UROK 2007

Antalya,
15 Nov. 2007

Axel Schiemann
Area Sales Manager RT

We protect, enhance and save lives

Who are we ?

Healthcare

Molecular

- Radiopharmaceuticals
- Research Radioisotopes & Radiochemicals
- FDG
- Molecular Technology

Advanced RadioTherapy

- Particle Therapy
- MM50
- Image Guidance

Dosimetry

- **Radiotherapy**
- **Diagnostics**

Industrial

E-Beam & X-Ray Irradiation

- Sterilization
- Polymer Enhancement
- Other Applications

Scanditronix Wellhöfer => IBA Dosimetry

From Pre- treatment (IMRT) - Verification

To On-Line Adaptive Radiotherapy

ONE company meets all RT Dosimetry needs!

IMRT

COMPASS

Linac & MLC QA

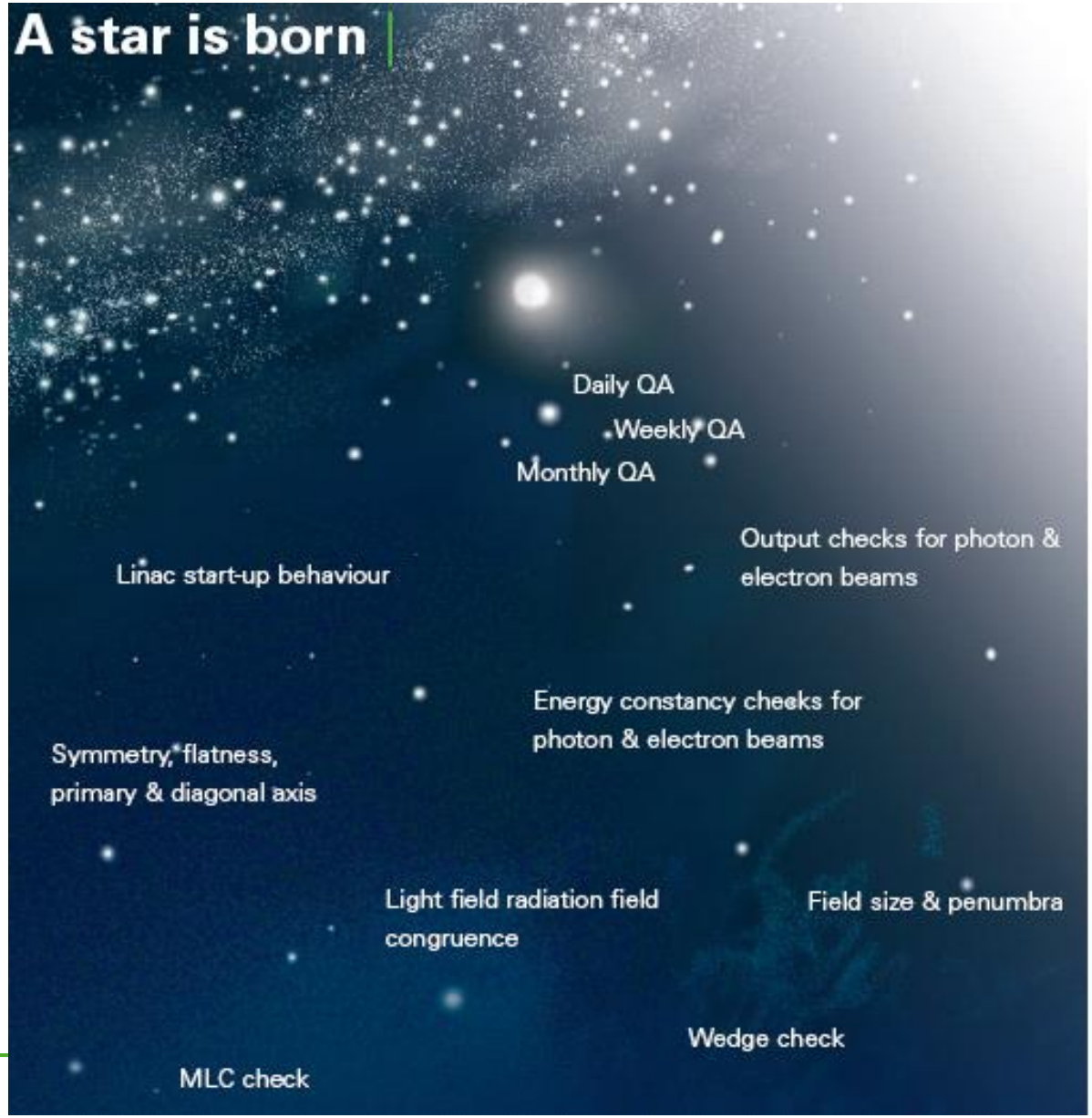
Relative Dosimetry

InVivo Dosimetry

Absolute Dosimetry

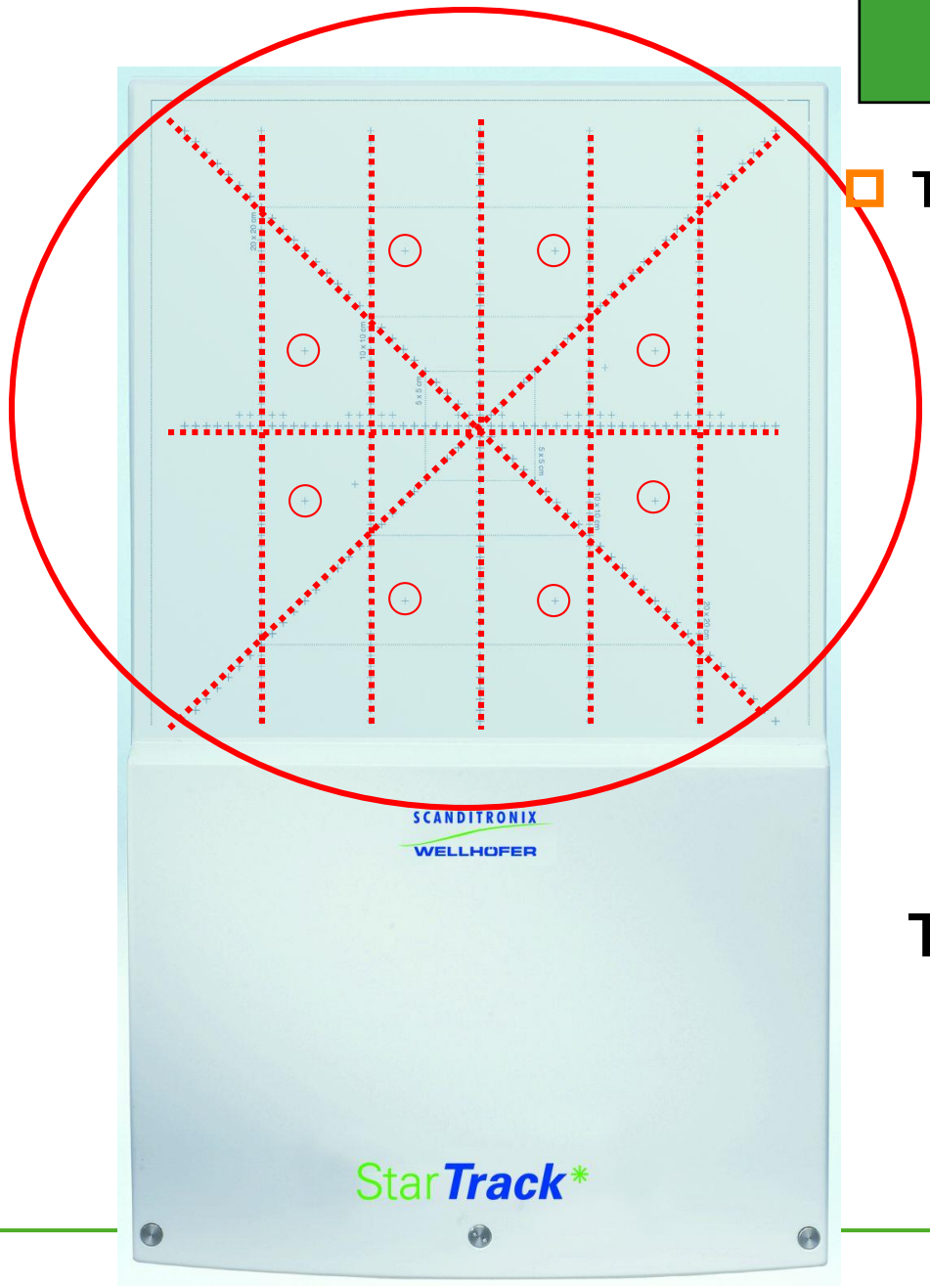
VISICOIL

Star*Track** for Mashine / routine QA



- Daily QA
- Weekly QA
- Monthly QA
- Output factor for phton and electron beams
- Energy constancy check
- Wedge Check
- MLC Check
- Symmetry, flatness for primary and diagonal axis
- Field size & penumbra

StarTrack*

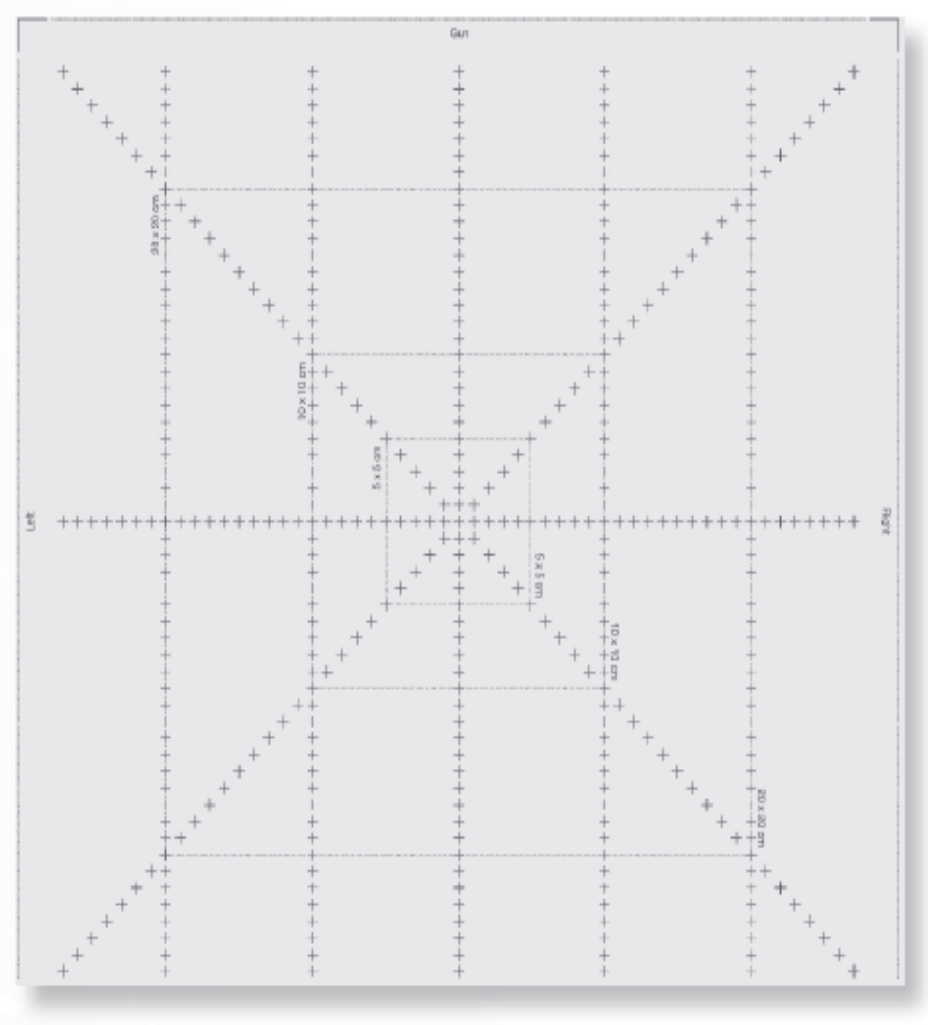


- **The most accurate QA solution**
  - Air-vented pixel Ionization chambers
  - Main axis and diagonals
  - Additional rows for MLC QA
  - Discrete chambers and 2
  - build up plates (ph,e) for energy constancy check

The universal QA solution !

Star*Track** - a real Star

- **Technical specification**
  - 453 plane parallel ion chambers
  - Air vented
  - Automated k(t,p) correction
  - 5 mm spacing
  - Advanced interpolation:
    Fermi-Fit grid < 1mm
  - Parallel read-out of all channels
  - 10ms read out



OmniPro™- Advance

- **Truly universal**
  - Predefinition of setup & queues
  - Trend analysis / point over time
  - ‘Fast Track’ measurement mode
  - LinAc startup behaviour
  - MLC and wedge check
  - Energy check for electrons and photons
  - Light field – radiation field congruence

OmniPro™- Advance

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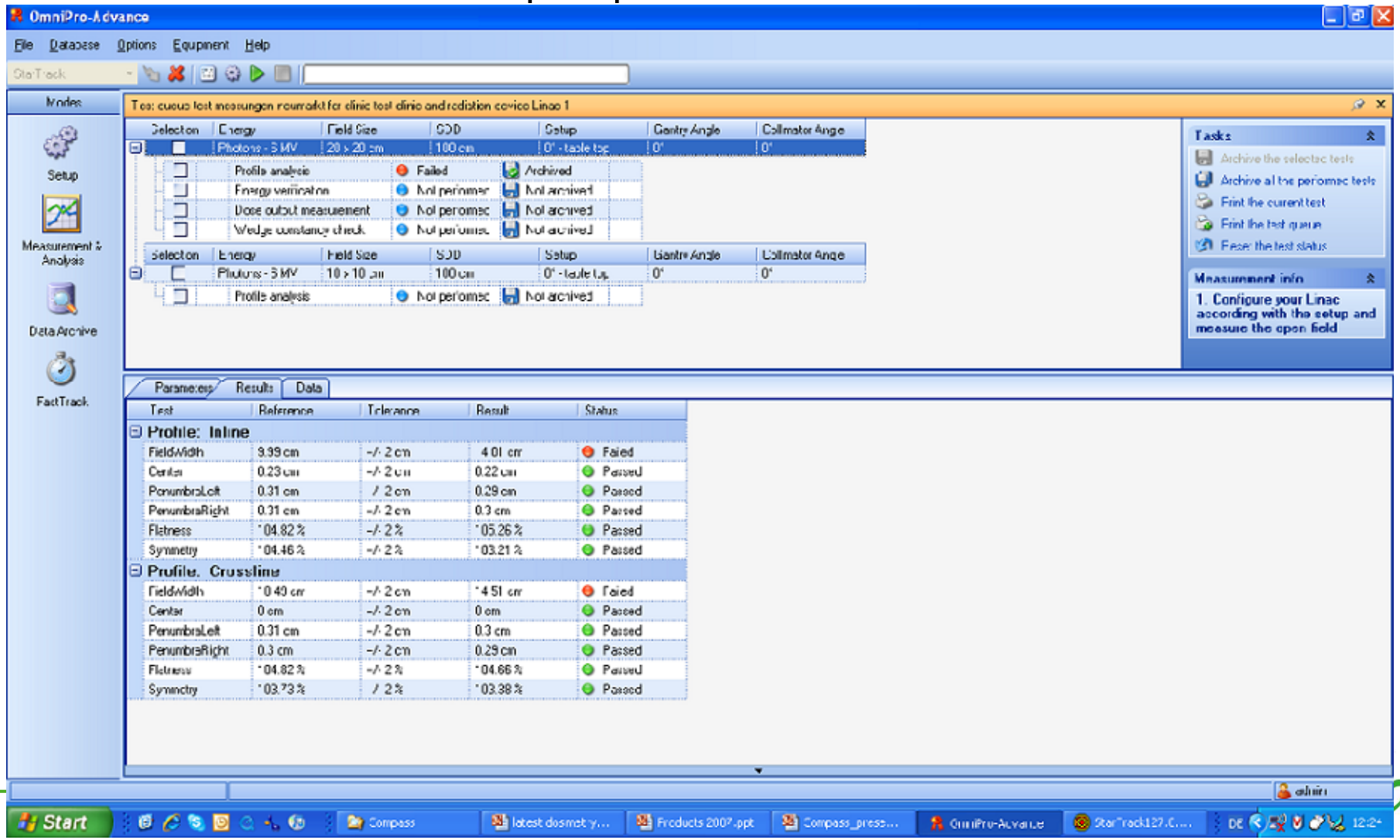

OmniPro™- Advance

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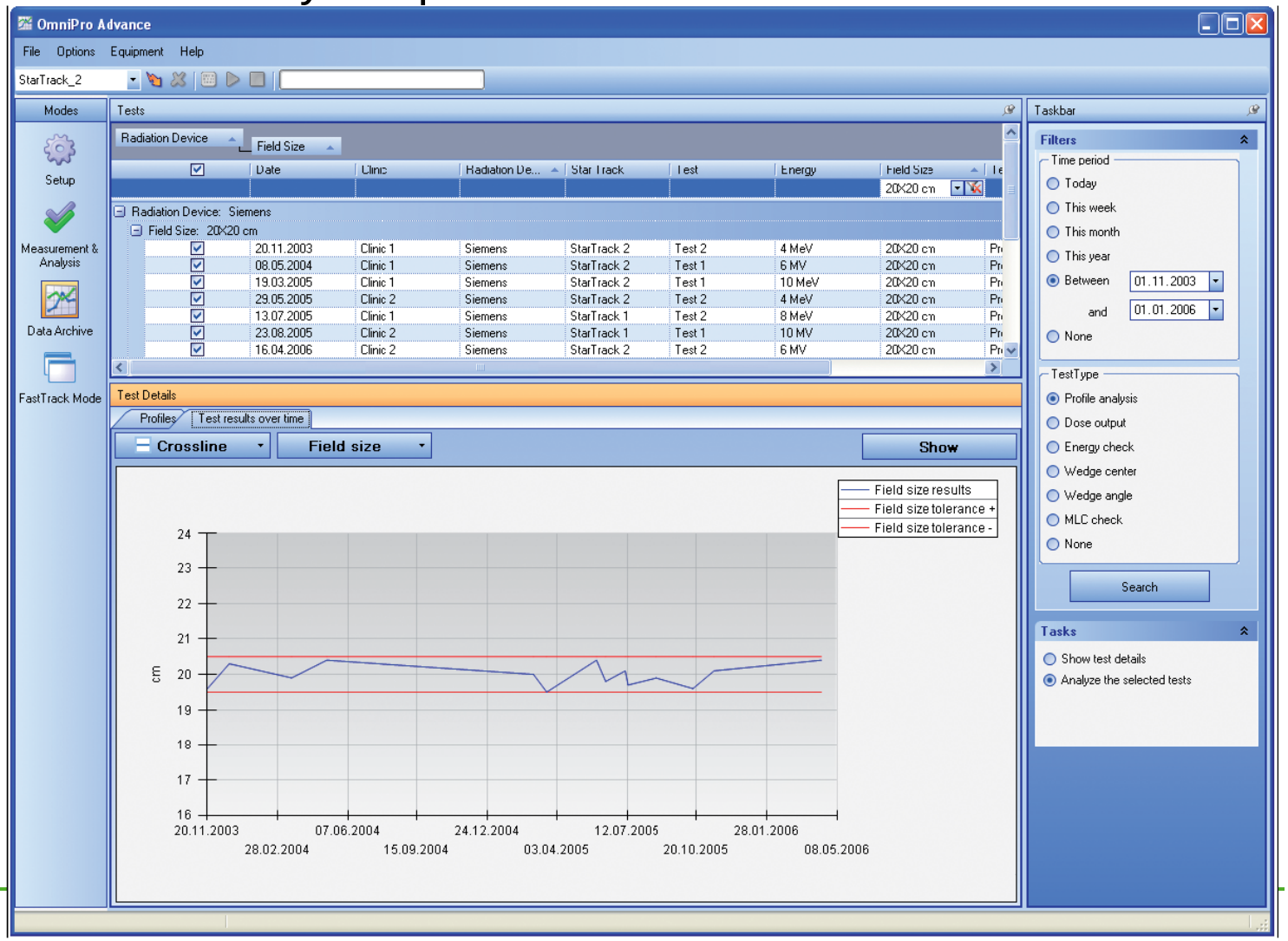
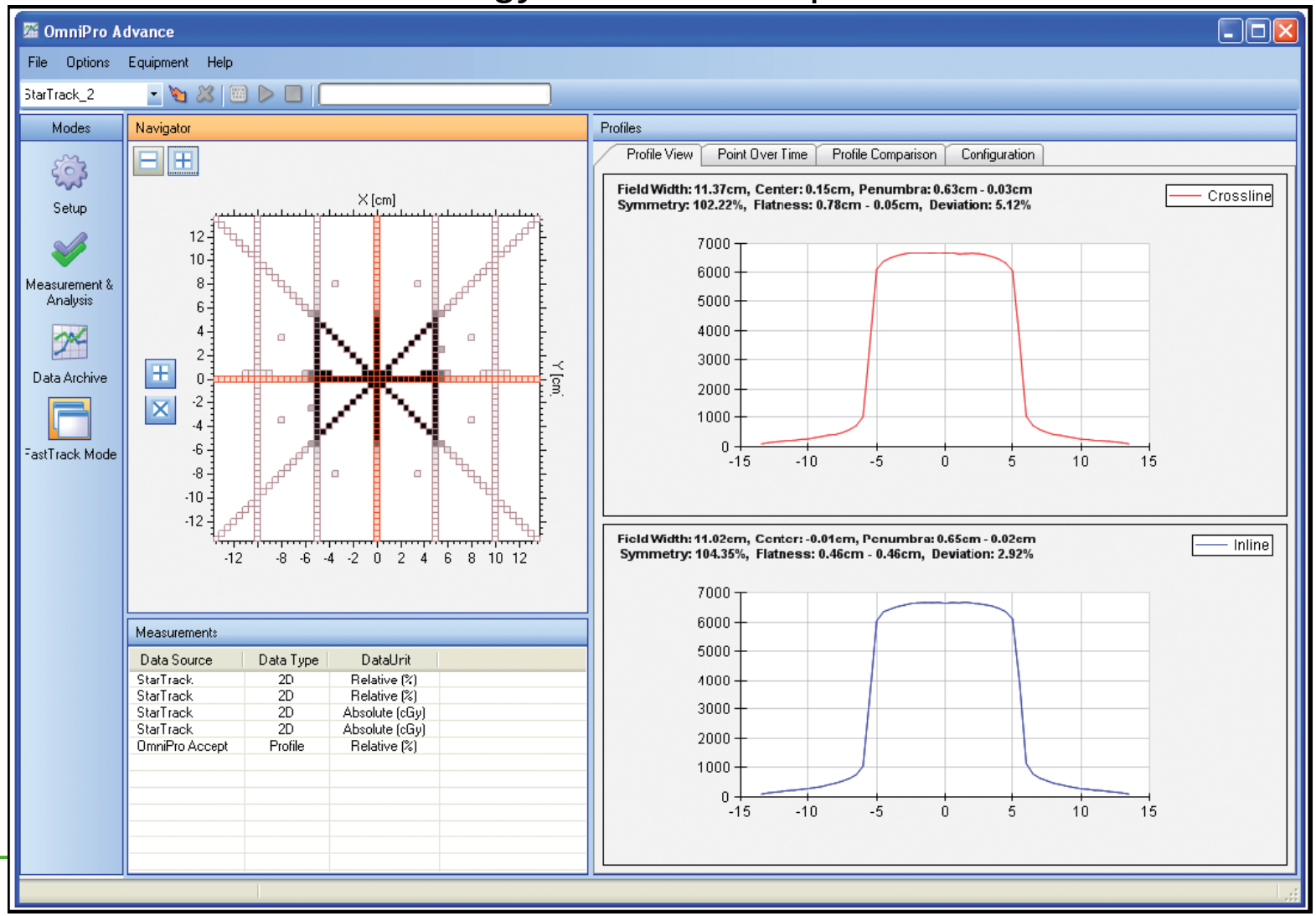
  - Trend analysis / point over time



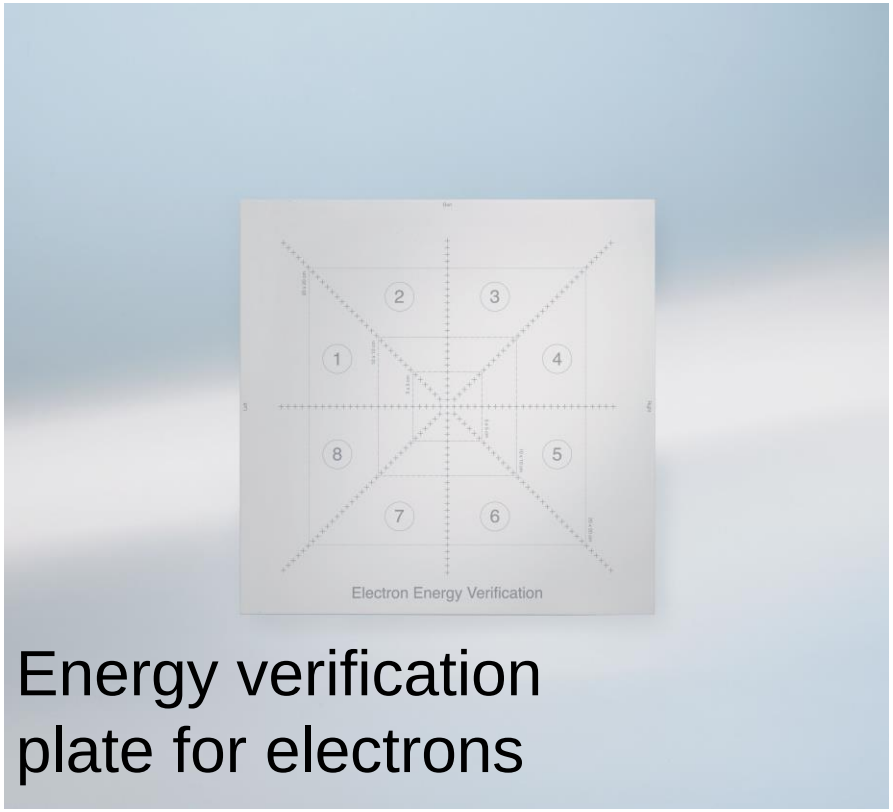
OmniPro™- Advance

- Analyses of symmetry/ flatness & Penumbra
- Field width & Energy and dose output

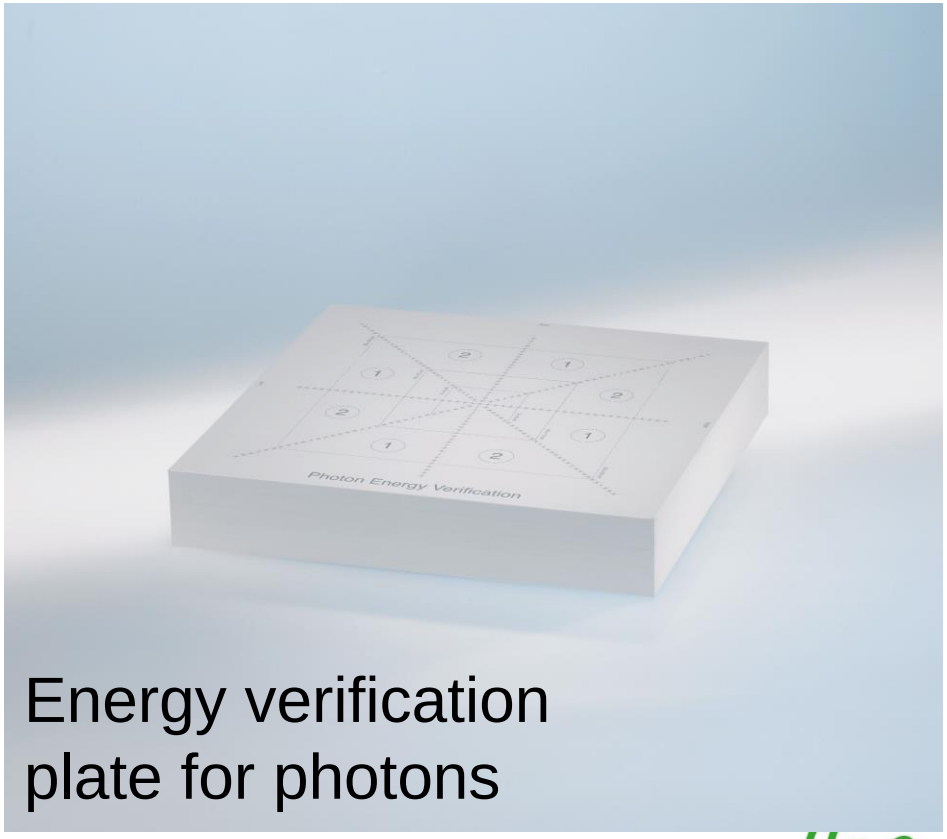


OmniPro™- Advance

- **Truly universal**
  - MLC and wedge check
  - Energy check for electrons and photons
  - Light field – radiation field congruence



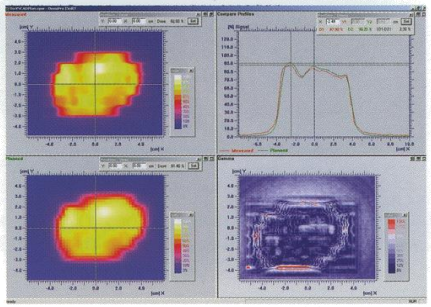
Energy verification plate for electrons



Energy verification plate for photons

IMRT Quality Assurance Solution

Data Import: TPS dose maps

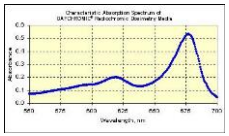


OmniPro™ I'm*RT*
I'm*RT* Phantom

OmniPro™ I'm*RT*

I'm*RT* MatriXX

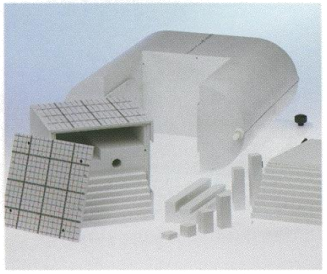
OmniPro™ I'm*RT*
I'm*RT* QA



- Film verification of delivered vs planned dose[1)]
- Verification of the absolute dose[2)]
- Basic MLC QA
- Linac QA

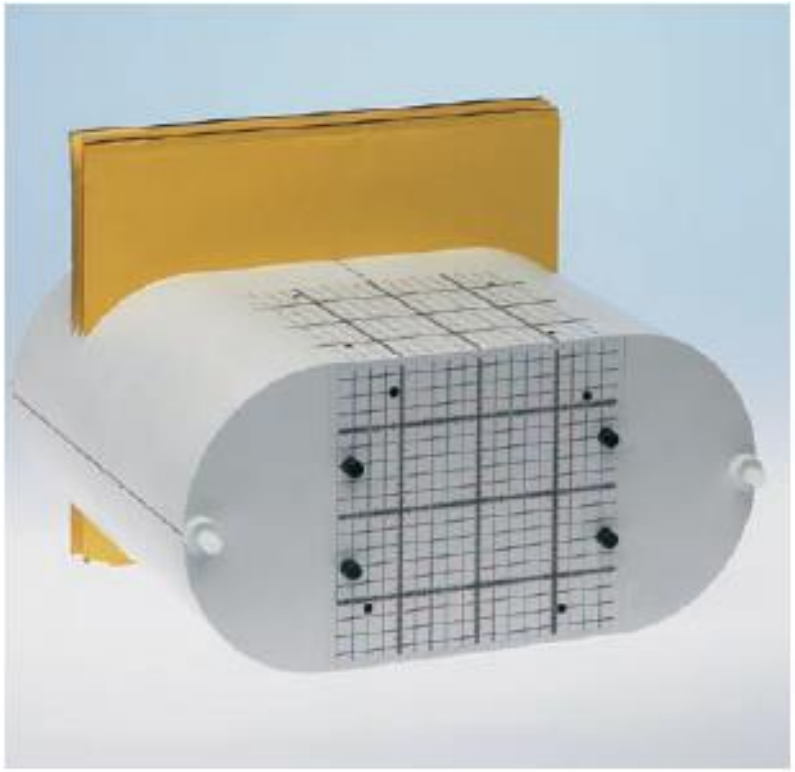
- Real-time verification of the IMRT delivered vs calculated planar dose
- Verification of individual and integrated IMRT fields
- Advanced MLC QA
- Light vs radiation field congruence
- Linac start-up
- Real-time Linac QA
- Simultaneous inplane and crossplane beam profile adjustment

I'm*RT* Phantom



MatriXX

Universal I‘mRT Phantom



I‘*m*RT MatriXX

„The new standard in 2D IMRT verification !“

I'*m*RT MatriXX

„The new standard in 2D IMRT verification !“

1020 Pixel Ionization Chambers

Sensor type: Vented parallel plate ionization chambers
Chamber dimensions: 4.5 mm, height: 5 mm,
Volume: 0.08 ccm

1024 electrometer channels onboard

parallel read out, NO deadtime

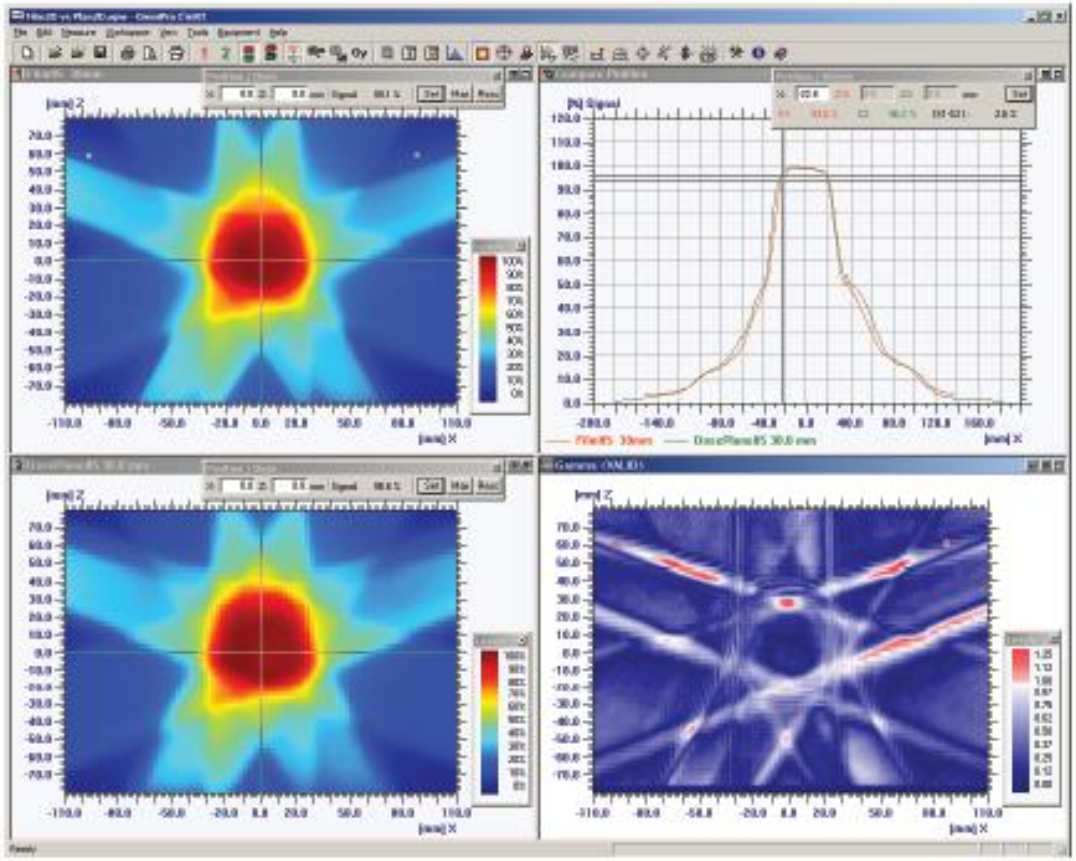
- **20 ms** minimum sampling time

- Absorbed Dose & Dose rate
- Field Size 24.4 x 24.4 cm2
- Sensitivity 2.4 nC/Gy (Co60)

ALL integrated in: OmniPro-I'*m*RT

measured data

TPS data



visual comparison
1D profiles
2D isodoses

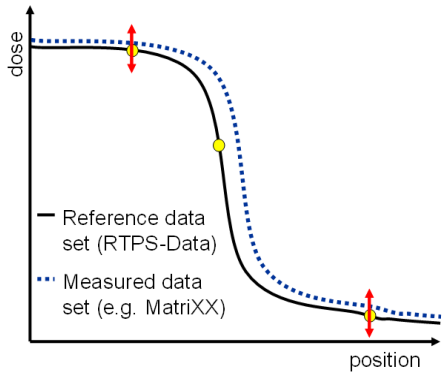
mathematical comparison
sum
difference
absolute difference
correlation
multiplication
Gamma method
discrete Gamma
division
DTA

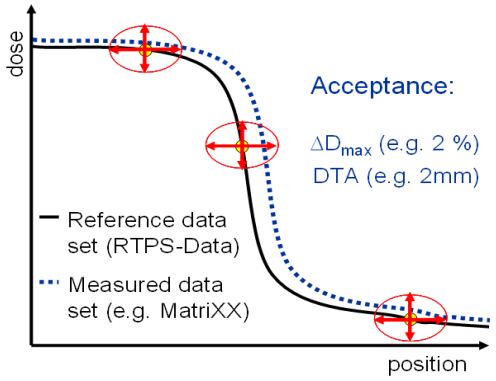
Latest development for IMRT / IGRT verification

New !

Where do DOSE errors come from?

Discrepancies in the magnitude of delivered dose were attributed to a variety of conditions including the use of inappropriate data in treatment planning systems and collimator leaf positioning errors; both of which should have been detected through the institutions' quality assurance procedures. Discrepancies due to the failure of institutions to correctly model the beam penumbra with a particular planning system reflected willingness of the institutions to accept the incorrect model, as the same planning system was apparently used at other institutions with acceptable results.

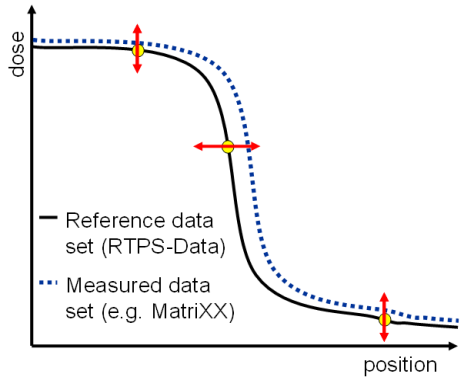


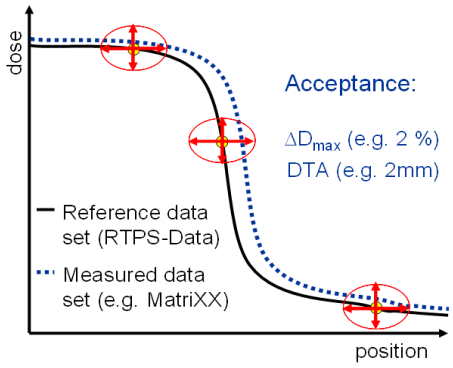


Dose difference for **small gradients**

Where do DTA errors come from?

The data available for analysis of the irradiated phantoms yielded an insight into the accuracy of delivery of IMRT at a cross section of North American institutions. The large failure rate of approximately 1/3 of participating institutions suggests that IMRT is not practiced uniformly across the US. The number of failures in the distance-to-agreement-measurements could indicate positioning errors but can also demonstrate failures of other types, including collimator leaf positioning error, gantry position error, or monitor unit delivery error. Anecdotal reports from the physicists performing the irradiations at participating institutions suggest that positioning errors were not the exclusive cause of the DTA discrepancies.





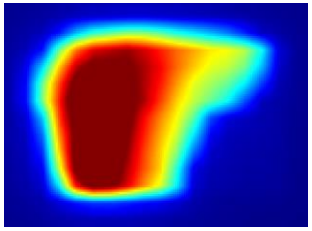
Distance to agreement (DTA) for **large gradients**

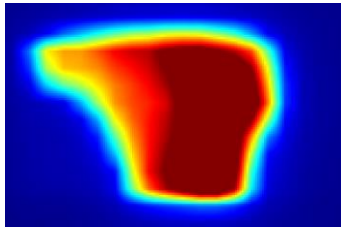
Planning

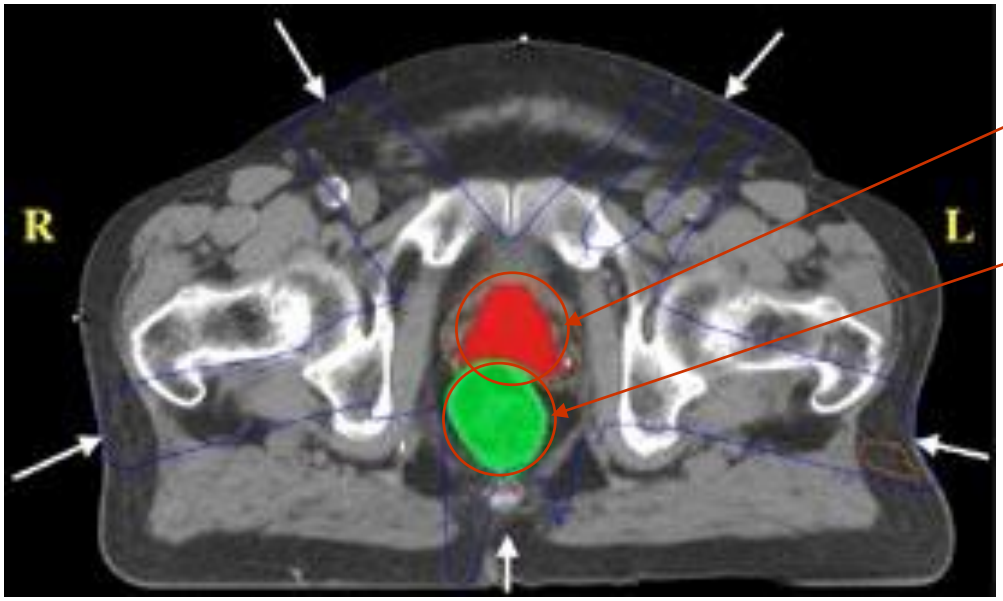
Take CT scan

Make Planning

IMRT Plan (Prostate)

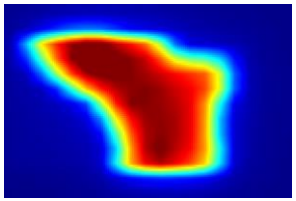


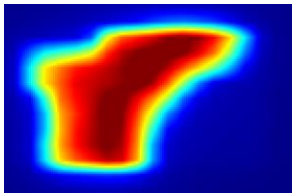


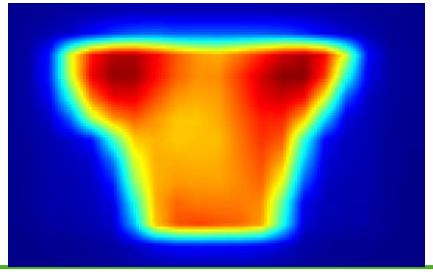


CTV

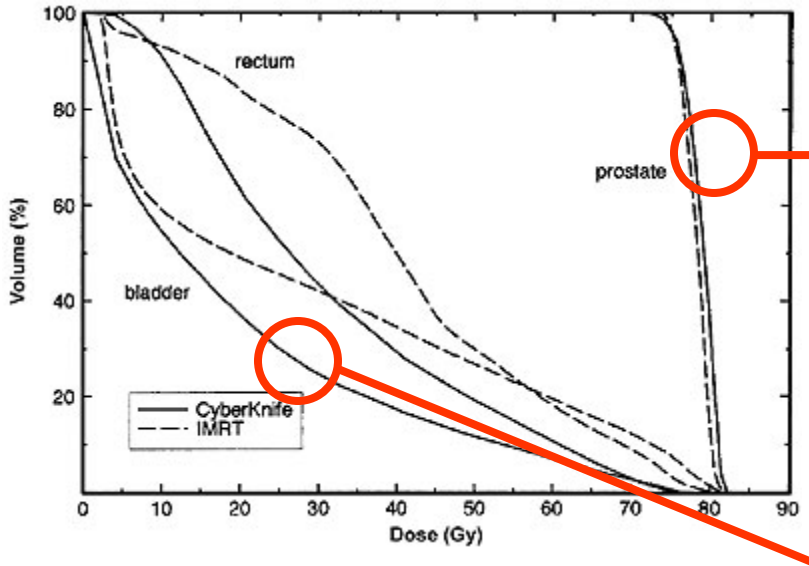
OAR







Dose-Volume Histograms



DVH shows percentage of organ volume exposed to a given dose

CTV (clinical target volume)

Flat, sharp high-dose fall-off (uniformity)

OAR (organ at risk)

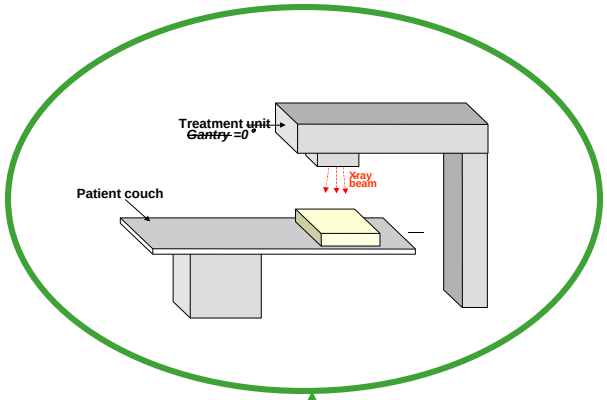
Small fraction with high dose (parallel organ), no HD (serial organ)

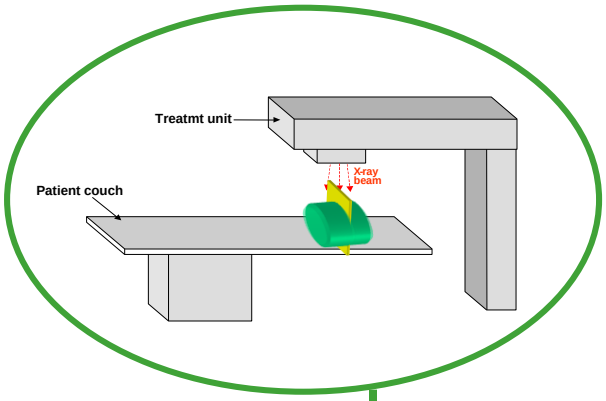
Patient Specific Verification – the whole story

- Prescription defines doses (DVHs) for Target Volume and OAR
- Have these goals been met ?

Patient-specific Verification ?

CT





TPS

3D Dose

Fields

3D Dose In Patient

3D Dose In Phant

disturbed Fields

Resulting 3D Dose In Patient

Targ. Vol/Dose/constraints

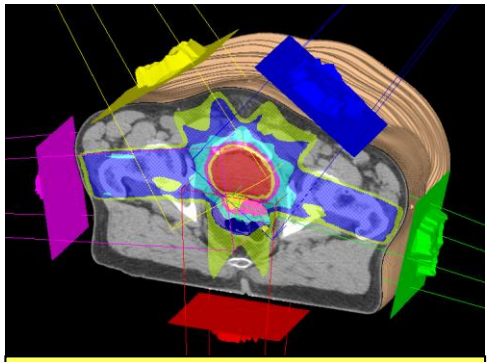
What is COMPASS ?

COntinously **M**onitoring **PA**tient **S**afety **S**ystem

What is COMPASS ?

Transmission Detector

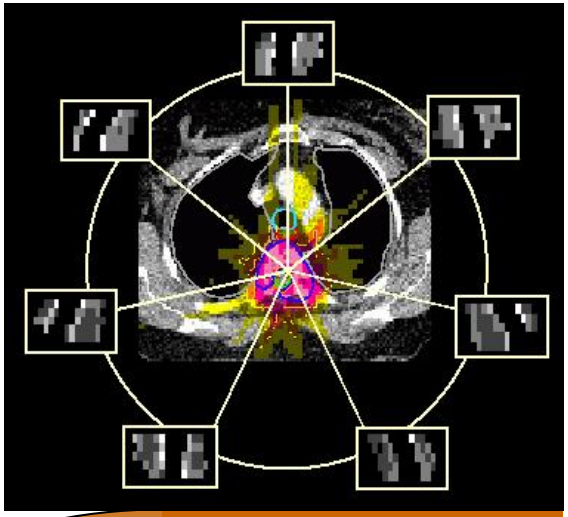
Beam model



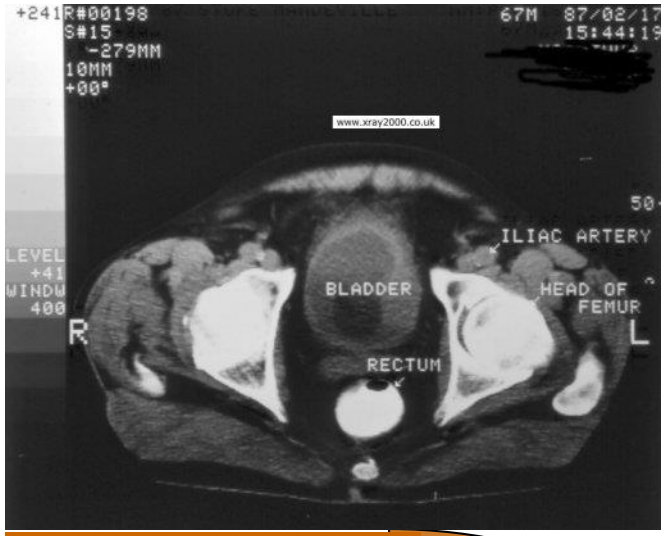
Dose engine

NOTE: all these elements are PART of COMPASS, not only the transmission detector

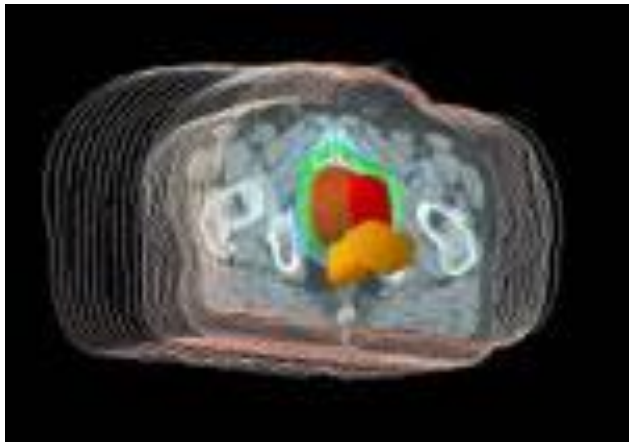
Basic COMPASS Concept



Take incoming **fluence**



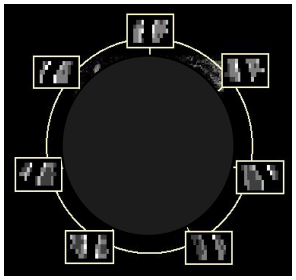
Take Patient **anatomy** CT



Reconstruct 3D Dose distribution !

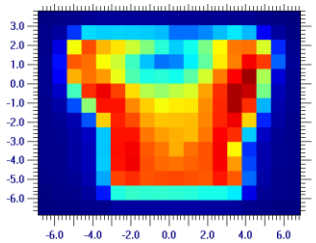
Fluence Determination

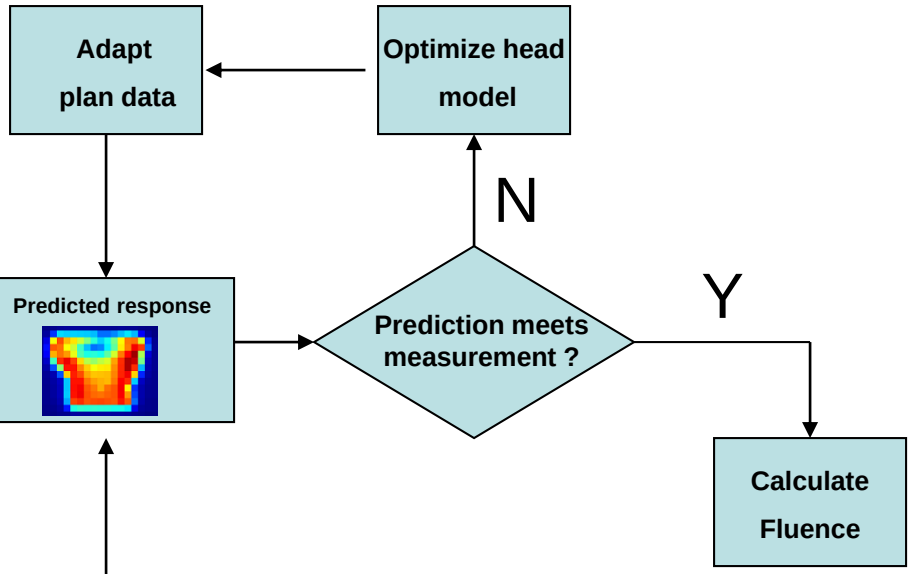
Plan data

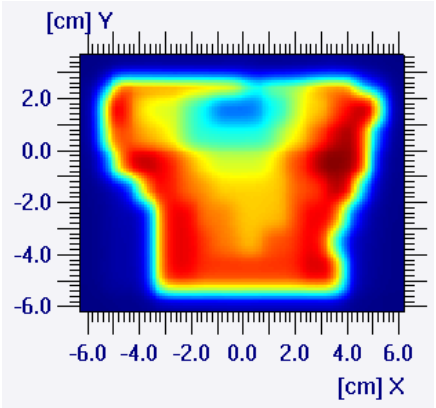


Head Model

Measured Response





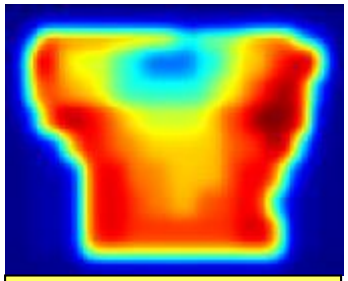


Compass Application: Patient 3D dosimetry

DICOM plan

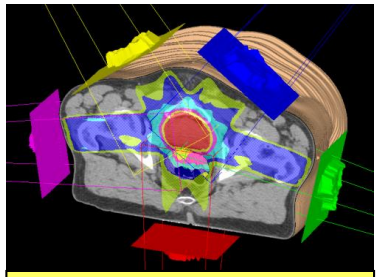
Beam model

Transmission Detector

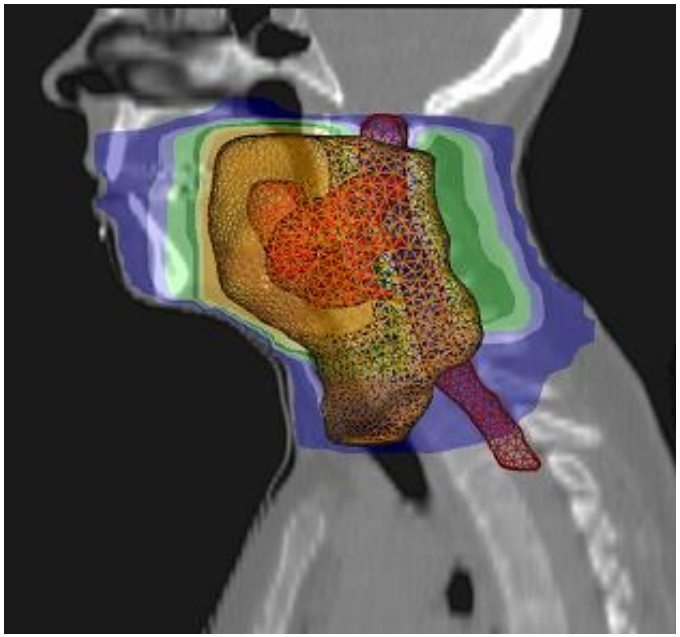


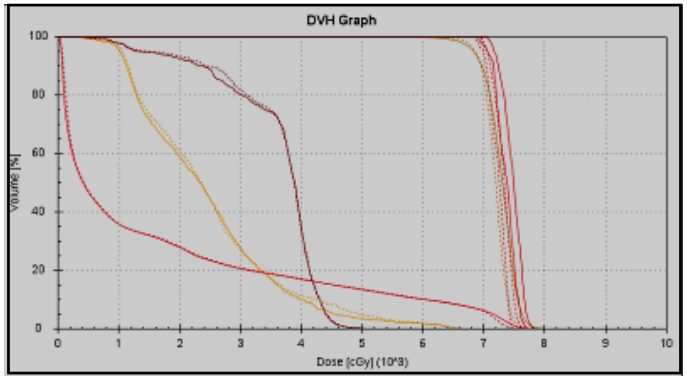
Real Fluence

CT

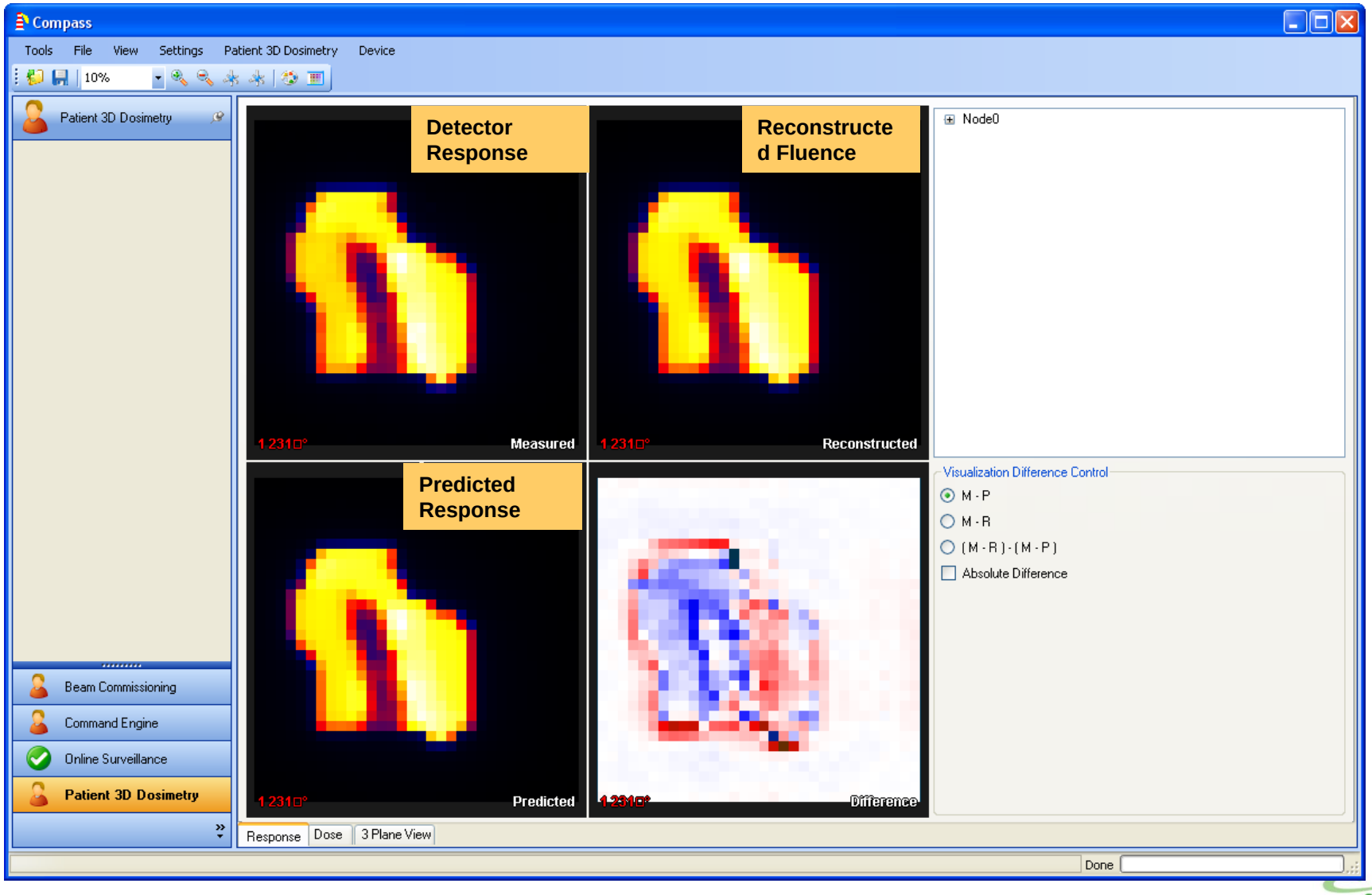


Dose engine

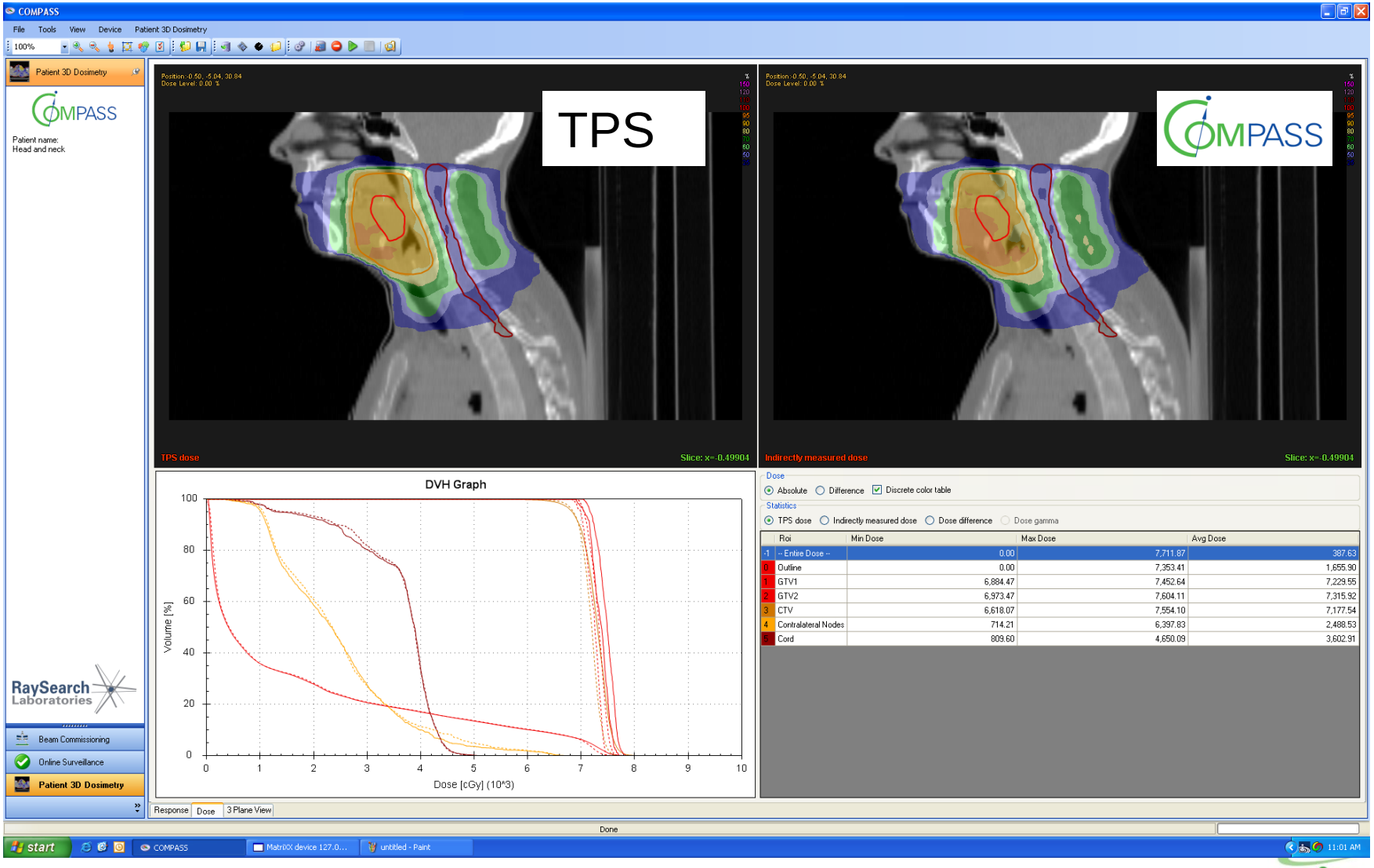




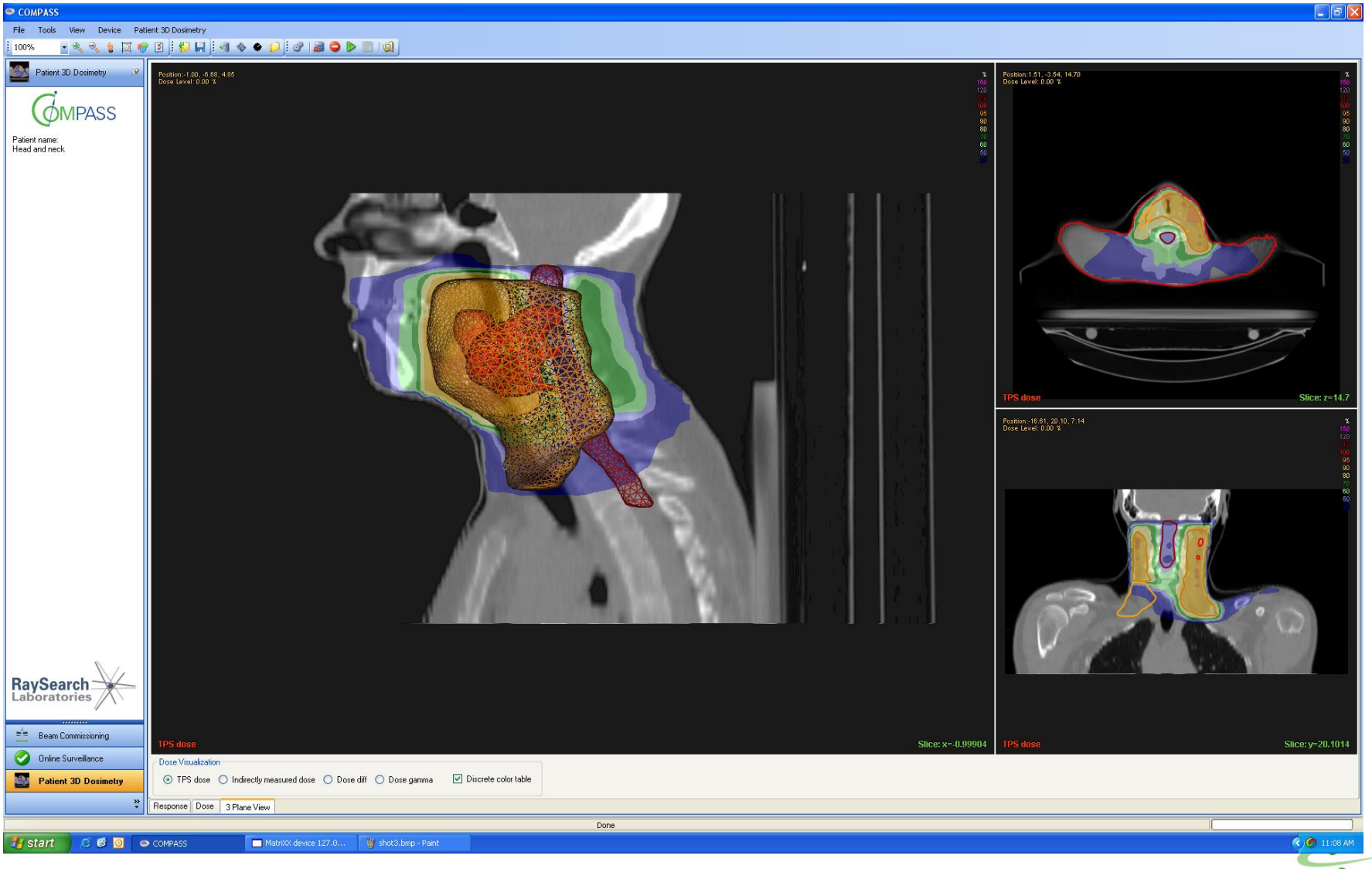
Fluences



Screenshot – Dose Computation



Dose Reconstruction



Compass, Visicoil & IGRT / Adaptive Radiotherapy

COMPASS

Visicoil

iba Dosimetry

iba

Guides the Therapy

COntinously **M**onitoring **PA**tient **S**afety **S**ystem

VISICOIL

- **VISICOIL**
  - Implantable gold marker
  - 99,8% purity
  - Length 1to 6cm
  - 0,35mmØ, 075mmØ, 1,1mmØ dependent on imager (Kv, Mv, Sim, CT, MRI)
  - No migration due to coil structure
  - Only 2 markers needed instead of 3-4 spherical or seed type markers

Thank you…