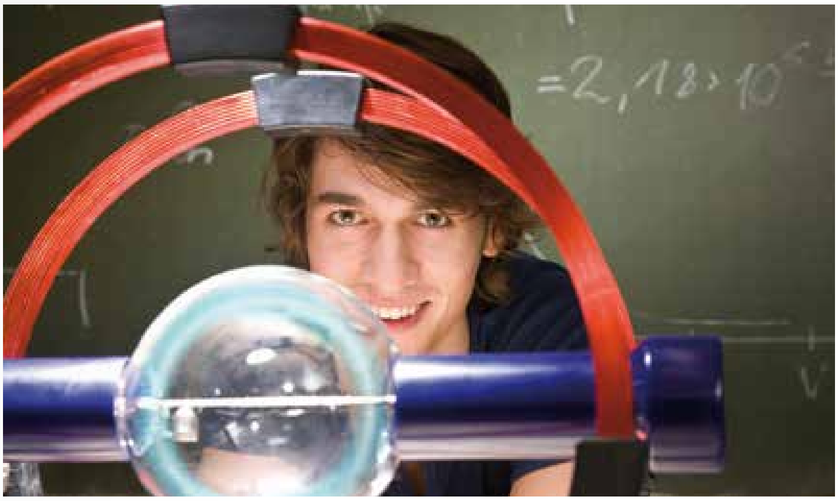
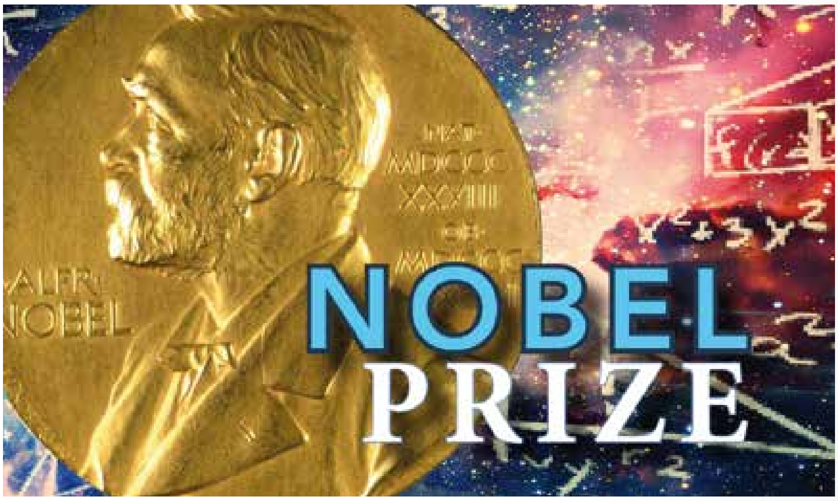
Premium class | PHYWE

PHYWE
excellence in science





Premium experiments

X-ray | Computed Tomography | Stern-Gerlach | Diffusion Cloud Chamber
Franck-Hertz | Planck | Compton effect | Moseley's law | Hall effect | Zeeman effect
Michelson | Rutherford | Millikan | e/m | STM | MRT | AFM | Gyroscope
Ripple tank | Gas chromatography | Glass jacket | Gas laws | Maxwell - Boltzmann
Heat capacity | RLC circuit | Stirling engine | Nerve cell interactions

Physics | Chemistry | Biology | Applied Sciences

Content

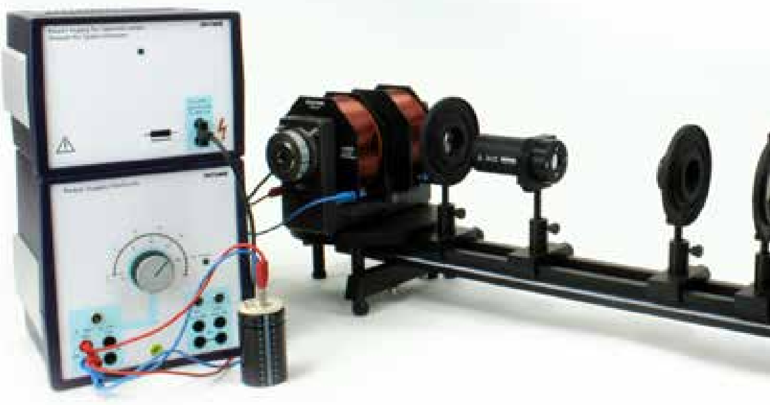
PHYWE supplies
50 Nobel Prize

1900 ...

1901 – Conrad Röntgen
1901 – J.H. van't Hoff
1902 – H. A. Lorentz, Pieter Zeeman
1903 – Henri Becquerel, Pierre Curie, Marie Curie
1907 – A. Michelson
1908 – E. Rutherford

1910 ...

1910 – J.D. van der Waals
1911 – Wilhelm Wien
1914 – Max von Laue
1915 – W.H. Bragg, W.L. Bragg
1917 – C.G. Barkla
1918 – Fritz Haber
1918 – Max Planck



more than experiments

1920 ...

- 1920 – W. Nernst
- 1921 – Albert Einstein
- 1922 – Niels Bohr
- 1923 – R.A. Millikan
- 1924 – Manne Siegbahn
- 1924 – Willem Einthoven
- 1925 – James Franck, Gustav Hertz
- 1927 – A. H. Compton
- 1927 – C.T.R. Wilson
- 1929 – Louis de Broglie

1930 ...

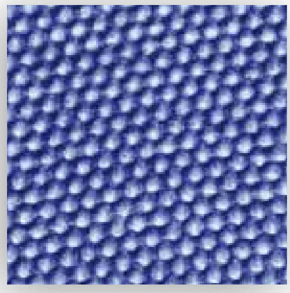
- 1930 – K. Landsteiner
- 1931 – Carl Bosch, Friedrich Bergius
- 1932 – W. Heisenberg
- 1932 – Irving Langmuir
- 1936 – Victor F. Hess, Carl D. Anderson
- 1936 – P. Debye
- 1937 – C.J.Davisson, G.P. Thomson

1940 ...

- 1943 – Otto Stern
- 1945 – Wolfgang Pauli
- 1948 – Arne Tiselius
- 1952 – F. Bloch, E.M. Purcell
- 1954 – Max Born Walther Bothe
- 1964 – C.H. Townes, N.G. Basov, A.M. Prokhorov

1970 until today

- 1971 – Dennis Gabor
- 1979 – A.M. Cormack, Sir G.N. Hounsfield
- 1986 – Heinrich Rohrer, Gerd Binnig
- 2003 – P.C. Lauterbur, Sir Peter Mansfield



XR 4.0 expert unit – made for better education

PHYWE XRE 4.0 X-ray expert set, with tungsten tube

Basic set covering the fundamental principles and areas of applications of X-rays, e.g. fluoroscopy experiments and X-ray photography. It can be extended for specific applications and topics by means of upgrade sets.

With the PHYWE X-ray XR 4.0 the physics of X-rays can be utilized in several different fields of education at universities, colleges and schools. Extension sets of the XR 4.0 product family permit custom applications in physics, chemistry, biology, medicine, material sciences and geo sciences. The XR 4.0 is unique as it provides an abundance of uses with an excellent price/performance ratio. Apart from its modern and innovative design the XR 4.0 excels at professional technology, a safety system, innovative software solutions, intuitive graphical user interface as well as extensive accessories packages – Quality Made in Germany!

NOBEL PRIZE

XRE 4.0 X-ray expert set,
with tungsten tube
Art. no. 09110-88

Scope of supply

YouTube

X-ray expert upgrade sets for every topic

PHYWE XRP 4.0 X-ray solid-state physics upgrade set

Upgrade set as an extension of the XRE 4.0 X-ray expert set. Particularly suitable for fundamental experiments in solid-state physics with X-rays. This set covers the following experiments and topics:

- Fluoroscopy and X-ray imaging
- Fundamental principles of X-ray spectroscopy
- Bragg reflection
- Bremsspectrum / characteristic lines
- Determination of Planck's quantum of action
- X-ray diffractometry

XRP 4.0 X-ray solid-state physics upgrade set
Art. no. 09120-88

Scope of supply

PHYWE XRC 4.0 X-ray characteristics upgrade set

Upgrade set as an extension of the XRE 4.0 X-ray expert set. It is used for the characterisation of the radiation spectra of various different anode materials. It is particularly suitable for studying the fundamental principles of X-ray physics. The set covers the following experiments and topics:

- Fluoroscopy and X-ray imaging / Debye-Scherrer analysis / Fundamental principles of X-ray spectroscopy / Bragg reflection / Bremsspectrum / K and L edges / Characteristic lines of different anode materials / Moseley's law / Determination of the Rydberg constant / Duane-Hunt's law / Determination of Planck's quantum of action / X-ray diffractometry

XRC 4.0 X-ray characteristics upgrade set
Art. no. 09130-88

Scope of supply

PHYWE XRM 4.0 X-ray material analysis upgrade set

Upgrade set as an extension of the XRE 4.0 X-ray expert set. This set is particularly suitable for qualitative and quantitative X-ray fluorescence spectroscopy of metallic samples in physics and material science (non-destructive testing). Other samples, like minerals and alloys, are also provided.

XRM 4.0 X-ray material analysis upgrade set
Art. no. 09160-88

Scope of supply

PHYWE XRS 4.0 X-ray structural analysis upgrade set

Upgrade set as an extension of the XRE 4.0 X-ray expert set. This set is particularly suitable for the structural analysis of different types of samples in materials physics, chemical analysis, and mineralogy. The set covers the following experiments and topics:

- Fluoroscopy and X-ray imaging
- Debye-Scherrer analyses and images
- Laue diffraction patterns
- Fundamental principles of X-ray spectroscopy
- Bragg reflection, Bragg-Brentano geometry
- Bremsspectrum
- Determination of Planck's quantum of action
- X-ray diffractometry, texture analyses, monochromatisation of X-rays
- Analysis of crystals with different crystal structures: cubic, hexagonal, tetragonal, diamond, BCC, and FCC

XRS 4.0 X-ray structural analysis upgrade set
Art. no. 09140-88

Scope of supply

PHYWE XRI 4.0 X-ray imaging upgrade set

Upgrade set as an extension of the XRE 4.0 X-ray expert set. This set is particularly suitable for studying the fundamental principles of X-ray imaging in medical applications (radiography) and material sciences (non-destructive testing).
The set covers the following experiments and topics:

- Fluoroscopy experiments and X-ray photography
- Radiography experiments using various different models

XRI 4.0 X-ray imaging upgrade set
Art. no. 09150-88

Scope of supply

PHYWE XRD 4.0 X-ray dosimetry upgrade set

Upgrade set as an extension of the XRE 4.0 X-ray expert set. This set is particularly suitable for studying the dosimetry in qualitative and quantitative way. Ideal for demonstration of ionization of air by X-rays. Quantitative measurement using measurement equipment that can also be used for other experiments. Experiment covers all topics relevant for teaching radiation exposure. Ideal experiment for all students in medicine, radiology, biology, and students dealing with X-ray radiation

XRD 4.0 X-ray dosimetry upgrade set
Art. no. 09170-88

Scope of supply

Discover the fundamental principles of Computed Tomography (CT)

PHYWE XRCT 4.0 X-ray Computed Tomography upgrade set

Upgrade set as an extension of the XRE 4.0 expert set. Shows the fundamental principles of computed tomography (CT) used in medical and industrial applications. Ease of use and speed make the Computed Tomography set particularly suitable for laboratory experiments and lectures in physics, medicine and material sciences.

The set covers the following experiments and topics:

- X-ray imaging of biological and technical samples
- Non-destructive testing (NDT)
- Digital image processing for the generation of three-dimensional images of an object
- Digital images of Laue patterns
- Complete CT scan and recontraction in less than 10 min

Software included. Computer not provided.

NOBEL PRIZE

XRCT 4.0 X-ray Computed Tomography upgrade set
Art. no. 09180-88

Scope of supply

PHYWE XR 4.0 CT accessories pro

9 experiments related to physical aspects, i.e.:

- Resolution and detail detectability
- X-ray attenuation and contrast
- Optimization of CT scan
- Beam hardening and measuring artefacts
- Hounsfield units and Laue diffraction

XR 4.0 CT accessories pro
Art. no. 09057-44

Scope of supply

Retrace the first proof of quantisation of the angular momentum of an atom

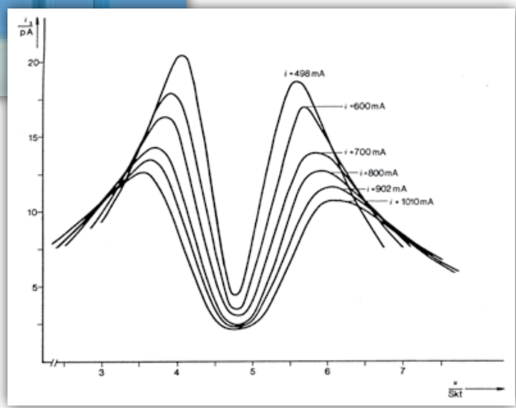
Experiment: PHYWE Stern-Gerlach

A beam of potassium atoms generated in a hot furnace travels along a specific path in a magnetic two-wire field. Because of the magnetic moment of the potassium atoms, the non-homogeneity of the field applies a force at right angles to the direction of their motion. The potassium atoms are thereby deflected from their path. By measuring the density of the beam of particles in a plane of detection lying behind the magnetic field, it is possible to draw conclusions as to the magnitude and direction of the magnetic moment of the potassium atoms.

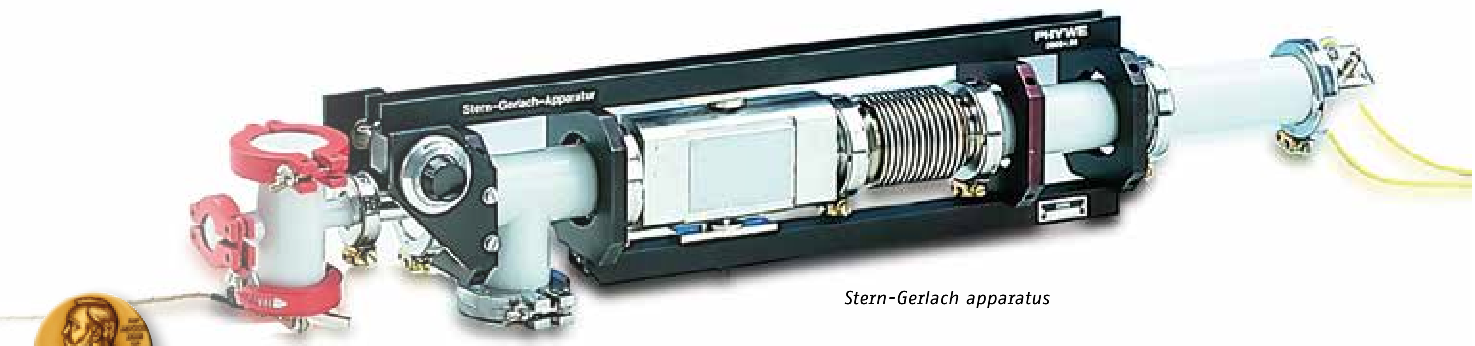
WHAT YOU CAN LEARN ABOUT:

- Magnetic moment
- Bohr magneton
- Directional quantization
- g-factor
- Electron spin
- Atomic beam
- Maxwellian velocity distribution
- Two-wire field

Stern-Gerlach experiment set up.



Ionization current as a function of position (u) of detector with large excitation currents in the magnetic analyser.



Stern-Gerlach apparatus

NOBEL PRIZE

Stern-Gerlach experiment
Art. no. P2511101

Scope of supply

Invisible becomes visible – observe natural background radiation

PHYWE Diffusion Cloud Chambers

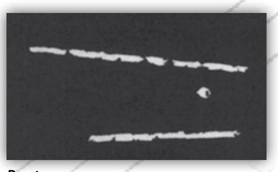
- Ideal for science centers
- Perfect for walk-around displays in science centers
- Only instrument to visualize background radiation (beta) and cosmic radiation (mesons, myons)
- Can discriminate between different types of radiation (alpha, beta, gamma, mesons and myons)
- Also ready to accept alpha, beta and gamma radiation sources for demonstration
- Nobel Prize experiment 1927

PHYWE's Diffusion Cloud Chambers are suitable for observing natural background radiation, i.e. the type of radiation which surrounds us wherever we go. There are two types of natural radiation: cosmic radiation and the natural radioactivity of the earth. The ever-changing patterns of both types of natural radiation can be observed simultaneously thanks to the large observation area. The cloud tracks gradually gravitate downwards and disintegrate before reaching the bottom plate just to be replaced by ever new cloud tracks.

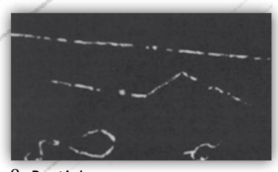
WHAT YOU CAN LEARN ABOUT:

- α,β,γ -particles
- β-deflection
- Ionising particles, mesons
- Cosmic radiation
- Radioactive decay
- Decay series, particle velocity
- Lorentz force

Background radiation:

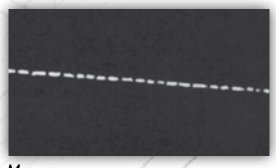


Proton



β-Particle

α-Particle



Meson

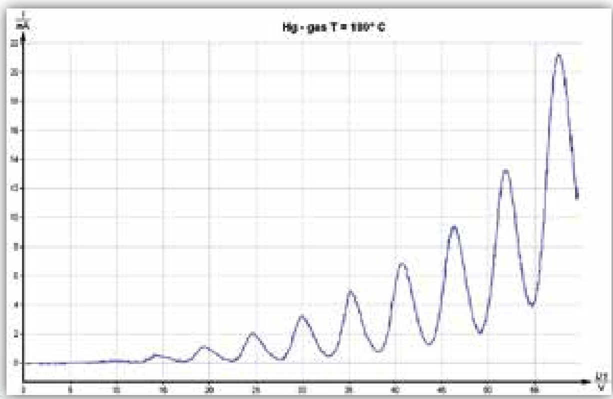
Small Diffusion Cloud Chamber.

Large Diffusion Cloud Chamber, 80 x 80 cm Art. no. 09043-93	Scope of supply	YouTube
Small Diffusion Cloud Chamber, 45 x 45 cm Art. no. 09046-93	Scope of supply	

Impact of an electron upon an atom

Experiment: Franck-Hertz with a Hg-tube

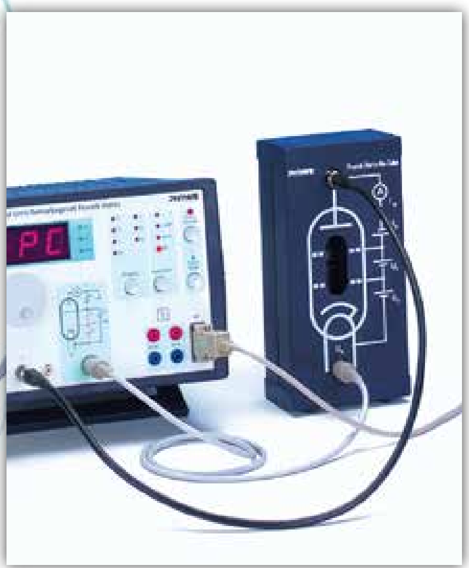
Electrons are accelerated in a tube filled with mercury vapour. The excitation energy of mercury is determined from the distance between the equidistant minima of the electron current in a variable opposing electric field. This experiment is also available with neon tube.



Example of a Franck-Hertz curve for Hg-gas at T = 180 °C.

WHAT YOU CAN LEARN ABOUT:

- Energy quantum
- Electron collision
- Excitation energy



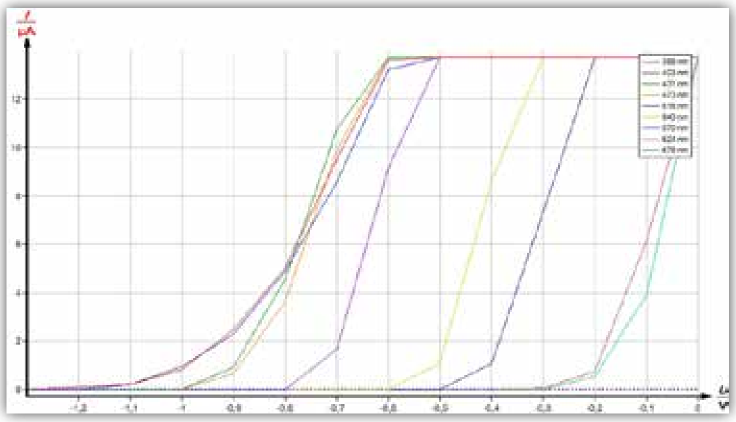
Franck-Hertz experiment with Ne-tube.

Franck-Hertz experiment with a Hg-tube Art. no. P2510311	Scope of supply	YouTube
Franck-Hertz experiment with a Ne-tube Art. no. P2510315	Scope of supply	

Quantum of action

Experiment: Planck's "quantum of action" and external photoelectric effect

A photocell is illuminated with monochromatic light of different wavelengths from a filament lamp with interference filters. The maximum energy of the ejected electrons in the photocell depends only on the frequency of the incident light, and is independent of its intensity. The stopping voltage U_0 at different light frequencies is determined by the *U/I* characteristics of the photocell and plotted over the corresponding light frequency *f*. Planck's quantum of action or Planck's constant (*h*) is determined from this graph.



Photoelectric current intensity I as a function of the bias voltage at different frequencies of the irradiated light.

WHAT YOU CAN LEARN ABOUT:

- External photoelectric effect
- Work function
- Absorption
- Photon energy

Planck's "quantum of action"
Art. no. P2510502

Scope of supply

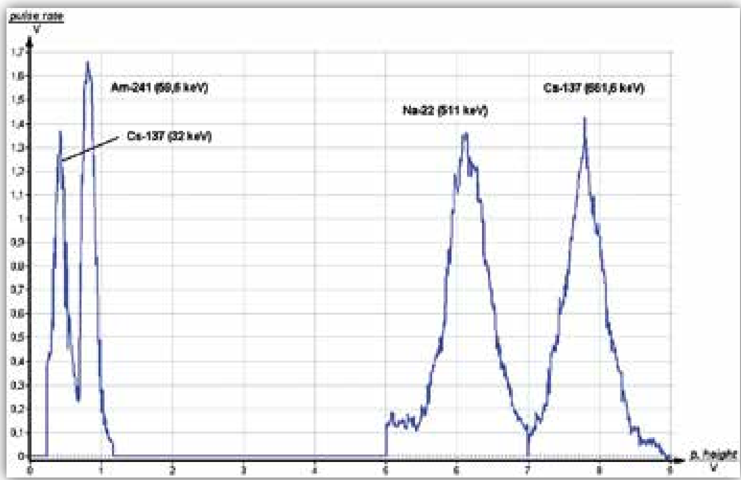
Understand A. H. Compton's Nobel Prize experiment

Experiment: Compton effect

The energy of scattered gamma-radiation is measured as a function of the angle of scatter. The Compton wavelength is determined from the measured values. This Nobel Prize experiment (1927) can be performed by students within a few hours.

WHAT YOU CAN LEARN ABOUT:

- Corpuscle
- Scattering
- Compton wavelength
- γ quanta
- De Broglie wavelength
- Klein-Nishina formula



Energy of known peaks as a function of the pulse height.

Fundamental experiment in nuclear physics

Compton effect with the multichannel analyser
Art. no. P2524415

Scope of supply

Learn about Moseley's contribution to understanding the atom

Experiment: X-ray fluorescence and Moseley's law

The irradiation of silver, tin, iodine and barium with soft γ radiations gives rise to K_α radiation characteristics of these elements. The X-ray spectra are recorded with a gamma spectrometer consisting of a scintillation counter and a multichannel analyser. After calibration of the spectrometer, the Rydberg constant is determined from the energies of the X-ray lines, using Moseley's law.

Energy of known peaks as a function of the pulse height.

WHAT YOU CAN LEARN ABOUT:

- Binding energy
- Photoelectric effect
- Shell structure of electron shells
- Characteristic X-ray radiation
- γ spectrometry
- X-ray spectral analysis

X-ray fluorescence and Moseley's law (MCA)
Art. no. P2524715

Scope of supply

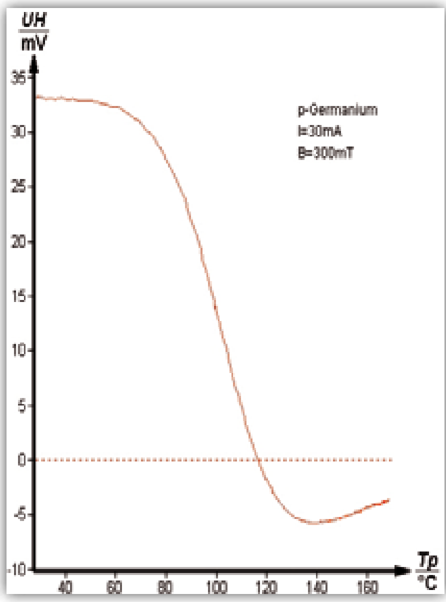
Solid-state and semiconductor physics

Experiment: Hall effect in n- and p-germanium

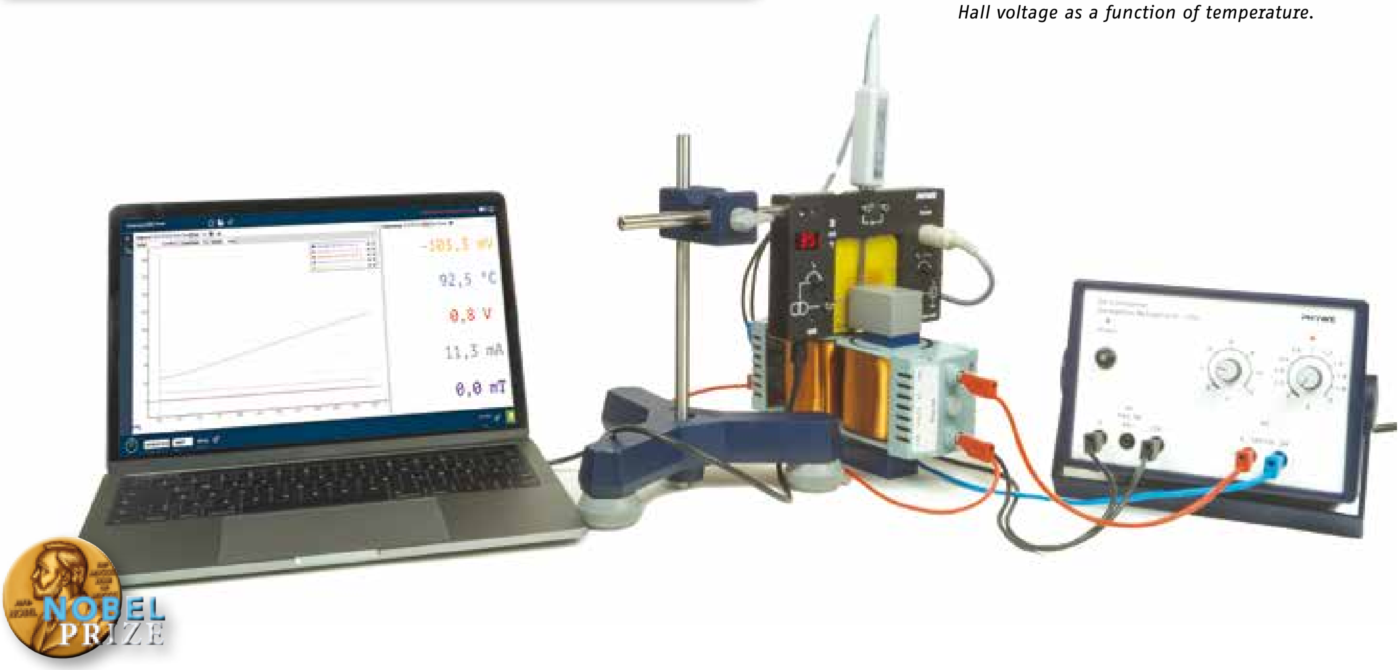
The resistivity and Hall voltage of a rectangular germanium sample are measured as a function of temperature and magnetic field. Band spacing, specific conductivity, type of charge carrier and mobility of the charge carriers are determined.

WHAT YOU CAN LEARN ABOUT:

- Semiconductors
- Band theory
- Forbidden zone
- Intrinsic conductivity
- Extrinsic conductivity
- Valence band
- Conduction band
- Lorentz force
- Magnetic resistance
- Mobility conductivity
- Band spacing
- Hall coefficient



Hall voltage as a function of temperature.



Hall effect in n- and p-germanium (PC) Art. no. P2530116	Scope of supply	
Hall effect in n- and p-germanium (with the teslameter) Art. no. P2530102	Scope of supply	

Spectroscopic and metrological investigations

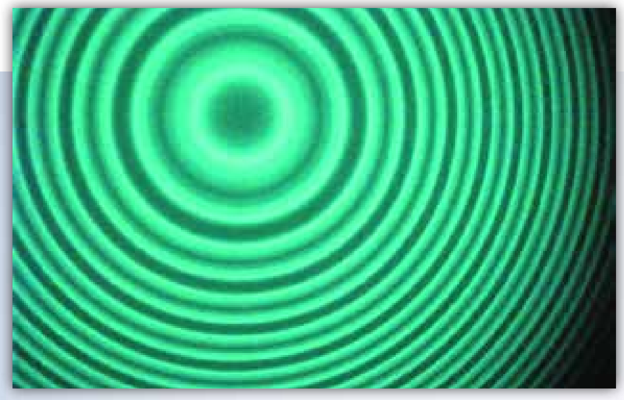
Experiment: Zeeman effect

The “Zeeman effect” is the splitting up of the spectral lines of atoms within a magnetic field. The simplest is the splitting up of one spectral line into three components called the “normal Zeeman effect”. In this experiment the normal Zeeman effect as well as the anomalous Zeeman effect are studied using a cadmium spectral lamp as a specimen. The cadmium lamp is submitted to different magnetic flux densities and the splitting up of the cadmium lines is investigated using a Fabry-Perot interferometer. The evaluation of the results leads to a precise value for Bohr’s magneton.

This experiment is also available with an electromagnet.

WHAT YOU CAN LEARN ABOUT:

- Bohr’s atomic model and Bohr’s magneton
- Quantisation of energy levels
- Electron spin
- Interference of electro-magnetic waves
- Fabry-Perot interferometer



Interference rings with the anomalous Zeeman effect.

Zeeman effect with a variable magnetic system Art. no. P2511007	Scope of supply	YouTube
Zeeman effect with an electromagnet Art. no. P2511005	Scope of supply	

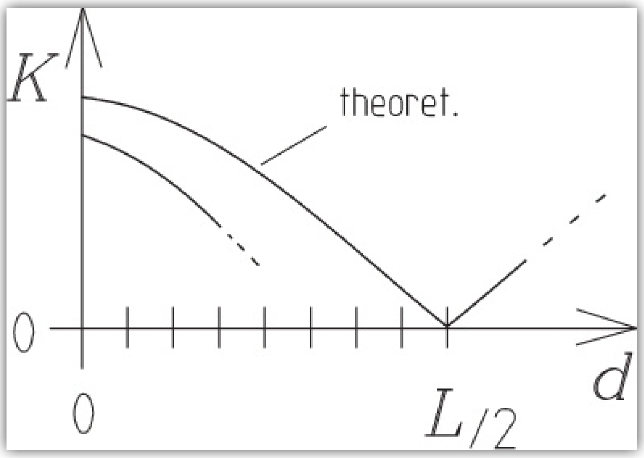
Spectroscopic and metrological investigations

PHYWE Michelson interferometer

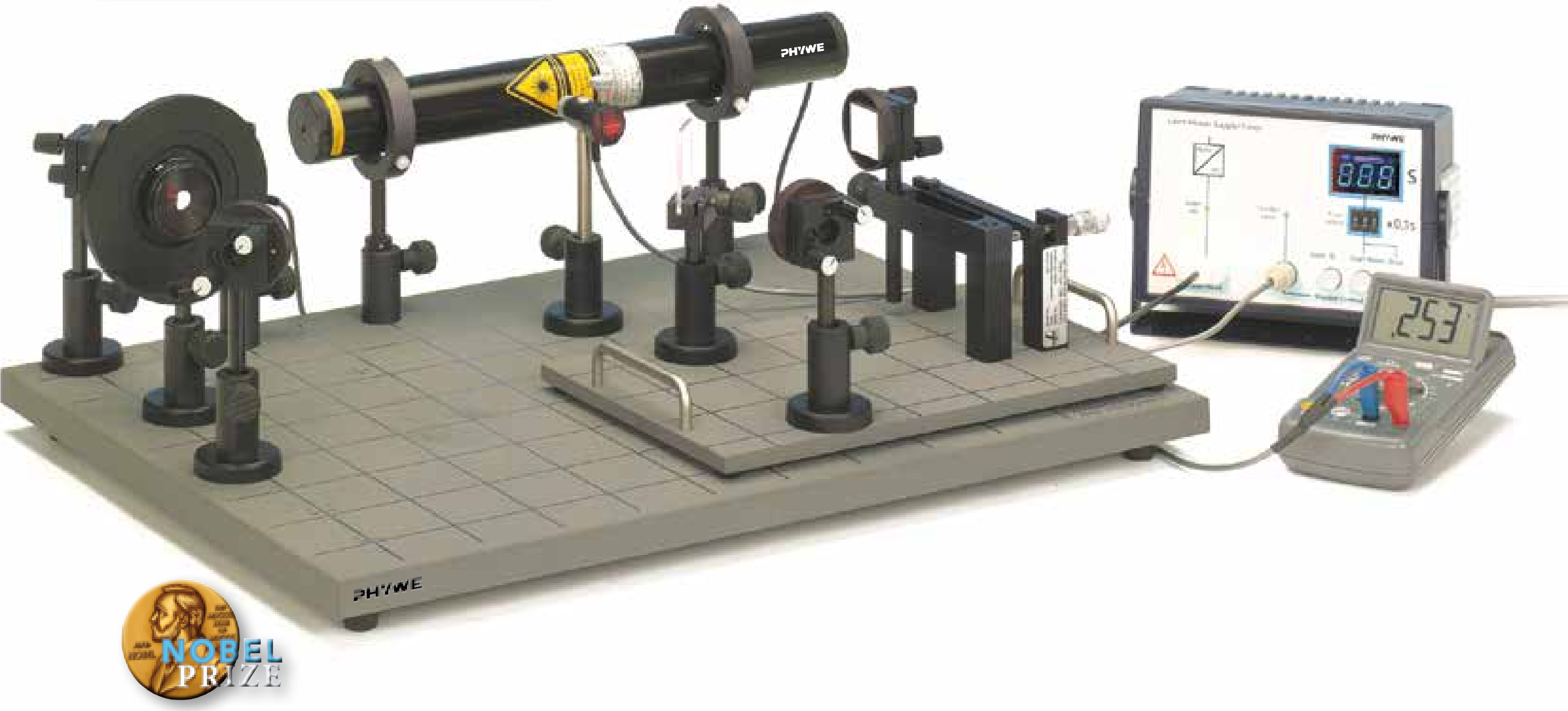
In the Michelson arrangement interference will occur by the use of 2 mirrors. The wavelength is determined by displacing one mirror using a micrometer screw.

WHAT YOU CAN LEARN ABOUT:

- Interference
- Wavelength
- Diffraction index
- Speed of light
- Phase
- Virtual light source



Experimentally determined contrast function in comparison to the theoretical contrast function K of a 2-mode laser.



Michelson interferometer - high resolution
Art. no. P2220900

Scope of supply

YouTube

Investigations into the disintegration of the elements

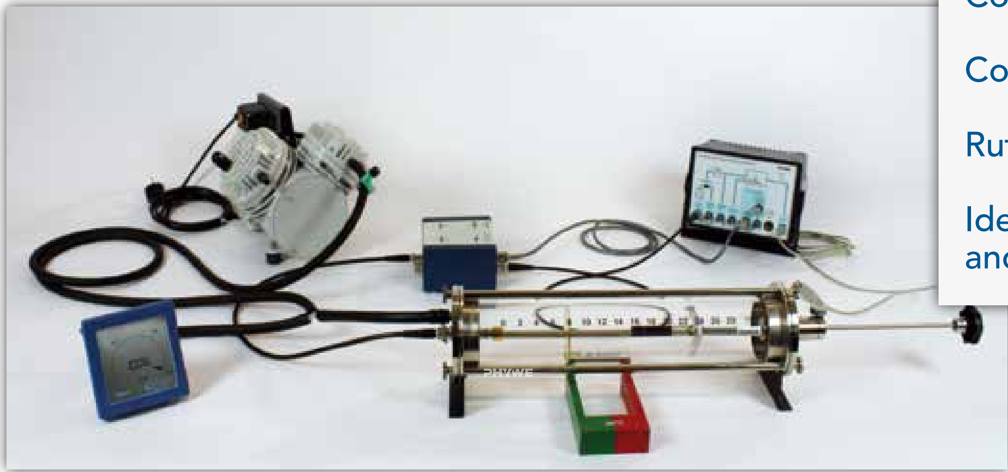
Experiment: Rutherford experiment

The Rutherford gold foil experiment is part of a landmark series of experiments by which scientists discovered that every atom contains a nucleus where its positive charge and most of its mass are concentrated.

In order to obtain maximum possible counting rates, the Chadwick geometry is used where the scattering angle is varied over a wide range by moving foil and source.

WHAT YOU CAN LEARN ABOUT:

- Scattering
- Angle of scattering
- Impact parameter
- Central force
- Coulomb field
- Coulomb forces
- Rutherford atomic model
- Identity of atomic number and charge on the nucleus



Rutherford experiment
Art. no. P2522115

Scope of supply

Experiment: Elementary charge and Millikan experiment

Charged oil droplets subjected to an electric field and to gravity between the plates of a capacitor are accelerated by application of a voltage. The elementary charge is determined from the velocities in the direction of gravity and in the opposite direction.

WHAT YOU CAN LEARN ABOUT:

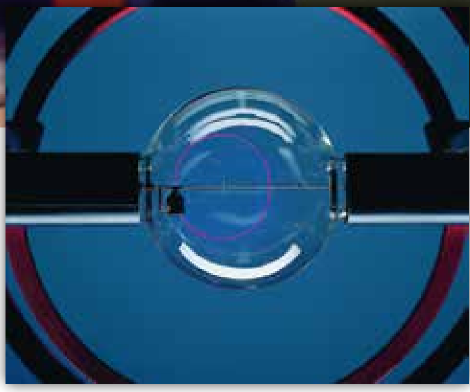
- Electric field
- Viscosity
- Stokes' Law
- Droplet method
- Electron charge

Elementary charge and Millikan experiment
Art. no. P2510100

Scope of supply

Understanding electrons

Experiment: Specific charge of the electron - e/m



Electrons are accelerated in an electric field and enter a magnetic field at right angles to the direction of motion. The specific charge of the electron is determined from the accelerating voltage, the magnetic field strength and the radius of the electron orbit.

WHAT YOU CAN LEARN ABOUT:

- Cathode rays
- Lorentz force
- Electron in crossed fields
- Electron mass
- Electron charge

Specific charge of the electron - e/m
Art. no. P2510200

Scope of supply

YouTube

Nano Physics

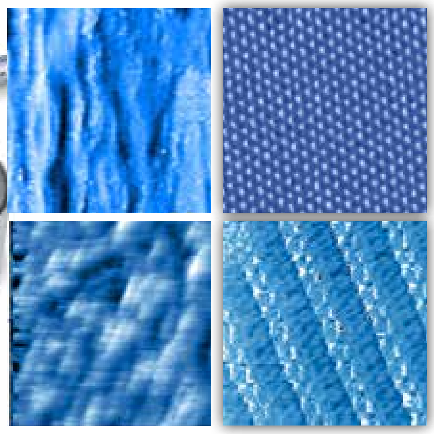
Experiment: Atomic resolution of the graphite surface by PHYWE STM (Scanning Tunneling Microscope)

Approaching a very sharp metal tip to an electrically conductive sample by applying an electrical field leads to a current between tip and sample without any mechanical contact. This so-called tunneling current is used to investigate the electronic topography on the sub-nanometer scale of a fresh prepared graphite (HOPG) surface. By scanning the tip line-by-line across the surface graphite atoms and the hexagonal structure are imaged.

Scanning Tunneling Microscope

WHAT YOU CAN LEARN ABOUT:

- Tunneling effect
- Hexagonal structures
- Scanning Tunneling Microscopy (STM)
- Imaging on the sub-nanometer scale
- Piezo-electric devices
- Local density of states (LDOS)
- Constant height mode
- Constant current mode



Microstructures

Atomic resolution of the graphite surface by STM (Scanning Tunneling Microscope)
Art. no. P2532000

Scope of supply

Nuclear magnetic resonance

PHYWE Compact MRT (Magnetic Resonance Tomograph)

Software included. Computer not provided.

WHAT YOU CAN LEARN ABOUT:

Nuclear spins; atomic nuclei with a magnetic moment

Precession of nuclear spins; magnetisation

Resonance condition, MR frequency

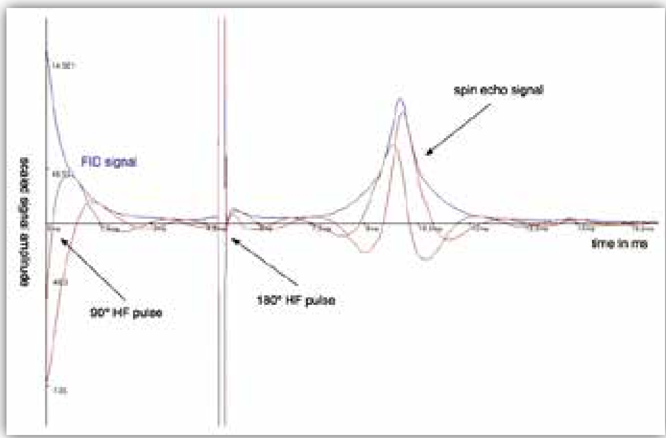
MR flip angle

FID signal (free induction decay)

Spin echo

Fully functional Magnetic Resonance Tomograph (MRT) for teaching purposes, covering all aspects from the basic principles of Nuclear Magnetic Resonance (NMR) to the high-resolution 2D and 3D MR imaging (MRI).

The system gives you the unique opportunity of offering training at a real MRT machine in the student lab. In order to provide for realistic and practice-oriented nuclear magnetic resonance (NMR) training for all fields of science and medicine. The training software makes it easy for the users to experience all aspects of magnetic resonance tomography. The following imaging procedures can be performed: spin-echo 2D, flash 2D, localized spin echo 2D, spin echo 3D.



Spin echo signal of an oil sample occuring 10 ms (echo time) after a 90° HF pulse (FID signal is shown).

NOBEL PRIZE

Compact MRT (Magnetic Resonance Tomography)
Art. no. 09500-99

Scope of supply

YouTube

Visualize and image structures

PHYWE Compact AFM (Atomic Force Microscope)

Compact and easy to use atomic force microscope to visualize and image structures on the micrometer scale. Developed for educational purposes in lab courses and pre-research labs in physics, chemistry, life sciences and material sciences.

The compact atomic force microscope by PHYWE is characterised by its particularly compact design with an integrated control unit, XY stage, vibration isolation system, and shielding against sources of interference such as sound and airflow. Thanks to its comfortable and easy operation and the supplied software "measureNANO" for measurements, evaluations, and visualisation, the device is suitable for numerous areas of application, e.g. as a demonstration unit or as a unit for practical laboratory courses at schools, universities, and science centres, or as a research-supporting device at universities. Laser and detector adjustments are not necessary. Simply unpack the device, connect it, install the cantilever, and then start your measurements.

WHAT YOU CAN LEARN ABOUT:

- Static mode, dynamic mode
- Imaging on the micrometer scale
- Lennard-Jones potential
- Magnetic force microscopy
- Phase contrast imaging

Microstructures

Compact AFM (Atomic Force Microscope)
Art. no. 09700-99

Scope of supply

YouTube

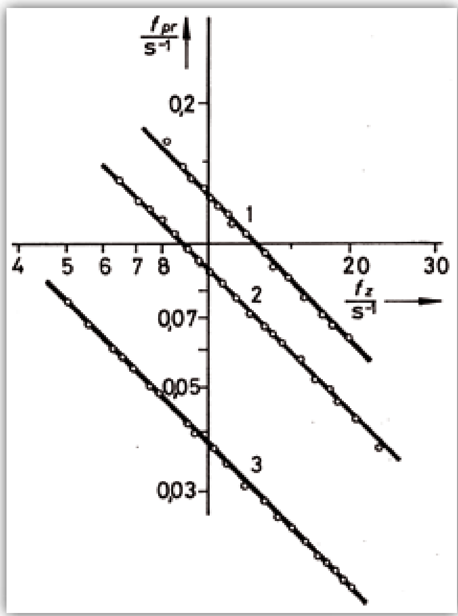
Take high-precision measurements with the Magnus gyroscope

Experiment: Laws of gyroscopes / cardanic gyroscope

Gyroscope, Magnus type, universal gyroscope for demonstration and quantitative evaluation of gyroscope laws and their applications. He is particularly useful in aviation degree courses.
Versatile accessories to demonstrate the following topics:

- Symmetrical and asymmetrical elongated and flattened gyroscope
- Force-free, driven and captive gyroscope, navigational gyroscope compass

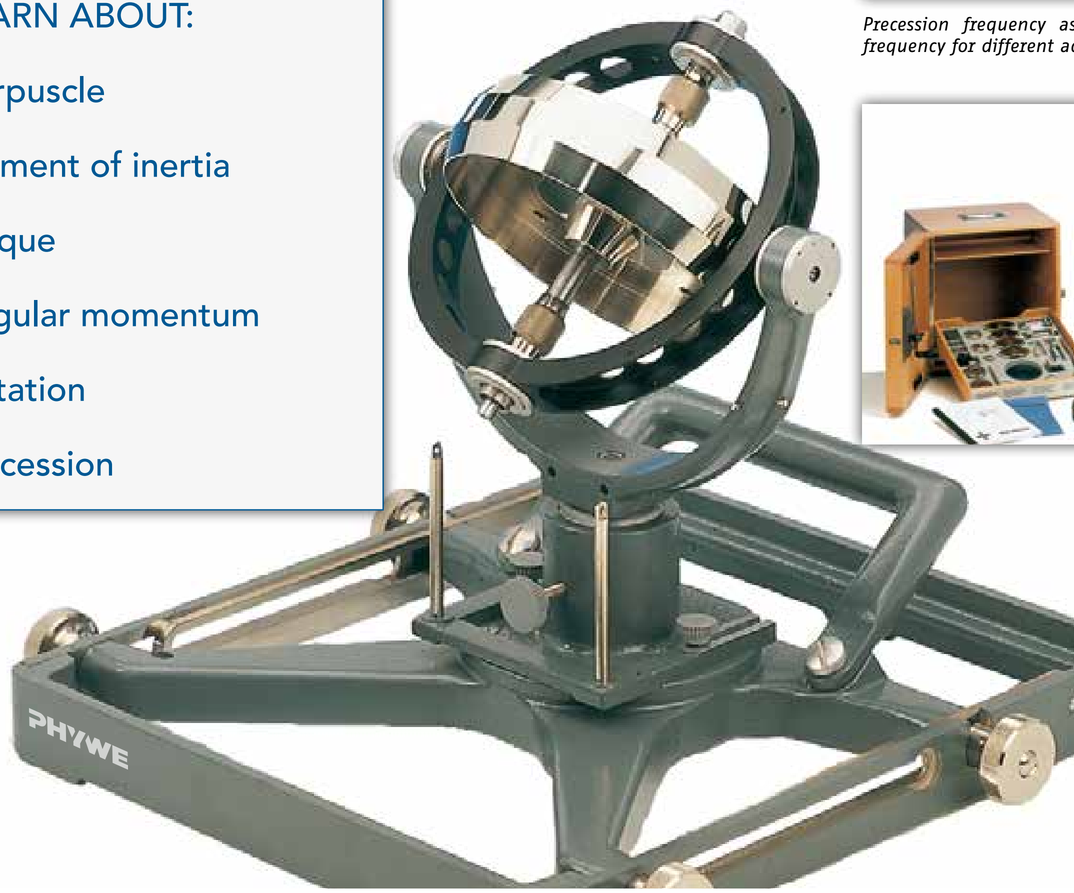
If the axis of rotation of the force-free gyroscope is displaced slightly, a nutation is produced. The relationship between precession frequency or nutation frequency and gyro-frequency is examined for different moments of inertia. Additional weights are applied to a gyroscope mounted on gimbals, thereby causing a precession.



Precession frequency as a function of the gyro-frequency for different additional masses.

WHAT YOU CAN LEARN ABOUT:

- Corpuscle
- Moment of inertia
- Torque
- Angular momentum
- Nutation
- Precession



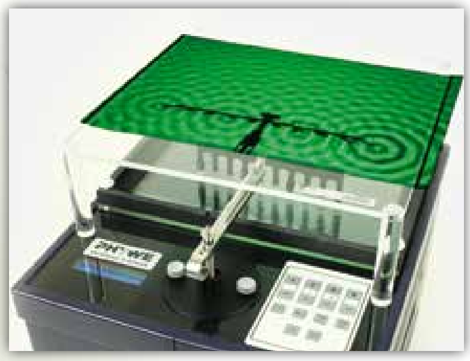
Scope of delivery with large variety of accessories.

Laws of gyroscopes / cardanic gyroscope
Art. no. P2132000

Scope of supply

Demonstration of wave mechanics

PHYWE Ripple tank



Easy to operate: just switch on the instrument, add water and start!

The PHYWE Ripple tank is an easy to use, virtually soundless and compact device which allows demonstrative and quantitative access to wave mechanics principles. The frequency range of 5 to 60 Hz with variable amplitudes covers all necessary frequencies to perform demonstration and lab course experiments both at schools and universities. With the PHYWE Ripple tank you can realize qualitative and quantitative results within a very short time.

With the optional available external vibration generator (Art. no. 11260-10) it is possible to demonstrate interference phenomena or the Doppler effect.

WHAT YOU CAN LEARN ABOUT:

Reflection

Dispersion

Refraction

Interference

Diffraction

Doppler effect

PHYWE Ripple tank with LED light source, complete set
Art. no. 11260-88

Scope of supply

YouTube

Chromatographic separation processes

Experiment: PHYWE Gas chromatography with Cobra4

Software included. Computer not provided.

WHAT YOU CAN LEARN ABOUT:

Chromatography

Chromatogram

Multiplicative distribution

Nernst's law of distribution (number of theoretical trays)

Thermal conductivity detector

Chromatographic procedures allow a separation of substance mixtures with the aid of a stationary separation phase and a mobile phase. In gas chromatography the mobile phase is a gas. The mobile phase, to which the mixture to be separated is added, transports the substance mixture through the separation column at a constant flow rate. Interactions occur between the mobile phase and the stationary phase.

The establishment of equilibria between the stationary phase and the different substances (distribution equilibria, adsorption-desorption equilibria) results in different migration rates of the individual components. At the end of the column there is a detector in the form of a thermal conductivity cell, which can detect the different substances on the basis of their differing thermal conductivities.

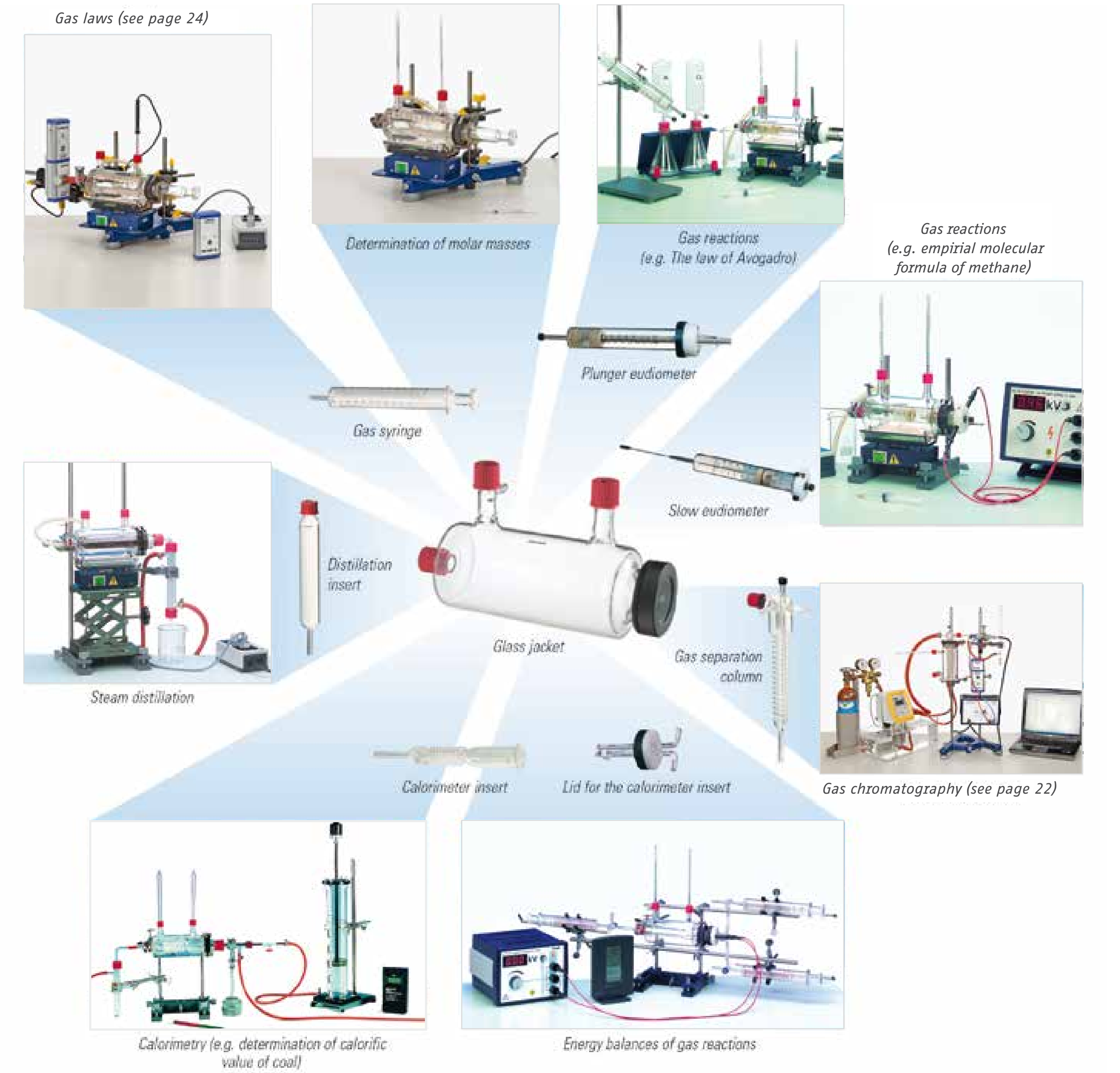
Chromatographic separation processes:
Gas chromatography with Cobra4
Art. no. P3031760

Scope of supply

Demonstrative and transparent – versatile modular system, easy to assemble

The PHYWE Glass jacket apparatus system

The glass jacket apparatus system consists of the glass jacket and special inserts and accessories. It was primarily developed for experimenting with gases and can be used for teaching in chemistry, physics and biology classes. It is used to develop the gas laws, to determine molar masses, to measure combustion enthalpies, and many other parameters.



Set gas laws with glass jacket
Art. no. 43003-88

Scope of supply

Demonstrate the temperature and the kinetic theory of gases

Experiment: Equation of state for ideal gases with Cobra4 (gas laws: Gay-Lussac, Amontons, Boyle)

The state of a gas is determined by temperature, pressure and amount of substance. For the limiting case of ideal gases, these state variables are linked via the general equation of state. For a change of state under isochoric conditions this equation becomes Amontons' law. In this experi-ment it is investigated whether Amontons' law is valid for a constant amount of gas (air). With this compact experiment setup all three gas laws can be performed.

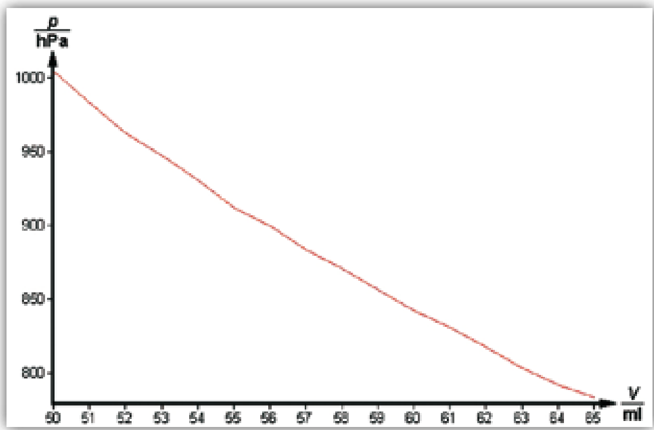
WHAT YOU CAN LEARN ABOUT:

Thermal tension coefficient

General equation of state for ideal gases

Universal gas constant

Amontons' law



Correlation between volume and pressure under isothermic conditions.

Equation of state for ideal gases with Cobra4 (gas laws: Gay-Lussac, Amontons, Boyle)
Art. no. P2320162

Scope of supply

Understand Thermodynamics

Experiment: Maxwell - Boltzmann velocity distribution

By means of the model apparatus for kinetic theory of gases the motion of gas molecules is simulated and the velocities determined by registration of the throw distance of the glass balls. This velocity distribution is compared to the theoretical Maxwell-Boltzmann equation.

WHAT YOU CAN LEARN ABOUT:

- Kinetic theory of gases
- Temperature
- Gas-molecules
- Model kinetic energy
- Average velocity
- Velocity distribution

Maxwell - Boltzmann velocity distribution
Art. no. P2320300

Scope of supply

Experiment: Heat capacity of metals with Cobra4

Heated specimens are placed in a calorimeter filled with water at low temperature. The heat capacity of the specimen is determined from the rise in the temperature of the water.

Software included. Computer not provided.

WHAT YOU CAN LEARN ABOUT:

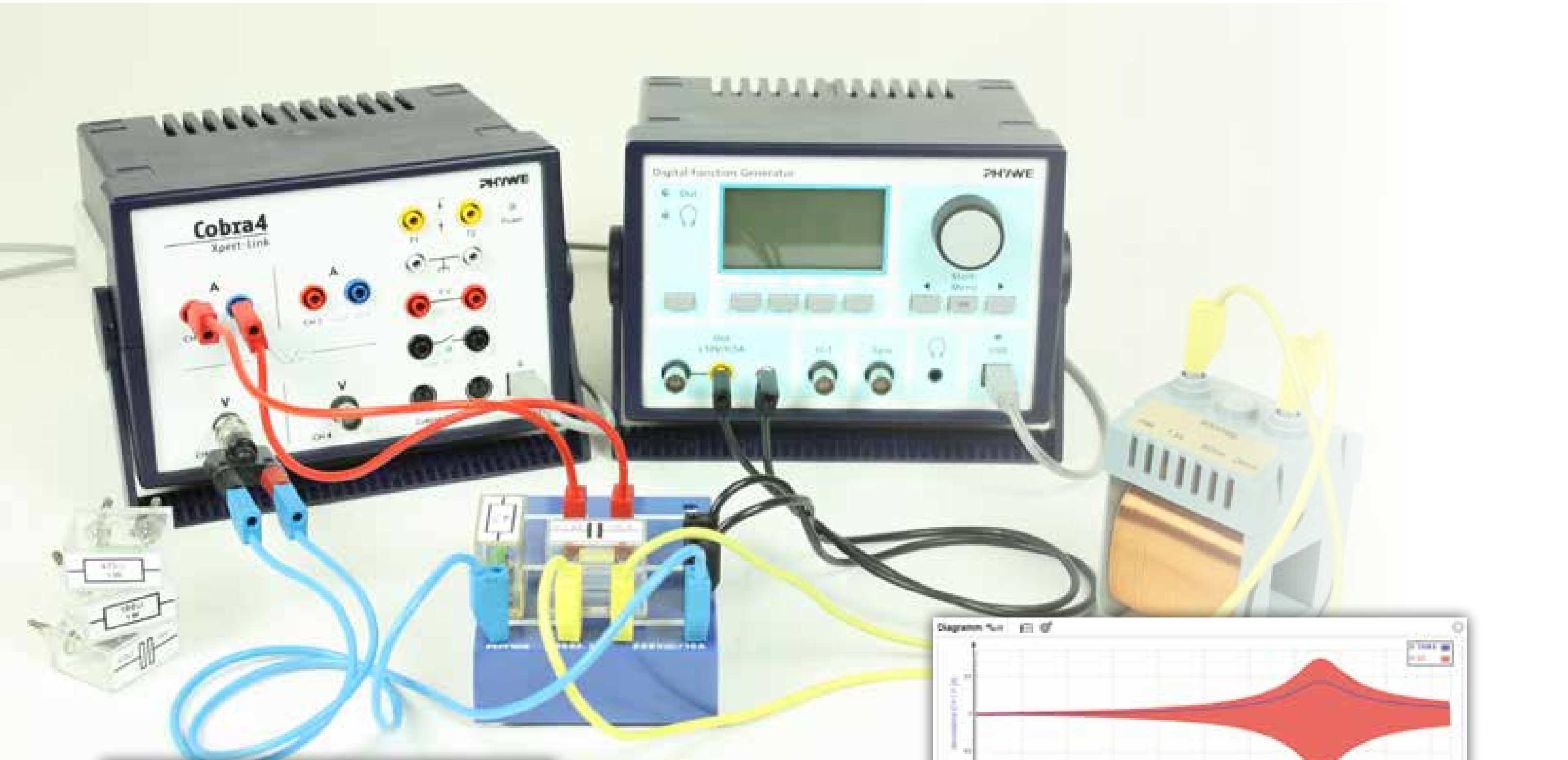
- Mixture temperature
- Boiling point
- Dulong Petit’s law
- Lattice vibration
- Internal energy
- Debye temperature

Heat capacity of metals with Cobra4
Art. no. P2330160

Scope of supply

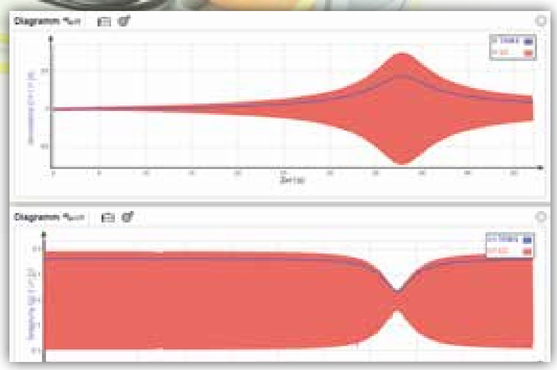
Study alternating currents

Experiment: RLC circuit with Cobra4 Xpert-Link



WHAT YOU CAN LEARN ABOUT:

- Periodic, damped and forced oscillations
- Kirchhoff's laws
- Series-tuned and parallel-tuned circuit
- Resistance / capacitance
- Inductance / reactance
- Impedance / phase shift
- Q-factor / bandwidth



Voltage and current measurement in AC+DC mode and TrueRMS mode.

In an RLC circuit, energy is exchanged periodically between a capacitor and a coil. When the electric field of the capacitor decreases by discharge over the coil, a magnetic field is established in the coil. As soon as the capacitor is completely depleted, the current flow through the coil vanishes. The magnetic field decreases again and the capacitor is charged, again.
The advanced features of the interface Cobra4 Xpert-Link are beneficial to performing the experiment: voltage and current are measured directly and simultaneously, the root mean square value and the impedance are displayed in real-time. In addition, the oscilloscope functions are integrated. The experiment can be varied smoothly simply by switching the components.

RLC circuit with Cobra4 Xpert-Link
Art. no. P2440664

Scope of supply

Visualization of a Carnot-process

Experiment: Stirling engine with an oscilloscope

WHAT YOU CAN LEARN ABOUT:

- First and second law of thermodynamics
- Reversible cycles
- Isochoric and isothermal changes
- Gas laws
- Efficiency
- Stirling engine
- Conversion of heat
- Thermal pump

The Stirling engine is submitted to a load by means of an adjustable torquemeter, or by a coupled generator. Rotation frequency and temperature changes of the Stirling engine are observed.

Effective mechanical energy and power, as well as effective electrical power, are assessed as a function of rotation frequency. The amount of energy converted to work per cycle can be determined with the assistance of the pV diagram. The efficiency of the Stirling engine can be estimated.

Stirling engine with an oscilloscope
Art. no. P2360401

Scope of supply

Learn about nerve cells and how they work together

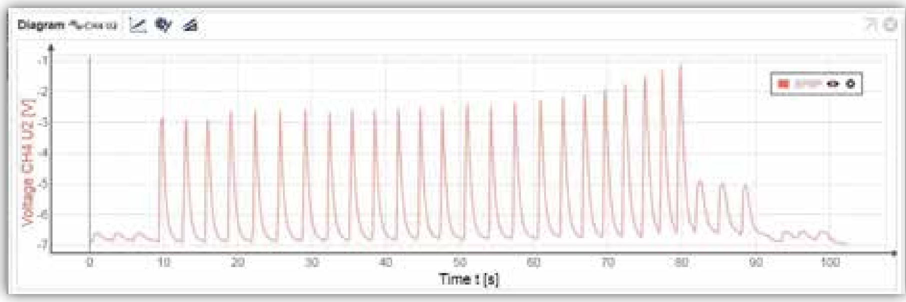
Experiment: Nerve cell interactions with Cobra4 Xpert-Link

WHAT YOU CAN LEARN ABOUT:

- Action potential
- Different types of synapses
- Synaptic learning and forgetting
- Conditioned reflex
- Contrast improvement
- Motoneuron
- And many other phenomena…

Interactive learning and teaching system with two neurosimulators for numerous experiments covering nerve cells and nerve cell interactions.

The system can be scaled up with one or two additional neurosimulators to perform experiments about neural networks. It is ideal for projects at schools and for lab courses in the degree course neurobiology.



Measurement of conditioned reflex.

Nerve cell interactions with Cobra4 Xpert-Link
Art. no. P4010864

Scope of supply

The PHYWE Service...

Our solutions for more customer satisfaction

PHYWE Campus

- Technical trainings for customers and International Sales Partners (ISP)
- International training weeks

Interactive

- Technical Hotline (Weekdays, 9 am - 12 am)
- Email support
- Online product trainings for customers
- Online webinars
- YouTube product videos (pre-sales / after-sales)

Service | PHYWE

Pre-Sales

- Consulting
- Curricula-based quotations
- Online orders
- Project planning, tender support
- Product introduction seminars
- Newsletters

After-Sales

- Installation and implementation
- On-site trainings by PHYWE engineers
- Turn-key project management
- Warranty, repairs and spare parts
- Follow-up trainings

More information...

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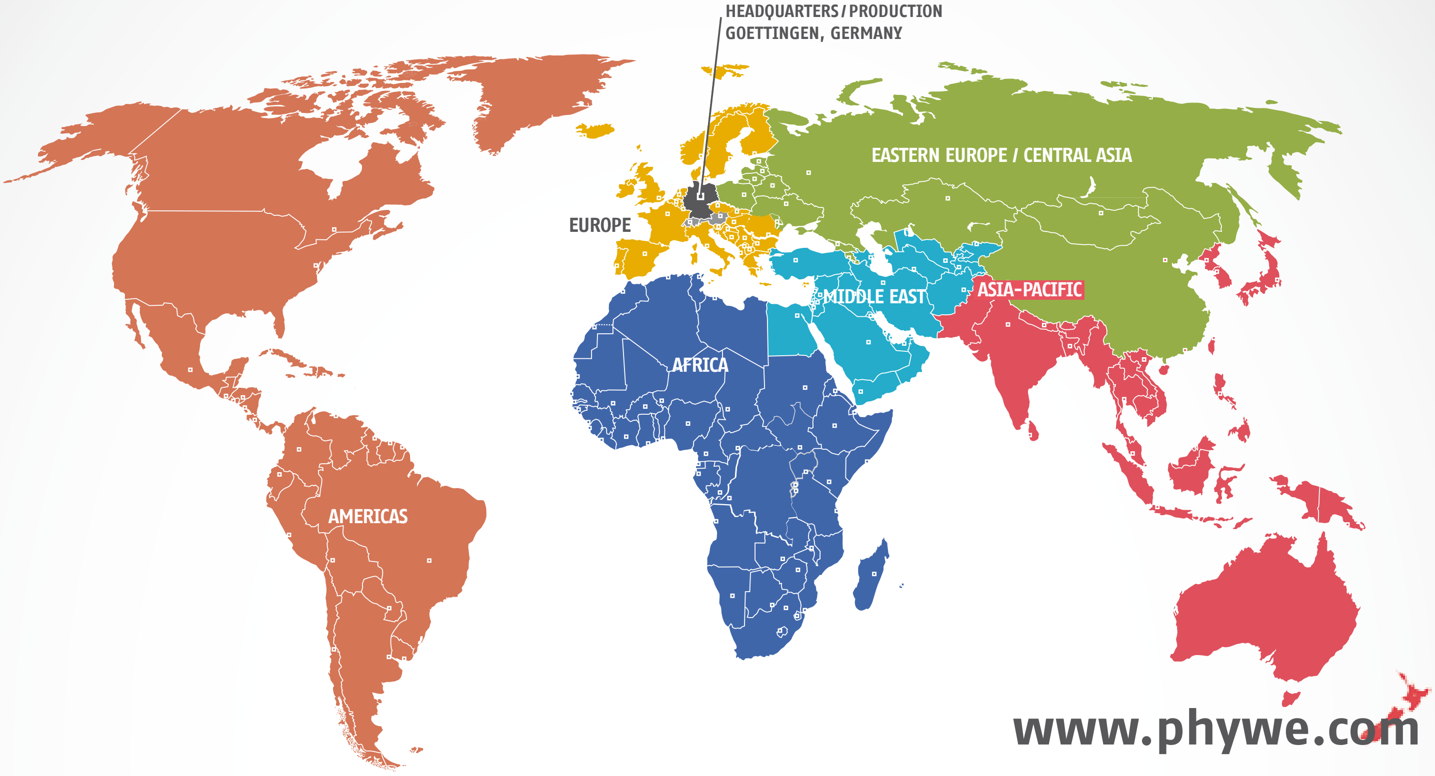

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