

# OCTAVIUS 4D

IMRT • VMAT • SRS/SBRT

Benefits for clinical applications



# OCTAVIUS 4D

## One phantom - modular solutions for 4D patient and machine QA

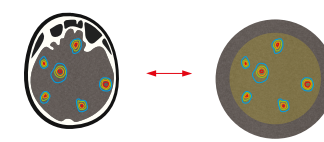
Its innovative modular design, coupled with the best detector technology on the market, makes OCTAVIUS 4D an ideal system for the routine patient and machine QA of all major radiotherapy techniques – from conventional step-and-shoot IMRT to dynamic multiple-arc IMRT treatment plans. Start working with OCTAVIUS 4D by selecting the phantom and detector combination that best fits the required clinical application. The modular system can be upgraded later at any time.

The functional design of the OCTAVIUS 4D trolley allows for the easy positioning of the OCTAVIUS 4D system onto the patient couch. Set up and align the system in just a few seconds.



## Task-specific detector designs and individual patient anatomy adaptation

### Application-specific phantom anatomy



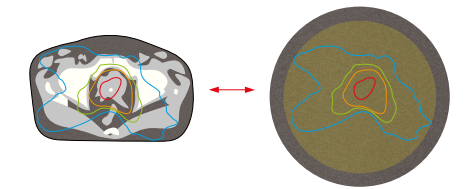
OCTAVIUS top SRS  
Patient QA of head applications

SRS phantom tops with 17 cm or 21 cm diameter approximates to the size of a human head (e.g. for verification of stereotactic brain metastases treatments)



OCTAVIUS top LINAC QA  
Machine QA

Flat machine QA top with 5 cm water equivalent build-up material

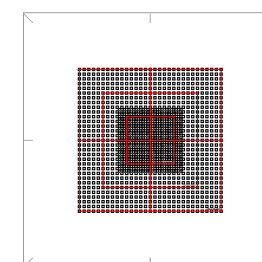


OCTAVIUS top Standard  
Patient QA of body applications

The standard phantom top with 32 cm diameter approximates to the size of a human body (e.g. for verification of usual IMRT/VMAT or SBRT treatments)

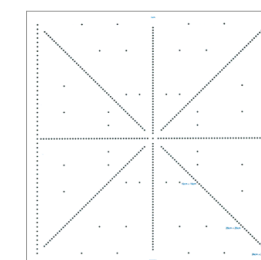


OCTAVIUS Detector 1600 SRS  
High-end SRS/SBRT QA



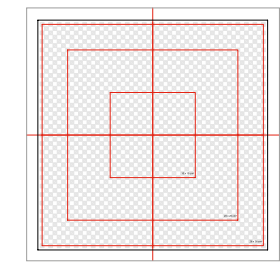
- ▶ Sensitive area: 15 cm x 15 cm
- ▶ 1521 liquid-filled ionization chambers
- ▶ Detector spacing: 2.5 mm (inner area)

STARCHECK  
Optimized machine QA



- ▶ Sensitive area: 26 cm x 26 cm
- ▶ 521 vented ionization chambers
- ▶ Detector spacing: 3 mm

OCTAVIUS Detector 1500  
Advanced IMRT / VMAT QA

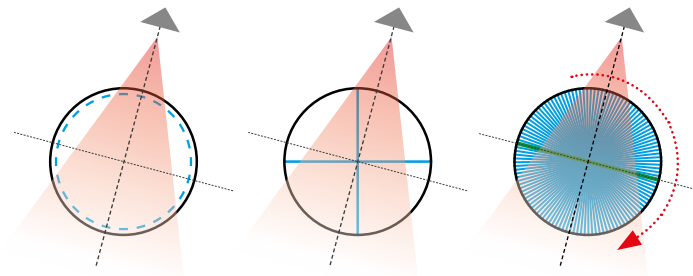


- ▶ Sensitive area: 27 cm x 27 cm
- ▶ 1405 vented ionization chambers
- ▶ Detector spacing: 7.07 mm (diagonal)

## Unique measurement principle

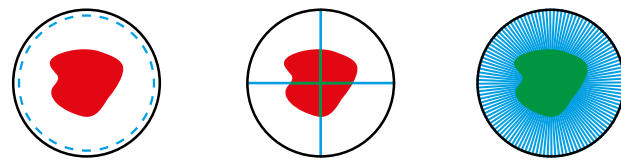
### Transparent measurements

OCTAVIUS 4D measures dose time dependent and angle dependent within a motorized rotational phantom. It ensures perpendicular irradiation of the PTW array detector through synchronous phantom rotation with the linac gantry avoiding any non-transparent, angular dependent dose response corrections.



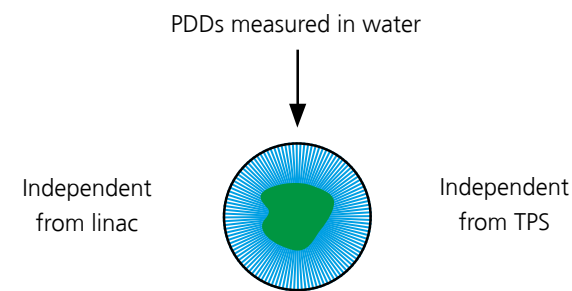
### Full coverage of clinically relevant regions

The measurement principle of OCTAVIUS 4D is the only 4D dose verification system that allows dose to be measured not only at isolated points but throughout the entire phantom volume. This ensures full coverage of all clinically relevant regions such as target volumes and organs at risk.



### Independent QA

OCTAVIUS 4D requires no data input from TPS / linac to achieve a 3D dose volume in phantom and patient. A simple set of PDDs in water - that's all! Unlike other commercially available 4D verification systems OCTAVIUS 4D is completely independent from environmental TPS / linac settings and guarantees maximum reliability in patient QA procedures.



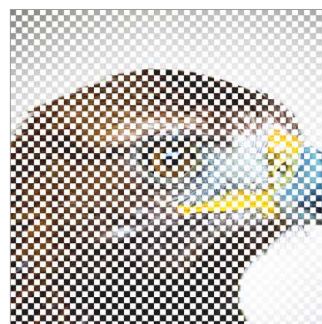
### Outstanding detectors

OCTAVIUS detectors use gold standard ionization chambers known for their outstanding stability and signal-to-noise ratio. With the largest field coverage of available commercial arrays and a detector

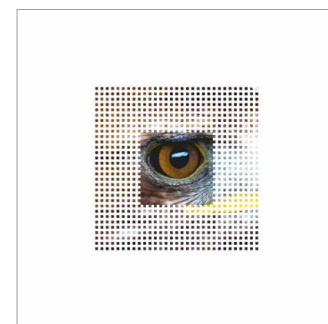
density and resolution perfectly adapted to their application, OCTAVIUS detectors assure highly accurate and reliable measurement of the dose delivered.



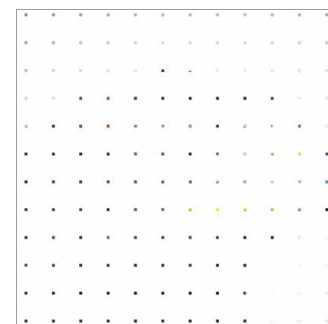
Original picture



OCTAVIUS Detector 1500



OCTAVIUS Detector 1600<sup>SRS</sup>

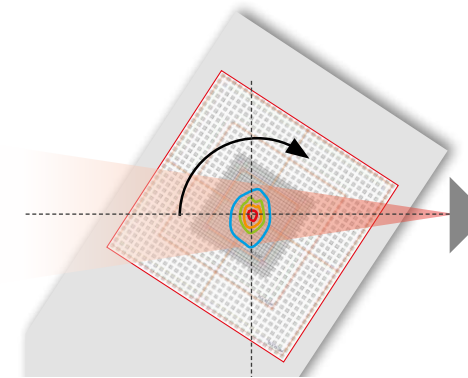


Diodes

## Special measurement approaches

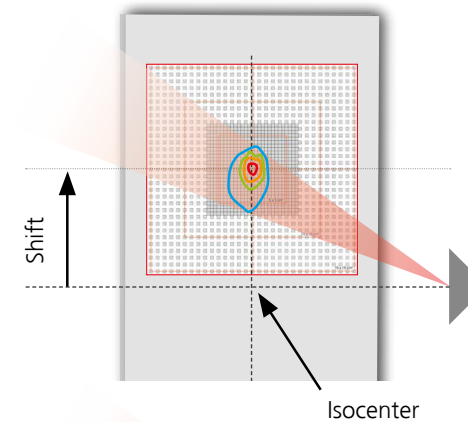
### Non-coplanar

Modern treatments, especially SRS deliveries such as Varian HyperArc™ multiple brain mets SRS planned with Brainlab Elements, use a mixture of coplanar and non coplanar beams to improve dose conformity. The OCTAVIUS software VeriSoft takes the different couch angles into account and allows a true verification of non-coplanar beams with OCTAVIUS 4D.



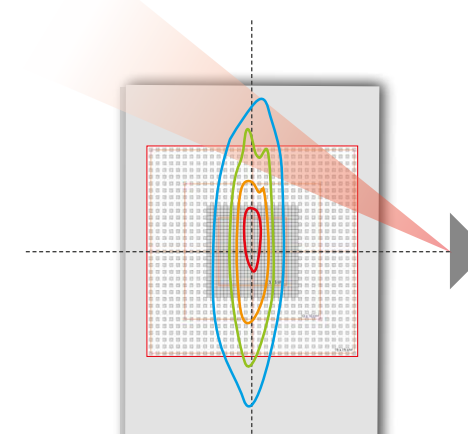
### Off-axis

Some treatments, such as SABR for lung metastases, involve a number of discrete, off-axis target volumes. If the sensitive area of the OCTAVIUS detector does not cover the dose volume(s) entirely OCTAVIUS 4D can be shifted to the region of interest and VeriSoft accounts for geometric changes.



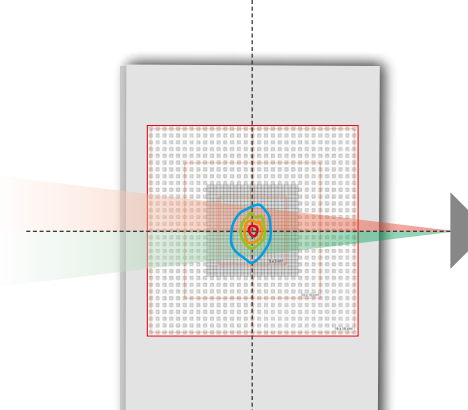
### Large fields

Very long target volumes, such as those typically seen in craniospinal treatments or prostate with nodes, can be verified with OCTAVIUS 4D by merging two 'shifted' measurements. With this method the detector's sensitive area can virtually be extended to a length of 48 cm (OCTAVIUS Detector 1500) in order to fully cover the dose volume(s).



### Multiple energies

Treatment plans can be made-up of beams with multiple energies, for example breast plans with FiF segments or boost fields using different energies. Such 'special' deliveries can be verified with OCTAVIUS 4D. VeriSoft accounts for different energies during dose calculation and allows either composite or beam-per-beam analysis.

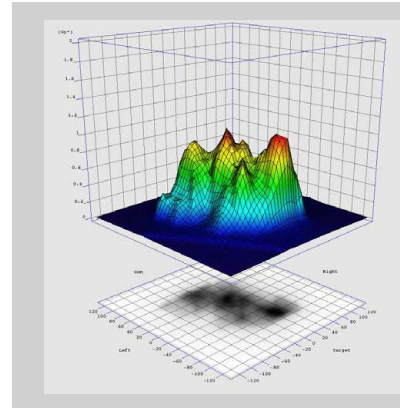




## VeriSoft software

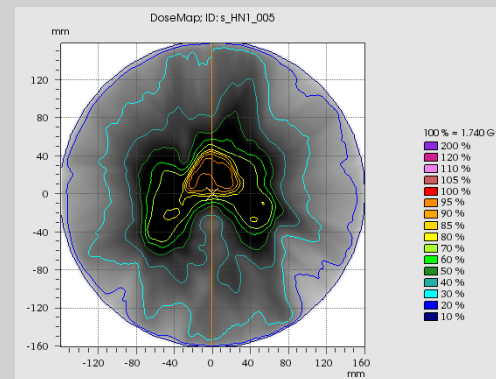
VeriSoft is PTW's sophisticated software solution for patient plan verification, offering all tools to control the OCTAVIUS system and efficiently perform plan evaluations.

### Measurement



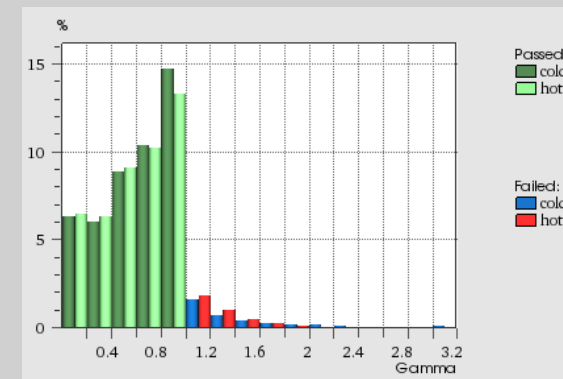
The control of the OCTAVIUS 4D measurement device is provided by an integrated measurement module. An online visualization of the dose measurement and a live representation of the measured gantry angle allow monitoring of the measurement in real time. OCTAVIUS 4D supports measurements at classical C-arm linacs as well as at certain ring-gantry treatment machines.

### Dose distribution visualization



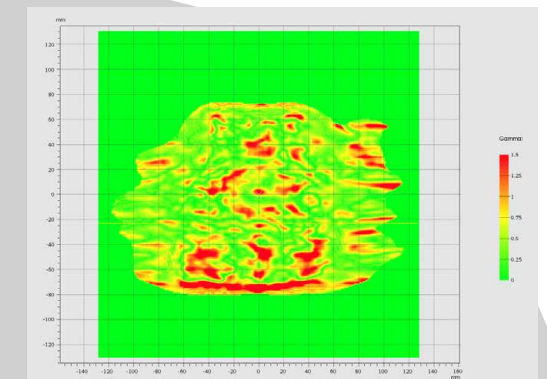
Planned and measured phantom dose distributions can be opposed and visualized in different styles (grey scale, dose colour wash, etc.). Scrolling through the 3D dose matrices is supported in all three planes (axial, sagittal, coronal) and interactive dose profile representations help to get a good impression of the present verification data sets.

### 3D gamma volume analysis



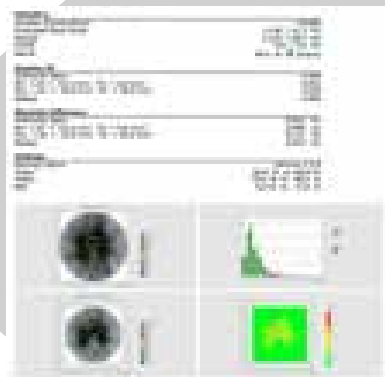
The 3D gamma volume analysis expands the analysis range from a plane to a volume. By calculating the gamma value for each voxel in the entire phantom volume and providing iso-dose level dependent results with histogram representations, the unique 3D volume analysis tool takes the commonly used gamma evaluation one step further.

### 3D gamma visualization



All results from dose distribution comparisons like 3D gamma analysis, failed points investigation or dose difference evaluation are visualized to efficiently interpret existing deviations.

### Documentation



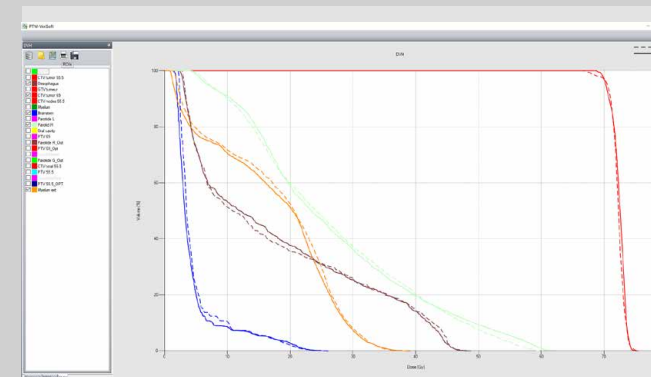
VeriSoft offers comprehensive documentation functionality. Customized reports can be generated and include all relevant QA data and a trace of all steps performed during the verification workflow, such as data entry, data modification, etc.

### Tracking of results



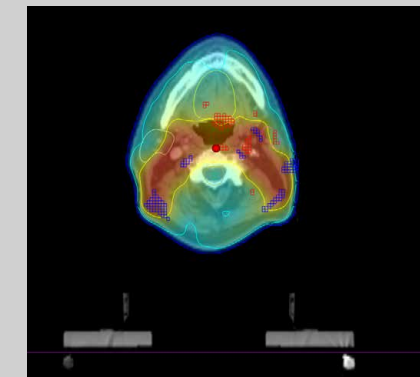
VeriSoft can be connected to the QA data management software Track-it. A regular transfer of case-related compare results (e.g. results from prostate, head and neck, etc. plan verifications) allows a retrospective review of the verification outcomes. The export contains data related to individual patient plan verifications including the verification results, along with the project file and graphics.

### DVH analysis



Dose-volume histograms (DVHs) can be calculated for each structure in the patient's CT and compared against the DVHs calculated by the treatment planning system. As a truly independent plan evaluation tool, DVH 4D requires no dose data from the TPS, but performs its calculations based entirely on patient CT data and OCTAVIUS 4D measurements.

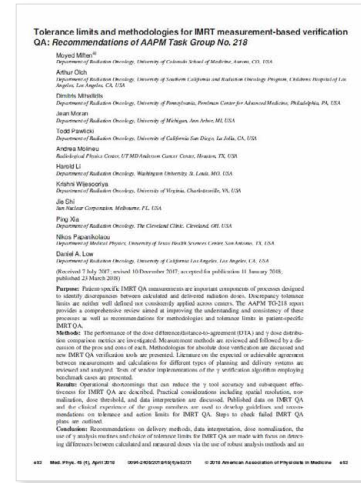
### Failed points analysis



To assist in the evaluation of the accuracy of the dose delivery, the measured dose contours, target volumes and OARs can be overlaid onto the patient's anatomy. The clinical significance of failed points with respect anatomy can be quickly visualised.

## Full compliance with recommendations from AAPM TG-218

AAPM TG-218 represents a guideline outlining safety standards for measurement based patient-specific IMRT QA. It suggests OCTAVIUS 4D as an advanced tool for three-dimensional absolute dose verification. Due to its exceptional measurement approach, a time and angle dependent 2D array measurement within an independently rotating phantom, OCTAVIUS 4D combines the advantages of all the described verification methodologies, especially the true composite (TC) method, as it samples the entire beam data, allows field-by-field analysis in 2D and 3D, detects inaccuracies in MLC- gantry or collimator positioning, accounts for couch attenuation, etc. Furthermore TG-218 suggests tumor / entity-specific tracking of gamma results. In combination with the Track-it-Export functionality, retrospective data analysis and trending of classified results is possible.



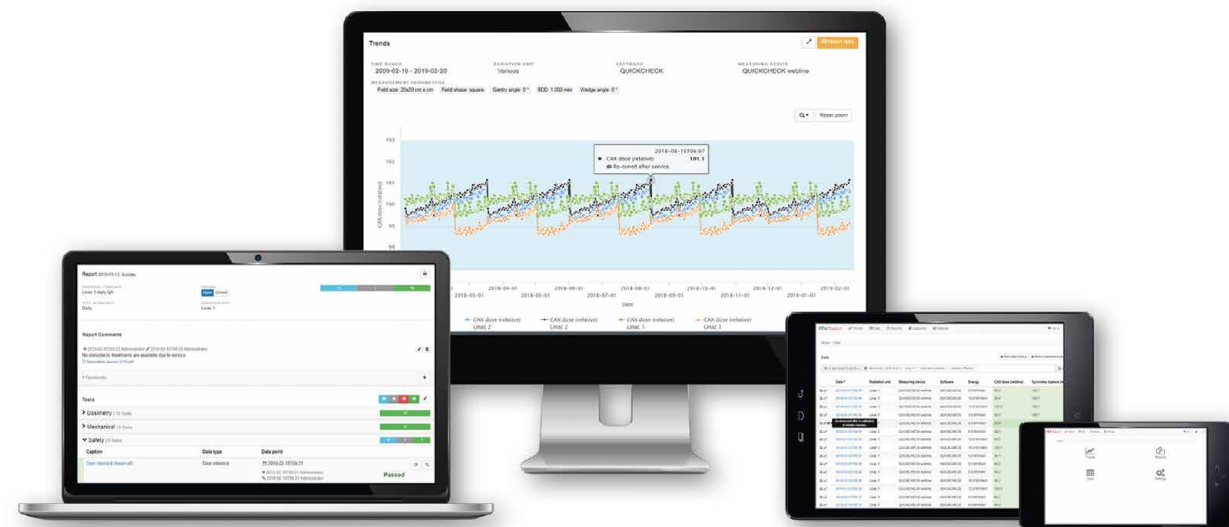
## Integrated QA with Track-it

With respect to risk minimization in radiotherapy TG-218 demands tracking of gamma passing rates across all patients, especially for the same clinical tumor entities, to look for systematic delivery errors. Unlike other vendors OCTAVIUS 4D's evaluation software VeriSoft can be connected to Track-it, a web-based data management platform for retrospective QA data analysis

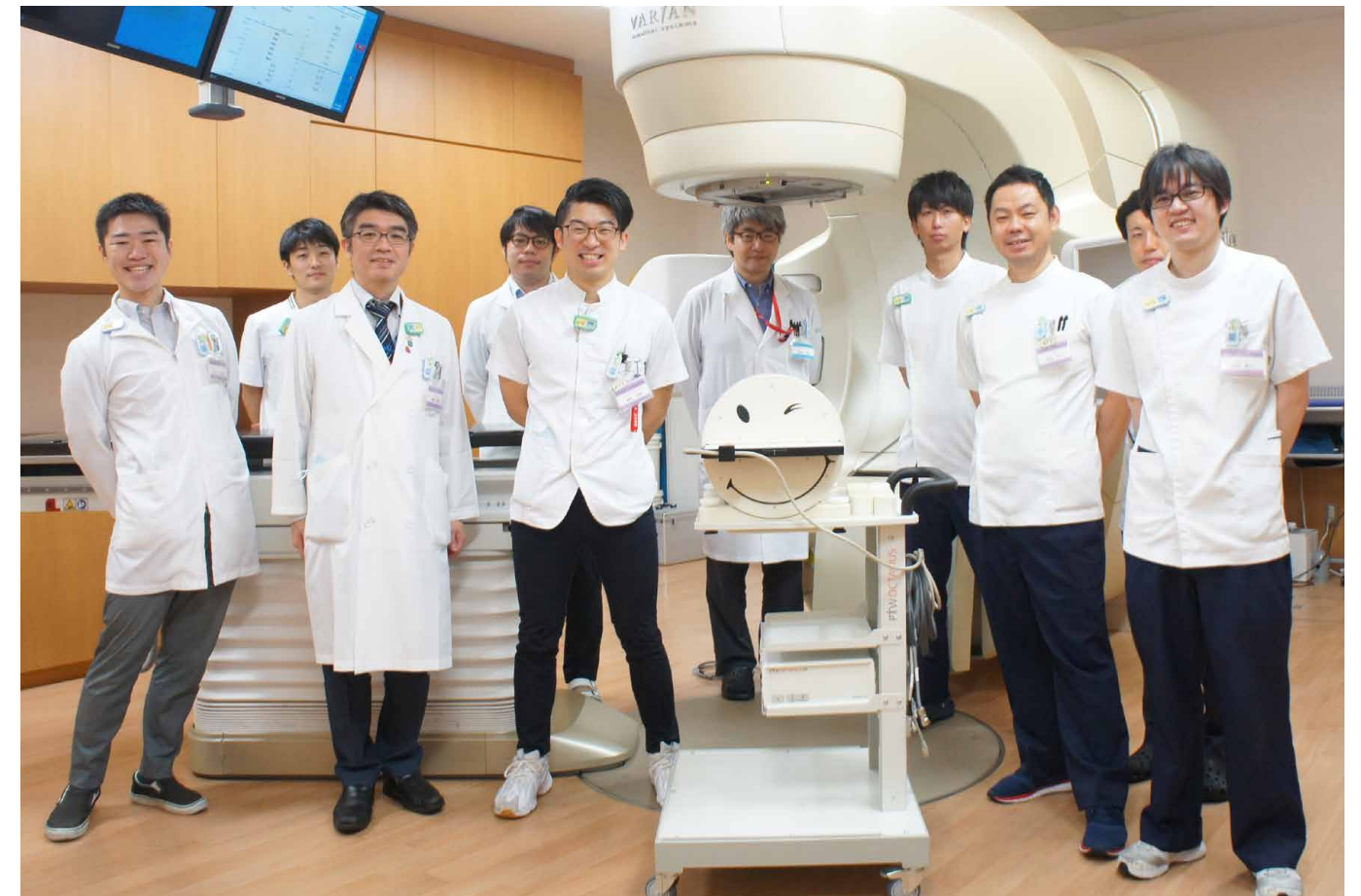
### Key Features of Track-it:

- ▶ Save time and resources by streamlining data management in patient QA. Export and reload your verification results to and from Track-it with the click of a single button.
- ▶ Track and manage patient and machine QA data on one single, consolidated platform and share it fast and effectively across your organization
- ▶ Easily access QA data from multiple sources, devices or satellite sites using a standard web browser
- ▶ Keep track of changes in your verification results over time to initiate action when needed
- ▶ Meet regulatory and audit requirements for a safe and secure documentation of your QA results

The software is tailored to various PTW products, but an open XML interface allows the import of measurement results from third-party devices.



## References



“Beautiful and seamless evolution of the OCTAVIUS system blew our mind. A unique idea of the gantry-synchronized rotating phantom enabled the 3D dose measurement. We have been using the series of OCTAVIUS systems including OCTAVIUS 729, OCTAVIUS 1500, OCTAVIUS II, and OCTAVIUS 4D. Especially among them, the OCTAVIUS 4D gives high resolution, high reproducibility, and high accuracy measurements.”

The acquisition principle of the 3D dose reconstruction is transparent and fully understandable. We are very happy with the OCTAVIUS system providing safe and secure patient specific QA.”

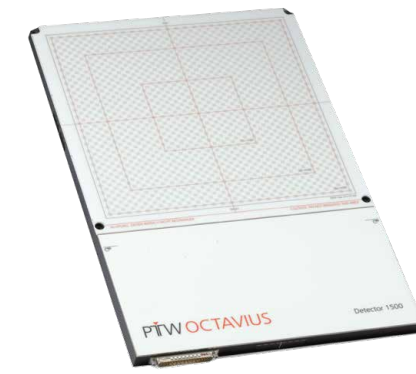
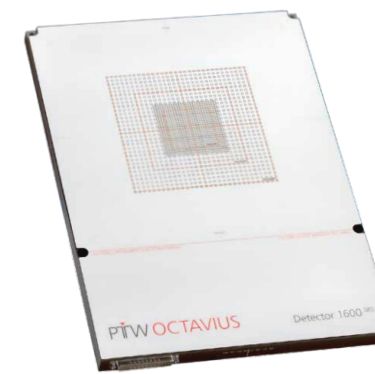
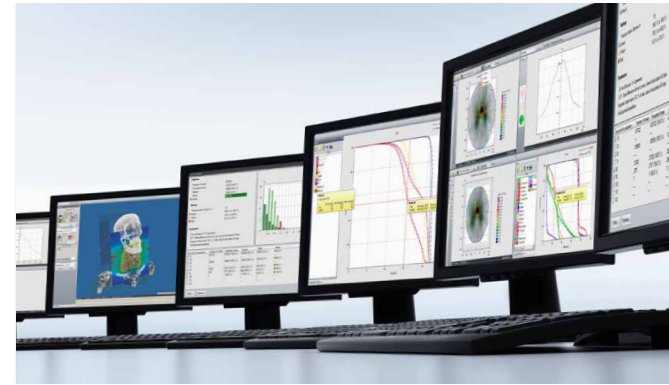
*Takuro Okumura, Medical Physicist,  
Hiroshima University Hospital*

## Publications

- ▶ Yang et al.: Development of a novel methodology for QA of respiratory-gated and VMAT beam delivery using Octavius 4D phantom, Med Dosim. 44(1), Spring 2019
- ▶ Chan et al.: Linking dose delivery accuracy and planning target margin in radiosurgery based on dose-volume histograms derived from measurement-guided dose reconstruction, Phys. Med. Biol. 64, Feb 2019
- ▶ Jevanandam et al.: Improvement of off-axis SABR plan verification results by using adapted dose reconstruction algorithms for the Octavius 4D system, Med. Phys. 45(4), Apr 2018
- ▶ Urso et al.: Practical application of Octavius 4D: Characteristics and criticalities for IMRT and VMAT verification, J Appl Clin Med Phys. 19(5), Sept 2018
- ▶ Swinnen AC et al.: Influence of the jaw tracking technique on the dose calculation accuracy of small field VMAT plans, J Appl Clin Med Phys. 18(1), Jan 2017
- ▶ Van Esch et al.: Implementing stereotactic RapidArc treatments into clinical routine: From algorithm configuration to treatment validation, Med Phys Int. 5(1), 2017
- ▶ Van Esch et al.: The Octavius 1500 2D ion chamber array and its associated phantoms: Dosimetric characterization of a new prototype; Med. Phys. 41(9), Sept 2014
- ▶ McGarry et al.: Octavius 4D characterization for flattened and flattening filter free rotational deliveries, Med. Phys. 40(9), Sept 2013
- ▶ Stathakis et al.: Characterization of a novel 2D array dosimeter for patient-specific quality assurance with volumetric arc therapy, Med. Phys. 40(7), July 2013



## Technical specifications



### OCTAVIUS® 4D modular phantom

Design:	Motorized, modular phantom, consisting of base unit with three exchangeable tops
Dimensions:	Phantom cylinder: diameter 320 mm, length 343 mm
Weight:	Base unit 20,7 kg
Angle range:	± 360°
Material:	Polystyrene
Density:	1.05 g/cm <sup>3</sup>

### Phantom tops

Top standard:	Diameter 293 mm x 317 mm x 137.4 mm, weight 8.9 kg
Top SRS:	Diameter 293 mm x 317 mm x 61 mm, weight 2.3 kg
Top Linac QA:	Diameter 293 mm x 317 mm x 25.6 mm, weight 2.2 kg

### Ordering information

T40063	OCTAVIUS Top Base unit
T40063.1.004	OCTAVIUS Top Standard
T40063.1.002	OCTAVIUS Top SRS
T40063.1.003	OCTAVIUS Top Linac QA
T40063.1.005	OCTAVIUS Top SRS Plus

### OCTAVIUS® 4D Trolley

Description:	Mobile cart for easy system setup on patient couch and safe equipment storage
Dimensions:	93.6 cm x 64 cm x 60 cm, height of lifting plate: 85.8 cm
Weight:	35.5 kg

### Ordering information

T40057	OCTAVIUS 4D Trolley
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### VeriSoft® 7.2 or higher / MultiCheck 3.6 or higher

Operating system:	Microsoft® Windows® (Windows 7 Professional x32/x64, Windows 8 / 8.1 Pro x32/x64, Windows 10 Pro x32/x64)
Processor:	Multi-core processor, 2.3 GHz or higher
Memory (RAM):	Min. 4 GB, 8 GB recommended
Hard disk:	Min. 500 MB of free space for application software and 1.5 GB of free space for .NET Framework 4.5.1
Screen resolution:	1280 x 1024 or higher
Interfaces:	Network interface
Other:	Windows® Internet Explorer® 8.0 or higher, Adobe® Reader® 7.0 or higher
Extend of supply:	VeriSoft® software for patient QA, MultiCheck® software for machine QA

### Ordering information

S070009	VeriSoft
S070011	MultiCheck

### OCTAVIUS® Detector 1600<sup>SRS</sup>

Type of product:	Two-dimensional array with 1521 liquid-filled ionization chambers
Application:	IMRT patient plan verification Machine-specific QA Online beam adjustment
Measuring quantities:	Absorbed dose rate and absorbed dose
Range of use:	0.1 - 24 Gy/min
Resolution:	0.1 mGy, 0.1 Gy/min
Dead time:	Zero
Display cycle:	100 - 800 ms
Type of detectors:	Plane-parallel, liquid-filled ionization chambers
Detector layout:	Center area (6.5 cm x 6.5 cm): spacing 2.5 mm Outer area (15 cm x 15 cm): spacing 5 mm
Nominal response:	16 nC/Gy
Size of detectors:	2.5 mm x 2.5 mm x 0.5 mm (0.003 cm <sup>3</sup> )
Active detector area:	15 cm x 15 cm
Outer dimensions:	300 mm x 420 mm x 22 mm
Weight:	5.9 kg

### Ordering information

L981626	OCTAVIUS® 4D system, 1600 <sup>SRS</sup>
L981628	OCTAVIUS Detector 1600 SRS measuring system
L981627	OCTAVIUS I, 1600 SRS inkl. VeriSoft software
L981642	OCTAVIUS Det. 1600 SRS, upgrade (1000 SRS)
L981454	Accessory package CyberKnife®

### OCTAVIUS® Detector 1500

Type of product:	Two-dimensional array with 1405 vented ionization chambers
Application:	IMRT patient plan verification Machine-specific QA Online beam adjustment
Measuring quantities:	Absorbed dose rate and absorbed dose
Range of use:	0.25 - 48 Gy/min
Resolution:	0.1 mGy, 0.1 Gy/min
Dead time:	Zero
Display cycle:	100 - 800 ms
Type of detectors:	Plane-parallel vented ionization chambers
Detector spacing:	7.07 mm center-to-center (diagonal)
Nominal response:	2 nC/Gy
Size of detectors:	4.4 mm x 4.4 mm x 3.0 mm (0.06 cm <sup>3</sup> )
Active detector area:	27 cm x 27 cm
Outer dimension:	300 mm x 467 mm x 22 mm
Weight:	6.0 kg

### Ordering information

L981438	OCTAVIUS 4D system, 1500
L981382	OCTAVIUS Detector 1500 measuring system
L981449	OCTAVIUS I, 1500 inkl. VeriSoft software
L981450	OCTAVIUS II, 1500 inkl. VeriSoft software
L981452	OCTAVIUS Det. 1500, upgrade (OD 729)
L981468	OCTAVIUS Det. 1500, upgrade (2D-ARRAY)



# Dosimetry Pioneers since 1922.

PTW is a global market leader for dosimetry and quality control solutions in radiation medicine, serving the needs of medical radiation experts in more than 160 countries worldwide. Starting with the famous Hammer dosimeter in 1922, the German manufacturer is the pioneer in medical radiation measurement, known for its unparalleled quality and precision.

For PTW, making medical radiation safer is both a passion and lifetime commitment. The family-run high-tech company operates the oldest and largest accredited calibration laboratory in the field of ionizing radiation and established THE DOSIMETRY SCHOOL to globally promote the exchange of knowledge in clinical dosimetry.

For more information on OCTAVIUS® 4D visit [ptwoctavius.com](http://ptwoctavius.com) or contact your local PTW representative: [ptwdosimetry.com/en/contact-us/local-contact](http://ptwdosimetry.com/en/contact-us/local-contact)

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