# Seeing sound waves

**Demonstration**

To give a clear picture of wave motion and link it to sound waves.

## Apparatus and materials

Loudspeakers, 2

Audio frequency (AF) generators, 2

Small mirrors, 2

Laser (e.g. HeNe or diode)

Lab jacks

Blocks to tilt speakers or retort stands and clamps

## Health & Safety and Technical notes

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You need to be aware that a laser beam is projected across the room. Relevant safety precautions must be taken - check that the laser is labelled 'Class 2' and warn students not to stare into the beam. Avoid reflection from classroom surfaces such as glass-fronted cupboards.

Read our standard health & safety guidance

Alignment is tricky and needs some playing around with - persevere, possibly setting up one mirror at a time. The demonstration is most effective with the lights out and the blinds or curtains closed.

There are more sophisticated ways to set this up, building a frame, but these involve permanently sacrificing the speakers.

A video [2] showing the use of an audio frequency (signal) generator is freely available at the National STEM Centre eLibrary.

## Procedure

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**a** Attach a small mirror off-centre (e.g. to the right) of the cone of a 4 inch diameter speaker. (Any speaker will do - this size has been found to work.) Note the mirror must be attached to the moving cone, not the centre or the cover.

**b** Align the laser beam so it reflects off the mirror towards a second speaker with a mirror mounted off-centre (e.g. above centre). If you can mount the speakers in clamps it is easiest to move them around, and the light path may well be angled up or down - this is fine. Try to arrange it so the light reflects onto a distant wall or ceiling several meters away.

**c** Drive the speakers with audio tones from the low impedance output of an AF generator. You should be able to see the laser beam trace out curved paths and Lissajous figures on the wall.

## Teaching notes

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**1** Sound is a wave created by moving the speaker cones. This motion is now shown in the motion of the laser beam. Adjusting one AF generator will change the beam's motion in one sense - up-down say.

**2** The students will be able to relate the volume they hear to the size of the displacement, and the pitch to the frequency.

**3** Picking frequencies for the two speakers which are integer multiples produces spectacular Lissajous figures, which often drift slightly as the two generators do not stay precisely phase-locked.

**4** A similar demonstration can be set up with two generators and a CRO on XY inputs. However, it is not as visible or spectacular and does not make the direct physical link of volume to size of displacement, and pitch to frequency.

*This experiment was submitted by Ken Zetie, Head of Physics at St Paul's School in West London. He is on the editorial board of Physics Education and regularly contributes to Physics Review.*

## Weblinks

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Many websites offer a Lissajous Lab - an explanation of the figures and animation which can also be set up on a CRO. (Enter "Lissajous lab" into a search engine to find one.)



**Links:**
[1] http://www.nuffieldfoundation.org/node/1634/
[2] http://www.nationalstemcentre.org.uk/elibrary/resource/4104/signal-generator