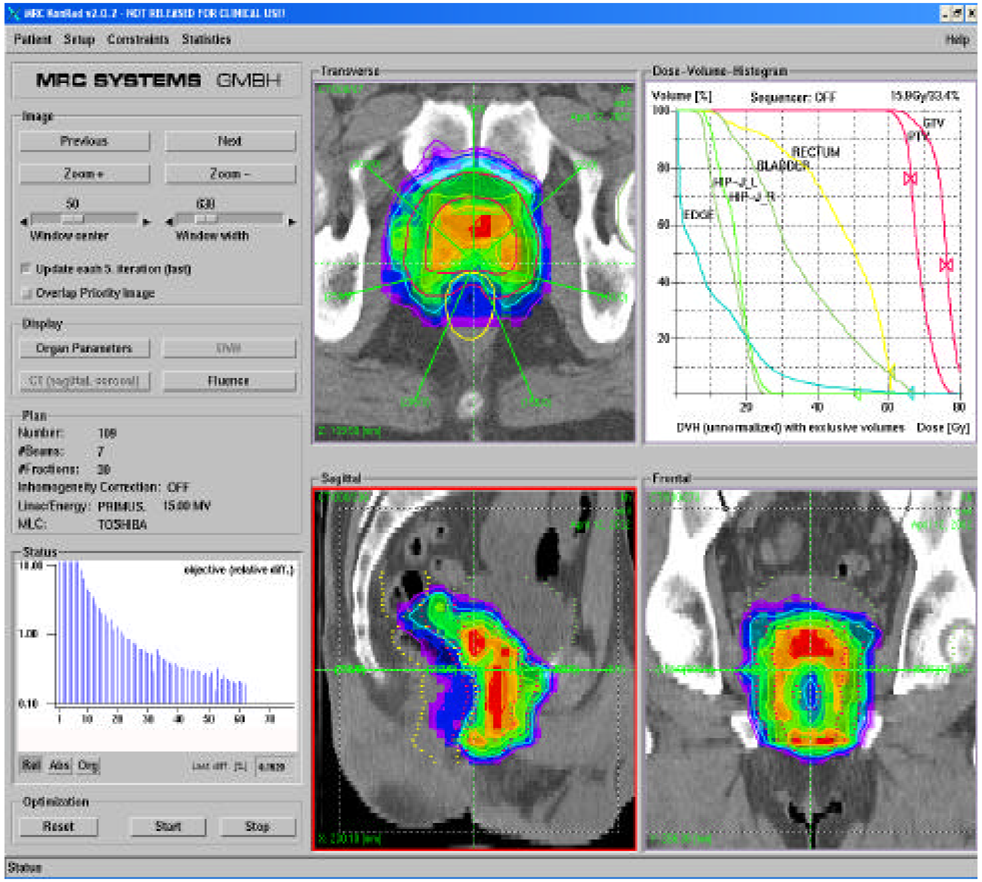
IMRT in der klinischen Anwendung
Aktueller Stand und Fragen bzgl. QA und Verifikation



Ulrich Schaller
Oncology Care Systems

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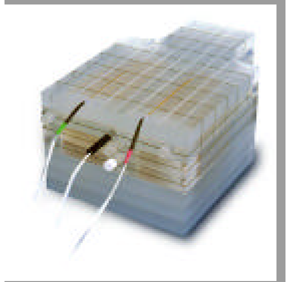
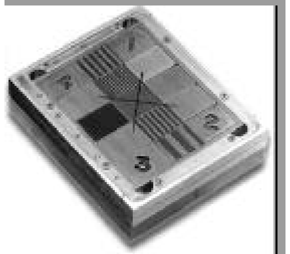
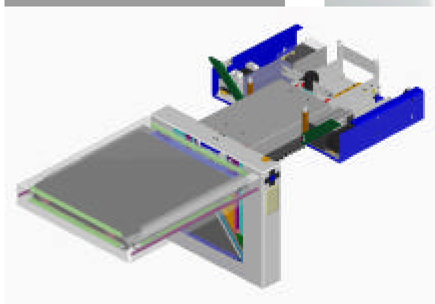
COHERENCE Physics Workspace
+ **WIP** +

Four main tabs will be there:
- Plan review
- Dosimetry Data Conditioner
- Patient QA
- Machine QA







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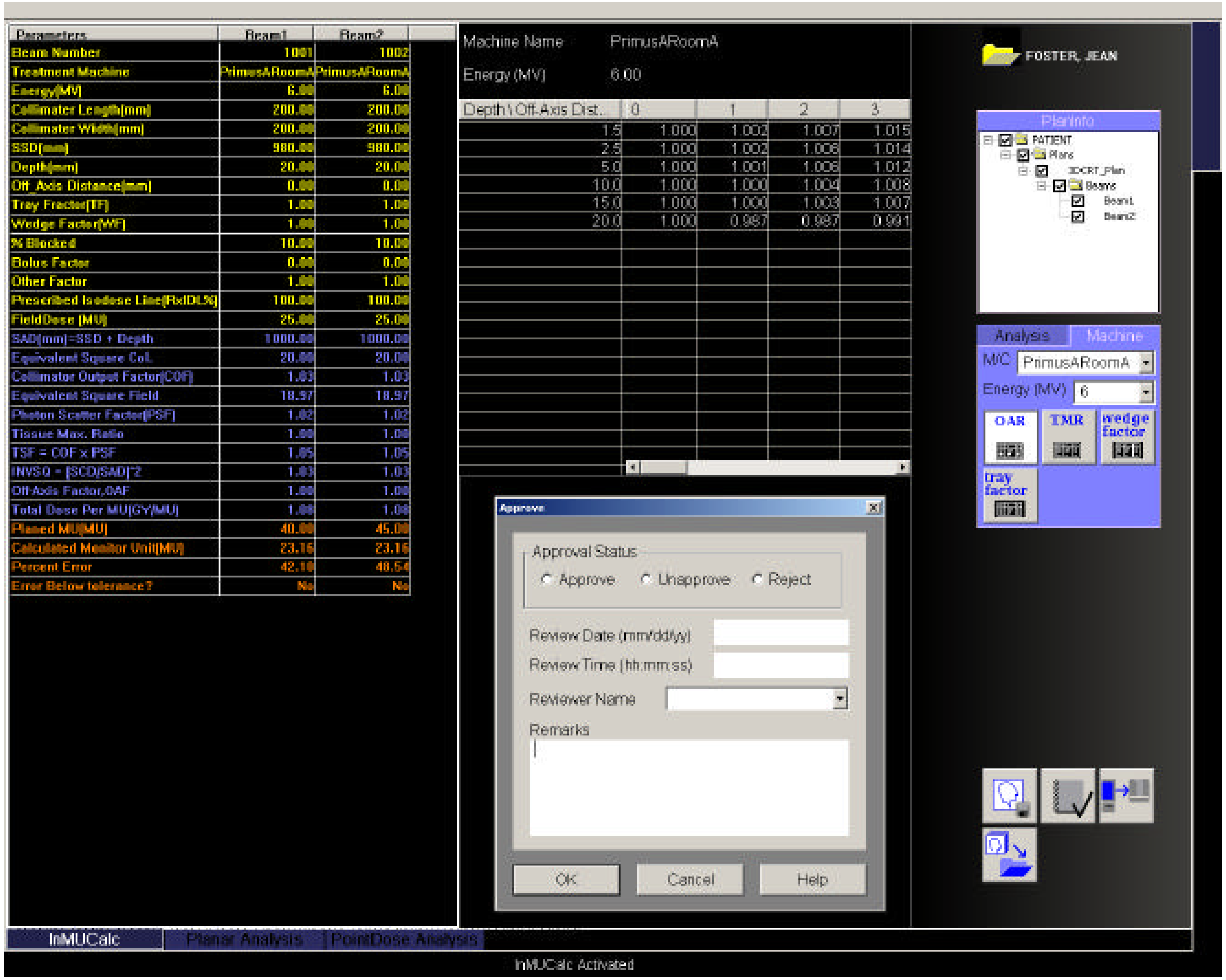
Patient QA: Independent MU calculation



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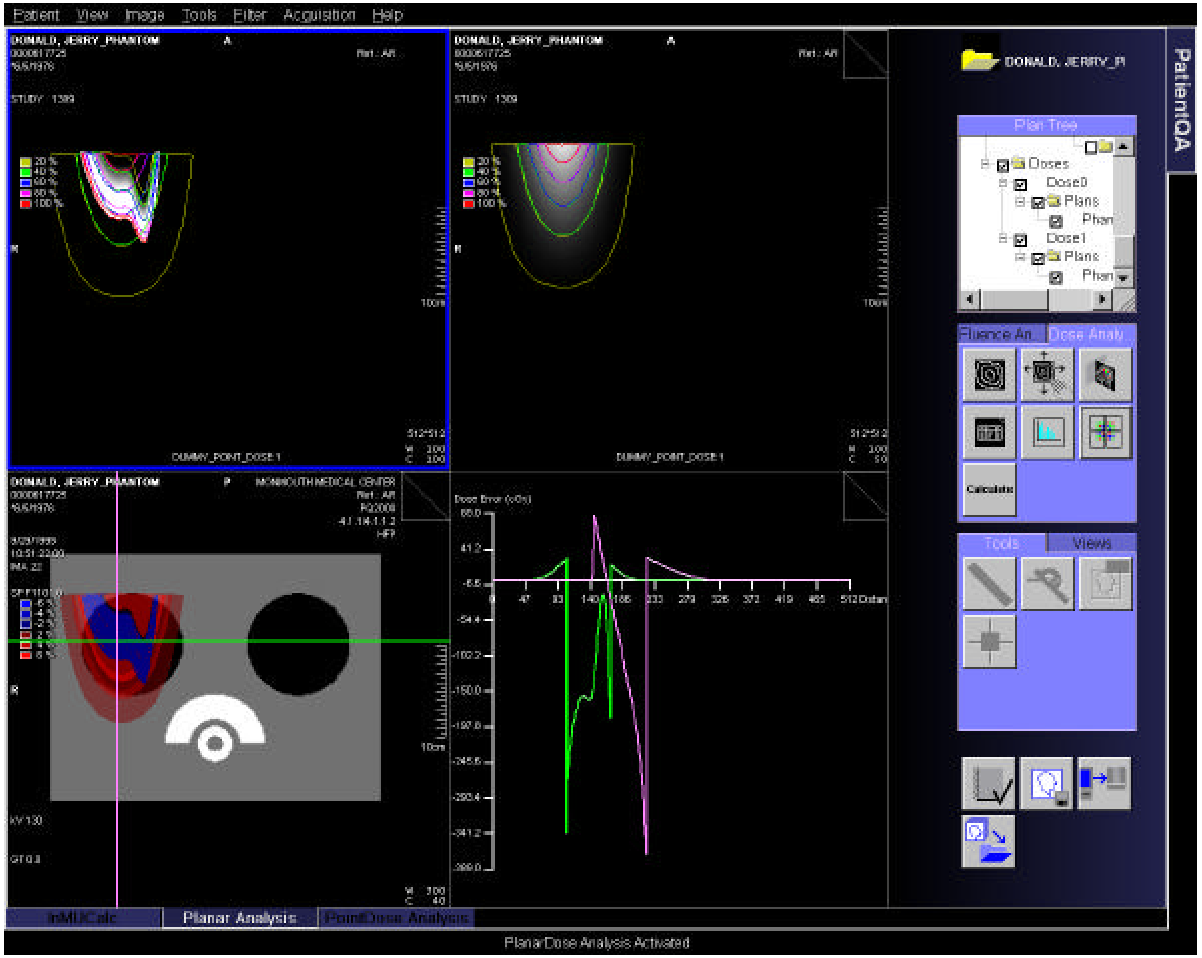
Sub Tab: Planar Analysis, full IMRT in a phantom.

- Compares Calculated at the RTP isodoses in a plan for the phantom IMRT plan against delivered doses in the phantom.
- Superimposes the error map on the phantom images
- Generates profiles of errors and also histogram



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Functional Requirements → Specifications

Accuracy	•penumbra and transmission •accurate beam projection •conformality •clinical resolution and complex shaping •fast and accurate modulation
Efficiency	• automated shaping • economy on resources • economy on material costs • reduce treatment time • increase patient clearance • Number of treatment fields • Dose escalation (same treatment time) • Automation, Integration, Control
Universality	•applicable to most clinical sites
Safety	•Any leaf position shall be verifiable

Specifications
leaf travel motion
leaf edge design
collimator to skin distance
leakage through body of leaf
leakage between adjacent leaves
leakage between opposed leaf ends
tracking with backup jaws
optical vs. radiation coincidence (spec)
physical resolution
clinical resolution
Interdigitation
leaf positioning speed (spec)
leaf monitoring method
leaf positioning accuracy (spec)
calibration method
fractional MU control
Integration between Dose and MLC
motor control
Automated Field Sequencing
clearance spec
Control System Integration
Master / Slave relationship
Maximum field size
max leaf to leaf separation

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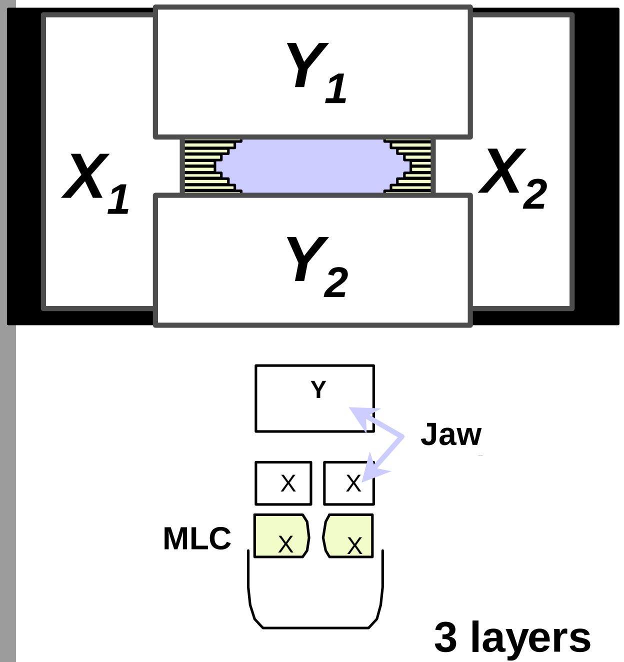
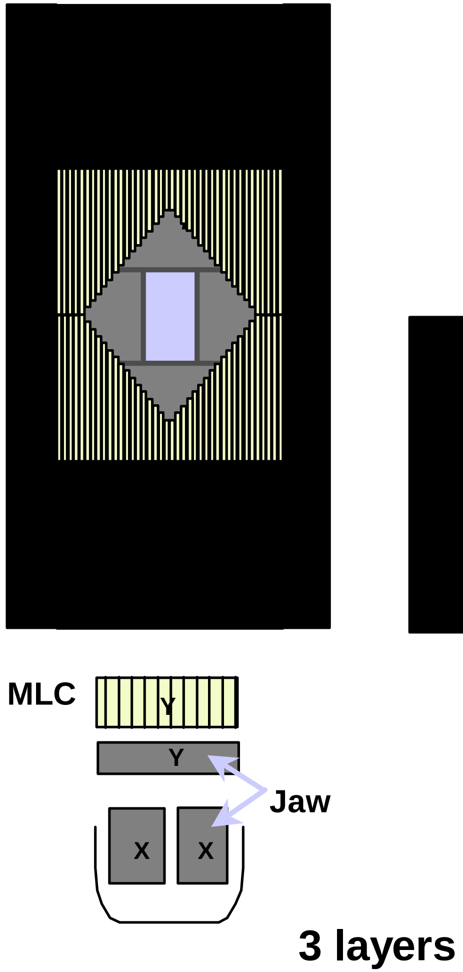
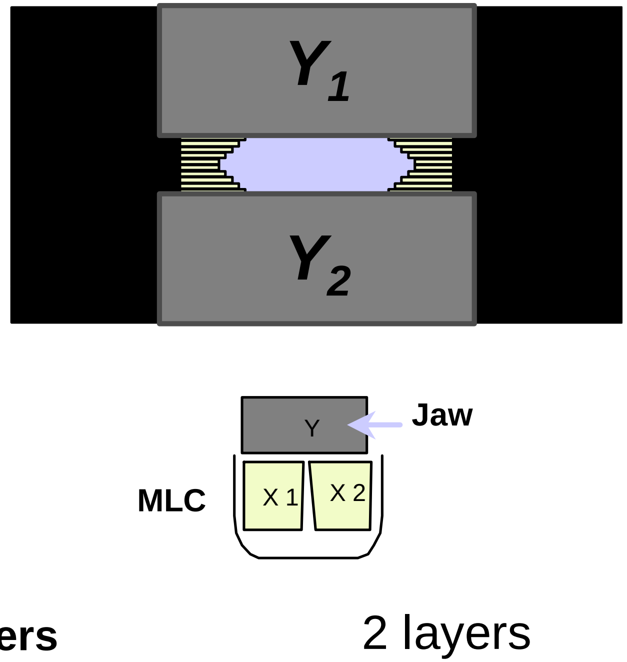
MLC Collimators
Important differences between manufacturers



Varian



Elekta



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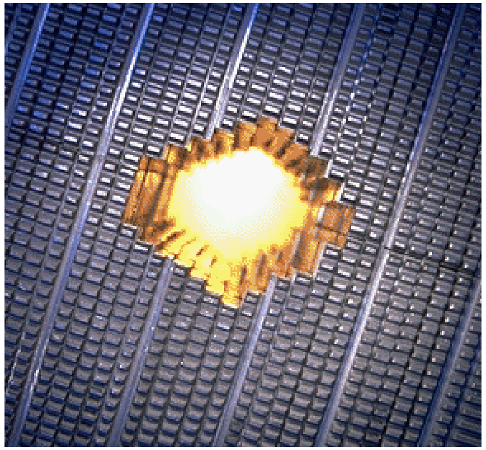

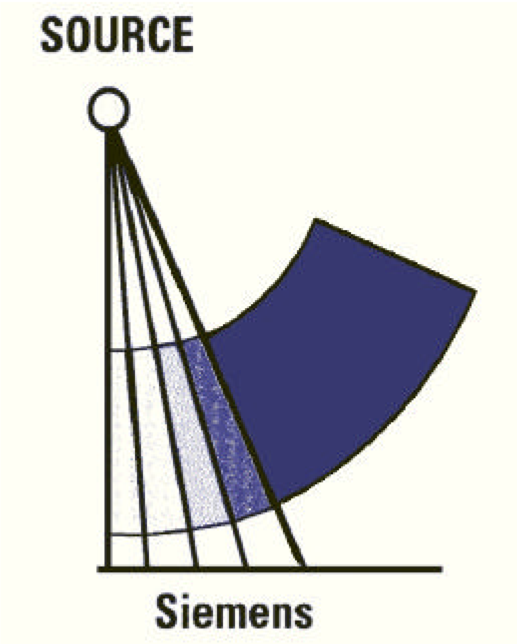

- Double focused (Conic geometry)
- Lower leakage
- Minimized penumbra independent of leave position
- Flat edges (no rounded edges)
- No gap between closed leaves

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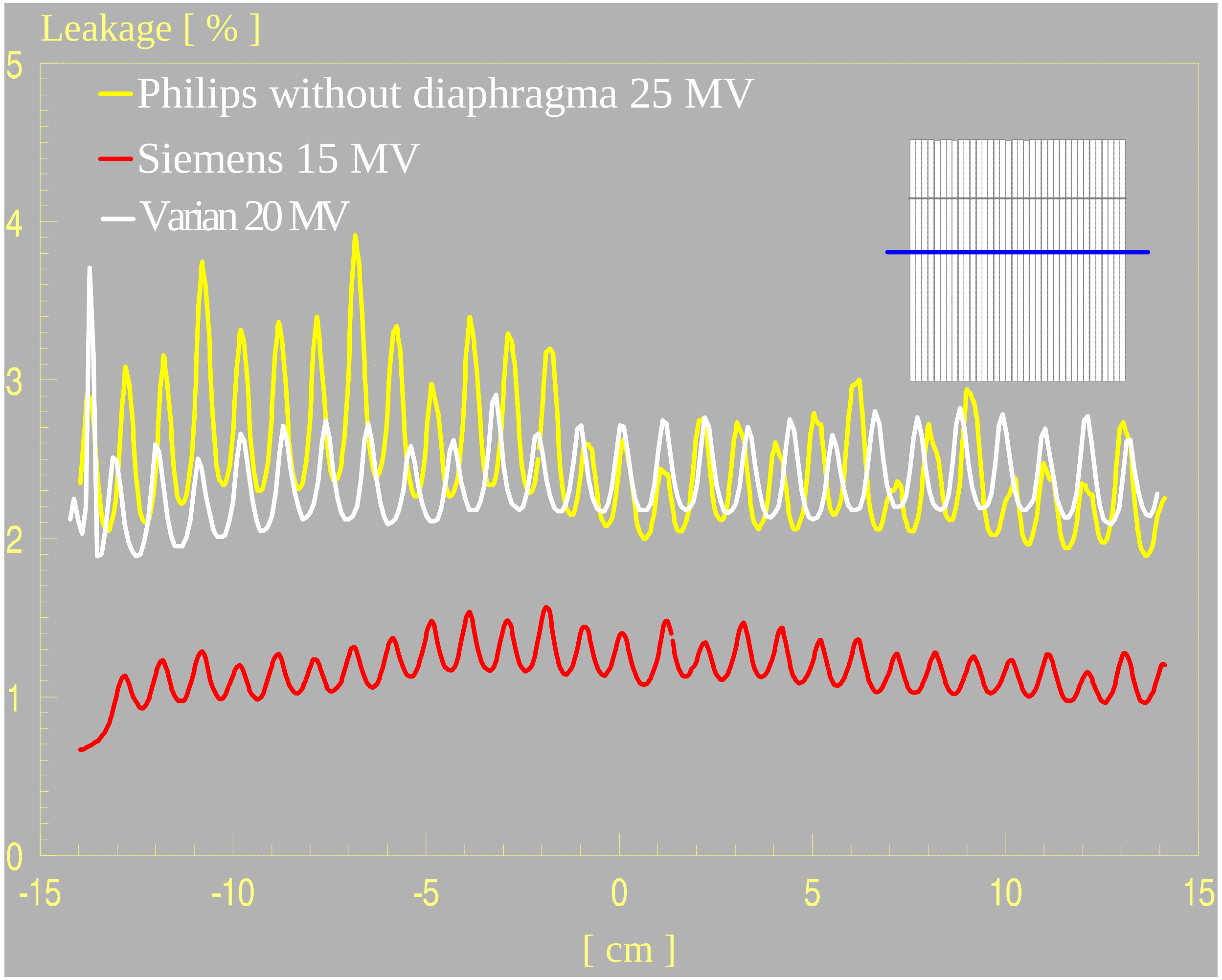
MLC leakage



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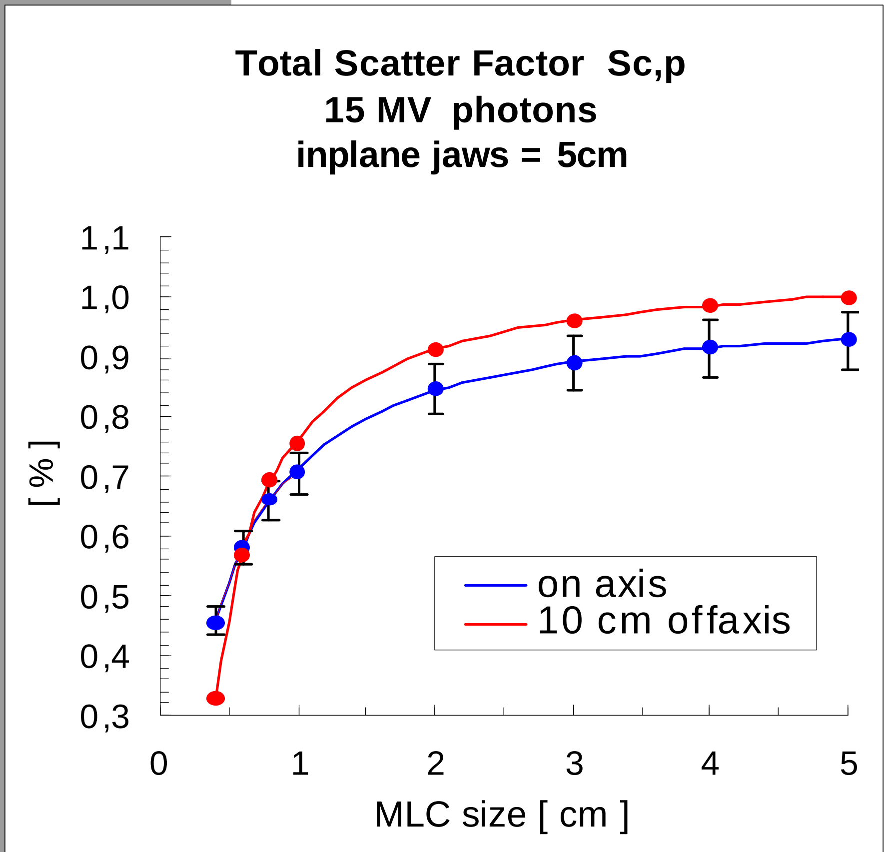
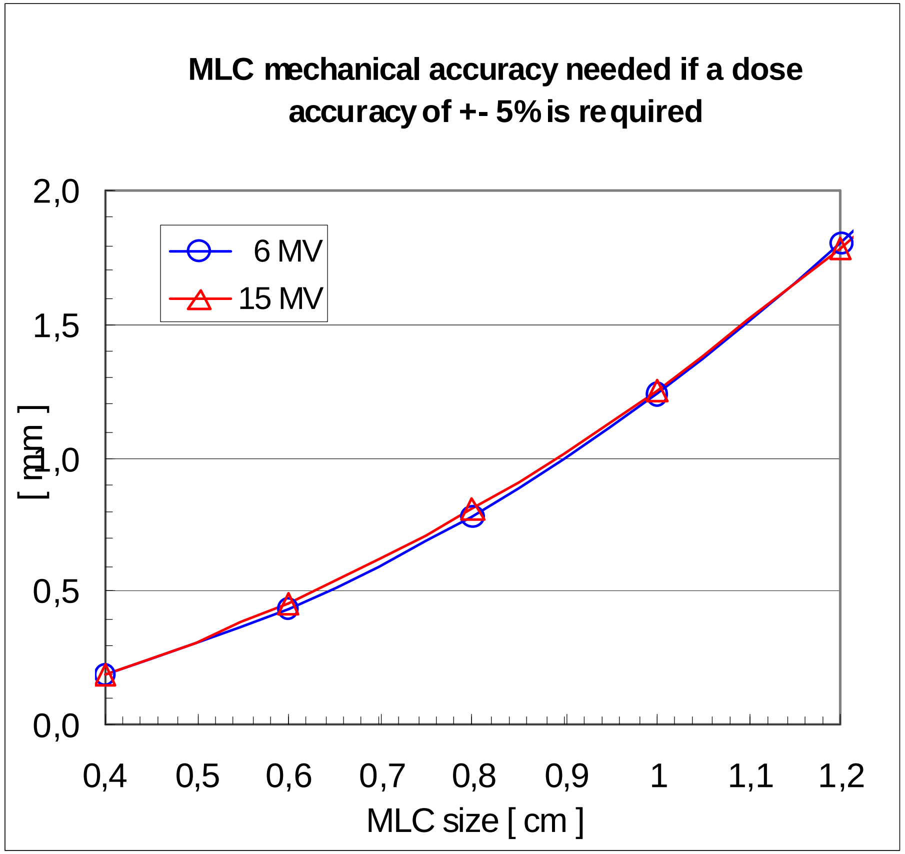
IMRT
Accuracy requirements for MLC positioning DKFZ Heidelberg - 2002





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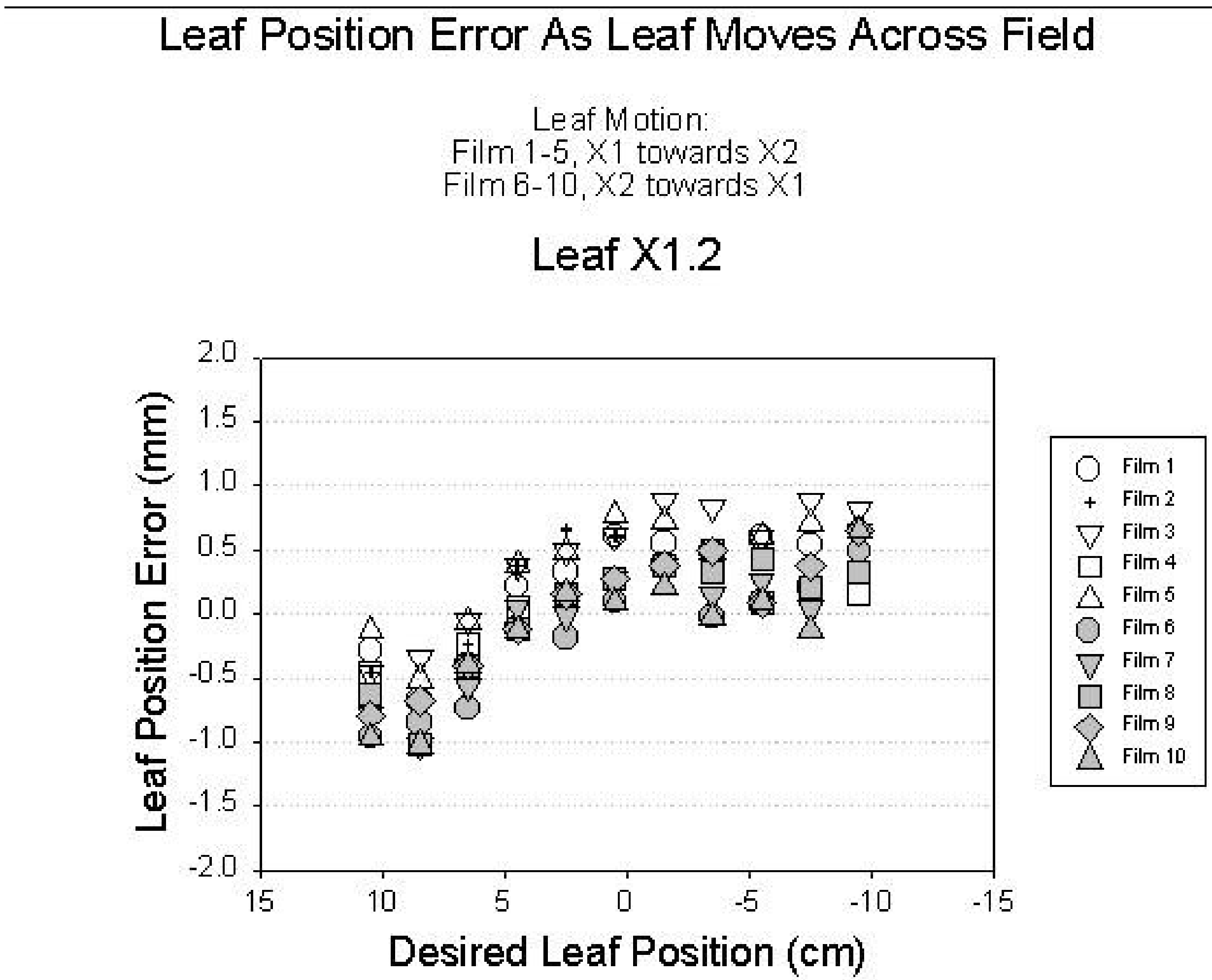
Calibrating the Siemens Primus MLC



Courtesy of Dr. Bayouth, UTMB

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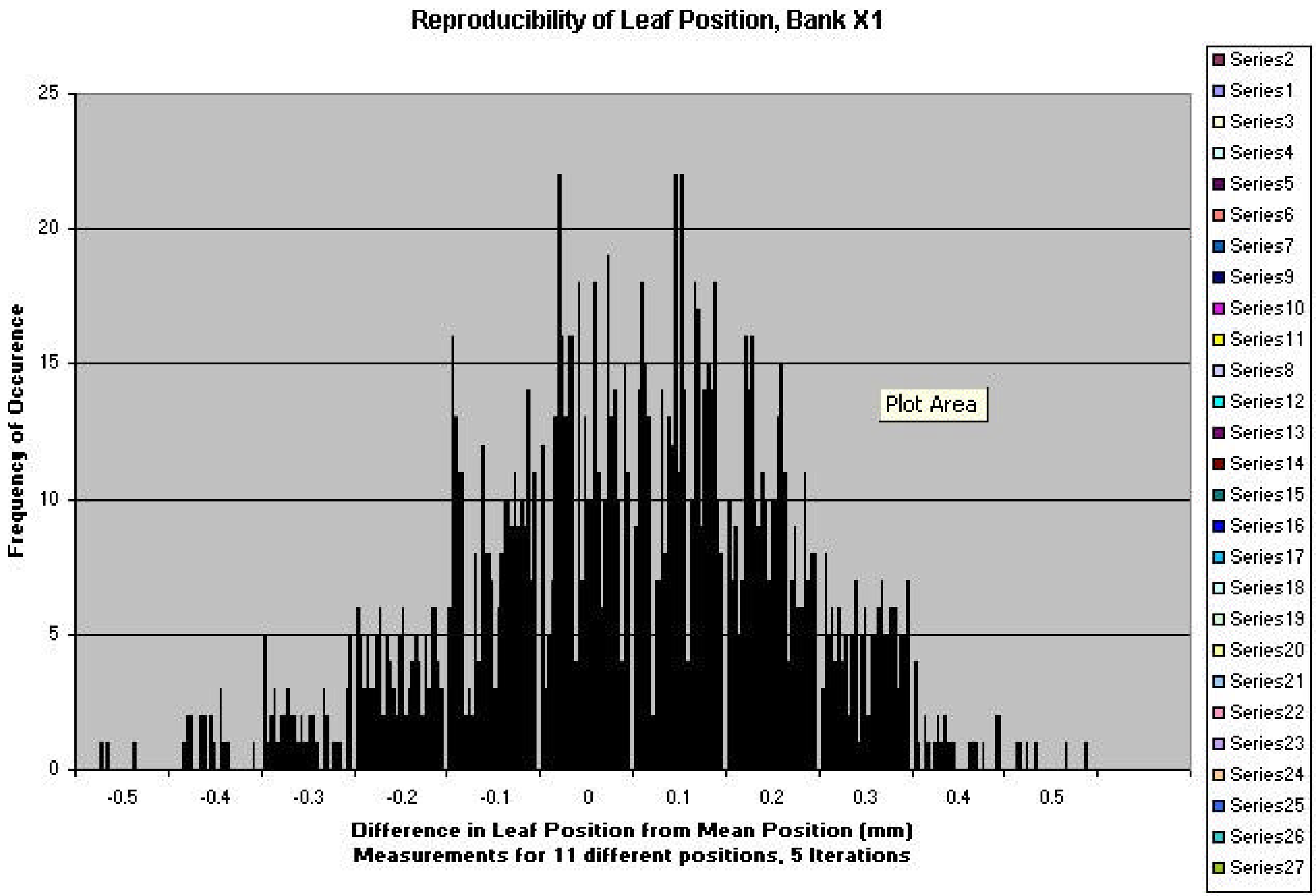
Calibrating the Siemens Primus MLC



Courtesy of Dr. Bayouth, UTMB

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EPAC Tool

+ 4-point calibration
+ Speed calibration

Purchase in combination with MLC training

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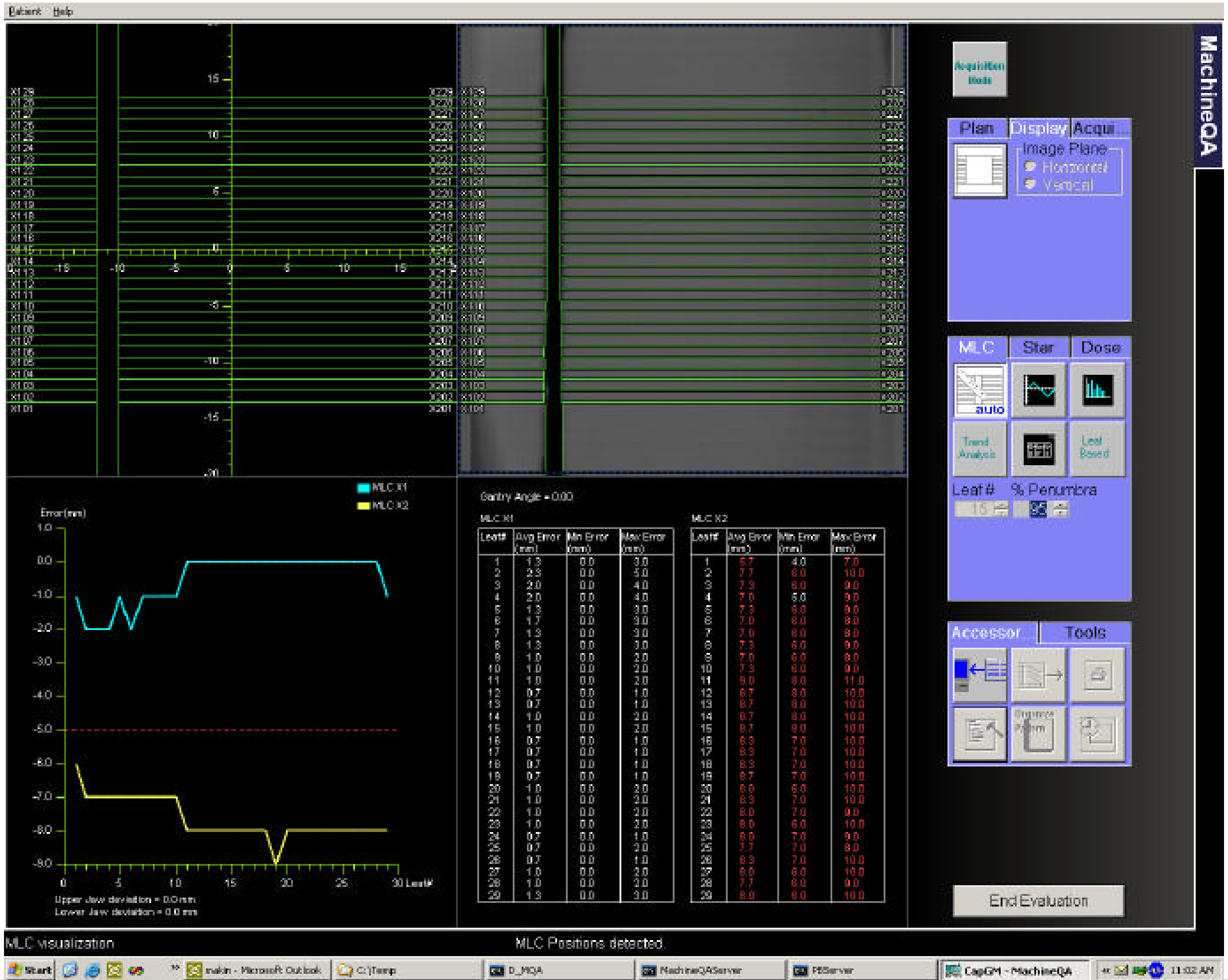
MLC QA – Physics Workspace, WIP



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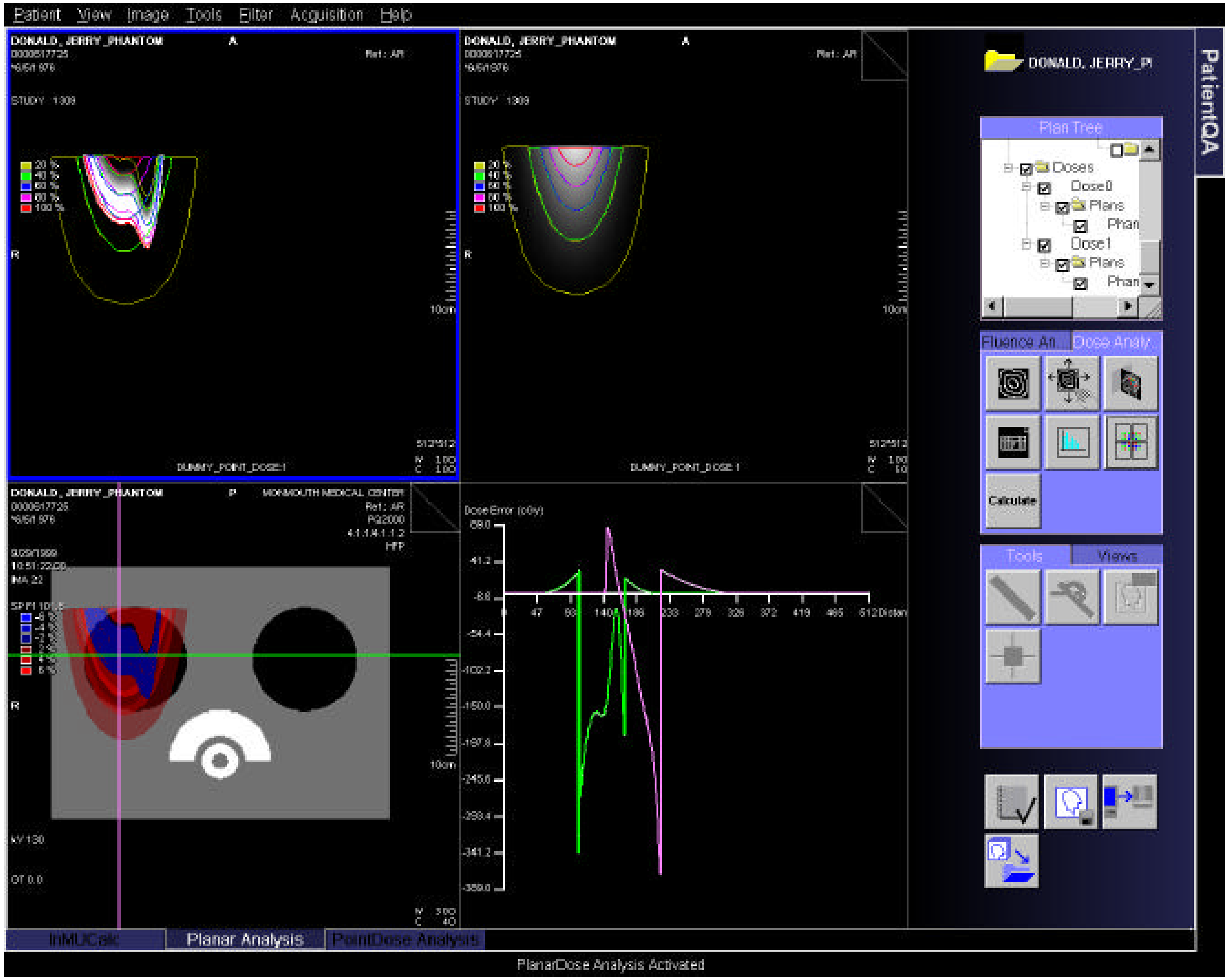
Planar Analysis, full IMRT in a phantom, Physics Workspace, WIP



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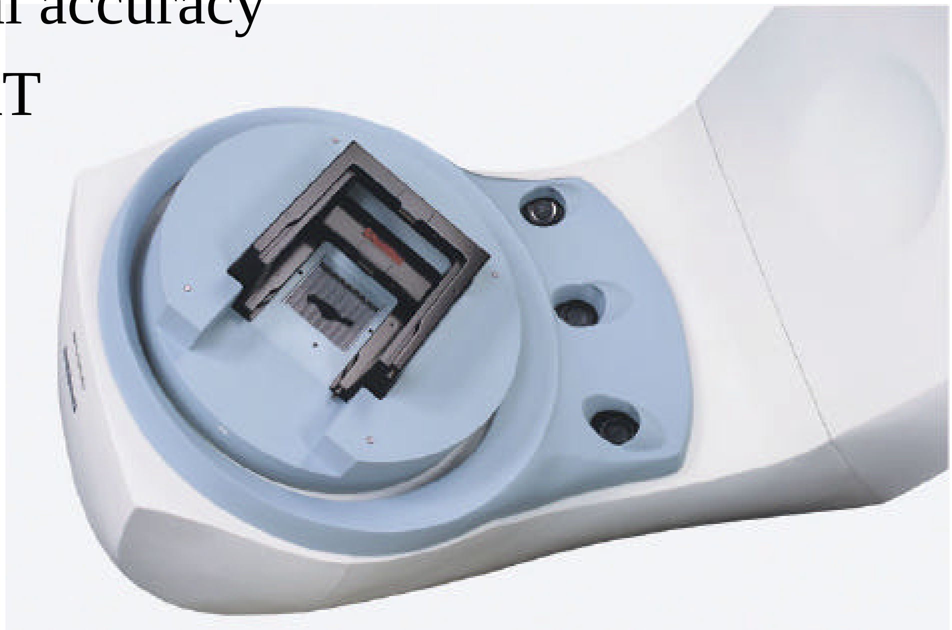
• OPTIFOCUS MLC

- 82 Leaf-MLC
- 1cm width, isocenter
- Accuracy +/-1mm
- Auto-Initialization and Autocalibration
- Full field, low leakage collimation
- Higher positional accuracy
- Enabler for IMRT



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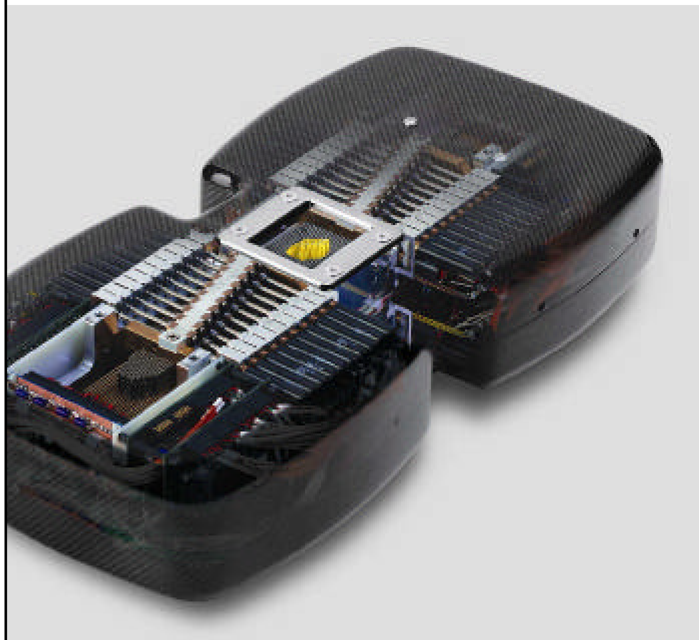
ModuLeaf: optimized for IMRT

- number of leaf pairs 40
- leaf width* 2,5 mm
- max. field size* 10x12 cm^2
- max. overtravel* 5,5 cm
- Max. leaf speed 2 cm/sec
- Positioning accuracy 0,5 mm
- Leaf design focusing
- penumbra (80/20%) 3 mm
- mean/max. leakage 1-1,5%/ 2,5%
- Automatic „step and shoot“ IMRT
- weight 40 kg (88lb)



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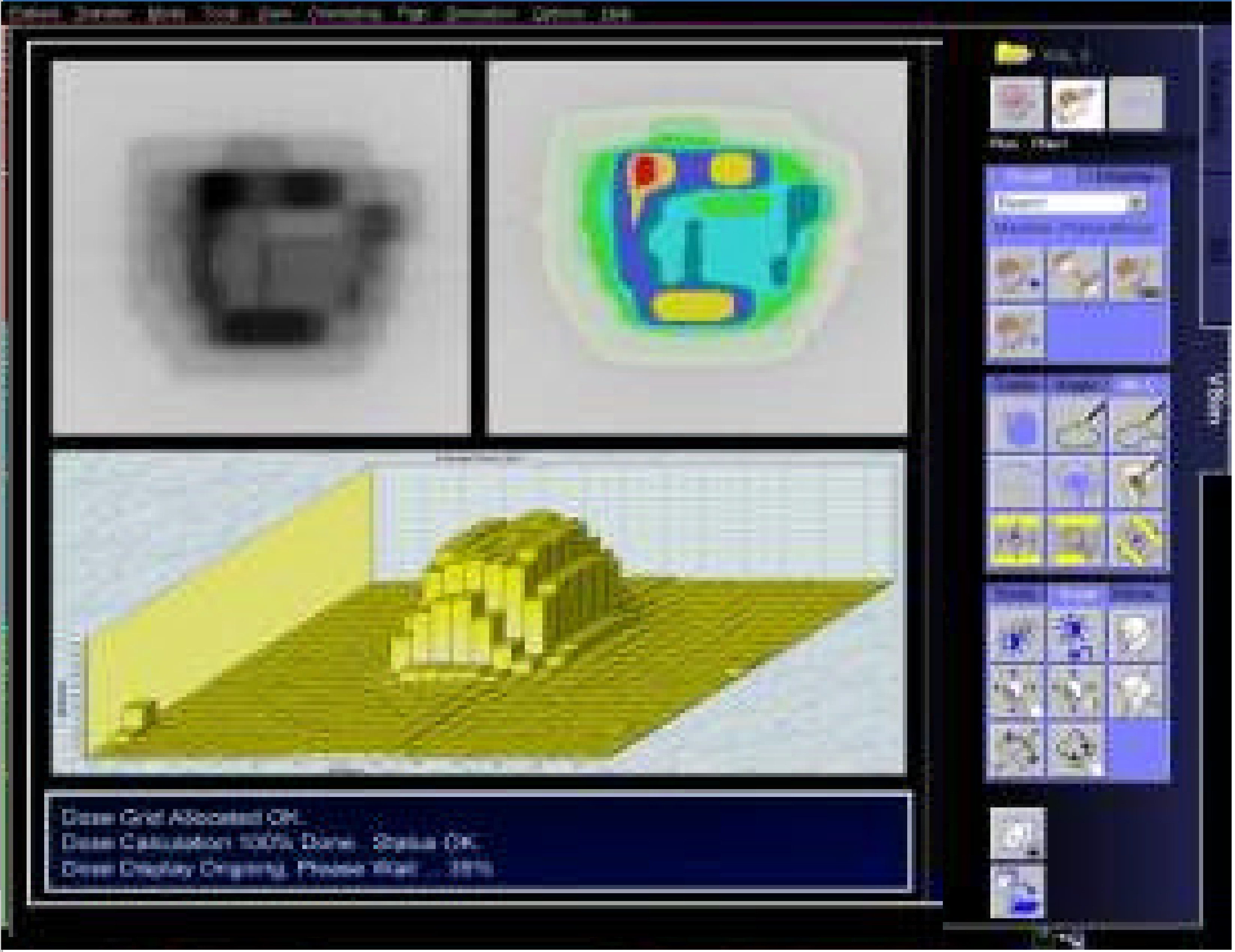

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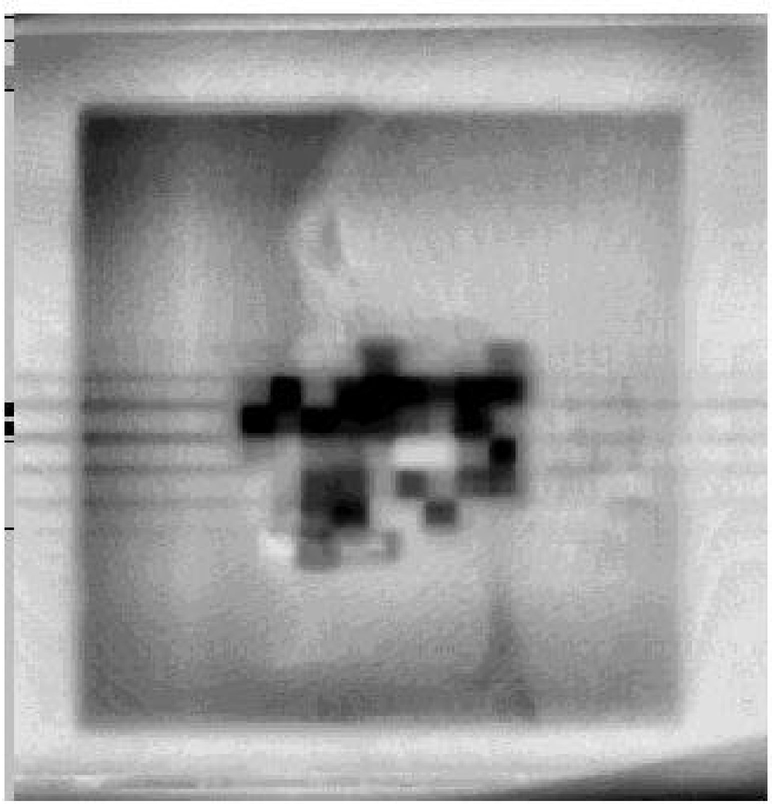
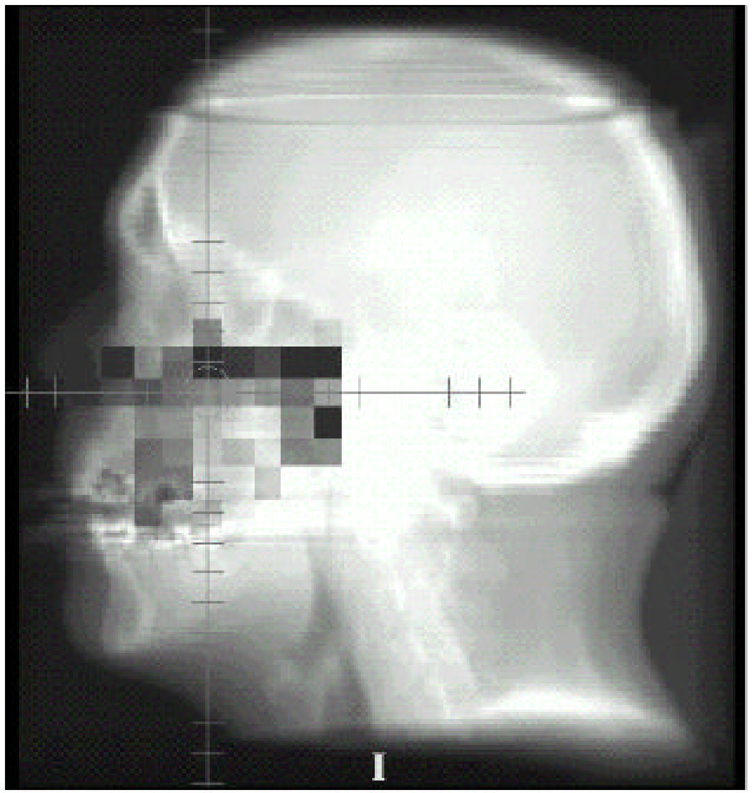
IMRT Intensity Map Test

- Visualization of intensity map correlated to the map superimposed on the DRR from planning system
- Checking the beamlets by intensity comparison





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QA process

			Dynamic Sliding	Cinematic Siemens
Phantom QA	Patient plan			
		Segment by Segment	not possible	possible
		Field by Field	possible	possible
		Total plan	possible	possible
Machine QA	Dose			
		Linearity low MU	Important	Important (good)
		Dose Rate	Critical	Not relevant
		Symmetry and Flattness	Important	Important (good)
	MLC			
		Leaves accuracy	Important	Important
		Leaves speed	Critical	Not relevant
		Leaves acceleration	Critical	Not relevant
		Carriage	Important	Not
		Carriage sag	Important	Not

QA for Cinematic IMRT is easier and possible for each step ……

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