

AAPM Spring Clinical Meeting MARCH 26, 2022

Improving Patient Safety through Standardized, Automated Quality Management for Standard & SRS Treatments

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Mission
ENABLING
HEALTHIER LIVES
by improving
the avoidance,
detection and
treatment of
cancer.



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**Comprehensive,
Independent Quality
Management Solutions**

PATIENT MACHINE DOSIMETRY LASER DIAGNOSTIC

Pa Ma Do La Dx

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WORLD-CLASS SUPPORT

**A Trusted Partner
for Patient Safety**

Hospitals and clinics worldwide
choose Sun Nuclear.

CONTINUING EDUCATION

130+
Countries with Sun
Nuclear Solutions

>90%
of U.S. Cancer
Treatment Centers
Use Sun Nuclear
Solutions

IN-DEPTH TRAINING

5,000+
Worldwide Cancer
Treatment Facilities
Use Sun Nuclear
Solutions

1
Worldwide Market
Leader in Radiation
Oncology Quality
Assurance

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The Right Partner for Your Needs

Nearly 40 Years of Service to the Field

300 Associates Worldwide

- 25% of Staff in Customer Support
- 30% of Staff in Research & Development
- 50+ Medical Physicists

4 Headquarters Facilities

- Melbourne, Florida – Global HQ & Training Center
- Madison, Wisconsin – Diagnostic QA HQ
- Hamburg, Germany – Sun Nuclear GmbH
- Breda, the Netherlands – SunServices™ Center - EMEA

State-of-the-art Manufacturing Facility, with Linac Testing Capabilities

ISO 13485:2016 certified QMS

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Independence.

It's the essence of everything we do.



Unrelenting
for safer, more effective treatments.

Independent Quality Management empowers clinical physicists to be guardians of Patient Safety, and to efficiently fulfill complex safety requirements.

Unbiased
for truth in data and analysis.


Independent Quality Management – free from the bias of self-checking – drives accurate, standardized data analysis and redundancies essential to reducing risk.

Unencumbered
to stay focused on catching errors.

In an expanding universe of imaging and treatment variables, independent Quality Management detects and prevents clinically relevant errors – ensuring safety is never taken for granted.

“A critical aspect of a QA program is independence; that is, the QA procedures conducted to assure the quality and accuracy of the product or process must be independent of the product or process itself.”


G.S. Ibbott, Journal of Physics: Conference Series 250 012001 (2010)

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SunCHECK™

Quality Management Platform
for Radiation Therapy



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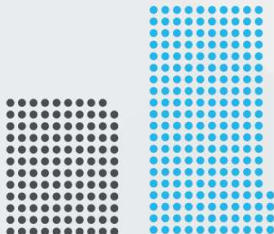
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It's about time.

- Countless new RT modalities and techniques have been introduced in the last 30 years
- Independent QA tools have kept pace, but have arrived as separate packages and solutions
- With demands for increased patient throughput, improved quality of care and reduced operational costs, every minute counts


SunCHECK™ provides flexible workflow automation for fully integrated and independent QA.




119 **204**

Globally, nearly **119 million** treatment fractions were treated in 2012. By 2035, that number is expected to jump to at least **204 million** per year.

Lancet Oncology Commission,
September 2015



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Integrated. Independent.

- **Integrated QA** provides optimal workflow efficiency & standardization
- **Independent QA** provides unbiased assurance systemic & random issues will be caught



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SunCHECK™ Independent QA. Your Way.



Platform

- One Database for Radiation Therapy QA
- Speed and Efficiency through Automation
- Access from Anywhere
- Seamless Clinical Integration



Patient

- Physics and Dosimetric Plan Checks
- Secondary Checks
- Phantomless and Array-Based Pre-Treatment QA
- In-Vivo Monitoring



Machine

- Daily, Monthly, Annual QA
- Measurement Device Connectivity
- Imaging, VMAT, MLC QA




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✓ EMR: System-Wide Patient Record


✓ OIS/R&V: Radiation Oncology Patient Record

✓ Treatment Planning & Delivery Ecosystem

✓ **SunCHECK**  Quality Management Platform


SunCHECK standardizes Quality Management for all patients and machines, regardless of vendor or modality – a solution similar to your EMR and Oncology Information System




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Single Platform form Machine and Patient QA: **SunCHECK™**






SunCHECK™ Machine

Machine

- Comprehensive TG142
- Daily/Monthly/Annual
- Includes Imaging

- SNC Machine** includes:
- TG142 Imaging & MLC QA
- VMAT QA



SunCHECK™ Patient

Patient

PlanCHECK™


- Physician DVH Protocols
- Automated DVH Checks
- Initial Physics Checks


DoseCHECK™

- 3D Secondary Checks

PerFRACTION™

- Pre-Treatment QA
- In-Vivo QA

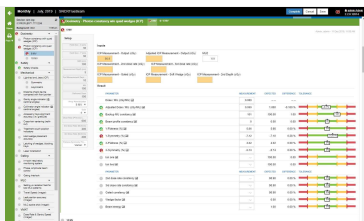
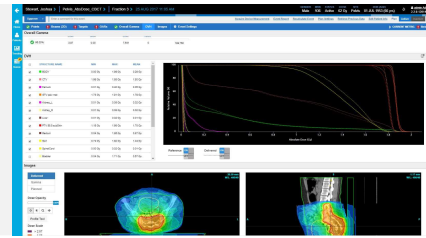


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One Solution for Radiation Therapy QA: SunCHECK™ Platform

Independent Patient QA in a Single Workflow
SunCHECK™ Patient



Complete Machine QA in One Application
SunCHECK™ Machine



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One Solution for Radiation Therapy QA: SunCHECK™ Platform

Platform

Clinical Overview:

Patient
Machine

- Complete, Comprehensive view of Patient and Machine QA
- User/permissions-based views and operation
- Single, browser-based application to access all functions and data
- Worklist-oriented dashboard

PATIENT WORKLIST				MACHINE WORKLIST			
DATE	PATIENT	TEST	STATUS	DATE	MACHINE	TEST	STATUS
19 APR 2019	Headley, Peter (PHIL_LUNG)	Holoxon Lung IG	080208	30 Oct 2019	SUNCHECK	Monthly 2	Overdue
19 APR 2019	Berkeley, David (PHIL_MAL_TIS)	Holoxon Malibu	080208	21 Apr 2019	Holoxon	Monthly	Overdue
06 APR 2019	Colson, Nathan (PHIL_HL_CCT)	Holoxon HSN	080208	21 Apr 2019	Tamoxifen	Daily 2019	Overdue
14 MAY 2018	Elms, Geoffrey (SCT)	Prostate Bed	080208	28 Apr 2019	SUNCHECK	Monthly	Overdue
14 MAY 2018	Chiu, Jennifer (SCT)	PTV Left Pelv	080208	28 Apr 2019	SUNCHECK	Monthly	Overdue
14 MAY 2018	Chiu, Jennifer (SCT)	PTV Left Temp	080208	16 May 2019	Tracheostomy	Monthly	Overdue
14 MAY 2018	Chiu, Jennifer (SCT)	PTV Right Arm	080208	26 May 2019	SUNCHECK	Annual	Overdue
14 MAY 2018	Buck, Keith (PROSTATE_NOCODE)	DoseCHECK	080208	06 May 2020	Elaris	Daily	Overdue
03 APR 2018	Lugan, Deepika (TIS)	Vag Cyl 30mm	080208	06 May 2020	GE Lightspeed	Daily	Overdue
21 AUG 2017	Shenoi, Jyoti (SCT)	Pelvic_JacDisc_1	080208	16 May 2020	Holoxon	Daily	Overdue
26 AUG 2017	Francis, Michael (SCT)	Abdominal CT	080208				
13 AUG 2017	Kali, Roshini (SCT)	Head/Neck_Tamoxifen	080208				
27 APR 2017	Earls, Eric (RT_BREAST)	RT Breast Scan R	080208				
07 APR 2017	Simmons, David (LUNG)	Head/NeckCT	080208				
01 APR 2017	Austin, James (LUNG)	Breast_CCT	080208				
16 MAR 2017	Palmer, Katherine (STRENGTH)	Electron Gun	080208				
27 MAR 2017	Garrett, Charles (CERVICAL)	CCTThyroid	080208				



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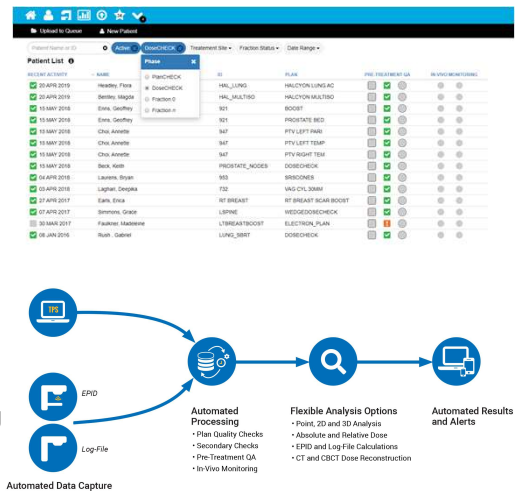
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Independent Patient QA in a Single Workflow: SunCHECK™ Patient

Platform
Patient
Machine

Workflow to match your clinic:

- Assure plan quality and validate performance vs. intent
- Calculated vs. planned dose calculations with 3D analysis
- Phantomless and Array-based Pre-Treatment QA analysis of plan deliverability
- Automatically analyze and verify patient setup, first fraction and ongoing fractions



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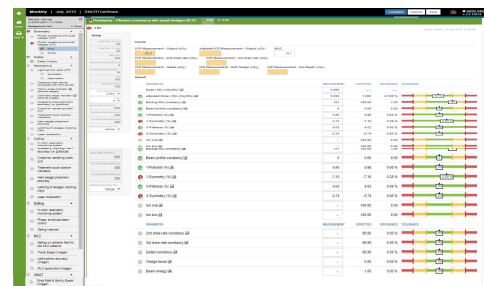
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Complete Machine QA in a Single Application: SunCHECK™ Machine

Platform
Patient
Machine

Streamlined Machine QA:

- Daily, Monthly and Annual QA
- Pre-set templates provided by modality and support for QA protocols
- Direct Device connectivity
- Automated Imaging, MLC and VMAT QA analysis



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SunCHECK Machine

ESTRO 2021, Time Savings

- PO-1720 **SunCHECK Machine, an automated QA software solution: A centres 5 year experience evaluation**, G. Martin¹, K. Fogarty^{2,1}, D. Egleston¹, L. Howard¹, M. Gilmore¹, ¹The Clatterbridge Cancer Centre, Medical Physics, Liverpool, United Kingdom; ²St. Lukes Radiation Oncology, Network, Medical Physics, Dublin, Ireland
- **Purpose or Objective:** Evaluate the key stages of the SunCHECK Machine implementation.....with 9 linacs and time saving quantification.
- **Time saved:** The time taken to complete QA measurements and analysis using legacy and SunCHECK Machine was compared (details in table).

QA specification requirement by frequency	Previous Test	Time to acquire and analyse historically	SunCHECK equivalent	SunCHECK Machine time	Time saved per test	Time saved annually per test, per linac
Monthly Picket fence/DR+GS/LS	Monthly 6 MV RapidArc	35 mins	Monthly VMAT picket fence, dose rate and gantry speed, leaf speed	7 mins	28 mins	336 mins
Monthly kv Blade positions	Blade position checks	15 mins	Monthly kv field size	2mins	13 mins	156 mins
Monthly flatness/symmetry	Monthly Starcheck ^{maxi}	45 mins	Monthly flatness and symmetry	3 mins	42 mins	504 mins
Monthly kv contrast and resolution	Monthly KV Image quality	10mins	Monthly Leeds test/ Tor18fg	3mins	7 mins	84 mins
Monthly CBCT HU and other	Monthly Catphan	20 mins	Monthly Catphan	10 mins	10 mins	120 mins
Three monthly Radiation Field size MLC and Jaw	Monthly Hole Phantom	30 mins	Three monthly field size/centre	5 mins	25 mins	100 mins
Six monthly radiation isocentre	Monthly Hole Phantom	30 mins	Six monthly Winston Lutz	15mins	15mins	-
Annual Flatness/symmetry (all gantry angles)	Annual Profiles with Gantry angle Starcheck ^{maxi}	60 mins	Annual flatness and symmetry with gantry angle	10 mins	50 mins	50 mins
Field size at extended SSD	Annual field size at extended SSD	15 mins	Annual field size at 150cm SSD	2 mins	13 mins	13 mins
	TOTAL	230 mins	TOTAL	57 mins	173 min	22hours 43mins



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Why SunCHECK™



Automate Workflows

- Automated Data Collection
- Automated Analysis & Results
- Automated Alerts & Notifications



Improve Efficiency

- More Time for High-Value Tasks
- Network-Wide Access
- Direct Device Control & Analysis



Increase Standardization

- Standardize Patient QA Across All Phases & Machine Types
- Standardize Data, Analysis & Workflows
- Identify Variability Between Sites, Staff, Linacs and More



Centralize Data & Management

- One Repository for all Data
- Simplified Deployment
- Easy Maintenance



Ensure Compliance

- Enable Accreditation via Auditing & Reporting
- Apply Pre-Defined Protocols & Machine Tests
- Satisfy Industry & Internal Requirements



Optimize Operations

- Reduce Risk with Confidence
- Identify Variations Between Linacs & Staff
- Predict & Prevent Downtime



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Clinical Examples

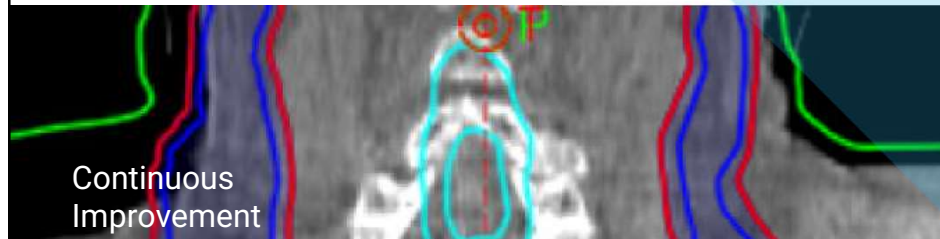


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Quality Management Applied: SunCHECK™ Results



56,000 delivery fractions

Completely automated analysis

4,000 actionable errors discovered

Corrective actions implemented

Iridium
Kankernetwerk
2-Year Experience



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Iridium Kankernetwerk Publication

A "How To" Guide on in vivo QA – AMARA Principle

- For in-vivo measurements we want to use an **AMARA-principle**: we want to detect errors, but only **As Many As Reasonably Achievable**, taking into account economic and societal factors.
 - Economic factors include costs of in-vivo systems and time spent on measuring and analyzing results
 - Societal factors include patient comfort - extending an imager during treatment is easier than using detectors for in vivo
- An AMARA-principle could be based on a few pillars:
 - Know the sensitivity, strengths and weaknesses of the system
 - Try to keep the number of false positives as low as possible and to automate their detection
 - Regularly evaluate tolerance levels, especially after introducing software or hardware changes e.g., tolerance levels could be made tighter when there is a software upgrade in which shifted imager positions can be taken into account or when the Clinacs are replaced by TrueBeams.



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Iridium Kankernetwerk Publication

A "How To" Guide on in vivo QA

"Conclusion: A commercially available automated pre-treatment and in-vivo transit dosimetry system has been clinically implemented for all patients and efficiently reveals a wide variety of deviations. It shows potential to serve as a base for adaptive planning..."

- Clinical guidelines from 2-year, 56,000+ fraction experience
- Gamma Criteria per Body Site**

	Normalization (Local/Global)	Dose Difference Tolerance (%)	Distance Tolerance (mm)	Low Dose Threshold (%)	Passing Tolerance Level (%)
Breast	Local	7	6	20	90
Whole Brain Radiotherapy	Local	7	3	20	90
Palliative treatments	Local	7	5	20	93
H&N and Brain	Global	3	3	20	95
Rectum	Global	5	5	20	93
Other treatment sites with mask	Global	5	3	20	95
Other treatment sites without mask (including lung, pelvis, abdomen,...)	Global	5	5	20	95
Stereotactic 1mm	Local	10	1	20	95
Stereotactic 2mm	Local	10	2	20	95
Stereotactic 3mm	Local	10	3	20	95



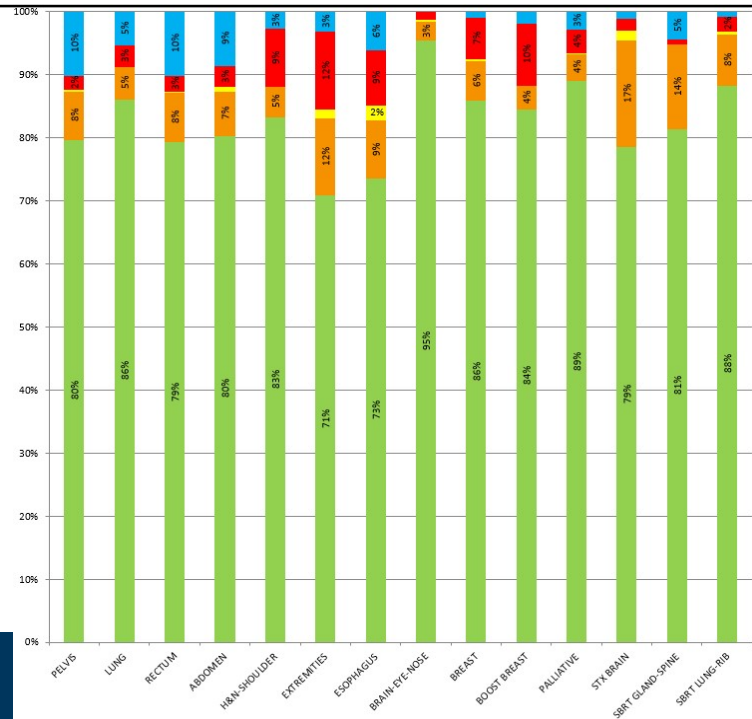
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Iridium Kankernetwork Publication

Pass Rates & Cause of Failure

- % Anatomy Change Patient
 - % Positioning Patient
 - % Planning Problem
 - % False Positives
 - % Number Passed
- Note: There were considerably more False Positives on the clinic's older linac

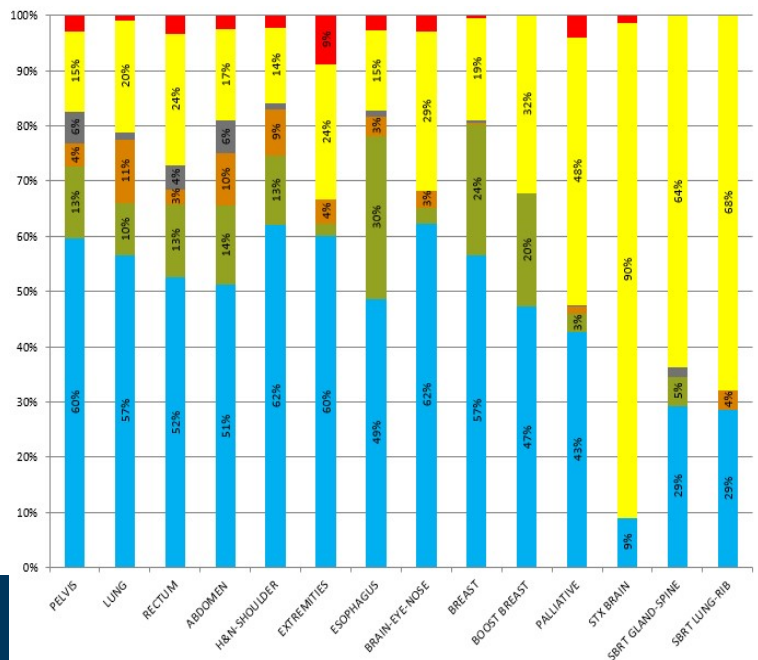


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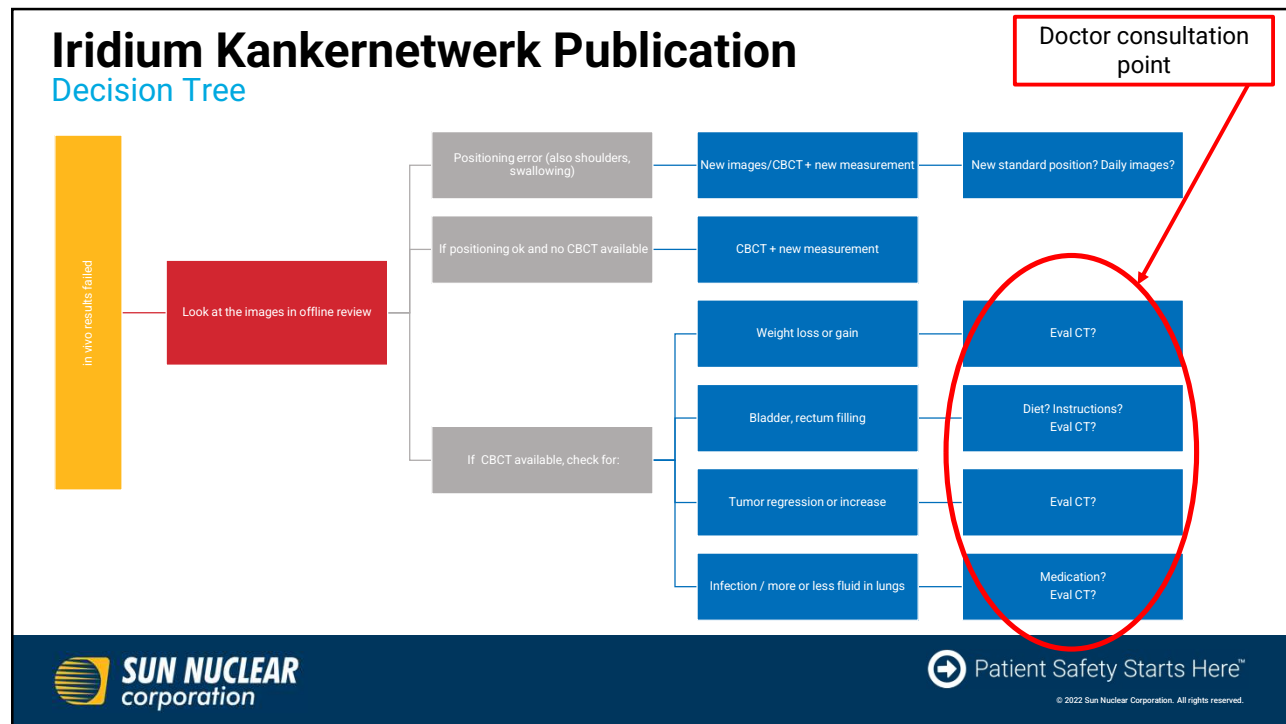
Iridium Kankernetwork Publication

Actions Taken

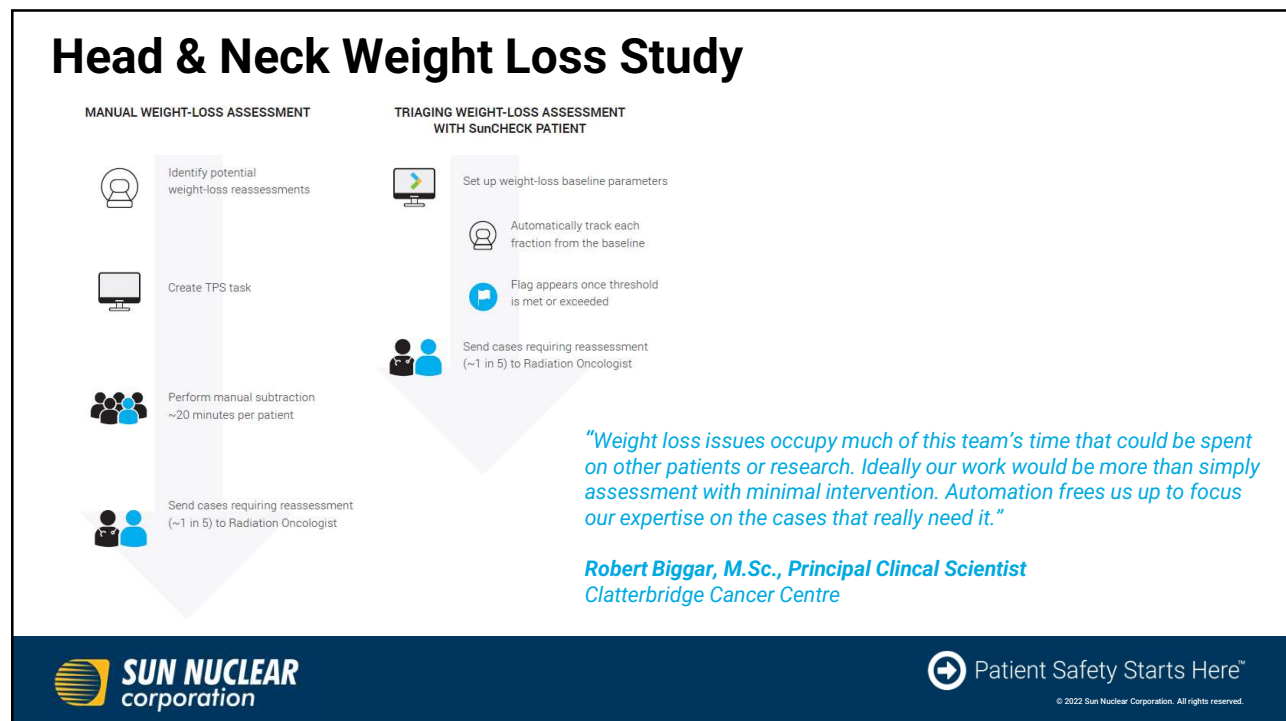
- Tolerances Adjusted
 - No Action
 - Patient Preparation
 - Plan Adjustment
 - Extra Imaging
 - New Measurement
- Mainly extremities
Random error or not clinically important
Bladder/rectal filling
Adaptive planning
To assist Therapists in proper alignment
Unsure of cause, event unlikely to recur, etc.



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Patient-Specific QA: “Field of View”

There are hazards to focusing on only one type of error, and selecting a QA method based on that narrow focus.

By broadening intended scope, other QA methods clearly become more appropriate.

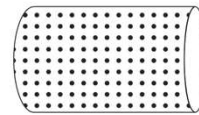
And clinically actionable.

Beam Modeling
Transfer Corruption
Deliverability
Patient Setup
Anatomy Changes



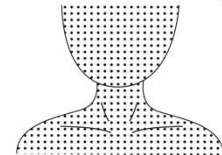
High Resolution
3D Secondary Calculations
Sensitivity to one error type

Beam Modeling
Transfer Corruption
Deliverability
Patient Setup
Anatomy Changes



High Resolution 3D
Measurement-based QA
Sensitivity to three types of error

Beam Modeling
Transfer Corruption
Deliverability
Patient Setup
Anatomy Changes



EPID-based In-vivo QA
Sensitivity to four types of error



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SRS MapCHECK™

StereoPHAN™ & MultiMet-WL Cube



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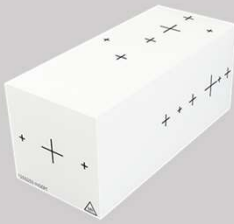
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StereoPHAN™ Platform Key Developments



SRS MapCHECK™
Released May 2018

Unmatched detector resolution
for **filmless SRS/SBRT QA**



MultiMet-WL Cube
Released September 2019

Assures targeting accuracy
for **off-axis SRS targets**



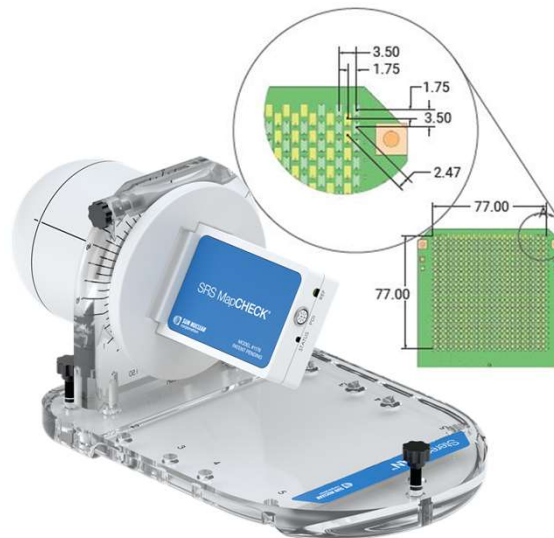
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SRS MapCHECK™

- Small-field digital alternative to film for SRS and SBRT QA and end-to-end testing

- Array Size: 7.7 x 7.7cm
- Detectors: 1,013
- Active Detector Area (mm): 0.48 x 0.48
 - Volume 0.007 mm³
- Detector spacing: 2.47 mm
 - 5 Diodes in 5 mm cone
- No film needed
 - Significant time-savings



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SRS MapCHECK™ // SNC Patient v8.3

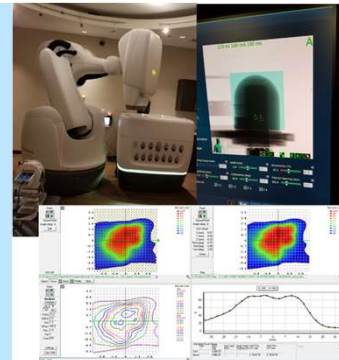
- Supported by SNC Patient software, as part of end-to-end solution
- Software corrections for well-known diode response characteristics:
 - Angular Dependence → [meets TG 218 requirements](#)
 - Field size
 - Temperature
 - Dose rate



Released September 2019:
SNC Patient v8.3

Enhanced capabilities to support:

- CyberKnife®
- Varian HyperArc™
- Vertex delivery beams for Varian/Elekta



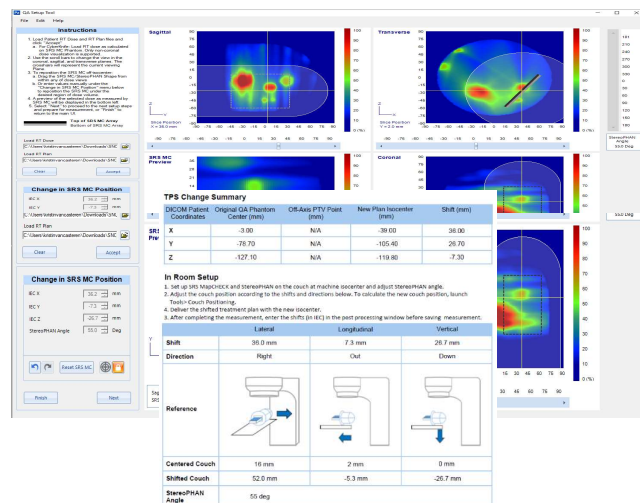
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SNC Patient v8.4 // Additional Functionality

- Enhanced SRS MapCHECK support:
 - QA Setup Tool
 - Improved Multi-Met set up
 - Preview dose on SRS MC before delivery
 - Provides complete guidance for positioning of SRS MC for off isocenter workflows
 - Off-axis workflow
 - Halcyon Support
 - 10x/FFF Support (including >45deg)



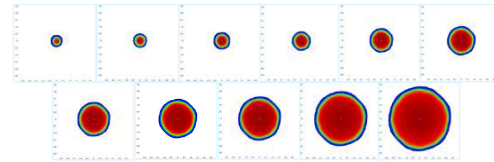
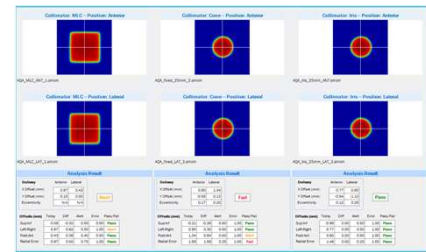
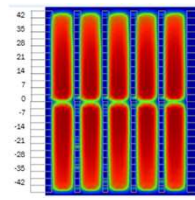
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SNC Patient v8.5 // Additional Functionality

- CyberKnife® Machine QA with SRS MapCHECK®
 - MLC QA Garden Fence Test
 - Iris Beam QA Test
 - Daily Targeting Accuracy QA Test
 - MLC and Fixed Cone Beam QA
- Expanded Support
 - **SRS MapCHECK®**
 - Varian Medical Systems® Ethos™ Therapy and Accuray® TomoTherapy® and Radixact™ System Support*
 - ArcCHECK®
 - Varian Medical Systems® Halcyon™ System and Ethos™ Therapy, Accuray® Radixact™ Support*
- New Data Security Features
 - User log in, Event Tracking, Windows recommended installation



*Does not include Synchrony for CyberKnife or Tomotherapy

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CyberKnife® Machine QA with SRS MapCHECK®

MLC QA

- Measure offsets from expected for 52 leaves at each of the 5 positions
- Apply Bayouth Test criteria
 - Total mean offset
 - % Passing for all offsets
 - # Offsets > Max
 - # Offsets per leaf
- View pass/fail and histogram of results
- Customize error thresholds
- Print report of analysis results

Offset from Expected (per Segment)										Result (per Leaf)	
Bank	X1	X2	X1	X2	X1	X2	X1	X2	X1	X2	Leaf Number
Segment	1	2	3	4	5						
1	-0.26	-0.16	-0.11	-0.16	-0.03	-0.07	0.06	0.06	0.09	0.04	26
2	-0.21	-0.18	-0.08	-0.37	-0.22	-0.19	-0.13	-0.06	-0.02	-0.04	25
3	-0.29	-0.28	-0.06	-0.35	-0.22	-0.20	-0.14	-0.10	0.04	-0.04	24
4	-0.14	-0.22	-0.11	-0.27	-0.06	-0.14	-0.72	-0.18	0.10	-0.07	23
5	-0.18	-0.07	-0.17	-0.14	0.07	-0.09	-0.39	-0.09	-0.02	-0.06	22
6	-0.11	0.03	-0.04	-0.01	0.04	0.03	-0.06	0.08	0.06	-0.07	21
7	-0.28	-0.07	-0.07	-0.09	-0.06	-0.05	-0.11	-0.08	0.42	-0.02	20
8	-0.07	0.02	-0.06	-0.14	0.00	0.17	0.04	0.06	0.11	-0.04	19
9	-0.06	-0.07	-0.04	-0.07	0.04	0.26	0.08	0.35	0.05	0.01	18
10	0.06	0.06	-0.06	-0.04	0.02	0.03	0.17	0.04	-0.02		17
11	0.00	0.06	0.00	-0.76	0.08	-0.03	0.07	0.03	0.07	0.04	16
12	0.01	0.14	-0.01	-0.13	-0.04	-0.04	0.06	0.01	0.03	0.47	15
13	0.00	0.06	0.03	0.01	0.06	0.02	0.06	0.00	0.13	0.00	14
14	-0.12	-0.06	-0.07	-0.25	-0.24	-0.10	0.10	-0.11	-0.21	-0.12	13
15	-0.22	-0.06	-0.03	-0.07	-0.09	-0.09	0.06	-0.03	-0.10	-0.14	12
16	-0.18	-0.02	-0.01	-0.03	-0.07	-0.06	-0.04	-0.10	-0.46		11
17	-0.06	0.04	0.36	-0.01	-0.04	-0.09	-0.01	-0.03	0.06	-0.09	10
18	-0.04	-0.01	0.04	0.03	0.05	0.02	-0.02	-0.02	-0.03		9
19	-0.04	0.02	-0.01	0.01	0.07	-0.06	-0.06	-0.03	0.08	-0.01	8
20	-0.01	0.06	0.04	0.01	0.00	0.02	0.06	0.01	0.01	-0.01	7
21	-0.07	-0.01	-0.01	0.38	-0.07	-0.02	-0.02	0.06	0.02		6
22	0.01	-0.11	0.10	0.00	0.07	0.07	0.06	0.01	-0.41	-0.01	5
23	0.03	0.06	0.06	0.10	0.06	-0.01	0.05	0.10	-0.41	0.06	4
24	0.02	-0.06	0.02	-0.02	0.06	0.02	0.06	0.20	0.03	0.03	3
25	0.06	0.01	0.06	0.01	0.12	0.11	0.07	0.31	0.04	0.13	2
26	-0.04	-0.11	0.01	0.01	0.06	0.11	0.07	0.08	0.08	0.07	1

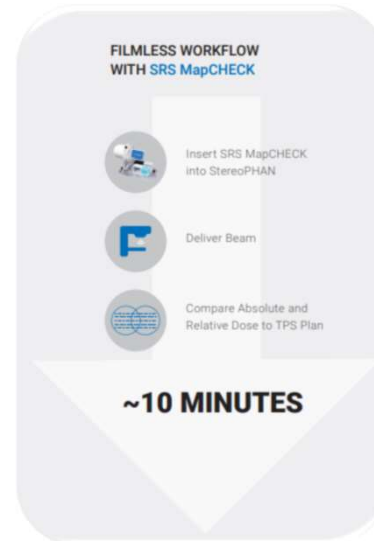
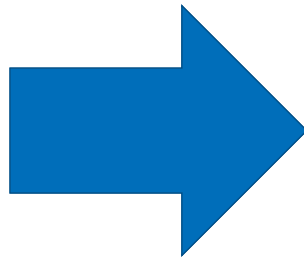


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Streamline Your Workflow



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Recent SRS MapCHECK webinars and publications

FEBRUARY 15 // 12 PM US ET
Evaluation of SRS MapCHECK for VMAT SRS Patient-Specific Quality Assurance

 **Richard Popple, Ph.D.**
 Professor & Director of the Medical Physics Division,
 University of Alabama at Birmingham



Webinar Overview & Recording

His talk focused on his team's experience moving away from film for patient-specific QA to using the SRS MapCHECK, including data from his recent paper on this subject. In his presentation he speaks highly of the capabilities of the SRS MapCHECK, its film equivalency, the efficiency it brings and how it may have brought to light some issues with the treatment planning system.

physicsworld

07 Feb 2022 Sponsored by Sun Nuclear Corporation

Independent QA: catching, understanding and correcting errors before radiotherapy begin



"Independent QA not only ensures delivery of intended therapeutic dose, it drives continuous improvement in patient safety by rooting out systematic machine and workflow errors"



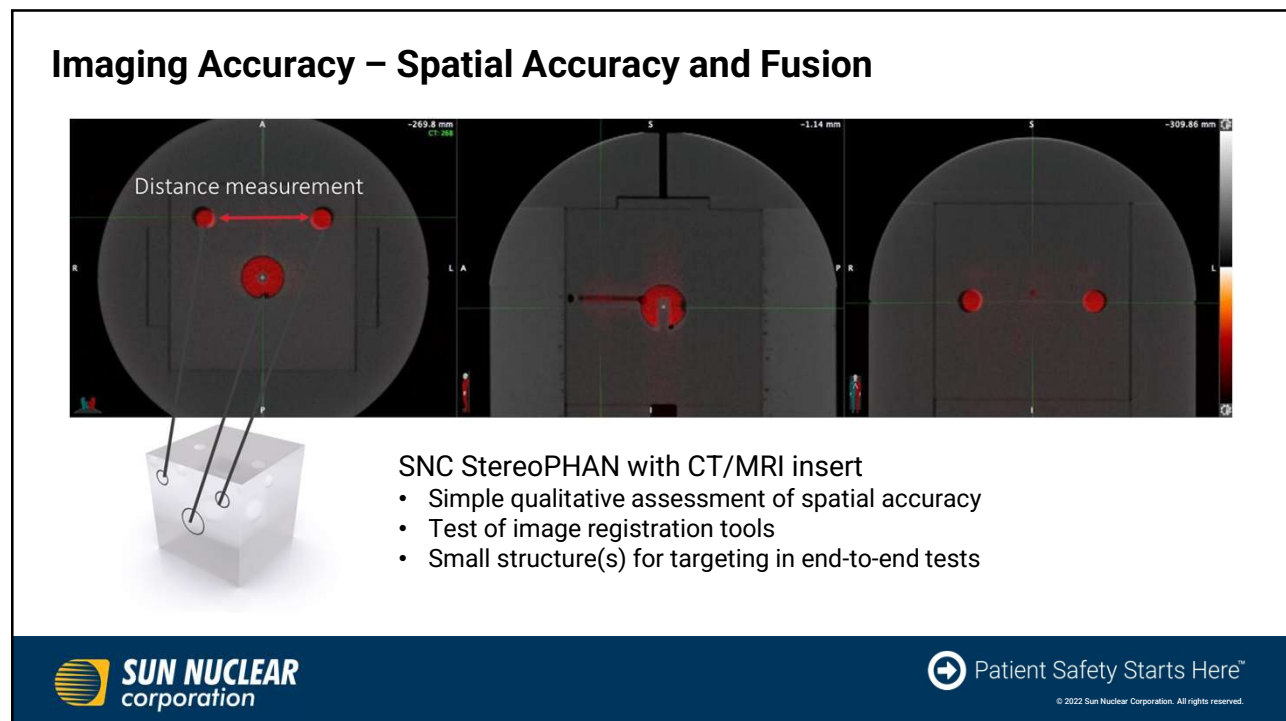
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CIRS Cranial SRS Distortion Phantom



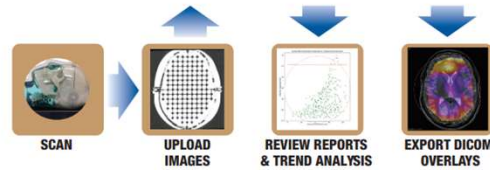
Distortion Check

Automated Analysis of Distortion in MRgRT

The fast, user friendly, cloud based solution.

Model 603S

distortion check
SOFTWARE FOR EVALUATION OF IMAGE DISTORTION



Cranial SRS Phantom to characterize your MRI distortion for your SRS program



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What's New in SRS QA...



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MultiMet-WL Cube // Released September 2019

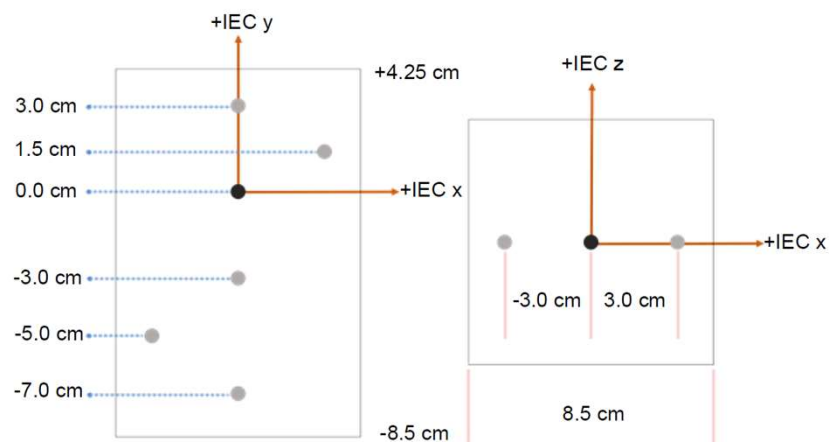
- New StereoPHAN insert
- Off-axis W/L test
- Quantifies accuracy out to 7cm off-axis
 - 0.1mm precision
- Automated Analysis Software Included
- Integration into SunCHECK Machine – Future



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MultiMet-WL Cube // Design



Six targets enable quantifying the margin of error up to 7 cm off-axis

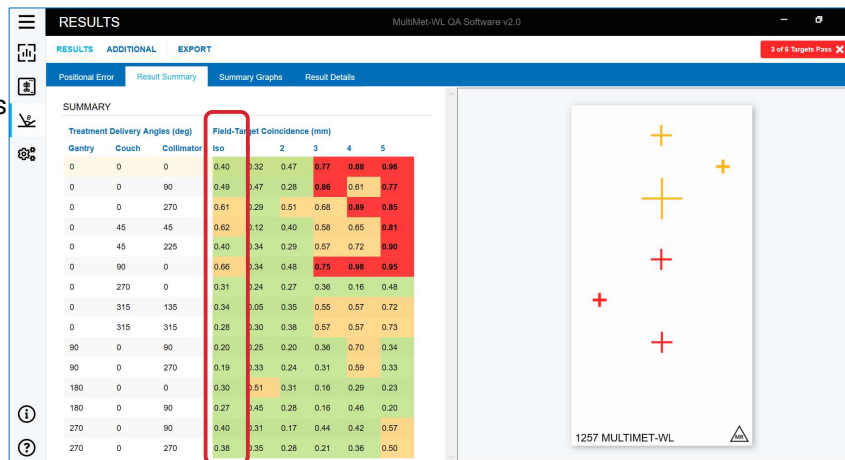
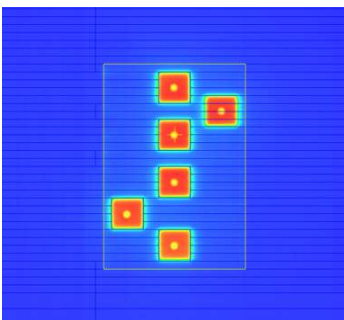


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MultiMet-WL Cube // Test Execution

- Off-axis target accuracy
- RT Plan provided
- Automated multi-target results



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Thank You,

Questions?

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