Early work looking at how tilting energy surfaces affects quantum transport in 1D and 2D.

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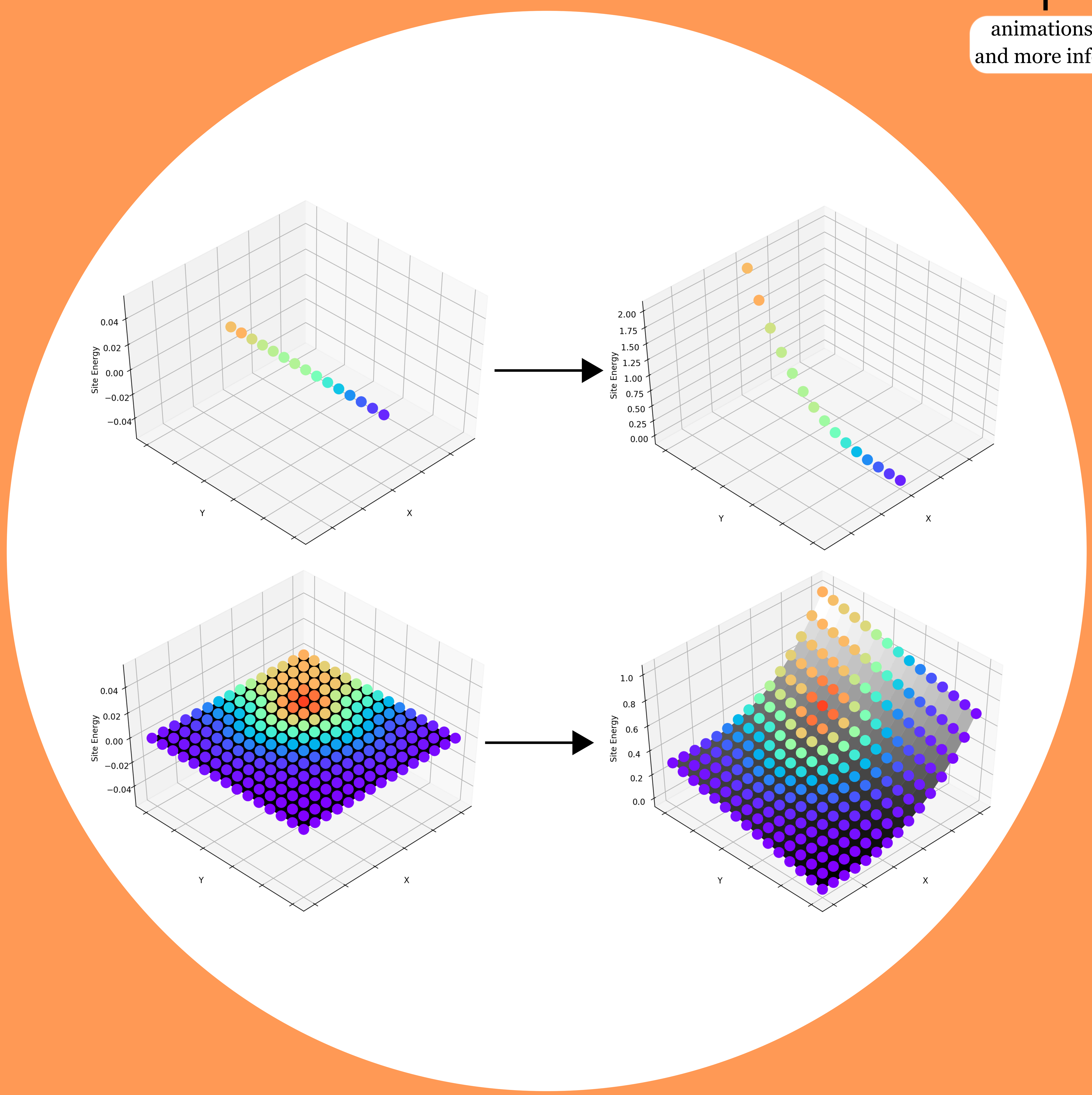
animations and more info!

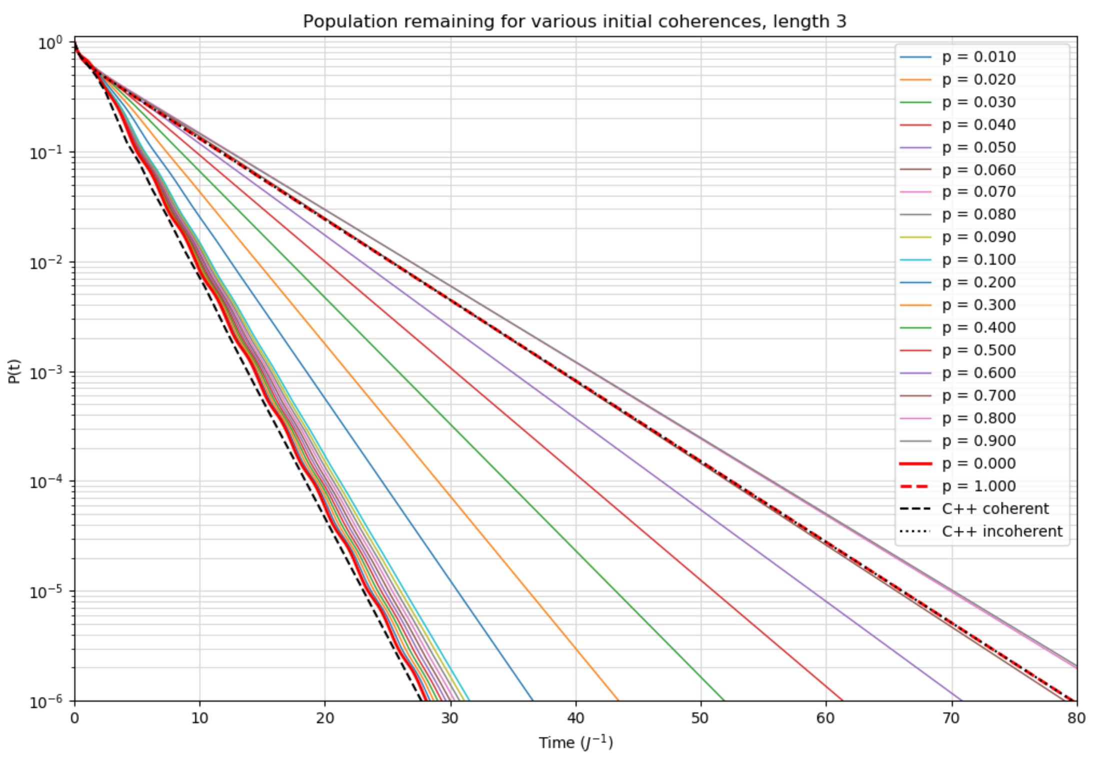
Abstract

Looking at low dimensional systems coupled to an environment, and seeing how transport is affected by varying on-site energy.
This breaks degeneracy and system symmetry, meaning finite temperature dynamics become more complicated.
The goal is to see if any new behaviour emerges, and under what regime biasing a system may improve transport.



Method

- Single Excitation assumption
- Tight-binding Hamiltonian
- Incoherent noise via on-site dephasing or classical hopping
- Weak coupling to environment
- So far exclusively using Lindblad master equation
- Work done using QuTiP package



Comparison between new code and published code for length 3 chain.

Results

Current simple approach with 2 level systems shows robust noise-assisted transport.
Results were checked against published results for transport in a degenerate system for rigour.
Currently limited by simplistic dephasing which only functions in zero- or infinite temperature limit for a non degenerate system.

Future work

- Adding in a more rigorous environment for finite temperature behaviour
- Try porting to Julia for a speed boost
- Strong coupling regime
- Adding noise to test robustness of transport
- Add in support for Bloch-Redfield master equation
- Investigate 'momentum rejuvenation' noise-assisted transport in biased systems

Comparison paper: Li, Y. et al. (2015). ‘Momentum rejuvenation’ underlies the phenomenon of noise assisted quantum energy flow. *New Journal of Physics*

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