X-ray XR 4.0 | PHYWE

PHYWE
excellence in science

XR 4.0 expert unit

Made for better education

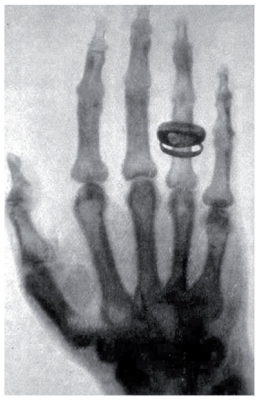
X-ray physics | Structural analysis | Radiography | Computed tomography

Physics Phy | Chemistry Che | Biology Bio | Applied Sciences Sci

1895 Wilhelm C. Roentgen discovers X-radiation –
PHYWE turns it into an experience!

In the 21st century, this discovery has formed the basis for scientific, medical and technical teaching and for research at schools, universities and institutes worldwide.

Roentgen received the first Nobel prize in 1901 for his discovery.



The fascination of X-rays

With the PHYWE X-ray XR 4.0 the physics of X-rays can be utilized in a broad range of 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 patent-pending safety system, innovative software solutions, intuitive graphical user interface as well as extensive accessories packages – **Quality Made in Germany!**

The PHYWE XR 4.0 expert unit was developed in cooperation with:

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

XLAB
Göttinger Experimentallabor für junge Leute e.V.

Part of the curriculum: topic - subtopic	Field of application	Phy	Che	Bio	Sci Med	Sci Geo	Sci Eng
Modern Physics - Atomic Physics Modern Physics - X-ray Physics	Characteristic spectra	x					
Modern Physics - Atomic Physics Modern Physics - X-ray Physics	Bremsspectrum	x					
Modern Physics - Molecular & Solid State Physics	Solid-state physics	x					
Modern Physics - X-ray Physics Inorganic Chemistry - Solid State Chemistry & Crystallography	X-ray diffraction	x	x				
Inorganic Chemistry - Solid State Chemistry & Crystallography Geo Sciences - X-ray analysis Material Sciences - X-ray Structural Analysis	Structural analysis		x			x	
Modern Physics - X-ray Physics Spectroscopy - X-ray Fluorescence Analysis Material Sciences - X-ray Fluorescence Analysis Geo Sciences - X-ray analysis	X-ray spectroscopy	x				x	x
Geo Sciences - X-ray analysis	Rock analysis					x	
Material Sciences - X-ray Structural Analysis Material Sciences - X-ray Fluorescence Analysis	Material analysis		x				x
Non-destructive Testing - X-ray Methods	Non-Destructive Testing (NDT)						x
Medicine/Biology - Radiology Non-destructive Testing - X-ray Methods	X-ray diagnostics				x		x
Medicine/Biology - Radiology Nuclear Medicine - X-ray Dosimetry	Dosimetry			x	x		
Medicine/Biology - Radiology	Radiology / Radiography			x	x		
Medicine/Biology - Radiology Non-destructive Testing - X-ray Methods	Computed tomography	x		x	x		x

XR 4.0 expert unit –
Sets for all applications

Basic set	Core components	Areas of application	Application examples
XRE 4.0 expert set, W **Art. No.** 09110-88 (Basic set with tungsten tube)	■ XR 4.0 expert unit (X-ray device) ■ XR 4.0 software measure X-ray ■ Optical bench ■ TESS expert manual ■ Fluorescent screen ■ USB cable, mains cable + adaptor		■ Basics & applications of X-radiation ■ Radiographic experiments ■ Radiology
XRE 4.0 expert set, Cu **Art. No.** 09111-88	Same as above but with copper tube		
XRE 4.0 expert set, Mo **Art. No.** 09112-88	Same as above but with molybdenum tube		
XRE 4.0 expert set, Fe **Art. No.** 09113-88	Same as above but with iron tube		

Extend the basic set with the respective extension set according to area of application

Extension sets	Core components	Areas of application	Application examples
XRP 4.0 solid-state physics Art. No. 09120-88	■ Goniometer, GM counter tube ■ LiF / KBr single crystal ■ Absorption set		■ Diffractometry ■ X-ray spectroscopy ■ Bragg reflection / bremsstrahlung ■ Characteristic lines
XRC 4.0 characterization Art. No. 09130-88	■ 3 X-ray tubes (Cu, Fe, Mo) ■ Goniometer, GM counter tube, ■ LiF / KBr single crystal		■ Radiation spectra of the anode ■ Moseley law ■ Rydberg constant ■ Duane-Hunt law
XRS 4.0 structure analysis Art. No. 09140-88	■ Goniometer, GM counter tube, ■ LiF / KBr / NaCl single crystal ■ Crystal holder ■ Powder samples		■ Structure investigations ■ Laue patterns ■ Debye-Scherrer images ■ Powder diffractometry
XRM 4.0 material analysis Art. No. 09160-88	■ Goniometer ■ X-ray energy detector ■ Multi-channel analyzer ■ Sample sets		■ X-ray fluorescence spectroscopy ■ Non-destructive testing (NDT) ■ Compton effect ■ Energy-dispersive experiments
XRI 4.0 radiophoto-graphy Art.-Nr. 09150-88	■ Digital SLR camera ■ Radiographic object ■ Model loader ■ Implant model		■ X-ray imaging ■ Radiography ■ Radiology
XRD 4.0 dosimetry and radiation damage Art. No. 09170-88	■ Parallel-plate capacitor ■ Power supply unit 600 V ■ DC current amplifier ■ Camera		■ Dosimetry ■ Degradation ■ Damage ■ Ionization of air
XRCT 4.0 computed tomo-graphy Art. No. 09180-88	■ Direct, digital X-ray image sensor ■ Rotation unit, vertical rotation ■ Measure Tomography software package		■ 3-dimensional reconstruction ■ Cross sections ■ Direct, digital image capture

Complete systems	Core components	Areas of application	Application examples
XR 4.0 X-ray system Art. No. 09057-88	Complete set for all X-ray experiments		All applications
XRE 4.0 X-ray expert set for schools Art. No. 09117-88	Set with copper tube ■ Goniometer, GM counter tube ■ LiF / KBr single crystal ■ Absorption set		Same applications as for Basic set and for Solid-state physics set

XRE 4.0 expert set –
Details at a glance

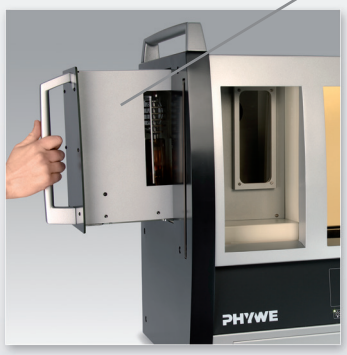
Experience the perfect synthesis of innovative technology, highest level of safety, well-proven PHYWE quality and modern design. Extensive performance characteristics and ideas make working with the PHYWE XR 4.0 a special experience.
We have presented some device highlights for you here.

XXL Chamber

- Large space for large experiments
- Temperature-controlled, internally-ventilated experimentation space

Tube XChange Technology

- Self-adjusting X-ray tubes with quick-change technology
- Contact protection against hot parts
- 4 anode materials for specific experiments (W, Mo, Cu, Fe)

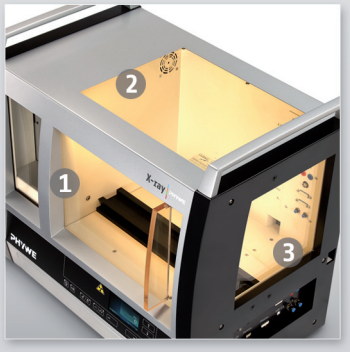


Touch Panel

- Simultaneous control, manually and by computer
- Interactive, intuitive handling
- Self-explanatory icons for fast operation

3View – Insight provides a transparent view

- Exceptional observability of the experimentation space
- Extra-large window front on 3 sides (Diagonals: : 18"/18"/14", 46cm/46cm/36cm)



Optical bench with riders

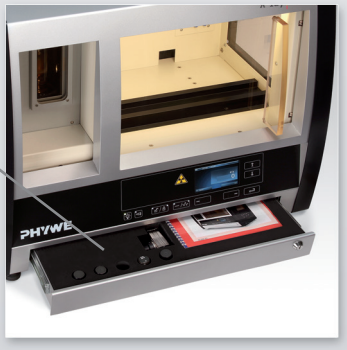
- Radiography experiments
- Simple, precise positioning of optical components

S-Lock – new PHYWE Safety interlock

- Electrical and mechanical safety lock
- Prevents door opening with switched-on X-radiation
- Offers the highest possible safety
- Patent pending

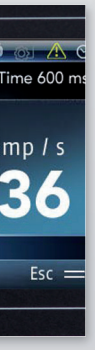
MultiLINK

- Connection field internal and external
- USB 2.0, N_2, BNC, XRED, Aux, etc.
- No annoying cable installation required
- In addition, extra-large cable conduit



Safekeeping drawer

- All accessories are kept safely and always ready at hand
- Lockable



High-resolution TFT backlit display

- Diagonal 4,3“
- 480 x 272 Pixel
- 16 Bit, 65.536 colors
- With LED lighting
- Optimal, dynamic representation of all important device parameters and measured values

Applications of the XR 4.0 expert set –
with three detectors for a wide range of experiments

Geiger-Müller counter tube

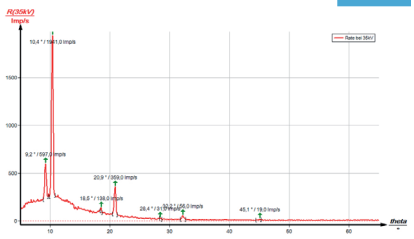
- For high-intensity signals of more than 14,000 counts per second

XR 4.0 X-ray Goniometer

- Self-calibrating
- Self-positioning

Characteristic lines and bremsstrahlung

Phy



X-ray energy detector

- Measure chemical elements starting with potassium
- Use immediately, no warm-up required
- Compact and robust

XR 4.0 X-ray Goniometer

- Self-calibrating
- Self-positioning

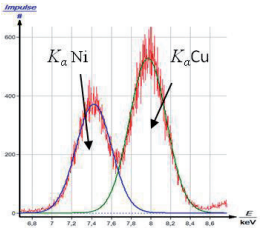
X-ray fluorescence analysis

Phy

Che

Eng

Geo

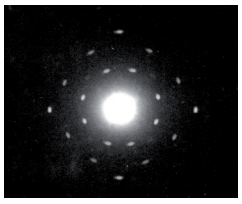


Digital image sensor

- Short exposure time at high resolution (0.5 sec. per image)
- Captures digital image directly
- Compact setup
- Can be used both for CT and for Laue images

Computed tompgraphy

Laue image



Eng Med

Che Phy

Experiment manual „X-ray experiments“

- 46 experiments

Experiment manual „Applications of X-ray Computed Tomography“

- 10 experiments

XRE 4.0 expert set –
Details and technical specifications

The XRE 4.0 expert set includes:

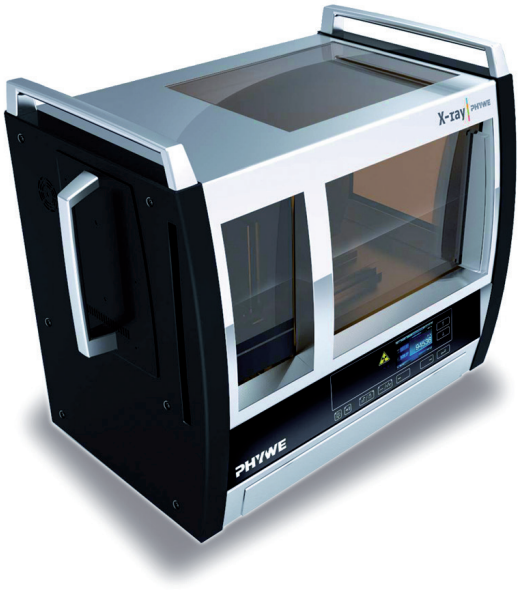
- XR 4.0 expert unit
- XR 4.0 tungsten tube or copper, molybdenum or iron tube
- XR 4.0 software measure X-ray
- TESS expert manual „X-ray experiments“
- USB cable
- Mains cable with adaptor
- Optical bench
- Quick Start Guide
- Operation instruction
- Fluorescent screen

Basic device XR 4.0 expert unit

- Microprocessor-based, basic device with a central safety monitoring, as well as 2 independent monitoring circuits, S-Lock (patent pending)
- 4 different X-ray tubes visible in operation (Fe, Cu, Mo, W) can be used
- Lead-reinforced, acrylic panes for shielding X-radiation, unbreakable
- Integrated display for the representation of measured values and device parameters
- TFT graphics display 480x272 color pixels, diagonal 4,3“
- 65,536 colors with backlit LED lighting
- Experimentation space accessible with operation over operating channel
- Built-in LED array for interior lighting (LED)
- Connection field for easy cabling
- Loudspeaker with the Geiger-Mueller counter tube
- Lockable drawer
- High voltage 0.0...35.0 kV, emission current 0.0 ... 1.0 mA
- Rate measurement unit
- Counter tube voltage: 100 ... 600 V
- Count time: 0.5...100 s
- Exposure time: 0...100 minutes
- Housing W x H x D (mm): 682 x 620 x 450
- Experimentation space W x H x D (mm): 440 x 345 x 354
- Supply voltage: 110/240 V, 50/60 Hz
- Power consumption: 200 VA
- Weight: 55 kg

- Computer controlled via USB 2.0
- Aux: Multi-pole socket (15-pole)
- USB 2.0: Socket for the connection of digital cameras etc.
- Max 600 V: 2 x 4 mm sockets
  For example, for the charge of the capacitor plates (09057-05) for dosimetry experiments
- GM tube: BNC socket for the Geiger-Mueller counter tube (09005-00)
- Motor: Socket for the connection of a motor
- Goniometer: Connection socket for the goniometer (09057-10)
- N_2: For the introduction of protective gas, and for the connection with a vacuum pump
- Operating temperature range 5°C... 40°C, typical 25°C
- Rel. humidity < 70%

- Goniometer:
  - o Angle step: 0,1...10°
  - o Speed: 0,5...100,0 s/step
  - o Samples pivot range: 0...360°
  - o Counter tube pivot range: -30°...+170°
  - o PC control over SubD socket
  - o Two-circuit system
  - o Self-positioning



made in Germany

CE

ISO 9001 DEKRA zertifiziert

DEUTSCHE WELTMARKTFÜHRER STANDARDS

x-ray.phywe.net

Certifications, permits and legal stipulations

EMC Directive 2004/108/EG /
Electromagnetic Compatibility 2004/108/EG
DIN EN 61326-1: 2006-10
Radiated interference: Class A (Emmission: Class A)
Reg TP 322 TE 01: 1998-01
Technical recommendation for usage of EMC (electromagnetic compatibility) laws for teaching aids

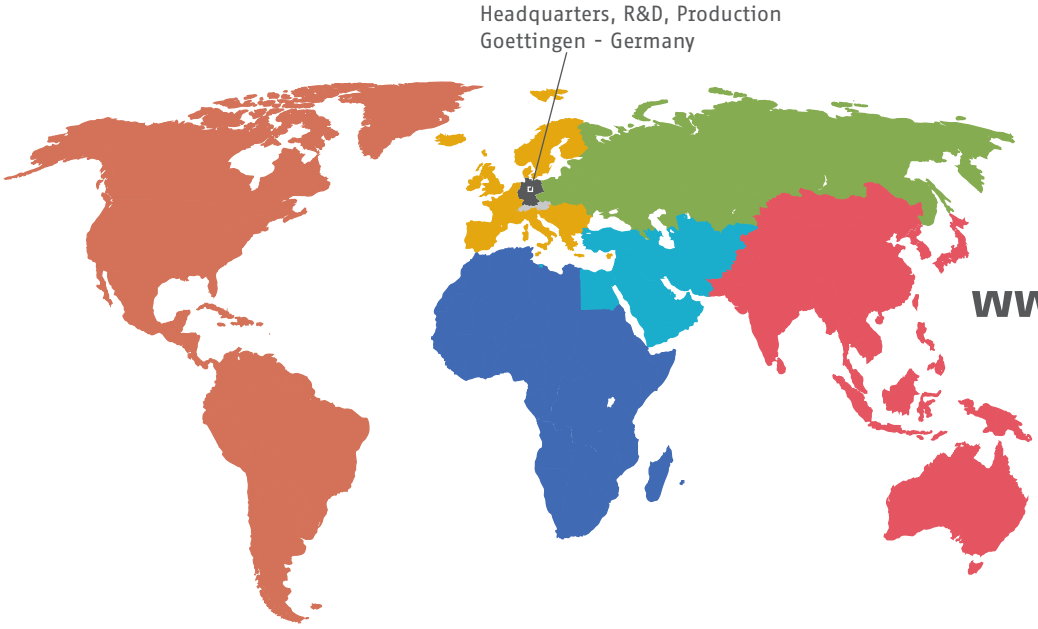
Low-voltage Directive 2006/95/EC
DIN EN 61010 -1: 2010

Dynamic testing of the strength of the cover (especially the panes)
DIN EN 61010 -1: 2010 § 8

Patent pending 10 2011 053 540.3
Design patent 001809237-0001, HABM
Utility patent DE 20 2011 000 396.5 IPC H05G 1/02

PHYWE is certified to **DIN** EN ISO 9001:2008

First-class PHYWE service –
worldwide consultation, ordering and information



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