Eigenstate Explorer 2.0

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Outline

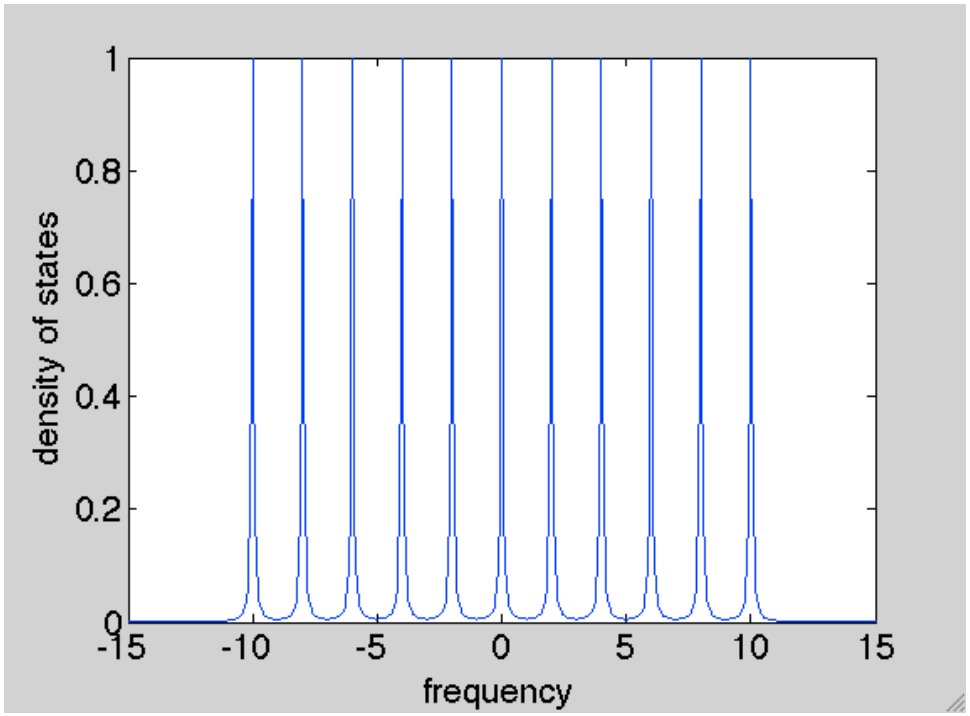
- Disclaimer
- Scientific Background
- What's been done
- What can be done

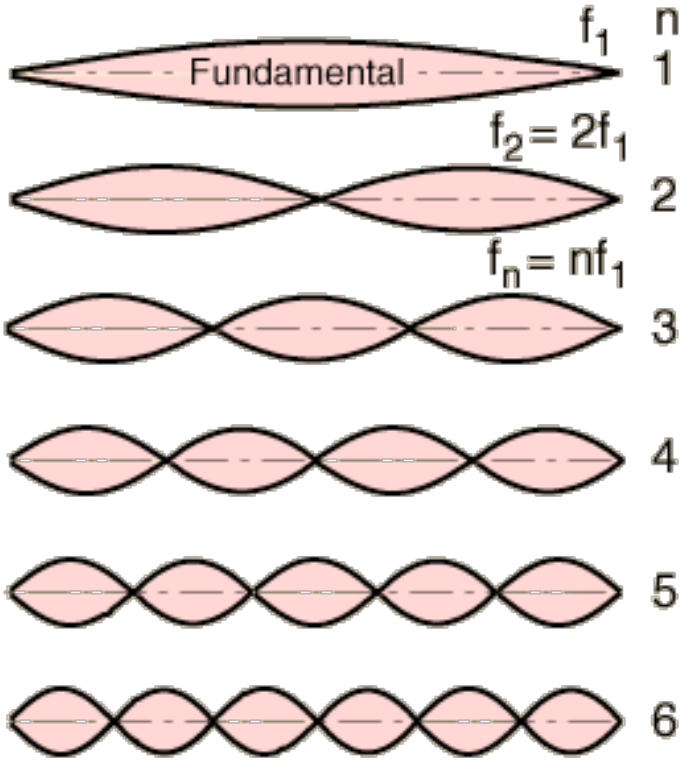
Disclaimer

(not written for self-preservation)

Background

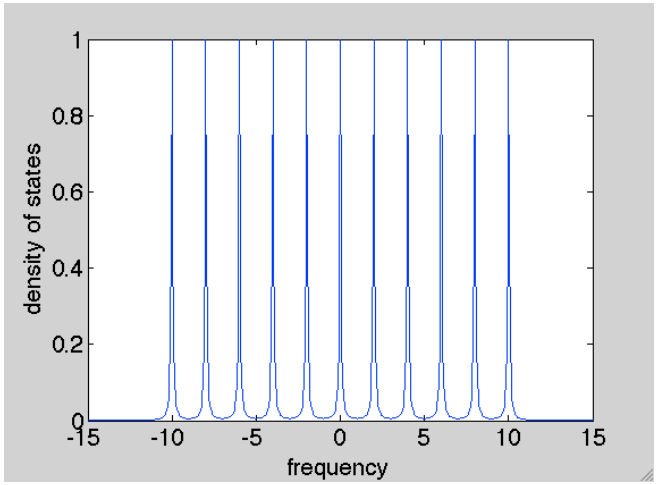
- A closed system has a resonant frequency for each eigenstate like a guitar string with fixed ends





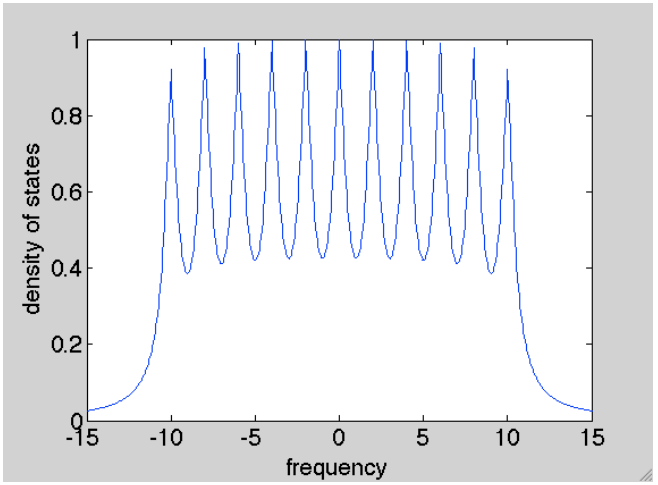
Background

- Density of states (DOS)
- Closed system → discrete
- Delta functions impossible to visualize
- Parameter Γ can broaden delta functions



Γ = 0.1

Γ = 1



Background

- Open system → continuous
- Fixed ends → Small masses (hold guitar string with your fingers, damping occurs)
- Mixing and broadening of eigenstates
- Different results when you image the system connected to leads and when you measure energy across the leads

What's Been Done

- Small multiples
- Scarring in the literature

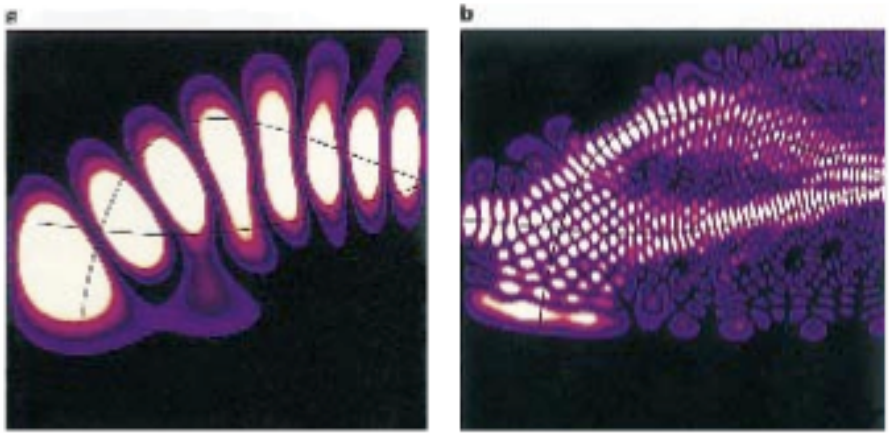
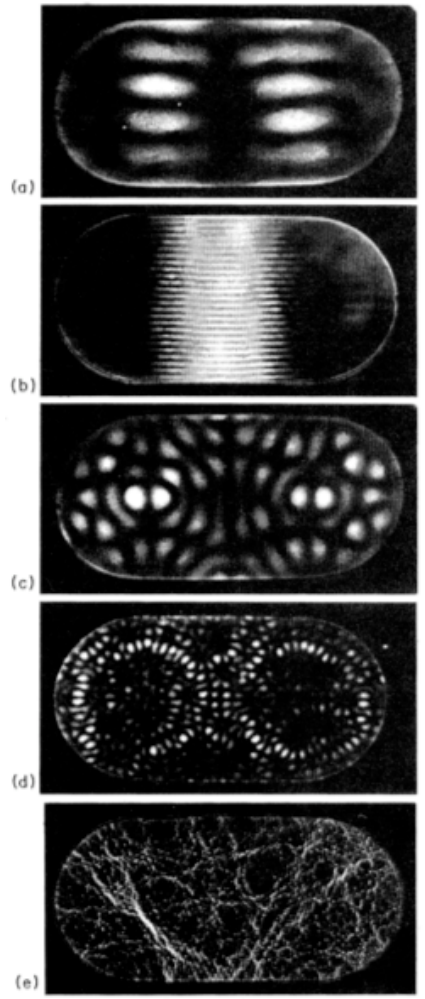
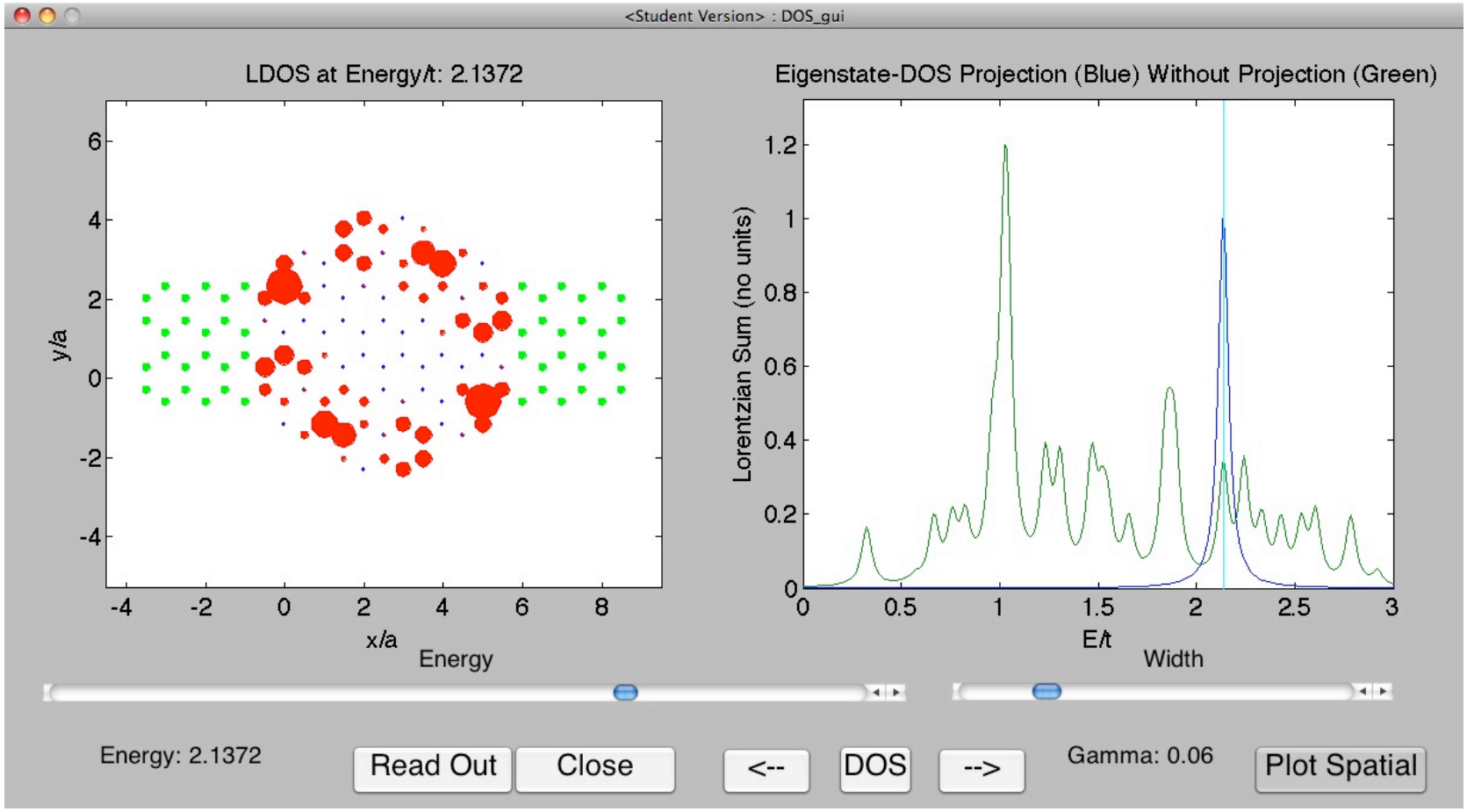


Figure 1 Quantum eigenstates which dominate tunnelling for: **a**, $n=1$ far from the semiclassical limit showing 'linear' quantization; and **b**, $n=30$ showing scarring by the S_1 unstable periodic orbit observed in wide-well experiments. We ensured that both states corresponded to exactly the same set of classical periodic orbits, differing only in effective size of $\hbar$ by using a scaling property of the dynamics.



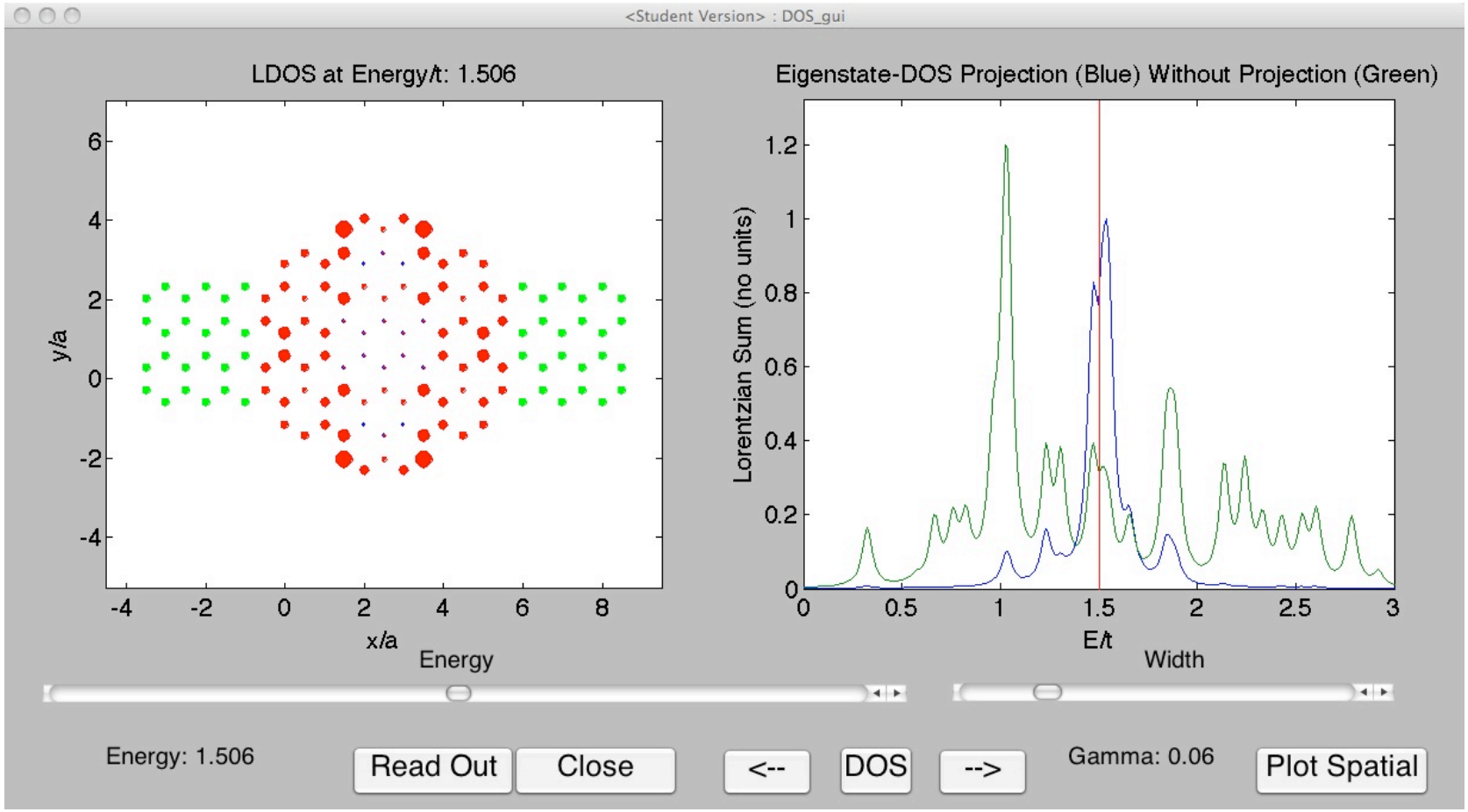
What's Been Done

Can Visualize Eigenstates of a Nanotransistor



What's Been Done

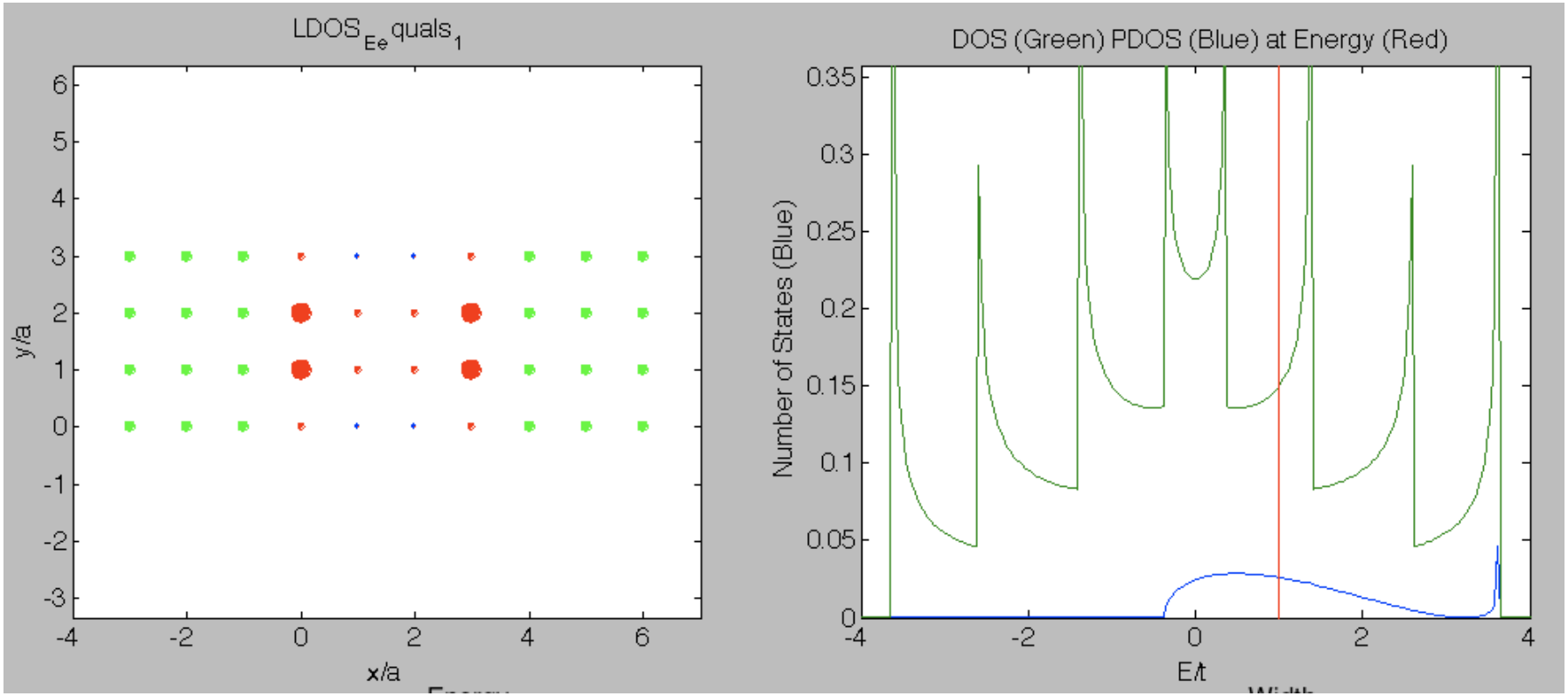
Can Decompose Eigenstates from DOS



What Can Be Done
Main Points

- Partial Density of States – Plot relative contribution of one eigenstate across all energies
- Use heterogeneous sizing and ordering of multiples to indicate relative contribution
- 2-D color plots of 3-dimensional information
- Self-similarity
- ON system vs. ACROSS system (DOS vs. T) – a scientifically useful extension of the above points providing opportunities for comparison

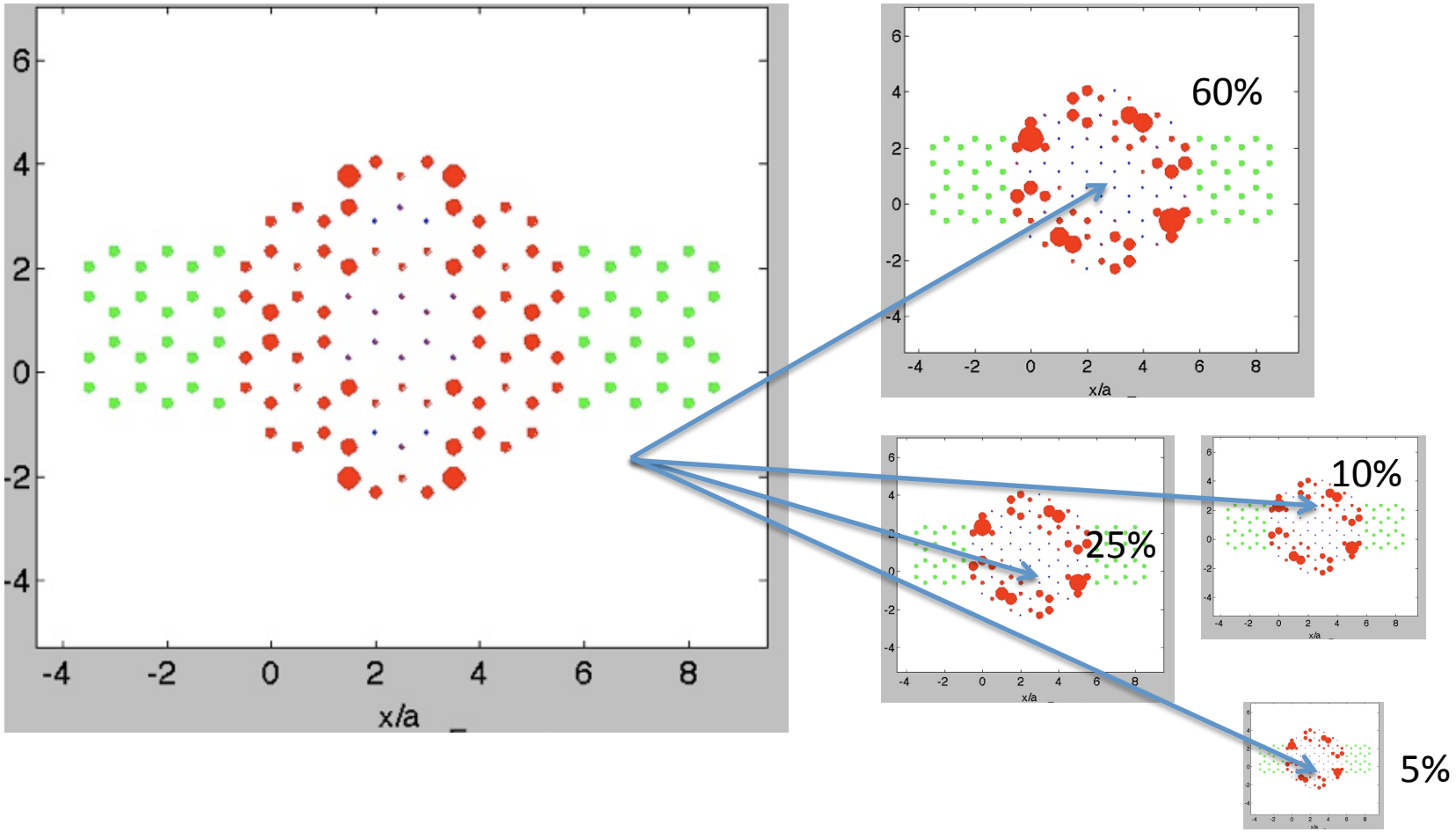
What Can Be Done
Partial Density of States



What Can Be Done
Partial Density of States

- How to convey meaning easily?
- Can utilize similar interface
- How should PDOS scale, since often much smaller than DOS but occasionally (and most interestingly) can be of same size
- Scaling complicated by desire to show comparison between eigenstates

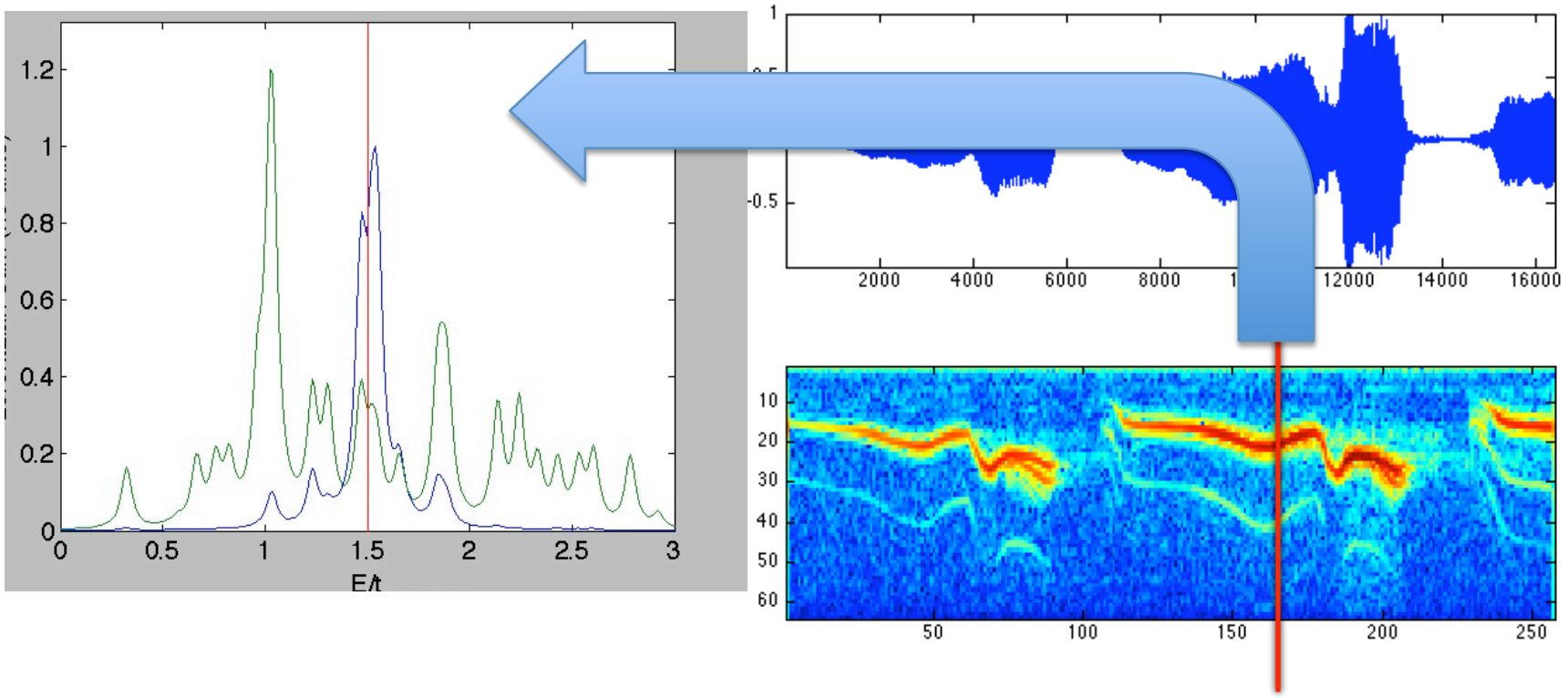
What Can Be Done
Heterogeneous Small Multiples



What Can Be Done
Heterogeneous Small Multiples

- Dynamic scaling and rearranging to fit into a finite space
- Visibility of low-contribution eigenstates
- Which scaling is best to represent these features? Quadratic/linear/logarithmic

What Can Be Done
2D Color Plots



What Can Be Done
2D Color Plots

- Move along in energy – plot projection line along with function plot
- Can you superimpose a background (green line, constant in energy), like the function plots (blue line, changes in energy)?

What Can Be Done
Self-Similarity

- We can find connections between different energies by plotting the self-similarity matrix
- Derived from audio analysis

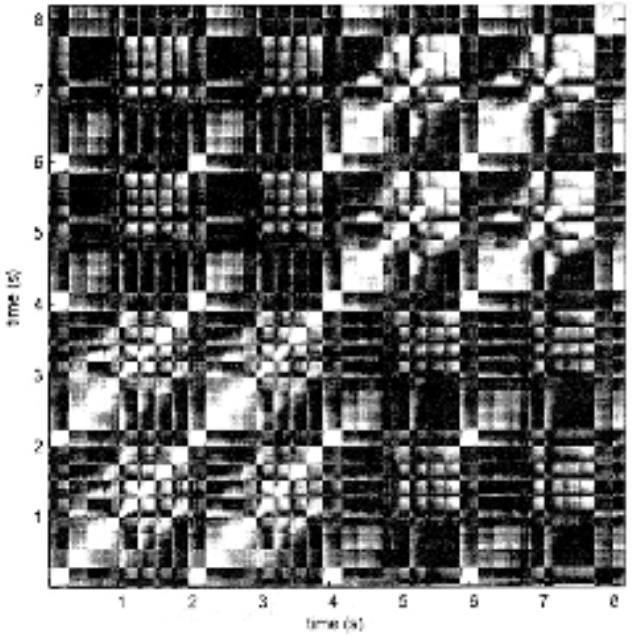


Figure 4. Self-similarity of Bach's *Prelude No. 1*