

Beam model validation of the MRIdian Linac with the THALES 3D MR SCANNER

AAPM 2020



OUTLINE

Challenges with MRgRT
Helicopter view of the THALES 3D MR SCANNER
Clinical workflows
Performances



New trend in IGRT with MR-Linac

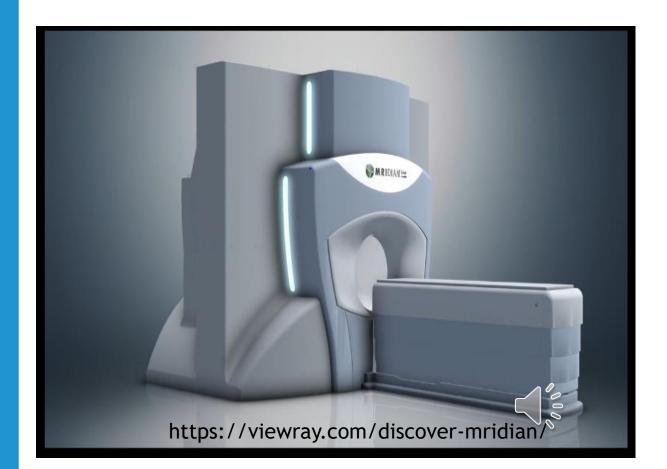
Beam model commissioning of the MRIdian

Identified complexities

- > Stereotactic treatments
- Flattening filter free (FFF) beam type
- Presence of the static magnetic field Bo
 (effect on dosimetry, conventional tools prohibited)

What to do

- Refer to existing guidelines: TG-106, TG-142, ...
- Prediction via simulations
- > Measure, measure, measure
- MR-compatible, efficient solution needed





Outcome of successful partnerships

Collaboration with ViewRay

- MRIDian & TPS specifications
- Early system characterization

Collaboration with early adopters

- Identify challenges
- Evaluate solutions
- Validate workflows

DEVELOPED WITH EARLY ADOPTERS OF MRIDIAN

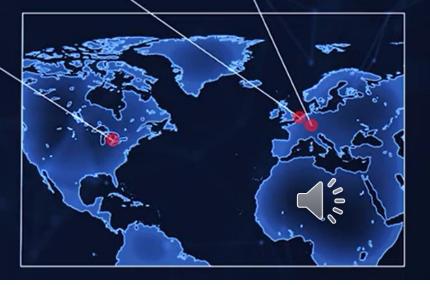
AMSTERDAM | Academic Medical Center

DETROIT Henry Ford Hospital

HEIDELBERG | University Hospital

"We have been positively impressed by the quality of the 3D MR compatible Water Phantom system prototype that has been left to us for evaluation with the ViewRay MRIdian Linac."

Winston Wen, PhD, MBA, Director, Clinical Physics, Department of Radiation Oncology, Henry Ford Health System

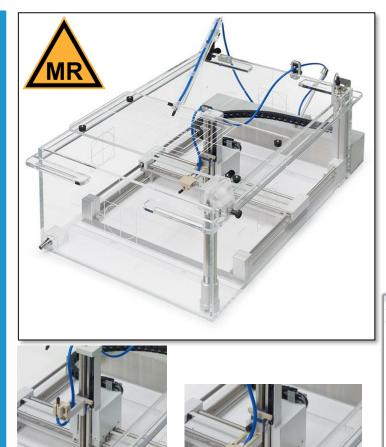




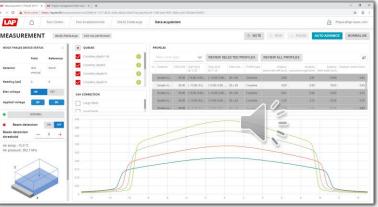
Solution for efficient commissioning and Quality Assurance

A complete package

- MR-Certified Water Phantom
 Scanning: 38cm(X)*38cm(Y)*24.2cm(Z)
 Accuracy: +/-0.25mm
- Integrated electronic in carriage system
 High resolution dual electrometer
 Compact equipment storage
- Web-based acquisition software Automated measurement process Dedicated Analysis tools for FFF







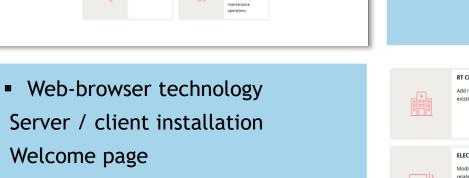


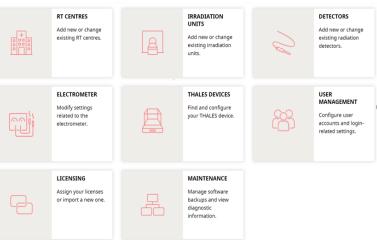
Getting started

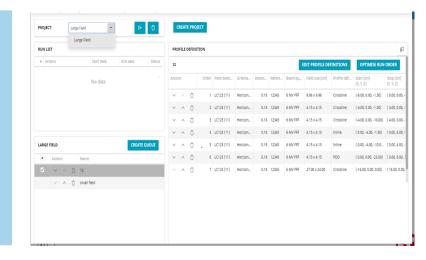
		*) \$ E
		admin@lap-laser.com 🕐
LATEST RT CENTRES PILOTE GREAT CENTER		
MRIDIAN 1 ViewRay MRIdian		
DATE EXPLORER Find, review, and export existing measurement data.	SETTINGS Configure the configure the configure THLAES devices, and perform maintenance operations.	
	PLOTE GRAT CNTR CNTR MIDIAN 1 VersRy Mitclan	PLOTE GREAT CINTR CINTR MEDIAN 1 Vendby MRIdian MEDIAN 1 Vendby MRIdian MEDIAN 1 Vendby MRIdian Ford, review, and export existing measurement data.

Access to different workspaces

 Environment settings RT centre Linac
 Detectors (EPOM shift)
 User management







Plan your work
 Project, Queue, trajectory
 Optimize scanning time: Run order

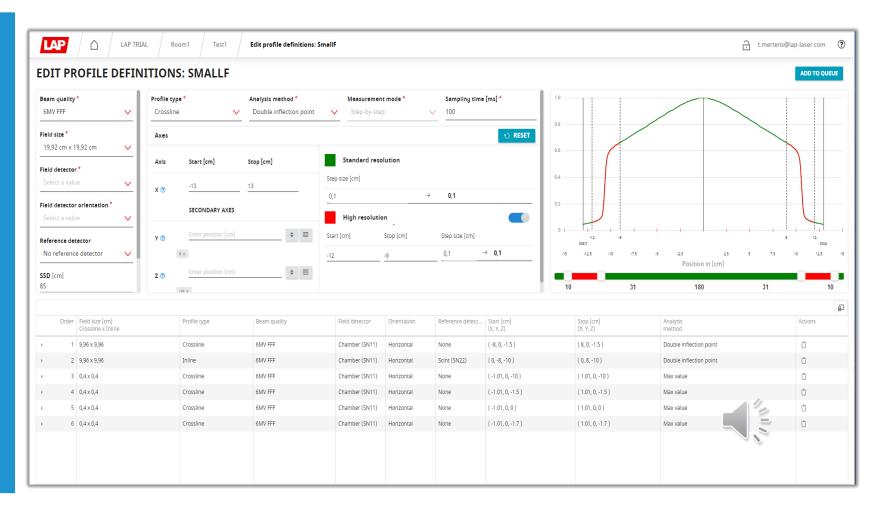




Preparation of the measurement plan

Guided trajectory definition

- Preparation of measurement queues
- Expected measurement lineshape for various field sizes
- Detector selection
- Dedicated analysis tools for FFF beams (small, large fields)





Setup: ready in 15min!



1. Installation on the couch

- Registration with index bars
- Localize vs. Lasers
- > Cables connect & Water filling



- 2. Detector alignment
- Adjustment vs. lasers
- > EPOM at water surface
- Reference detector positioned



- 3. Localize at the isocenter
- Send inside the bore
- Perform CAX corrections



Acquire your data

Acquisition screen

- Real time key informations
 - > Position field chamber
 - > Electrometer readout
- Automated CAX process
- Data acquisition status progress
- Link to review & analysis screen

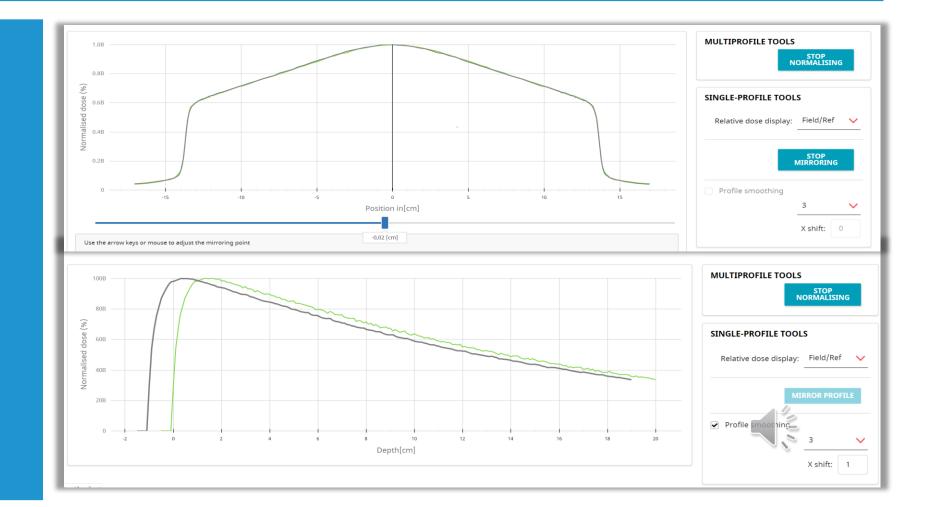
LAP	\triangle	Test Centre	Test IrradiationUnit	20x20_FieldLarge	Data acqui	sition							ē P	hysic@lap-laser.com
IEASURE	EMENT	20x20_Field	Large CAX not performed							B NOTE	⊳ RUN	\rightarrow PAUSE	AUTO ADVANC	E NORMALISE
IOCK THALES DE	EVICE STATUS	•	QUEUES		PROFILES									
Field Reference Crossline_depth		Crossline_depth1.45	0	Filter curve	~	REVIEW SELECTED PRO		ROFILES REVIEW ALL PR		ROFILES		í)		
tector	test vertical	None	Crossline_depth5	0	ns Detector	SSD [cm]	Start [cm] (X, Y, Z)	Stop [cm] (X, Y, Z)	Field size	Profile type	Analysis penumbra left [cm]	Analysis penumbra right [cm]		Analysis centre [mm]
			Crossline_depth10	3	Exradin A	85.00	(15.00, 0.00,	(-15.00, 0.00	20 x 20	Crossline	2.95	2.81	18.80	0.42
ading [pA]	0	0	Crossline_depth15	3	Exradin A	85.00	(-15.00, 0.0	(15.00, 0.00,	20 x 20	Crossline	0.00	0.00	19.03	0.45
as voltage	ON	OFF	CAX CORRECTION		Exradin A	85.00	(15.00, 0.00,	(-15.00, 0.00	20 x 20	Crossline	0.61	0.62	19.82	0.33
plied voltage	ov	ov	Large fields		Exradin A			(15.00, 0.00,		Crossline	3.28	3.12	19.55	0.53
	ZEROING		Small fields		Exradin A	85.00	(-15.00. 0.0	(15.00. 0.00	20 x 20	Crossline	3.56	3.42	20.63	0.45
Beam de earn detection reshold r temp: -15.9 ° r pressure: 30; Z	n	ON OFF 0 +	0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.05	Æ										



Review your data

Analysis tools

- Curve normalization
- Analysis functions
 - > Mirroring profiles
 - Smoothing curves
 - > Beam parameters analysis
 - Linac stability during measurement (ref. chamber output)





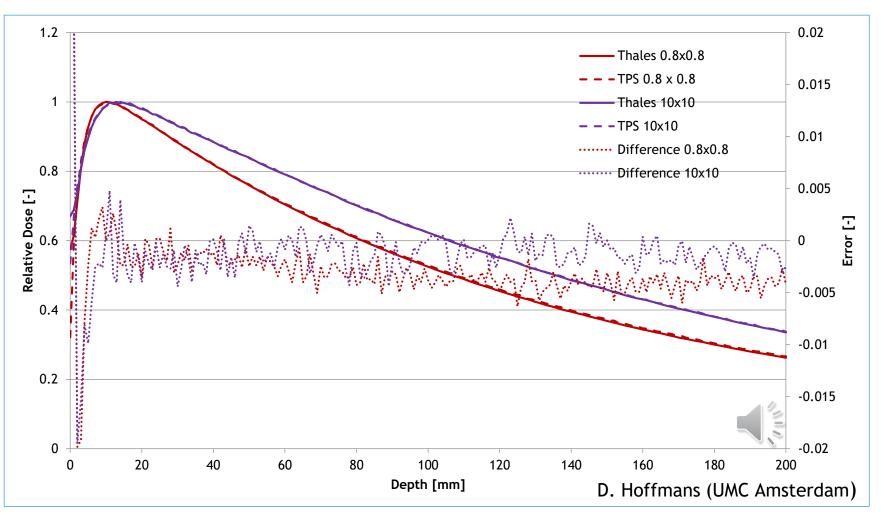
Performance assessment (1)

Comparison with Monte Carlo

- Small and large fields
 9.96cm * 9.96cm
 8.3mm *8.3mm
- A26MR (small field)
- A1SL (large field)

#11

 Excellent agreement is observed: deviations < 1mm



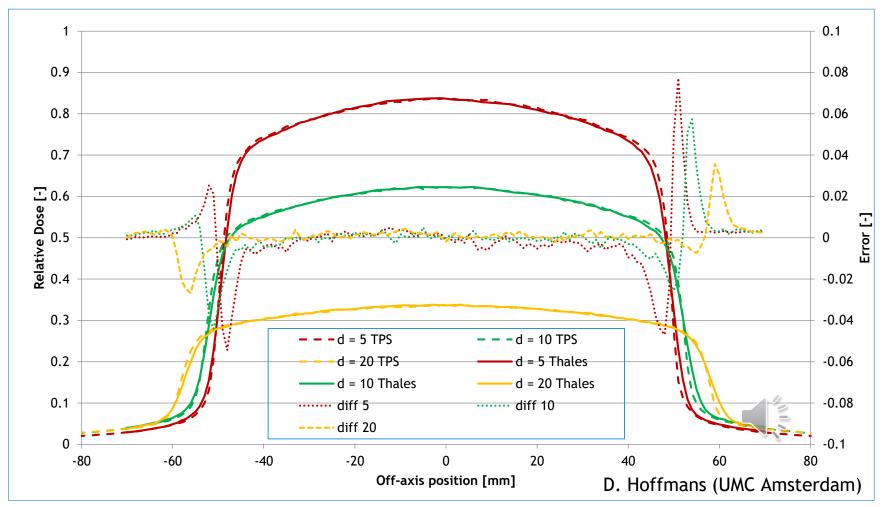


Performance assessment (2)

Comparison with Monte Carlo

- Field size: 9.96 * 9.96
- A1SL field chamber
- Crossline for various depths

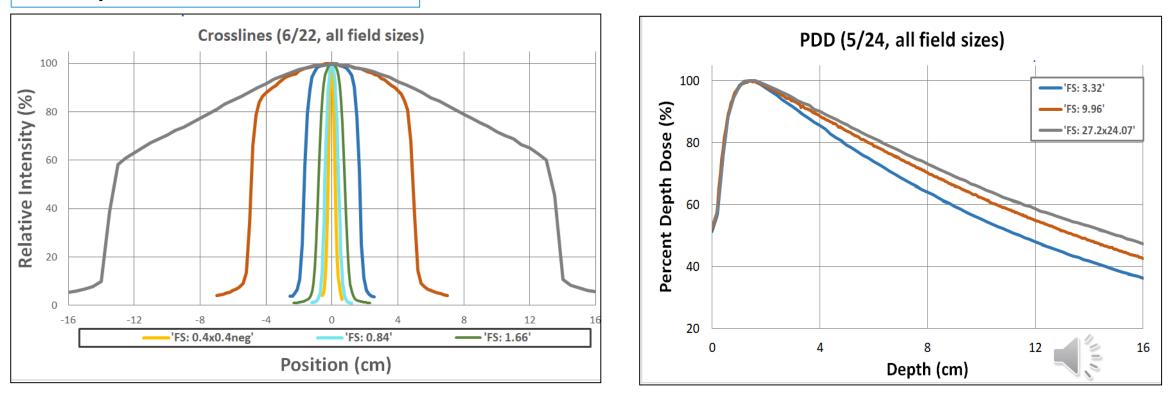
 Excellent agreement is observed: deviations < 1mm





Performance assessment (3)

Example of data collection



N. Weng (Henry Ford Detroit)



THALES 3D MR SCANNER News THALES 3D MR SCANNER is now FDA (510k) cleared! Available Q4 2020 For more information please contact your regional Sales representative: https://www.lap-laser.com/de/produkte/thales-3d-mr-scanner/ 000 Follow-us on LinkedIn https://www.linkedin.com/showcase/lap-radiation-therapy/



Time for questions





