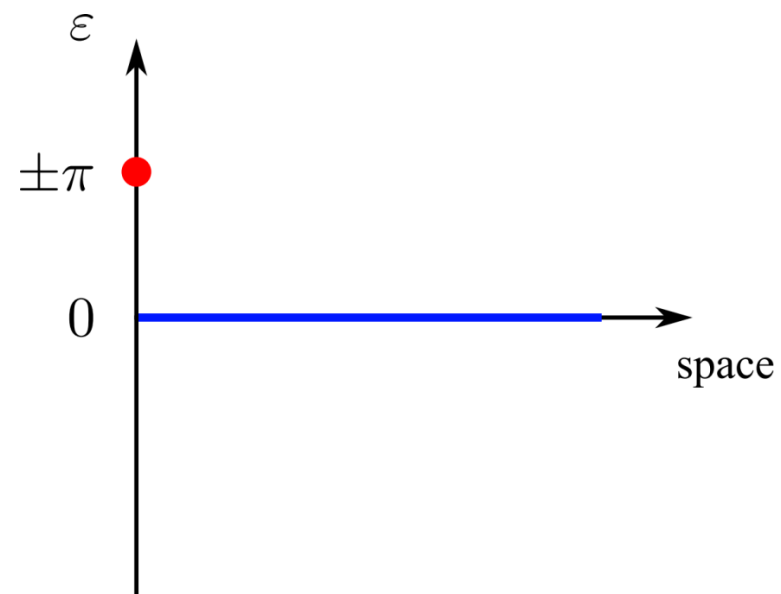
End mode decay



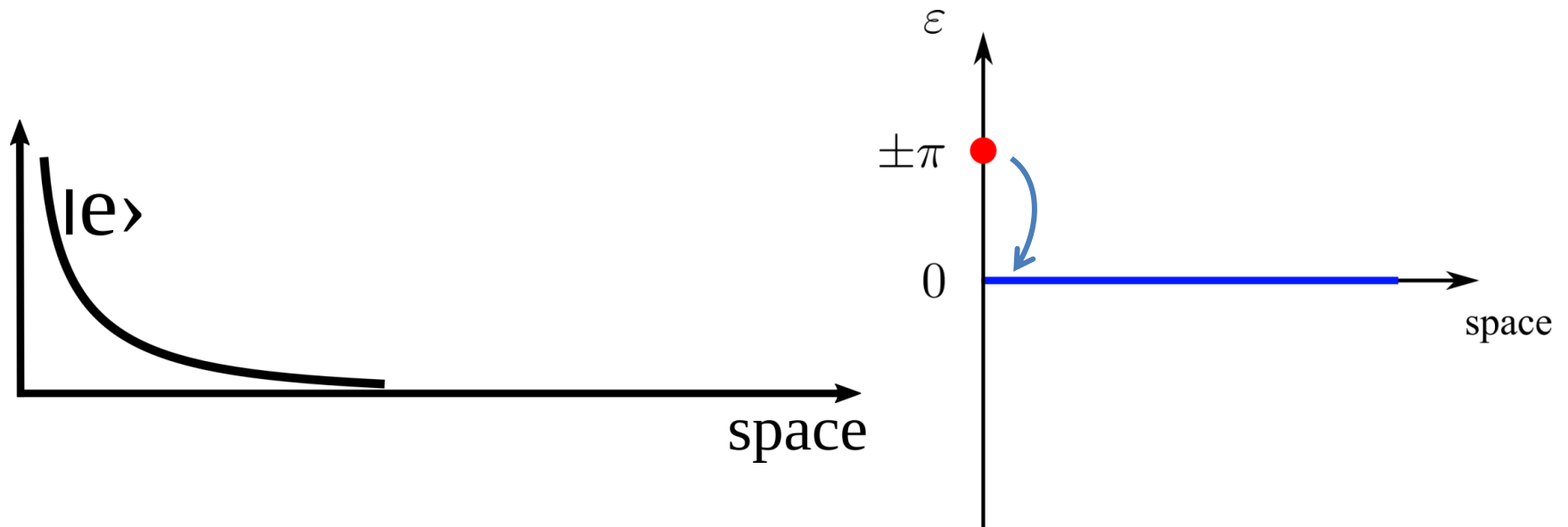
End mode decay



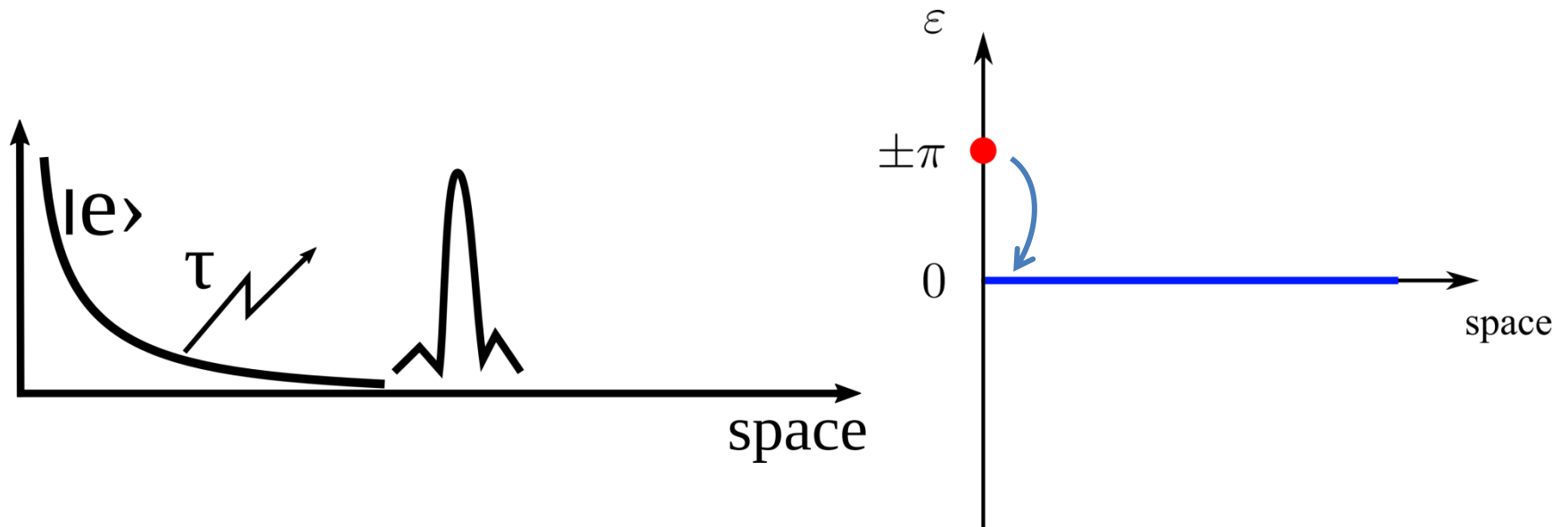
End mode decay



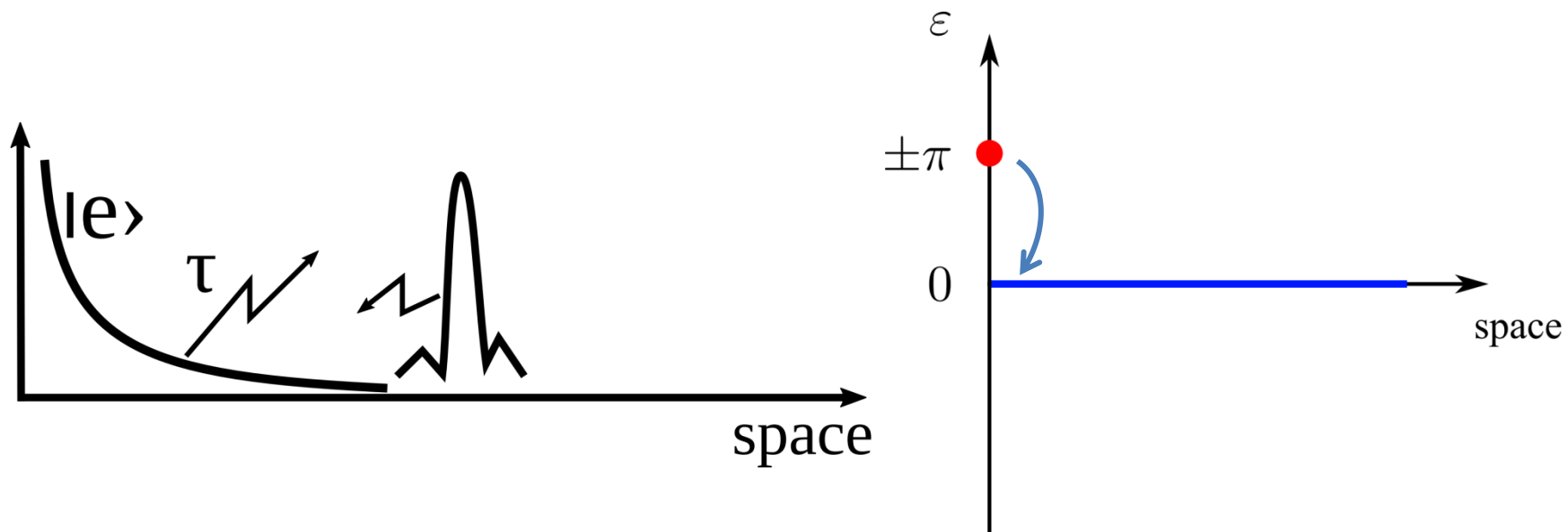
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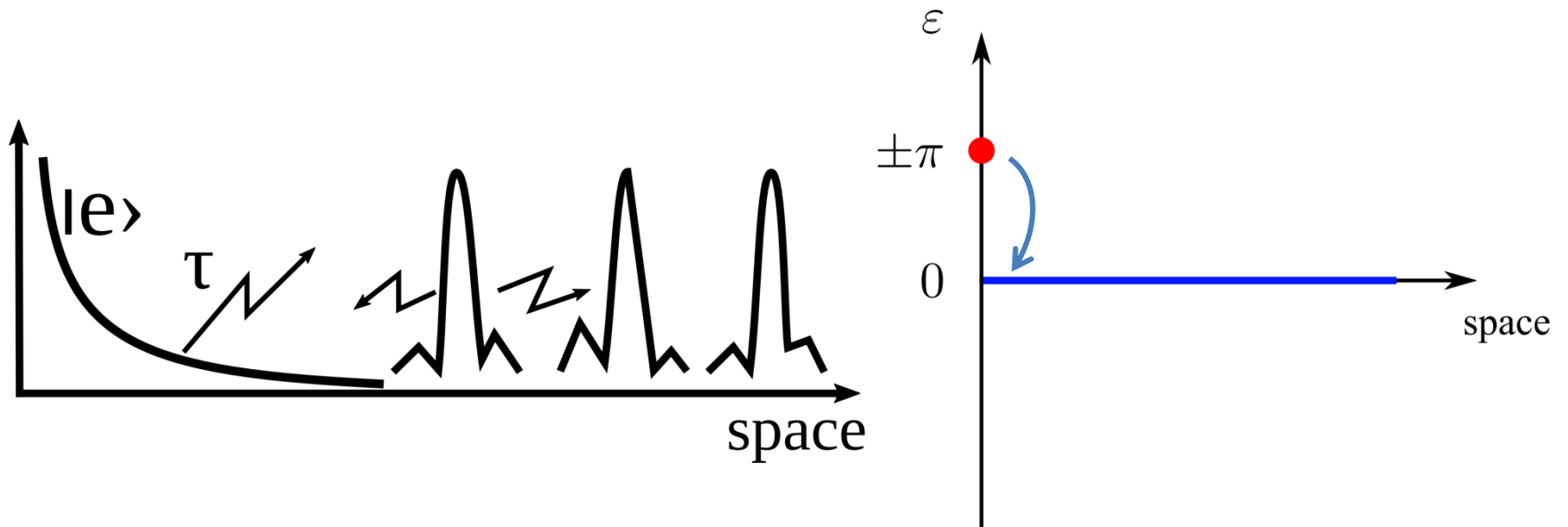
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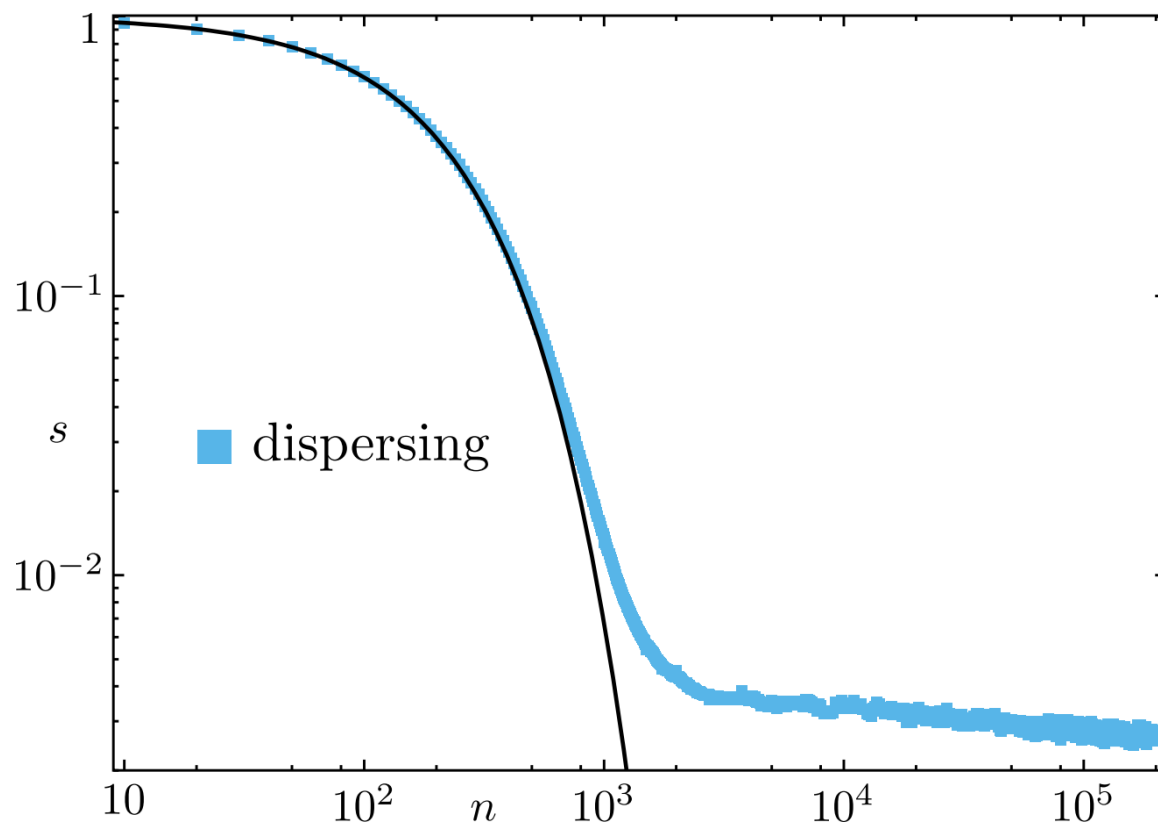
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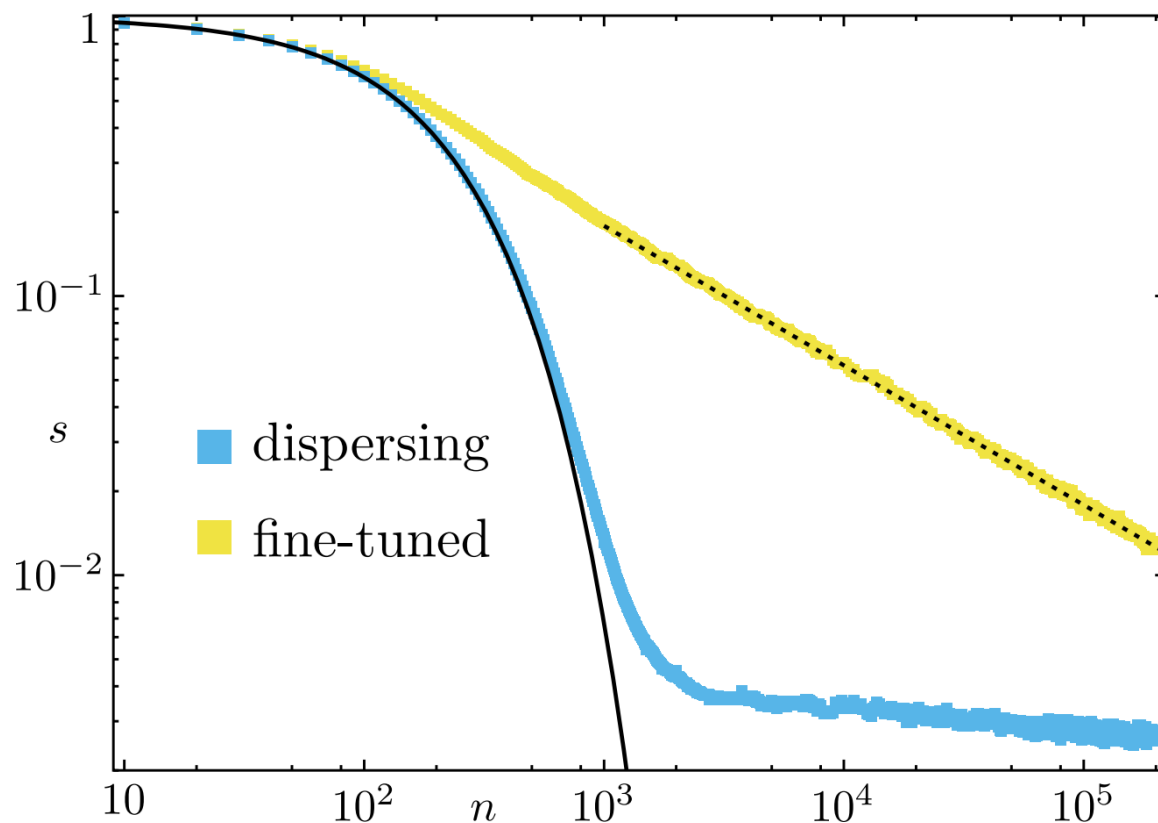
End mode decay



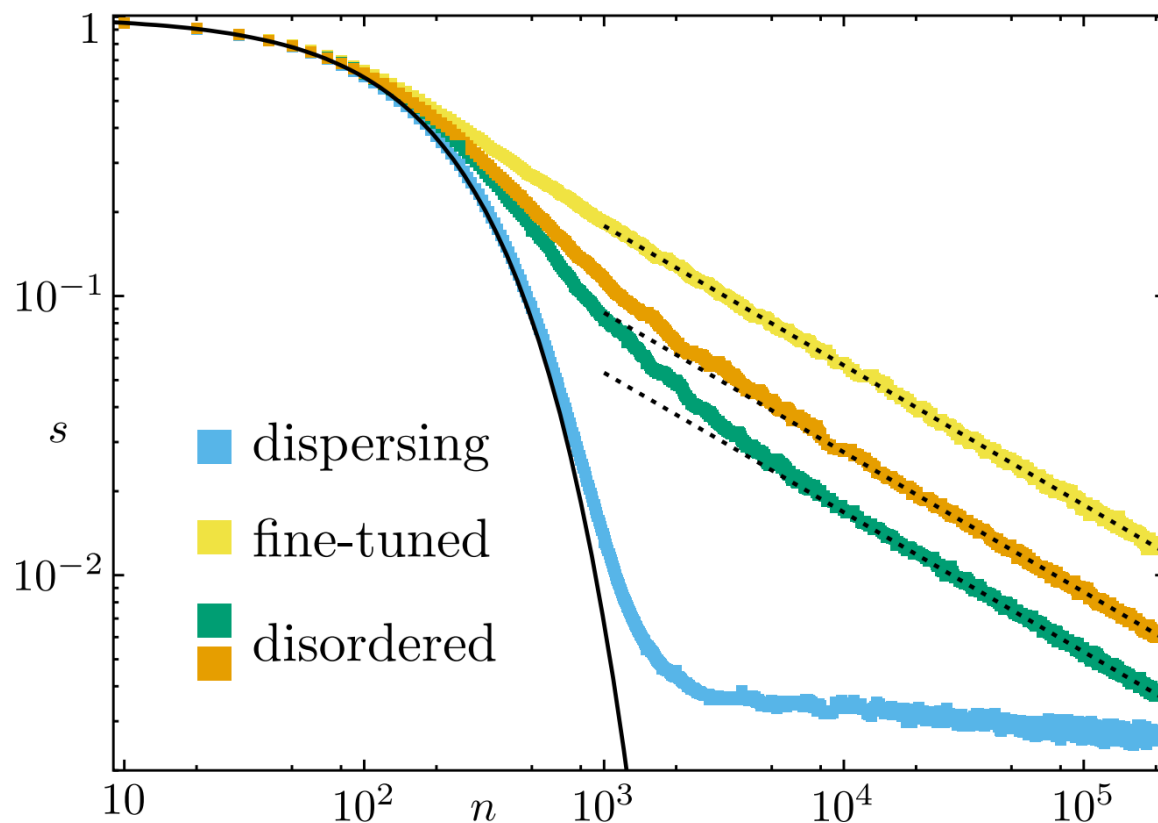
Localization fights decoherence



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Conclusions

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- ... even when disorder breaks the symmetry protecting the topological phase
- Analytical formalism: discrete time Floquet – Lindblad equations
 - topological phases in the strong noise limit (see PRB)
 - strongly interacting Floquet systems (“time crystals”)
 - higher dimensions

Floquet – Lindblad formalism

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Perfect driving: $U_F = U_4 U_3 U_2 U_1$ $\rho_{n+1} = U_F \rho_n U_F^\dagger$

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Floquet – Lindblad formalism

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Noisy driving: $U_{F,n} = U_{4,n} U_{3,n} U_{2,n} U_{1,n}$

$$\rho_{n+1} = \overline{U_{F,n+1} \rho_n U_{F,n+1}^\dagger}$$

Floquet – Lindblad formalism

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$$L_1 = H_1$$

$$L_2 = U_1^\dagger H_2 U_1$$

$$L_3 = U_1^\dagger U_2^\dagger H_3 U_2 U_1$$

$$L_4 = U_1^\dagger U_2^\dagger U_3^\dagger H_4 U_3 U_2 U_1$$