TESS expert PHYWE

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Eng

Geo

JAN. 2013

Engineering/Geo Science

University Experiments

Materials Science and Engineering: Curricula Compliant Experiments –

for your educational needs

PHYWE™ experiments have been matched to the curricula of more than 30 selected universities worldwide. The interaction between PHYWE's experiments and the supporting content of experimental lectures and lab courses has led to the creation of a teaching package that is highly relevant to the curriculum worldwide.

Materials Science and Engineering

Bachelor of Science Course – Reference Curriculum

Content	1. Sem.	2. Sem.	3. Sem.	4. Sem.	5. Sem.	6. Sem.
Laboratory Experiments	General Physics*		Electrical Engineering (Chapter 5)		Material Analysis and Testing (e.g. NDT) (Chapter 4)	
	General and Inorganic Chemistry**		Physical Chemistry**	Crystallography (Chapter 3)	Thermo-chemistry**	
		Materials Science 1 (Chapter 3)	Materials Science 2 (Chapter 3)			
Lecture, Tutorial, Experiments	General Physics*		Electrical Engineering (Chapter 5)		Solid State Physics*	
	Materials Science 1 (Chapter 3)		Materials Science 2 (Chapter 3)		Material Analysis and Testing (e.g. NDT) (Chapter 4)	
	General and Inorganic Chemistry**		Physical Chemistry**	Organic Chemistry**	Electrochemistry**	
			Crystallography (Chapter 3)		Thermo-chemistry**	
Elective Subject			e.g. Metals, Polymers, Ceramics, Biomaterials		e.g. Nanotech., Renew. Energy, Electr. Devices, Photonics (Chap. 5,6,7)	
Theoretical Courses	Mathematics		Computer Sciences and Engineering		Measurement Technology	
			Technical Mechanics		Design and Construction	Business Administration and Industrial Management
Intership			Industrial Intership		Research Intership	
Bachelor Thesis						Bachelor Thesis

More than 80% of the experimental courses are covered by PHYWE experiments!

PHYWE Experiments available in this catalogue * Please refer to TESS expert Physics catalogue ** Please refer to TESS expert Chemistry catalogue

Geo Science: Curricula Compliant Experiments –

multidisciplinary education with PHYWE

Geo science is one of the most multidisciplinary subjects taught in natural sciences. The first semesters or introductory courses cover general topics in physics, chemistry and biology followed by classical topics of geo science such as: geology, petrology, palaeontology, mineralogy, environment (climate, soil, water), spectroscopy, or X-ray analyses. Find corresponding experiments in this catalogue or refer to our TESS expert and Demo expert cataloques Physics, Chemistry or Biology.

Geo Science

Bachelor of Science Course – Reference Curriculum

Content	1. Sem.	2. Sem.	3. Sem.	4. Sem.	5. Sem.	6. Sem.
Laboratory Experiments	General Chemistry**		Optics and Microscopy***	Water: Cycle and Quality (Chapter 8.1)	General Biology***	Ore Microscopy, Nanoimaging (Chapter 3)
	General Physics*		Geochemistry	Soil Science (Chapter 8.3)	Mineralogy and Crystallography (Chapter 4.1)	Elementary Analysis/ Spectroscopy (e.g. XRF) (Chapter 4.1, 8.4)
Lecture, Tutorial, Experiments		Introductory Geology	Mineralogy and Petrology	Geophysics	Geoecology (Chapter 8)	Petrololgy / Petro-chemistry**
Elective Subject		Metallurgy**	Atmosphere: Science, Climate, and Change (Chapter 8.2)	Meteorology	Water: Hydrogeology, Hydrochemistry**	X-ray Powder Diffraction Laboratory (Chapter 8.9)
Theoretical Courses	Mathematics		Palaeontology	Sedimentation	Digital Mapping	
	Geology	Mineralogy	Sedimentary / Igneous	Petrology	Geomorphology	Meteorology, Climatology
Field Studies	e.g. Field Mapping		e.g. Landscape Evolution and Analysis		e.g. Environmental Geology	
Bachelor Thesis						Bachelor Thesis

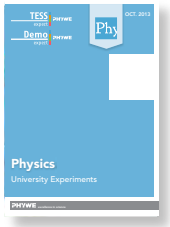
More than 60% of the experimental courses are covered by PHYWE experiments!

PHYWE Experiments available in this catalogue.

* Please refer to TESS expert Physics catalogue

** Please refer to TESS expert Chemistry catalogue

*** Please refer to TESS expert Biology catalogue



TESS expert and Demo expert Physics

TESS expert and Demo expert Chemistry / Pharmacy

TESS expert and Demo expert Biology

TESS expert Engineering and Geo Science

How to use

the table of contents

Use the curricula-based content on the next pages to find your topics and our corresponding experiments. The TESS expert catalogue is adapted to international university curricula making it easy for you to find experiments corresponding to your desired topic. On each page you find the detailed description of one of our university level experiments. More information including the complete experiment description is available on our website **www.phywe.com.**

Overview TESS expert

2 Applied Mechanics

Curricular topic = main chapter of the catalogue

2.1 Statics

Curricular subtopic = sub-chapter of the catalogue

P2120200	Modulus of elasticity	14
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P1253500	Torque	16
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P2131500	Moment and angular momentum	20
P2131305	Moment of inertia and angular acceleration with a precision pivot bearing	21
P2131301	Moment of inertia and angular acceleration and with an air bearing	21
P2131311	Moment of inertia and angular acceleration with Cobra3 and with an air bearing	21

Curricular fitting PHYWE experiments

Find the overview of all experiments fitting to the international reference curriculum on our hompage!

Click www.phywe.com

2 Applied Mechanics

3 Materials Science

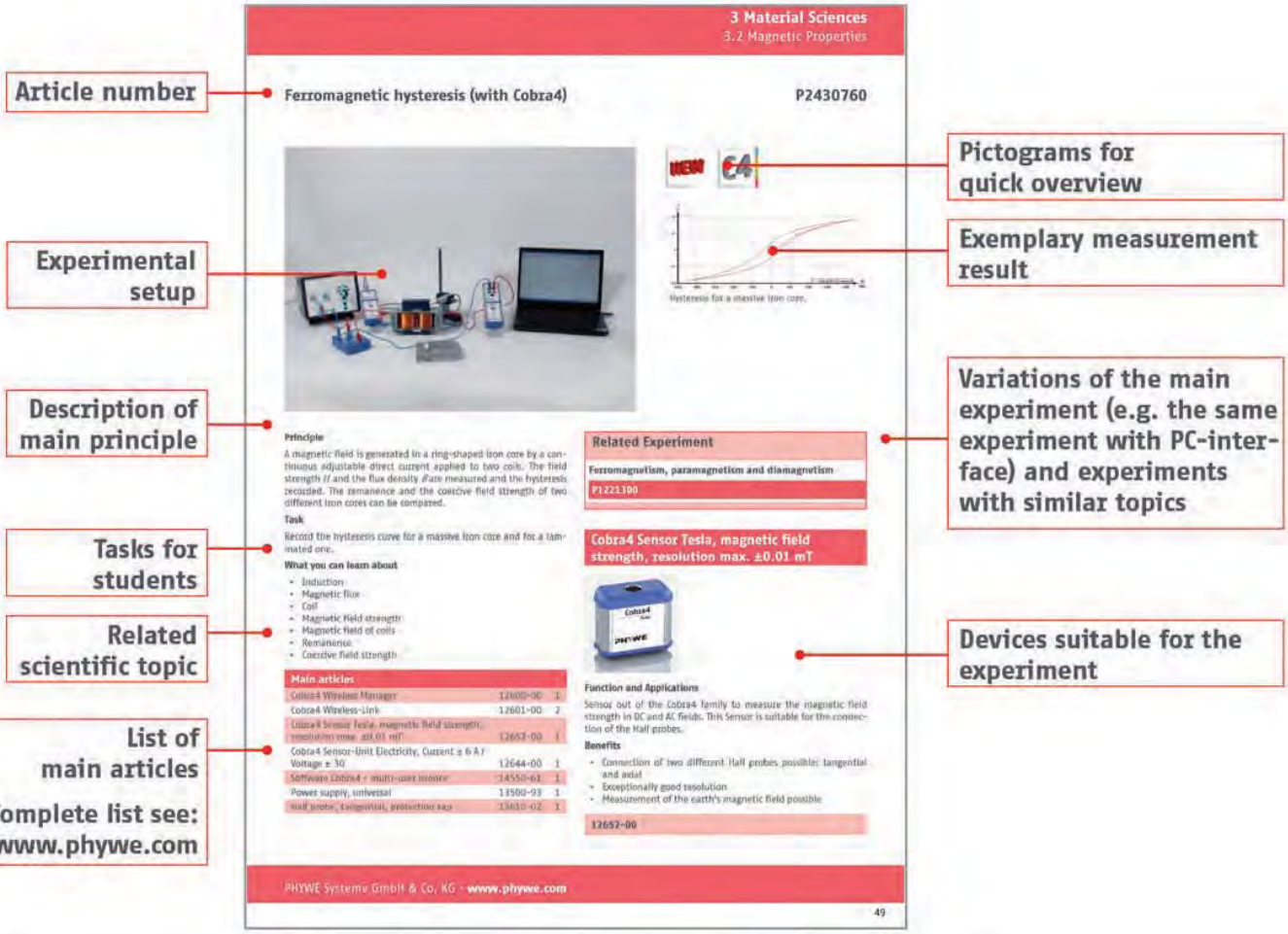
7 Photonics

8 Geo Science

How to use

Facts about the TESS expert catalogue

The TESS expert catalogue is adapted to the PHYWE reference curriculum. PHYWE's experiments fit to the content of experimental lectures and lab courses of schools, colleges and universities. The description of each experiment offers you a lot of information:



Pictograms for a quick overview of categories, related films or information:

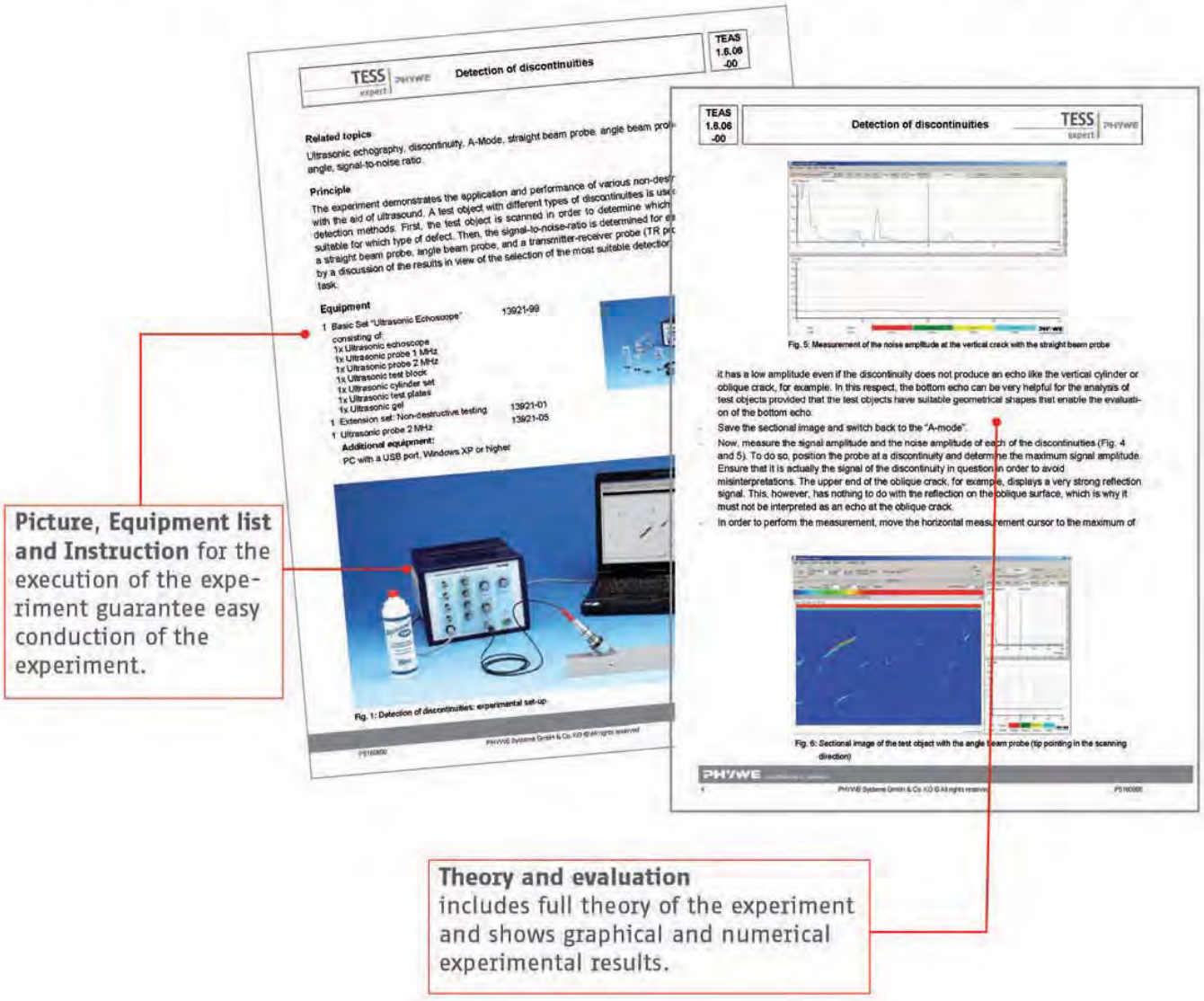
- Experiments with the Computer based measuring system Cobra4
- Demonstration experiments
- Experiments with laser
- Experiments which have received a Nobel Prize
- Computer based measuring
- Experiments with radioactivity
- Product movie available - click at www.phywe.com
- New and completely revised experiments
- Training recommended

Didactic literature –

comprehensive guide for every experiment

Extensive experimental literature is available for all our university level experiments.
Rely on the advantages of our TESS expert experiment descriptions:

- All experiments are uniformly built up
- Experiments cover the entire range of classical and modern chemistry
- Didactically adapted descriptions – enables direct preparation by the student
- Developed and proven by practitioners – comfortable and reliable performance
- Excellent measurement accuracy – results agree with theory
- Computer-assisted experiments – easy, rapid assessment of results
- Modular experimental set-up – multiple use of individual devices, cost effective and flexible



Picture, Equipment list and Instruction for the execution of the experiment guarantee easy conduction of the experiment.

Theory and evaluation includes full theory of the experiment and shows graphical and numerical experimental results.

Your solution
with just one click!

WEB@PHYWE

Our comprehensive Internet site **www.phywe.com** provides you with all the information you need covering the full spectrum of solutions and products from PHYWE – in five languages! Whether your specific needs involve physics, chemistry, biology or applied sciences, and whether you are looking for information relating to school or university-level materials, you can always find just the right products there quickly and easily.

Further highlights on our website include:

- More than 50 product videos
- Complete assembly instructions in video form
- Up-to-date software downloads
- Free-of-charge descriptions of the experiments
- Operating manuals and instruction sheets to download

1. Language
2. Subject area = Physics, Chemistry, Biology, Applied Sciences
3. Education level = School, University
4. Media e. g. product videos
5. Downloads e. g. experimental literature

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There's a way to do
it better – find it.

Thomas Edison

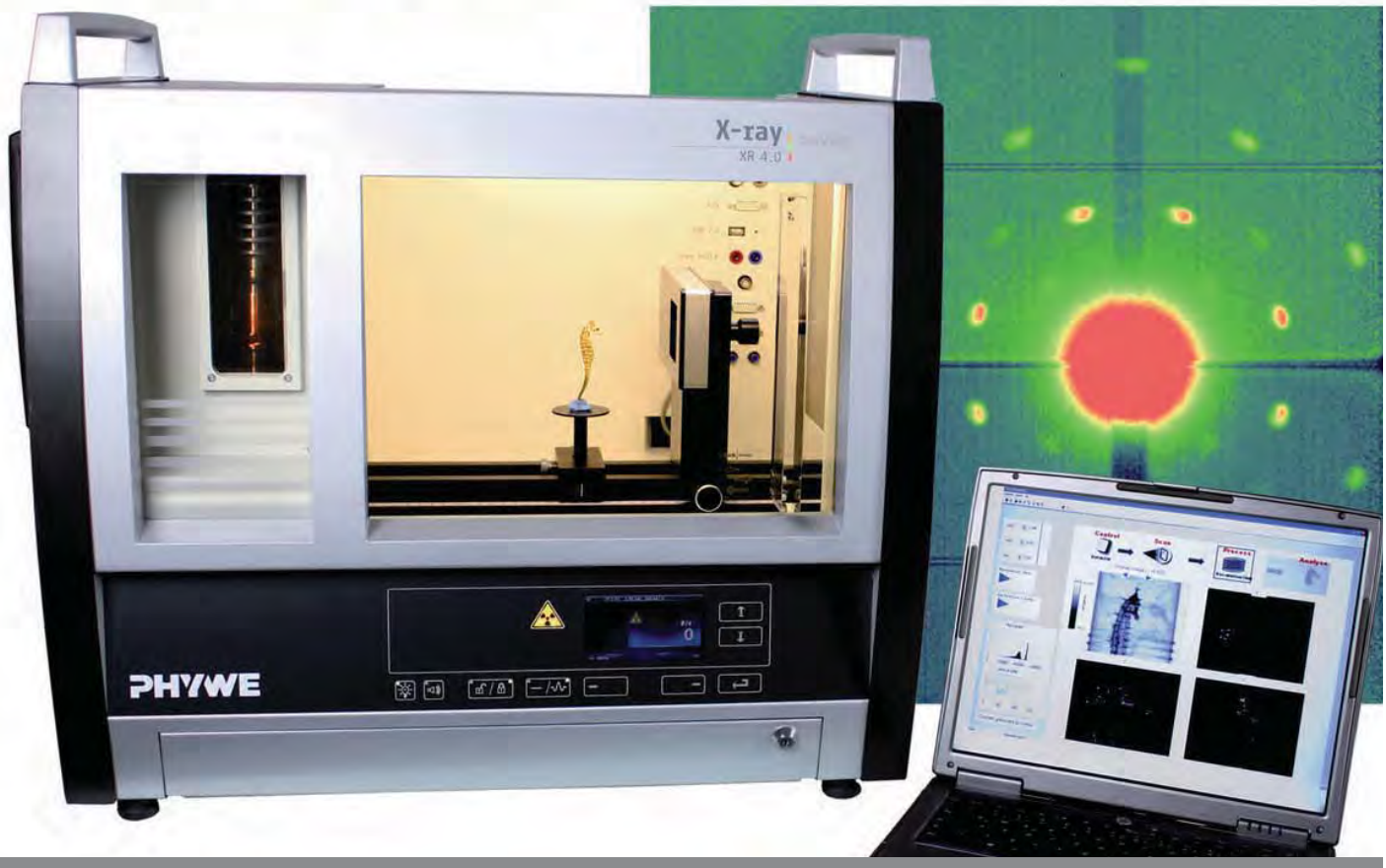
The share of ideas and transfer of knowledge between academia and PHYWE is one of our major attempts in R&D. Our network is spread out worldwide and comprises cooperation projects, research assignments, and the education of expert staff.

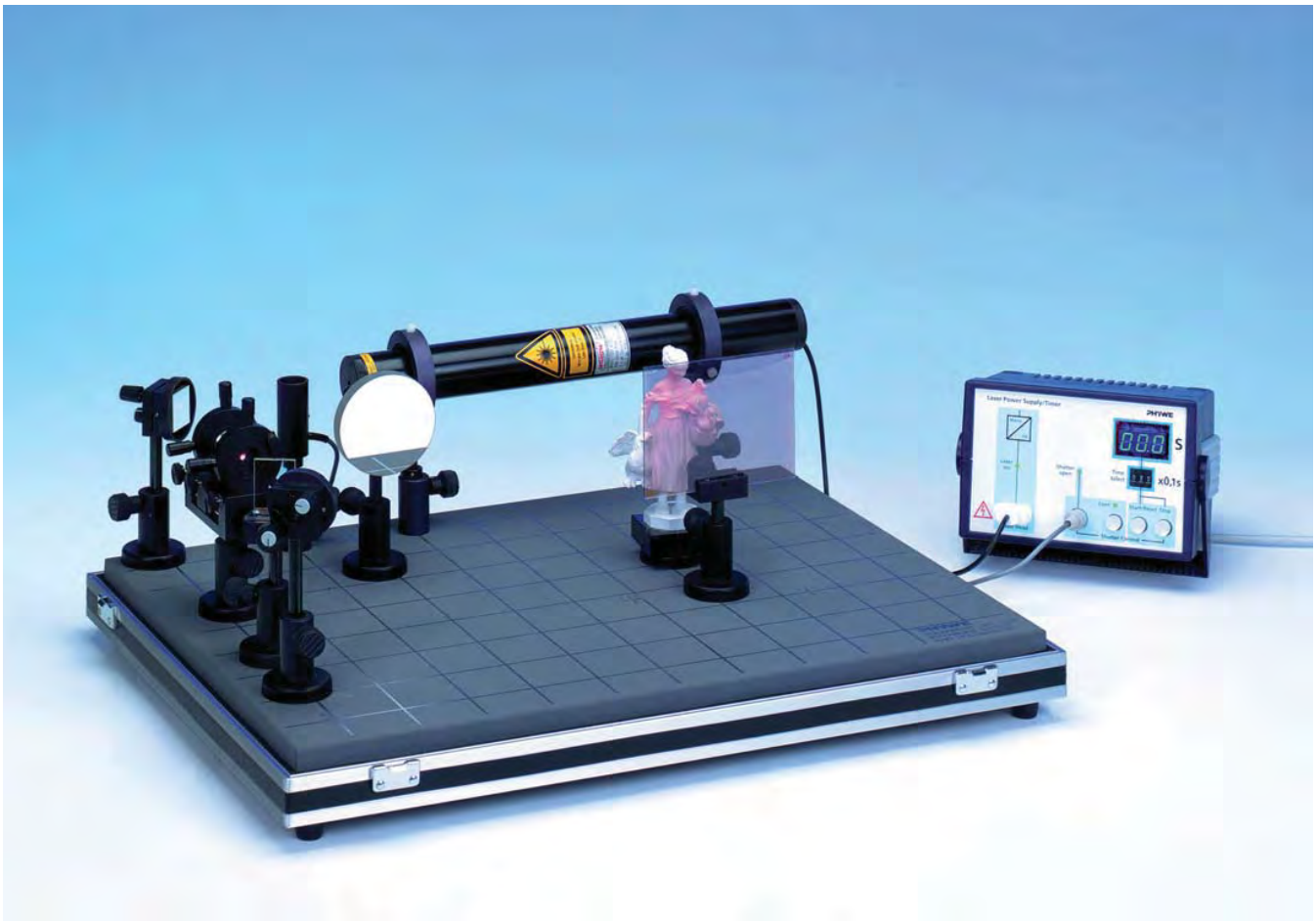
Some breathtaking novelties of our new XR 4.0 plattform are one by one the result of fruitful cooperation in this regard - thank you!

GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

HOCHSCHULE FÜR ANGEWANDTE WISSENSCHAFT UND KUNST
HILDESHEIM/HOLZMINDEN/GÖTTINGEN
FACULTY OF NATURAL SCIENCES AND TECHNOLOGY
HAWK

XLAB
Göttinger Experimentallabor
für junge Leute e.V.





Photonics

P2240405 Lambert's law of radiation on optical base plate

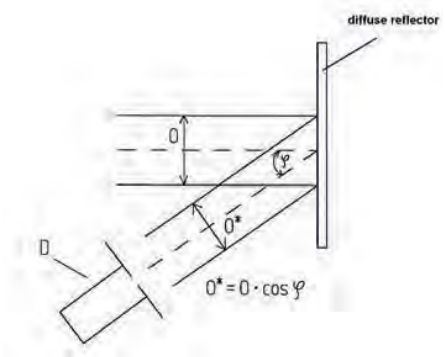


Diagram of the principle of measurements with the used magnitudes (with O^* as apparent magnitude of surface O).

Principle

Visible light impinges on a diffusely reflecting surface. The luminance of this surface is determined as a function of the angle of observation.

Tasks

1. The luminous flux emitted reflected by a diffusely reflecting surface is to be determined as a function of the angle of observation.
2. Lambert's law (cos-law) is to be verified using the graph of the measurement values.

What you can learn about

- Luminous flux
- Light quantity
- Light intensity
- Illuminance
- Luminance

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Universal measuring amplifier	13626-93	1
Optical base plate with rubberfeet	08700-00	1
Rot. guide rail w. angular scale	08717-00	1
Photoelement f. opt. base plt.	08734-00	1
Diaphragm holder f.opt.base plt.	08724-00	1

Related Experiment

Lambert's law

P2240400

Laser, He-Ne, 0.2/1.0 mW, 230 V AC

Function and Applications

Linearly polarised light source, very short design.

Benefits

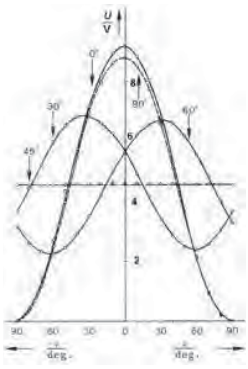
- Welded glass tube assures a very long lifetime > 18 000 operating hours
- Key switch and integrated greyfilter to reduce radiation power to 0.2 mW. Screw-in release to activate the grey filter.
- Anodised aluminium casing with integrated mains power supply, screw in holding stem, signal light and required warnings printed on both sides. Fixed mains connecting cable 140 cm.

Equipment and technical data

- Wavelength 632.8 nm, optical output power without filter 1.0 mW, with filter 0.2 mW
- Beam diameter 0.5 mm, beam divergence < 2 mrad.
- Minimum polarisation 500:1, max drift over 8 hours ± 2.5%
- Oscillating mode TEM00, lifetime > 18000 h
- Power requirements 35 VA, connecting voltage 230 V, 50/60 Hz

08180-93

Polarisation through quarter-wave plates with optical base plate P2250105



Intensity distribution of polarised light for different angles of the /4 plate, as a function of the analyser position.

Principle

Monochromatic light impinges on amica plate, perpenicularly to its optical axis. If the thickness of the plate is adequate (lambda/4 plate), a phase shift of 90° occurs between the ordinary and the extraordinary beam when the latter leaves the crystal. The polarisation of exiting light is examined for different angles between the optical axis of the lambda/4 plate and the direction of polarisation of incident light.

Tasks

1. Measurement of the intensity of linearly polarised light as a function of the analyser's position (Malus' law).
2. Measurement of the light intensity behind the analyser as a function of the angle between the optical axis of the lambda/4 plate and the analyser.
3. Carrying out experiment (2) with two succesive lambda/4 plates.

What you can learn about

- Linearly, circularly an elliptically polarised light
- Polarizer; Analyser; Malus' law; Plane of polarisation
- Double refraction; Optical axis; Ordinary and extraordinary beam

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Universal measuring amplifier	13626-93	1
Optical base plate with rubberfeet	08700-00	1
Photoelement f. opt. base plt.	08734-00	1
Diaphragm holder f.opt.base plt.	08724-00	2
Polarizing filter f.opt.base pl.	08730-00	2

Related Experiment

Polarisation through quarter-wave plates with optical profile bench

P2250100

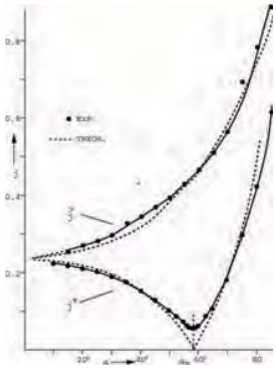
Universal measuring amplifier

Function and Applications

Universal measuring amplifier for amplification of AC and DC voltages. Suitable for practical exercises.

13626-93

P2250305 Fresnel's law - theory of reflection with optical base plate



Measurement results.

Principle

Plane-polarized light is reflected at a glas surface. Both the rotation of the plane of polarization and the intensity of the reflected light are to be determined and compared with Frewsnel's formulae for reflection.

Tasks

1. The reflection coefficients for light polarized perpendicular and parallel to the plane of incidence are to be determined as a function of the angle of incidence and plotted graphically.
2. The refractive index of the flint glass prism is to be found.
3. The reflection coefficients are to be calculated using Fresnel's formulae and compared with the measured curves.
4. The reflection factor for the flint glass prism is to be calculated.
5. The rotation of the polarization plane for plane polarized light when reflected is to be determined as a function of the angle of incidence and presented graphically. It is then to be compared with values calculated using Fresnel's formulae.

What you can learn about

- Electromagnetic theory of light
- Reflection coefficient; Reflection factor
- Brewster's law
- Law of refraction
- Polarisation; Polarisation level

Main articles		
Laser, He-Ne, 0.2/1.0 mW, 230 V AC	08180-93	1
Universal measuring amplifier	13626-93	1
Optical base plate with rubberfeet	08700-00	1
Prism, 60 degrees, h.36.4mm,flint	08237-00	1
Rot. guide rail w. angular scale	08717-00	1
Photoelement f. opt. base plt.	08734-00	1
Polarizing filter f.opt.base pl.	08730-00	2

Related Experiment

Fresnel's equations - theory of reflection with optical profile bench

P2250300

Optical base plate with rubberfeet

Function and Applications

For setting up magnetically adhering optical components.

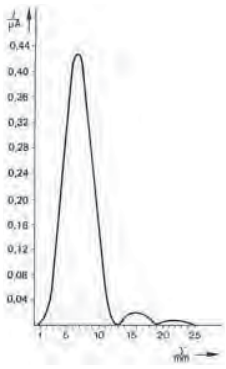
Equipment and technical data

- Rigid and vibration-damped working base made of steel plate
- With corrosion protection, NEXTEL® plastic coating and imprinted grid (5×5) cm
- Three fixed adapter sleeves for laser and laser shutter
- With rubber feet for non-slip working
- Base plate size (mm): 590 × 430 × 24
- Weight: 7 kg

08700-00

Diffraction at a slit and Heisenberg's uncertainty principle with optical base plate

P2230105



Intensity distribution of the diffraction pattern of a 0.05 mm wide slit, at a distance of 490 mm.

Principle

The intensity distribution in the Fraunhofer diffraction pattern of a slit is measured. Measurement results are evaluated both in the wave representation through comparison with Kirchhoff's diffraction fromula and in the photon representation, in order to verify Heisenberg's uncertainty principle.

Tasks

1. The intensity distribution of the Fraunhofer diffraction pattern due to a simple slit is measured. The amplitudes of the peaks and of the minima are calculated according to Kirchhoff's diffraction formula and compared to measured values.
2. Momentum uncertainty is calculated with the assistance of the diffraction patterns of simple slits of different widths, and Heisenberg's uncertainty relation is verified.

What you can learn about

- Diffraction; Sharpness; Kirchhoff's diffraction
- Formula; Measurement precision
- Local uncertainty; Impulse uncertainty
- Wave-matter duality; De Broglie's relation

Related Experiment

Diffraction at a slit and Heisenberg's uncertainty principle with optical bench

P2230100

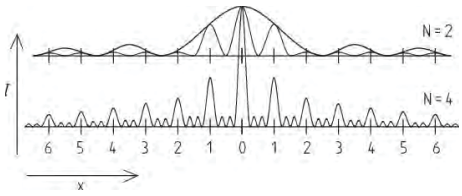
Main articles

Laser, He-Ne, 0.2/1.0 mW, 230 V AC	08180-93	1
Universal measuring amplifier	13626-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
Photoelement f. opt. base plt.	08734-00	1
Diaphragm holder f.opt.base plt.	08724-00	1
Voltmeter,0.3-300VDC,10-300VAC /	07035-00	1

Werner Heisenberg

1932, Nobel Prize in Physics

P2230405 Diffraction of light through a double slit or by a grid with optical base plate



Qualitative intensity distribution of diffraction through 2 and 4 slits, the distance x being normalised to /s. The intensity distribution of the simple slit has been represented with exaggerated height to give a clearer view.

Principle

The coherent monochromatic light of a laser is directed to a diaphragm with a varying number of slits. The resulting interference patterns are studied using a photoelement.

Tasks

- The intensity distribution of diffraction patterns formed by multiple slits is mesasured using a photoelement.
- The dependence of this distribution from the slit widths, the number of slits and the grid constant is investigated.
- The obtained curves are compared to the theoretical values.

What you can learn about

- Fraunhofer diffraction
- Huygens' principle
- Interference
- Coherence

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Universal measuring amplifier	13626-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
Photoelement f. opt. base plt.	08734-00	1
Diaphragm holder f.opt.base plt.	08724-00	1

Related Experiment

Diffraction intensity due to multiple slits and grids with optical profile bench

P2230400

Photoelement for optical base plate

Function and Applications

For determination of light intensities.

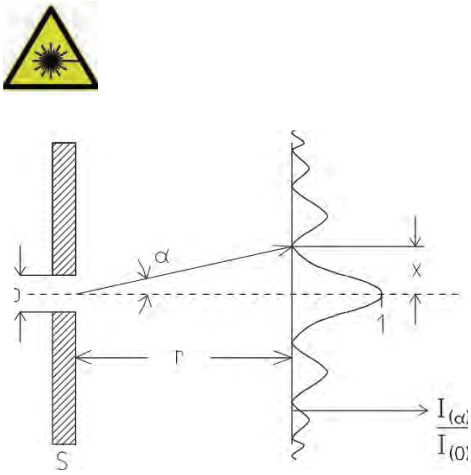
Equipment and technical data

- Spectral range: 400 nm...1100 nm.
- With changeable stem Ø =10mm and /=110 mm respectively /= 250 mm.
- Slit diaphragm d=0.3mm.

08734-00

Diffraction intensity at a slit and at a wire - Babinet's theorem with optical base plate

P2230605



Principle of set up for diffraction through a slit and qualitative distribution on intensities in the detector plane LD.

Principle

Babinet's Principle states that the diffraction pattern for an aperture is the same as the pattern for an opaque object of the same shape illuminated in the same manner. That is the pattern produced by a diffracting opening of arbitrary shape is the same as a conjugate of the opening would produce.

Tasks

Babinet's theorem is verifid by the diffraction pattern of monochromatic light directed through a slit and an opaque stripe complementary to the latter. The experiment is also performed with a circular aperture and an opaque obstacle conjugate to this opening.

What you can learn about

- Fraunhofer interference
- Huygens' principle
- Multiple beam interference
- Babinet's theorem
- Coherence

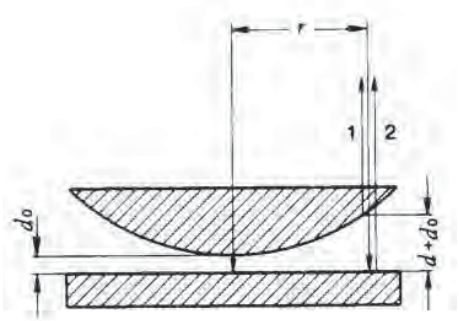
Related Experiment

Diffraction intensity at a slit and at a wire - Babinet's theorem with optical profile bench

P2230600

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Universal measuring amplifier	13626-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
Screen, with diffracting elements	08577-02	1
Photoelement f. opt. base plt.	08734-00	1

P2220205 Newton's rings with optical base plate



Generation of Newton's rings.

Principle

The air wedge formed between slightly convex lens and a plane glass plate (Newton's colour glass) is used to cause interference of monochromatic light. The wavelength is determined from the radii of the interference rings.

Tasks

The diameters of interference rings produced by Newton's colour glass are measured and these are used to:

1. Determine the wavelength for a given radius of curvature of the lens.
2. Determine the radius of curvature for a given wavelength.

What you can learn about

- Coherent light
- Phase relation
- Path difference
- Interference at thin layers
- Newton's colour glass

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Optical base plate with rubberfeet	08700-00	1
Newton colourglass f.opt.b. pl.	08730-02	1
Sliding device, horizontal	08713-00	1
xy shifting device	08714-00	2
Pin hole 30 micron	08743-00	1

Related Experiment

Newton's rings with interference filters

P2220200

He/Ne Laser, 5mW with holder

Function and Applications

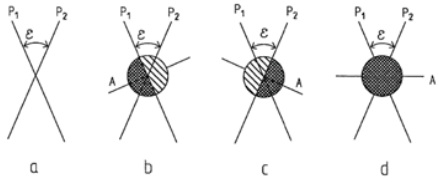
He/Ne laser with fixed connection cable with HV jack for laser power pack.

Equipment and technical data

- Wave length 632.8 nm
- Modes TEM00
- Degree of polarisation 1:500
- Beam diameter 0.81 mm
- Beam divergence 1 mrad
- Max. power drift max. 2.5%/ 8 h
- Service life ca. 15000 h
- Coaxial cylinder casing Ø = 44.2mm, l = 400 mm
- Incl. 2 holders with three-point bearing and 2 setting collars

08701-00

Polarimetry with optical base plate P2250505



Working principle of the half shadow polarimeter.

Principle

Optically active substances cause very slight rotations of the light polarisation plan, which the method of crossed polarisation filters is not strong enough to measure. With this method, the direction of polarisation of the analyser is perpendicular to that of the polarizer. If an optically active substance is placed between them, the polarisation direction of the analyser must be corrected by the corresponding angle of rotation of the plane of polarisation in order to obtain an intensity minimum again. A stronger adjustment possibility for the determination of the angle is given with the half shadow polarimeter, used in this experiment to measure the angle of rotation of the plane of polarisation caused by glucose-water solutions of different concentrations.

Task

Determine the angle of rotation for sugar solutions of different concentrations.

What you can learn about

- Lippich polariser
- Malus' law

Main articles		
Laser, He-Ne, 0.2/1.0 mW, 230 V AC	08180-93	1
Optical base plate with rubberfeet	08700-00	0
Pol.filter halfshade f.opt.b.pl.	08730-01	1
Polarizing filter f.opt.base pl.	08730-00	2
Adjusting support 35 x 35 mm	08711-00	1
Surface mirror 30 x 30 mm	08711-01	1
Holder,dir.vis. prism,opt.b.pl.	08726-00	1

Related Experiment

Polarimetry

P2250200

Laser, He-Ne, 0.2/1.0 mW, 230 V AC

Function and Applications

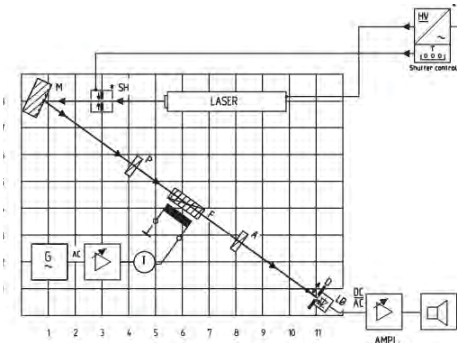
Linearly polarised light source, very short design.

Benefits

- Welded glass tube assures a very long lifetime > 18 000 operating hours; Key switch and integrated greyfilter to reduce radiation power to 0.2 mW. Screw-in release to activate the grey filter.
- Anodised aluminium casing with integrated mains power supply, screw in holding stem, signal light and required warnings printed on both sides. Fixed mains connecting cable 140 cm.

08180-93

P2260106 Faraday effect with optical base plate



Experimental setup.

Principle

When the Faraday effect was discovered in 1845 it was the first experiment that elucidated the relation of light and electromagnetism. If linearly polarised light passes through a region with magnetic field the angle of rotation of the plane of polarisation is altered. This alteration appears to be a linear function of both the average magnetic flow density and the distance that the wave covers in the magnetic field. The factor of proportionality is a mediumspecific constant and is called Verdet's constant.

Task

Investigate the Faraday effect qualitatively through observation of the electro optical modulation of the polarised laser light with frequencies in the acoustic range.

What you can learn about

- Interaction of electromagneticfields
- Electromagnetism
- Polarisation
- Verdet's constant
- Malus' law
- Electronic oscillation

Main articles

Digital Function Generator, USB, incl. Cobra4 Software	13654-99	1
Laser, He-Ne, 0.2/1.0 mW, 230 V AC	08180-93	1
Universal measuring amplifier	13626-93	1
Optical base plate with rubberfeet	08700-00	1
Faraday modulator f.opt.base pl.	08733-00	1
Loudspeaker,8 Ohm/5 kOhm	13765-00	1
Photoelement f. opt. base plt.	08734-00	1

Related Experiment

Faraday effect with optical profile bench

P2260100

Faraday modulator for optical base plate

Function and Applications

Copper coil on temperature-stable aluminium winder with insert for holdingglass rods (SF58) for Faraday effect.

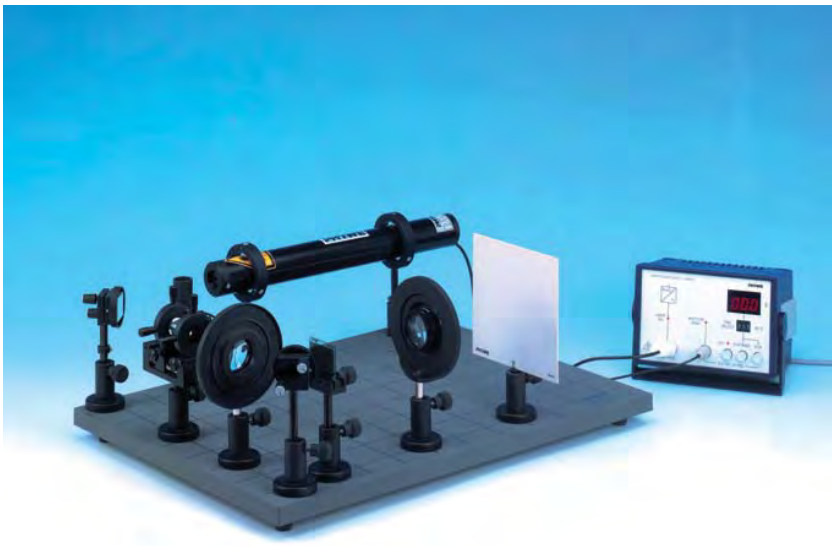
Equipment and technical data

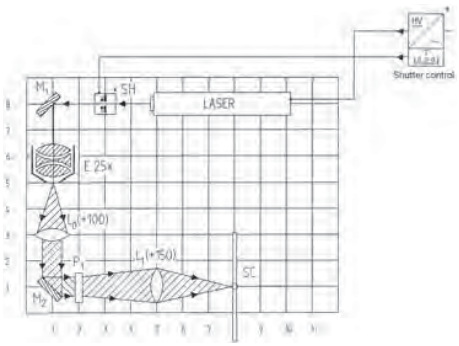
- With round stem, clamp screws and fixed connection cable = 1m with 4-mm jacks
- Number of windings 1200
- Inductivity 6.3 mH
- Ohm's resistance 4 Ω
- Internal diameter 14 mm
- Max. current 5 A (1min)

08733-00

Fourier optics - 2f arrangement

P2261100





Experimental setup for the fundamental principles of Fourier optic (2f setup).

Principle

The electric field distribution of light in a specific plane (object plane) is Fourier transformed into the 2 f configuration.

Task

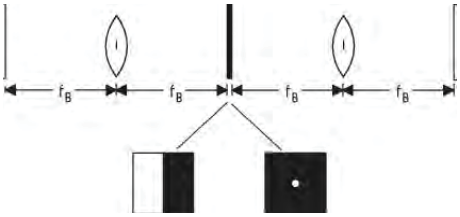
Investigation of the Fourier transform by a convex lens for different diffraction objects in a 2 f set-up.

What you can learn about

- Fourier transform
- Lenses
- Fraunhofer diffraction
- Index of refraction
- Huygens' principle

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
Screen, with diffracting elements	08577-02	1
xy shifting device	08714-00	2
Pin hole 30 micron	08743-00	1

P2261200 Fourier optics - 4f arrangement - filtering and reconstruction



Principle of the setup for coherent optical filtration.

Principle

The electric field distribution of light in a specific plane (object plane) is Fourier transformed into the 4f configuration by 2 lenses and optically filtered with appropriate diaphragms.

Tasks

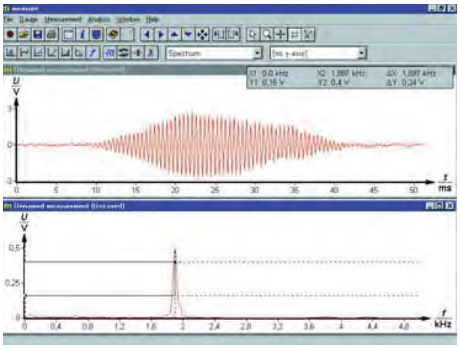
1. Optical filtration of diffraction objects in 4 f setup.
2. Reconstruction of a filtered image.

What you can learn about

- Fourier transform
- Lenses
- Fraunhofer diffraction
- Index of refraction
- Huygens' principle
- Fog technique

Main articles		
Ultrasonic generator	13920-99	1
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
Screen, with diffracting elements	08577-02	1
Glass cell, 150x55x100 mm	03504-00	1

LDA - laser Doppler anemometry with optical base plate (with Cobra3) P2260511



Measurement of the signal spectrum with a signal peak.

Principle

Small particles in a current pass through the LDA measuring volume and scatter the light whose frequency is shifted by the Doppler effect due to the particle movement.

The frequency change of the scattered light is detected and converted into a particle or flow velocity.

Task

Measurement of the light-frequency change of individual light beams which are reflected by moving particles.

What you can learn about

- Interference
- Doppler effect
- Scattering of light by small particles (Mie scattering)
- High- and low-pass filters
- Sampling theorem
- Spectral power density
- Turbulence

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Cobra3 BASIC-UNIT, USB	12150-50	1
Si-Photodetector with Amplifier	08735-00	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
Control Unit for Si-Photodetector	08735-99	1

Cobra4 Experiment - available 2013

LDA - laser Doppler anemometry (with Cobra4)

P2260560

Control Unit for Si-Photodetector

Function and Applications

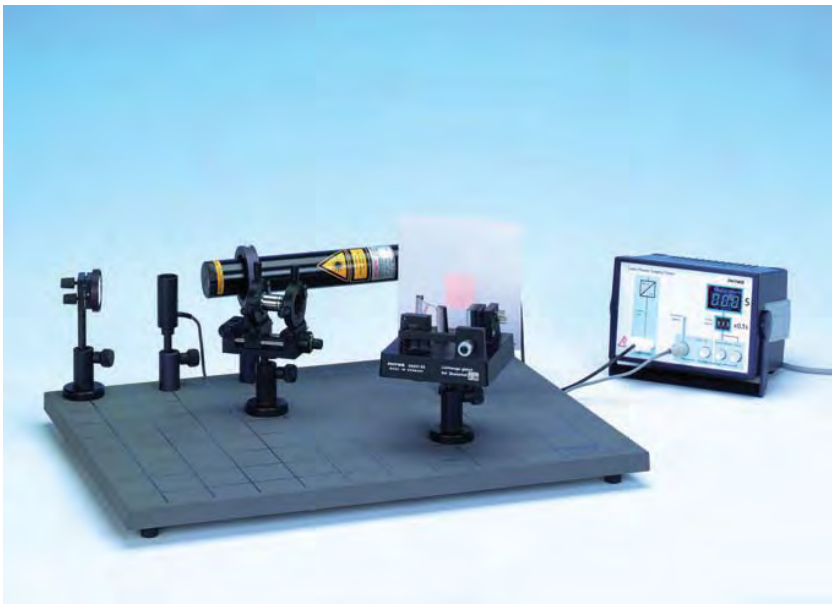
Amplifier for silicon photodetector.

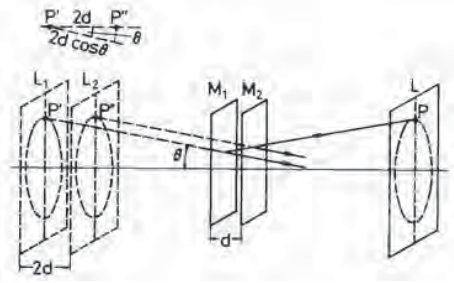
Equipment and technical data

- 3 BNC outputs:
  Output 1 (monitor output), gain 1, bandwidth for DC ... 60 kHz
  Output 2 , gain 1 ... 100, band width for AC 10 Hz ... 60 kHz
  Output 3 (filter output), gain 1 ... 100, band width for AC 200 Hz ...10 kHz
- Input: 5-pole diode socket for silicon photodetector
- Connections +9 V ... +12 V, Power consumption 1 W
- Impact-resistant plastic case (194 x 140 x 130) mm with carrying handle; Includes 110-V/240-V power supply

08735-99

P2220505 Michelson interferometer with optical base plate





Formation of interference rings.

Principle

In a Michelson interferometer, a lightbeam is split into two partial beams by a semi transparent glass plate (amplitude splitting). These beams are reflected by two mirrors and brought to interference after they passed through the glass plate a second time.

Task

The wavelength of the used laserlight is determined through the observation of the change in the interference pattern upon changing the length of one of the interferometer arms.

What you can learn about

- Interference
- Wavelength
- Refraction index
- Light velocity
- Phase
- Virtual light source
- Coherence

Main articles		
Michelson interferometer	08557-00	1
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
xy shifting device	08714-00	2
Pin hole 30 micron	08743-00	1

Related Experiment

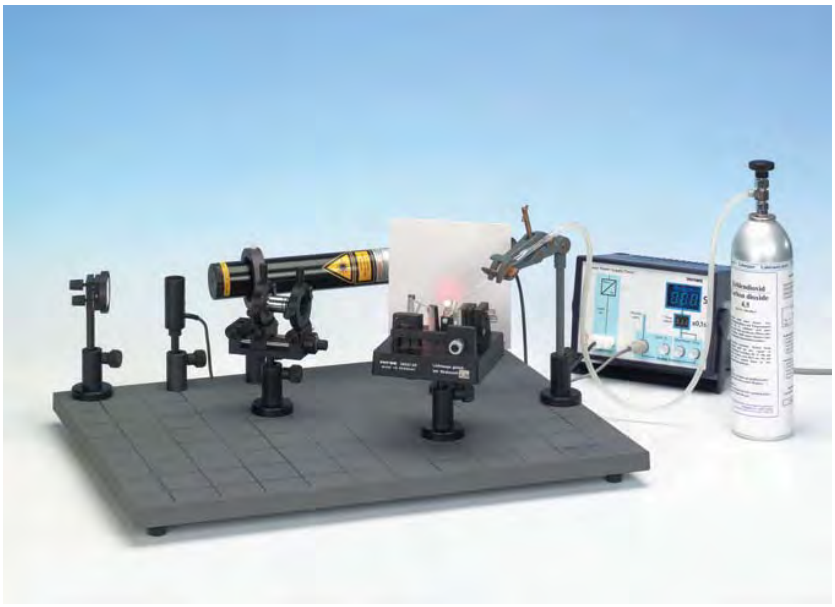
Michelson interferometer with optical profile bench

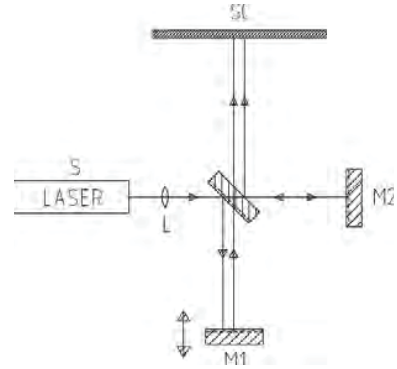
P2220500

Albert A. Michelson

1907, Nobel Prize in Physics

Refraction index of C02 with the Michelson interferometer with optical base plate P2220705





Michelson's setup for interference.

Principle

Light is caused to interfere by means of a beam splitter and two mirrors according to Michelson's set up. Substituting the air in a measurement cuvette located in one of the interferometer arms by CO_2 gas allows to determine the index of refraction of CO_2.

Task

Determine the difference of the refraction index between air and CO_2 from changes in the interference pattern.

What you can learn about

- Interference
- Wavelength
- Index of refraction
- Light velocity
- Phase
- Virtual light source
- Coherence

Main articles		
Michelson interferometer	08557-00	1
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
xy shifting device	08714-00	2
Pin hole 30 micron	08743-00	1

Related Experiment

Refraction index of air and C02 with the Michelson interferometer with optical profile bench

P2220700

Michelson interferometer

Function and Application

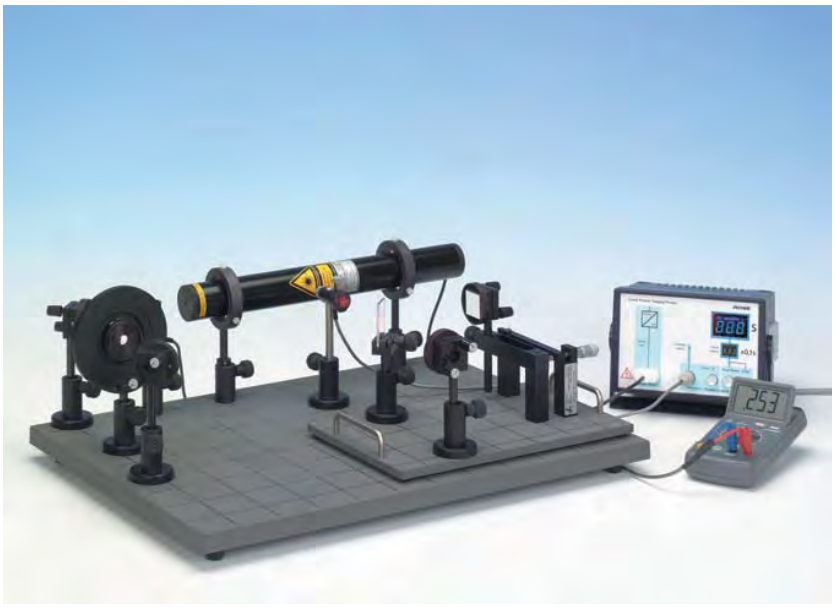
To measure light wavelengths and refractivity of liquids and gases.

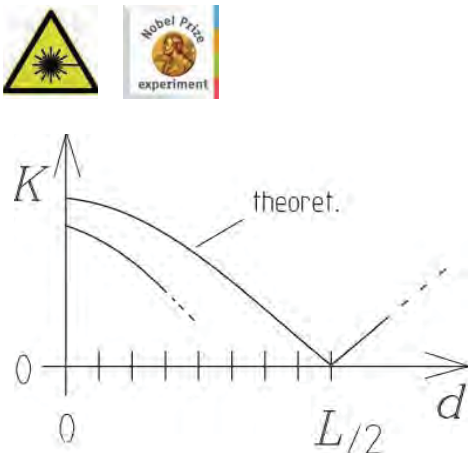
Equipment and technical data

- Metalbase-plate 120 x 120 mm with removable holding stem and with adjustable surface mirrors 30 x 30 mm
- Two polarising filters and micrometer
- Fine shoots to the tilt adjustment of fixed mirror
- Bracket for additional required cell for investigation of gases

08557-00

P2220900 Michelson interferometer - High Resolution with optical base plate





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

Principle

With the aid of two mirrors in a Michelson arrangement, light is brought to interference. While moving one of the mirrors, the alterationin the interference pattern is observed and the wave length of the laser light determined.

Tasks

1. Construction of a Michelson interferometer using separate components.
2. The interferometer is used to determine the wavelength of the laser light.
3. The contrast function K is qualitatively recorded in order to determine the coherence length with it.

What you can learn about

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

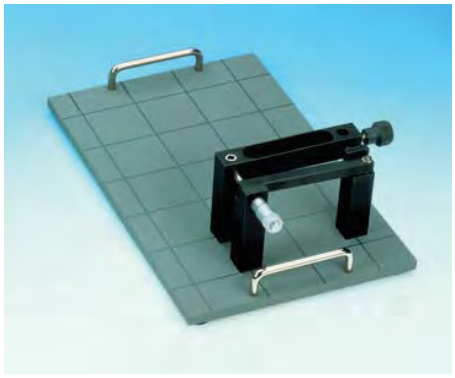
Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Interferometerplate w prec.drive	08715-00	1
Optical base plate with rubberfeet	08700-00	1
Surface mirror 30 x 30 mm	08711-01	4

Related Experiment

Twyman-Green interferometer

P2221305

Interferometerplate with precision drive



Function and Applications

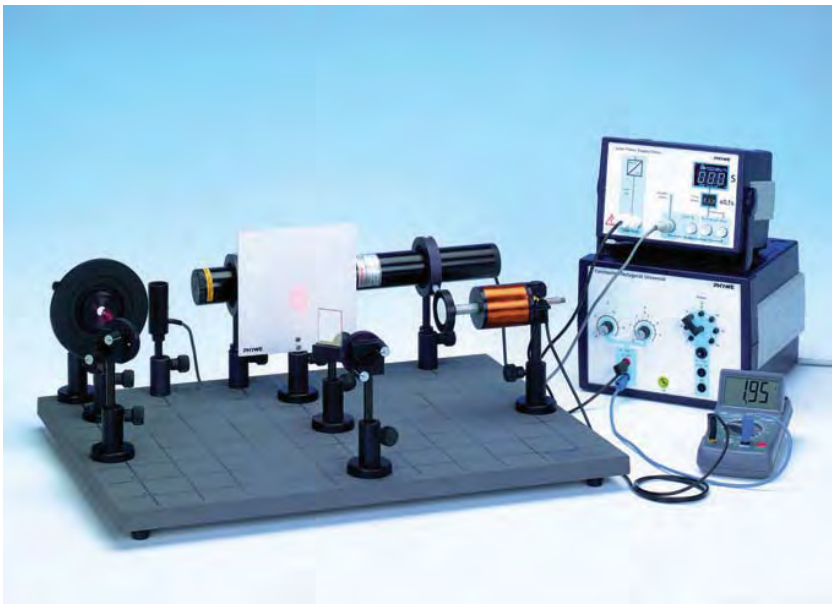
For precise and reproducible linear shift of optical components e.g. in interferometer setups.

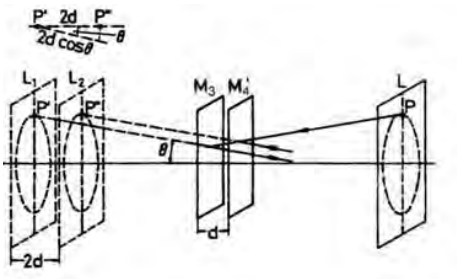
Equipment and technical data

- Suppression of tilting effects due to traverse construction.
- Wavelength adjustment through lever device with micrometer screw.
- Stiff steel base plate with NEXTEL®-Plastic coating.
- Set up on base plate.
- Shift path: max. 0.25 mm.
- Resolution: 500 nm.
- Dimensions (mm): 320 × 200 × 14.
- Mass: 5 kg.

08715-00

Magnetostriction with the Michelson interferometer P2430800





Formation of circular interference fringes.

Principle

With the aid of two mirrors in a Michelson arrangement, light is brought to interference. Due to the magnetostrictive effect, one of the mirrors is shifted by variation in the magnetic field applied to a sample, and the change in the interference pattern is observed.

Tasks

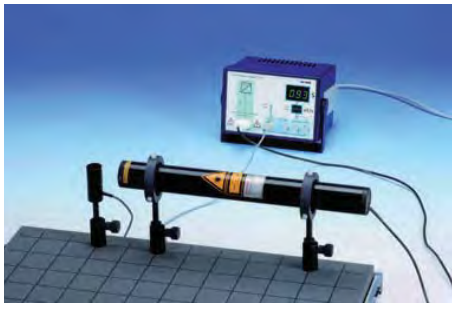
1. Construction of a Michelson interferometer using separate optical components.
2. Testing various ferromagnetic materials (iron and nickel) as well as a non-ferromagnetic material (copper), with regard to their magnetostrictive properties.

What you can learn about

- Interference
- Wavelength
- Diffraction index
- Speed of light
- Phase
- Virtual light source
- Ferromagnetic material
- Weiss molecular magnetic fields
- Spin-orbit coupling

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Power supply, universal	13500-93	1
Optical base plate with rubberfeet	08700-00	1
Faraday modulator f.opt.base pl.	08733-00	1
Rods for magnetostriction,set	08733-01	1
Adjusting support 35 x 35 mm	08711-00	3

Power supply for laser head 5 mW



Function and Applications

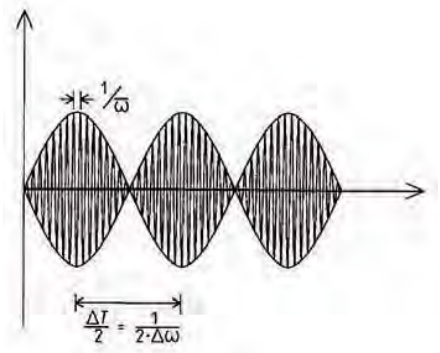
High voltage power supply for lasers, e. g. the 5 mW laser (08701-00).

Equipment and technical data

- With programmable timer for selection of exposure time of holograms between 0.1 ... 99 s.
- With acontrollable shutter.
- Digital display for preset shutter times as well as those which have already occured.
- Shutter control via time select, new start, stop and shutter open (permanent open).
- Dimensions of plastic housing (mm): 184 x 140 x 130.
- Incl. shutter with fixed connection cord with unit plug on holding rod.
- Rod diameter: 10 mm.

08702-93

P2221000 Doppler effect with the Michelson interferometer with optical base plate



Resulting difference signal during interferometric measurement.

Principle

With the aid of two mirrors in a Michelson arrangement, light is brought to interference. While moving one of the mirrors, the alteration in the interference pattern is observed and the modulatione frequency is measured using the Doppler effect.

Tasks

1. Construction of a Michelson interferometer using seperate components.
2. Measurement of the Doppler effect via uniform displacement of one ofthe mirrors.

What you can learn about

- Interference
- Wavelength
- Diffraction index
- Speed of light
- Phase
- Virtual light source
- Temporal coherence
- Special relativity theroy
- Lorentz transformation

Main articles		
Recorder, tY, 2 channel	11415-95	1
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Interferometerplate w prec.drive	08715-00	1
Optical base plate with rubberfeet	08700-00	1
Light barrier with counter	11207-30	1
Power supply 0...12 V DC/ 6 V, 12 V AC, 230 V	13505-93	1

Light barrier with counter

Function and Applications

With the function of an electronic time measuring and counting device.

Benefits

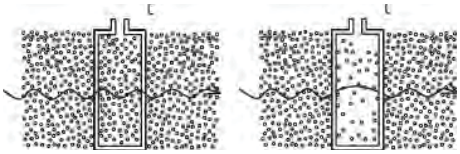
- 4 figure luminous display, selection switch for 4 operating modes
- RESET key, BNC jack for exterior starting and/ or stopping of time measurement, TTL output to control peripheral devices
- power supply connector (4 mm jacks)

Equipment and technical data

- Fork width: 70 mm, Usable barrier depth: 65 mm
- Sensitivity adjustable, LED-Display: 4digits, 8 mm
- Time measurement: 0...9,999 s, Counting: 0...9999
- Supply voltage: 5 V DC, Max. working frequency: 25 kHz
- External dimensions (mm): 160 x 25 x 105M6
- Threaded holes in casing: 7, Stem included: 100 mm, M6 thread

11207-30

Refraction index of air with the Mach-Zehnder interferometer with optical base plate P2221100



Schematic representation of the cell with normal pressure (a) and nearly absolute vacuum (b).

Principle

Light is brought to interference by two mirrors and two beam splitters in the Mach-Zehnder arrangement. By changing the pressure in a measuring cell located in the beam path, one can deduce the refraction index of air.

Tasks

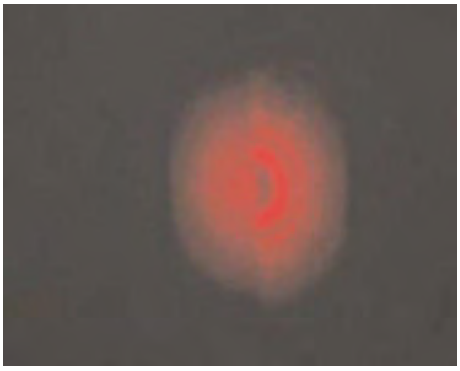
1. Construction of a Mach-Zehnder interferometer using individual optical components.
2. Measurement of the refraction index n of air by lowering the air pressure in a measuring cell.

What you can learn about

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

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Optical base plate with rubberfeet	08700-00	1
Sliding device, horizontal	08713-00	1
xy shifting device	08714-00	2
Pin hole 30 micron	08743-00	1
Adjusting support 35 x 35 mm	08711-00	4

P2220800 Quantum eraser



Pattern seen on the screen when blocking half of the beam.

Principle

A Mach-Zehnder-interferometer is illuminated with a laser beam. Circular interference fringes appear on the screens behind the interferometer. If polarisation filters with opposite polarisation planes are placed in the two interferometer paths the interference patterns disappear. Placing another polariser before one of the screens causes the pattern to reappear. Electromagnetic radiation can be described both in terms of propagating waves, as well as particles (photons). The experiment illustrates this duality by showing how interference patterns can be explained on the basis of both classical wave mechanics and quantum physics.

Tasks

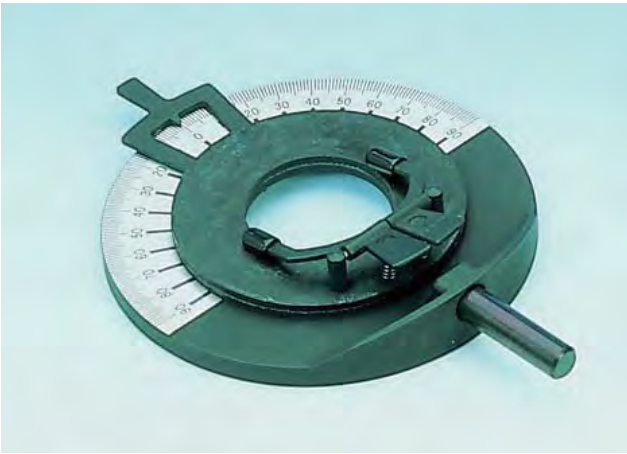
1. Set up the experiment and observe the interference pattern on the screen.
2. Change the polarisation of the beams with the PF1 and PF2 polarisers and observe the influence on the interference pattern.
3. Use the third polariser PF3 to cancel the polarisation of the light in the two beams, and observe the reappearance of the interference pattern.

What you can learn about

- Wave-particle duality
- Wave interference
- Quantum mechanics

Main articles		
Laser, He-Ne, 0.2/1.0 mW, 230 V AC	08180-93	1
Optical base plate in exp.case	08700-01	1
Diaphragm holder f.opt.base plt.	08724-00	1
Polarizing filter f.opt.base pl.	08730-00	3
Adjusting support 35 x 35 mm	08711-00	4
Polarization specimen, mica	08664-00	1
Surface mirror 30 x 30 mm	08711-01	4

Diaphragm holder for optical base plate

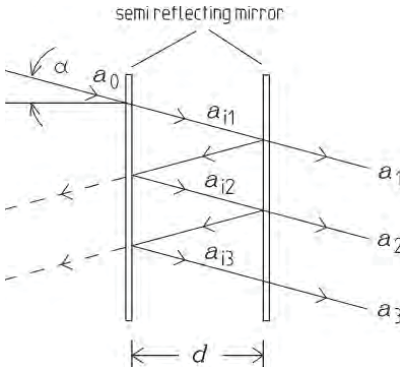


Function and Applications

Diaphragm holder for optical base plate with shortstem l = 35 mm.

08724-00

Fabry-Perot interferometer - determination of the wavelength of laser light on optical base plate P2221205



Multibeam interferometer after Fabry and Perot. Illustration of the principle for deriving the individual amplitudes.

Principle

Two mirrors are assembled to form a Fabry-Perot interferometer. Using them, the multibeam interference of a laser's light beam is investigated. By moving one of the mirrors, the change in the interference pattern is studied and the wavelength of the laser's light determined.

Tasks

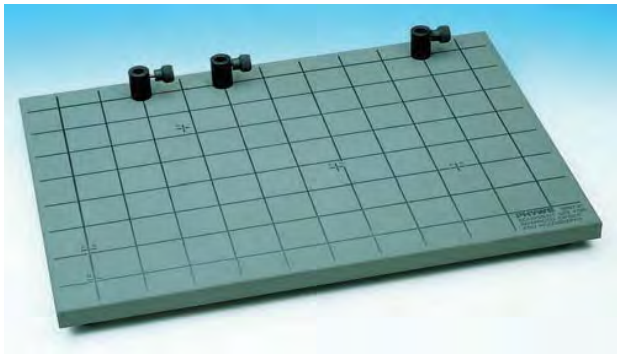
1. Construction of a Fabry-Perot interferometer using separate optical components.
2. The interferometer is used to determine the wavelength of the laser light.

What you can learn about

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

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Interferometerplate w prec.drive	08715-00	1
Beam splitter T=30,R=70, w.holder	08741-01	1
Optical base plate with rubberfeet	08700-00	1
Adjusting support 35 x 35 mm	08711-00	3
Surface mirror 30 x 30 mm	08711-01	3

Optical base plate with rubberfeet



Function and Applications

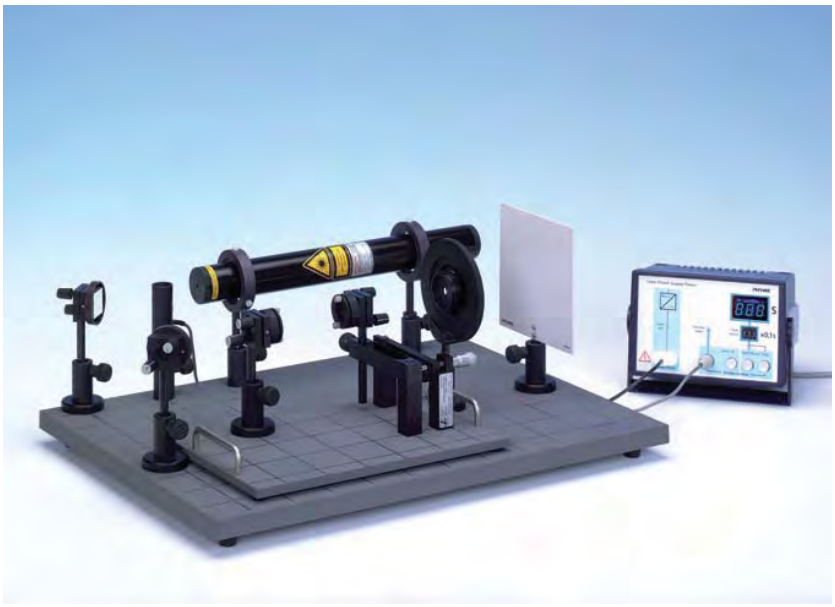
For setting up magnetically adhering optical components.

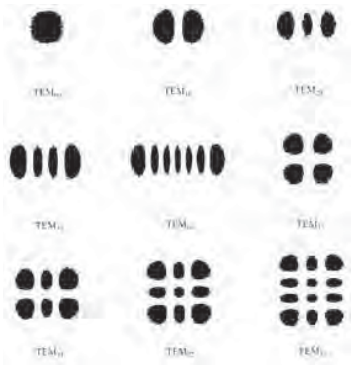
Equipment and technical data

- Rigid and vibration-damped working base made of steel plate.
- With corrosion protection, NEXTEL® plastic coating and imprinted grid (5×5) cm.
- Three fixed adapter sleeves for laser and laser shutter.
- With rubber feet for non-slip working.
- Base plate size (mm): 590 × 430 × 24
- Mass: 7 kg

08700-00

P2221206 Fabry-Perot interferometer - optical resonator modes





Intensity distribution of the Hermitian-Gaussian resonator modes.

Principle

Two mirrors are assembled to form a Fabry-Pert Interferometer. Using them, the multibeam interference of a laser's light beam is investigated. On moving one of the mirrors, the change in the intensity distribution of the interference pattern is studied. This is a qualitative experiment, to study the shape of different lasermodes and compare it with some photos given in the description.

Tasks

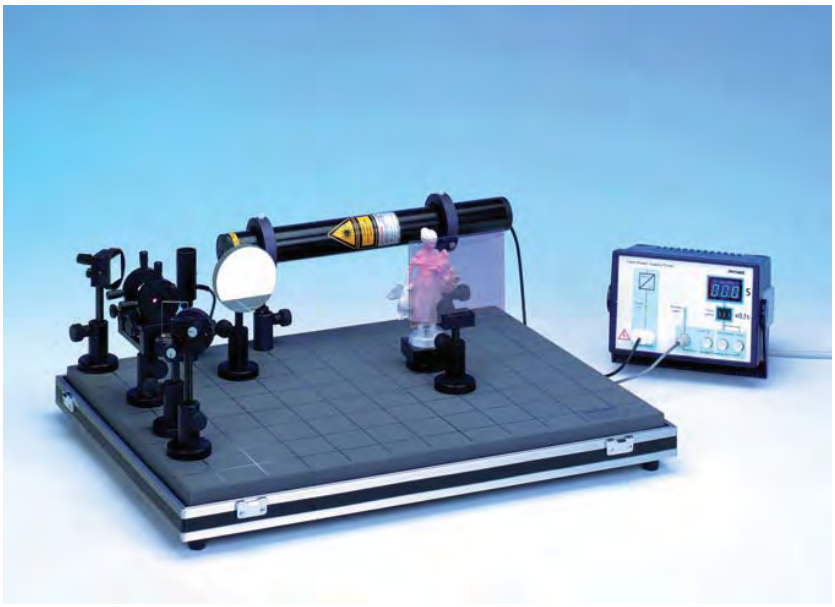
1. Construction of a Fabry-Perot interferometer using separate optical components.
2. The interferometeris used to observe different resonator modes within the interferometer.

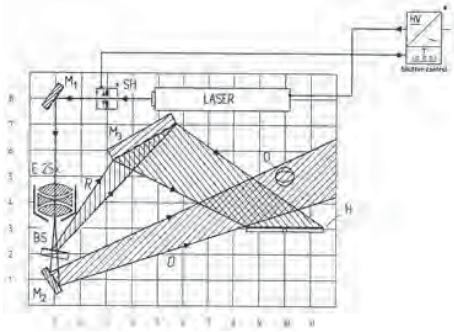
What you can learn about

- Interference
- Wavelength
- Diffraction index
- Speed of light
- Phase
- Virtual light source
- Two-beam interferometer

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Concave mirror OC;r=1.4m,T=1.7%	08711-03	1
Interferometerplate w prec.drive	08715-00	1
Plane mirror HR>99%,mounted	08711-02	1
Optical base plate with rubberfeet	08700-00	1
Adjusting support 35 x 35 mm	08711-00	4

Recording and reconstruction of holograms with optical base plate P2260300





Setup for recording and reconstruction of a transmission hologram.

Principle

In contrast to normal photography a hologram can store information about the three-dimensionality of an object. To capture the three-dimensionality of an object, the film stores not only the amplitude but also the phase of the light rays. To achieve this, a coherent light beam (laser light) is split into an object and a reference beam by being passed through a beam splitter. These beams interfere in the plane of the holographic film. The hologram is reconstructed with the reference beam which was also used to record the hologram.

Tasks

1. Record a laser light hologram and process it to get a phase hologram. Reconstruct it by verifying the virtual and the real image.
2. Record a white light reflection hologram and process it to get a phase hologram. Laminate it for reconstruction by a white light source.

What you can learn about

- Object beam; Reference beam; Real and virtual image
- Phase holograms; Amplitude holograms; Interference
- Diffraction; Coherence; Developing of film

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
Optical base plate in exp.case	08700-01	1
Surface mirror,large, d=80 mm	08712-00	1
Holographic plates, 25 pieces	08746-00	1
Sliding device, horizontal	08713-00	1
Darkroom equipment for holography, 230 V	08747-88	1

Optical base plate in exp.case

Function and Applications

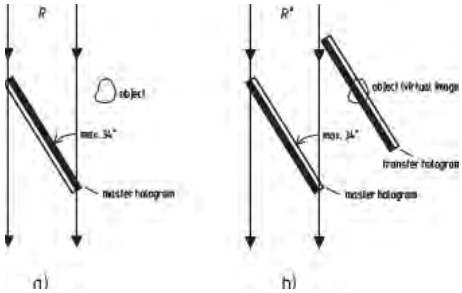
For vibration-damped storage of magnetic adherent optical components.

Equipment and technical data

- Bottom clamp screws.
- When carrying out the experiments, the base plate remains in the bottom of the case.
- Separate case hood with lock.
- Case dimensions (mm): 620 × 460 × 280.
- Mass: 13 kg.

08700-01

P2260305 Transfer hologram - master hologram



Correct selection of the object position so that the image-capture of a transfer hologram is possible.

Principle

In contrast to normal photography a hologram can store information about the three-dimensionality of an object. To capture the three-dimensionality of an object, the film stores not only the amplitude but also the phase of the light rays. To achieve this, a coherent light beam (laser light) is split into an object and a reference beam by being passed through a beam splitter. These beams interfere in the plane of the holographic film. The hologram is reconstructed with the reference beam which was also used to record the hologram.

Tasks

1. Capture the holographic image of anobject.
2. Perform the development and bleaching of this phase hologram.
3. Reconstruct the transmission hologram (reconstruction beam is the reference beam during image capture).

What you can learn about

- Object beam; Reference beam; Real and virtual image
- Phase holograms; Amplitude holograms
- Interference; Diffraction
- Coherence; Developing of film

Main articles		
He/Ne Laser, 5mW with holder	08701-00	1
Power supply for laser head 5 mW	08702-93	1
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Holographic plates, 25 pieces	08746-00	1
Sliding device, horizontal	08713-00	1
Darkroom equipment for holography, 230 V	08747-88	1

Related Experiment

Holography - Real time procedure

P2260306

Advanced Optics, Holography package incl. manual, 230 V

Function and Applications

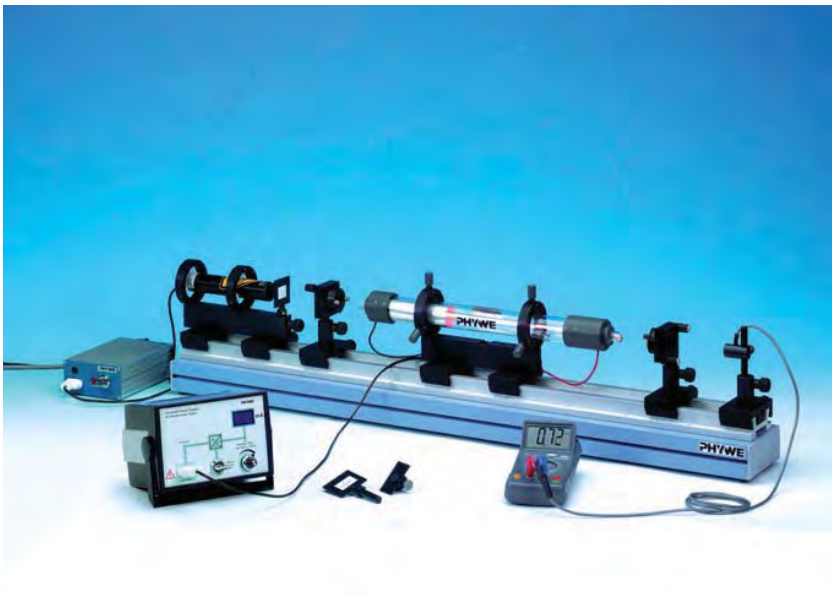
A complete set to perform the following experiments using the experimental system "Advanced Optics" incl. handbook "Holography" with 11 described experiments:

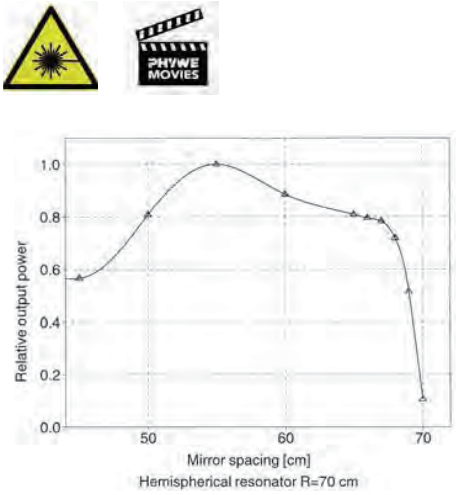
- white light holography
- transmission holography
- transfer a hologram from a master hologram

With the aid of a base plate and magnetic adhering holders, which can be positioned jolt-free, 1- and 2-dimensional setups can be quickly and reliably realised. By folding the lightpaths experiments with larger focal distances can be carried out on the working base. The high stiffness and vibration damping of the base plate allows sensitive holography arrangement to be set up.

08700-55

Helium neon laser, basic experiment P2260701





Relative output power as a function of mirror spacing.

Principle

The difference between spontaneous and stimulated emission of light is demonstrated. The beam propagation within the resonator cavity of a He-Ne laser and its divergence are determined, its stability criterion is checked and the relative output power of the laser is measured as a function of the tube's position inside the resonator and of the tube current. The following items can be realised with advanced set 08656-02. By means of a birefringent tuner and a Littrow prism different wavelengths can be selected and quantitatively determined if a monochromator is available. Finally you can demonstrate the existence of longitudinal modes and the gain profile of the He-Ne laser provided an analysing Fabry Perot system is at your disposal.

Tasks

1. Set up the He-Ne laser. Adjust the resonator mirrors by use of the pilot laser (left mirror: VIS, HR, plane; right mirror: VIS, HR, R = 700 mm).
2. Check on the stability condition of a hemispherical resonator.
3. Measure the integral relative output power as a function of the laser tube's position within the hemispherical resonator.
4. Measure the beam diameter within the hemispherical resonator right and left of the laser tube.
5. Determine the divergence of the laser beam.
6. Measure the integral relative output power as a function of the tube current.

What you can learn about

- Spontaneous and stimulated light emission; Inversion
- Collision of second type; Gas discharge tube; Resonator cavity
- Transverse and longitudinal resonator modes
- Birefringence; Brewster angle
- Littrow prism; Fabry Perot Etalon

Main articles

Exp.Set-Helium-Neon Laser	08656-93	1
Sliding device, horizontal	08713-00	1
Protection glasses HeNe-laser	08581-10	1
Photoelement f. opt. base plt.	08734-00	1
Cleaning set for laser	08582-00	1
Diffraction grating, 600 lines/mm	08546-00	1
DMM, auto range, NiCr-Ni thermocouple	07123-00	1

Related Experiment

Helium neon laser, advanced experiment

P2260705

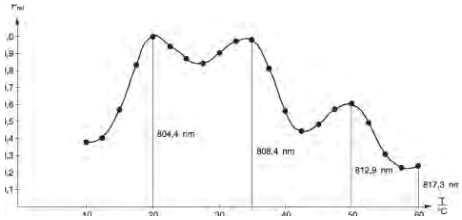
Training recommended

Service PHYWE

For this experiment we recommend a seminar on equipment technology, handling and information of equipment-specific characteristics on site.

03333-02

P2260800 Optical pumping



Relative fluorescent power of the Nd-YAG rod as a function of the diode temperature (wavelength) for I = 450 mA.

Principle

The visible light of a semiconductor diode laser is used to excite the neodymium atoms within a Nd-YAG (Neodymium Yttrium Aluminium Garnet) rod. The power output of the semiconductor diode laser is first recorded as a function of the injection current. The fluorescent spectrum of the Nd-YAG rod is then determined and the maon absorption lines of the Nd-atoms are verified. Conclusively, the mean life-time of the 4F3/2-level of the Nd-atoms is measured in approximation.

Tasks

1. To determine the power output of the semiconductor diode laser as a function of the injection current.
2. To trace the fluorescent spectrum of the Nd-YAG rod pumped by the diode laser and to verify the main absorption lines of neodymium.
3. To measure the mean life-time of the 4F3/2-level of the Nd-atoms.
4. For further applications see experiment "Nd-YAG laser".

What you can learn about

- Spontaneous emission
- Induced emission
- Mean lifetime of a metastable state
- Relaxation; Inversion; Diode laser

Main articles		
Basic set optical pumping	08590-93	1
Sensor f. measurem. of beam power	08595-00	1
30 MHz digital storage oscilloscope with colour display, 2 x BNC cables l =75 cm incl.	11462-99	1
Protection glasses for Nd:Yag laser	08581-20	1
Digital multimeter 2010	07128-00	1

Basic set optical pumping

Function and Applications

The light from a lasersiode is used to excite neodymium atoms in a Nd:YAG crystal.

Benefits

- The power emitted by the laser diode can be measured as a function of the supply current.
- The fluorescence spectrum of the Nd:YAG crystal is analysed and the main absorption lines of the Nd-Atoms are verified.
- Finally the half-life of the 4F3/2-level is estimated.
- With only a small number of additional components it is possible to build a Nd:YAG laser with this system.

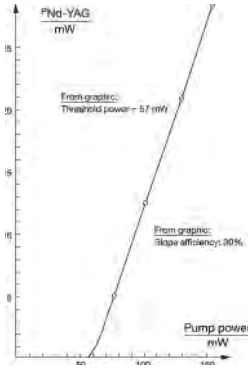
Equipment and technical data

- 1 Flat rail 500 mm with scale
- 1 Laser diode 450 mW in X-Y adjustment holder on carrier
- 1 Control electronics LDS 1200
- 1 Beam shaping optics in holder on carrier
- 1 Beam Focusing in holder on carrier
- 1 Nd:YAG crystal in holder adjustable on carrier
- 1 Filter holder on carrier with filter RG 1000
- 1 Photo detector in holder on carrier and adjustment target
- 3 BNC cables
- 1 IR detector converter screen 800-1200 nm
- 1 Set for optics cleaning
- 1 User manual

08590-93

Nd:YAG laser

P2260900



Nd-YAG laser power output as a function of the pump power = 808.4 nm.

Principle

The rate equation model for an optically pumped four-level laser system is determined. As lasing medium, a Nd:YAG (Neodymium-Yttrium Aluminium Garnet) rod has been selected which is pumped by means of a semiconductor diode laser. The IR-power output of the Nd:YAG laser is measured as a function of the optical power input and the slope efficiency as well as the threshold power are determined. Finally, a KTP-crystal is inserted into the laser cavity and frequency doubling is demonstrated. The quadratic relationship between the power of the fundamental wave and the beam power for the second harmonic is then evident.

Tasks

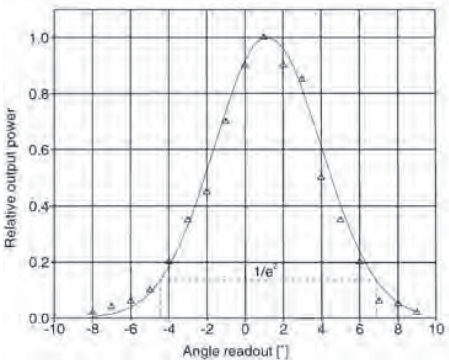
1. Set up the Nd:YAG laser and optimise its power output.
2. The IR-power output of the Nd:YAG laser is to be measured as a function of the pump power. The slope efficiency and the threshold power are to be determined.
3. Verify the quadratic relationship between the power of the fundamental wave, with lambda = 1064 nm, and the beam power of the second harmonic with lambda = 532 nm.

What you can learn about

- Optical pumping
- Spontaneous emission
- Induced emission
- Inversion
- Relaxation
- Optical resonator
- Resonator modes
- Polarization
- Frequency doubling

Main articles		
Basic set optical pumping	08590-93	1
Frequ. doubling crystal in holder	08593-00	1
Nd-YAG laser cavity mirror/holder	08591-01	1
Laser cav.mirror frequ. doubling	08591-02	1
Sensor f. measurem. of beam power	08595-00	1
30 MHz digital storage oscilloscope with colour display, 2 x BNC cables l =75 cm incl.	11462-99	1
Protection glasses for Nd:Yag laser	08581-20	1

P2261000 Fibre optics



Relative output power at the fibre end versus angle readout.

Principle

The beam of a laser diode is treated in a way that it can be coupled into a monomode fibre. The problems related to coupling the beam into the fibre are evaluated and verified. In consequence a low frequency signal is transmitted through the fibre. The numerical aperture of the fibre is recorded. The transit time of light through the fibre is measured and the velocity of light within the fibre is determined. Finally the measurement of the relative output power of the diode laser as a function of the supply current leads to the characteristics of the diode laser such as "threshold energy" and "slope efficiency".

Tasks

1. Couple the laser beam into the fibre and adjust the setting-up in a way that a maximum of output power is achieved at the exit of the fibre.
2. Demonstrate the transmission of a LF-signal through the fibre.
3. Measure the numerical aperture of the fibre.
4. Measure the transit time of light through the fibre and determine the velocity of light within the fibre.
5. Determine the relative output power of the diode laser as a function of the supply current.

What you can learn about

- Total reflection; Diode laser
- Gaussian beam
- Monomode and multimode fibre
- Numerical aperture
- Transverse and longitudinal modes
- Transit time; Threshold energy
- Slope efficiency; Velocity of light

Main articles

Experimental set Fibre optics	08662-93	1
Digital Storage Oszilloscope 200 MHz, 2-Kanal,2 GSa/s	11453-99	1
Screened cable, BNC, l 750 mm	07542-11	2

Charles K. Kao

2009, Nobel Prize in Physics

About PHYWE

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Marie von Ebner-Eschenbach

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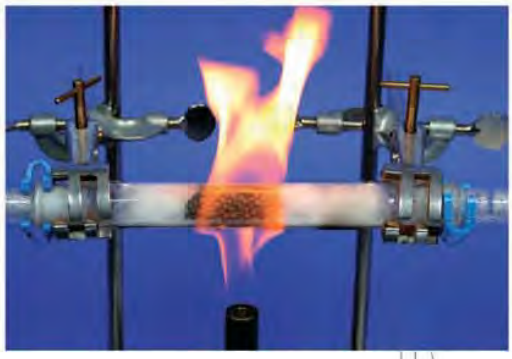
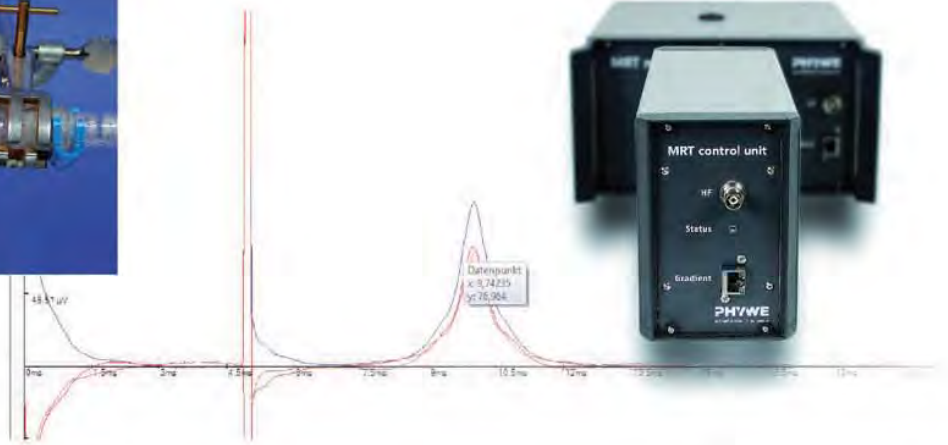




Nobel Prize awarded experiments (Selection)

1900 ...

1901 – Wilhelm Conrad Röntgen

1901 – Jacobus Henricus van 't Hoff

1902 – Hendrik A. Lorentz, Pieter Zeeman

1903 – Henri Becquerel, Pierre Curie, Marie Curie

1908 – Ernest Rutherford

1909 – Wilhelm Ostwald

1910 ...

1910 – Johannes Diderik van der Wals

1914 – Max von Laue

1915 – Sir William Henry Bragg, Sir William Lawrence Bragg

1912 – F. A. Victor Grignard

1918 – Fritz Haber

1920 ...

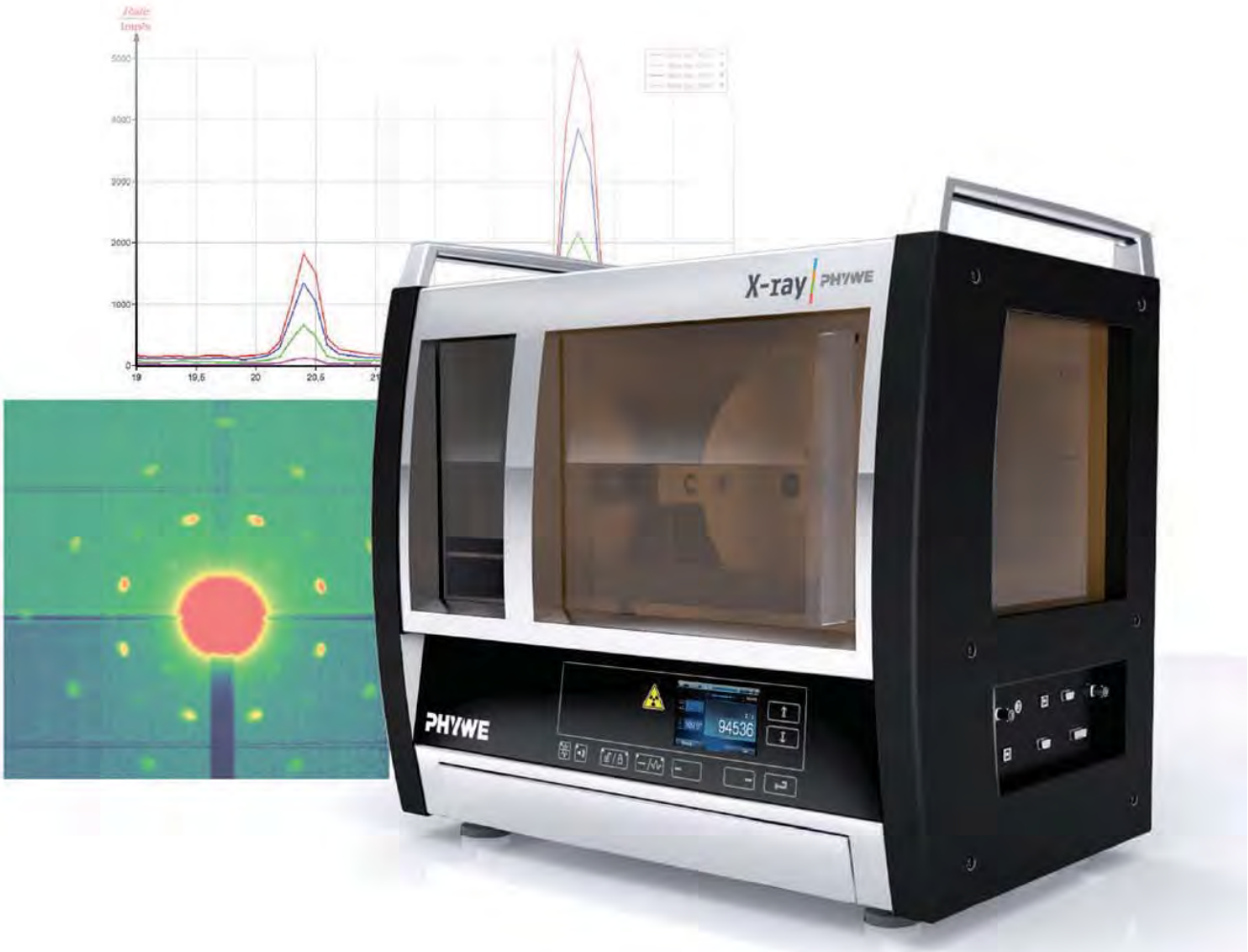
1921 – Albert Einstein

1922 – Niels Bohr, Henrik David

1924 – Manne Siegbahn

1924 – Willem Einthoven

1925 – James Franck, Gustav Hertz



1930 ...

1931 – Carl Bosch, Friedrich Bergius

1932 – Irving Langmuir

1936 – Victor Franz Hess,
Carl David Anderson

1936 – Peter Josephus W. Debye

1940 ...

1943 – Otto Stern

1952 – Felix Bloch, Edward M. Purcell

1952 – Archer John P. Martin,
Richard Laurence M. Synge

1954 – Max Born, Walther Bothe

1970 until today

1971 – Dennis Gabor

1979 – Allan M. Cormack,
Godfrey N. Hounsfield

1986 – Heinrich Rohrer, Gerd Binnig

2003 – Paul C. Lauterbur,
Sir Peter Mansfield

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Oxygen (12676-00)

Forceplate (12661-00)

Colorimeter (12634-00)

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Faraday effect (P2260106)

Chladni's figures (P2150702)