Using Automated Phantom Analysis to Improve Imaging and Volumetric Quality Metrics

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The Phantom Laboratory, Inc.

CT Phantoms

Basic Imaging Performance

- CT number accuracy
- Uniformity and noise
- High contrast resolution
- Low contrast resolution
- Slice thickness

Corgi CT Phantom

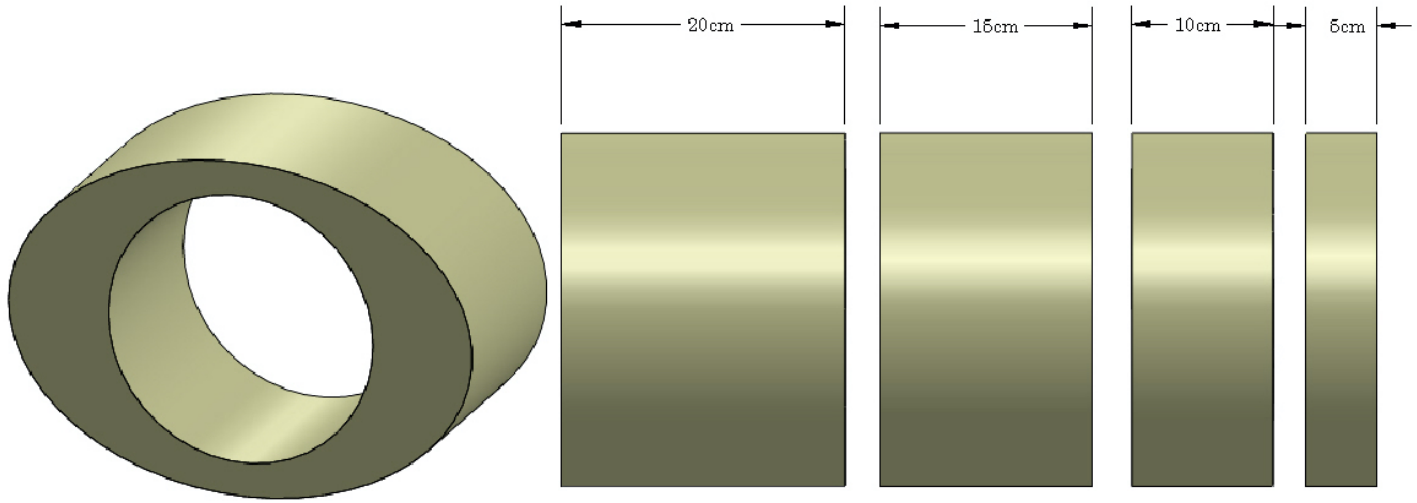
Ideal for small CT systems including dental and extremity scanners.

Tests include:

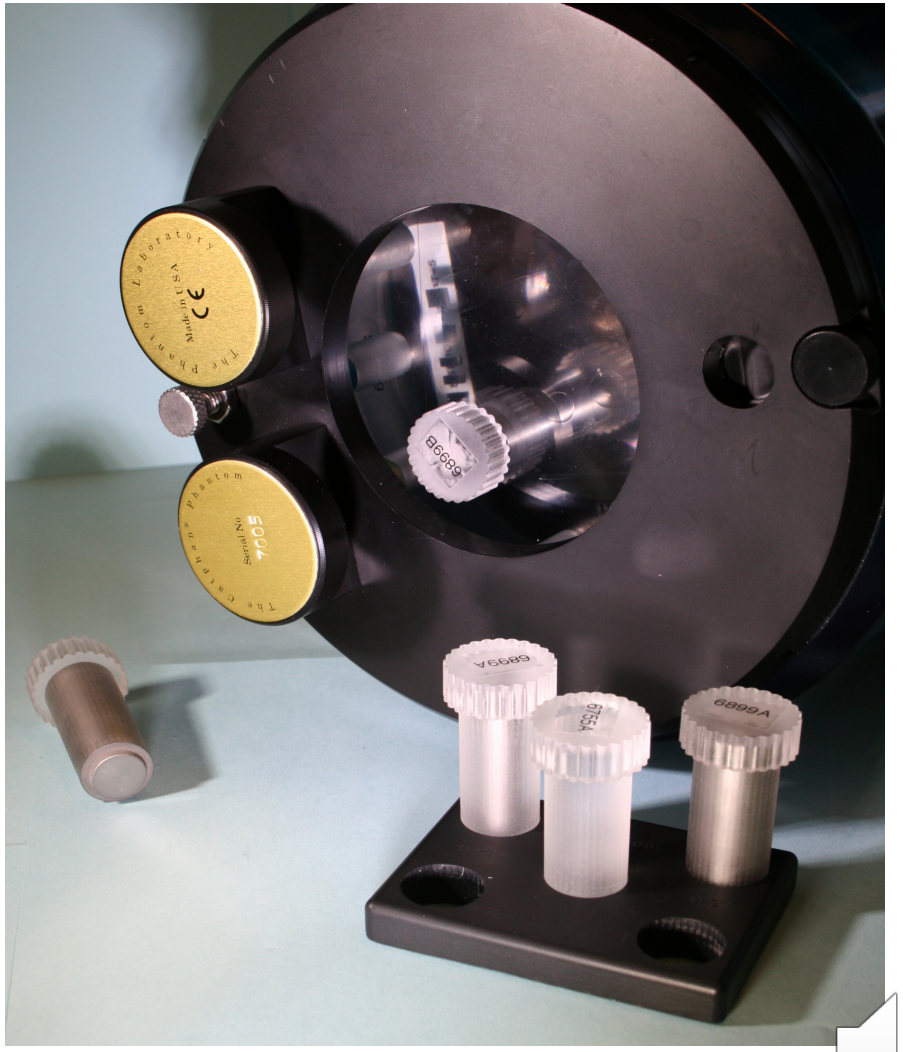
- Sensitometry
- Resolution – axial 45º or other angle
- Cone artifact beam test
- X-Y distortion measurement
- Z distortion measurement
- Holes for dose measurements

Advanced Imaging Performance

Annuli are available in a range of sizes and in both round and oval shapes.

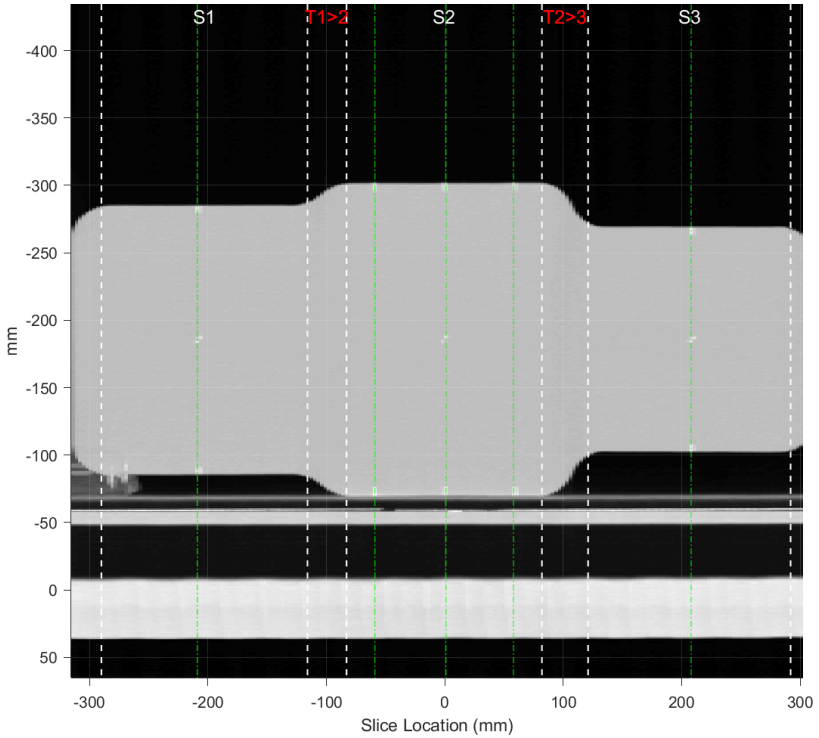


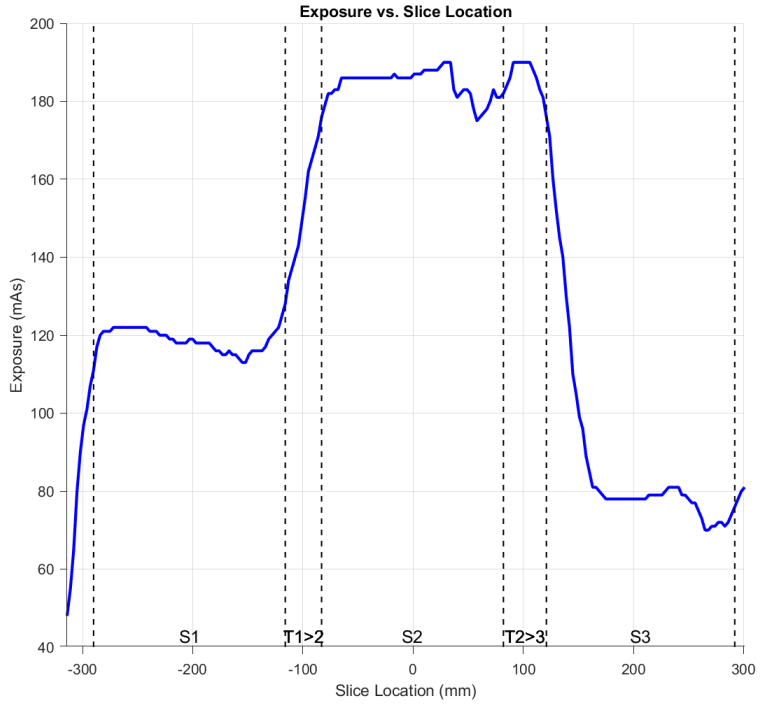
Catphan® 700 Metal Artifact Inserts



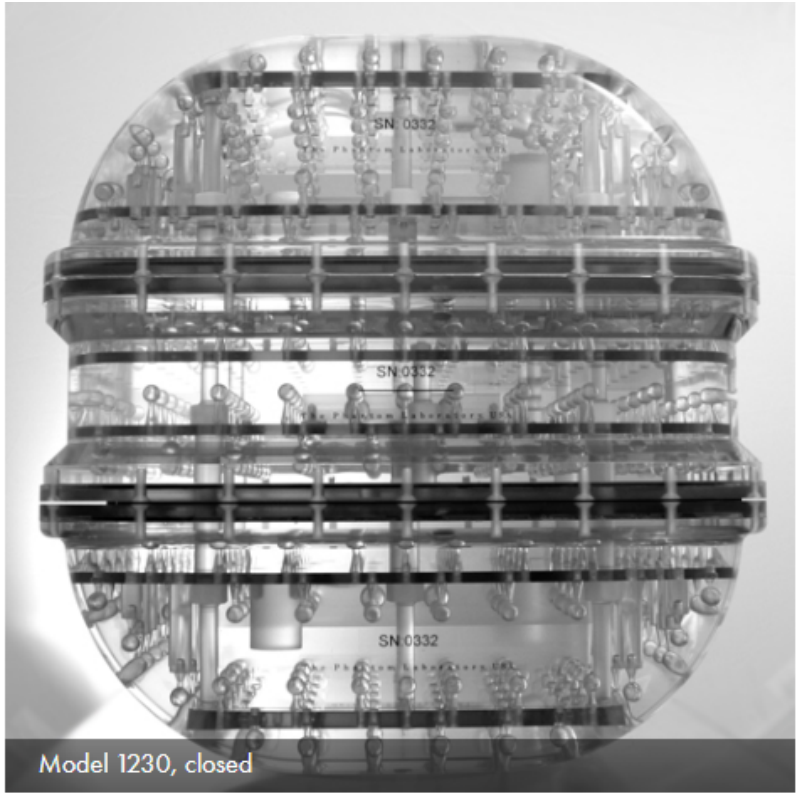
Advanced Imaging Performance

The ATCM Phantom; for characterization of ATCM performance.

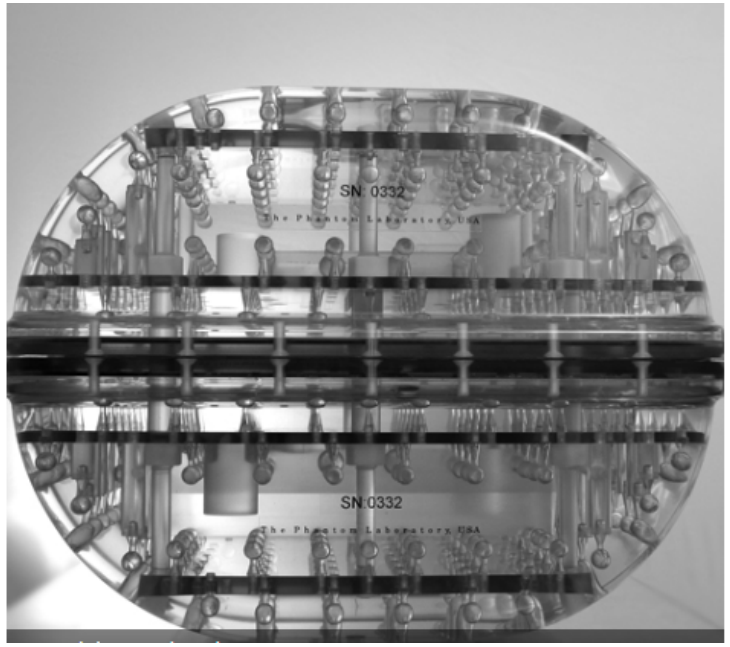


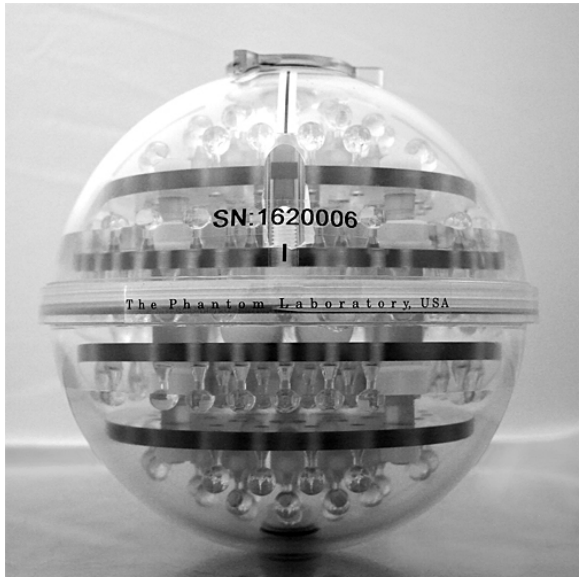


The Magphan RT and S162 Phantoms



Model 1230, closed

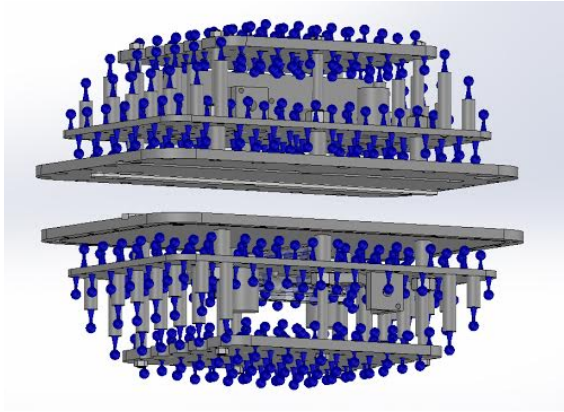


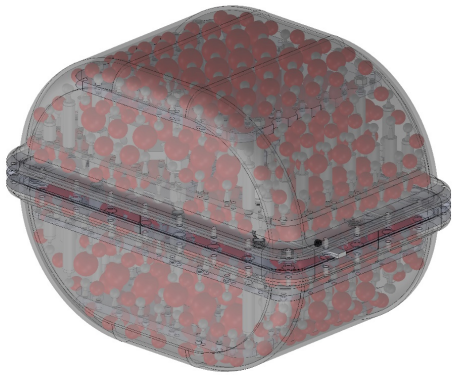


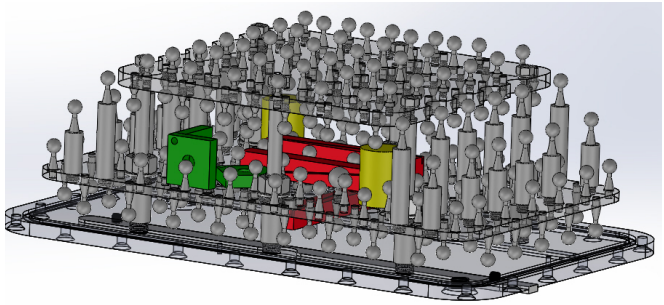
Designed to address the particular needs of Radiation Therapy Planning

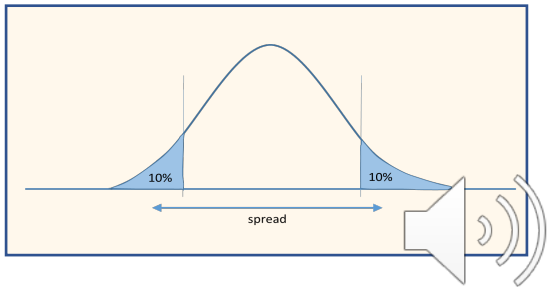
MR Quality Control Protocol for Radiation Therapy Planning

- Efficient to perform
- Easy to interpret by non-MRI specialists, deeper info available for specialists.
- Thorough – 3D measurements where possible
- Sensitive to many types of general scanner failures
- Sensitive to specific failures of importance in RTP (distortion)
- Sensitive to user and configurational errors









Magphan®RT Measurements and Analysis

- **Geometric Distortion**
- **SNR**
- **Laser Alignment**
- Slice Thickness
- Resolution (MTF/PSF/ESF)
- Signal Uniformity

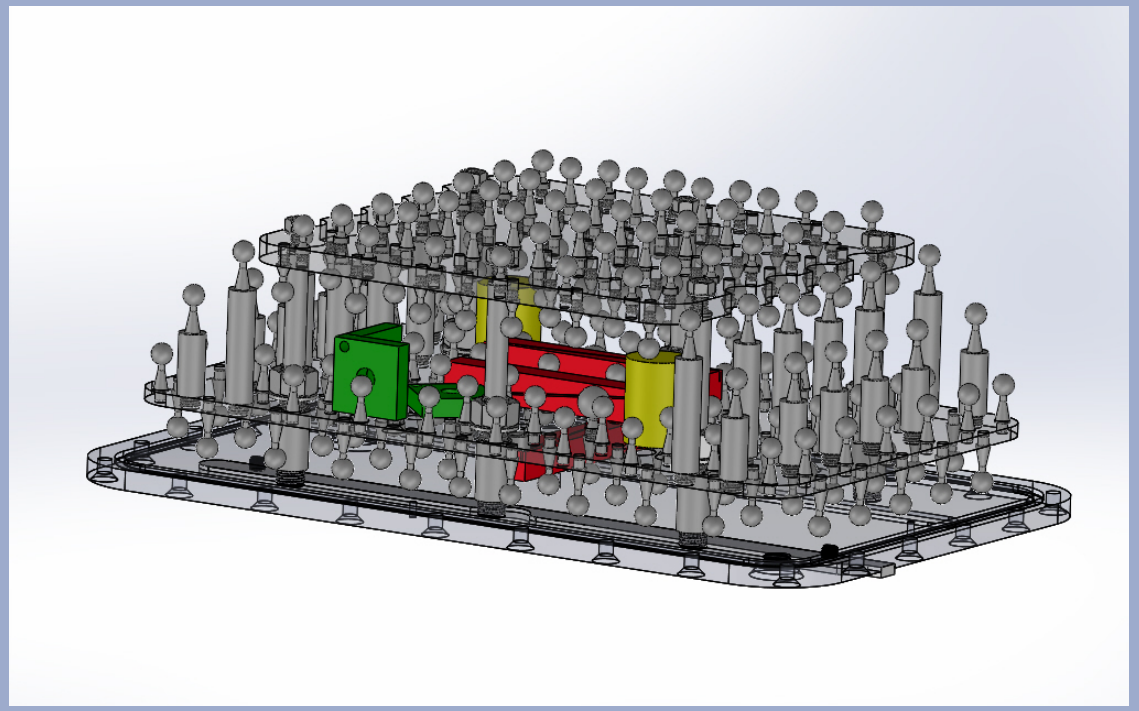
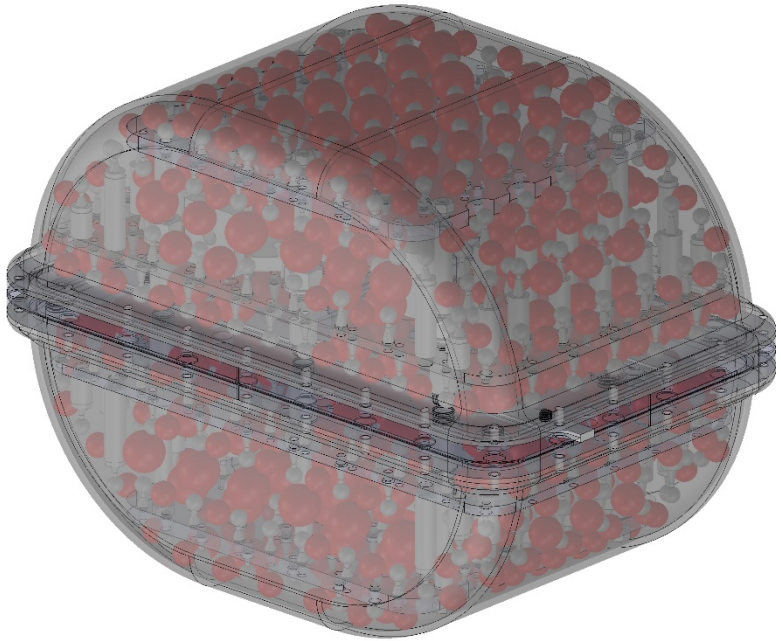
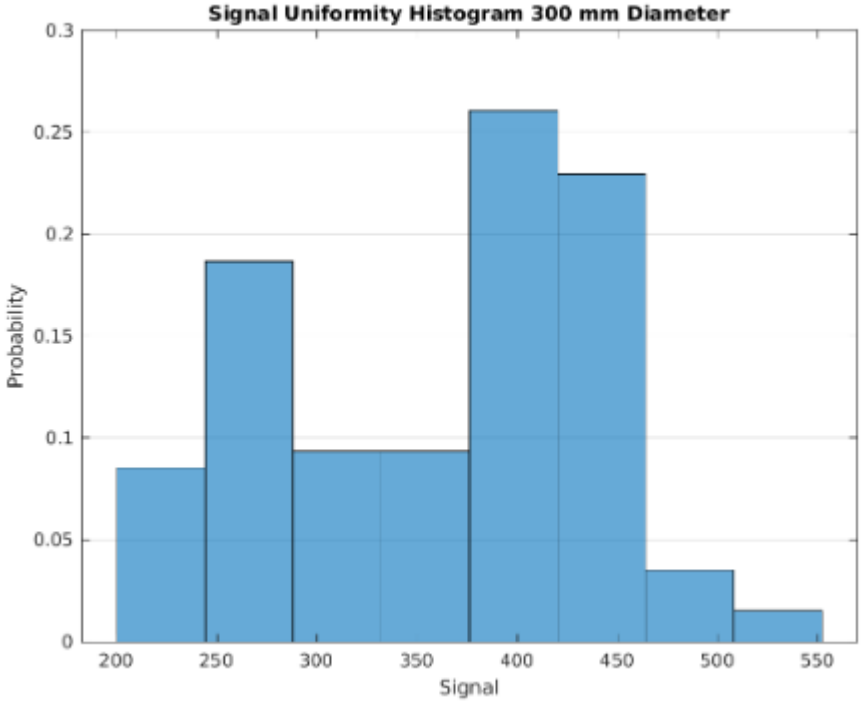
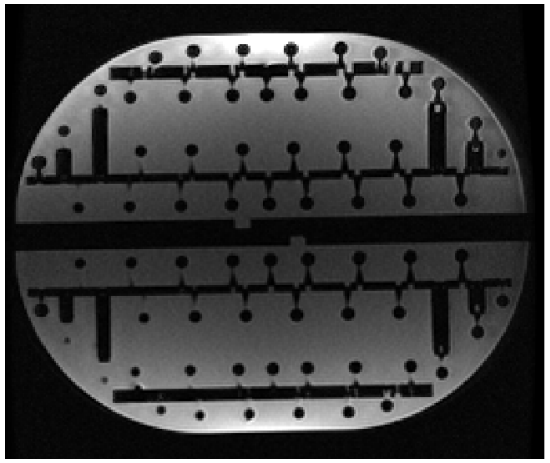


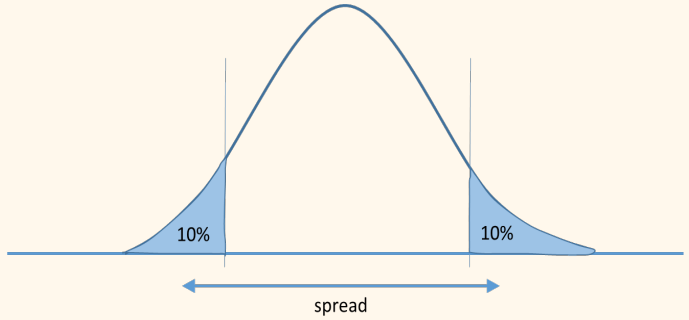
Image Uniformity







Definition:



Signal Uniformity Statistics Diameter 1

Series Description: G0HR 01242020

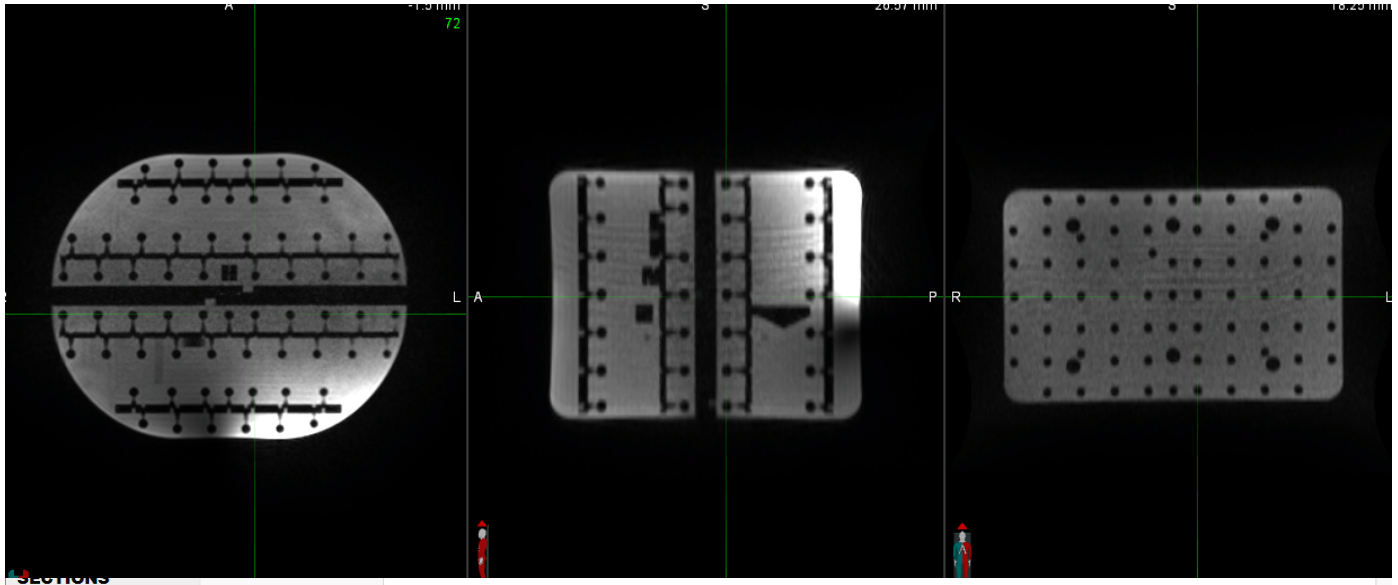
Diameter [mm]	Mean Signal	Normalized Standard Deviation	Normalized Spread
150	261	0.130	0.400

Signal Uniformity Statistics Diameter 2

Series Description: G0HR 01242020

Diameter [mm]	Mean Signal	Normalized Standard Deviation	Normalized Spread
300	361	0.220	0.670

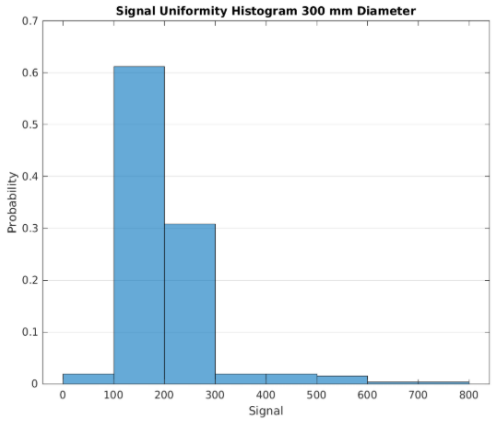
Clinical Example



SECTIONS

- Magphan RT Distortion Analysis
- SNR Analysis
- MTF Analysis
- Feature Set Uniformity Analysis
- Phantom Placement Test
- Phantom Info
- Scan Parameters
- Result Download

Uniformity Histogram over 300 mm diameter + Add Comment



Signal Uniformity Statistics Diameter 1 + Add Comment ○ Absolute ◉ Deviation

Series Description: MP11252019

Diameter [mm]	Mean Signal Δ	Normalized Standard Deviation Δ	Normalized Spread Δ
150	-13	+0.080	+0.290

Signal Uniformity Statistics Diameter 2 + Add Comment ○ Absolute ◉ Deviation

Series Description: MP11252019

Diameter [mm]	Mean Signal Δ	Normalized Standard Deviation Δ	Normalized Spread Δ
300	-48	+0.420	+1.360

Phased Array Failure

Courtesy of Dr. Yingli Yang, UCLA

Smári Automated Image Analysis

Smári

Home
Review
Reports
Documents
Analysis
Manage
Help

Io Dev
Sign out

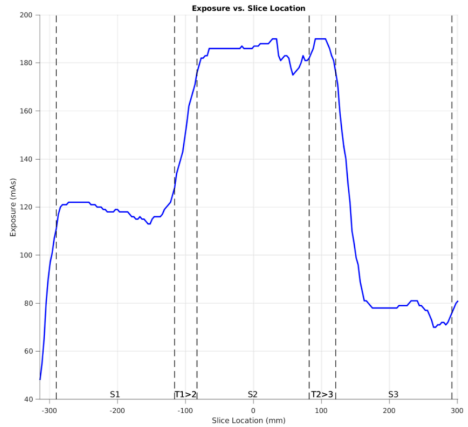
Collapse all | Expand all

SECTIONS

- Geometry
- Dose
- Noise
- Uniformity

Dose

Exposure Plot + Add Comment

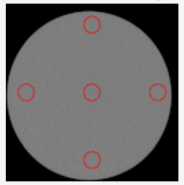


Exposure Statistics + Add Comment

Series Description: std 3.0 B30f

Slice Location Start mm	Slice Location End mm	Median mAs	Maximum mAs	Minimum mAs	Standard Deviation mAs
-290	-116	119.00	128.00	111.00	3.16
-113	-86	152.00	171.00	134.00	13.65
-83	82	186.00	190.00	175.00	3.69
85	118	189.00	190.00	181.00	3.26
121	292	79.00	176.00	70.00	26.29

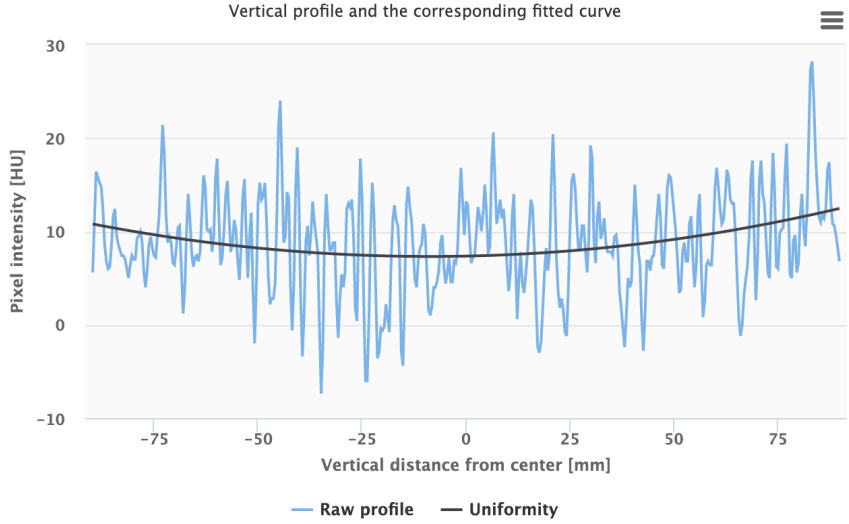
Uniformity and Noise



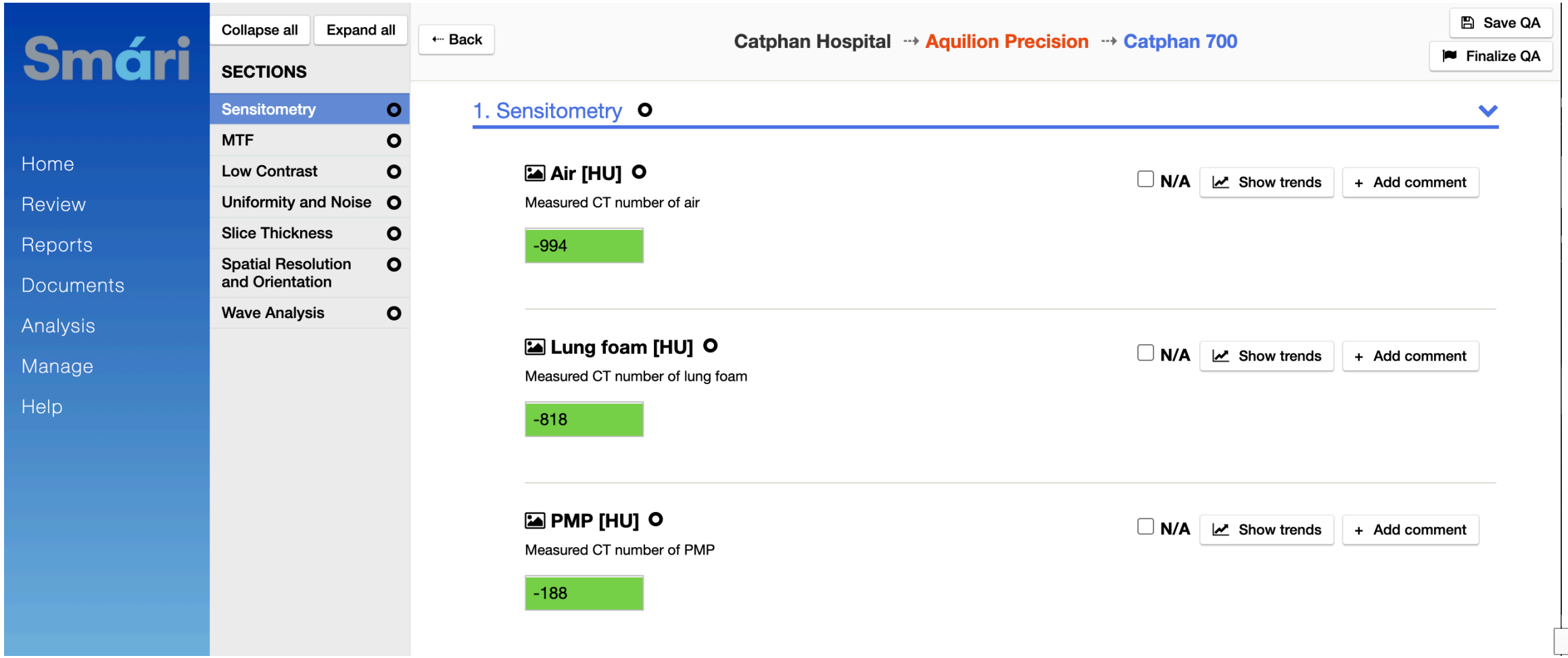
File name: **685886bb48c5d**
Series description:
1.2mm 1pitch
Module ID: **CTP712**
Total collimation width: **40 mm**
kVp: **120**
mA: **315**
Time: **1000 ms**
Recon FOV:
210 mm recon filter
Scan mode: **HELICAL MODE**
CTDI volume: **N/A mGy**
Spiral pitch factor: **0.984**
Images: **1.2mm 1pitch**

Vertical profile and the corresponding fitted curve + Add Comment

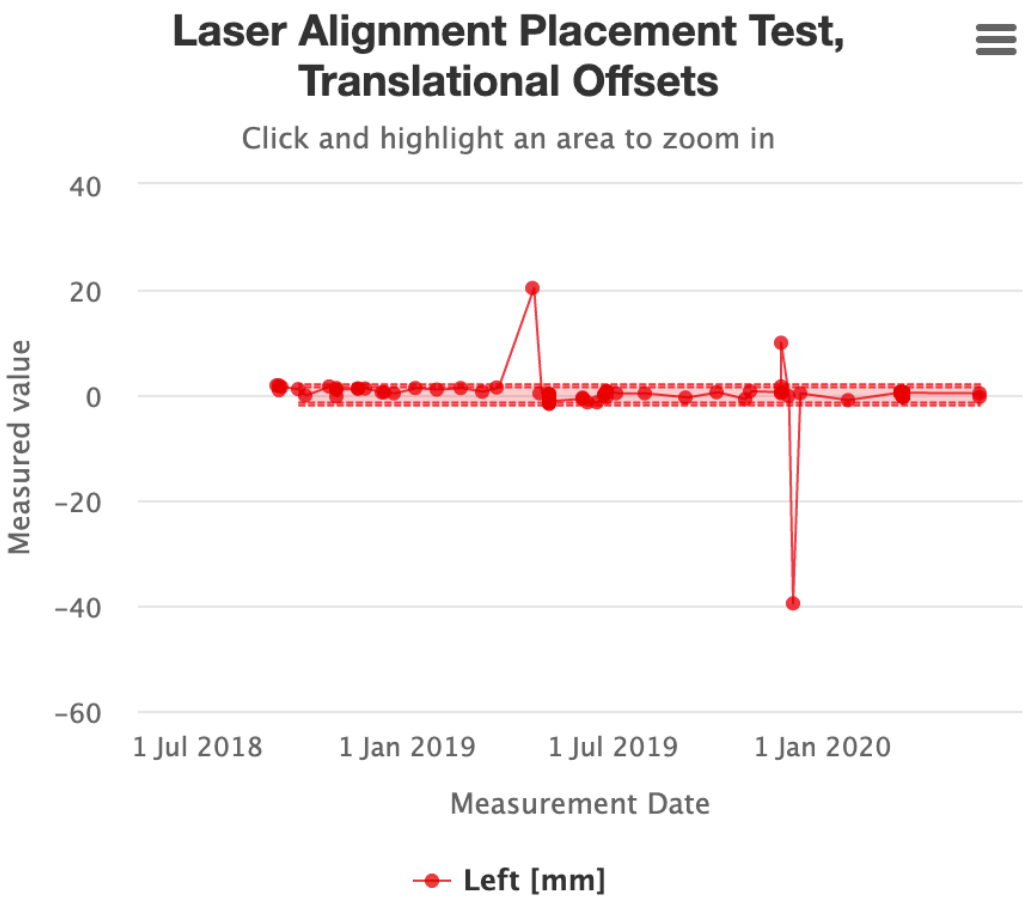
Series description: 1.2mm 1pitch

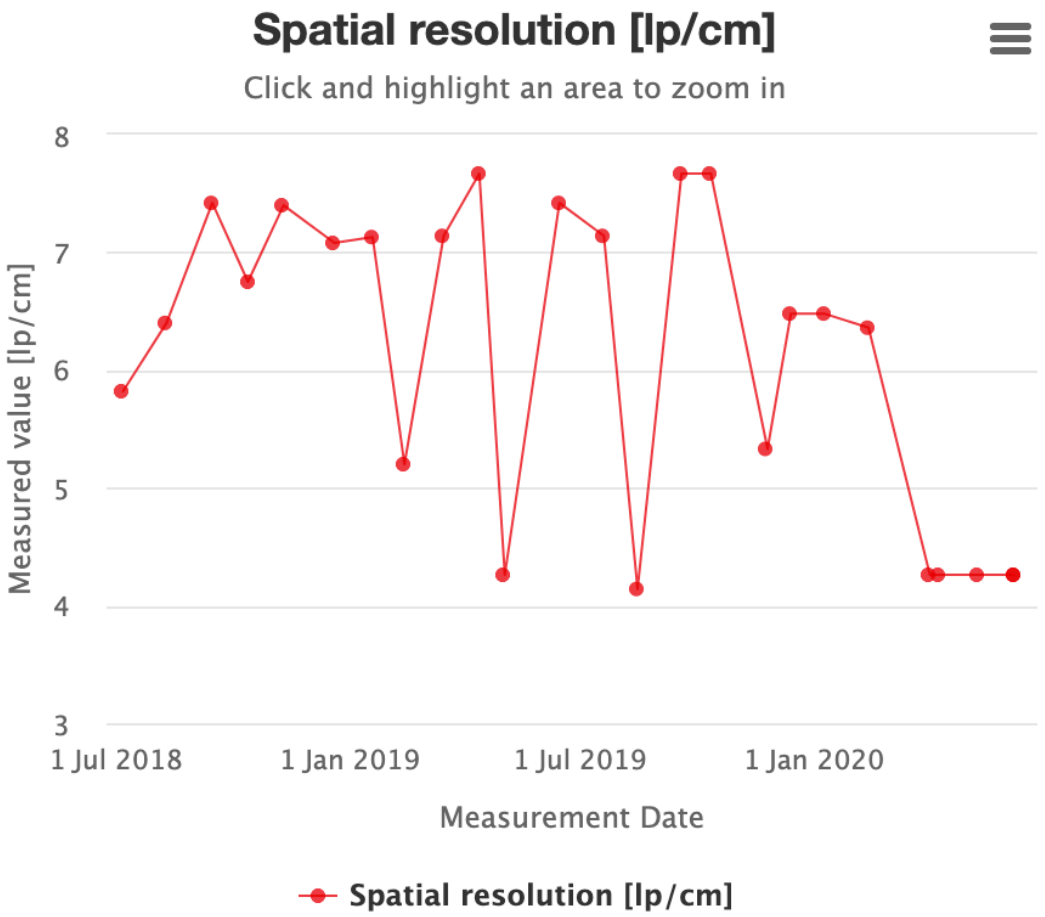


Performance Monitoring and Benchmarking Tools



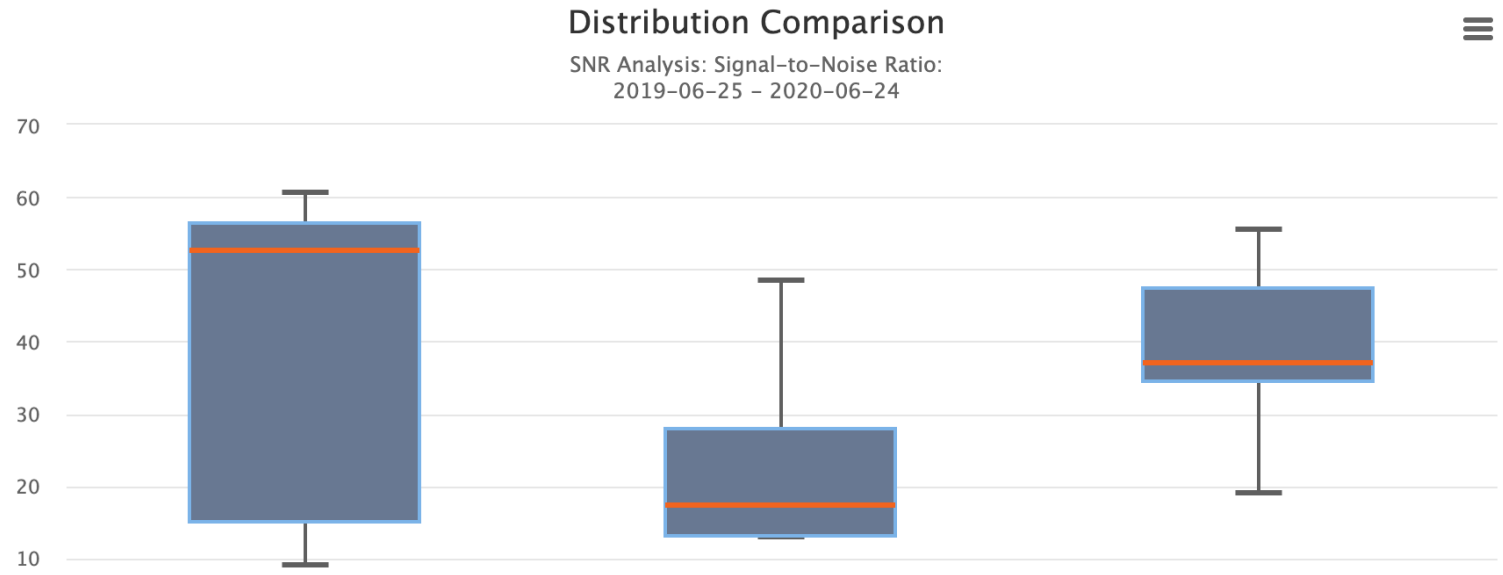
Longitudinal Data





Interactive longitudinal displays with filtering and data export tools

Machine and Protocol Comparison Tools



Machine	Schedule	Count	Mean	Median	Standard Deviation	Max	Min
MR Linac	Elekta Unity	80	36.28	52.85	20.9620	60.60	9.20
Another MR	Uppsala	9	21.31	17.60	11.2210	48.50	12.90
Another MR	Rigshospitalet	2	41.40	41.40	7.1000	48.50	34.30
Another MR	NIMBUS	19	37.63	37.10	10.9615	55.60	19.10
MR-Sim 1.5T Philips	Philips Ingenia	2	39.90	39.90	21.7000	61.60	18.20
Select a Machine(s	Select a Sche	112					

Thank you

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