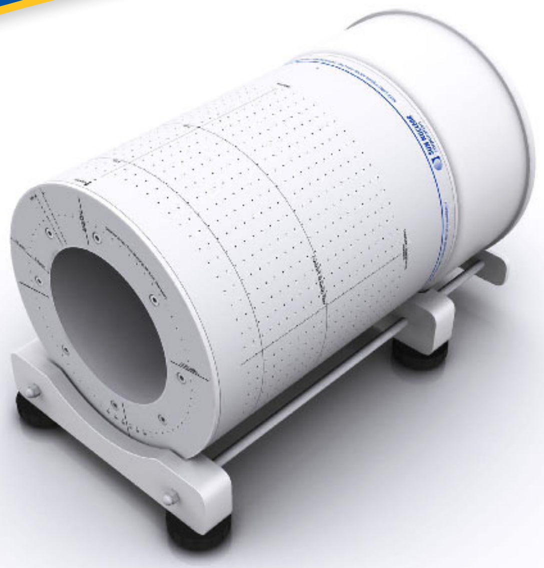
SUN NUCLEAR corporation



ArcCHECK™

The Ultimate 4D QA Solution

A 4D isotropical cylindrical detector array for Rotational Delivery QA and Dosimetry

What is ArcCHECK?

ArcCHECK -

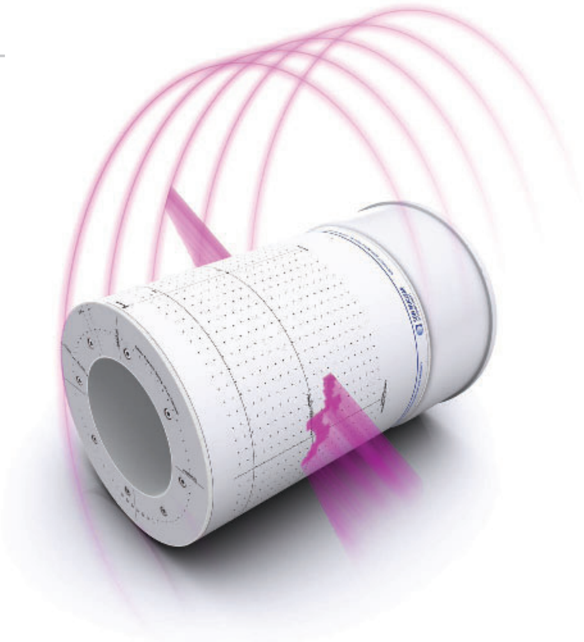
- The world's first *true* 4D detector array
- The world's first cylindrical detector array
- The world's first array designed specifically for rotational dosimetry

Applications -

- Imaging, machine, room, and setup QA
- Patient plan QA
  - RapidArc™, VMAT and TomoTherapy®
  - Routine IMRT and 3D conformal

Key Benefits -

- Smallest available detectors for accurate measurements
- Consistent BEV regardless of gantry angle
- High detector density in BEV
  - More than 230 detectors in central 10x10cm
- Easy setup
  - Lightweight (16kg)
  - Only one cable connection
- Measure both composite and sub-arcs
- Real-time updates (50ms)
- Versatile cavity for detector inserts



Compatible with:

VMAT
TomoTherapy®
RapidArc™
Traditional IMRT
Pinnacle³ SmartArc™

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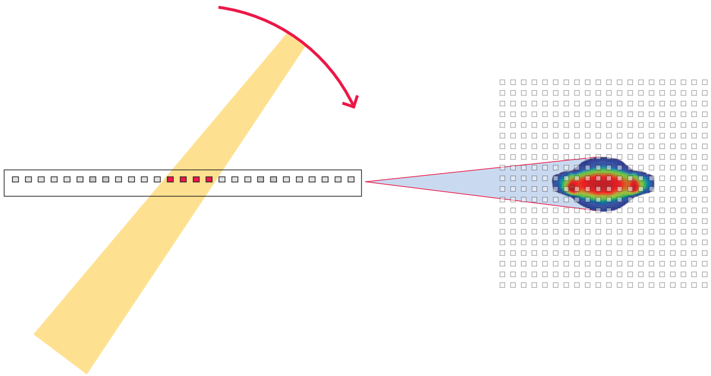
With ArcCHECK, see the entire picture

Below is what a 2D array and ArcCHECK will see for the same plan measurement. Unrolling ArcCHECK dose makes it possible to see much more, highlighting areas that would not normally be seen with a 2D array. The unique cylindrical (helical) design of the ArcCHECK enables failure mode mechanism analysis.

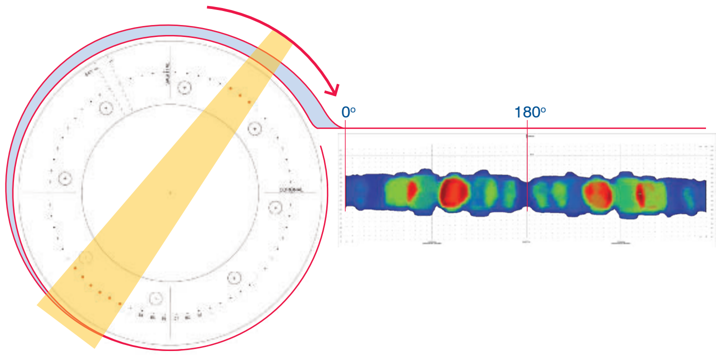
Measure and correlate gantry angle, leaf end position, absolute dose and time (4D) to identify the source of the error. Error sources include the Treatment Planning System, Linear Accelerator, imaging system, setup and the MLC position errors.

What you see with a 2D array

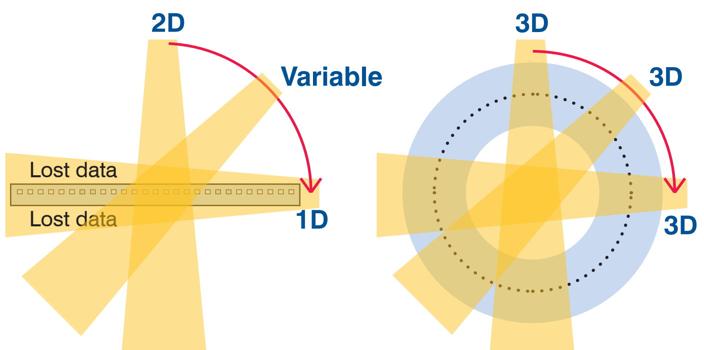


2D Array Measured: With a 2D array, only a fraction of dose information is available, this is inherent with all available 2D arrays

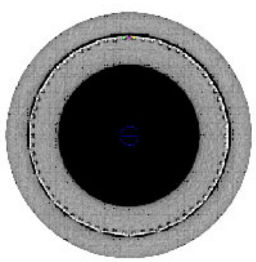
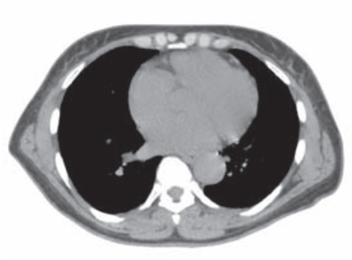
What you see with ArcCHECK



ArcCHECK Measured: A cylindrical array displays BEV dose distribution throughout the entire rotational delivery. More data is available to perform a more thorough QA analysis



Coherent. ArcCHECK detectors and their angle of incidence remain coherent to the delivery beam regardless of angle. The BEV detector geometry does not change based on angle. When a 2D array is irradiated obliquely, the 2D array degrades to 1D. Even if there is no detector shadowing effect, significant information is lost on a 2D array

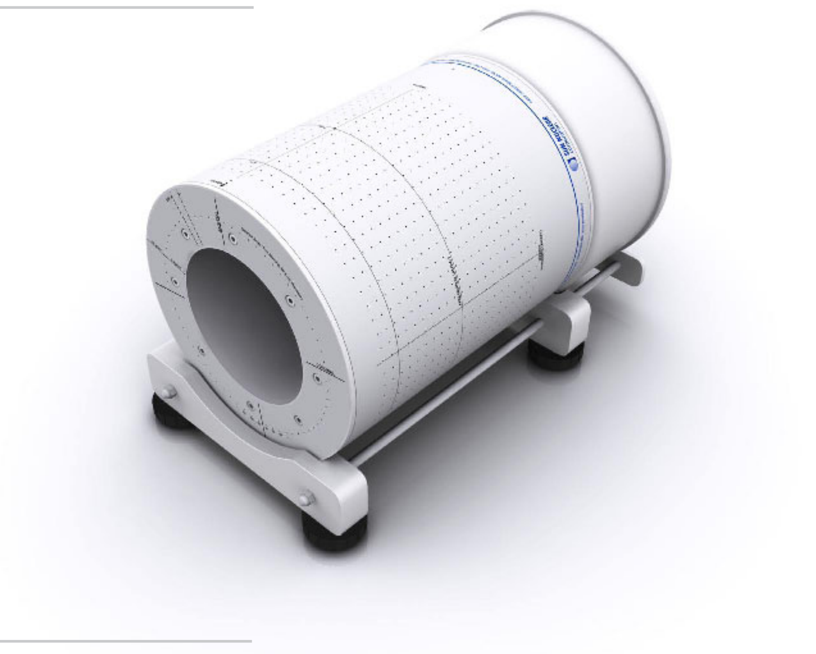



Shape. Phantoms are ideally shaped like a patient. The cylindrical design of ArcCHECK intentionally emulates patient geometry to better match reality. Solid inserts are available to provide homogeneous density.

Ease of use

As with all Sun Nuclear solutions, efficiency is an essential part of the ArcCHECK design.

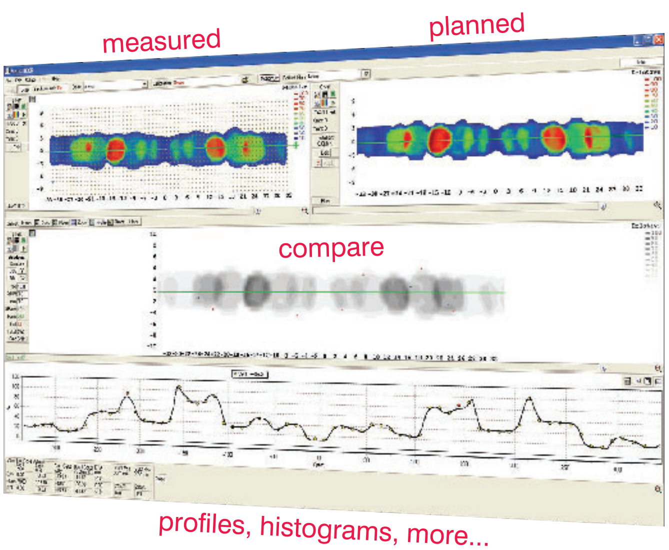
- Single power/data cable. Manages all power and data in one connection.
- Integrated electronics. ArcCHECK is self-contained with no electronics to setup separately. And unlike 2D arrays, a separate phantom is not needed.
- Lightweight (16kg). ArcCHECK is easily portable for daily use without the need for a separate cart.
- Quick setup. The included cradle holds ArcCHECK securely and provides leveling.



Software

The ArcCHECK interface is built upon MapCHECK software; a powerful and proven patient QA and analysis application in clinical use in over 1500 MapCHECK installations since 2002.

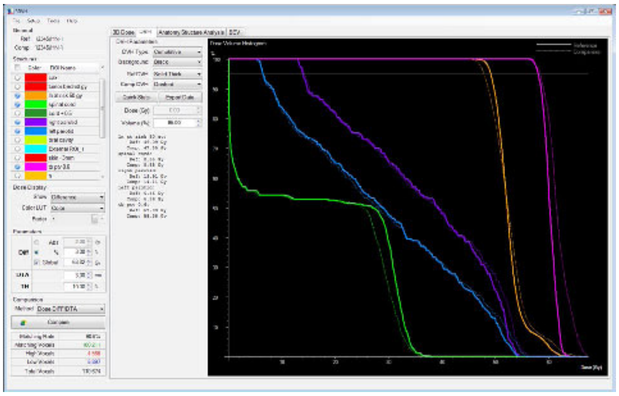
- ArcCHECK QA plans are in three dimensions. DICOM RT Dose is imported and ArcCHECK software then extracts 3D dose corresponding to detector locations, and performs a comparison.
- The same analysis and workflow options from MapCHECK are available in ArcCHECK.
- All data files from ArcCHECK are an open format for easy export, including raw data.
- See the MapCHECK family datasheet for more information on software features.



DVH Analysis (3DVH™)

3DVH will be available for ArcCHECK in November of 2010 and is available for MapCHECK today. This patent pending method will enable the comparison of measured and planned DVH's without the complications of a secondary dose algorithm. The planned DVH is extracted from the DICOM patient plan file, then compared to the ArcCHECK measured DVH result.

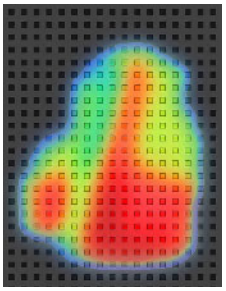
DVH Comparisons



Your Most Valuable QA and Dosimetry Tools

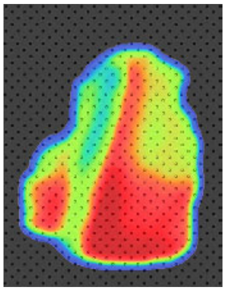
SunPoint Diode Detectors: The Right Choice for Rotational QA

Smaller detectors provide pinpoint sized sampling of dose data proven to detect errors over an entire field, both in and out of gradient. Attempts to measure the entire field by increasing the detector size creates a blurred measurement in dose gradients. Such measurements are counter-productive to accurate and useful dose sampling.



Chambers ▶
Ion chamber measurements lack high-resolution, resulting in a blurred measurement

EPID/Film ▶
Superior density and resolution, however absolute dose, accuracy, uniformity and reproducibility need to be verified



Diodes ▶
Diodes, with proper spacing are capable of accurate, reproducible high-resolution measurements

Benefits of SunPoint Diode Detectors:

- **Smaller Active Area**
- **Better Sensitivity**
- **Thinner Active Thickness & Volume**
- **Less Drift**
- **No Dose Volume Averaging**

SunPoint Diode Detectors: Frequently Asked Questions

- **Calibration.** SunPoint Diode Detectors are very stable. Users typically calibrate every one to three years using Sun Nuclear's patented 15 minute WFC method. Sun Nuclear developed and owns a patent on Wide-Field Calibration (WFC). WFC affords users an easy, accurate, and independent calibration method. WFC is used for ion chamber and diode array products and is a benefit to all Sun Nuclear array product users. Every Sun Nuclear array product receives a factory calibration using our factory Varian 2100C. WFC provides the user the ability to calibrate their Sun Nuclear product with their own linac, at any time they wish.

- **Absolute dose:** SunPoint Diode Detector based instruments measure the absolute dose accurately with the dose calibration of the reference detector to the standard accelerator output, exactly as an ion chamber device would do.

- **Repeatability:** SunPoint Diode Detectors utilize proprietary radiation hardened diodes (n-type) which have been proven to be highly reproducible at 0.2%. Sensitivity change is less than 0.5%/ kGy with a 6 MV beam, and 1.5%/ kGy with a 10 MeV beam.

- **Sensitivity as a function of accumulated dose.** SunPoint Diode Detectors exhibit consistent sensitivity with accumulated dose. Sensitivity variation is < 0.5%/kGy at 6MV, <1.5%/kGy at 10 MeV. The benefit is infrequent array calibration (< once per year) even when detectors receive different accumulated doses.

- **Sensitivity as a function of dose per pulse.** Unlike other diodes from different manufacturers, SunPoint Diode Detector sensitivity only changes about ±1% for 600-fold changes in dose per pulse[2]. Semiconductor diodes can remain linear with dose per pulse after very high accumulated dose. [3,4]

- **Dose rate dependence.** The dose rate dependence of the SunPoint Diode Detectors is < 2% from 50 to 600 MU/min. For most applications, including RapidArc, dose rate dependence is not an issue since the dose rate does not change in a very wide range. If the dose rate varies significantly during the measurement session, a median dose rate (such as 160 MU/min) for the dose calibration will reduce the dependence to < +/- 1%.[1,2]

*For detailed information on SunPoint Diode etectors, please ask for our Diodes vs. Chambers document

Hardware

Leading Specifications

- 1386 SunPoint™ Diode Detectors
- 21.0cm array diameter and length
- 2.9cm phyical detector depth
- User calibrated
- Only one cable connection
- Lightweight -16.0kg

Cylindrical Advantage: Coherent QA

- BEV is consistent regardless of angle
  - Detectors remain coherent to beam vectors
- Measure entrance and exit dose
- Versatile central cavity
- Cylindrical array is shaped like a patient

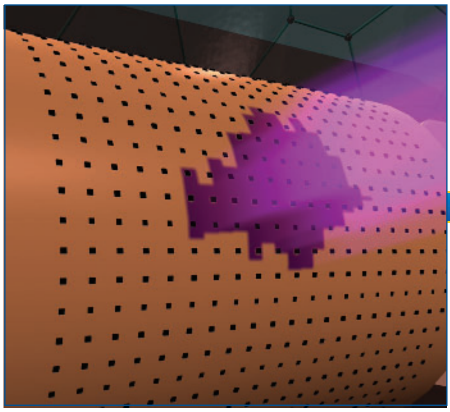
Central Cavity

- Reduces weight
- Tests TPS model
- Accommodates inserts and detectors

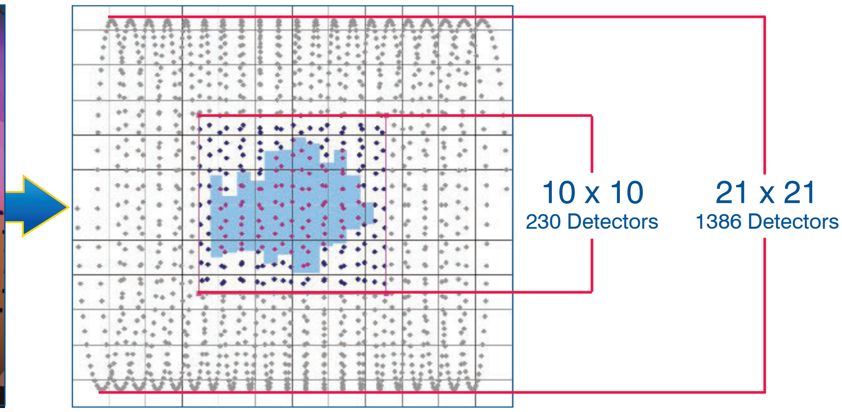
HeliGrid™

- Helical detector geometry
- Less detector overlap from a BEV perspective
- Increased detector density

Beam Simulation

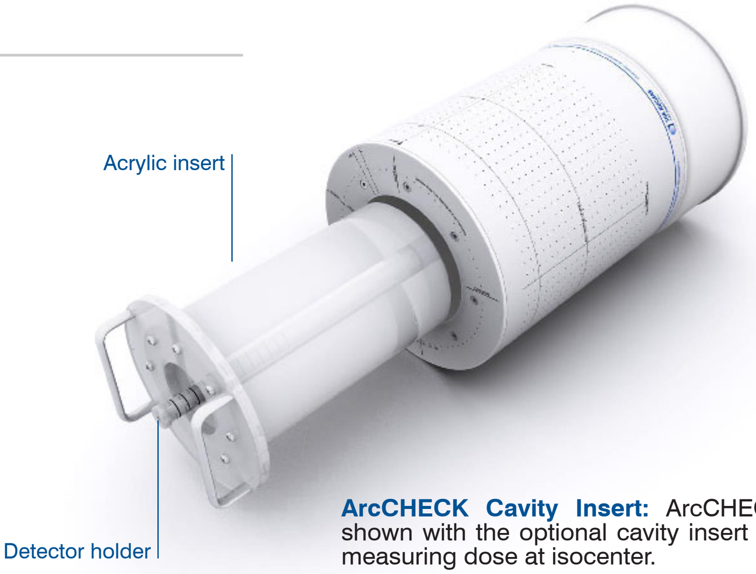


ArcCHECK Detector BEV



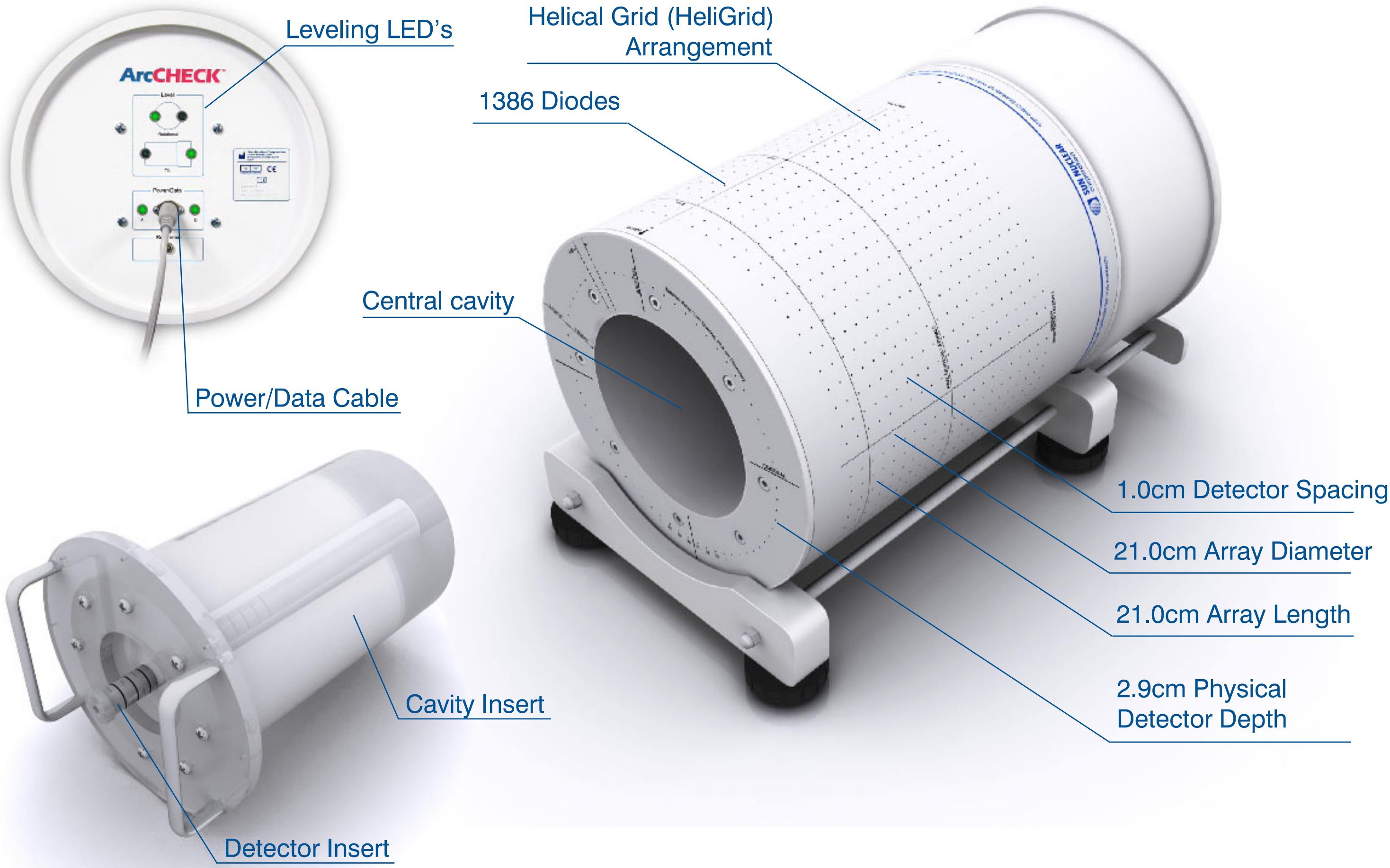
Stringent measurement

ArcCHECK measures entry before the isocenter, and exit dose after the isocenter at two effective depths for every angle. Measuring completely around the isocenter in a uniform manner for each angle is a more stringent measurement than a simple composite dose at the isocenter. Errors visible in the isocenter will also be visible in the surrounding dose measurements, but in more detail.[1] For those who would like to measure the dose at isocenter or target, Sun Nuclear offers a cavity plug option with detector insert.



ArcCHECK Cavity Insert: ArcCHECK shown with the optional cavity insert for measuring dose at isocenter.

Features, Specifications and References



Detector type:	SunPoint Diode Detectors
Detector quantity:	1386
Detector spacing (cm):	1.0
Array diameter (cm):	21.0
Array length (cm):	21.0
Cavity diameter (cm):	15.0
Inherent buildup (g/cm^2):	3.2
Inherent backscatter (g/cm^2):	3.2
Detector physical depth (cm):	2.9
Array geometry (cm):	Helical Grid (HeliGrid) 1cm offset
Phantom Material:	PMMA (Acrylic)
Active detector area (mm^2):	0.64
Detector volume (cm^3):	0.000019

Detector stability:	0.5%/kGy at 6MV
Dose rate dependence:	± 1%, 75 - 250cm SSD
Update frequency (ms):	50
Radiation measured:	• Electrons, 6 MeV to 25 MeV • Photons, Co-60 to 25 MV
PC Hardware:	2 CPU Core, 1.6 GHz CPU Speed, 2 GB RAM
Number of connection cables:	Single power/data cable
Dimensions (cm^2) / Weight (kg):	27.0 x 43.0 / 16.0
Operating system:	Windows 2000, XP 32-bit, or Vista 32-bit
Minimum Requirements:	2 GB RAM, 1 available USB port, Dual-core processor, 50 MB hard disk space, 4 MB VGA video card (1024 x 768), 16-bit color depth
Recommended Requirements:	16 MB video RAM, OpenGL harware accelerated video card

1 "Novel dosimetric phantom for quality assurance of volumetric modulated arc therapy", Daniel Létourneau, Julia Publicover, Jakub Kozelka, Douglas J. Moseley and David A. Jaffray, Medical Physics, Vol. 36, No. 5, May 2009

2 "Modeling the instantaneous dose rate dependence of radiation diode detectors", J. Shi, W.E. Simon, T.C. Zhu, Med. Phys. 30 (9), 2509-2519 (2003).

3 "Performance evaluation of a diode array for enhanced dynamic wedge dosimetry", T. C. Zhu et al, Med Phys 24, 1173-1180 (1997).

4 "Dose rat and SSD dependence of commercially available diode detectors", AJ S. Saini and T. C. Zhu, Med. Phys., 31 (4), 914-924 (2004).

SunPoint™ PRECISION QA

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