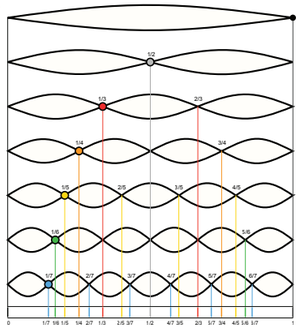
www.maths.bristol.ac.uk

I AM A QUANTUM GRAPH

How do I sound?

1

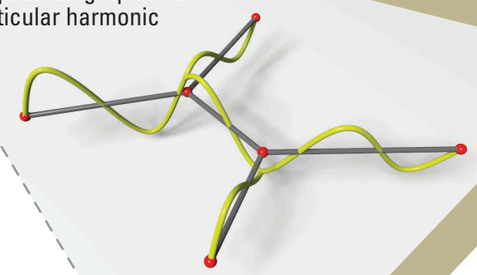
Picture a single guitar string. It can produce an infinite number of different notes when plucked in different ways. These are called **harmonics**. For each harmonic, the string vibrates at a particular frequency. This collection of frequencies is known as the **spectrum** of the string.



The harmonics of a single guitar string

2

Vibration pattern of a quantum graph at a particular harmonic



Imagine a network of strings connected together, as in the picture above. This is an example of what physicists call a **quantum graph**. Quantum graphs, like the single string, also have a spectrum of harmonics associated with them. These harmonics are studied by University of Bristol mathematicians and physicists.

3

Use our exhibit to build your own quantum graph. Be creative! Vary the number and length of the strings, and try different ways to connect them. Each time, you will get a new quantum graph with its own spectrum of sounds; how does this spectrum change with the quantum graph?

University of BRISTOL

Shape of leaflet inspired by figure from "Some planar isospectral domains" by Buser *et al.* in Int. Math. Res. Not. 9, 391-400 (1994)