Eine komplette Qualitätssicherung für die moderne Strahlentherapie

Mobius 3D
Mobius FX
Mobius MVP

Johann Kindlein

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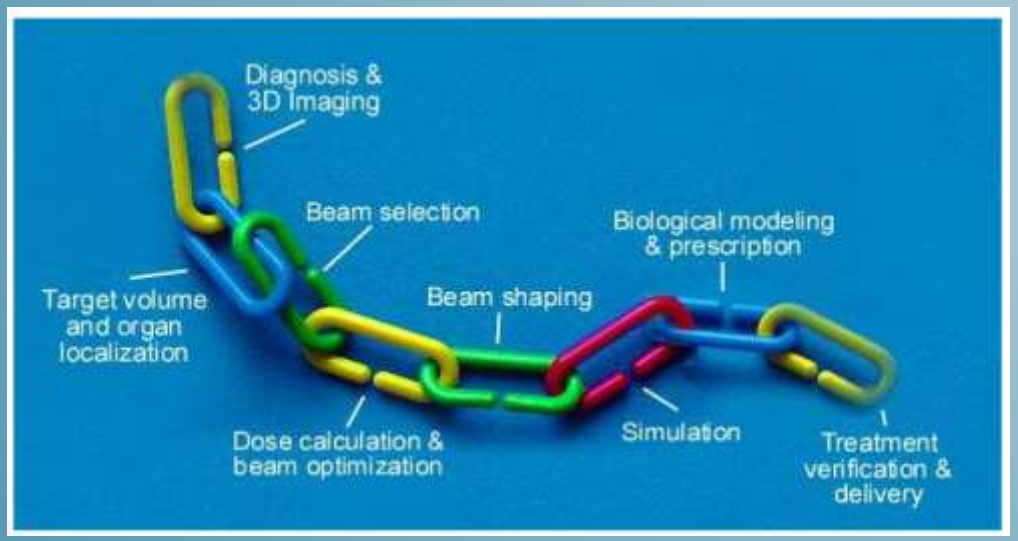
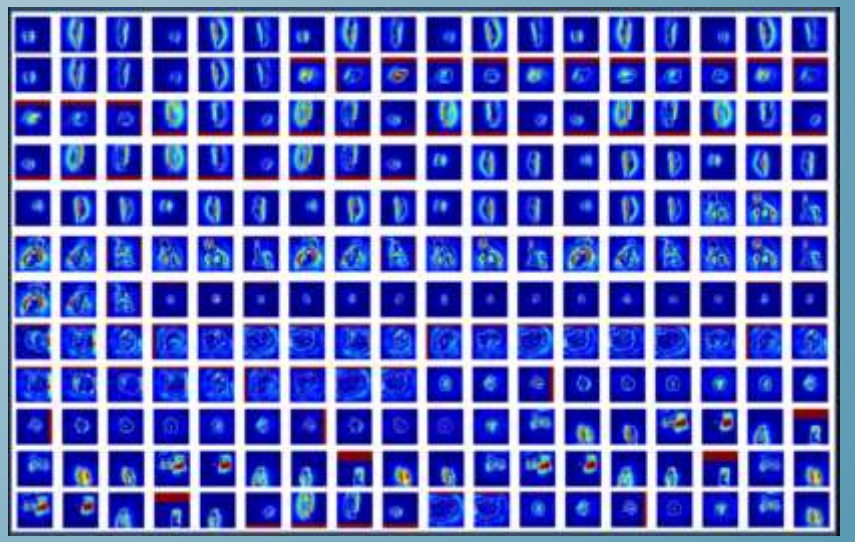
www.medinex.com.de

Arbeitskreis IMRT der DGMP Erlangen 19.-20. 03.2015

WIE MÖCHTEN SIE DIE DATENFLUT IN DER STRAHLENTHERAPIE ZEITEFFIZIENT IM AUGE BEHALTEN ?





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WIE MÖCHTEN SIE VERSTECKTE FEHLER FINDEN UND UNFÄLLE VERHINDERN ?

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WIE MÖCHTEN SIE DIE FEIN ABGESTIMMTE FEHLERLOSE ZUSAMMENARBEIT IHRER SYSTEME SICHERN UM UNFÄLLE ZU VERHINDERN?

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Die **Mobius** Produktlinie ist eine effiziente, zeitsparende und effektive Lösung für die :

- Planungsüberprüfung
- Fraktionsüberprüfung
- Datenintegrität
- Messüberprüfung
- Versteckte Fehler zu entdecken

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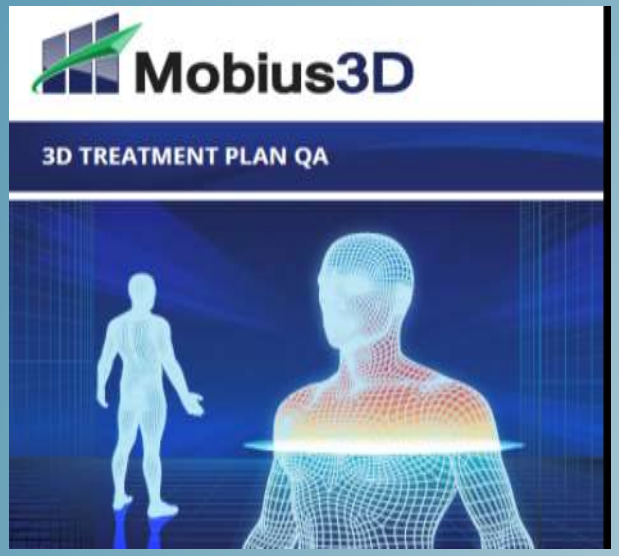
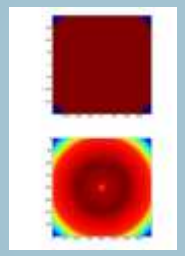
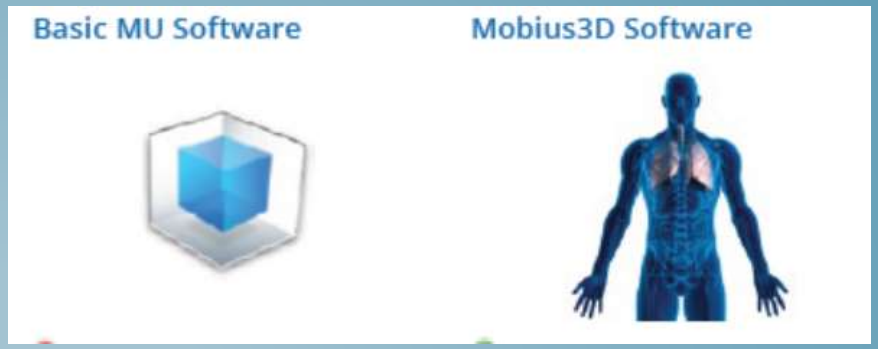
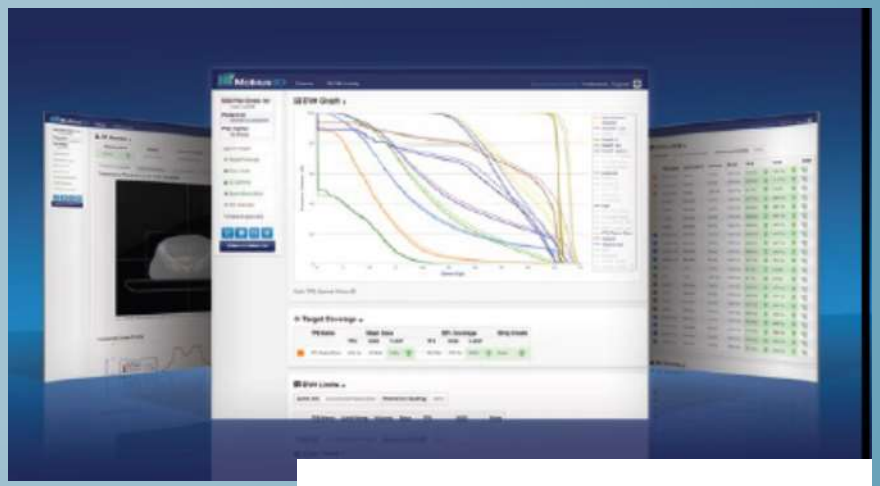
MOBIUS 3D AUF EINEN BLICK









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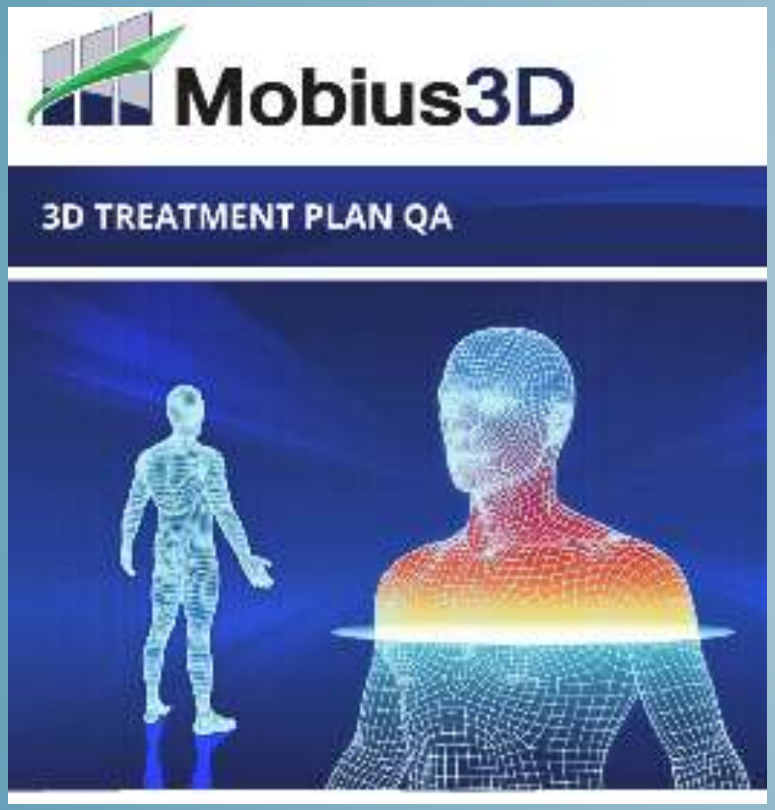

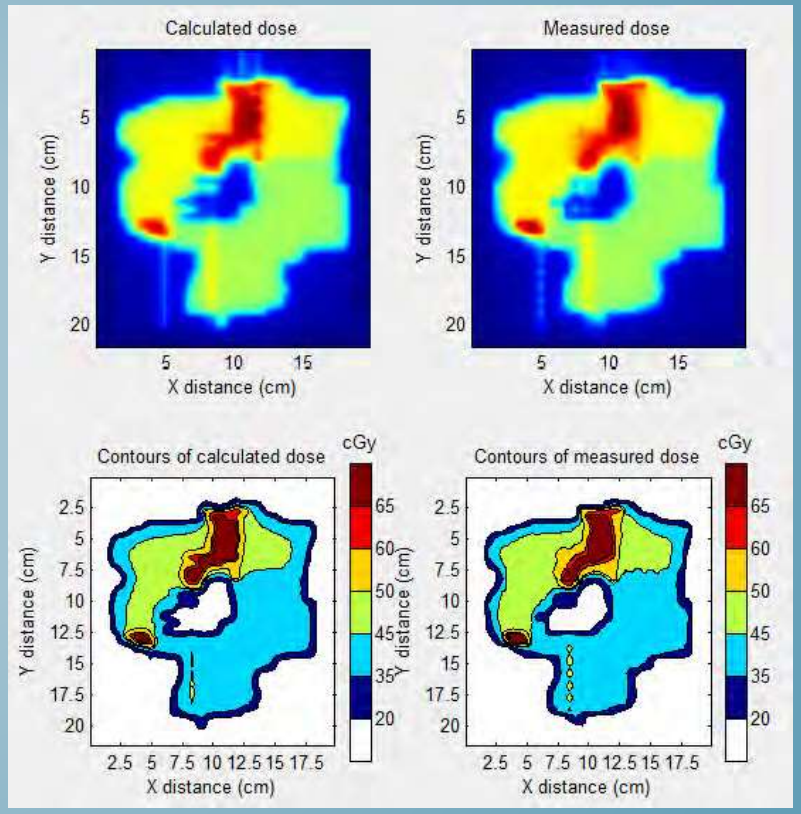

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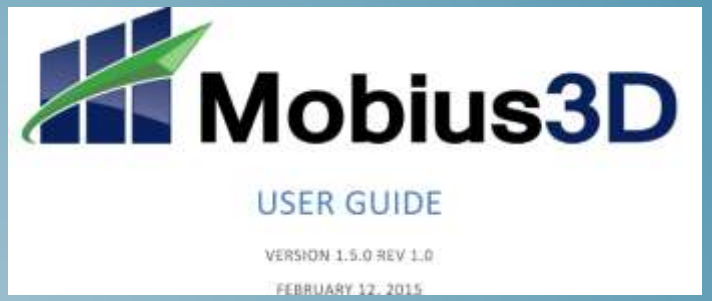
MOBIUS 3D – KEY FEATURES



Mobius 3D

Das automatische System für 3D- Bestrahlungsplanung QA

Key Features

- 3 % Genauigkeit für IMRT & VMAT Anwendungen mit komplexer Anatomie
- PlugIn -Einsatzbereitschaft
- Kein Zeitaufwand
- Automatischer Start mit minutenschnellen GPU Berechnungen
- Voreinstellungen der Server-Funktionen
- Voreinstellungen der Schnittstellen Ihrem Planungssystem und Linearbeschleuniger
- Unabhängiger schneller „Collapsed-Cone Faltungsüberlagerungs (CCCS)-Algorithmus“
- Gold Standard „Commissioning-Beam – Modell“ zur Überprüfung die Ihrer Messdaten
- Automatisches Importieren der DICOM RT Planungsdaten.
- Verwendung der Planungs-CT Daten für die Berechnungen
- Automatische Kontrolle der DVH Zielvolumen
- Überprüfung der Dosis im gesamten Patientenbehandlungsvolumen
- MU Prüfung in mehr als einem einzigen Punkt (3D)
- Patienten Heterogenitäten werden automatisch mit den CT- Daten berücksichtigt
- Überprüft ob die DVH-Ziele Ihrer Pläne erfüllt werden
- Berechnung der 3D-Passing Rate

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MOBIUS 3D – KEY FEATURES

- 3D Gamma-Analyse in einzelnen CT-Schnitten (Transversal, Koronar, Sagital)
- Individuelle ROI-Einstellungen mit Identifizierung der anatomischen Strukturen.
- Einstellung individueller Toleranzen für Warnungen
- Streu-Voxel Erkennung in den Zielstrukturen Verhinderung falscher Dosisberechnungen
- Vorinstallierte DVH Zielvorgaben von RTOG und TG -101 DVH
- PDF- Reports für die Planungsdaten jedes Patienten
- Intuitive Browser-Schnittstellen und Bedienung
- Browser Zugang von Laptops, Tablets und Handys
- Kompatibel mit jedem modernen Bestrahlungsplanungssystem
- Kompatibel für konventionelle Beschleuniger und Tomo-Geräten
- Benutzer Verwaltung, Zugangsberechtigungen und Passwörter
  Für Physiker und Ärzte.
- Überprüfung der MLC Funktionalität (Bewegungsfähigkeit) (wie das gemacht wird ?)

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MOBIUS 3D – KEY FEATURES

- Überprüfung der Kollisionsgefahr zwischen Gantry und Patient
- Bestimmung der benötigten MLC Zeiten und der Bestrahlungszeit
- Behandlungsarten
  - Photonen
  - Elektronen - Pencil Beam Neudefinition Algorithmus (PBRA)
  - Alle Energien
  - SRS / SBRT (MLC)
  - ARCS & VMAT IMRT
  - Free Flat Filter (FFF)
  - Keil-Einschübe (Physical , Dynamic, Universal)
- Bestrahlungsplanungssysteme (TPS)
  - Pinnacle
  - Eclipse
  - XIO
  - iPlan
  - RayStation
  - Masterplan
- Multileafkollimatoren
  - Millenium Series
  - BrainLab m3
  - Strahl Modulator
  - Siemens 160 ML
  - HD 120
  - MLC i2
  - Optifocus

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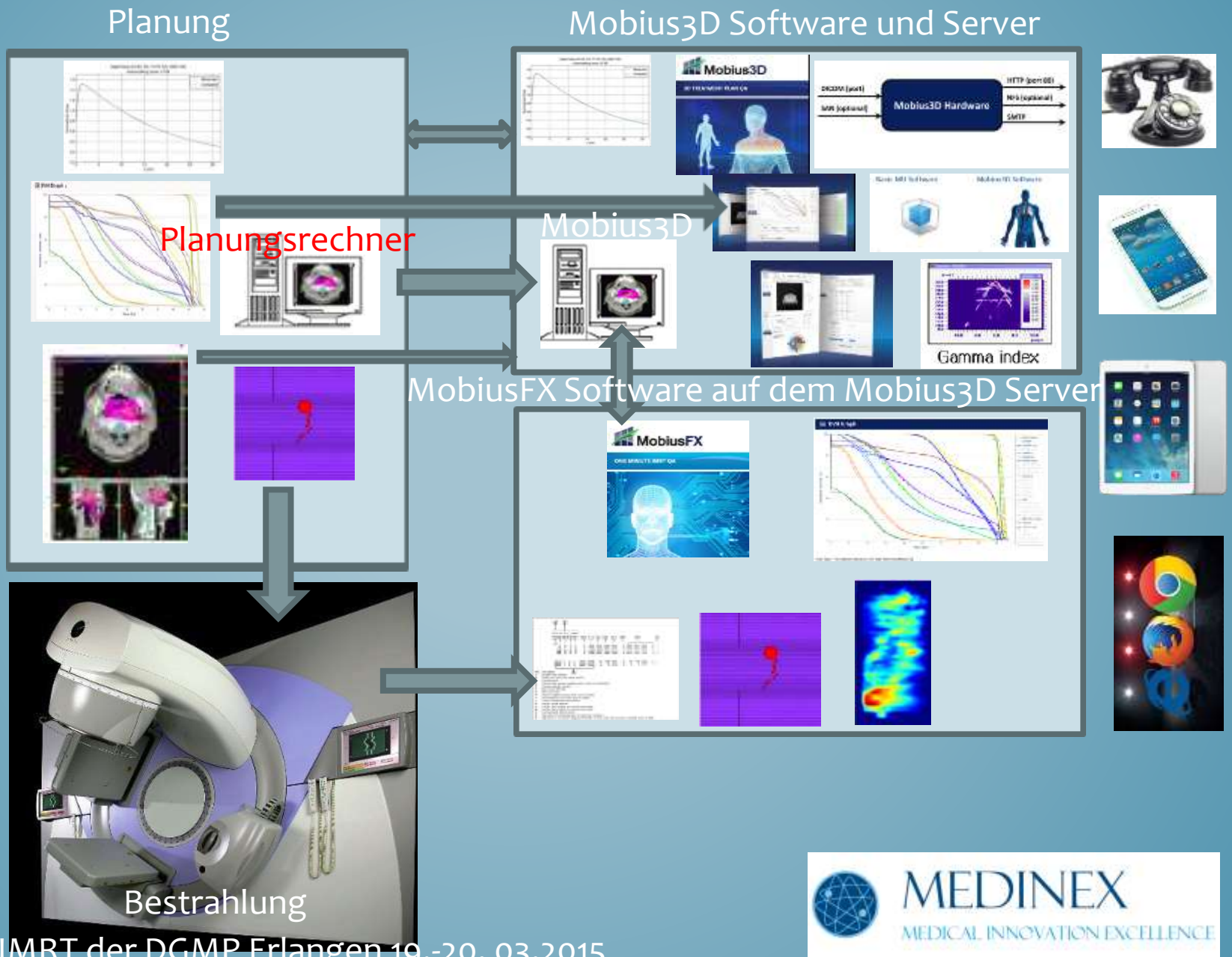
DAS FUNKTIONSPRINZIP



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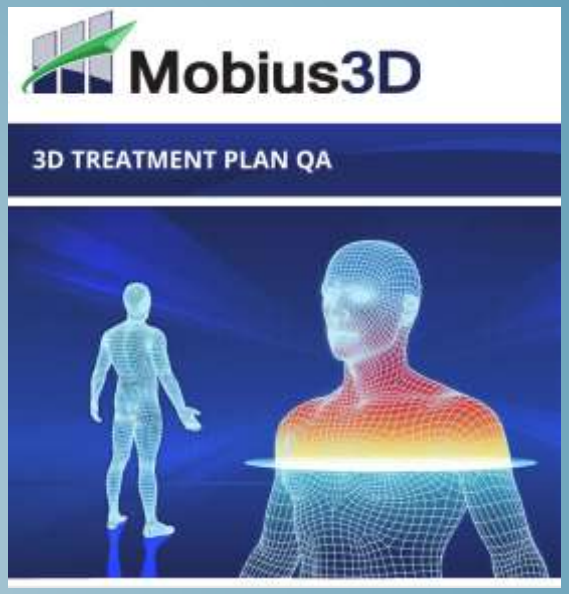
MOBIUS 3D LIZENZEN PRO LINAC



Institution Name	Machine Name	Matched Machines	Vendor	Model	MLC	100 MU Dose at 10 cm for 10x10 field (cGy)				
						6	7	10	15	18
Unknown Insitution	21EX		Varian	21 EX	Millennium 120	66.3				79.6
Unknown Insitution	2300X		Varian	2300X	Millennium 120	66.6				79.4
Unknown Insitution	600C		Varian	600C	Millennium 120	67.2				
Unknown Insitution	ARTISTED		Siemens	Artiste	Siemens 160	67.6				78.3
Unknown Insitution	Agility		Elekta	Agility	Agility 160	67.16			75.95	

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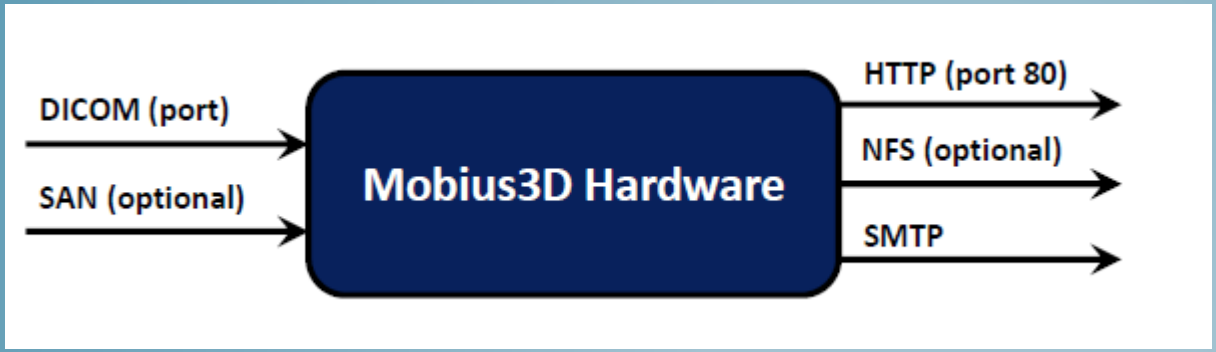
MOBIUS 3D MIT HARDWARE SERVER UND SOFTWARE



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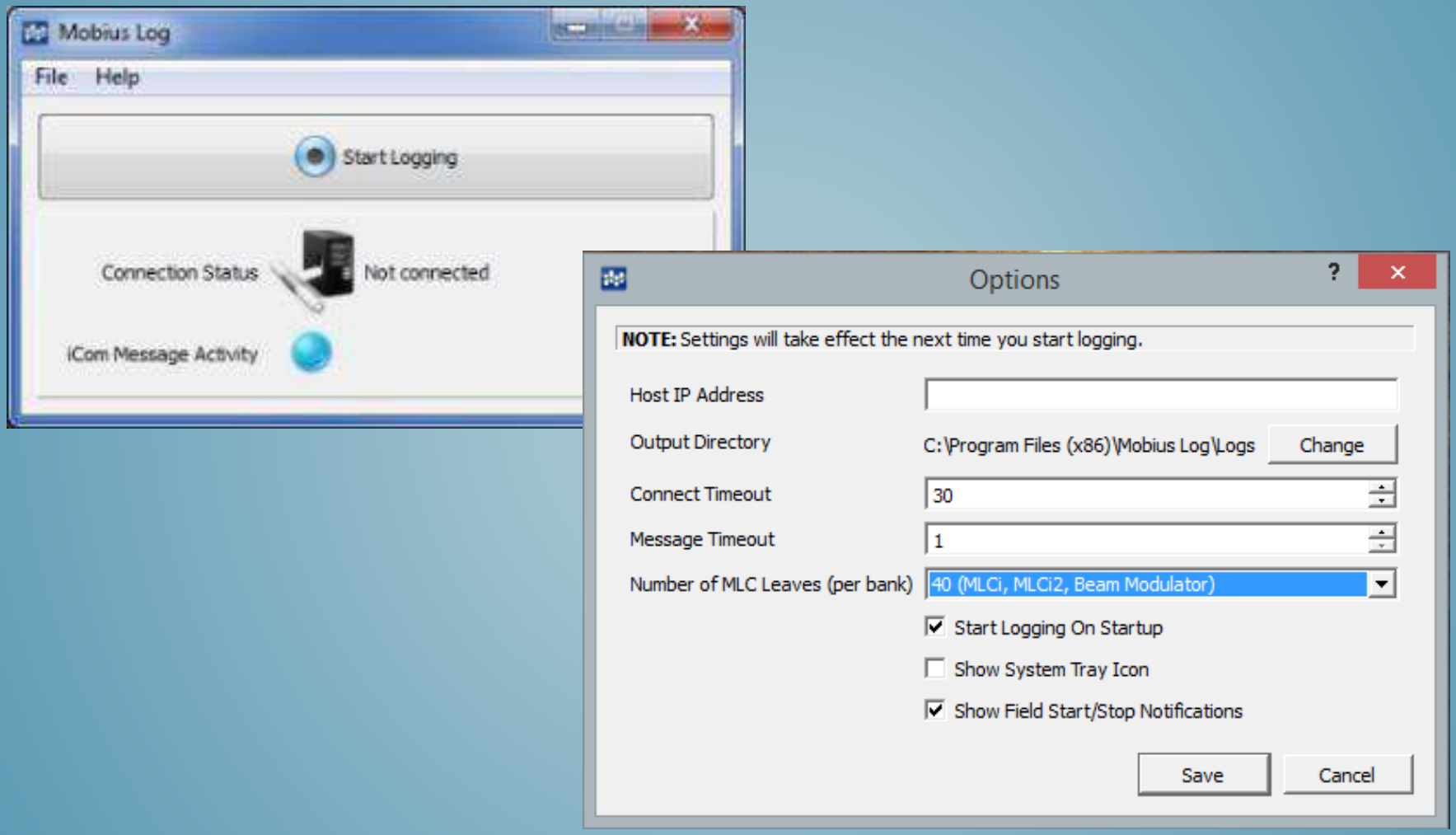
MOBIUS 3D NETZWERKEINBINDUNG



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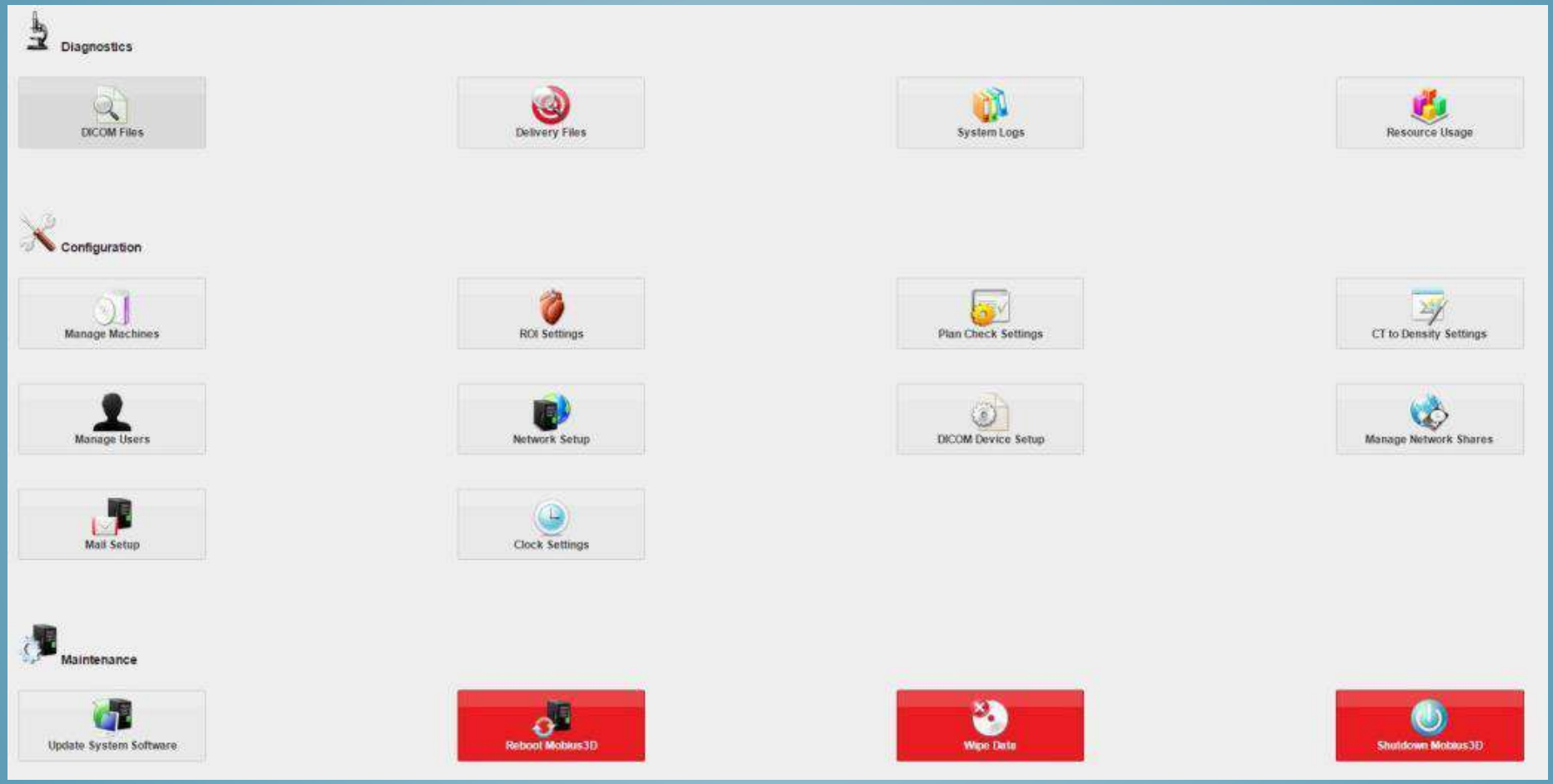
MOBIUS 3D ANWENDER EINSTELLUNGSMÖGLICHKEITEN



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MOBIUS3D LINAC KOMPATIBILITÄT

Vendor	Supported Machine Models	Photon Energy (MV)	Supported Physical Wedge Angles	Virtual Wedge/Dynamic Wedge	Electron Energy [MeV] *(as applicable)*	SRS Cone Energy (MV)[1]
Accuray	TomoTherapy	6	N/A	N/A	N/A	N/A
Elekta	Synergy S	6, 10, 15	Universal wedge	Universal wedge	6, 7, 9, 10, 11, 12, 13, 15, 16, 18, 20	6
	Synergy, SL, SLi, Infinity, Precise, VersaHD	6, 10, 15, 18	Universal wedge	Universal wedge		N/A
		6FFF,10FFF	N/A	N/A		
Siemens	Artiste	6, 18	15, 30, 45, 60	Yes	6, 8, 10, 12, 15, 18	N/A
	Oncor, Primus	6, 15, 18, 23	15, 30, 45, 60	Yes		
		10	N/A	Yes		
		6FFF	N/A	N/A		
Varian	2100C/D, 21EX/23EX, 21iX/23iX, Trilogy, TrueBeam/TrueBeam STx, Novalis Tx	4, 6, 10, 15, 16, 18, 23	15, 30, 45, 60	Yes	6, 9, 12, 15, 16, 18, 20	6, 6FFF, 6SRS
		8, 20, 25	N/A	Yes		
		6FFF, 10FFF, 6SRS	N/A	N/A		
	6EX, 600C, Novalis	6	15, 30, 45, 60	Yes		6

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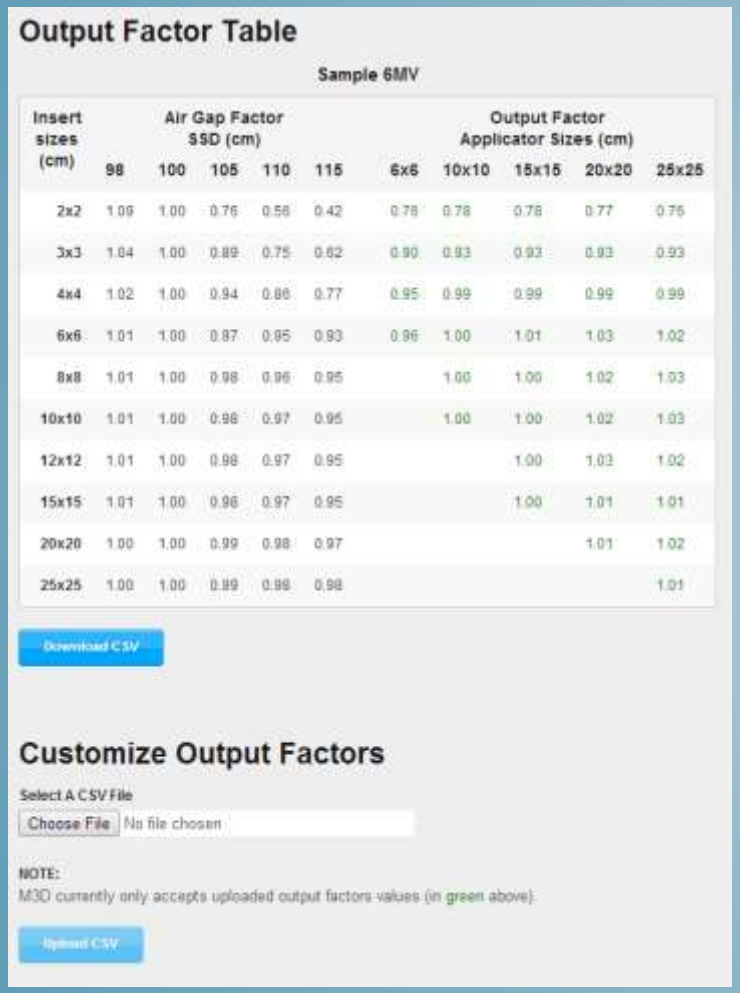
LINAC PARAMETER EINSTELLUNGEN



Output Factor Table

Sample 6MV

Insert sizes (cm)	Air Gap Factor SSD (cm)					Output Factor Applicator Sizes (cm)				
	98	100	105	110	115	6x6	10x10	15x15	20x20	25x25
2x2	1.09	1.00	0.76	0.56	0.42	0.78	0.78	0.78	0.77	0.76
3x3	1.04	1.00	0.89	0.75	0.62	0.90	0.93	0.93	0.93	0.93
4x4	1.02	1.00	0.94	0.86	0.77	0.95	0.99	0.99	0.99	0.99
6x6	1.01	1.00	0.97	0.95	0.93	0.96	1.00	1.01	1.03	1.02
8x8	1.01	1.00	0.98	0.96	0.95		1.00	1.00	1.02	1.03
10x10	1.01	1.00	0.98	0.97	0.95		1.00	1.00	1.02	1.03
12x12	1.01	1.00	0.98	0.97	0.95			1.00	1.03	1.02
15x15	1.01	1.00	0.98	0.97	0.95			1.00	1.01	1.01
20x20	1.00	1.00	0.99	0.98	0.97				1.01	1.02
25x25	1.00	1.00	0.99	0.99	0.98					1.01

Download CSV

Customize Output Factors

Select A CSV File

Choose File | No file chosen

NOTE:
M3D currently only accepts uploaded output factors values (in green above)

Upload CSV

Customize Machine Configuration

Machine: 23IX | Energy: 6 MV

Multileaf Collimator

DLG Correction From M3D's Default: 0 mm

Dose

Dose Rate: 400 MU/min

Max MU Per Field: 999

Collimator Clearance

Distance Between Isocenter And Collimator Surface: 40 cm

Collimator Radius: 37.5 cm

Change Machine Configuration

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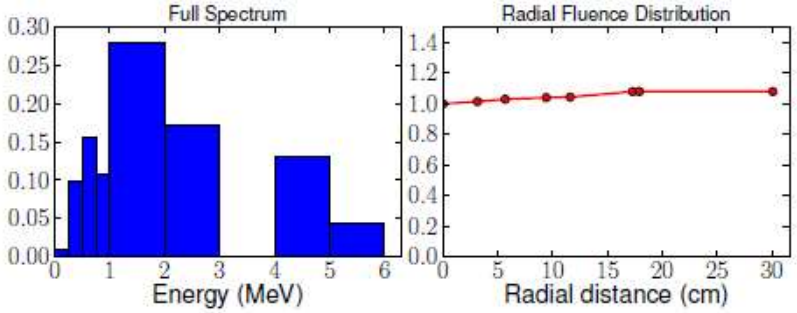
MLC-KOMPATIBILITÄT

Vendor	MLC Model
Accuray	TomoTherapy
Elekta	Agility 160 MLCI/MLCi2 80[2] BeamModulator 80 microMLC 112 (Apex)
Novalis	NovalisM3 52
Siemens	Siemens 82 Siemens 160 3DMLC 58
Varian	Millennium 120 Millennium 80 Millennium 52 High Definition 120

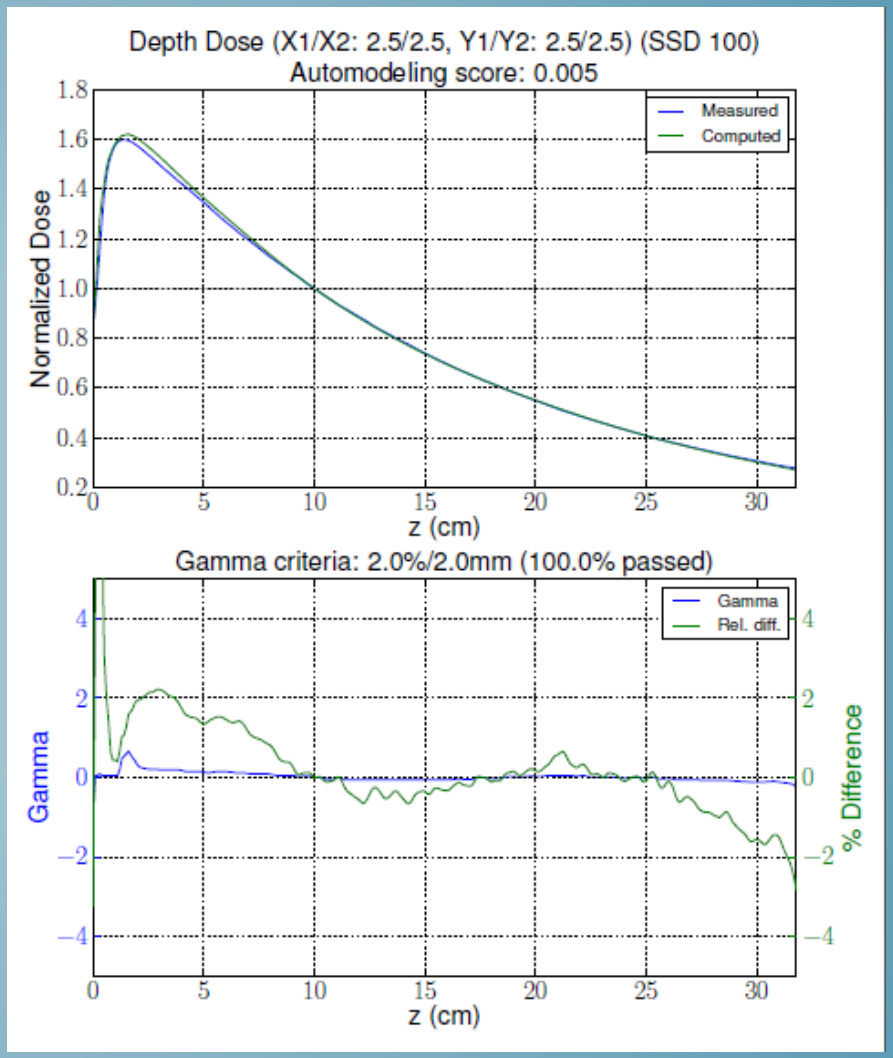
MOBIUS3D BEAM MODELL ANPASSUNG



Jaw Transmission	
Fraction	0.006
Filter Scatter	
Gaussian width (cm)	3.58
Gaussian height	0.039
Offaxis Softening	
Factor	0.0687
MLC Leaves	
MLC Transmission	0.017
Curvature (cm)	10.8
Thickness (cm)	8.57
Source Size	
FWHM (cm)	0.177
Electron Contamination	
Surface contamination	0.439
Linear contamination	0.125
Linear distance (cm)	0.1
Coefficient	1.75
C_1	0.196
C_2	5.87
C_3	0.106
Offaxis coefficient	10.

Output Factors			
Field Size (cm)	OF	OF_c	OF_p
2	0.786	0.974	0.807
5	0.891	0.985	0.905
10	1.	1.	1.
20	1.11	1.01	1.09
30	1.17	1.03	1.13
40	1.21	1.07	1.13

Calibration
10×10 field at 10 cm depth
100MU dose: 66.1 cGy



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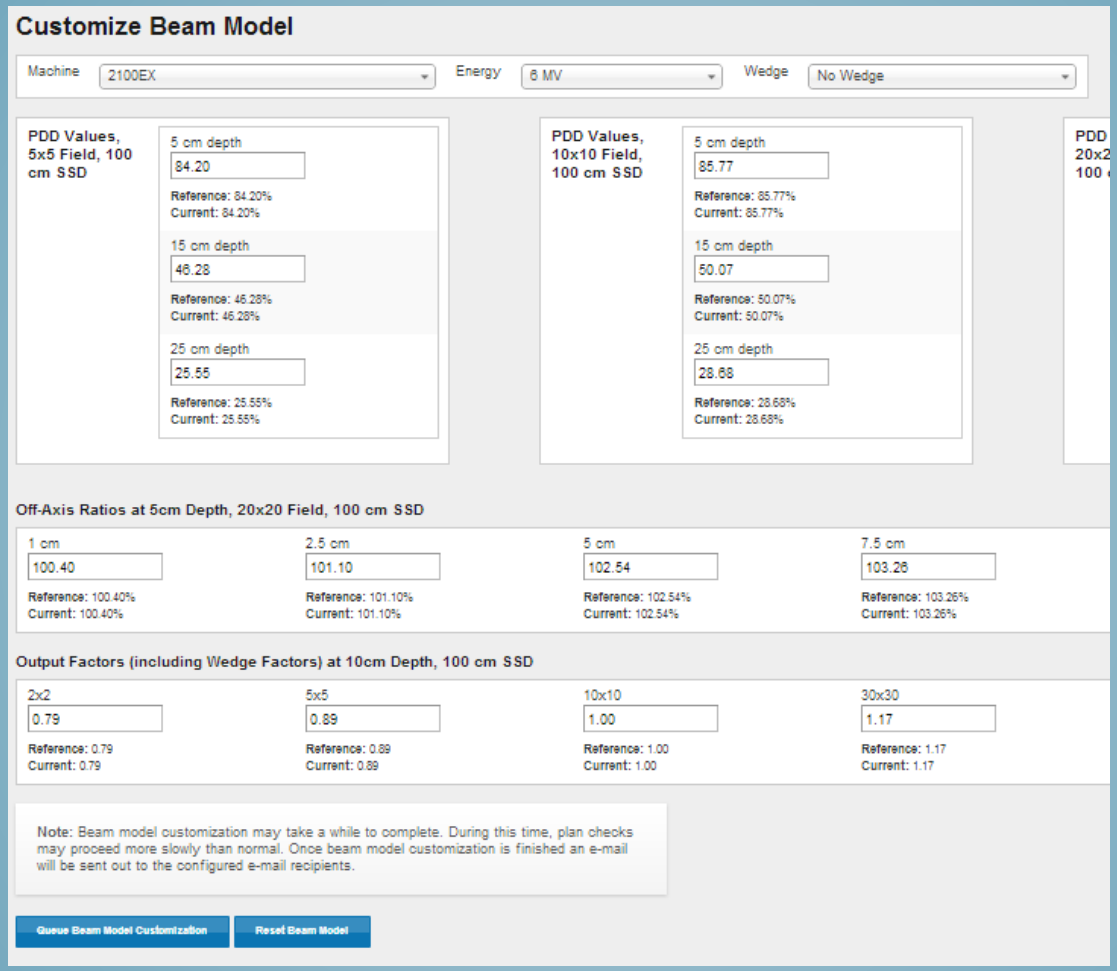
BEAM MODELL ANPASSUNGEN



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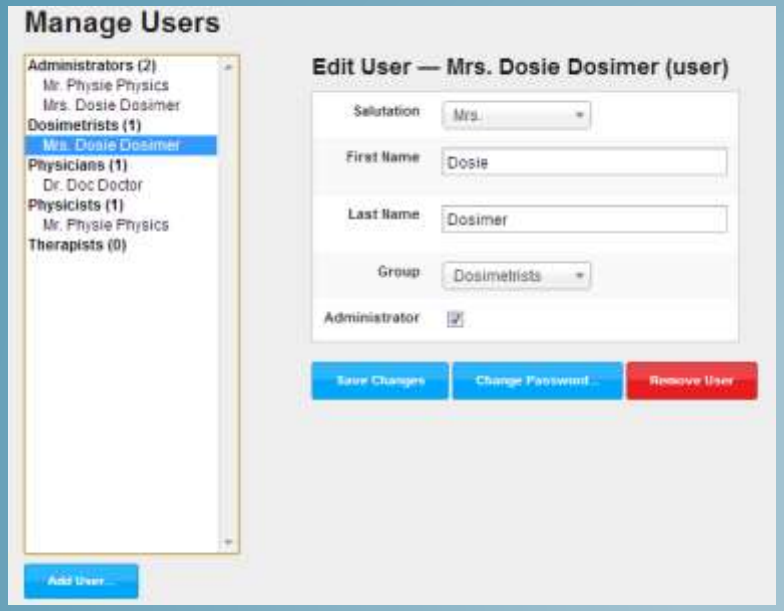
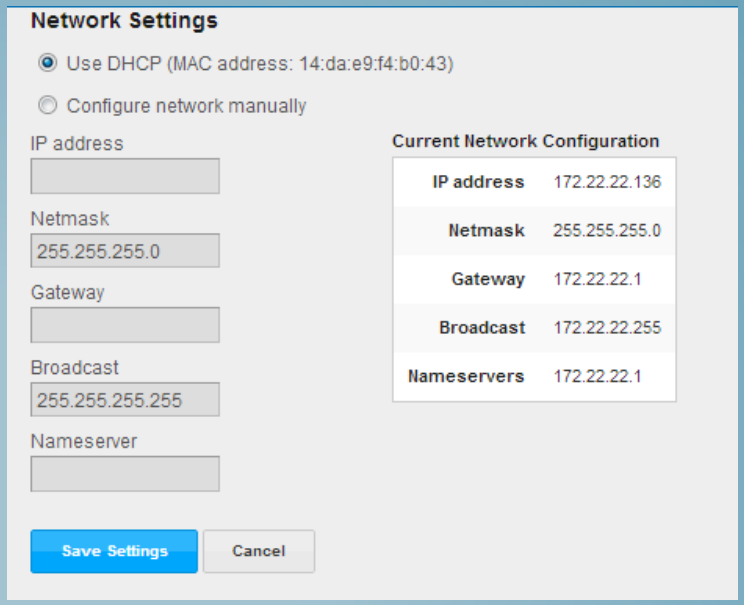
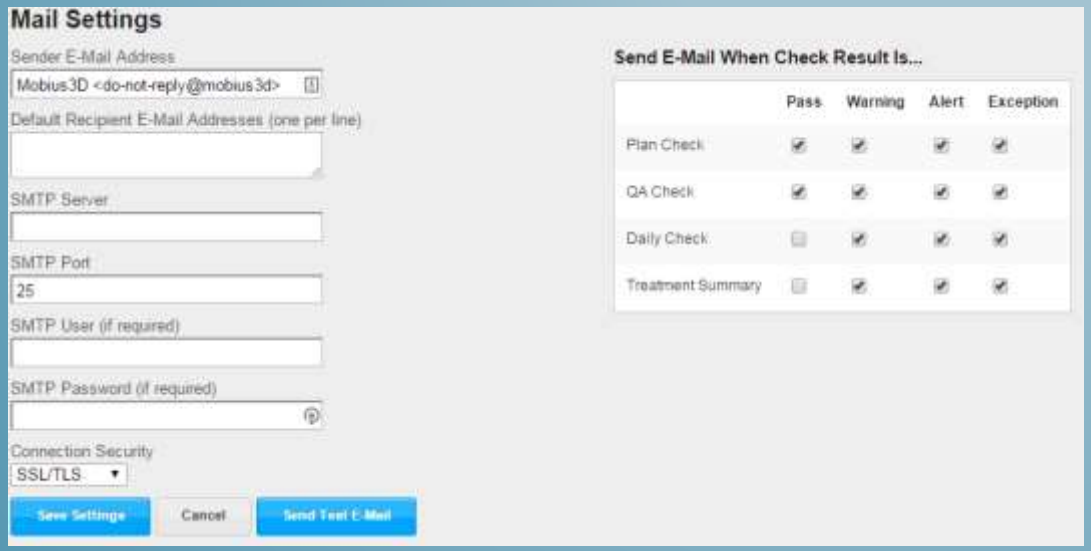
ANWENDERZUGANS-EINSTELLUNGEN







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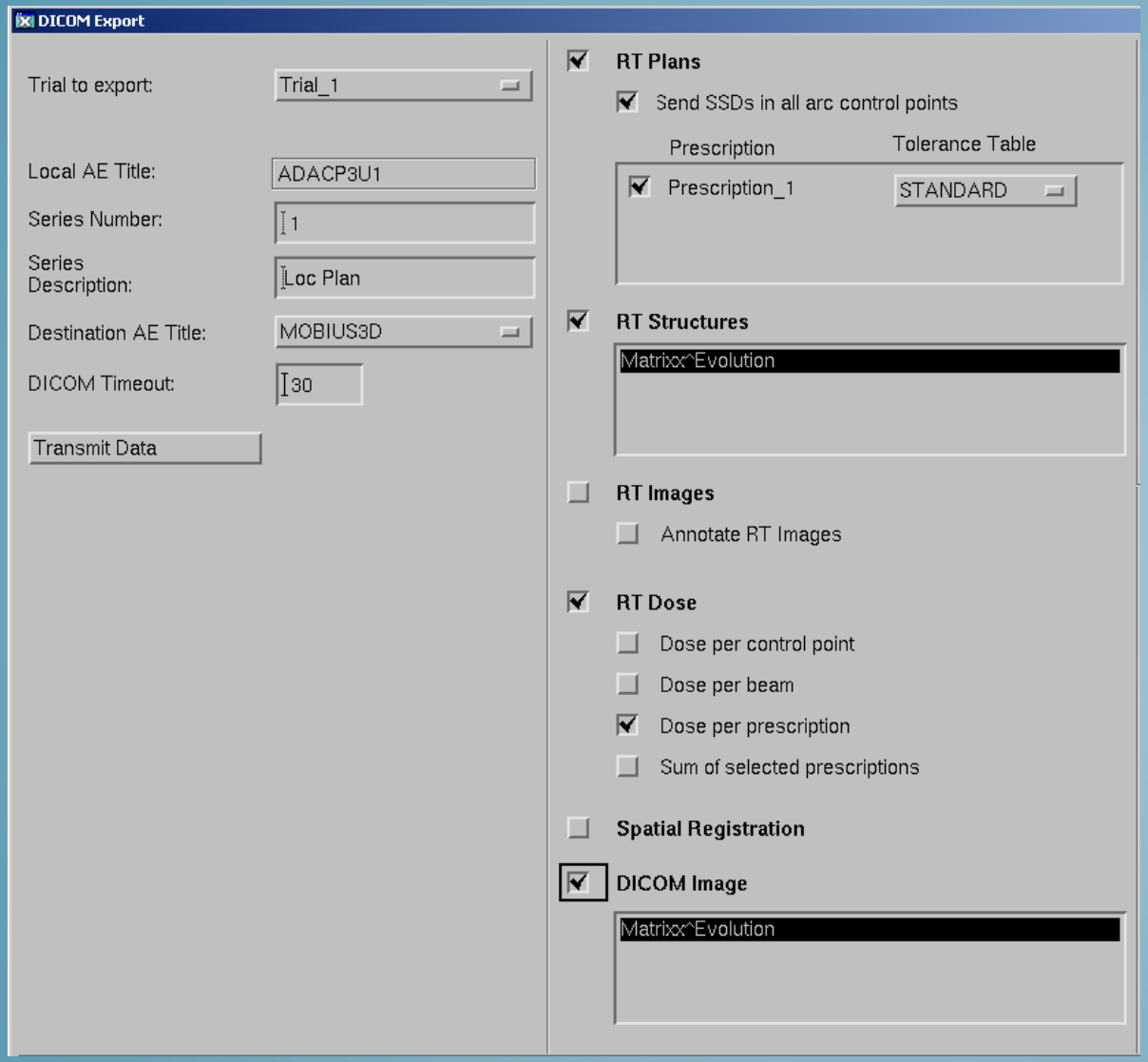
BEISPIEL PINNACLE DATEN EXPORT



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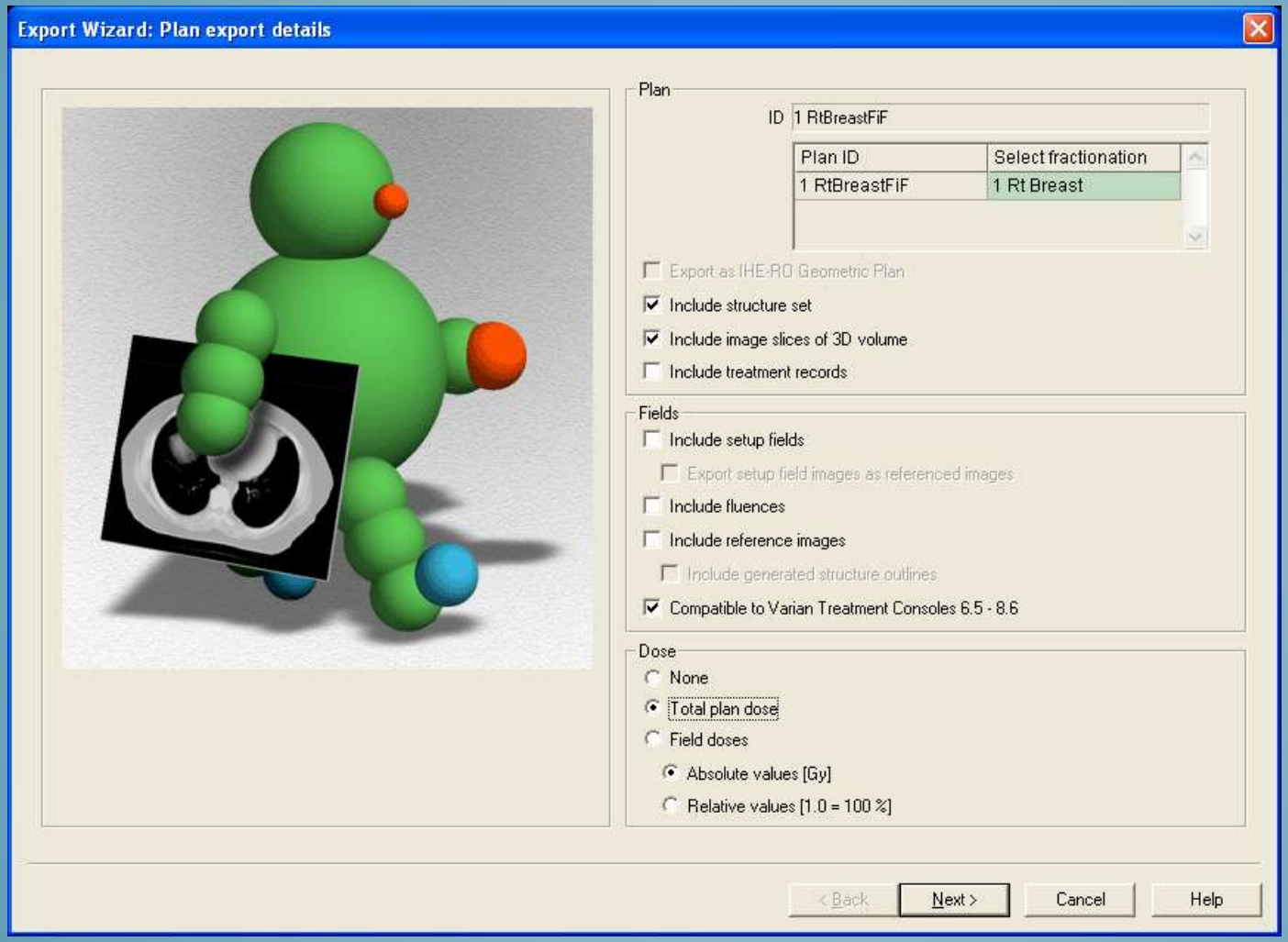
BEISPIEL ECLIPSE



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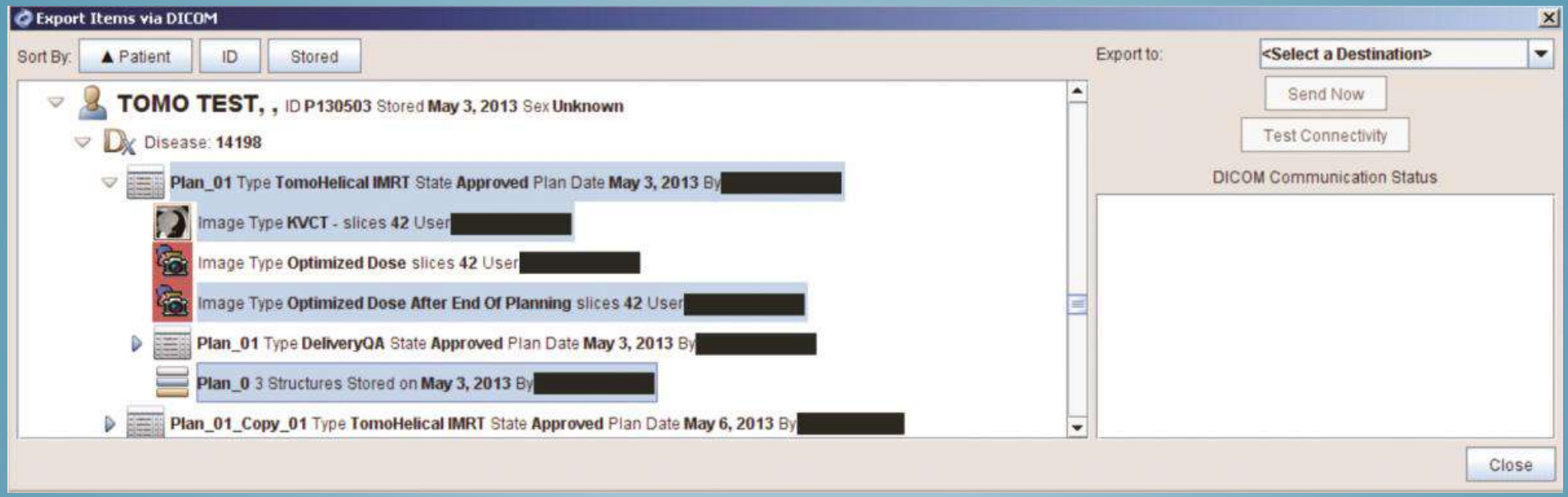
TOMO DATEN EXPORT EINRICHTUNG



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PLAN ÜBERPRÜFUNGS-EINSTELLUNGEN

Plan Check Settings for Minnesota Romeo ZZ, Brain

Dose Calculation	Recalculate Dose	☐		Default: Unchecked
CT Couch Removal	Table Height Override		cm	Default:
	Use Body Contour (if present)	Yes		Default: Yes
	Use CT Table Height (if present)	No		Default: No
	Use Dose Edge	Yes		Default: Yes
Dose Calculation	Voxel Size	Automatic Detection		Default: 0.0
3D Gamma	Dose Difference Criteria	5	%	Default: 5%
	Distance Criteria	3	mm	Default: 3 mm
	Dose Threshold	10	%	Default: 10%
	Warning Percent <	90	%	Default: 90%
	Alert Percent <	85	%	Default: 85%
	Reference Dose		Gy	Default:
Target Coverage	Mean Dose Difference <	5	%	Default: 5%
	Percent Coverage	90	%	Default: 90%
	Stray Voxel Threshold <	0.1	cc	Default: 0.1 cc
DVH Limits	Limit Set	Automatic Detection		Default: Automatic
	Tolerance Scaling	100	%	Default: 100%
Single Point MU Calculation	Search Radius	3	mm	Default: 3 mm
Mobius Phantom	Calculate Mobius Phantom Dose	No		Default: No
Treatment Summary	Include First Fraction	No		Default: No

ROI Identification	ROI Name	Classification	Density Override (g/cc)	Direction
	Lt Eye	Eyes	None	Automatic
	ROI_1	Select DVH Limits / Targets...	None	Automatic
	Rt Eye	Eyes	None	Automatic

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DICOM BROWSER

Browse DICOM Objects

Patient	Hotel Lima ZZ (SN00006-403018eb)
	DICOM can be uploaded to files.mobiusmed.com.
Modality	RTPLAN (2 objects)
Series UID	2.25.318580257560667858429255553977867844064 (2 instances)
SOP Instance UID	2.25.206201031443114931034518638949057648708

Download anonymized DICOM

(300a, 0070) Fraction Group Sequence	
(0008, 1030) Study Description	RT^CHEST_TP (Adult)
(0008, 0080) Institution Name	
(0020, 000e) Series Instance UID	2.25.318580257560667858429255553977867844064
(0008, 0005) Specific Character Set	ISO_IR 100
(0008, 0050) Accession Number	
(300a, 00b0) Beam Sequence	
(0020, 000d) Study Instance UID	2.25.314940684395471722738608045087161778609
(0008, 103e) Series Description	ARIA RadOnc Plans

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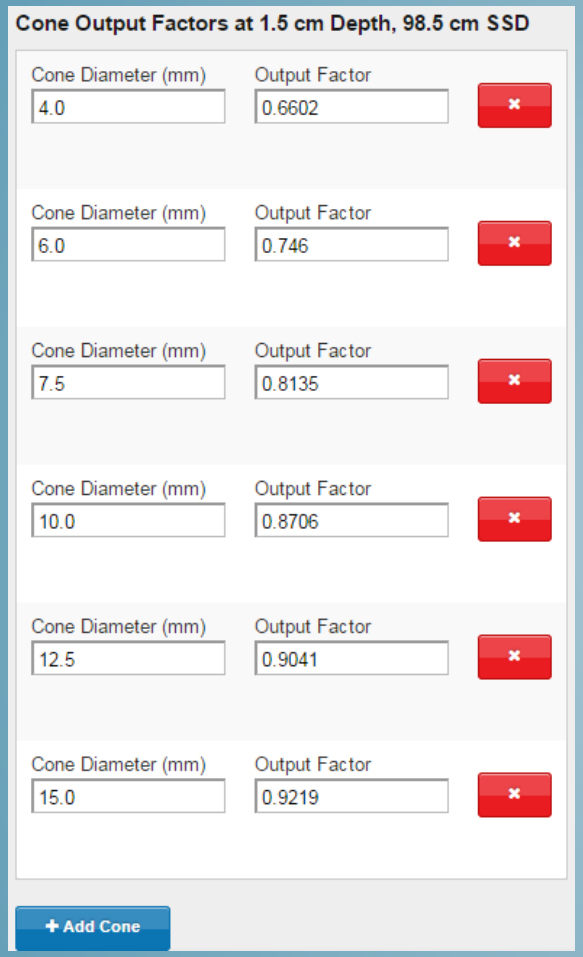
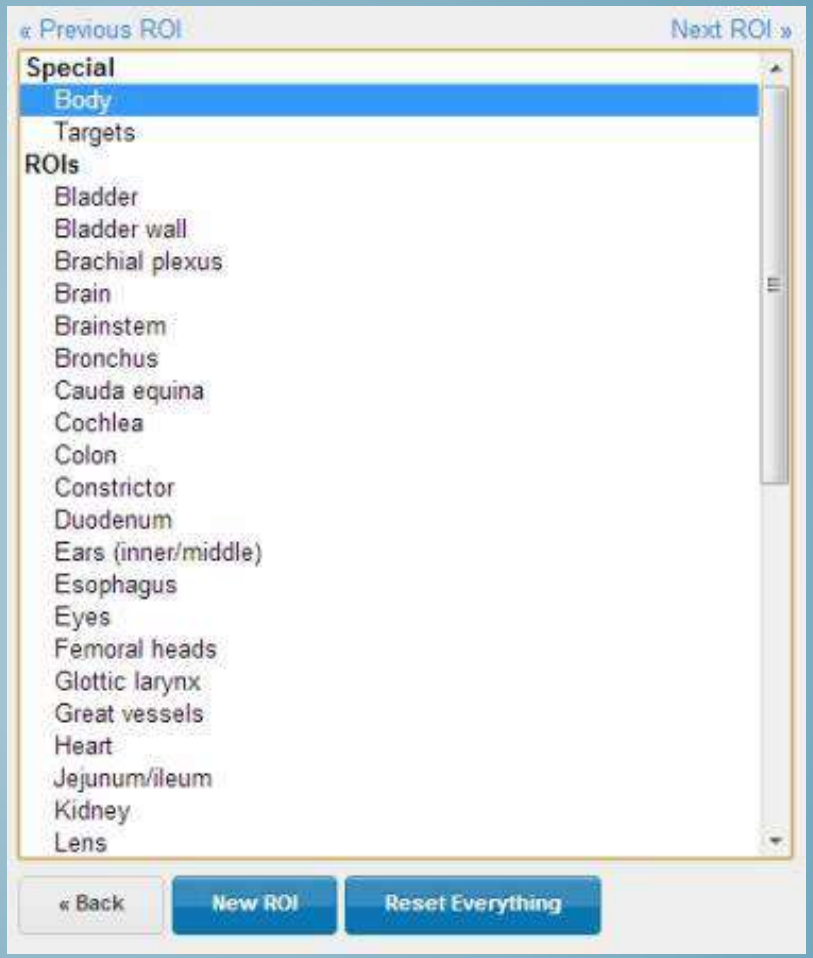
WEITERE EINSTELLUNGSMÖGLICHKEITEN





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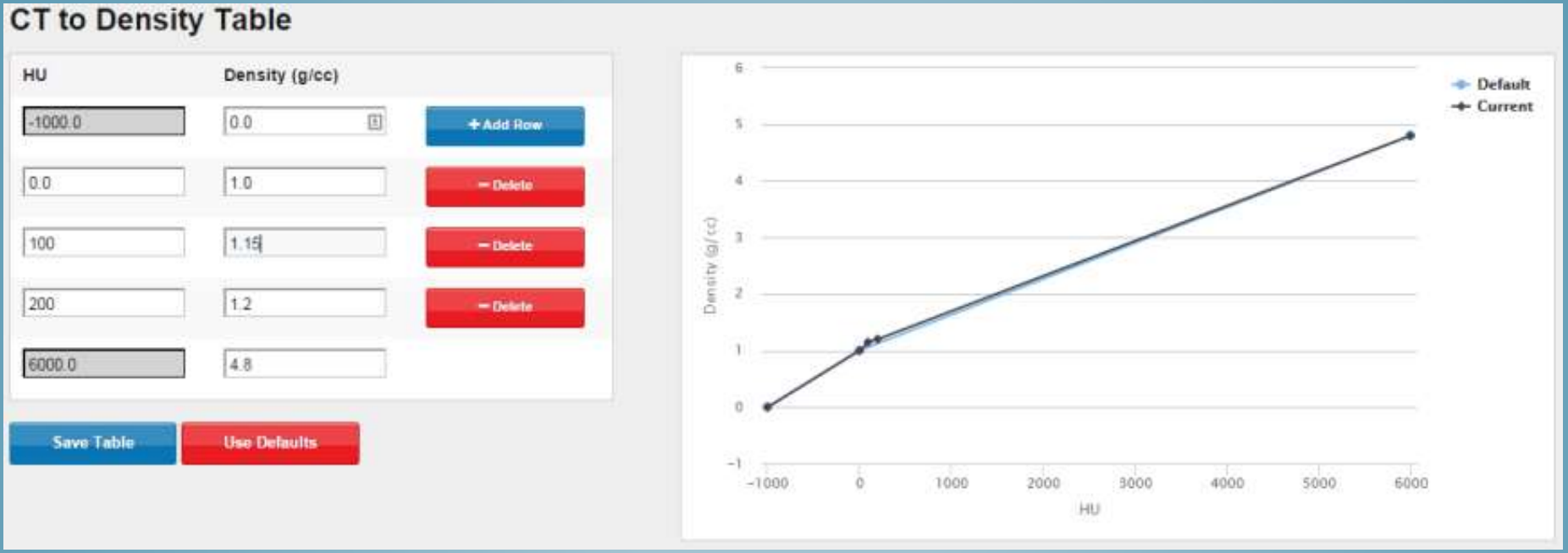
CT DATEN ANPASSUNG



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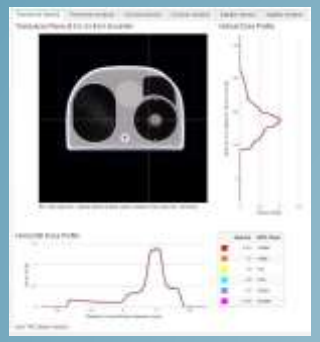
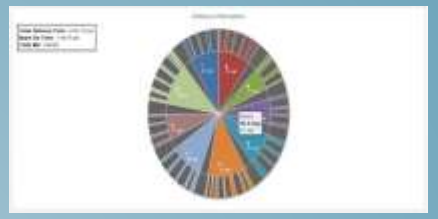
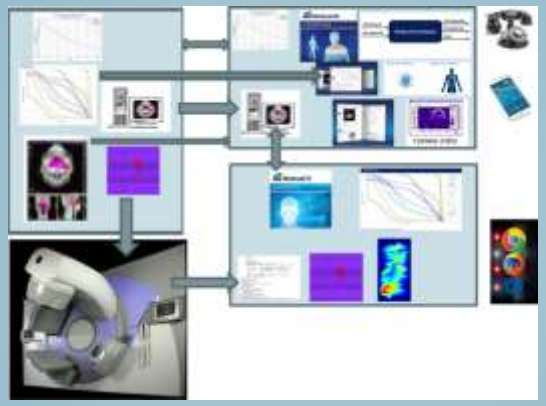
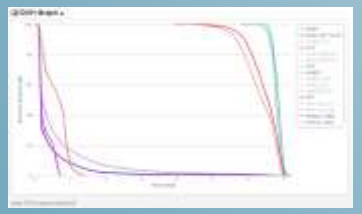
ERGEBNISBERICHTE









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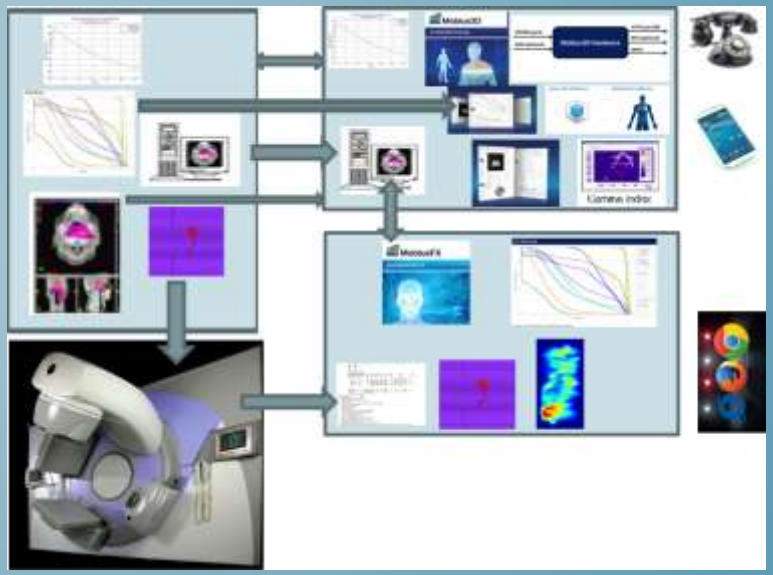
MOBIUS 3D ANALYSE-ERGEBNISSE



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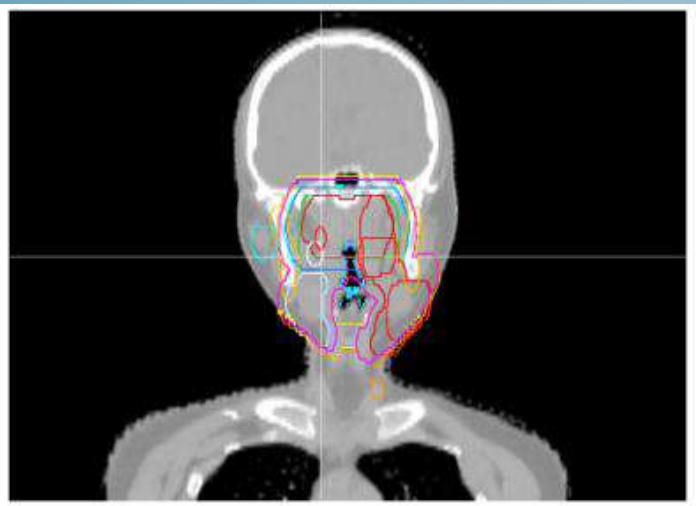
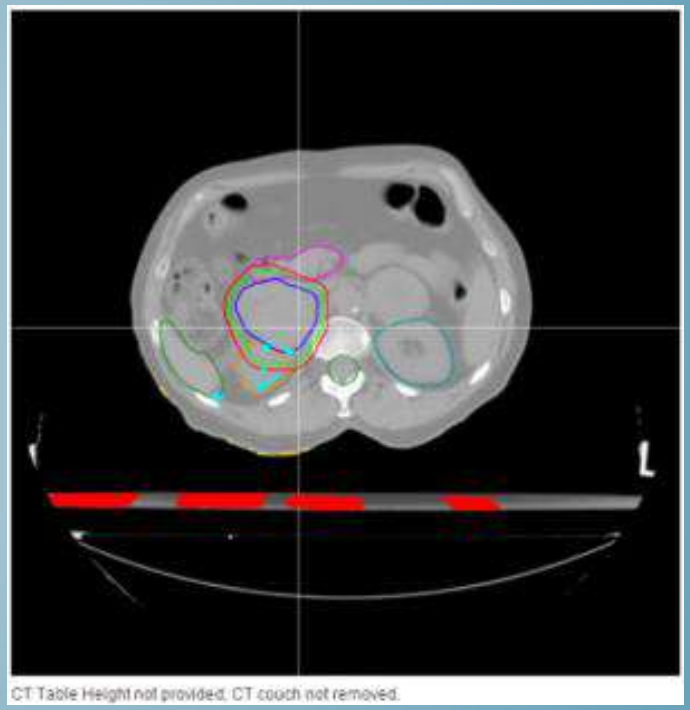
Arbeitskreis IMRT der DGMP Erlangen 19.-20. 03.2015

TARGET COVERAGE DIFFERENCES

DIFFERENCES IN AIR AND BONE



GAMMA FAILURES IN THE TREATMENT COUCH



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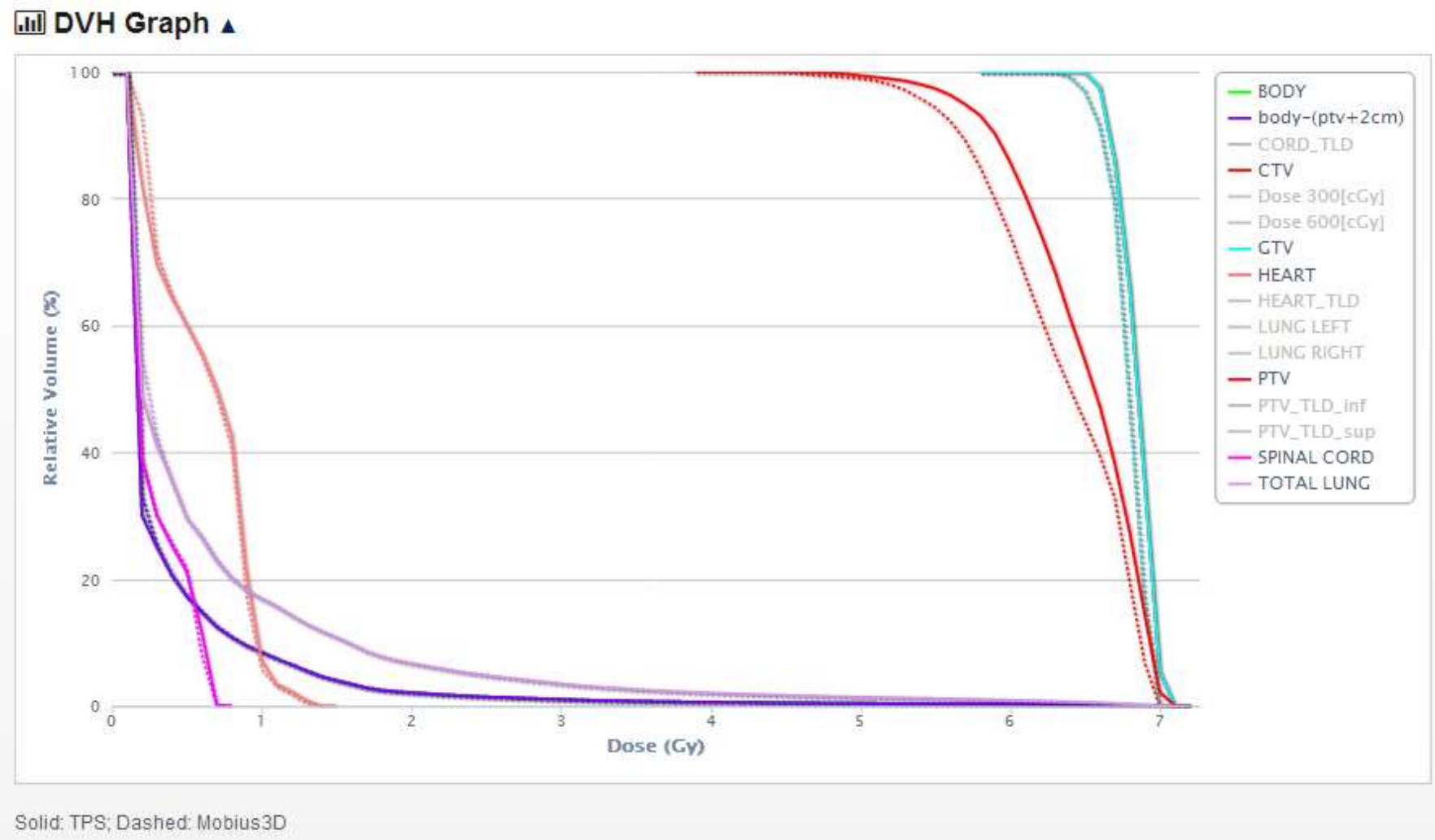
DVH- ERGEBNIS



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MEDICAL INNOVATION EXCELLENCE

ZIELVOLUMEN ANALYSE

Target Coverage ▲

	TPS Name	Mean Dose			90% Coverage			Stray Voxels	
		TPS	M3D	% Diff	TPS	M3D	% Diff		
	PTV	6.37 Gy	6.23 Gy	-2.0%	5.81 Gy	5.58 Gy	-3.3%	None	
	CTV	6.74 Gy	6.68 Gy	-0.8%	6.58 Gy	6.52 Gy	-0.8%	None	
	GTV	6.74 Gy	6.68 Gy	-0.8%	6.58 Gy	6.52 Gy	-0.8%	None	

DVH Limits ▲

Limit Set	Conventional Fractionation	Tolerance Scaling	100%

	TPS Name	Limit Name	Volume	Dose	TPS	M3D	Note
	esophagus	Esophagus	Mean	<35 Gy	19.9 Gy	19.9 Gy	
	esophagus	Esophagus	33%	<45 Gy	39.2 Gy	39.2 Gy	
	esophagus	Esophagus	15%	<54 Gy	45.4 Gy	46.3 Gy	
	heart	Heart	33%	<60 Gy	7.92 Gy	7.6 Gy	
	heart	Heart	67%	<45 Gy	2.87 Gy	2.99 Gy	
	heart	Heart	100%	<40 Gy	0.44 Gy	0.37 Gy	
	total lung	Lung (right and left)	37%	<20 Gy	7.71 Gy	7.62 Gy	
	total lung	Lung (right and left)	Mean	<20 Gy	12.6 Gy	12.5 Gy	

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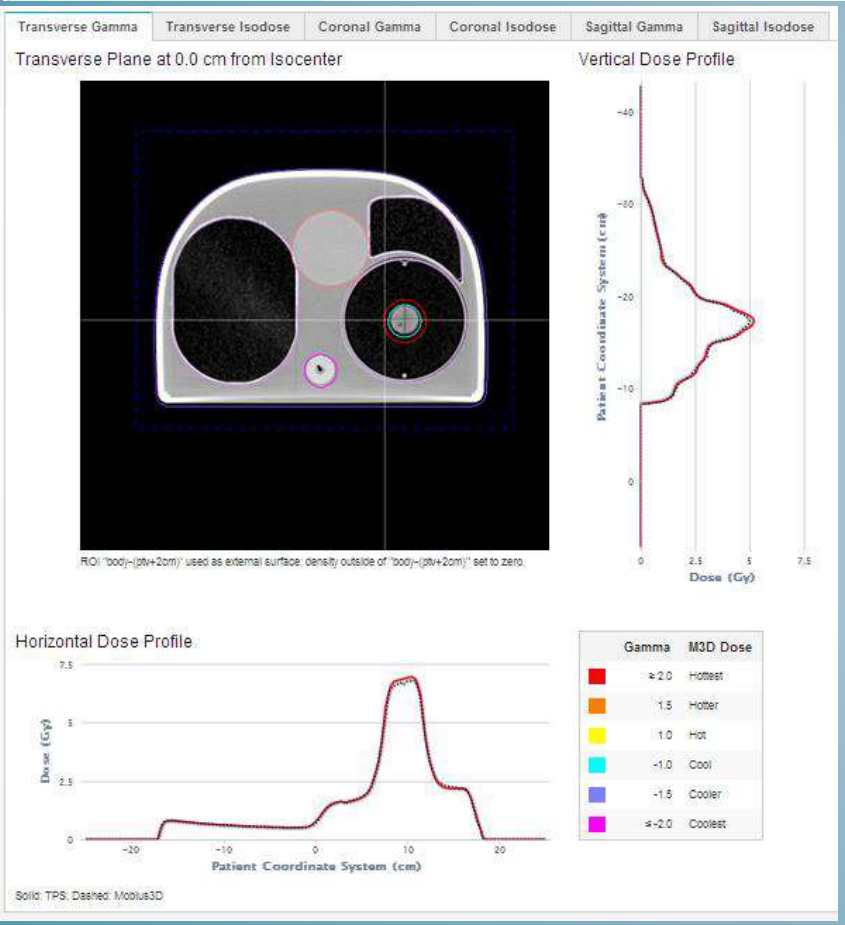
3D GAMMA ANALYSE

Passing Rate	Criteria	Reference Dose	Threshold Dose	TPS Voxels	M3D Voxels
100.0%	5.0% / 3.0 mm	7.04 Gy (Max Dose)	0.7 Gy	3.0 mm, 2.5 mm, 2.5 mm	3.0 mm

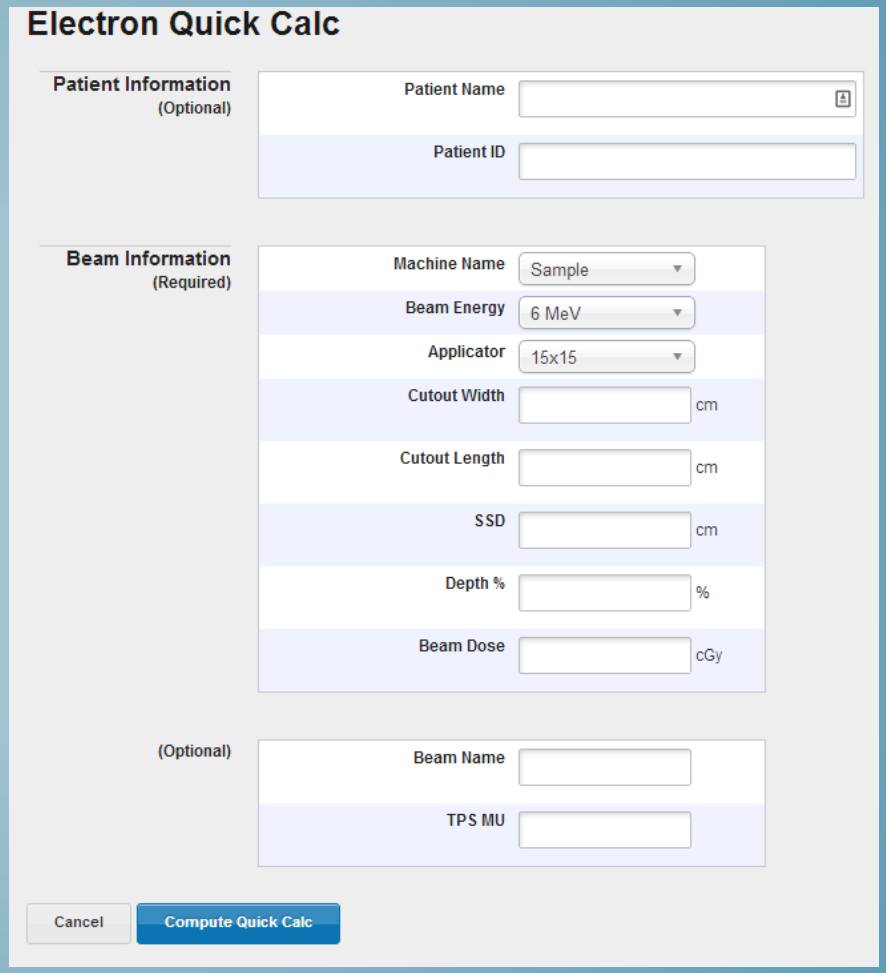


ROI Overview ▲

	TPS Name	Volume	3D Gamma (5.0% / 3.0 mm)	Mean Dose TPS	Mean Dose M3D	Mean Dose % Diff	Density Override
	PTV	72.8 cc	99.9%	6.37 Gy	6.23 Gy	-2.0%	None
	LUNG RIGHT	3488 cc	100.0%	0.13 Gy	0.12 Gy	-0.1%	None
	PTV_TLD_sup	0.07 cc	100.0%	6.82 Gy	6.68 Gy	-2.0%	None
	PTV_TLD_inf	0.05 cc	100.0%	6.8 Gy	6.66 Gy	-2.0%	None
	TOTAL LUNG	7021 cc	100.0%	0.5 Gy	0.51 Gy	0.1%	None
	SPINAL CORD	132 cc	100.0%	0.17 Gy	0.17 Gy	0.0%	None
	body-(ptv+2cm)	23990 cc	100.0%	0.24 Gy	0.25 Gy	0.0%	None

MEDINEX
MEDICAL INNOVATION EXCELLENCE

SCHNELLE AUSWERTUNGSMÖGLICHKEIT



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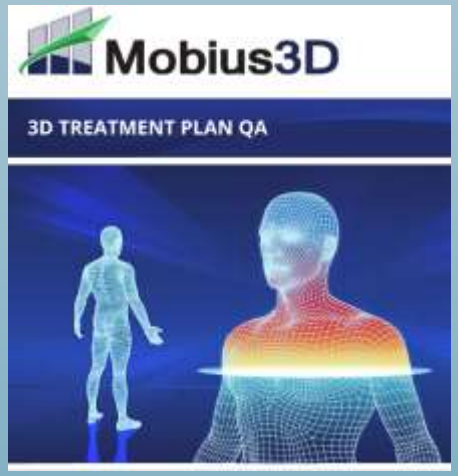
MOBIUS FX



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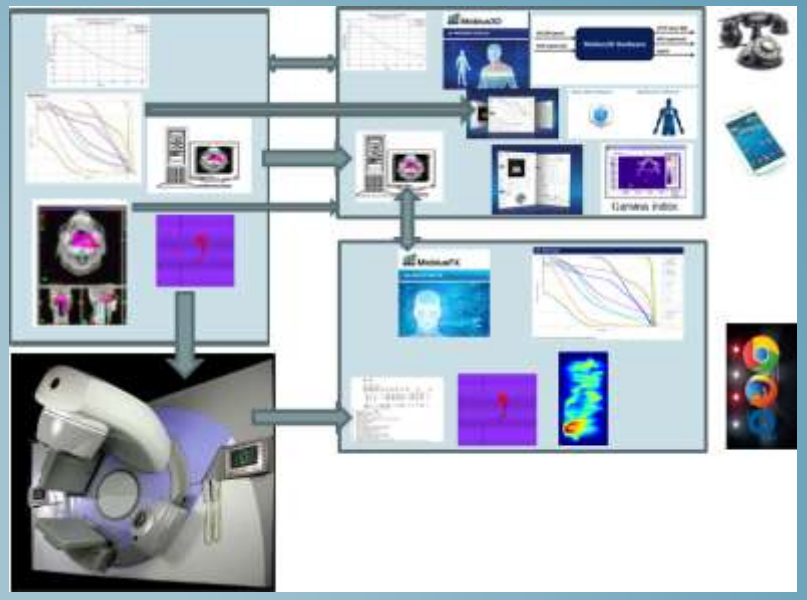
MOBIUS FX LIZENZEN PRO LINAC



Institution Name	Machine Name	Matched Machines	Vendor	Model	MLC	100 MU Dose at 10 cm for 10x10 field (cGy)				
						6	7	10	15	18
Unknown Insitution	21EX		Varian	21 EX	Millennium 120	66.3				79.6
Unknown Insitution	2300iX		Varian	2300iX	Millennium 120	66.6				79.4
Unknown Insitution	600C		Varian	600C	Millennium 120	67.2				
Unknown Insitution	ARTISTED		Siemens	Artiste	Siemens 160	67.6				78.3
Unknown Insitution	Agility		Elekta	Agility	Agility 160	67.16			75.95	

MEDINEX
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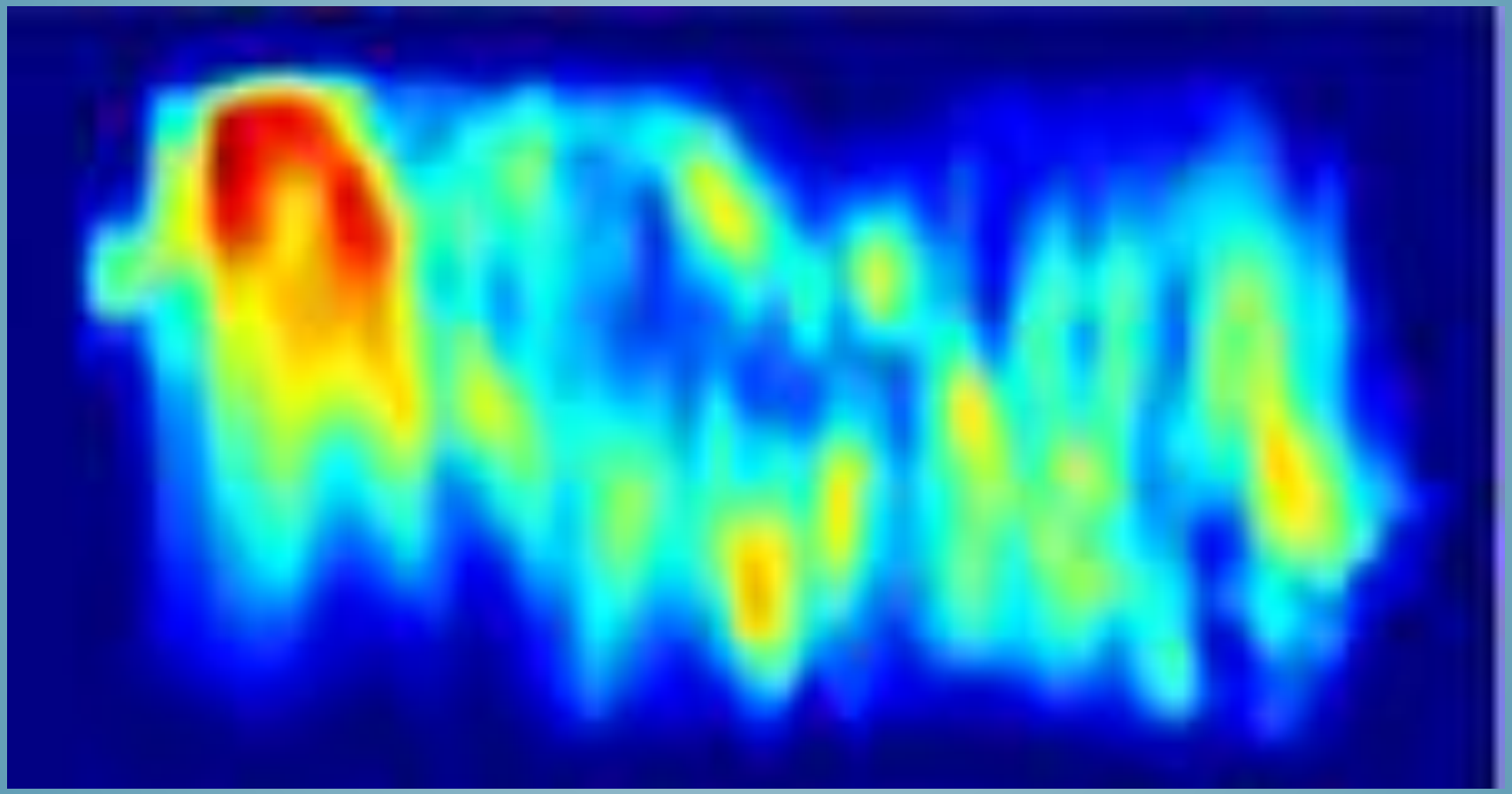
MIT MOBIUS FX AUS DEN MLC-LOGFILES DATEN FLUENZWERTE



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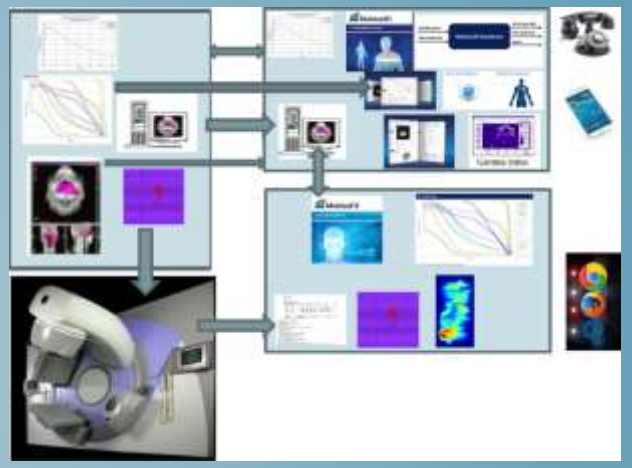
MOBIUS FX - KEY FEATURES

- Keine Hardware erforderlich
- Kein selbständiges System.Verwendet die Mobius3D Software Module und Hardware
- Analysiert und überprüft die Funktion jedes einzelne Leaf des MLC-Kolimators
- Patienten Heterogenitäten werden automatisch mit den CT- Daten berücksichtigt
- Erkennung von Übertragungsfehler oder „Beam Commisioning“ Fehler
- 3D Kontrolle der dem Patienten verabreichte Dosis
- Überprüft ob die DVH-Ziele Ihrer Pläne erfüllt werden
- 30-90 Minuten Zeitersparnis pro Patient für Überprüfung der Bestrahlung
- Berechnung der 3D-Passing Rate
- 3D Gamma-Analyse in einzelnen CT-Schnitten (Transversal, Koronar, Sagital)
- Individuelle ROI-Einstellungen mit Identifizierung der anatomischen Strukturen.
- Einstellung individueller Toleranzen für Warnungen
- Streu-Voxel Erkennung in den Zielstrukturen Verhinderung falscher Dosisberechnungen
- Vorinstallierte DVH Zielvorgaben von RTOG und TG -101 DVH
- PDF- Reports für die Planungsdaten jedes Patienten
- Intuitive Browser-Schnittstellen und Bedienung
- Browser Zugang von Laptops, Tablets und Handys



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MOBIUS FX DATEN TRANSFER GENAUIGKEITS EINSTELLUNGEN

MobiusFX Data Transfer Limits

Collimator Fail Level	>	2 deg	Default: 2 deg
Couch Alert Level	>	10 deg	Default: 10 deg
Couch Warn Level	>	2 deg	Default: 2 deg
Gantry Fail Level	>	2 deg	Default: 2 deg
Jaw Fail Level	>	5 mm	Default: 5 mm
MLC Fail Level	>	5 mm	Default: 5 mm
MU Difference Fail Level	>	2 mu	Default: 2 mu

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MOBIUS FX PARAMETER LIMITS FÜR WARNUNGSMELDUNGEN

MobiusFX RMS Limits

Collimator RMS Failure Level	> 3	deg	Default: 3 deg
Collimator RMS Warning Level	> 2	deg	Default: 2 deg
Couch RMS Failure Level	> 3	deg	Default: 3 deg
Couch RMS Warning Level	> 2	deg	Default: 2 deg
Gantry RMS Failure Level	> 3	deg	Default: 3 deg
Gantry RMS Warning Level	> 2	deg	Default: 2 deg
Jaw RMS Failure Level	> 3.5	mm	Default: 3.5 mm
Jaw RMS Warning Level	> 2.5	mm	Default: 2.5 mm
MLC RMS Failure Level	> 3.5	mm	Default: 3.5 mm
MLC RMS Warning Level	> 2.5	mm	Default: 2.5 mm

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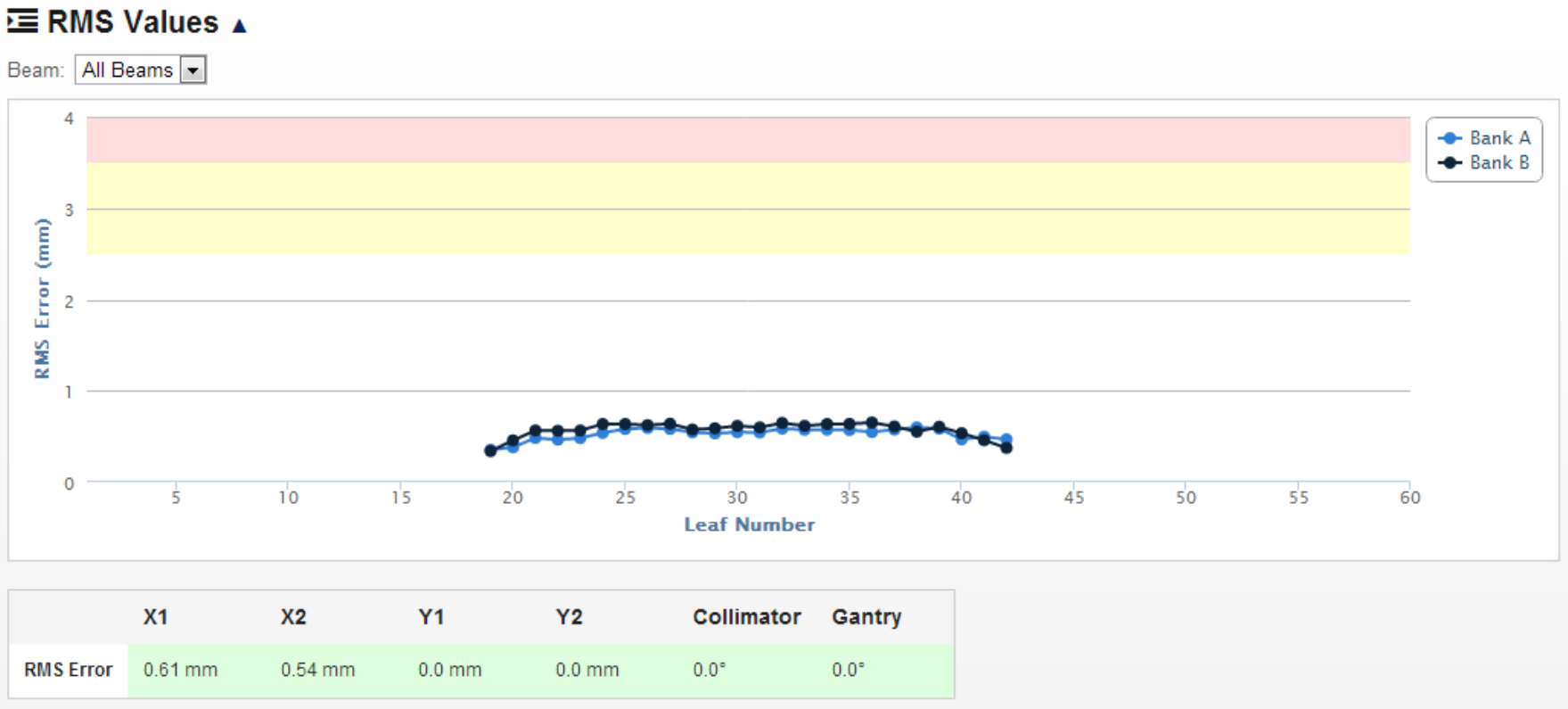
DARSTELLUNG DER RMS-WERTE



	X1	X2	Y1	Y2	Collimator	Gantry
RMS Error	0.61 mm	0.54 mm	0.0 mm	0.0 mm	0.0°	0.0°

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BEAM DATEN ANALYSIEREN UND ERBNISSE BERICHTEN

✱ Beam Information ▲

Number of Fractions Planned	1
Planning Machine Name	TrueBeam1
Delivery Start Time	Fri, November 15, 2013, 02:39 PM

Beam	L	M	N	O	P
Data Transfer	Pass	Pass	Pass	Pass	Pass
Energy (MV)	6	6	6	6	6
MU	99	125	74	104	47
Segments	498	629	373	523	239
X1 / X2 Jaws (cm)	4.5 2.5	3.5 4	3.5 3.5	4.5 3	3.5 3.5
Y1 / Y2 Jaws (cm)	4 3.5	2.5 4.5	3 4.5	3 4.5	3.5 4.5
Wedge	None	None	None	None	None
MLC	SnS	SnS	SnS	SnS	SnS
Rotation	Static	Static	Static	Static	Static
Gantry	315°	60°	45°	300°	230°
Collimator	0°	0°	0°	0°	0°
Couch	0°	0°	0°	0°	0°
Delivery Time	24 sec	27 sec	16 sec	23 sec	14 sec
Beam On	40.9%	47.3%	46.4%	44.7%	35.3%

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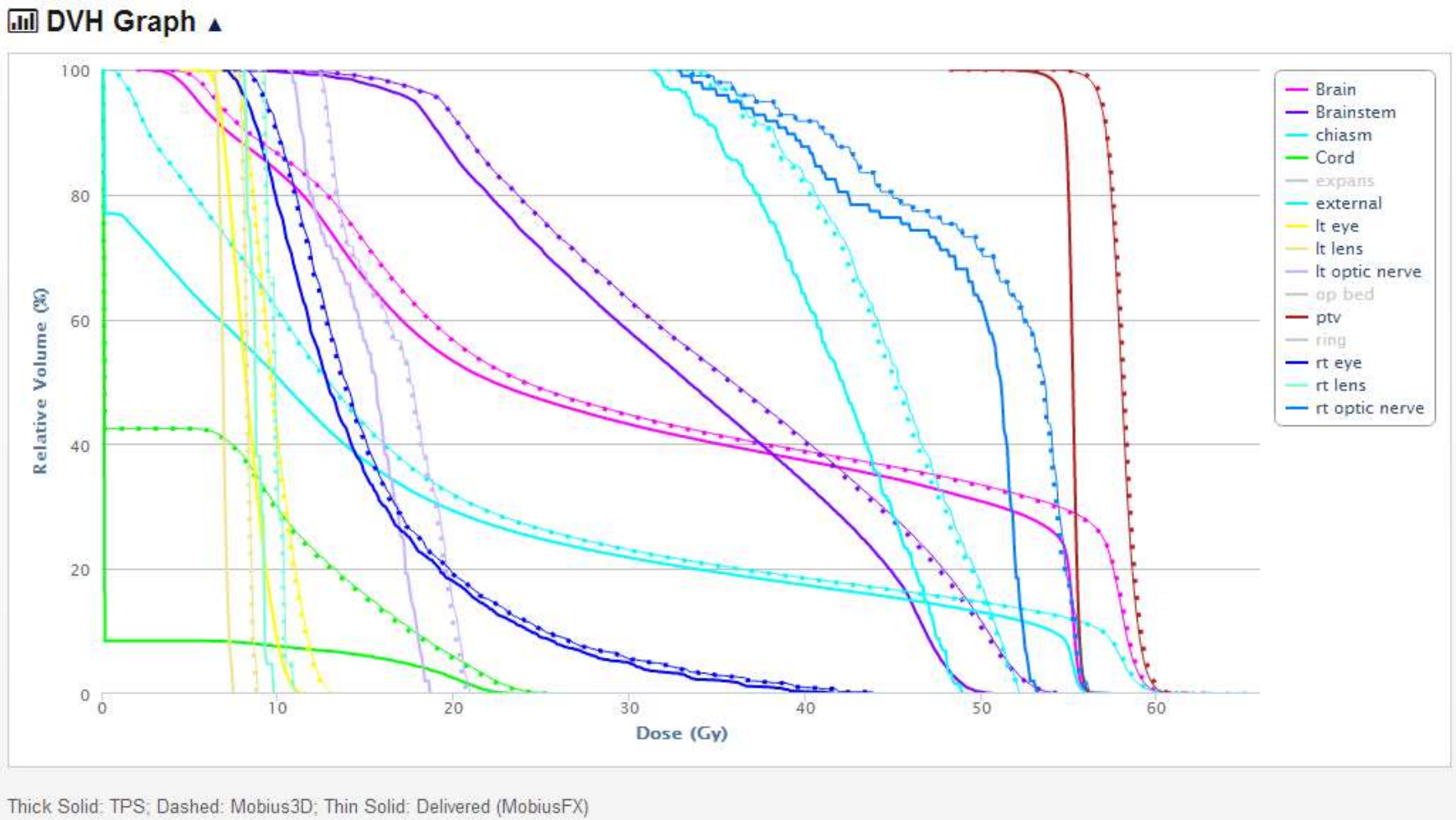
DVH- AUSGABE UND VERGLEICH



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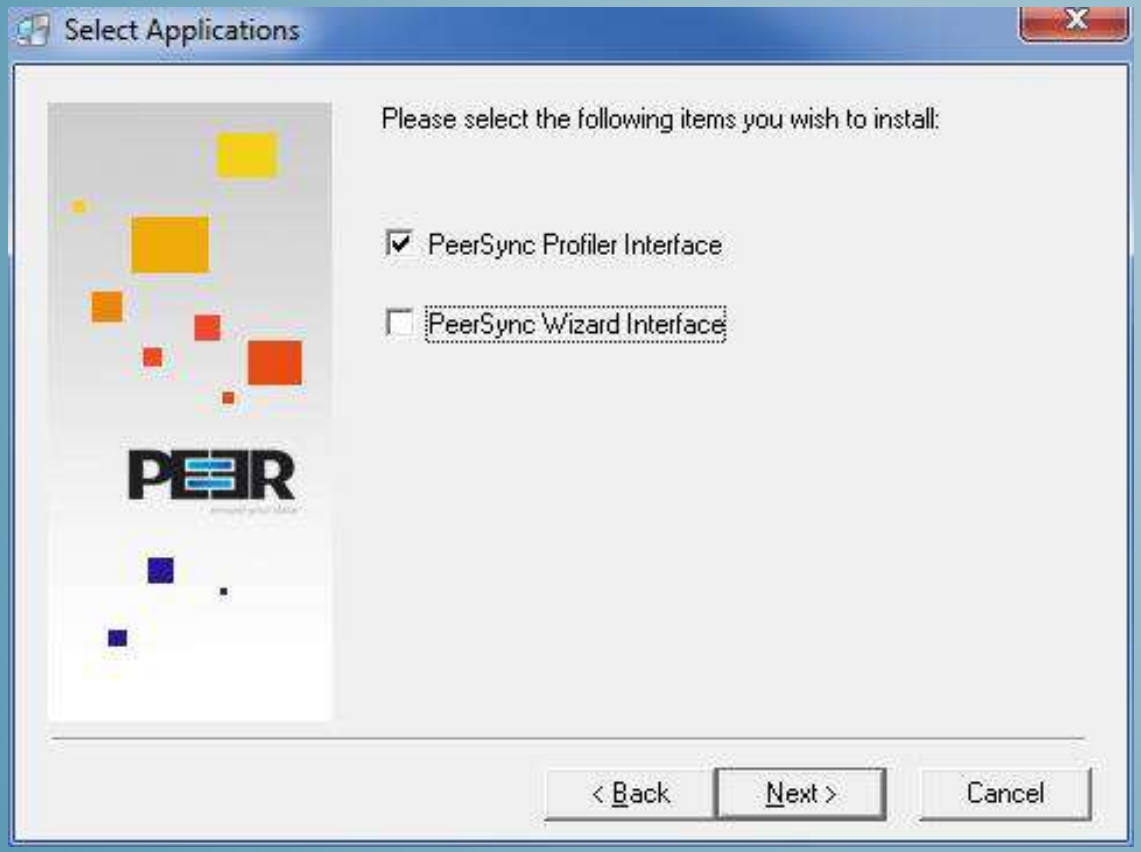
PEERSYNC VARIAN-LOGFILE DATENÜBERTRAGUNG IN EINEN ORDNER IM NETZWERK



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PEERSYNC VARIAN-LOGFILE DATENÜBERTRAGUNG IN EINEN ORDNER IM NETZWERK

VARIAN DYNALOG FILES

Alle 50 ms werden folgende Daten registriert :

- **Beam on/off state**
- **Beam hold on/off state**
- **Fractional dose (not absolute MU)**
- **Planned leaf positions**
- **Delivered leaf positions**
- **Jaw positions**
- **Collimator rotation**
- **Gantry rotation**
- **Carriage positions**

.

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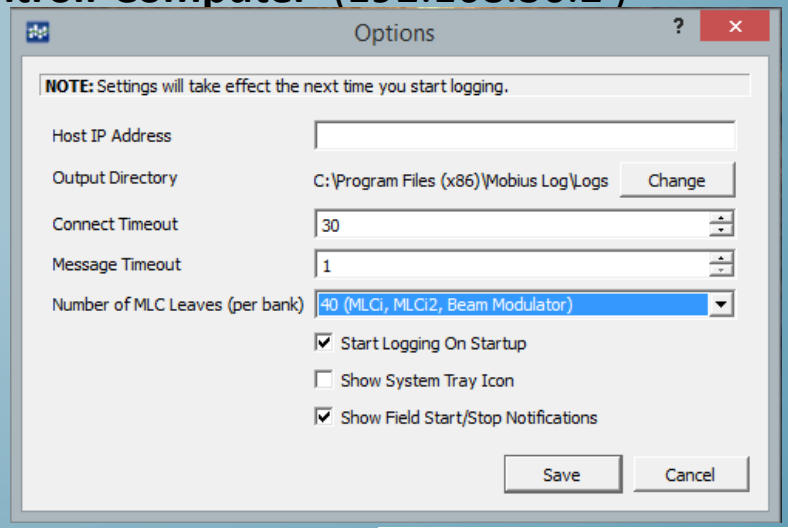
MOBIUS LOG FÜR ELEKTA

ELEKTA LOG FILES

MobiusFX und Mobius Log 1.31 .
Mobius Log – Aufnahme der Elekta iCom Vx stream files.
Mobius Log kann auf jedem im Strahlentherapie-Netzwerk PC installiert werde.
iCom-Vx - Elekta Netzwerk Kommunikationsprotokoll.
It is supported by Elekta Desktop and Integrity treatment control systems.

MOBIUS LOG –Funktionsweise und Konfiguration

Mobius Log
Netzwerk Installation mit Zugang zum Elekta Kontroll-Computer (192.168.30.2)
Oder NSS (wenn außerhalb der Elekta Firewall)..



Ein PC für jeden Elekta – Linac

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MOBIUS MVP

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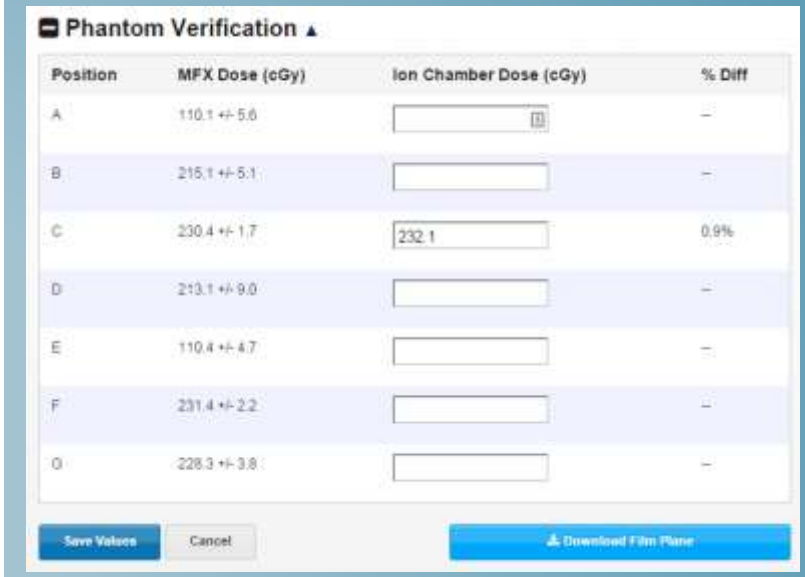

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VIELEN DANK FÜR IHRE AUFMERKSAMKEIT !

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