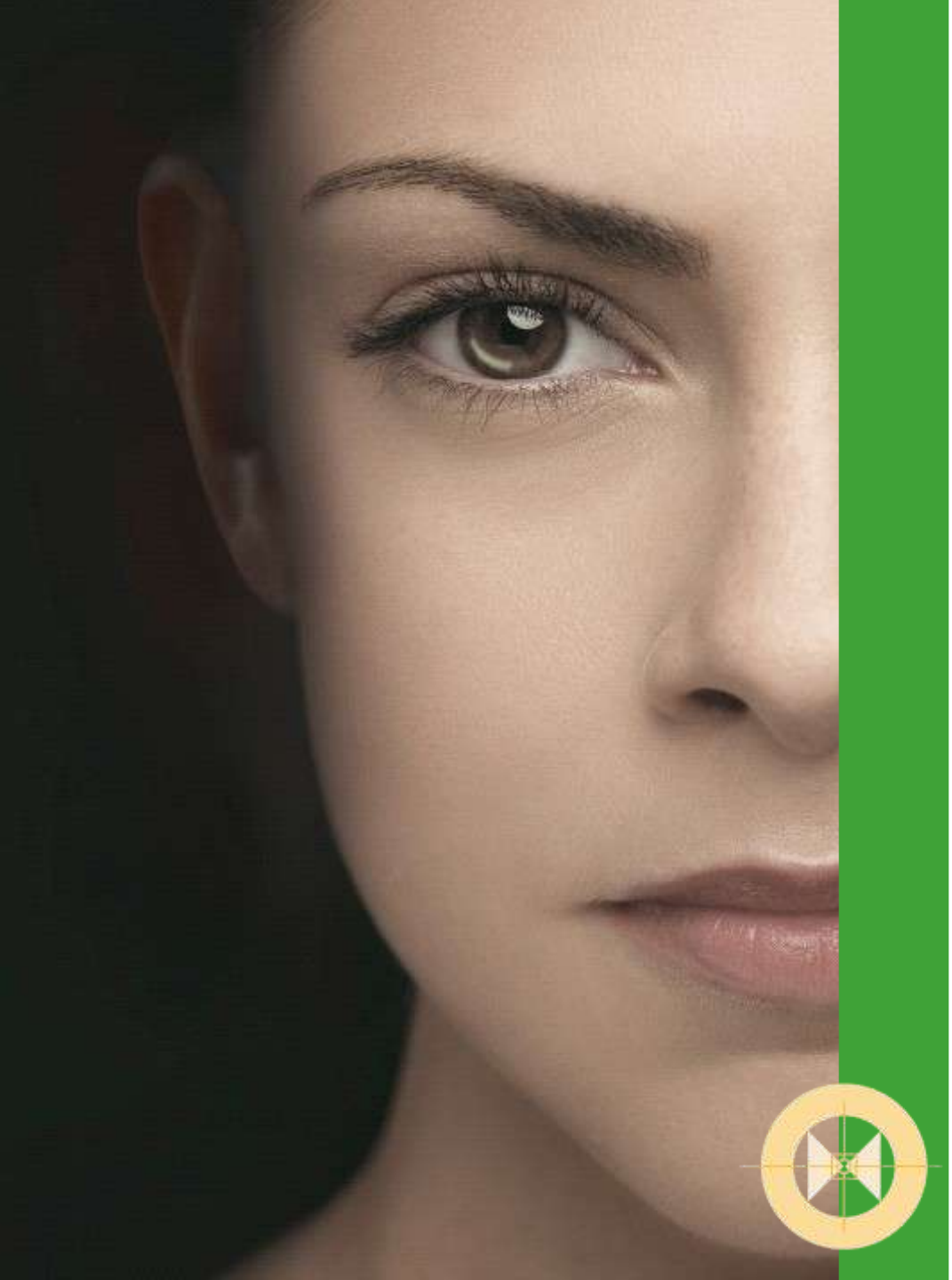


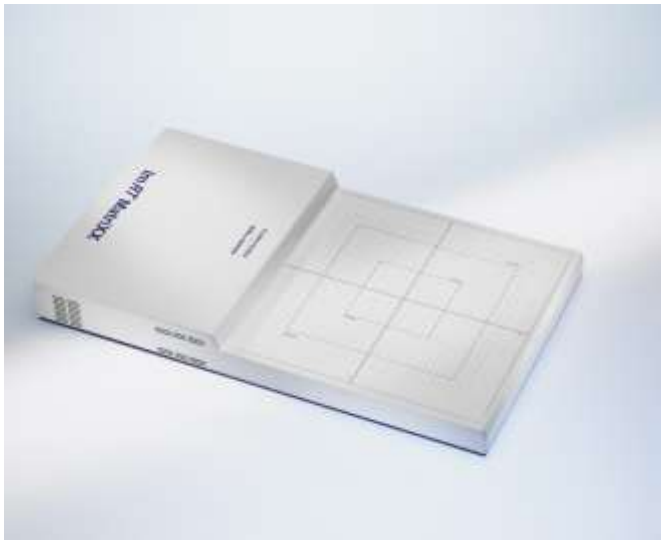
COMPASS

AK IMRT
Würzburg 2009

Dr. Lutz Müller

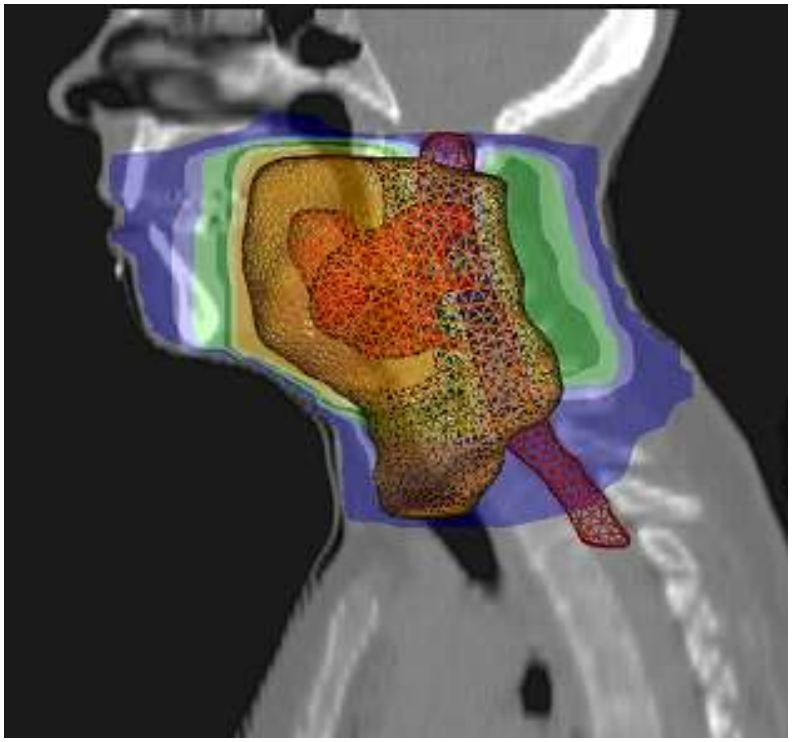
FASTest | mostACCURATE | mostRELIABLE

Generations of electronic IMRT Dosimetry



1st

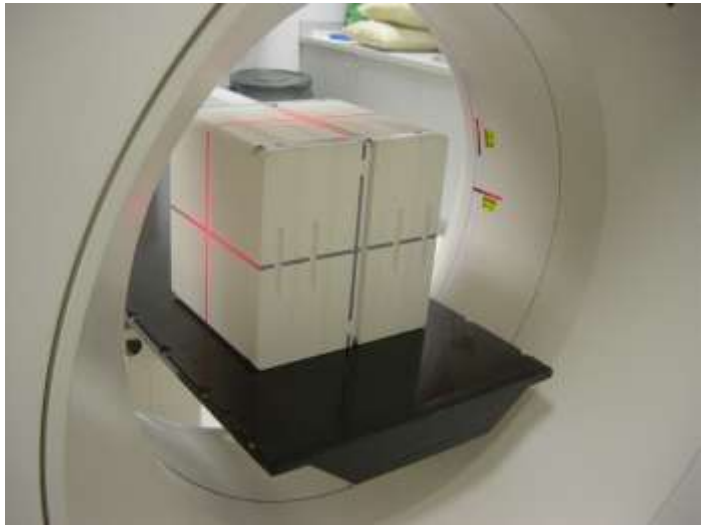
Single fields, perpendicular



2nd

Homo-geneous phantom,

composite



3rd

COMPASS

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The Second Generation

© 2006

MatriXX Evolution: MULTICube phantom

- Multiple Configurations (6 cm increments)
- Multiple depth positionning on the MatriXX
- Optional film cassette






© 2006

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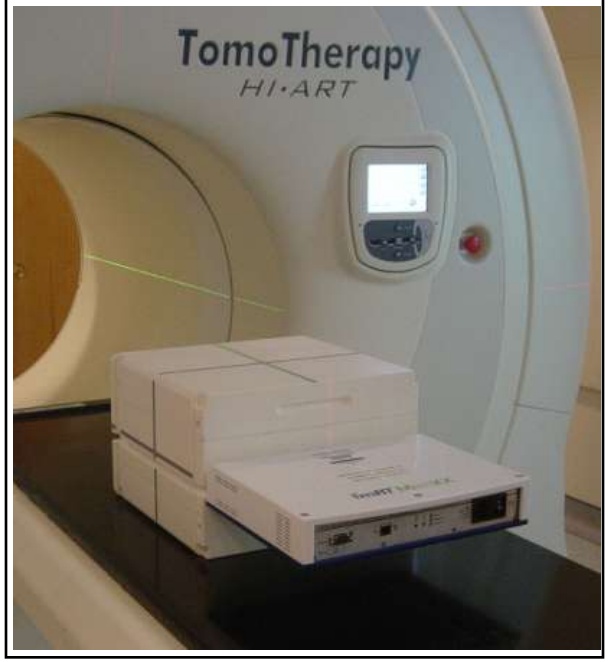
MatriXX Evolution:
Dosimetry QA of existing rotational therapy techniques

TomoTherapy Hi-ART



Elekta VMAT

Varian RapidArc

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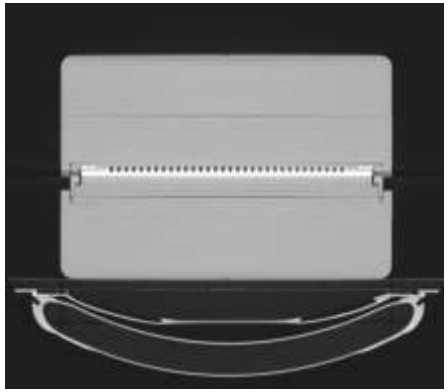
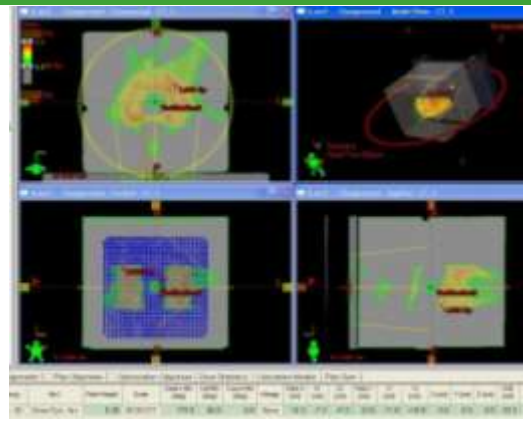
Treatment Plans QA: Typical workflow



1.- CT: acquire images



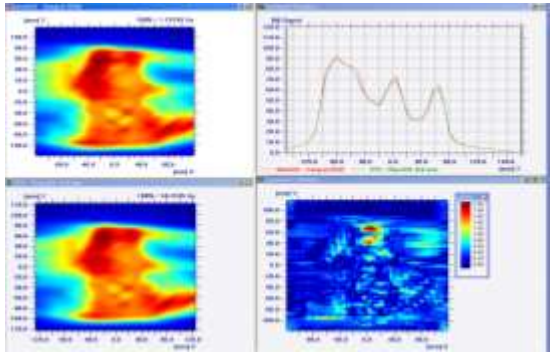
2.- Create Plans (TPS)

MatriXX™ (IBA)

Multi Cube™ (IBA)

OP ImRT software (IBA)

3.- Deliver planned treatment



4.- Evaluate Plan vs Measurements

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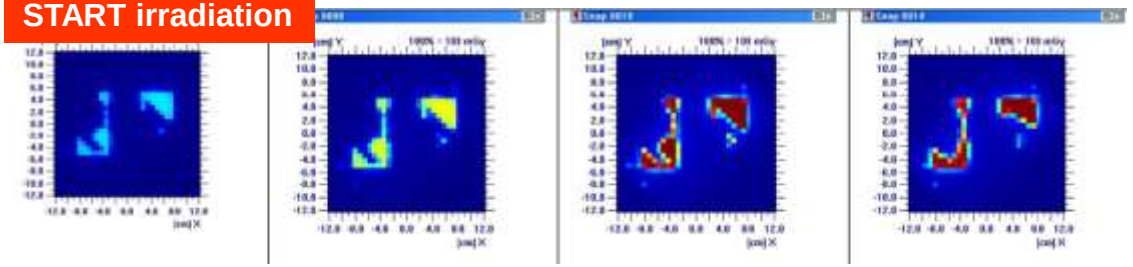
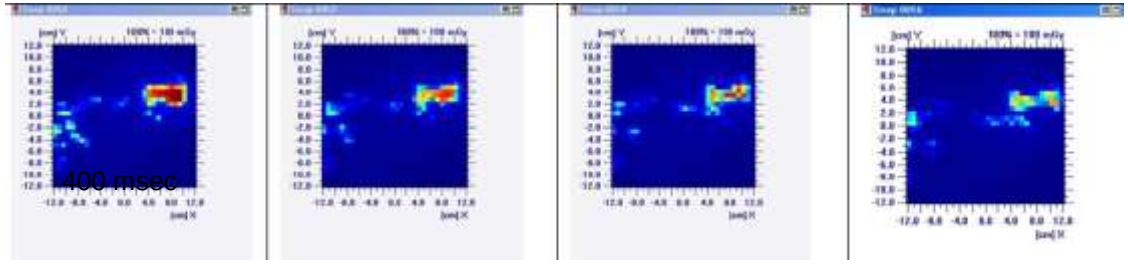
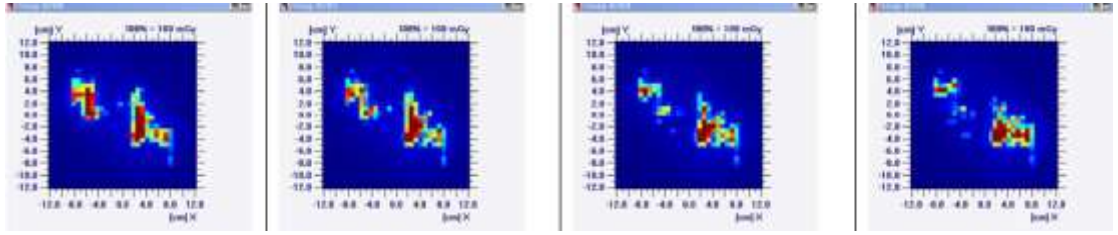
Patient QA using IBA MatriXX Evolution , H&N case Measurements

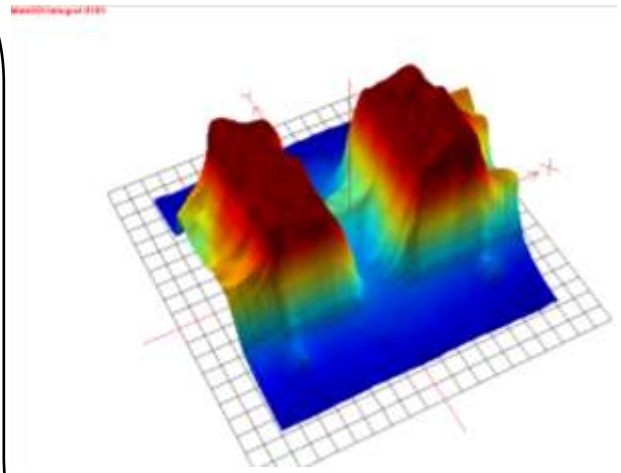
START irradiation



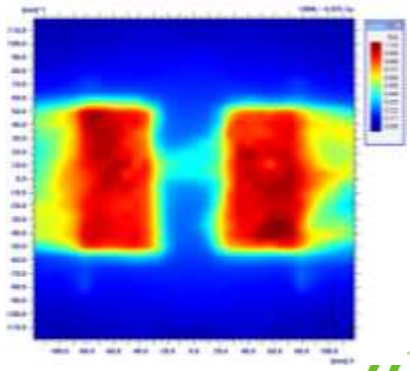




END

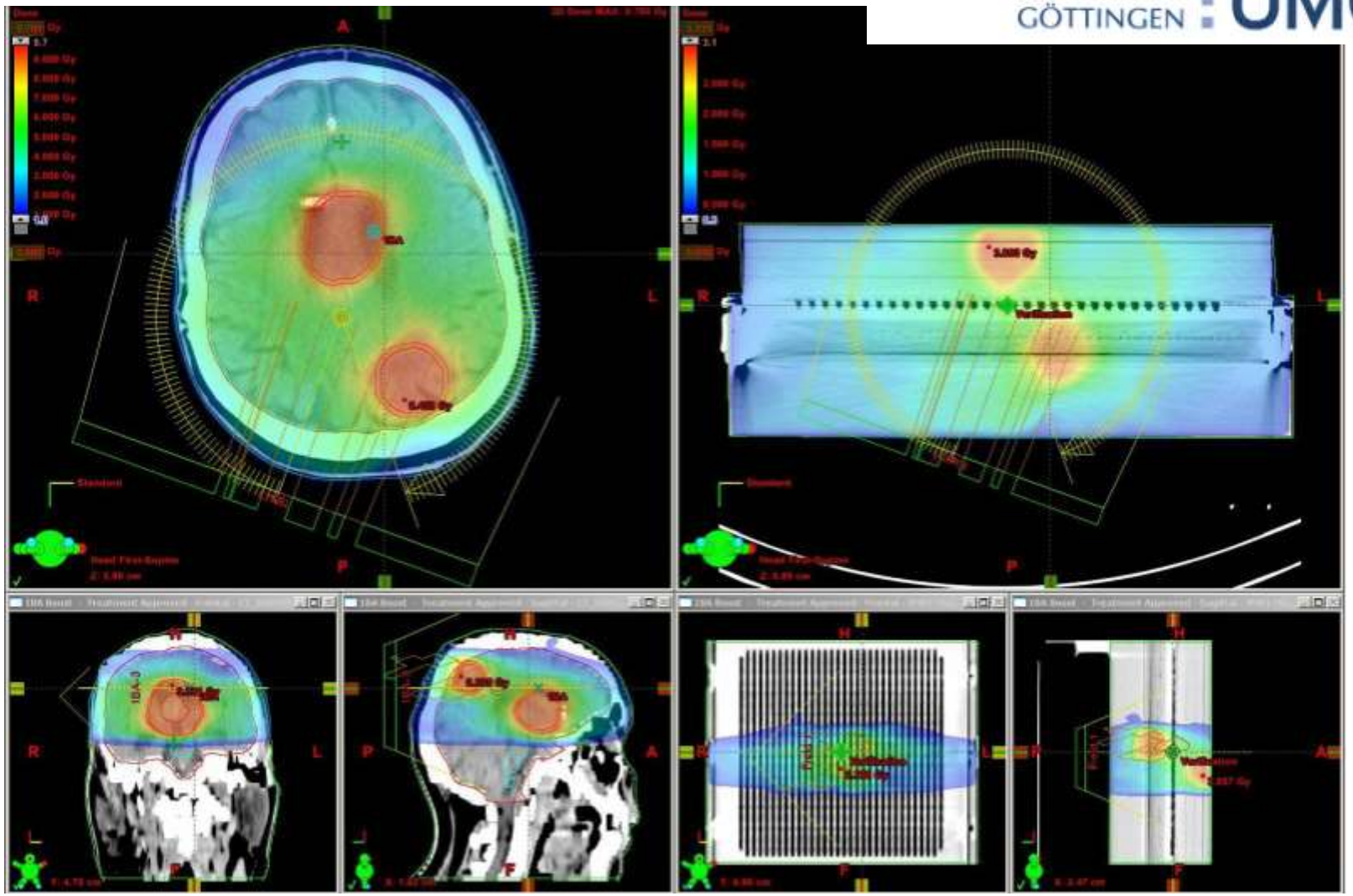


This Case total delivery time 76 sec.



© 2006

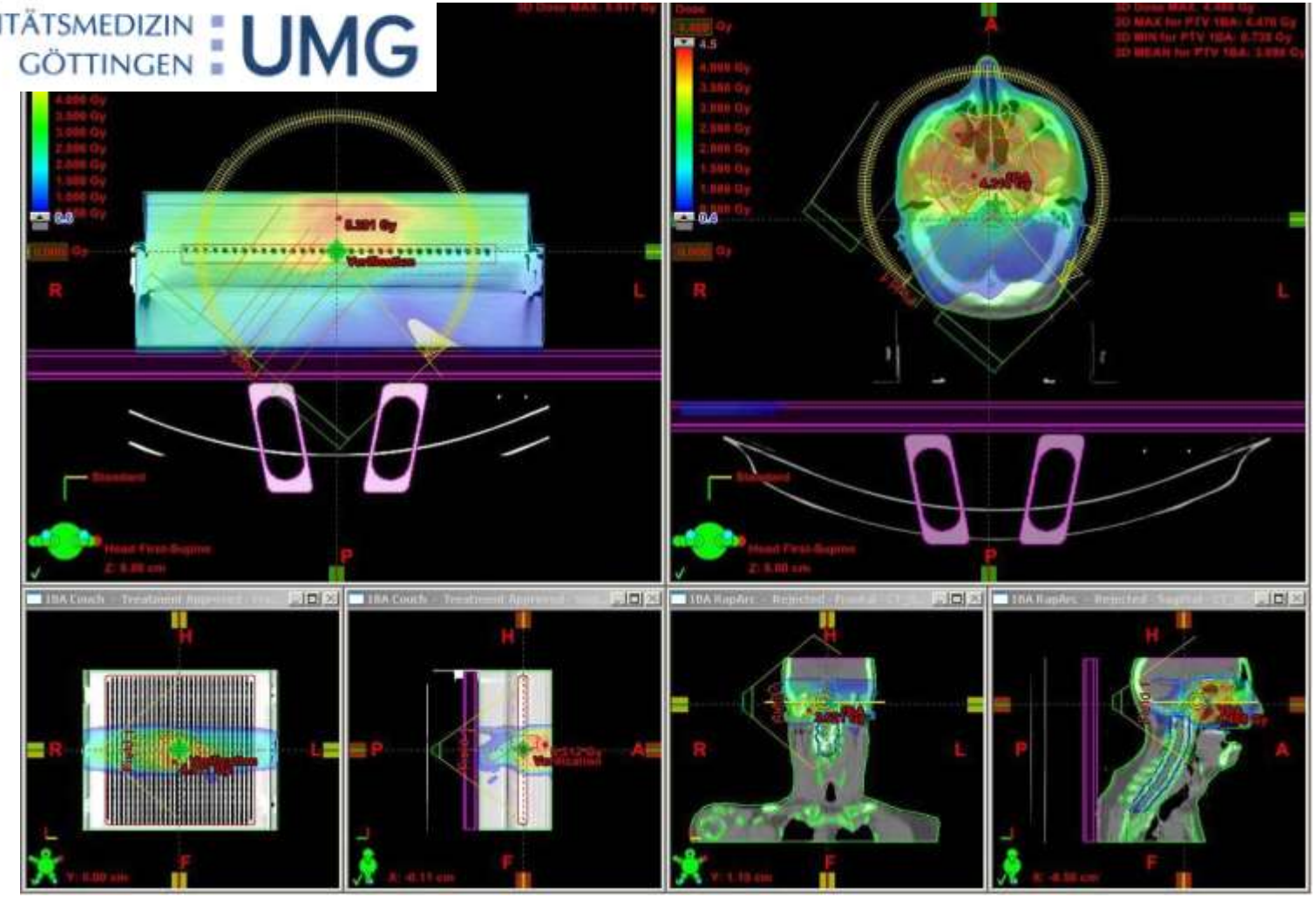
Dosimetry



Left: Rapid Arc treatment plan of a patient with cerebral metastasis

Right: Rapid Arc verification plan of the same patient calculated using the CT-dataset of the IMRT-MatriXX with 4cm PMMA above and beneath

UNIVERSITÄTSMEDIZIN GÖTTINGEN : UMG



Right: Rapid Arc treatment plan of a patient with head and neck cancer (boost volume) considering the treatment couch structures during the treatment planning process

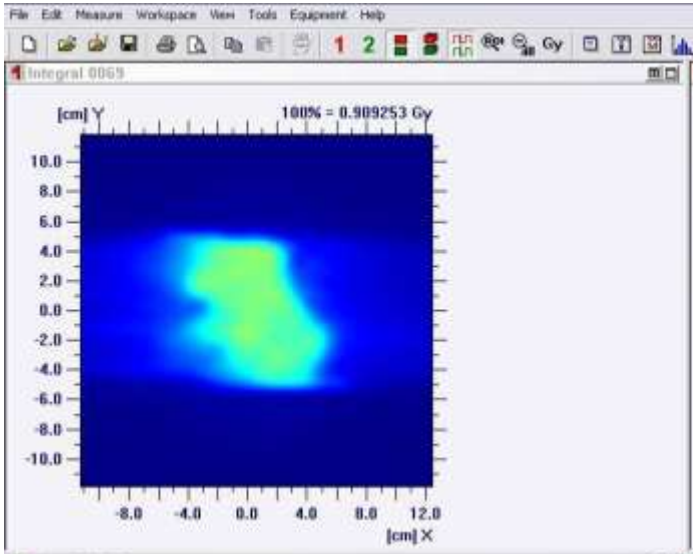
Left: Rapid Arc verification plan of the same patient calculated using the CT-dataset of the IMRT-MatriXX with 4cm PMMA above and beneath considering the treatment couch structures during treatment planning process

Patient with head and neck cancer (boost volume)

(s. port folio 2)

UNIVERSITÄTSMEDIZIN GÖTTINGEN : UMG

1

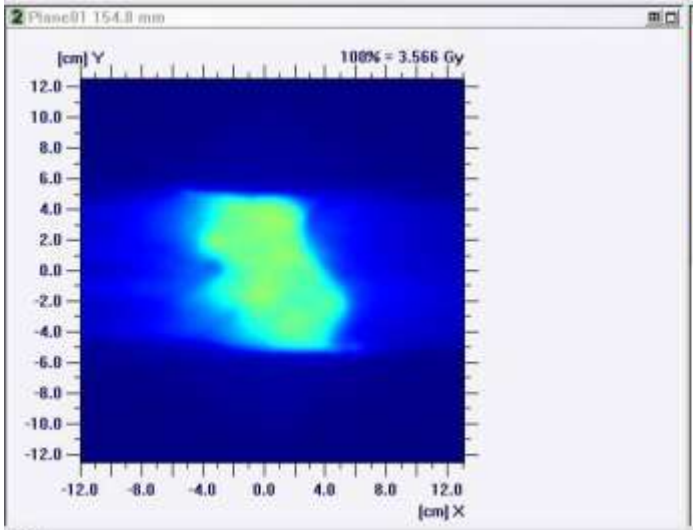


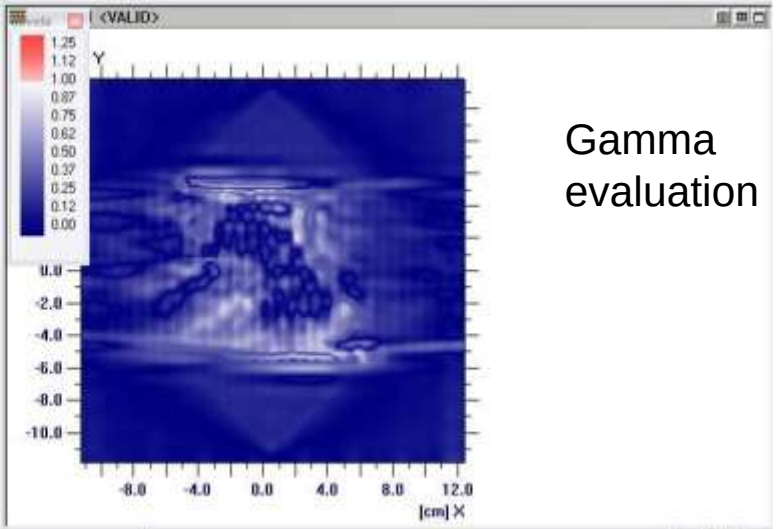
1: Measured fluence distribution of the IMRT-MatriXX

2. Calculated fluence distribution of Eclipse

Gamma evaluation using 3% and 3mm

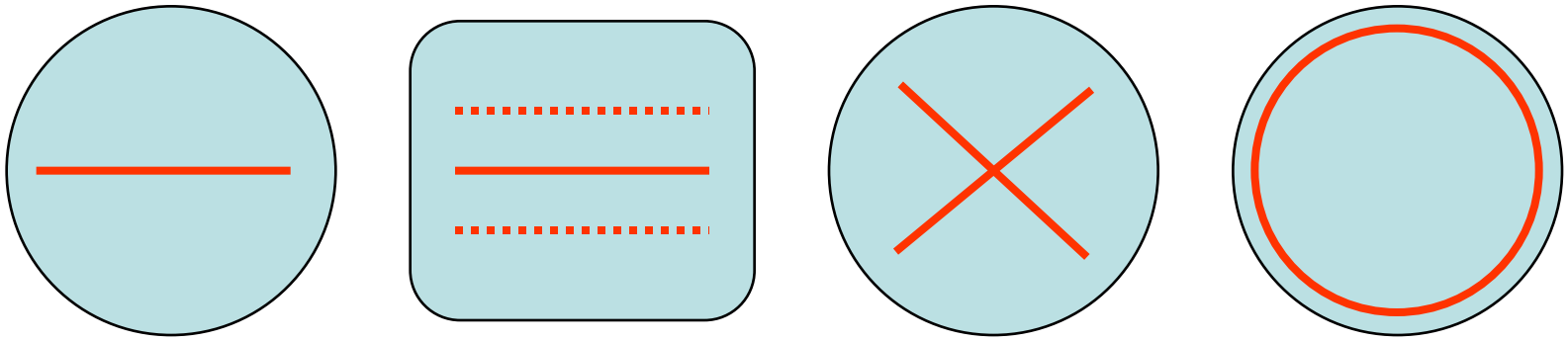
2





Gamma evaluation

The ‚Second Generation‘



PTW chambers

IBA chambers

Delta4 diodes

SNC diodes

© 2006

2nd Generation

© 2006

How to assess dose to the patient for IMRT?

- **Invasive Method: place a film in the patient**

© 2006

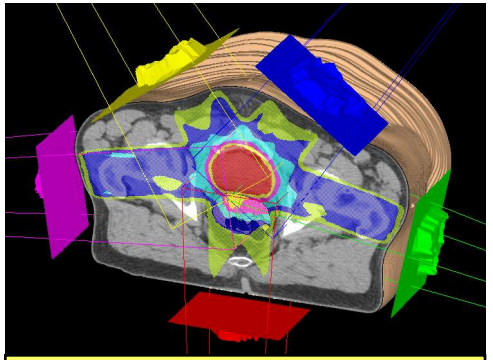
What is COMPASS ?

Detector

+

Beam model

+



Dose engine

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

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MatriXX + COMPASS

- 1020 ion chambers
- Pre-treatment verification
- Verification of systematic errors
- Display of 3D dose distribution in patient anatomy

COMPASS + transmission detector (T2D)

- 1600 ion chambers
- Pre-treatment + online verification
- Dose distribution *measurement during patient treatment*
- Systematic and random errors
- Display of 3D dose distribution in patient anatomy

© 2006

The Beam Model (RaySearch)

A Beam Model...

Is a ‚virtual accelerator', which allows fluence and spectrum calculation from MU number and collimator settings

In order to do so...

The model needs to be commissioned, i.e. has to ‚learn' features of specific accelerator and energy

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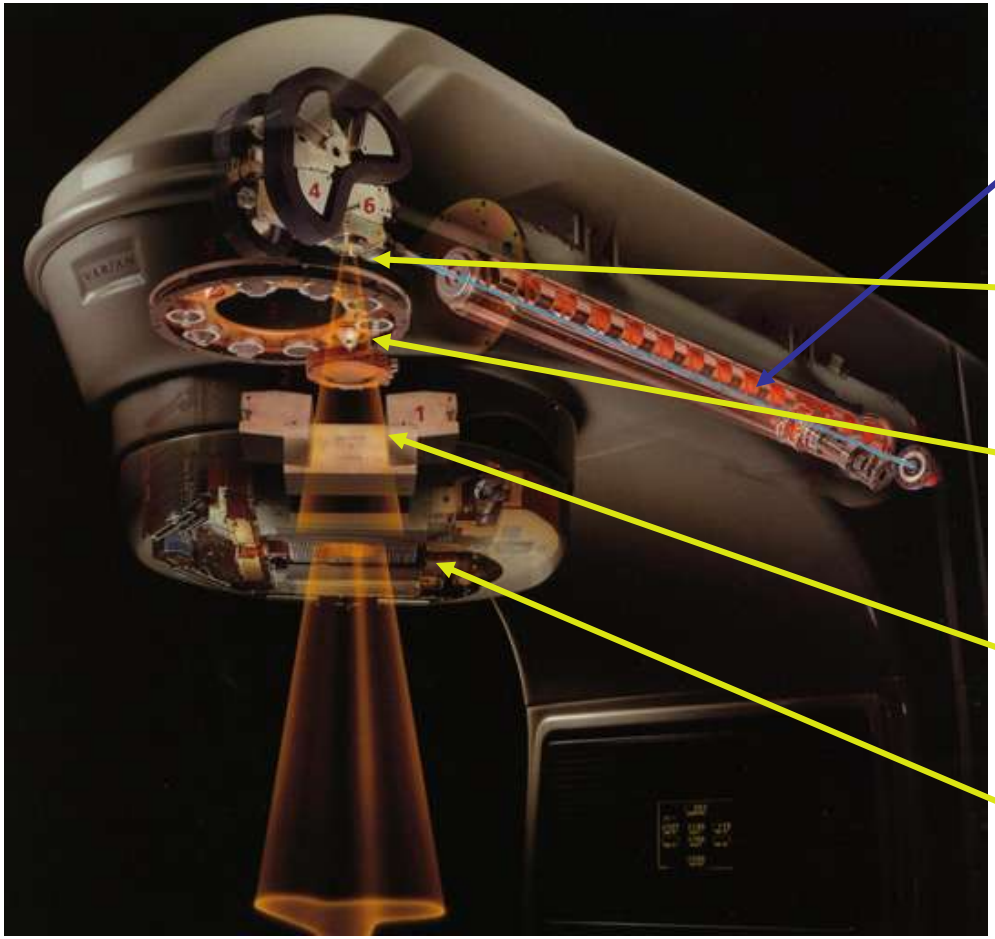
The Beam Model (RaySearch)



LINAC
Electron beam

TARGET
Photon beam

FLATTENING FILTER
Flat beam shape

COLLIMATOR (JAWS)
Rectangular beam delimitation

COLLIMATOR (MLC)
Irregular beam shape

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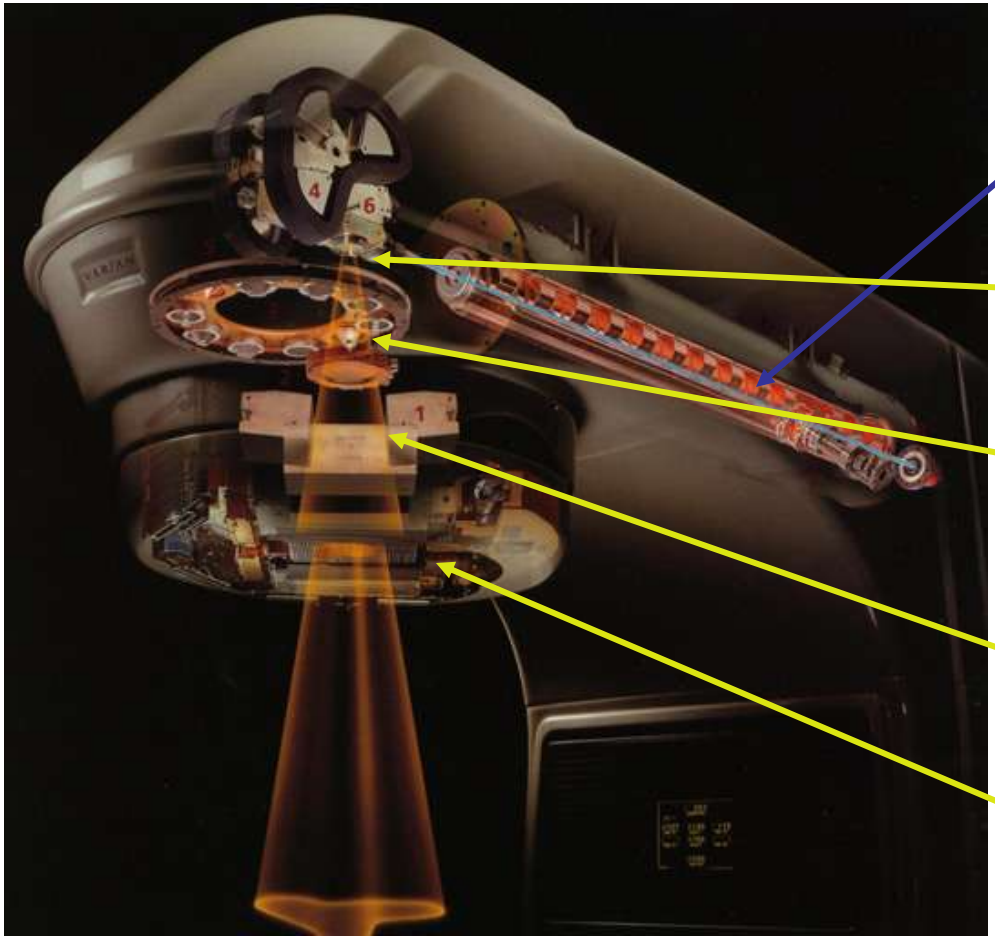
It‘s not so simple, though....



LINAC

Electron beam

TARGET

Photon spectrum, lateral variation, shape

FLATTENING FILTER

Off-axis softening, shape

COLLIMATOR (JAWS)

Scattering and hardening

COLLIMATOR (MLC)

Scattering, hardening, leaf transmission, inter-leaf transmission, tongue and groove

+ electron contamination from all elements !!!

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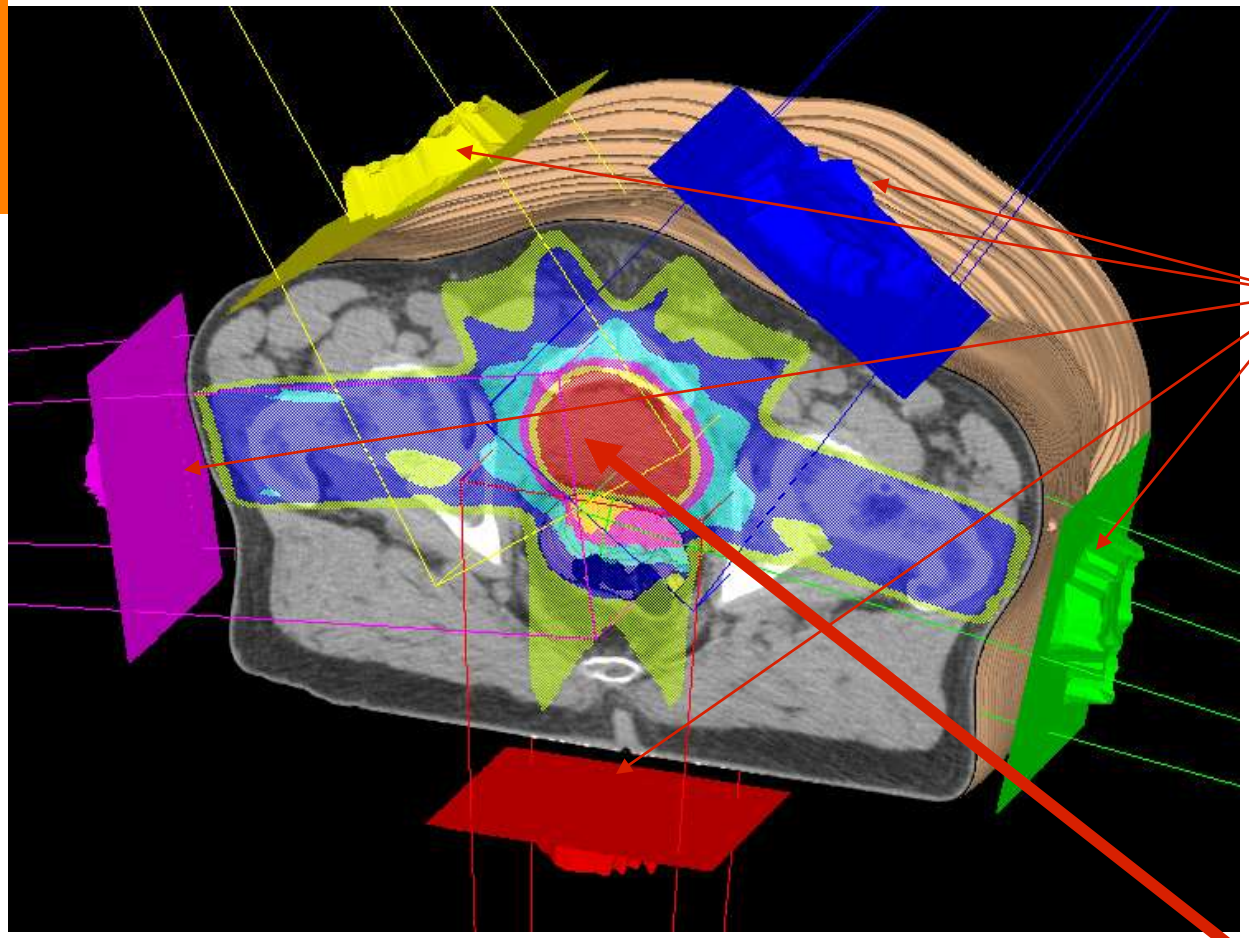
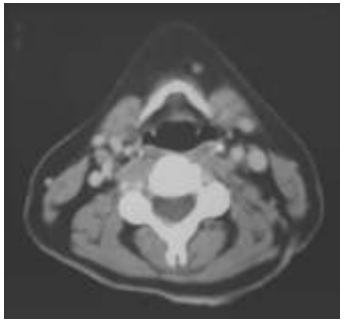
Dose engine



A Dose Engine...

Takes the incoming fluences

Takes the CT



Calculates the resulting dose distribution in patient anatomy

Copyright philips

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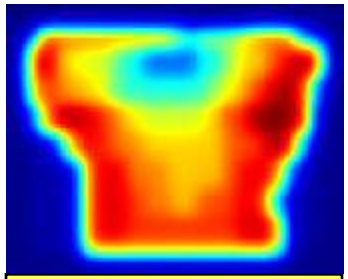
iba Dosimetry

Compass Application: Patient 3D dosimetry

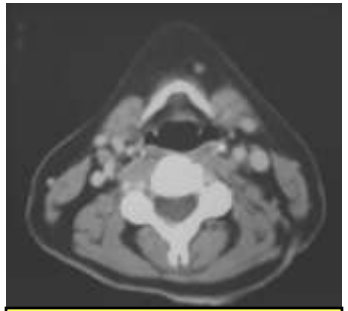
DICOM plan

Beam model

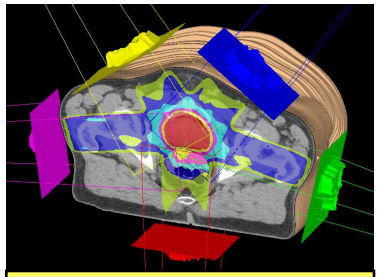
Transmission Detector



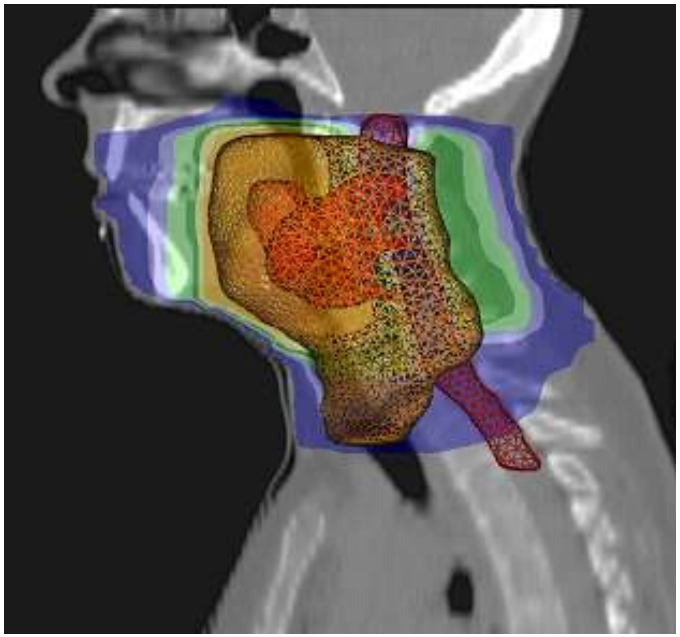
Real Fluence

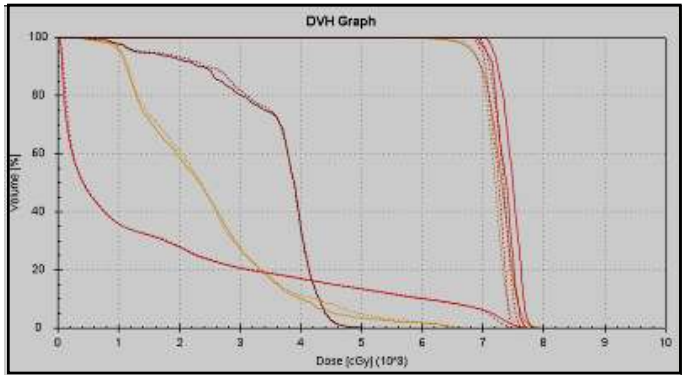


CT



Dose engine





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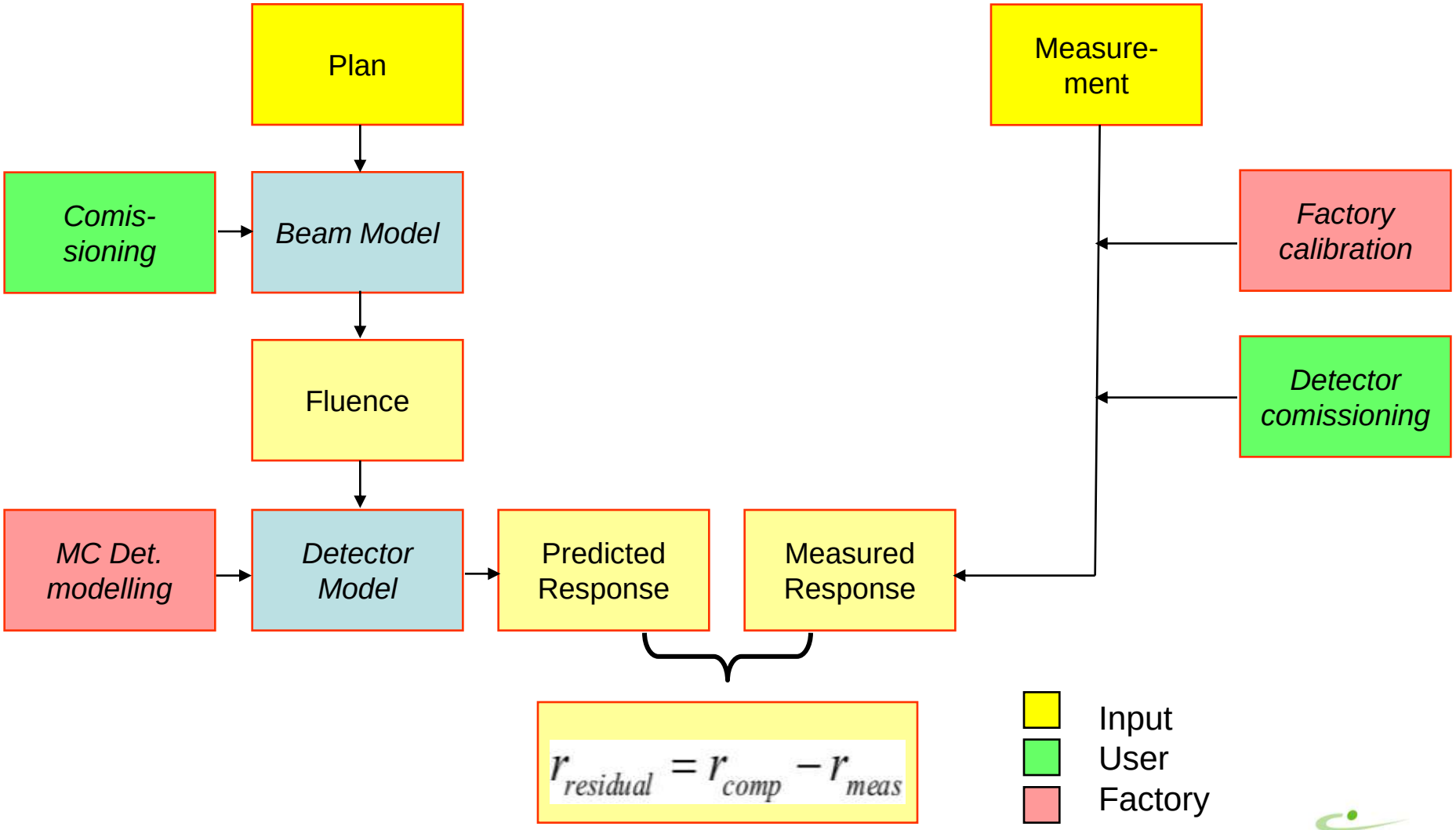
Fluence Correction: 1. Residual Response



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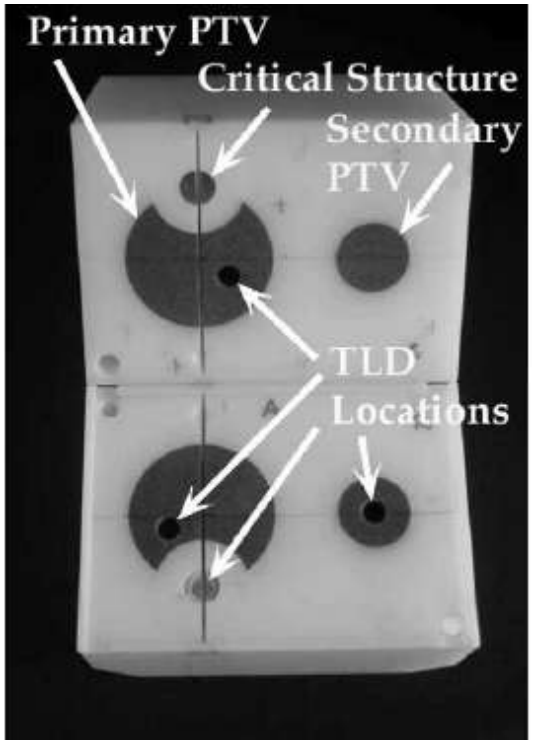
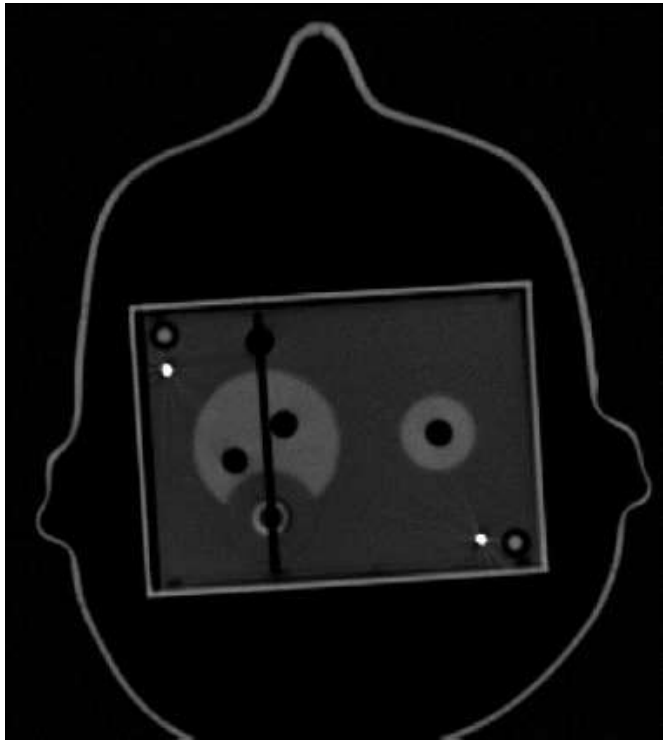
IMRT Quality Comparative Study





DESIGN AND IMPLEMENTATION OF AN ANTHROPOMORPHIC QUALITY ASSURANCE PHANTOM FOR INTENSITY-MODULATED RADIATION THERAPY FOR THE RADIATION THERAPY ONCOLOGY GROUP

ANDREA MOLINEU, M.S.,* DAVID S. FOLLOWILL, PH.D.,* PETER A. BALTER, PH.D.,*WILLIAM F. HANSON, PH.D.,* MICHAEL T. GILLIN, PH.D.,* M. SAIFUL HUQ, PH.D.,†AVRAHAM EISBRUCH, M.D.,‡ AND GEOFFREY S. IBBOTT, PH.D.*

*Department of Radiation Physics, The University of Texas M. D. Anderson Cancer Center, Houston, TX; Department of Radiation Oncology, University of Pittsburgh Medical Center, Pittsburgh, PA; ‡Department of Radiation Oncology,University of Michigan Medical Center, Ann Arbor, MI

7%/4mm ca. 30 % fail !

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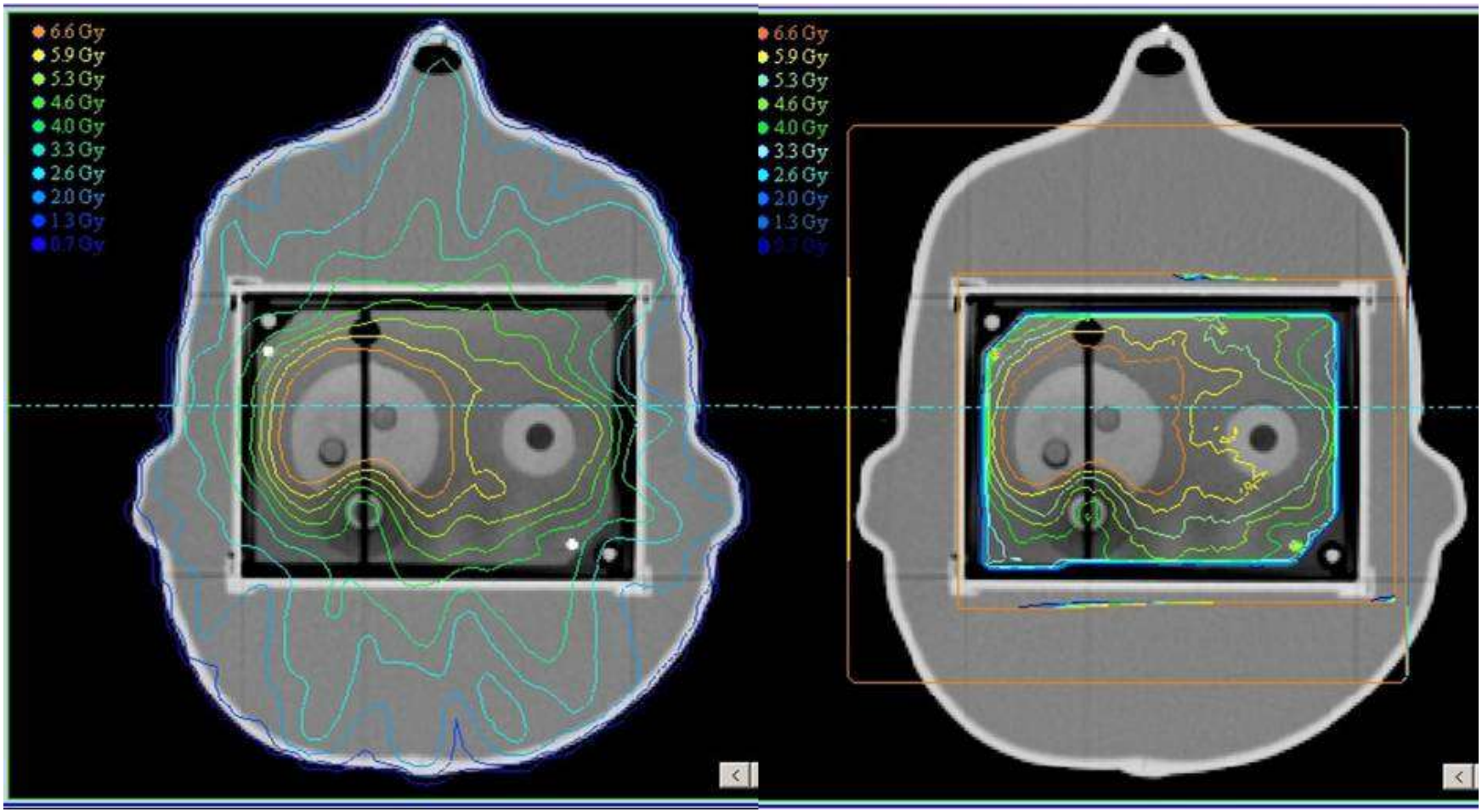
Gradient around medulla



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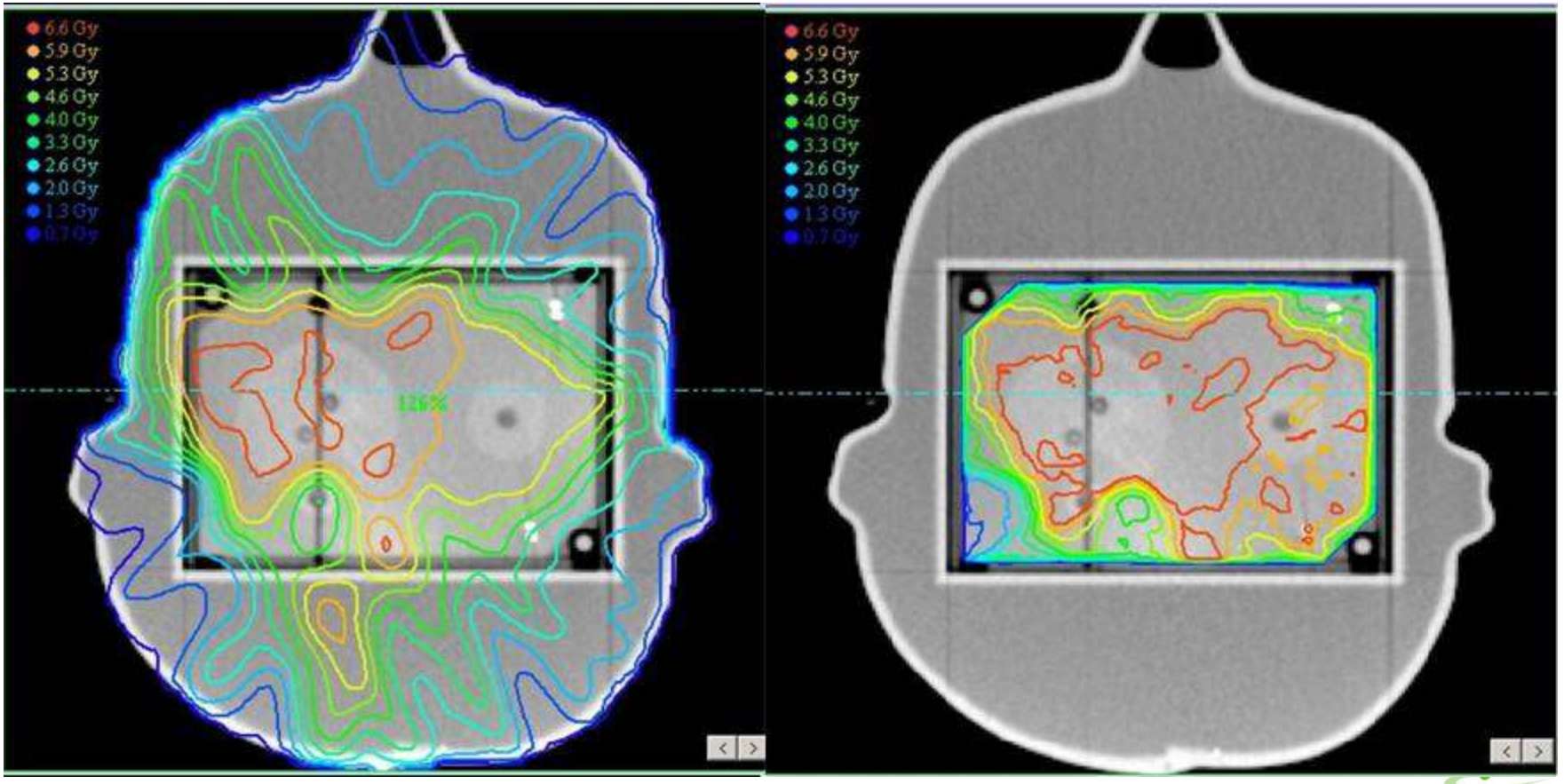
Examples of Failures



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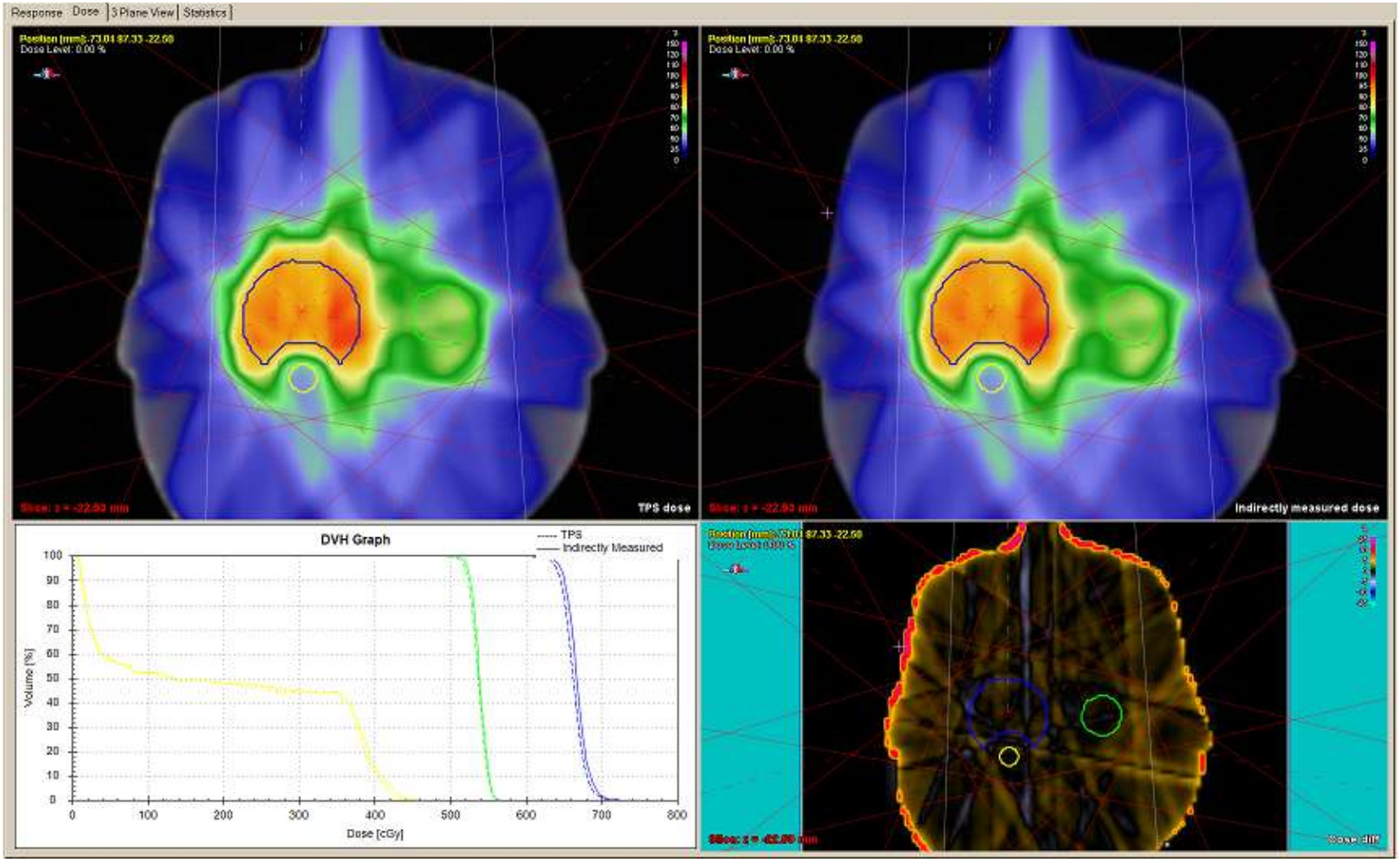
Iba Dosimetry

3rd Generation. Dose in the Patient Anatomy



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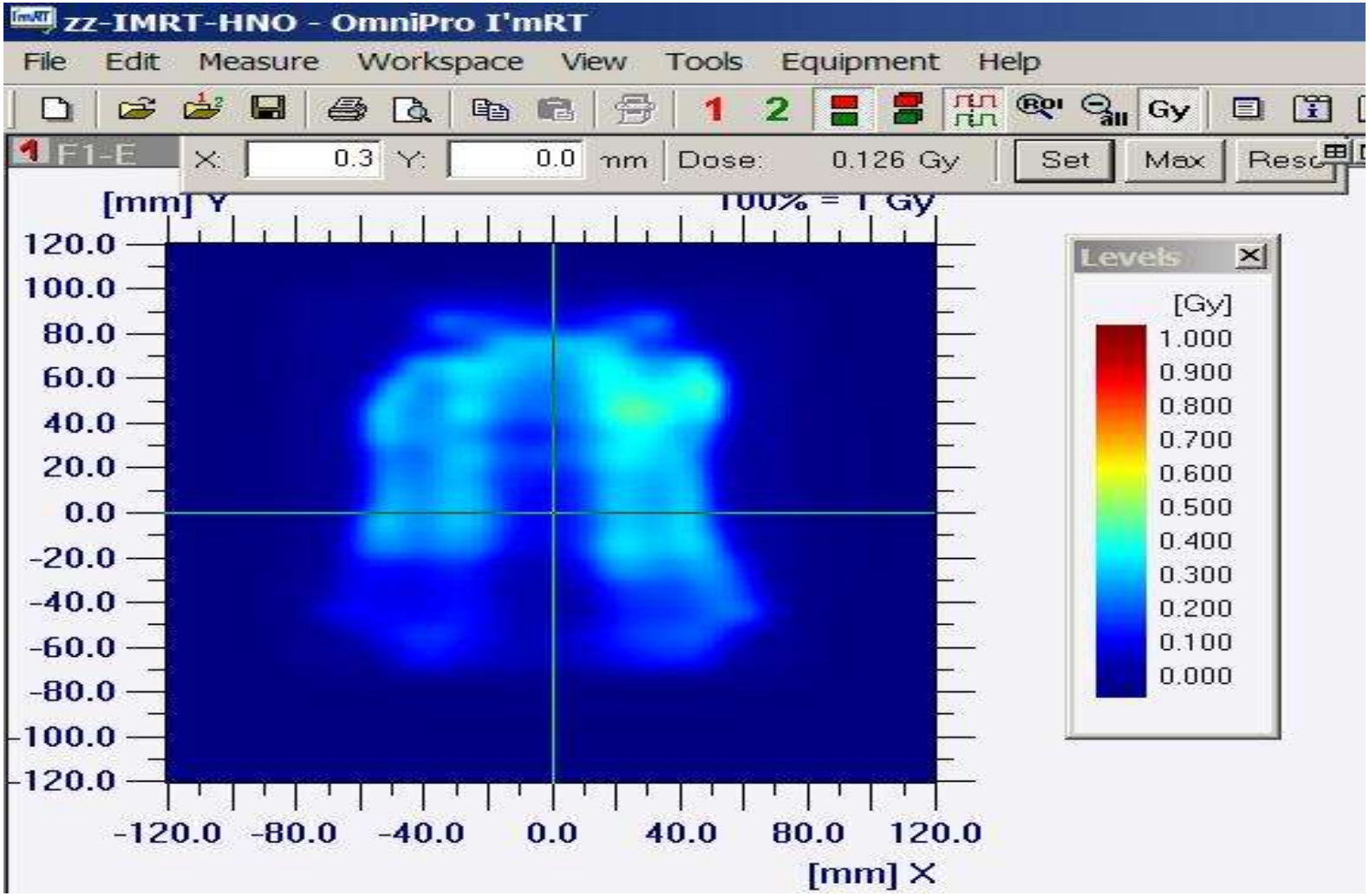
Dosimetry

The conventional way. Phantom. 2D dose maps



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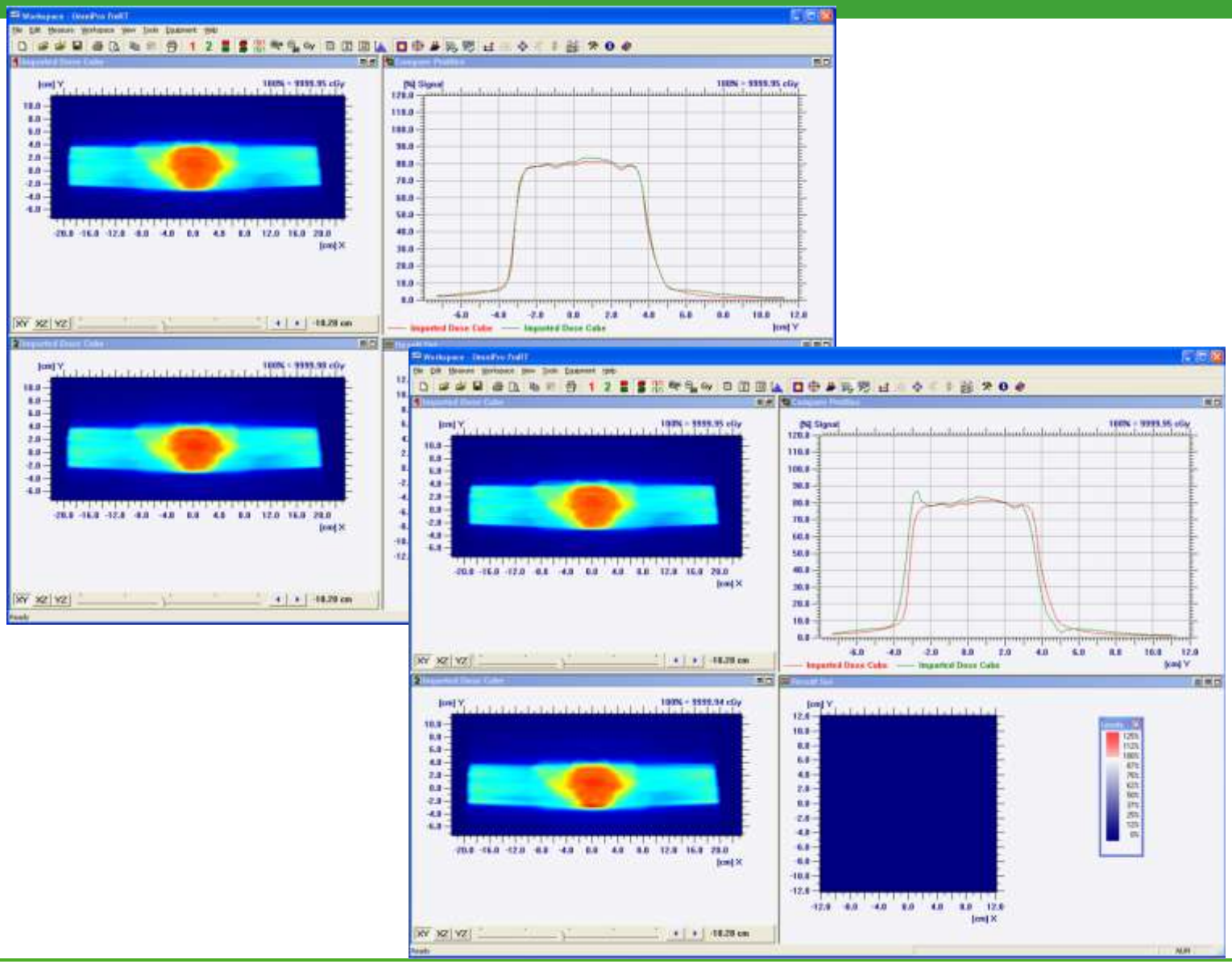
Delivery Error – 2mm Shift (Generation 2)



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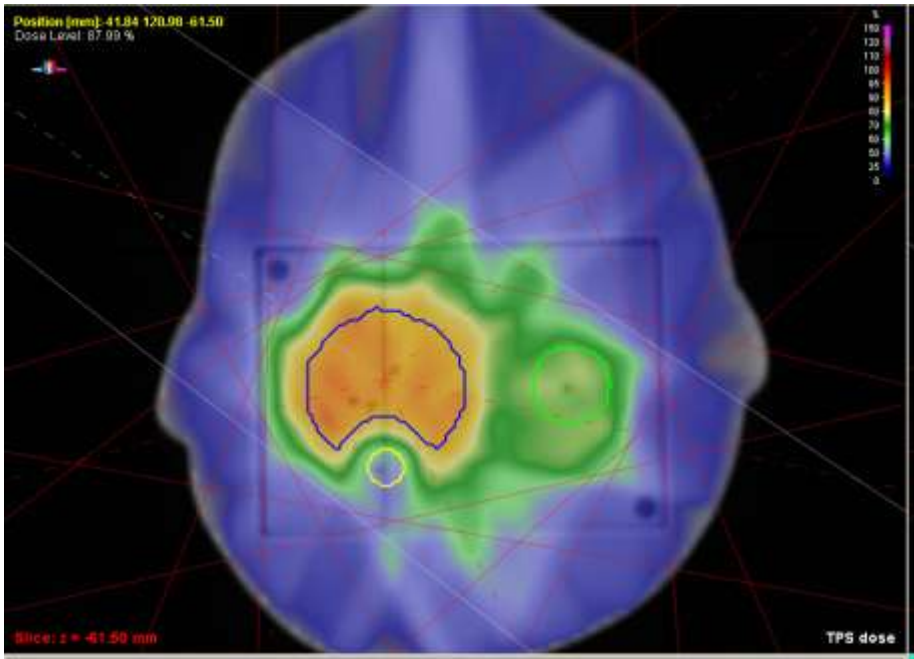
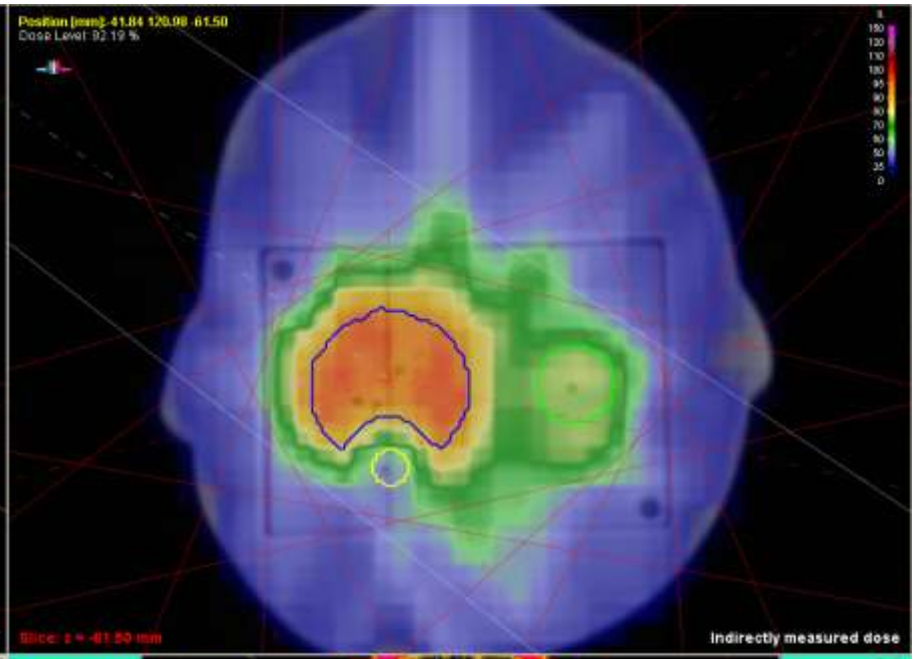
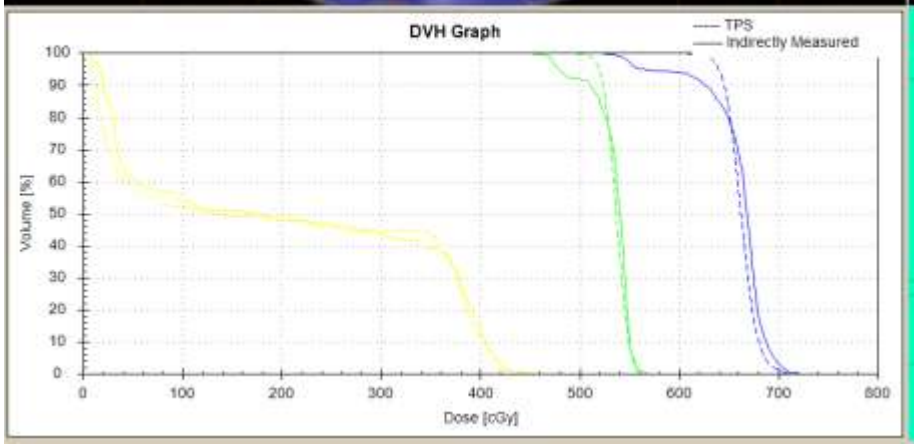
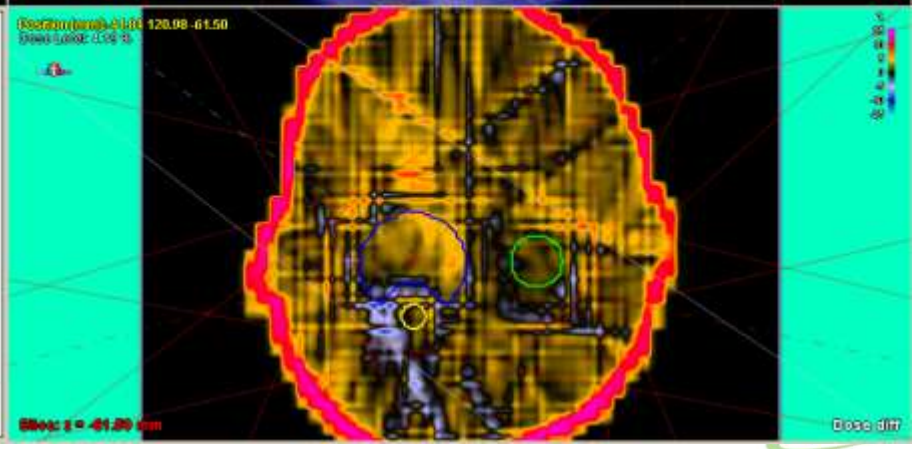
Dosimetry

2mm delivery error introduced









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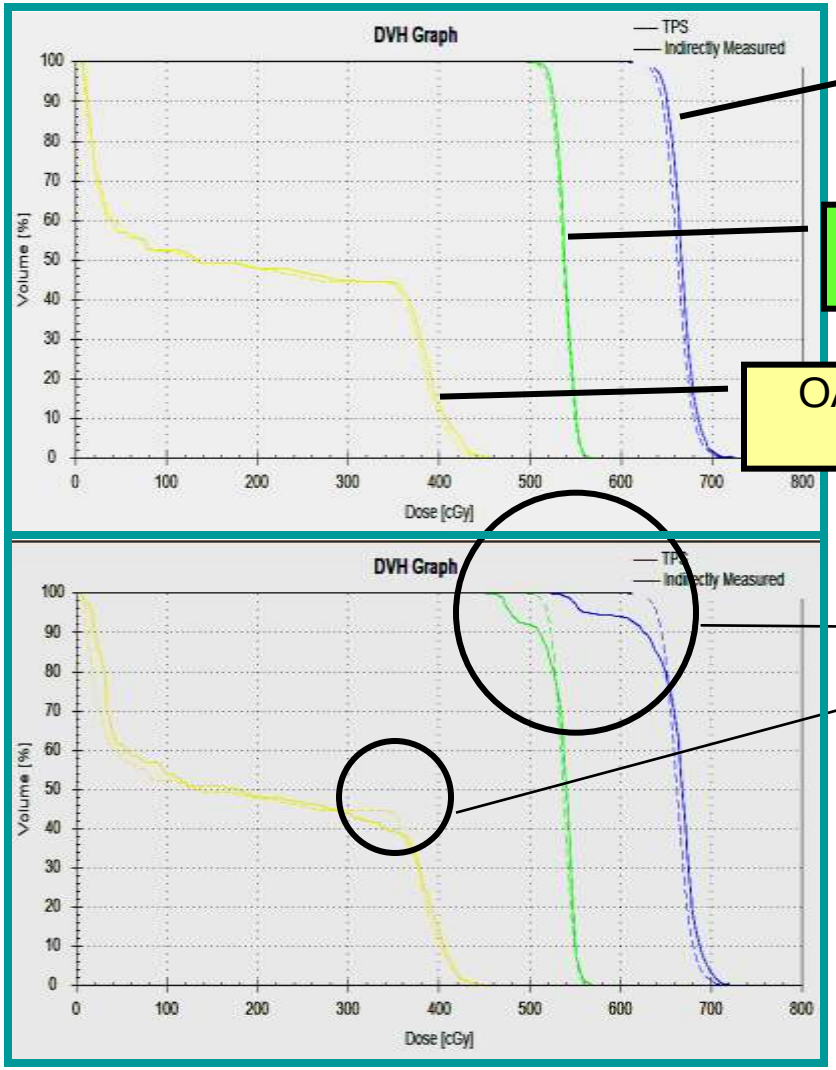
Iba Dosimetry

Delivery error in RPC phantom case



Primary PTV

Secondary PTV

OAR: spinal cord

Effect of 2mm y-shift on DVH

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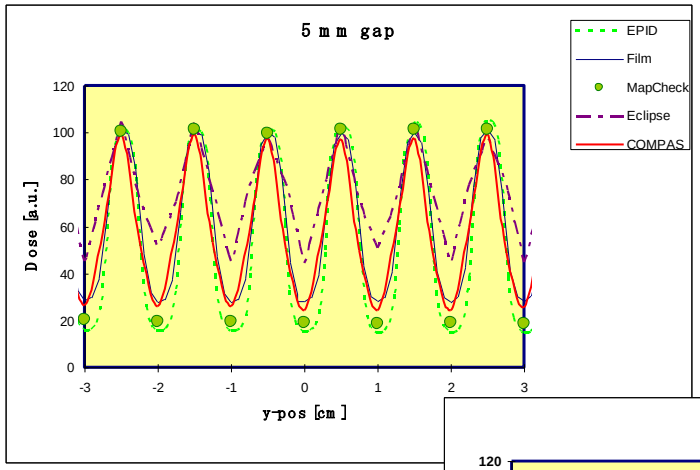
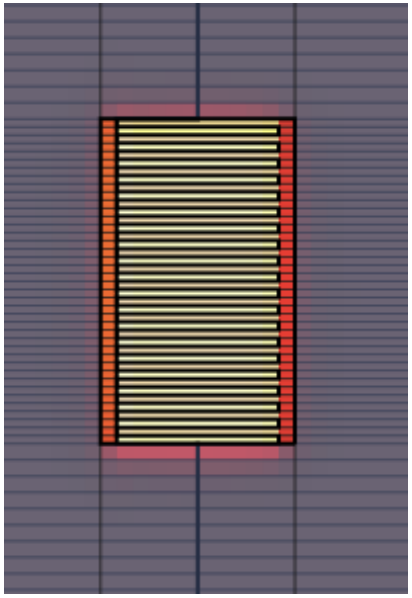
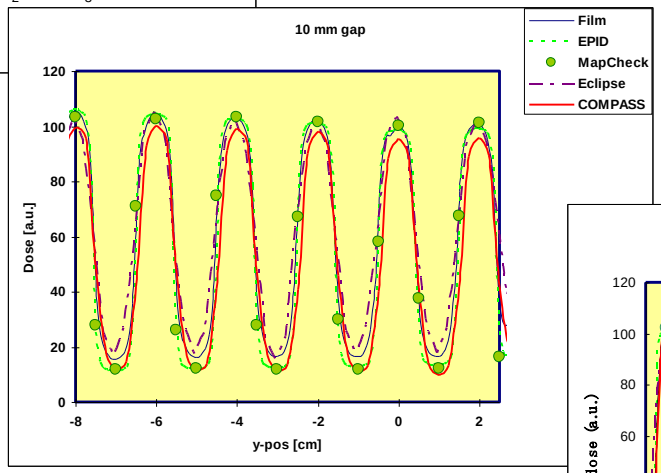
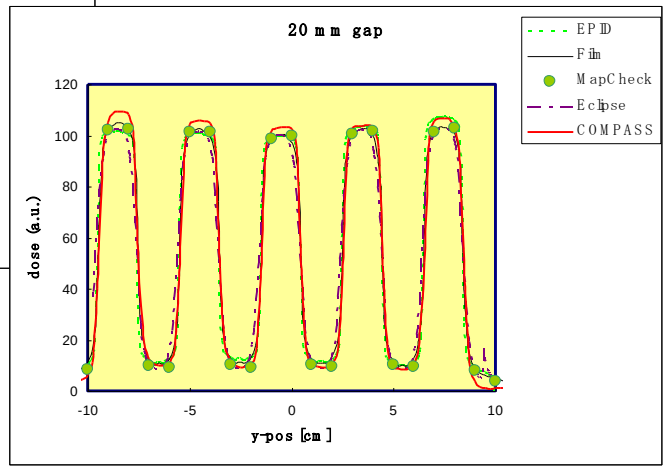
Dosimetry

Gaptest









Data: Fujito Araki

Kumamoto, Japan

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iba Dosimetry

Collecting the Gantry Angle Information

- **Starting with R2.0 Compass allows to track the gantry angle while measuring the treatment plan.**

Gravity-based Gantry Angle Sensor to be mounted on gantry.

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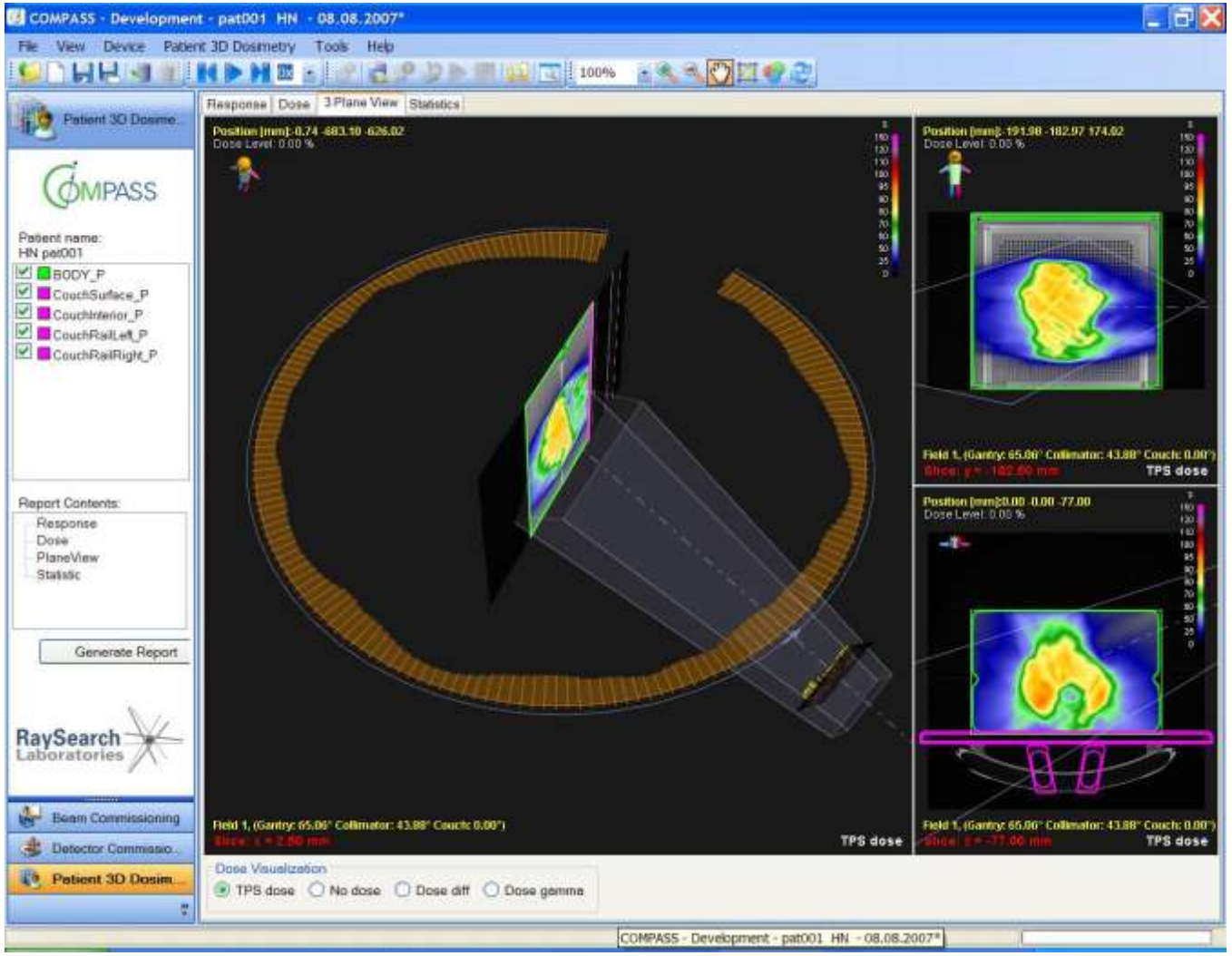
Plane View



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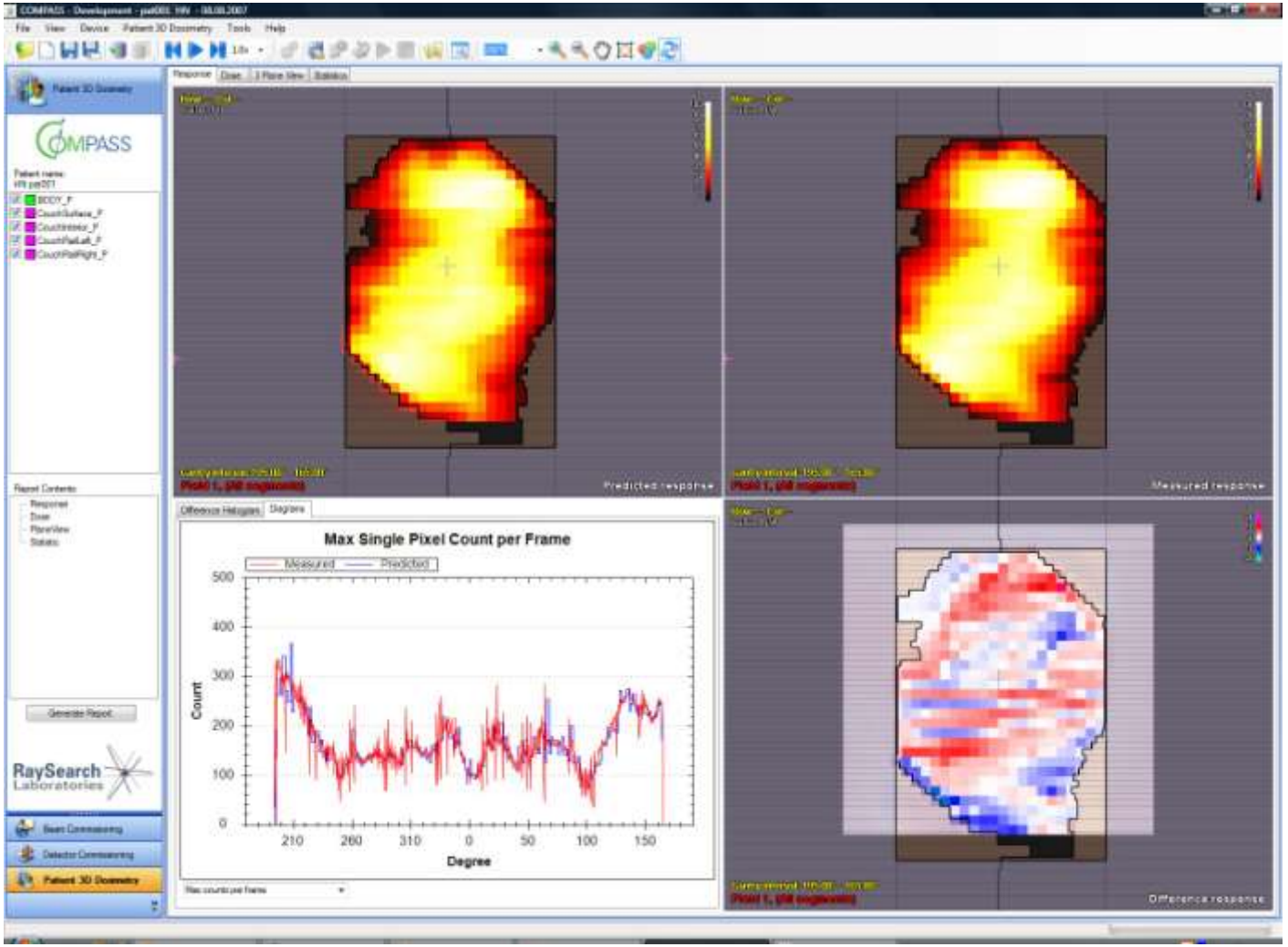
Response View



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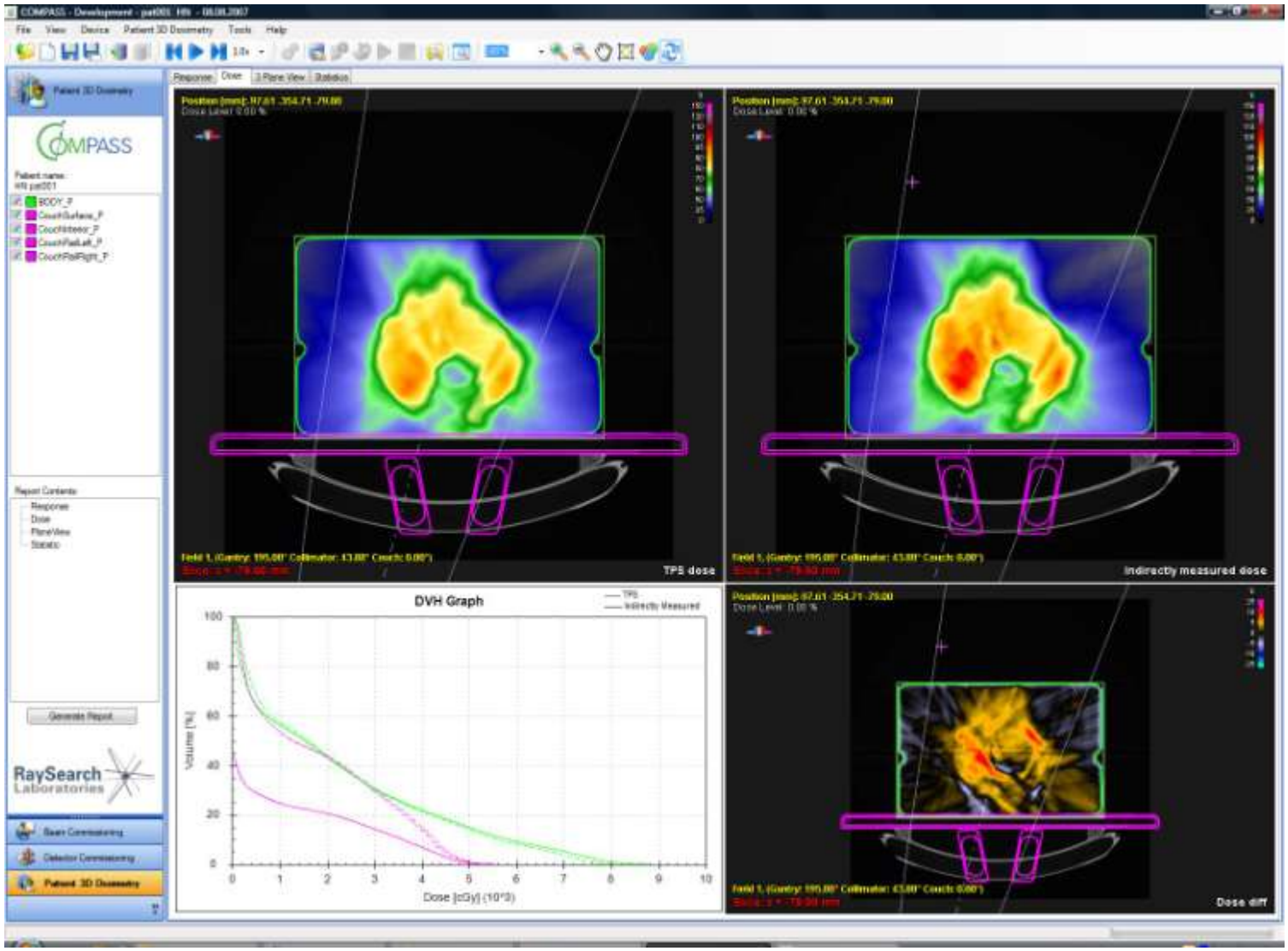
Dose View



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