

# PTW-Freiburg: Detectors for Medical Dosimetry

HEPTech Workshop, 10–11 November 2011



## Outline

- ▶ Introduction to PTW
- ▶ The PTW product family
- ▶ Ionization chambers, electrometers and monitor chambers
- ▶ Our research interests

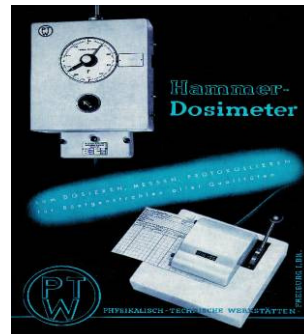
Founded in 1922



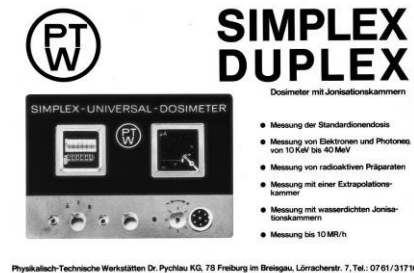
## Contemporary Electrometer Design



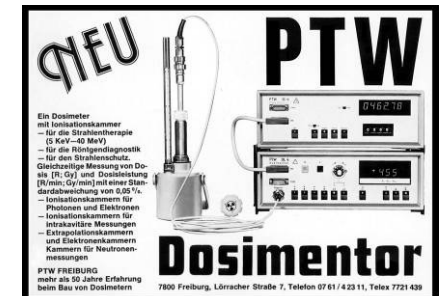
1922



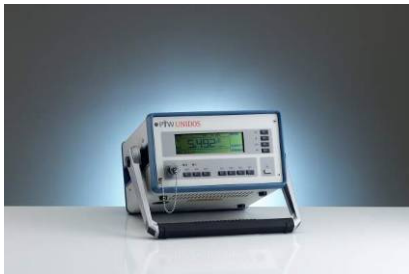
1949



1959



1977



1992



1998



2004



## PTW Today

- ▶ PTW-Freiburg GmbH (1922)
- ▶ PTW-New York Corp. (1995)
- ▶ PTW-France SARL (2001)
- ▶ PTW-Beijing Ltd. (2004)
- ▶ PTW-Latin America Ltd. (2005)
- ▶ PTW-Asia Pacific Ltd. (2007)
- ▶ PTW-UK Ltd. (2008)
- ▶ PTW-India Pvt. Ltd. (2011)
- ▶ Employees: 250
- ▶ More than 60 distributors worldwide
- ▶ ISO 9001 and ISO 13284 certified
- ▶ Accredited calibration laboratory

*Calibration, Service*

*Diagnostic Radiology*

*Radiation Therapy*



- ▶ 90% designed & manufactured in-house

## Calibration Laboratories



### ▶ **PTW-Freiburg**

Secondary Standard Dosimetry Laboratory (SSDL)  
First accredited secondary standard dosimetry  
laboratory of the German Calibration Service DKD  
Accredited by PTB since 1979  
Member of DKD and IAEA network  
12,000 Chamber calibrations per year



### ▶ **K&S Associates**

Accredited Dosimetry Calibration Laboratory (ADCL)  
Accredited by AAPM since 1982  
1,500 Chamber calibrations per year



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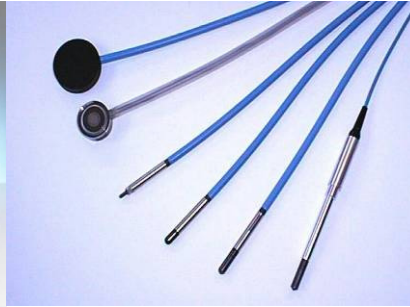
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# The PTW product family

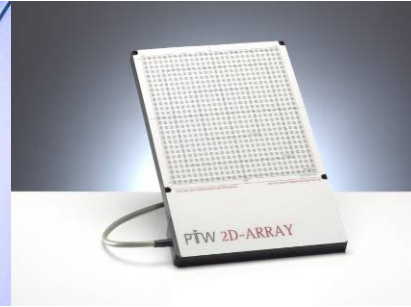
## PTW Product Range



Electrometers



Ionization Chambers



Detector Arrays

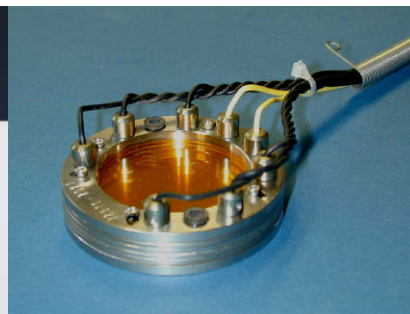


Water Phantoms

X-Ray Test Tools



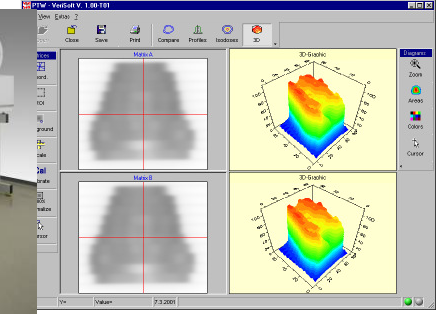
OEM Components



Calibration Benches



Application Software





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### Chambers for Absolute Dose Measurements



#### Farmer Chamber Type 30013

*Waterproof therapy chamber for absolute dosimetry in high-energy photon, electron and proton beams*

- ▶ Calibrate the (photon) radiation output of a linear accelerator
- ▶ Diameter 6.1 mm, length 23.0 mm

### *The Chamber for Water Phantom Scans*



### 0.125 cm<sup>3</sup> Semiflex Chamber

Type 31010

*Standard therapy chamber for scanning systems and for absolute dosimetry*

- ▶ Dose to water measurements in water phantom
- ▶ Profiles perpendicular to the beam and depth profiles
- ▶ Diameter 5.5 mm, length 6.5 mm

## For Particle Beams



### Bragg Peak Chambers

Types 34070, 34073

*Waterproof plane-parallel chambers  
for dosimetry in proton beams*

- ▶ Measure the depth of the Bragg Peak in water
- ▶ 81.6 mm diameter, 2 mm thickness of sensitive volume
- ▶ Low saturation loss in high dose rate
- ▶ Waterproof
- ▶ Intended to be larger than the beam

## Detectors for Small Field Dosimetry



- ▶ Detectors for radiation field sizes of roughly  $1 \times 1 \text{ cm}^2$  to  $10 \times 10 \text{ cm}^2$
- ▶ Many different detectors, depending on the intended use



### Soft X-Ray Chambers



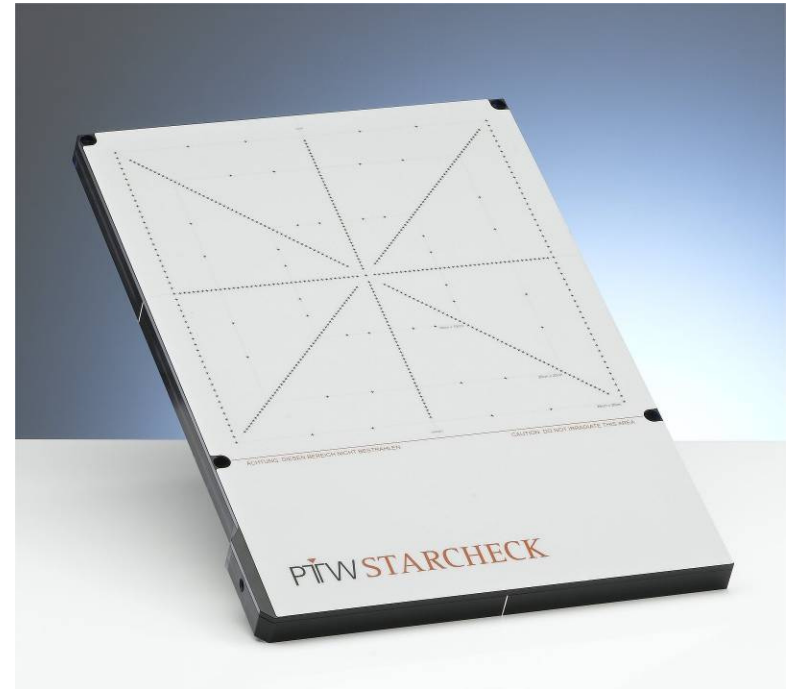
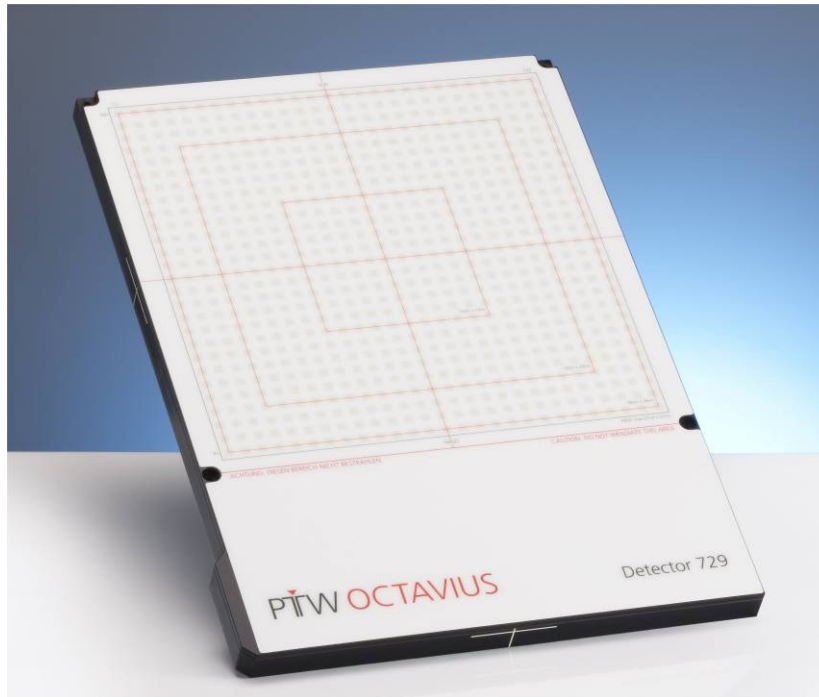
### 0.02 cm<sup>3</sup> Soft X-Ray Chamber

Type 23342

*Thin window plane parallel chamber  
for dose measurements in superficial  
radiation therapy*

- ▶ 8..35 keV X-rays
- ▶ Sensitive volume: 3 mm diameter, 1 mm thickness
- ▶ Other sizes available

### “Pixel” Detectors



- ▶ 5x5 mm<sup>2</sup> air filled ionization chambers on 10x10 mm<sup>2</sup> grid
- ▶ Pre-Treatment verification and QA
- ▶ STARCHECK (detector pitch 3 mm) mainly for QA

### Monitoring the Surroundings of a Beam



### 3 Liter Radiation Monitoring Chambers Types 34031, 32004

*Cylindrical polyethylene ionization  
chambers for stationary radiation  
monitoring of gamma radiation*

- ▶ Measure background radiation level
- ▶ Similar chambers are used in the tunnel of CERN

### Monitoring the Beam Itself



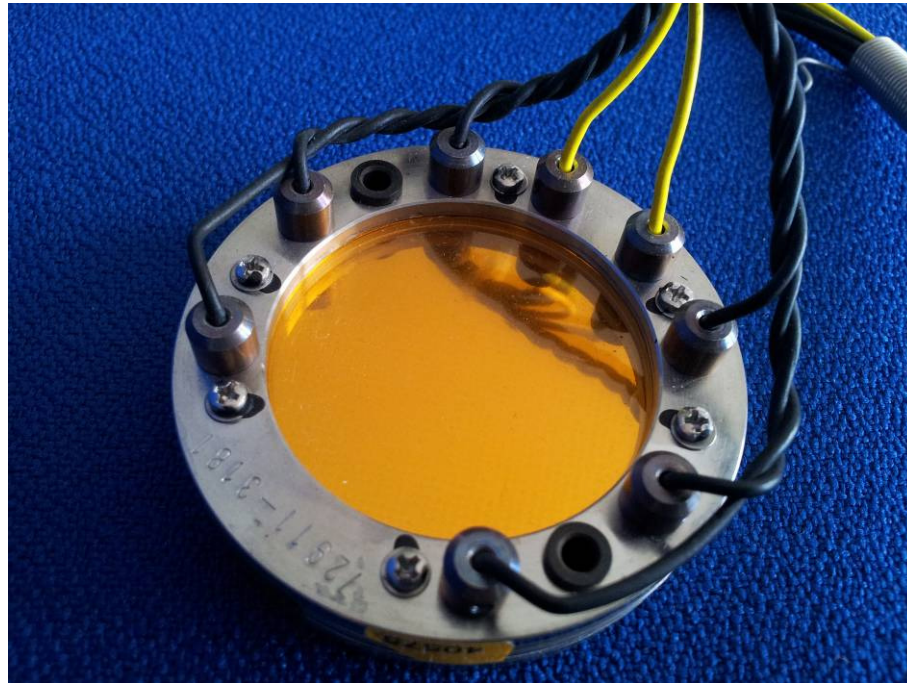
### Monitor Ionization Chambers

Types 34014, 786

*Large size plane parallel transmission chambers for use as dose monitors combined with calibration facilities*

- ▶ Integrate beam output
- ▶ In use in calibration facilities
- ▶ Twin sensitive volumes (two stacked chambers)
- ▶ Chamber intended to be larger than the beam
- ▶ Diameter: 155 mm
- ▶ Radiologically very thin windows (polyimide & graphite)

### OEM Monitor Chambers



- ▶ Most monitor chambers are OEM products
- ▶ Designed especially for the linac manufacturer
- ▶ Usually chambers are segmented for beam localization



### Electrometers

- ▶ High quality electrometers are mandatory in dosimetry
- ▶ PTW dosemeters are among the best electrometers in the world
- ▶ 0.5 % precision at lower end of range of use (IEC 60731)

## The UNIDOS (One Channel)



- ▶ Very precise charge and current measurements
- ▶ UNIDOS<sup>atto</sup>: range down to 2 fA, resolution 10 aA
- ▶ UNIDOS<sup>webliner</sup>: range down to 200 fA, resolution 1 fA
- ▶ But: no compliance, fastest signal acquisition rate 0.5 s

### The TANDEM (Two Channels)



- ▶ Measurement range down to 5 pA, resolution 10 fA
- ▶ Signal acquisition rate down to 10 ms

### The MULTIDOS (12 Channels)



- ▶ Measurement range down to 10 pA, resolution 50 fA
- ▶ Signal acquisition rate down to 0.5 s

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### We Are Generally Interested in...

- ▶ New measurement methods for dose
- ▶ 2D and 3D detecting principles or detectors
- ▶ Solid state low-Z detector media
- ▶ Radiation resistant solid state detectors
- ▶ Detectors for high LET, high dose per pulse or high dose rate applications

Thank You for Your Attention

