



myQA iON & the automation of QA

Combined Efficiency for Patient QA

Lourens Strauss, Application Specialist

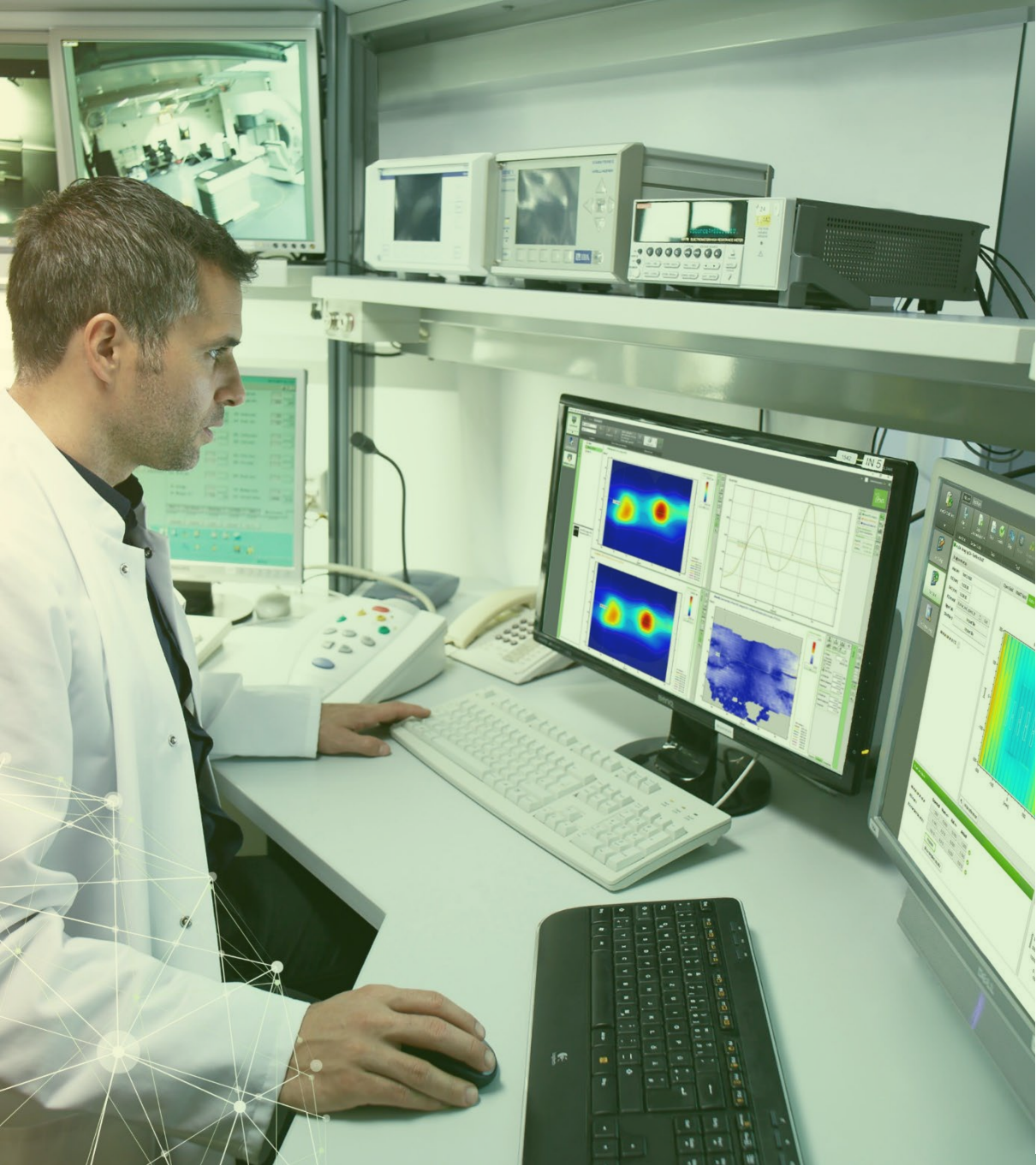


Life.
Science.

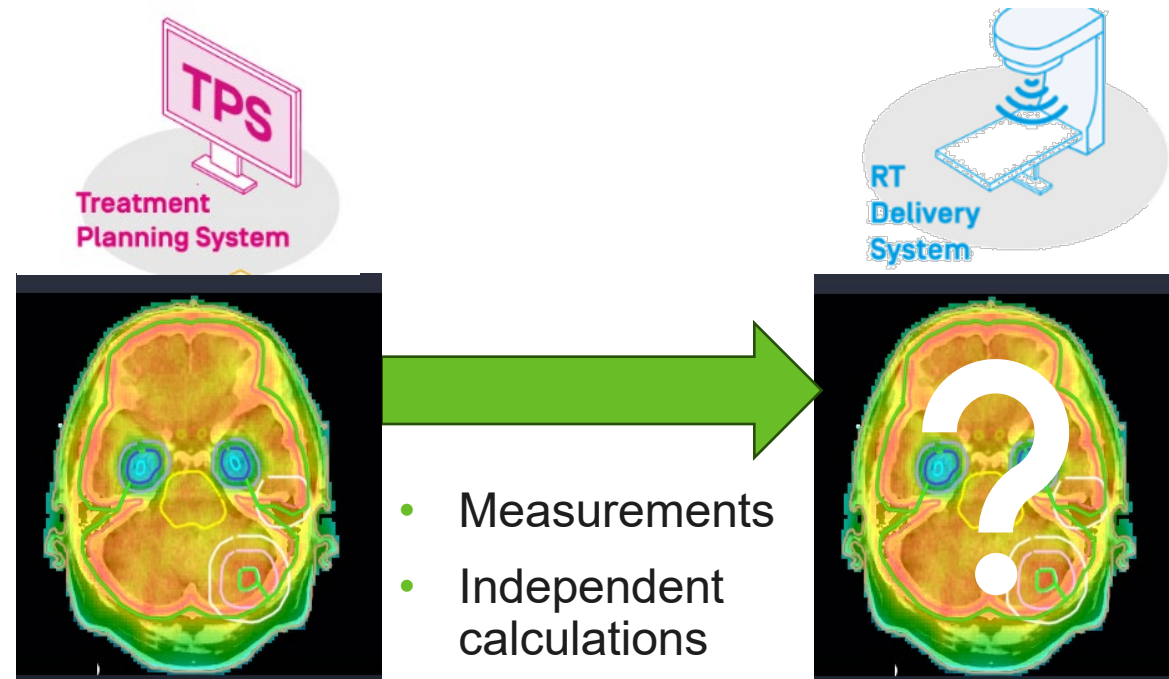
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DOSIMETRY

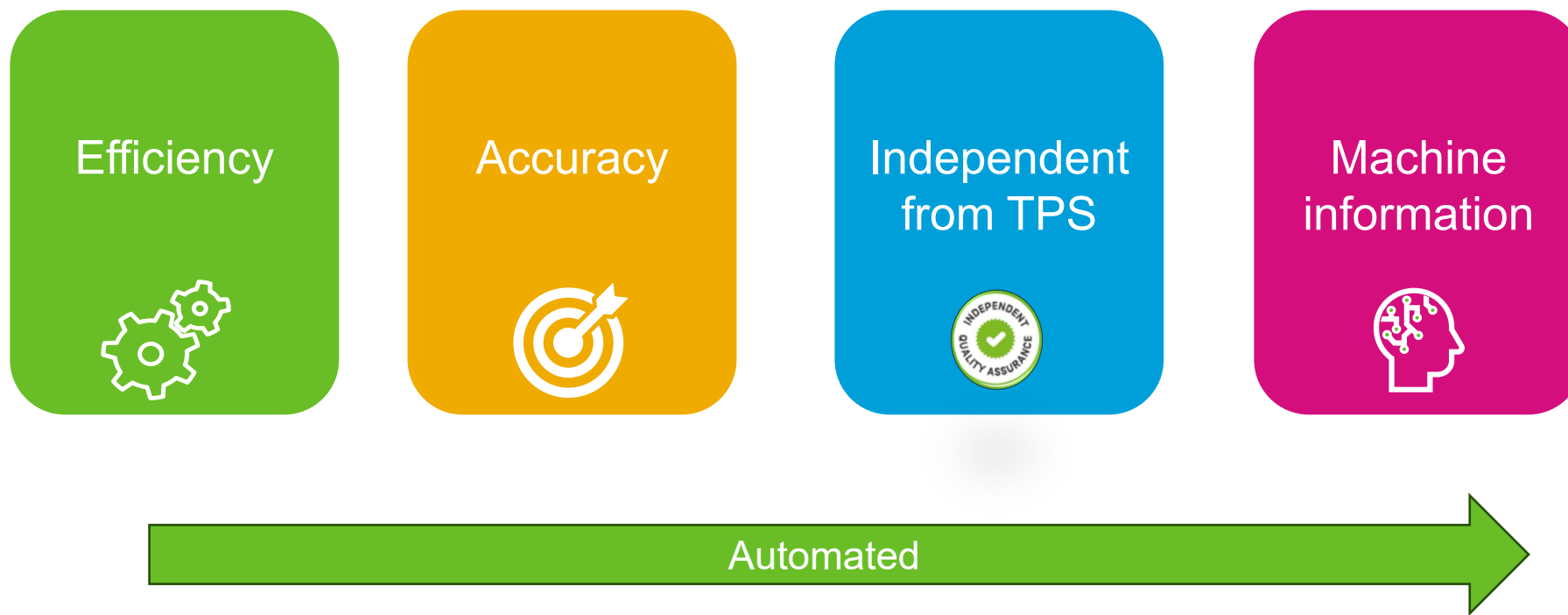




What are the steps in Patient QA?



What are the issues surrounding Patient QA?



Efficiency



Idea: Spending less time on certain procedures like:

- Asking colleagues what needs to be done
- Searching through patients to find errors
- Guessing from where error might come from
- Starting calculations by hand

But: Focus on important PSQA tasks:

- Assessing real dose errors
- Easily finding error sources
- Approving plans





QA plans to Review



Log Acquisition



MatriXX Measurement



Total Tasks



Tasks



Patients



History



Settings

Status	Task description	First name	Last name	Plan label	Physician	Treatment machine ↑
✓	QA plan	Neck	Head	AORIGINAL	-	VersaHD
✓	QA plan	-	IF001, Irina	COPY6MV	-	Agility
⌚	QA plan	IFTEST	IFTEST	01APlan45Gy	-	Agility
✓	QA plan	IFTEST	IFTEST	IAcopy6Gy	-	VersaHD
ⓘ	QA plan	PROSTATE	NODES	AIMR17b	-	Agility
✓	QA plan	PROSTATE	NODES	AVM01	-	Agility
⌚	QA plan	PROSTATE	NODES	AVM01	-	Agility
✓	QA plan	PROSTATE	NODES	AVM01	-	VersaHD
✓	QA plan	PROSTATE	NODES	AVM01	-	Agility
✓	QA plan	-	Pat01	LLL HYPOFRAC	-	GSHalcyon
✓	QA plan	-	Pat02	LUNG	-	GSHalcyon
✓	QA plan	-	Pat03	RLL MEDIA	-	GSHalcyon
✓	QA plan	-	Pat04	LUNG	-	GSHalcyon
✓	QA plan	-	Pat05	PELVIS	-	GSHalcyon

Task based workflow Overview of all plan QA results

Independent Dose



Irradiation Logs



Dose Evaluation

Passed With 99.57%

Cancel

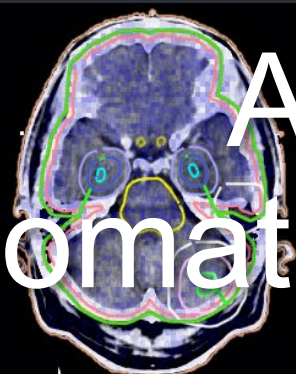
Calculation

3D Gamma

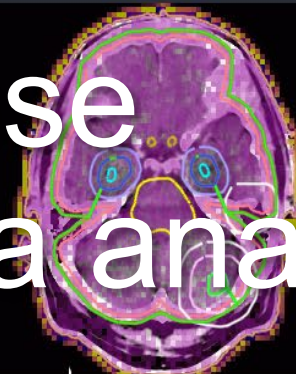
Secondary MU

Gamma / Structure

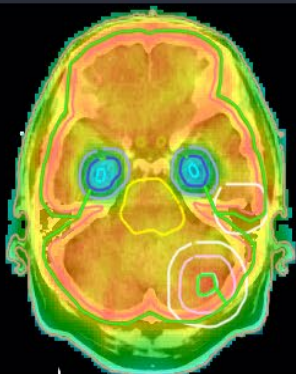
3D Gamma comparison (TPS vs MC)

Axial view
60/103
-246.0 mm

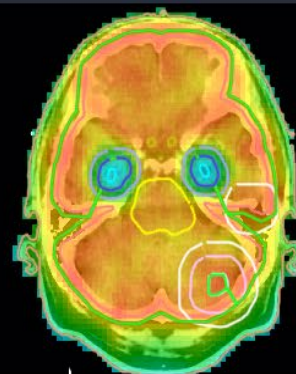
Difference dose map (MC - TPS)

Axial view
60/103
-246.0 mm

Monte Carlo dose map

Axial view
60/103
-246.0 mm

Original dose map

Axial view
60/103
-246.0 mm

Automated Dose Automated 3D-gamma analysis

Tasks

Patients

History

Settings

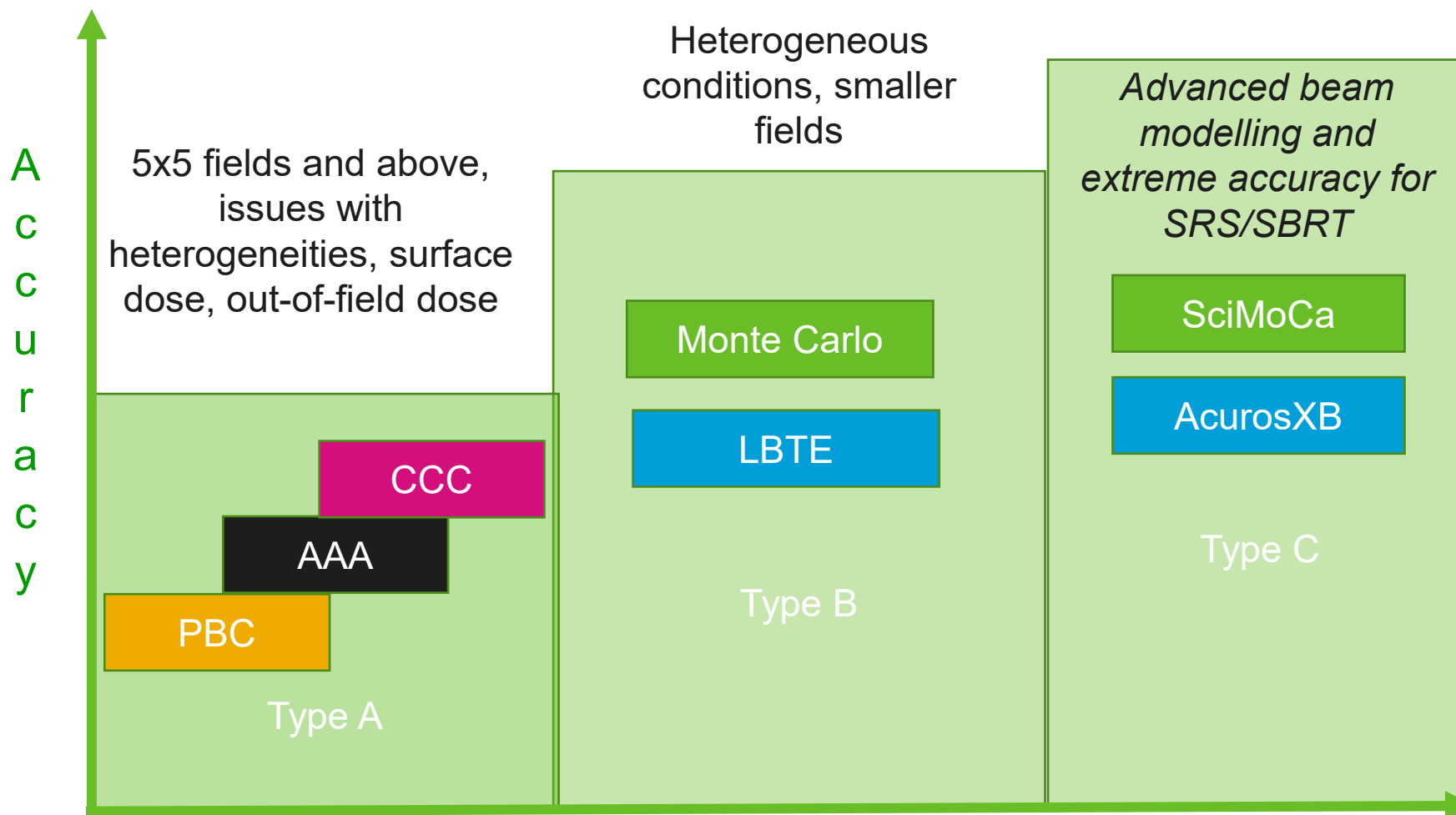
Mode:

Log Out

Accuracy



What algorithms are out there?

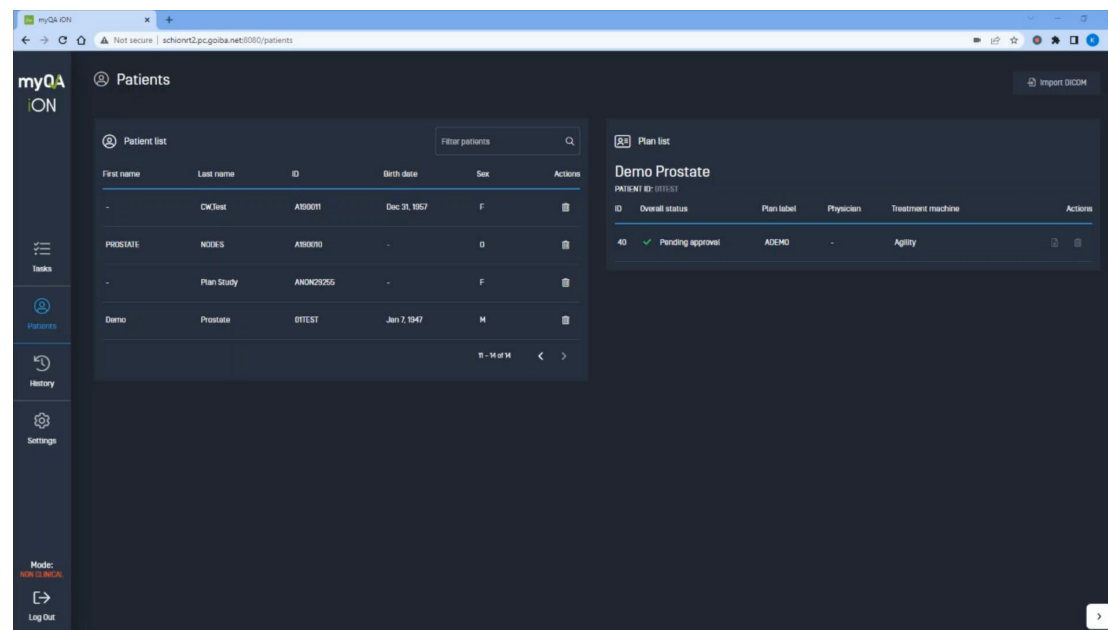


Knoos et al – Comparison of dose calc algorithms for treatment planning in external photon beam therapy for clinical situations. [Phys Med Biol 2006;51\(22\) 5785-807](#)

SciMoCa is the future



- SciMoCa Monte Carlo is proven to be accurate for dose calculation^{4,5,6}
 - for small and large fields
 - for dose in complex anatomies, even at the junction of high and low density
 - can incorporate the beam model and treatment machine characteristics
- **FAST** calculation done under 3 minutes
- Calculation started automatically once plan from TPS arrives.



4. Validation of the Acuros XB dose calculation algorithm versus Monte Carlo for clinical treatment plans. [Medical Physics. Medical Physics Volume 45, Issue8 p.3909-3915](#)
5. Validation of a secondary dose check tool against Monte Carlo and analytical clinical dose calculation algorithms in VMAT. [Journal of Applied Clinical Medical Physics Volume 22, Issue 4 p 52-62](#)
6. Commissioning and clinical implementation of the first commercial independent Monte Carlo 3D dose calculation to replace CyberKnife M6™ patient-specific QA measurements. [Journal of Applied Clinical Medical Physics, Volume 21, Issue 11 p304-311](#)

Independent Check

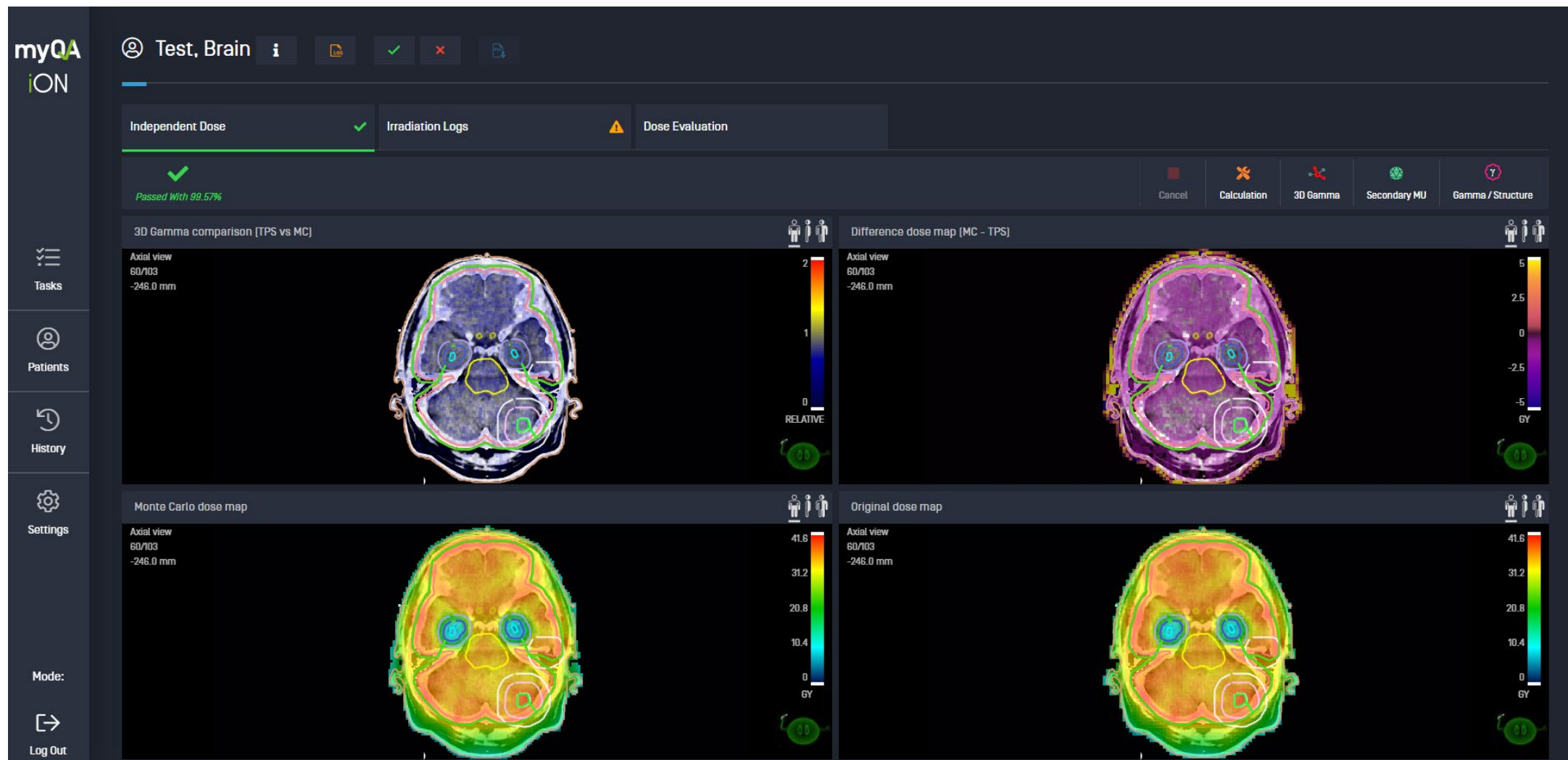




Independent Beam Data

- For Photons and electrons
- Detection of errors and inaccuracies in beam data collection
- Reports include comprehensive details of the sources of inconsistencies or errors
- Not depending on the TPS

Independent 3D Dose Check



Independent 3D Dose Check – Gamma per structure



myQA
iON

Tasks

Patients

History

Settings

Mode:

Log Out

Test, Brain

Independent Dose

Irradiation Logs

Dose Evaluation

Passed With 99.57%

Cancel

Calculation

3D Gamma

Secondary MU

Gamma / Structure

Name	Result
Brainstem	99.9 %
Cochlea_Lt	100 %
Cochlea_Rt_	84.62 %
CTV	99.87 %
Eye_Lt	100 %

Name	Result
Eye_Rt	100 %
GTV_1	100 %
GTV_2	100 %
GTV_3	100 %
GTV_4	100 %

Name	Result
GTV_5	100 %
GTV_6	100 %
HAR	100 %
Hippocampus	100 %
HippoR	100 %

Name	Result
Optic_Chiasm	100 %
Optic_Nerve_Lt	100 %
Optic_Nerve_Rt	100 %
patient	99.91 %
PTV_1	100 %

Name	Result
PTV_2	100 %
PTV_3	100 %
PTV_4	100 %
PTV_5	100 %
PTV_6	100 %

Name	Result
PTV_Hippo	99.85 %
PTV_whole_brain	99.86 %
PTVOpt	99.85 %
R1	100 %
R2	99.59 %

Name	Result
R3	97.17 %
Spinal_cord	100 %
SumPTVs	100 %

TESTLOGS

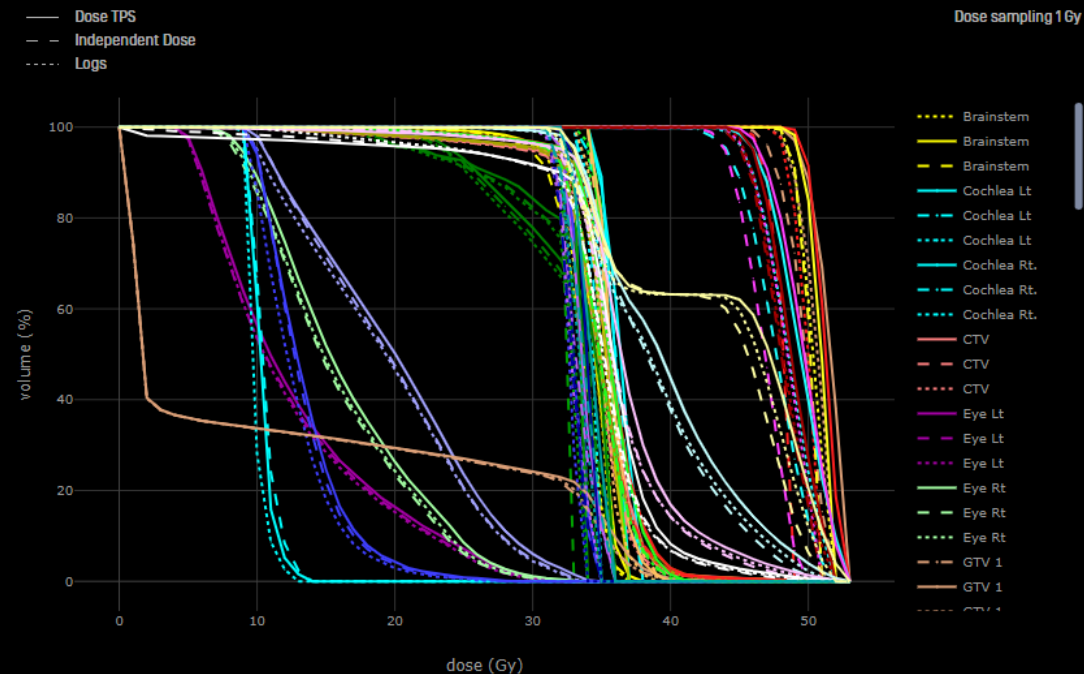
Select logs

Start

Dose Statistics

Volume	Min Dose [Gy]			Max Dose [Gy]			Mean Dose [Gy]		
	TPS	MC	LOGS	TPS	MC	LOGS	TPS	MC	LOGS
Brainstem	16.20	17.19	16.59	36.82	37.61	37.58	33.02	33.66	32.79
Cochlea Lt	33.49	32.69	32.43	37.98	38.06	36.74	35.70	35.46	34.85
Cochlea Rt.	33.88	32.57	32.69	37.02	35.80	35.26	35.38	34.23	34.09
CTV	8.89	8.83	8.47	53.06	51.59	51.99	34.46	33.72	33.75
Eye Lt	2.85	3.53	3.61	32.35	31.84	31.36	12.34	12.00	11.92
Eye Rt	5.49	5.49	5.89	34.04	33.18	33.11	15.89	15.23	15.41
GTV 1	44.86	47.62	46.82	51.59	52.96	51.86	49.17	50.96	50.01
GTV 2	48.10	44.70	46.58	52.83	49.26	51.22	50.69	47.63	49.40
GTV 3	33.84	33.93	33.30	37.04	37.37	36.23	35.10	35.12	34.49

DVH Graph



Clinical Goals

WBRT Structures

Brainstem

Name	TPS	MC	LOG
Max. Dose < 38Gy	37.61 ✓	36.82 ✓	37.58 ✓

Hippocampus

Name	TPS	MC	LOG
Mean Dose <= 10Gy	9.86 ✓	9.42 ✓	10.08 ✗

Select template

Start

Filter

Independent Secondary MU check



myQA
ION

Tasks

Patients

History

Settings

Mode:

Log Out

Passed With 99.57%

CancelCalculation3D GammaSecondary MUGamma / Structure

SECONDARY MU

Number of fractions: 15
Prescription dose: 45 Gy

	1	3
Beam name	1A01	1A02
Energy [MV]	6	6
Beam type	VMAT	VMAT

GEOMETRY

DOSE CHECK

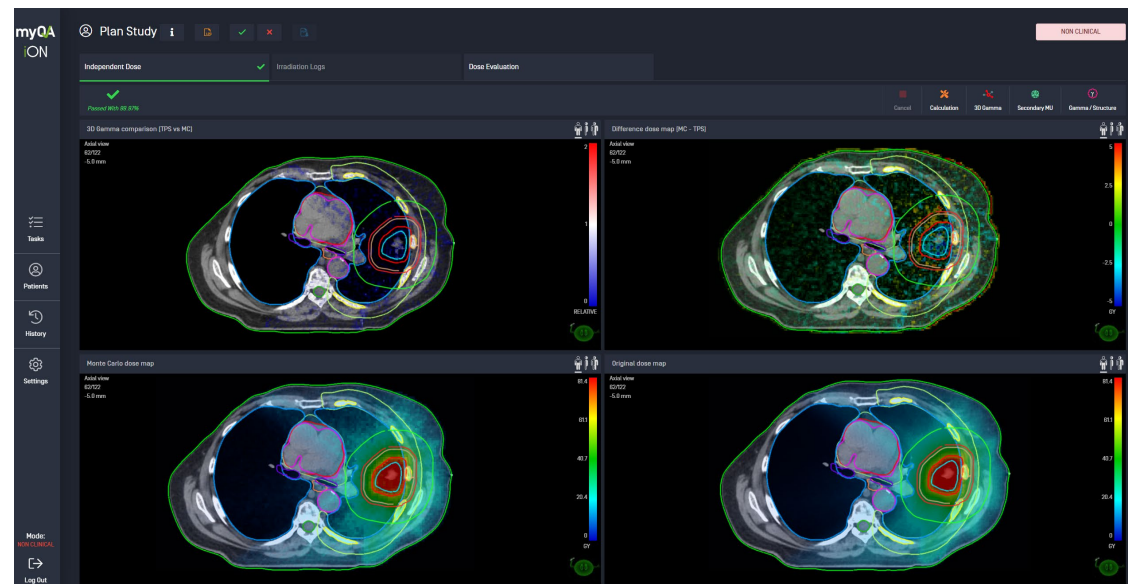
Beam dose specification point [X, Y, Z]	11, -285.7, -237	11, -285.7, -237
Density at specification point [g/cm³]	1.02	1.02
TPS beam dose [Gy]	0.92	1.25
SciMoCa beam dose [Gy]	0.91	1.23
Beam dose percentage difference (%)	1.29	1.29
TPS MU	637.57	772.82
SciMoCa MU	645.79	782.79
MU Difference	8.22	9.97

COMPLETION MESSAGE

Proven efficiency with the independent check



- Guida et al*, presented at the 2021 ECMP congress concludes:
- *“The dose calculation accuracy and independence of the SciMoCa system provides a rigorous second check for a modern TPS calculation...our early results show that SciMoCa allows to safely reduce the number of patient specific pre-treatment QA measurement by 50% to approximately 35%.”*



- *TrueBeam STx and Radixact data

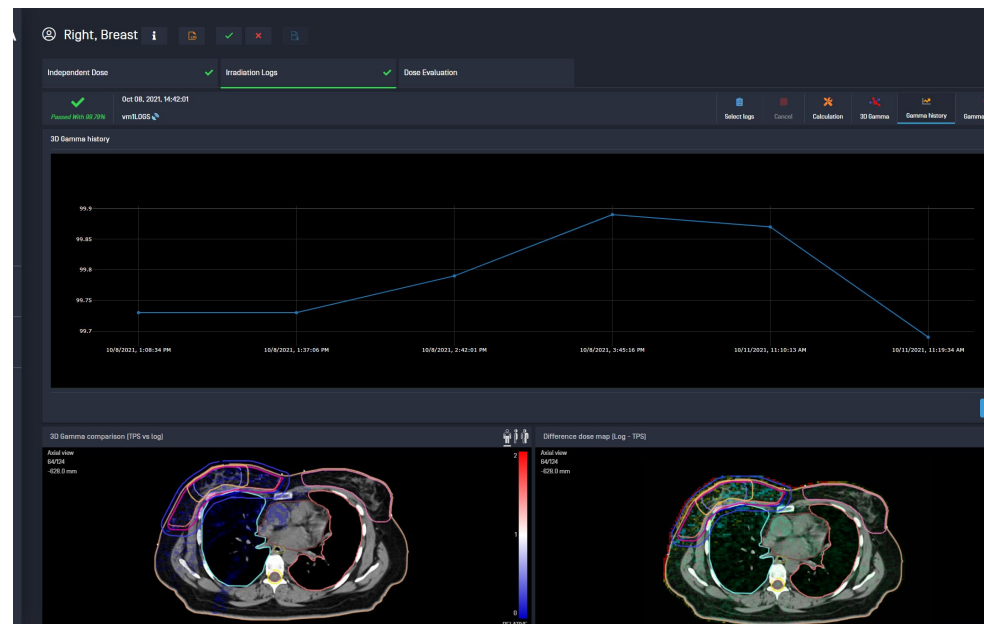
Machine Information

Logfiles vs Algorithms



Logfile analysis

- **Combination of Logs and Monte Carlo Algorithm (SciMoCa)**
- By using 2 methods errors can be detected and analyzed at both the treatment planning system and treatment machine
- Giving you higher confidence in your treatments and equipment



	Source of Error					
	Commissioning Data	TPS calculation	Linac MLC /Gantry/Collimator accuracy	Linac MU output	Random day to day errors	Measurement in "patient-like" phantom
SciMoCa™	✓	✓				
Log Files			✓	✓	✓	
Delta 4			✓	✓	✓	✓

Independent Dose



Irradiation Logs



Dose Evaluation

Passed With 99.79%

Oct 08, 2021, 14:42:01

vm1LOGS

Select logs

Cancel

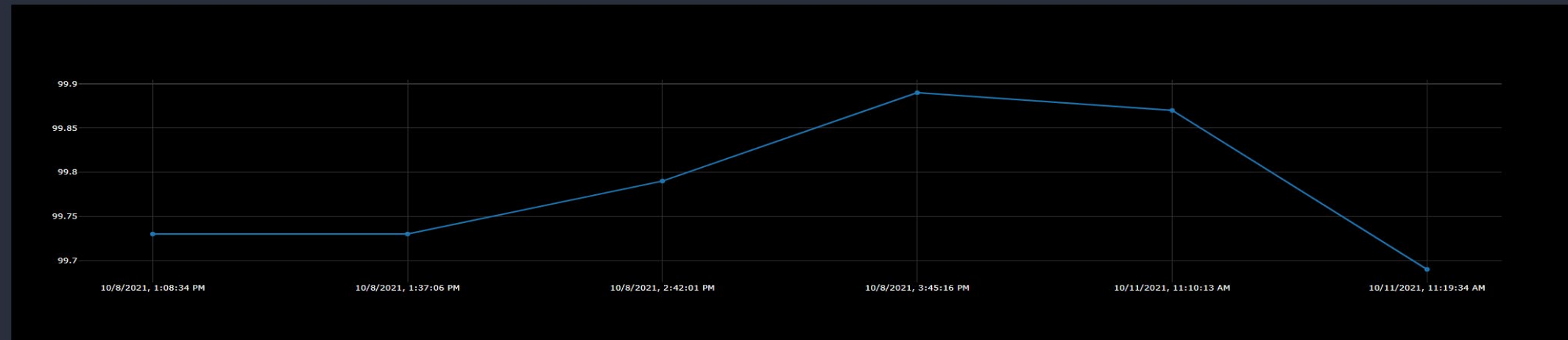
Calculation

3D Gamma

Gamma history

Gamma / Structure

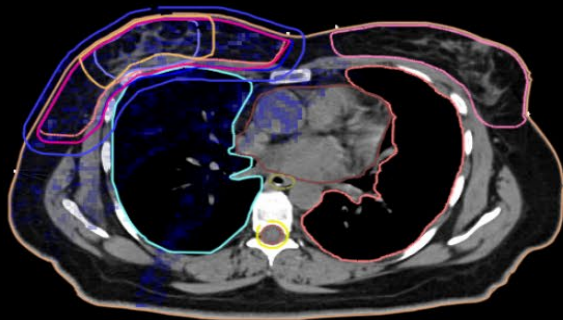
3D Gamma history



CLOSE

3D Gamma comparison [TPS vs log]

Axial view
64/124
-628.0 mm



Difference dose map [Log - TPS]

Axial view
64/124
-628.0 mm



Tasks

Patients

History

Settings

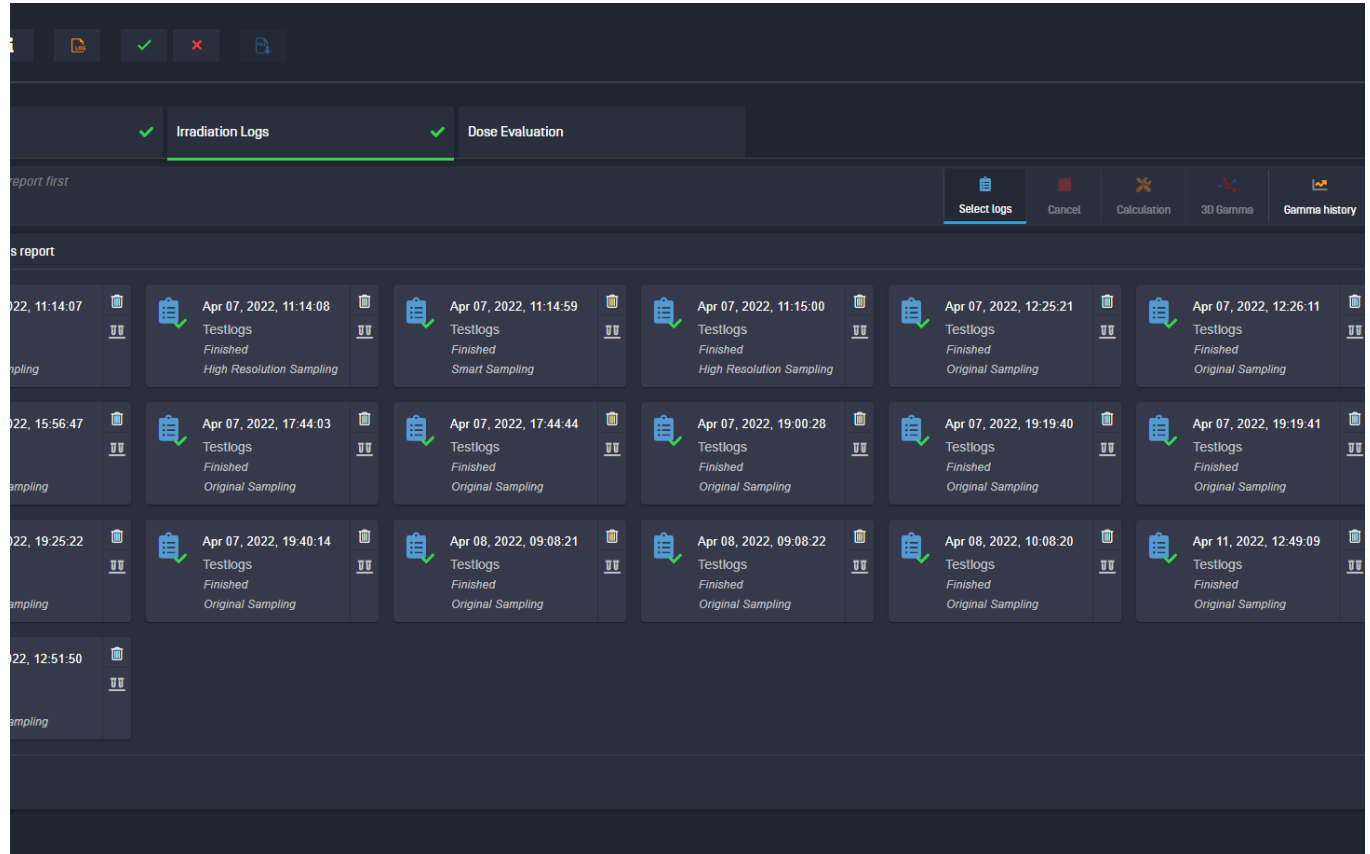
Mode:

Log Out

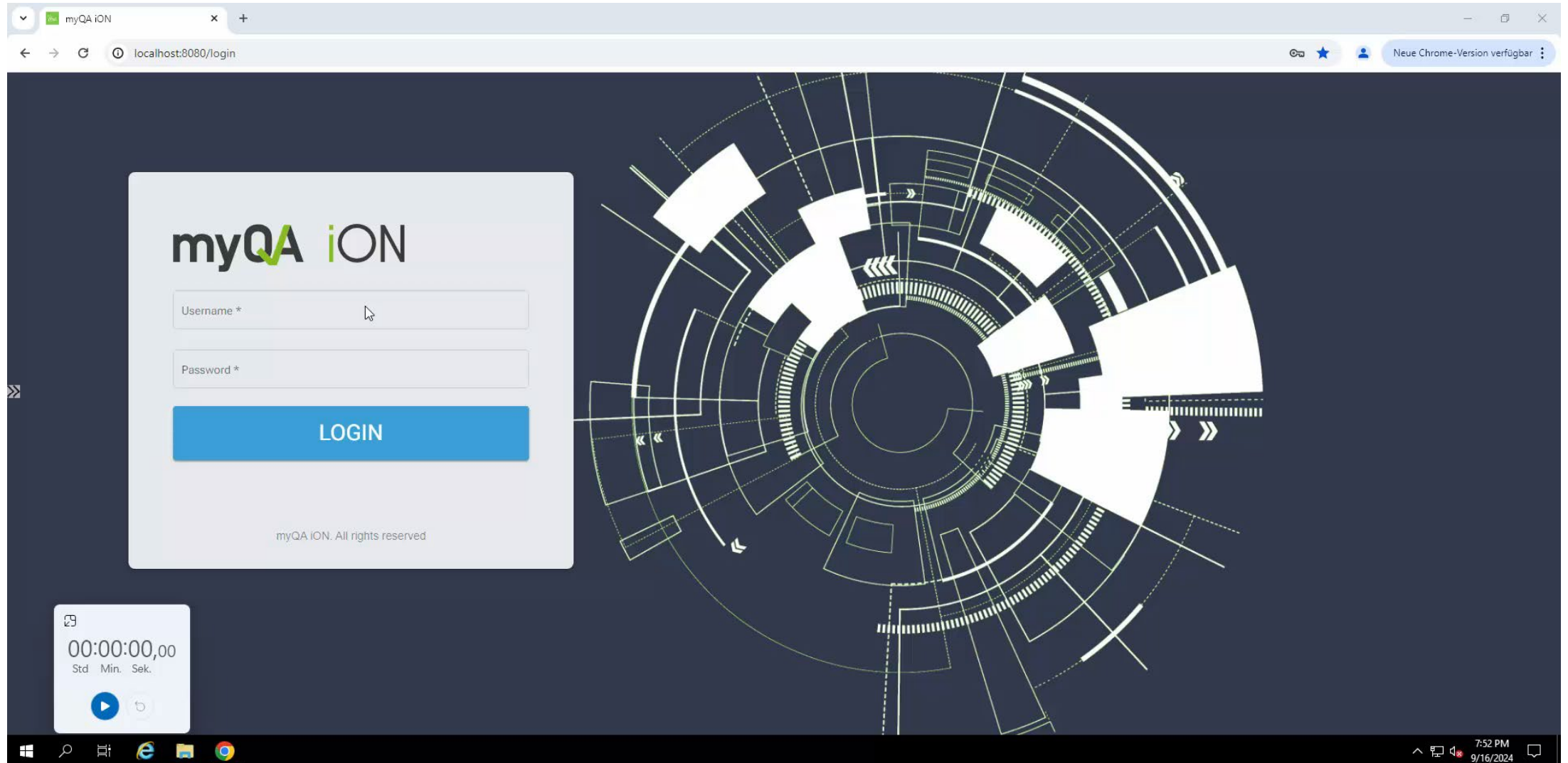
Logfile analysis

Can I be confident that log files measurements are accurate ?

- Szeverinski et al concludes:
- *“SciMoCa Monte Carlo calculations of Monaco RT plans and RT log file plans are in excellent agreement to each other. Therefore, log files and Monte Carlo can replace labor-intensive phantom-based measurements as patient-specific QA.”*



Log-File Analysis



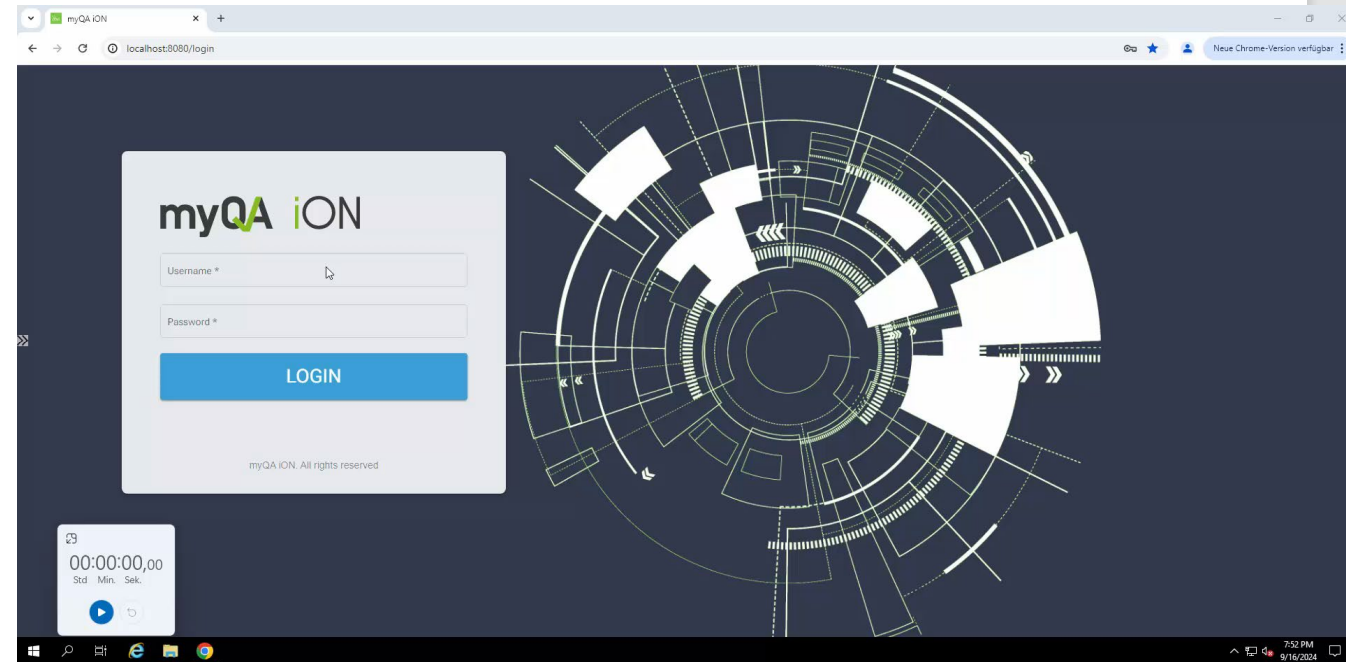
Log-File Workflow



- Automatic collection and calculation of Log-files once plan irradiation is done
- No manual data transfer
- Upon calculation, automatic status update on Task List

Video: Log-File Workflow

1. Requesting Log-files for Patient – Visible in Task View
 2. See that the logs arrive in the folder and are taken by myQA iON automatically for calculation (a step usually invisible for the user, just for visualization of the process)
 3. Check calculation is ongoing – fast forward
 4. Calculation done after 3 minutes
- No user interaction necessary for calculation

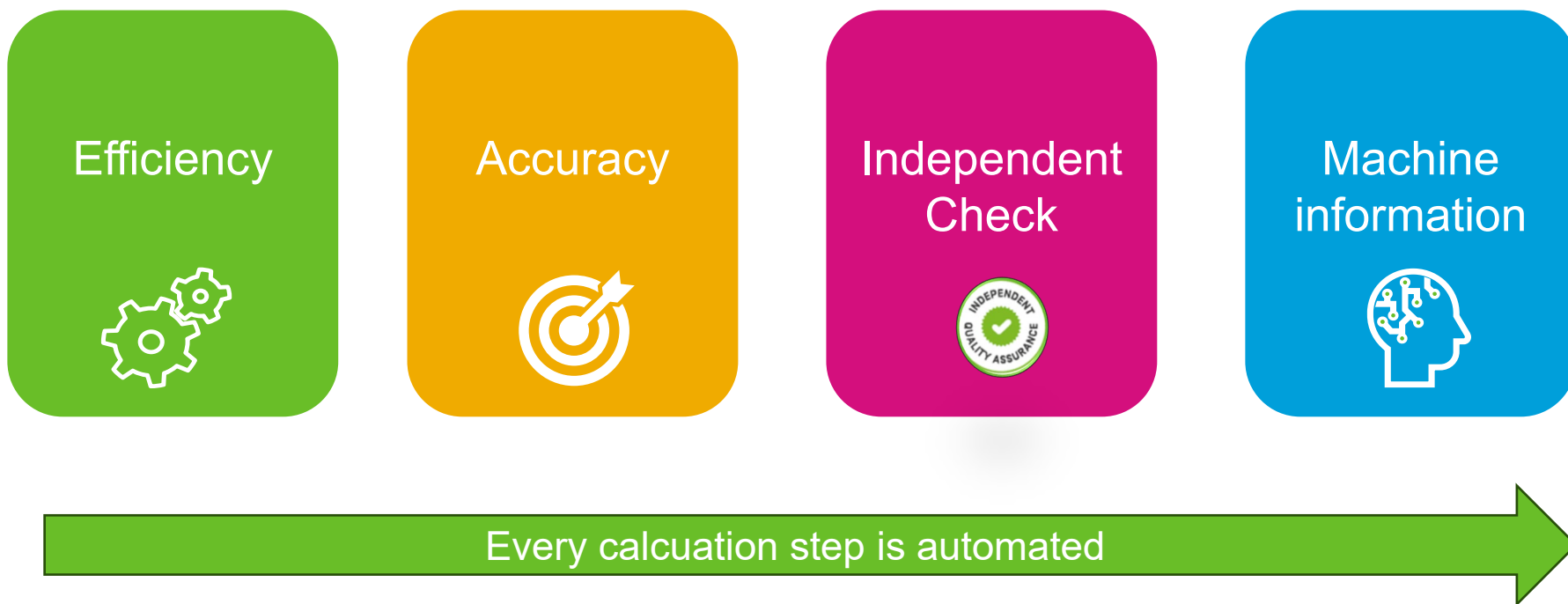


Delta4 Measurements

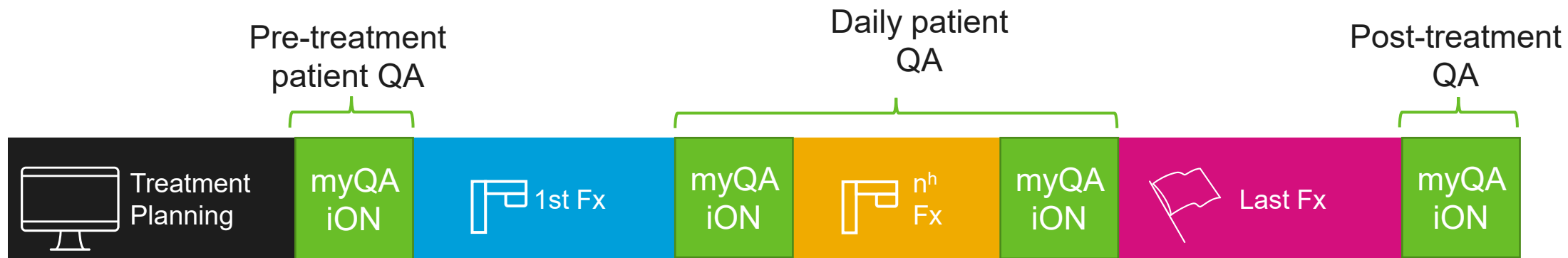


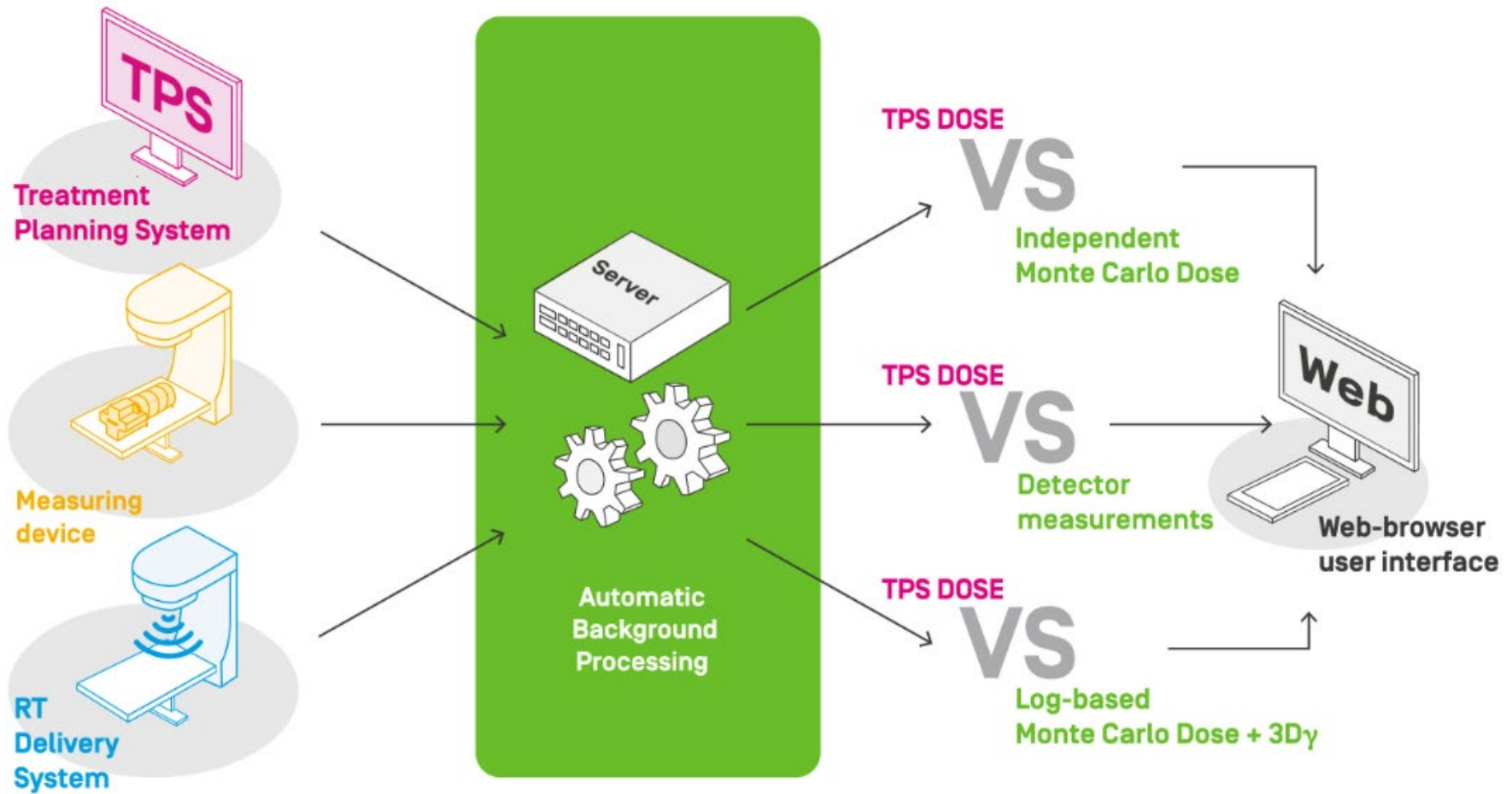
Independent Dose		✓	Irradiation Logs		✓	Delta4 Measurement		✓	Dose Evaluation						
✓ Passed with 100.00%	Measurement time: May 22, 2020, 10:42:37		Plan: Testlogs									Select measurement	Import	Start Delta4	
Results					Acceptance criteria										
Beam	Norm. dose (Gy)	Dist. to agreement (%)		Gamma Index (%)		Dose deviation (%)		Parameter		Δ Dose	Δ Dist	Acceptance limits			
Composite	2.416	✓	97.23	✓	100.00	✓	94.55	Distance to agreement		n/a	n/a	90% with DTA ≤ 2mm			
LOG01	2.416	✓	97.23	✓	100.00	✓	94.55	Gamma Index		± 3.00%	3.00mm	96% with Gamma ≤ 1			
								Dose deviation		n/a	n/a	90% within ± 3%			
								Comparison reference		TPS					
Measurement analysis															
✓ Composite															
		DTA		Dose deviation								Dose deviation			
				0.5 %	1 %	1.5 %	2 %	2.5 %	3 %	3.5 %	4 %	4.5 %	5 %	Median Deviation (%)	-0.56
5.0 mm		✗	94.97	✓	96.15	✓	97.14	✓	98.82	✓	99.70	✓	100.00	✓	100.00
4.5 mm		✗	93.98	✗	95.56	✓	96.75	✓	98.62	✓	99.61	✓	100.00	✓	100.00
4.0 mm		✗	93.00	✗	94.48	✓	96.06	✓	98.52	✓	99.51	✓	100.00	✓	100.00
3.5 mm		✗	91.91	✗	93.69	✗	95.66	✓	98.22	✓	99.41	✓	100.00	✓	100.00
3.0 mm		✗	90.04	✗	92.60	✗	95.07	✓	97.53	✓	99.11	✓	100.00	✓	100.00
2.5 mm		✗	88.56	✗	91.42	✗	93.79	✓	96.75	✓	98.62	✓	100.00	✓	100.00
2.0 mm		✗	86.49	✗	89.64	✗	93.10	✓	96.06	✓	98.52	✓	99.80	✓	100.00
													Gamma Index		
													Average Gamma value	0.22	
													Max Gamma value	0.99	

myQA iON Combined Efficiency for Patient QA



Where does myQA iON fit in?







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|

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|

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Life.
Science.

