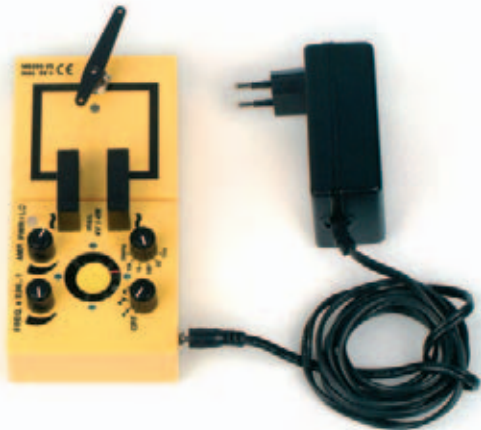




standing waves

Apparatus Set "Standing Waves" - "compact"

For generating transverse standing waves on a metal plate, allowing nodes and antinodes as well as changes in their number at different excitation frequencies to be easily recognised. Magnetic compact system (MBCS) modules, 84x84x39 mm, each including four built-in neodymium magnets, special jacks for using either normal 4-mm plugs or safety plugs, clasps for easily opening the components



- 1x MB200-2S Motor for wave generator "compact"
- 1x MB250-3F Function generator "compact"
- 1x P3130-1P Mains transformer 12V/2A
- 2x P3712-1S Jumper plugs, black
- 1x P3710-1T MBC lead, t-shaped
- 1x P3711-4K Clamping socket with plug
- 1x DW451-2R Elastic string, white, L=3 m



MB200-2S
Motor for wave generator "compact"
 Magnetic module with built-in DC motor; max. input voltage 3 V; drive shaft with permanently mounted pulley, with grooved edge, and plastic lever; lever with arms of two different lengths ($r_1=20\text{mm}$, $r_2=40\text{mm}$) and holes for attaching threads or cords



MB250-3F
Function generator "compact"
 Output signals: sine, triangle and square
 Frequency range: 0.1 Hz ... 50 kHz, continuously variable
 Output voltage: $4 V_{\text{eff}}/1 A_{\text{eff}}$ (4 watts at 4 ohms) from two 4-mm safety jacks
 Input voltage: 12 V DC through hollow jack, supplied by mains transformer P3130-1P (12V/2A)



DS605-1T
Metal plate on support, narrow
 For use in assemblies on the magnetic panel or to provide background contrast; green powder-coated; with edges folded over for greater rigidity; with support (10x40 mm)
 Dimensions: 960x250 mm



Experiment: Transverse standing waves (apparatus set "standing waves" - "compact")

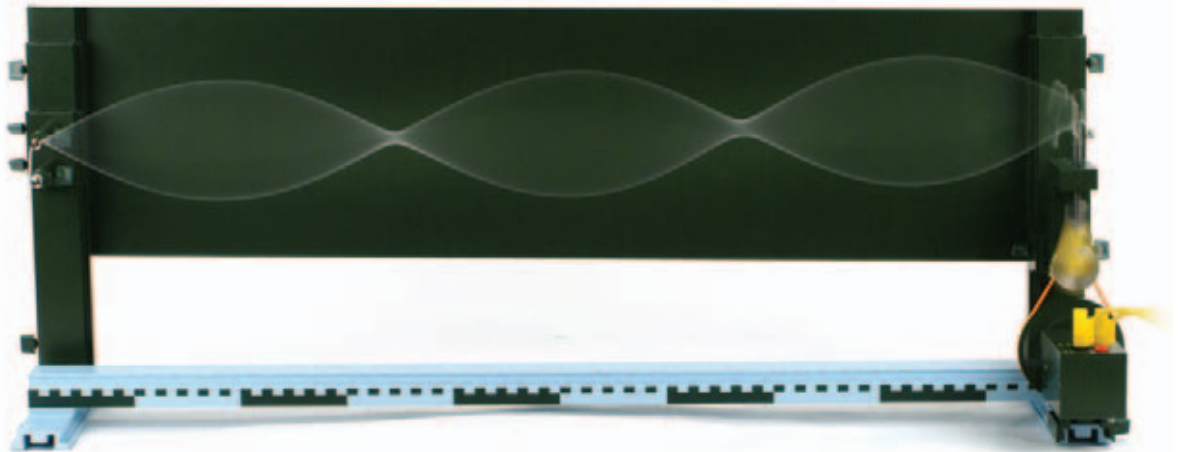
standing waves



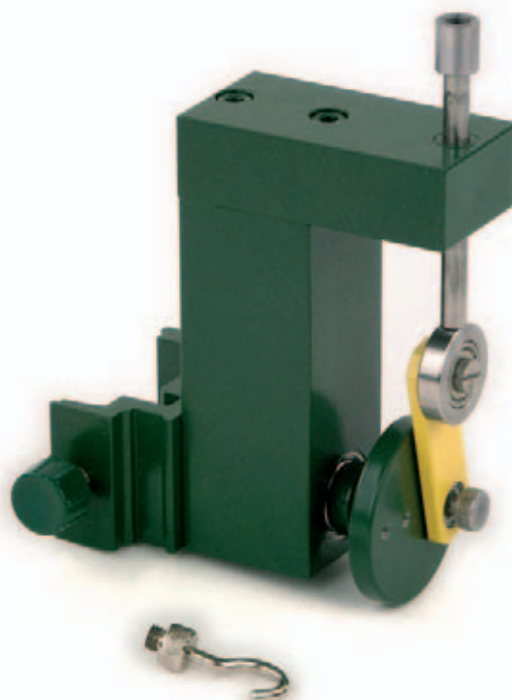
DW380-1S Stroboscope

For observing rapid periodic motion and measuring rpm without contacts; 4-digit LED display, xenon white-light flash tube (6,500 °K); flash energy: 4Ws (joules); flash frequency: 100 ... 10,000 flashes per minute, continuously variable, both rough and fine adjustment possible; deviation: +/- 0.05 %
Dimensions: 210x120x120 mm; weight: 1 kg; input voltage: 230 V/50...60 Hz

Experiment:
Transverse standing waves (with cam)



Detail: String tension can be easily varied to any magnitude



DS403-2X Cam adapter

Used for generating linear, periodic motion, as when producing standing waves in a cord or the motion required by the particle motion model. May be driven by geared motor DS403-1G by means of drive belts DS401-1A (set of 2). The piston is self-lubricating at work and is equipped with an M6 tapping to accommodate the threaded c-hook DS102-3S or the threaded impact plate DS102-4P. Length of piston stroke may be varied. The drive pulley, running on double ball-bearings, is firmly mounted on a sliding saddle made of a special aluminium profile and includes a clamping screw for mounting and fastening onto the NTL special rod profile.

DS102-3S C-hook, threaded



waves



Apparatus set for recording sine waveforms caused by rotational motion:

DW427-1S Recording tape

White plastic strip, may be pulled through guide DW427-1L
Dimensions: 500x64x2 mm

DW427-1L Guide for recording tape

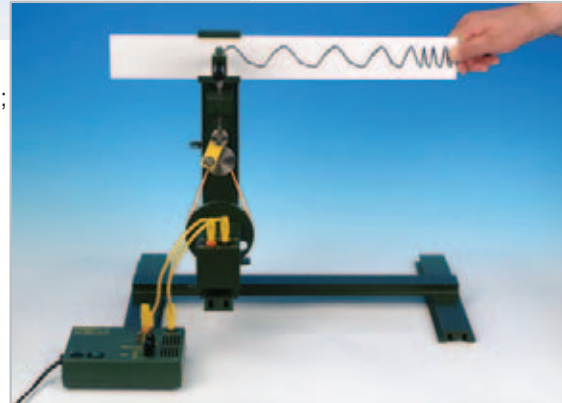
Plastic guide for recording tape DW427-1S, mounted on sliding saddle;
Dimensions: 60x78 mm

DW427-1H Marking pen holder

Aluminium block, green powder-coated, with tapping for screwing onto the piston of cam adapter DS403-2X;
dimensions: 20x20x30 mm

C7720-2F Marking pen, black

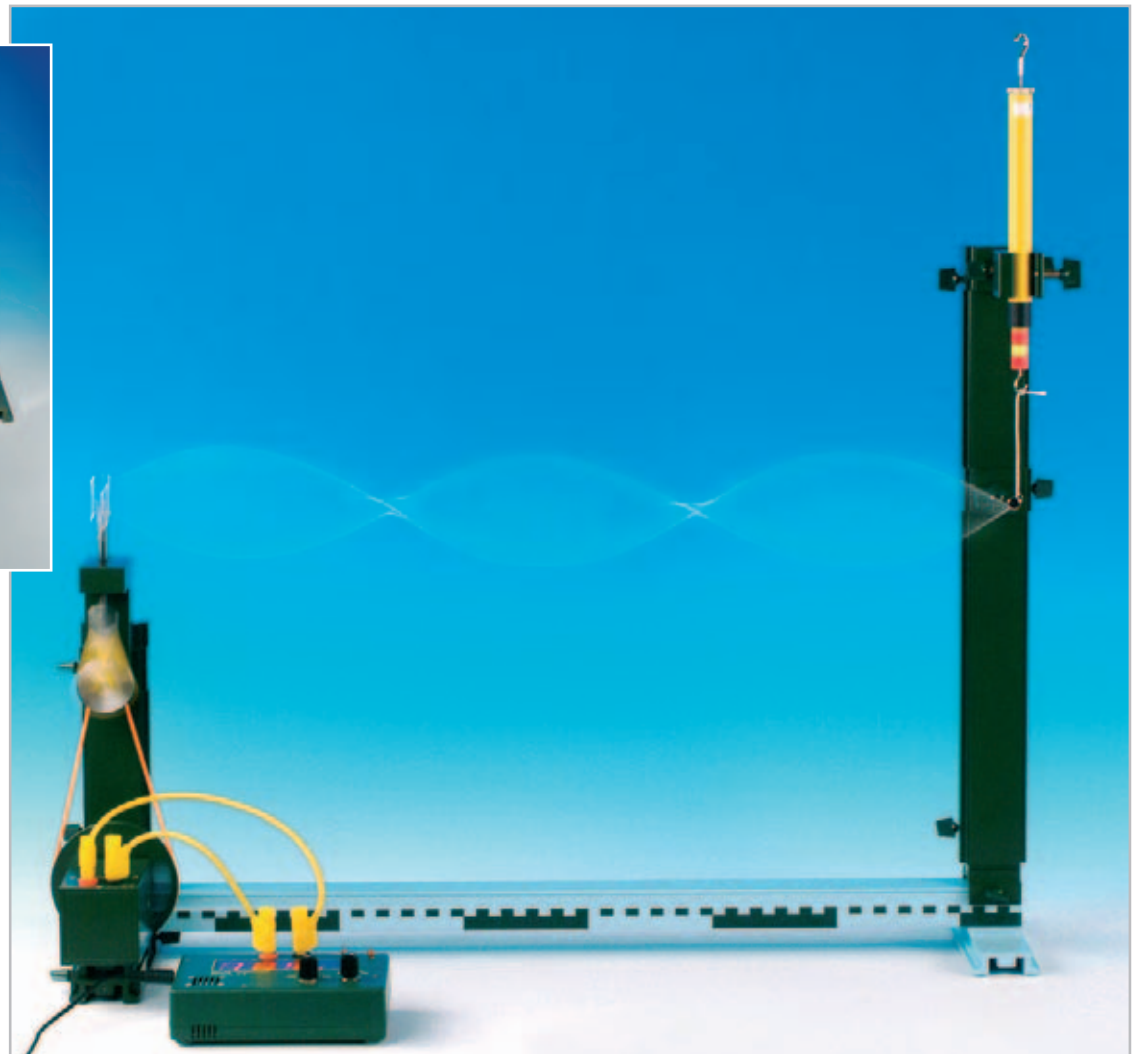
Fibre-tipped marking pen for writing on metallic or plastic surfaces, medium thickness, water-soluble ink



Experiment:
Sine waveform resulting from rotational motion



Example of an experiment:
Simultaneous observation of pendulum motion and circular motion



Experiment:
Transverse standing waves at varying tensions



Experiment:
Observation of sine-wave oscillations produced by the flat spring with mirror, rotating mirror and a laser



DW310-1D Rotating mirror

For observing periodic motion over time; hollow block with mirrors on four sides; mirror surface: approx. 110x75 mm mm each; base on support (10x55 mm); may be manually rotated using screw on lid
Dimensions: 75x75x120 mm

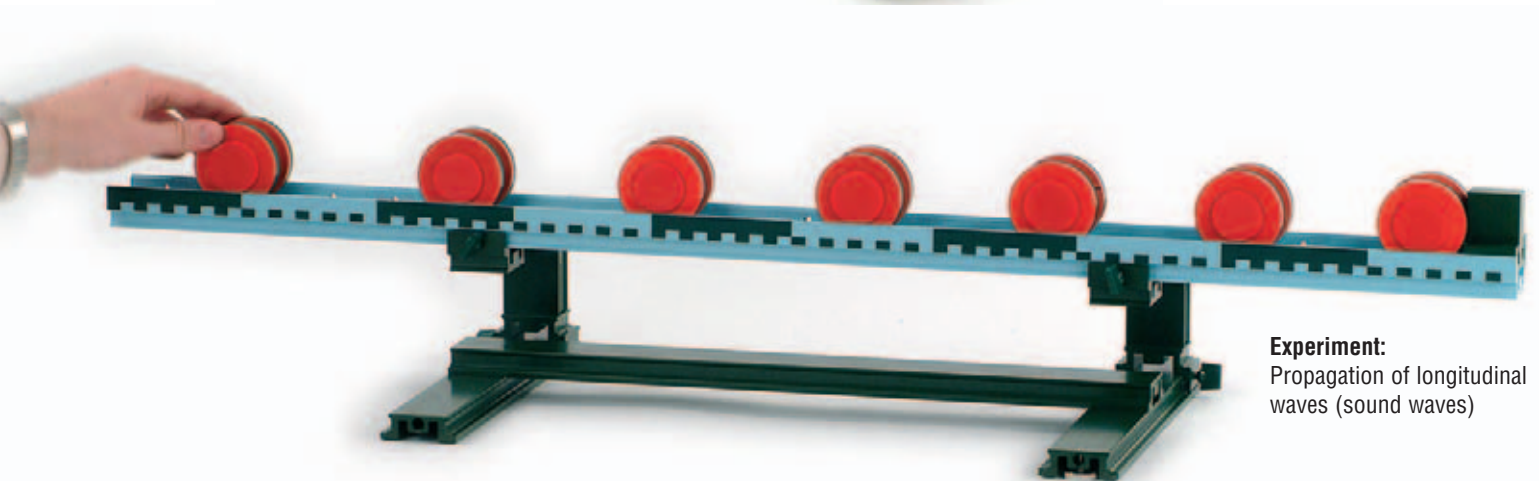
DW310-2S Flat spring with mirror

For generating regular damped oscillations; mirror is used to reflect a laser beam in order to generate sine-wave oscillations using rotating mirror DW310-1D; flat spring of hardened steel; mirror (40x30 mm) permanently mounted at one end of spring; clamp-on weight DW310-1M may be attached to the spring to vary the frequency
Dimensions: 225x25x0.5 mm

DW310-1M

Clamp-on weight for flat spring

For changing the frequency of flat spring DW310-2S; plastic block with slit and fastening screw
Dimensions: 20x20x30 mm;
Weight: 100 g



Experiment:
Propagation of longitudinal waves (sound waves)

DW470-1M Rolling magnet assembly

For experiments on longitudinal wave propagation and elastic collision; set consisting of:

7x DW470-1R Axle for ring magnets

Used for holding two ring magnets DE420-1A and may thus be used in the rolling magnet assembly; acrylic cylinder with two plastic rings (red and green) and two plastic caps (red and green) for attaching ring magnets to the axle, D=30 mm, W=40 mm

7x DE420-1A Ring magnets, pair

Extremely strong ferrite magnets, each embedded in a red or green plastic casing; outside D = 63 mm, inside D = 30 mm

Required accessories:

- 1x DS101-3B Universal rail with scale, L=1000 mm
- 1x DS101-1G Support base, large, L=500 mm
- 2x DS103-4G Rail support stand, vertical, H=101 mm
- 2x DS105-4G Rail holders, fixed
- 1x DM361-1K Ball stopper on base

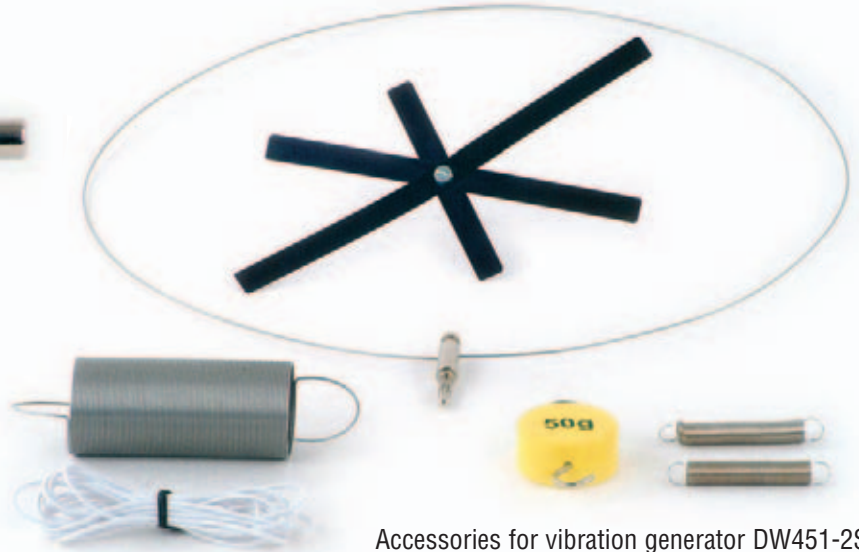


waves



DW451-2S Vibration generator

Used together with a function generator (e.g. P3120-1G or P3160-3A) for generating mechanical vibrations; loudspeaker mounted horizontally in a heavy-duty acrylic housing; includes a metal centre spindle with a 4-mm hole for various attachments; spindle secured mechanically; support (10x40 mm) on the side for mounting on ordinary support material; max. input voltage: 6V AC/1A; fuse: T 630 mA
D=approx. 100 mm, H=approx. 100 mm



Accessories for vibration generator DW451-2S:

DW451-4R Metal reeds

Used for constructing a vibrating-reed frequency meter; metal reeds of various lengths mounted on 4-mm pin plugs; for resonating at 11, 15, 21, 36 and 50 Hz; 40-90 mm in length

DW451-3R Resonating wire hoop

For generating circular standing waves; steel wire hoop mounted on 4-mm pin plug; D=approx. 300 mm

DW451-2R Elastic string, white, L=3 m

For generating transverse standing waves

P1810-2A Coil spring 3 N/m

For generating longitudinal standing waves; dimensions: approx. 35x75 mm

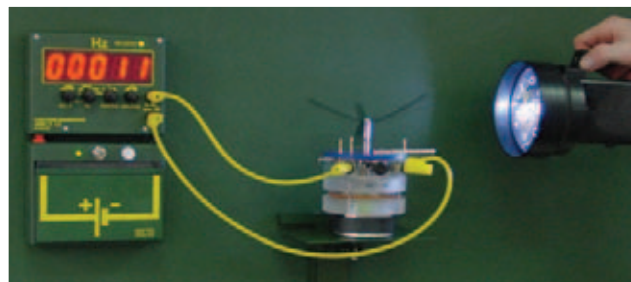
P1810-2C Coil springs 2N, set of 2

For constructing a spring pendulum; dimensions: approx. 10x50 mm

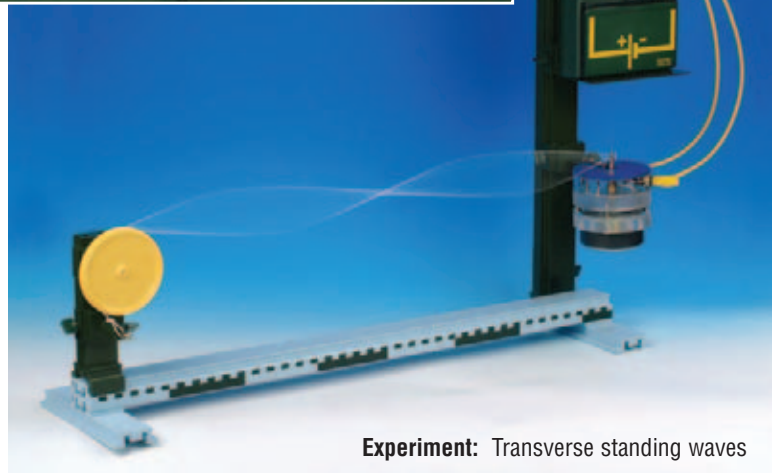
DM121-4A Weight on hook 50 g



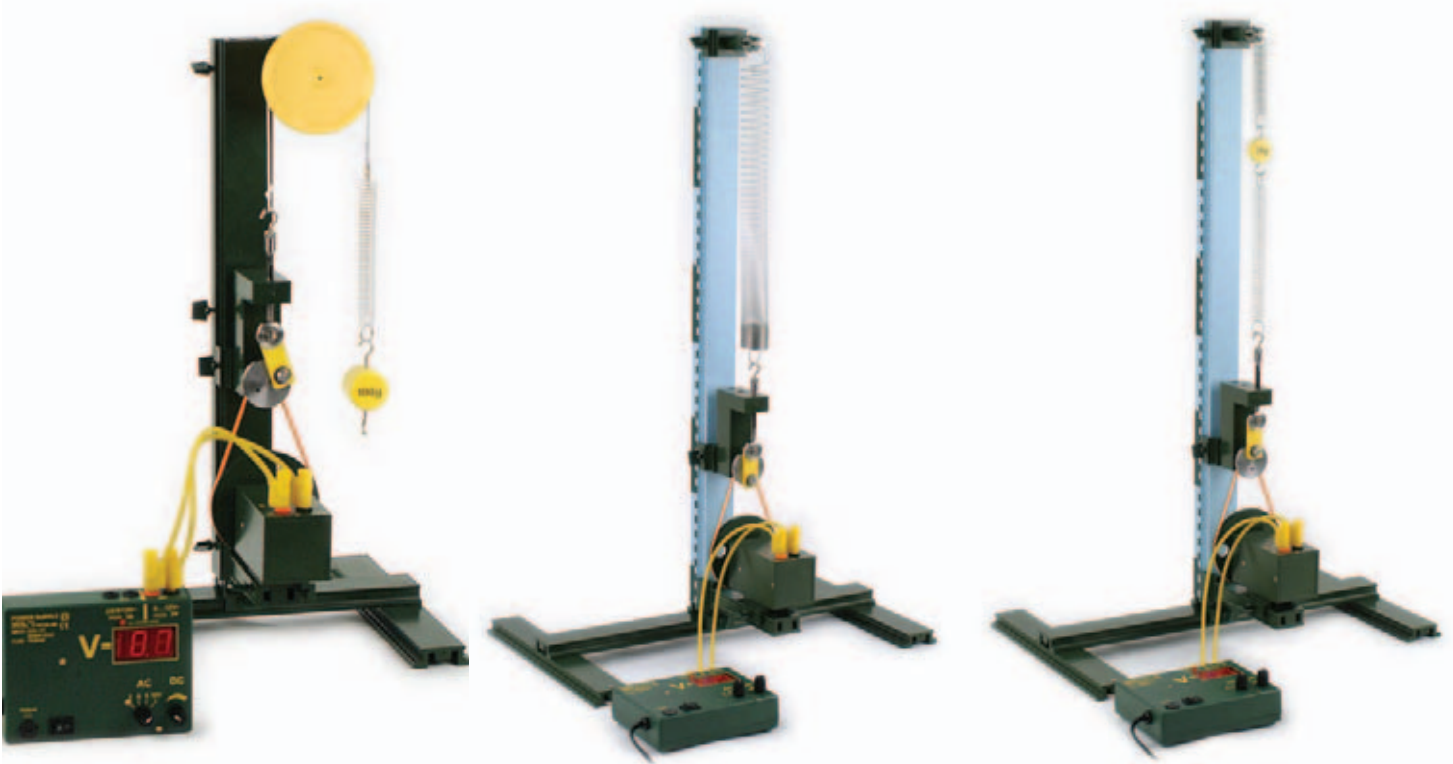
Experiment: Circular standing waves



Experiment:
Vibrating-reed
frequency meter



Experiment: Transverse standing waves



Experiments: Spring pendulum - longitudinal waves



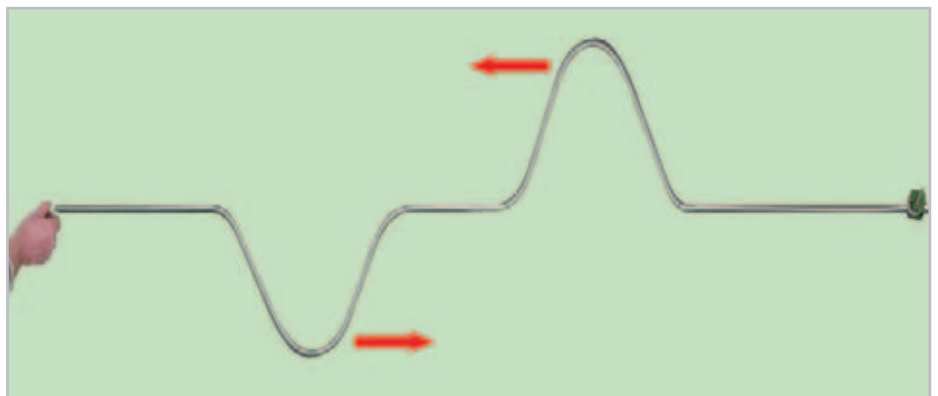
DW170-1F Slinky
For demonstrating wave motion and conservation of momentum; steel spring, may be extended to up to 10 m
D=approx. 75 mm, H=approx. 150 mm



DW160-1G Round rubber cord
For demonstrating transverse wave propagation and reflection
D=8 mm, L=10 m

DW171-1S Coil spring, long
For demonstrating transverse wave propagation and reflection
D=13 mm, L=200 cm

Experiments: Superimposition of waves





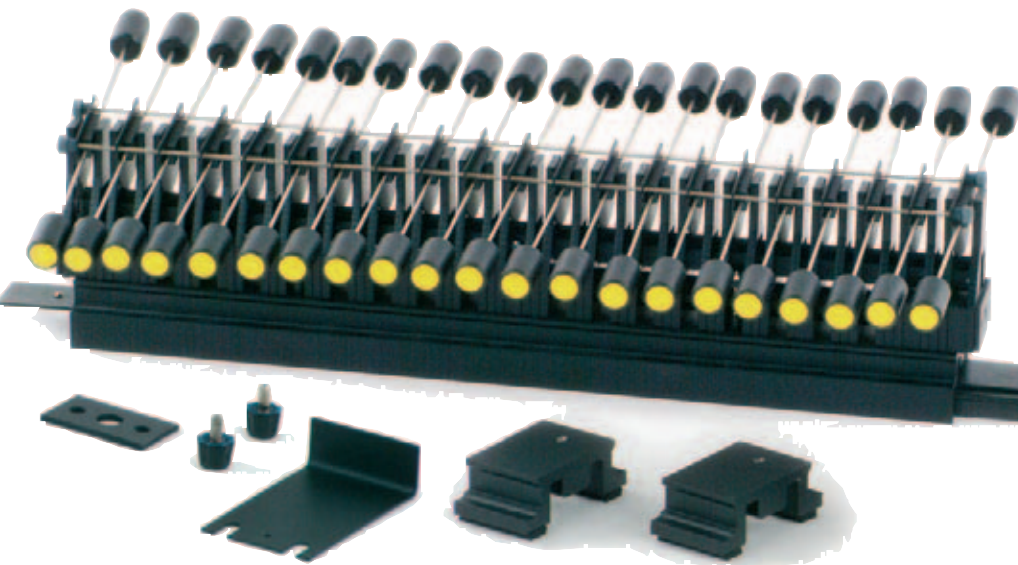
wave demonstrator

The wave demonstrator reveals the principles and properties behind mechanical transverse waves.

The wave demonstrator is assembled using a modular system. Many experiments can be done just by using oscillation module I. Combining modules adds length to the assembly, making it easier to observe individual experiments.

Experiments:

- Propagation of continuous waves
- Reflection at a fixed end
- Reflection at a loose end
- Standing waves
- Superimposition of waves
- Speed of wave propagation
- Damping waves



DW405-1A Oscillation module I, with brake

21 Double pendulums, 21.5 cm long each, mounted on a special aluminium profile. The aluminium pendulum weights are cylindrical and mounted 1.8 cm apart so as to be able to rotate horizontally. Adjacent pendulums are joined using two coil springs,

allowing waves to be propagated.

Built-in brake pads allow the wave motion to be stopped immediately, so that, for example, wavelength may be measured. Supplied with two padded aluminium feet and a clamp for creating a fixed end. Total length: approx. 41.5 cm



DW405-2A Wave demonstrator, drive unit

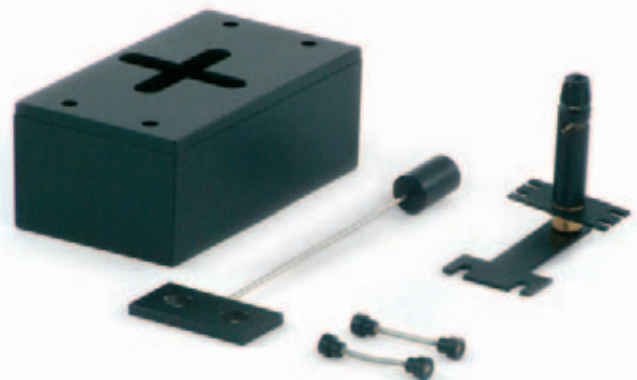
While waves or pulses can be generated manually, an electric motor produces constant motion, generating waves that are easier to observe and compare.

A DC motor, attached to a cam, controls the speed of the exciter plate, which in turn causes the pendulum motion. Increasing or decreasing the amount of DC input voltage likewise affects the pendulum frequency of the exciter plate.

Aluminium case, 14 cm long, mounted on special aluminium profile with two 4-mm safety jacks

Supplied with two coupling springs

Required accessories: power supply able to set variably from 0 to 6 V DC, 0.5 A min. (e.g. P3130-3D)

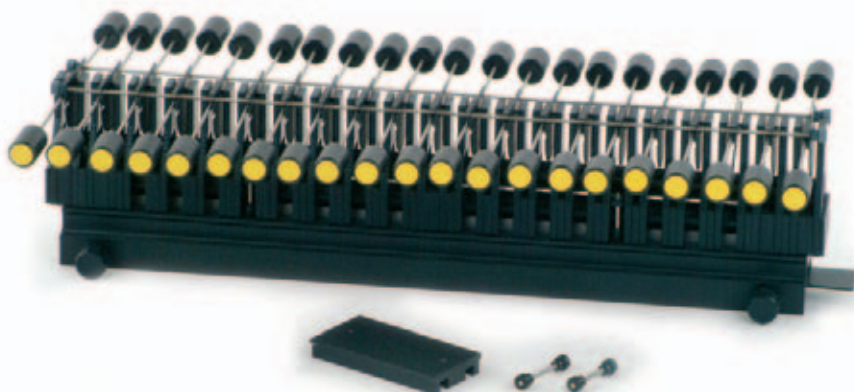


DW405-2D Damping unit

This unit is mounted at the end of the wave demonstrator and serves by means of a damping plate submerged in water to prevent undesired reflection of waves.

The unit consists of one pendulum mounted rotatably, a water tub and two coupling springs.

wave demonstrator



DW405-1E Oscillation module II with brake

Used to extend module I, resulting in a unit with 42 double pendulums, which allows experiments to be observed more easily; technical data similar to modul 1 DW405-1A; supplied with a rail connector and two coupling springs
Total length: approx. 41.5 cm

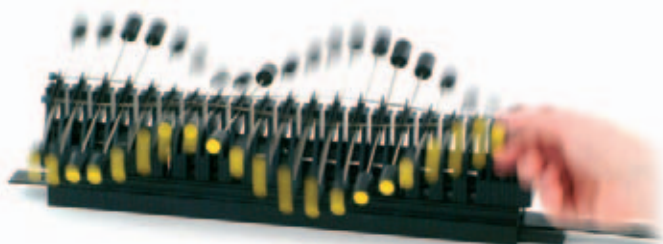
DW405-2E Oscillation module III with brake

Used to extend modules I and/or II. Technical data similar to modules 1 and 2 except that the pendulums are lighter (made of plastic), making it possible to achieve other wave velocities. Supplied with a rail connector and two coupling springs
Total length: approx. 41.5 cm



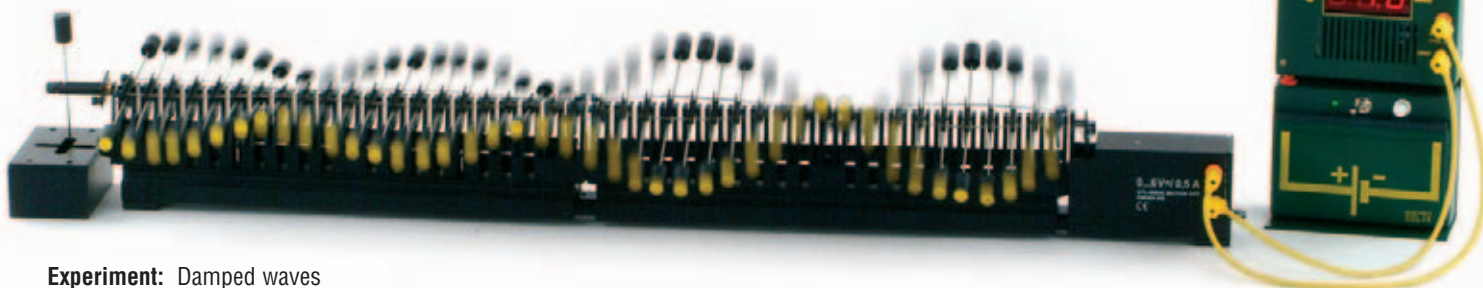
Experiment:

Standing waves - brake activated



Experiment:

Standing waves - powered by hand



Experiment: Damped waves

DW405-0W Wave demonstrator set consisting of:

- DW405-1A Oscillation module I with brake
- DW405-2A Wave demonstrator, drive unit
- DW405-2D Damping unit
- DW405-1E Oscillation module II with brake

Operation and experiment manual

Optional required:

- DW405-2E Oscillation module III with brake



ripple tank

DW400-1W DW400-1W Ripple tank, complete with accessories

The ripple tank serves to demonstrate the behaviour and characteristics of waves. The various types of behaviour exhibited by natural waves can be shown very well in the classroom situation by projecting the wave images onto a screen. Depending on the type of wave source used, one-point, two-point or plane waves may be generated.

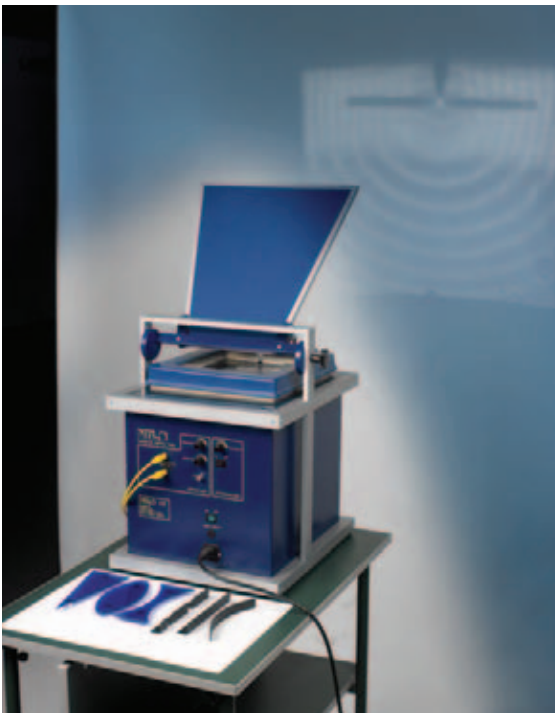
Included:

- Built-in projector with 50-watt xenon lamp and stroboscope
- Built-in function generator for controlling the wave generator and allowing standing waves or slow waves to be generated
- Vibration generator DW451-2S (may also be used as a stand-alone device for generating standing waves) to be used as a wave generator, including vibrating arm and an assortment of adapters
- Adjustable mirror
- Water tank; dimensions: 190x180 mm
- Objects for reflection, diffraction and refraction (see illustration)
- Operating Instructions

Portable unit with handle
Dimensions: approx. 350x400x470 mm



Rear view: operating panel



Set of objects for illustrating refraction, blue glass plates with polished edges, each with two metal feet:

- 1x Object for refraction, prism, 180 mm
- 1x Object for refraction, biconcave, 160 mm
- 1x Object for refraction, biconvex, 160 mm

Set of objects for illustrating reflection, metal angles or plates, painted black:

- 1x Object for reflection, arc, 160 mm, for illustrating reflection from concave and convex mirrors

- 1x Object for reflection, straight edge, 160 mm, for illustrating reflection from a straight edge

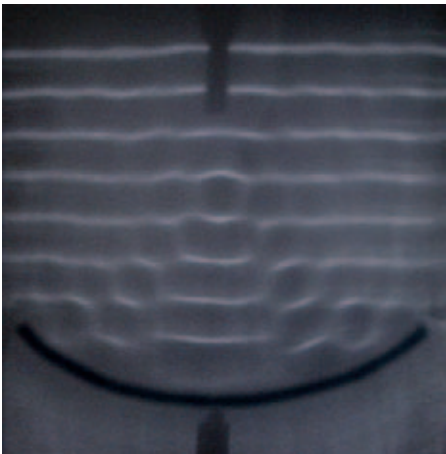
Objects for illustrating diffraction:

- 2x Objects for diffraction, straight edge, 70 mm
- 1x Object for diffraction, straight edge, 30 mm
- 1x Object for diffraction, straight edge, 160 mm

Adapters for wave generator:

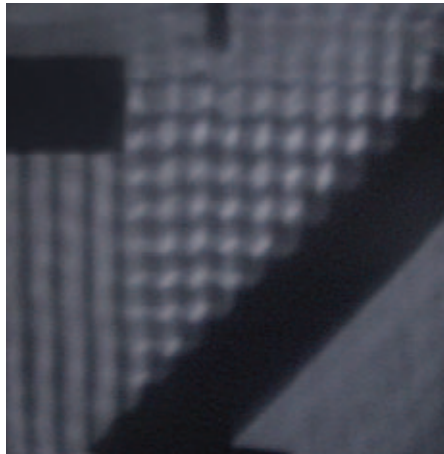
- 1x Dipper for plane waves
- 1x Dipper for generating waves from one or more points
- 1x Balancing weight for wave generator bridge

ripple tank



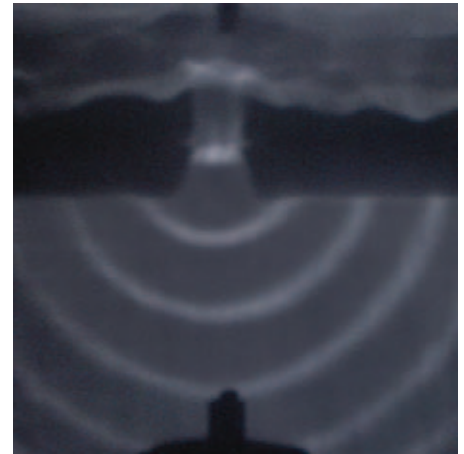
Experiment results:

Reflection of plane waves from a concave mirror



Experiment results:

Reflection of plane waves from a straight edge



Experiment results:

Diffraction through one slit



Experiment results:

Interference of two circular waves

DW400-2W Ripple tank for overhead projection

Acrylic tank, 260x260 mm, with chamfered foam edges, feet adjustable in height; adjustable-speed, battery-powered wave generator

Accessories included:

- 3 Wave sources for concentric waves
- 1 Wave source for plane waves
- 1 Reflection panel, flexible
- 1 Diffraction panel, set of 3
- 1 Acrylic panel for refraction

Experiments:

- Reflection from a planar and a concave mirror
- Refraction of waves
- Elementary waves and refraction
- Interference of circular waves
- Wave sources in phase and out of phase
- Doppler Effekt

