IBO & Sun Nuclear

Hans Ozimek

Neuruppin 27.- 28.03.08

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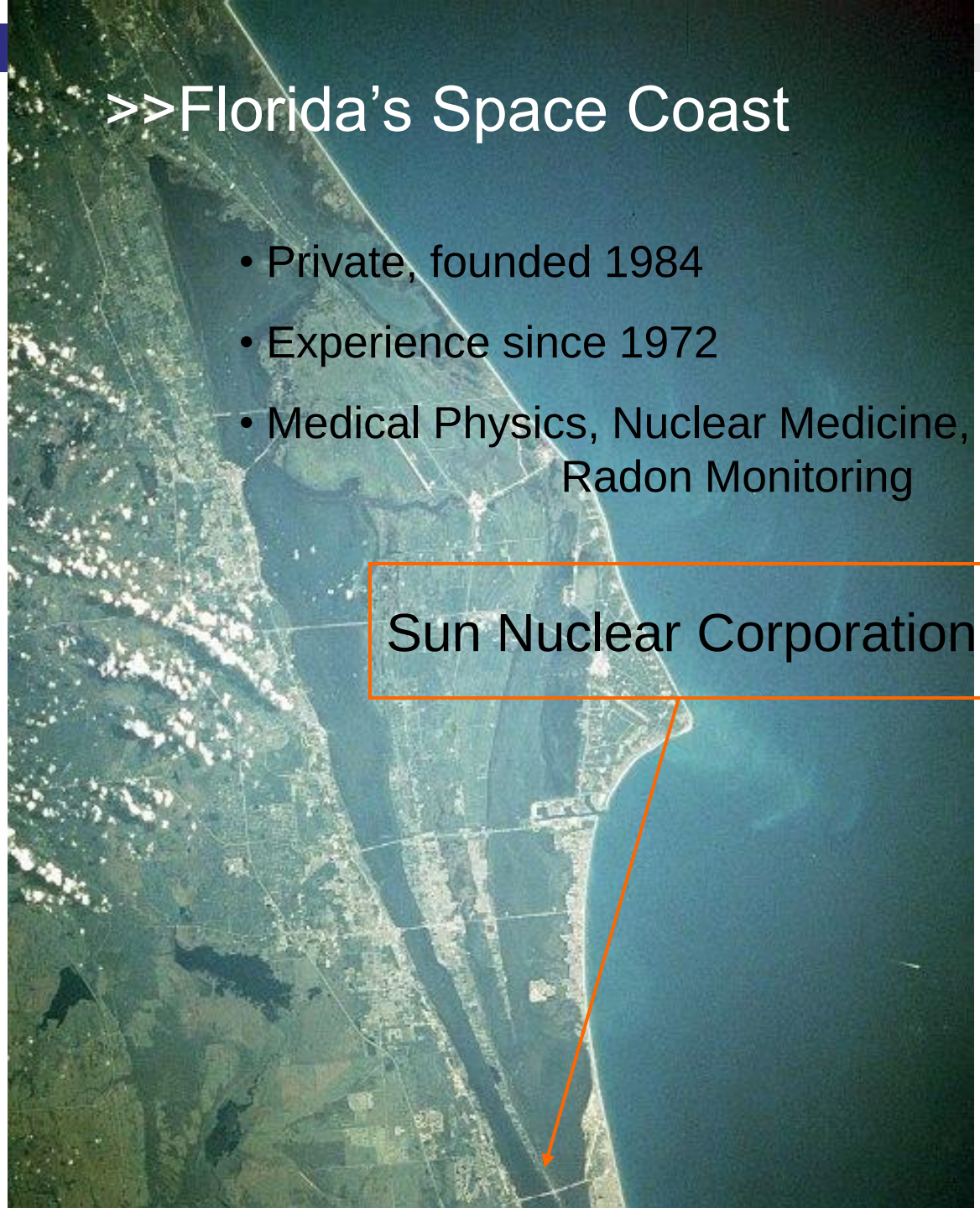
>>Florida's Space Coast



- Private, founded 1984
- Experience since 1972
- Medical Physics, Nuclear Medicine, Radon Monitoring

Sun Nuclear Corporation

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Core Tools → MapCHECK™

#1 Requirement: Built for IMRT QA

- Small detectors do not hide errors
- No warmup time, no waiting
- Calibration stable > 1 year
- User calibrated

#2 Requirement: Advanced features

- Beam QA
- Film support: EBT & EDR2
- Anatomical structure filter
- MLC QA
- Respiratory Motion/Gating QA (XY/4D)
- EPID based analysis
- Combine feature to increase field size and data density

>> Over 50 publications, 5 years of clinical use

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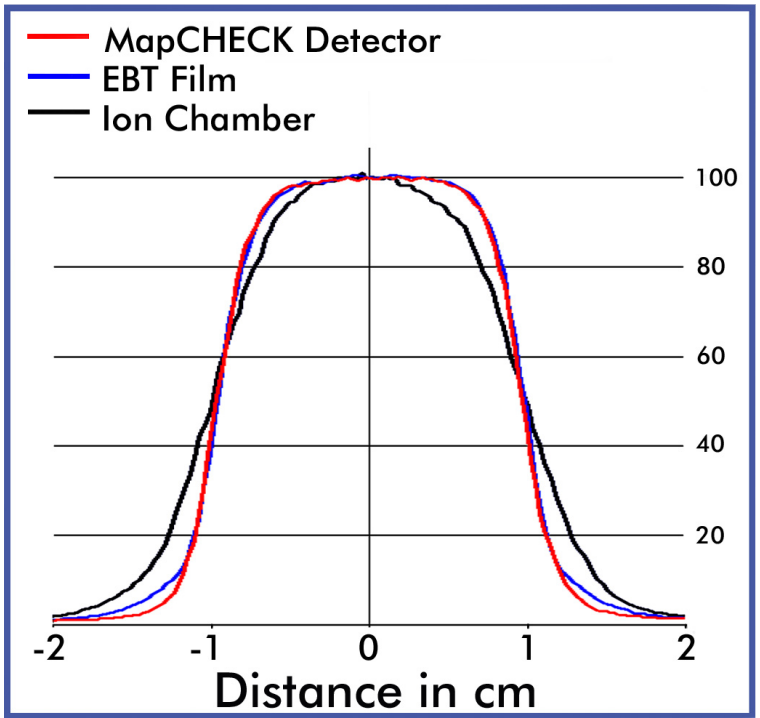
Why Diodes?

- IMRT fields are collections of small fields with steep dose gradients
  - Small field beam scanning results are best with a diode
    - The same is logically true with IMRT fields

Detector response for a 2cm x 2cm field



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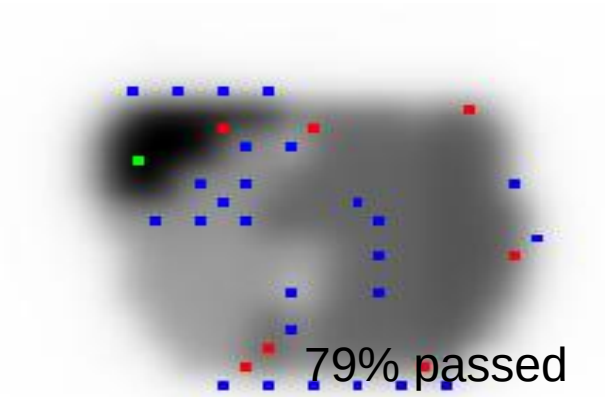
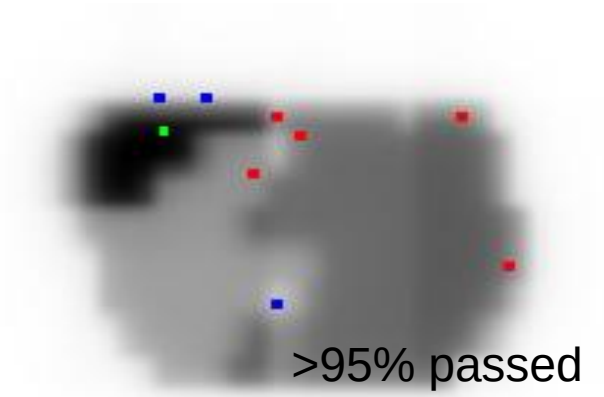
Dose Volume Averaging

Case Study: Beam modeling error detected by MapCHECK



(a) 79% passed

Old model,
(6 mm chamber)



(b) >95% passed

New model
(2 mm detector)

- The small diodes in MapCHECK detected the beam modeling error in (a), where the data was collected by a large volume ion chamber.

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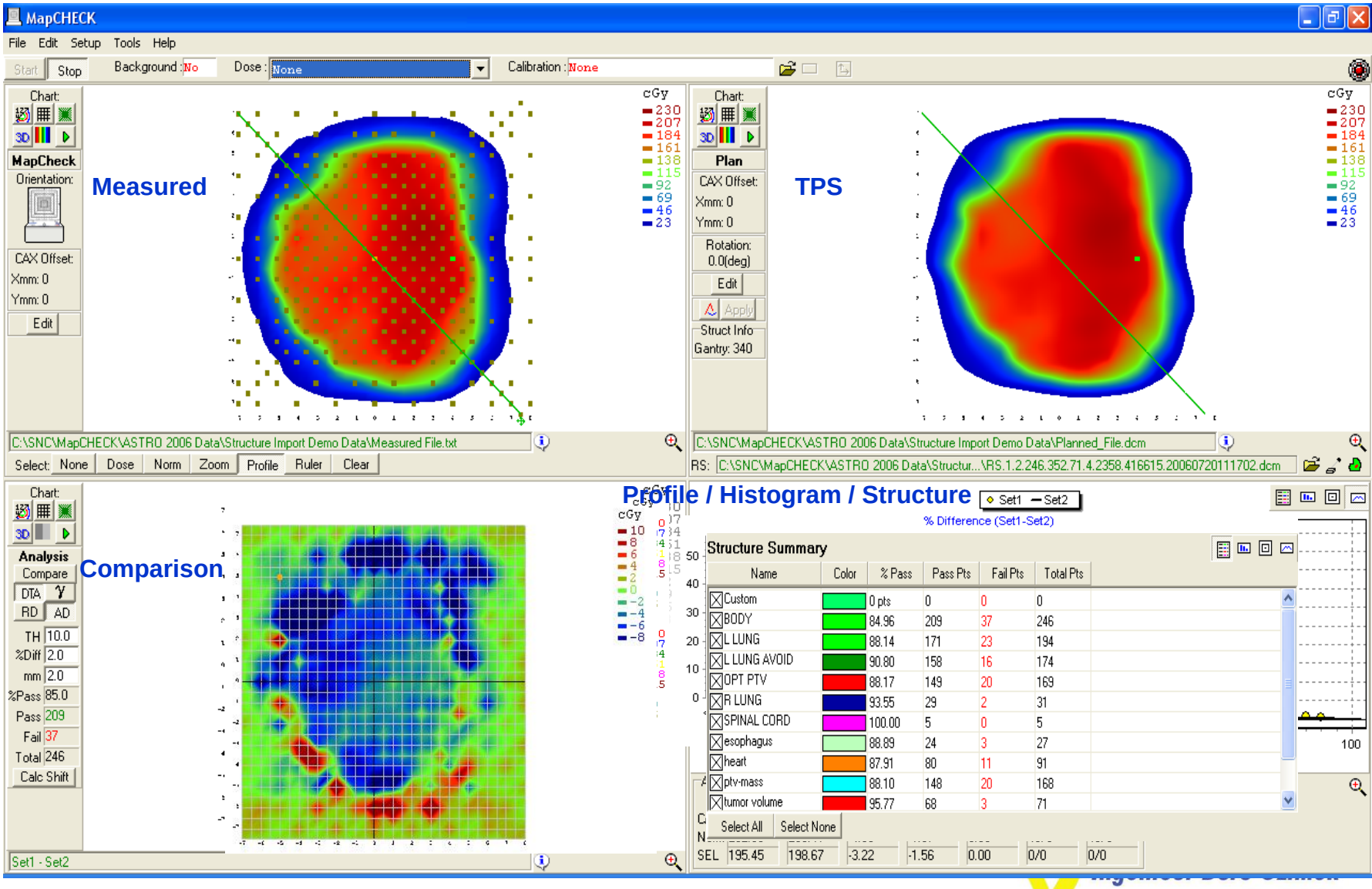
MapCHECK: Current Version



Anatomical Structure Filter

- There is a need for more intuitive and clinically relevant tools for IMRT QA
  - Relate QA “failures” to contoured BEV patient anatomy
- Benefits
  - See if there are any ‘cold’ spots in your PTV mass
  - See if there are any ‘hot’ spots in the patient’s critical structures
- Must account for patient isocenter, couch angle, gantry angle when projecting structures

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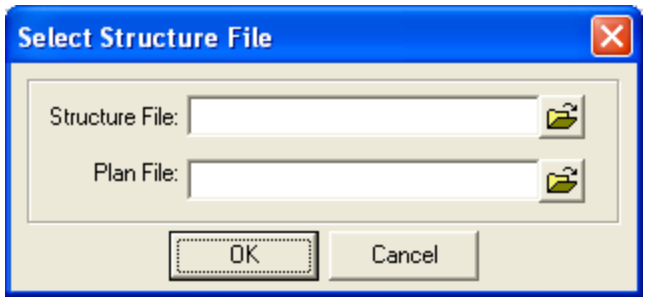
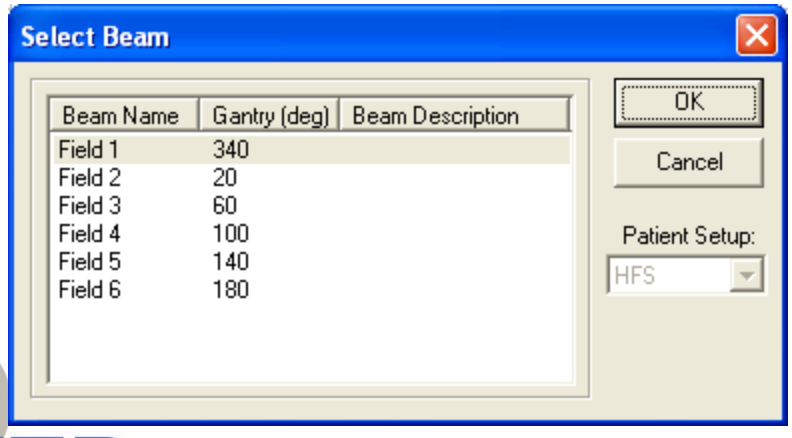
How it Works

1) Select DICOM Structure & Patient Plan File
2) Select Beam
3) Accept Gantry Setup

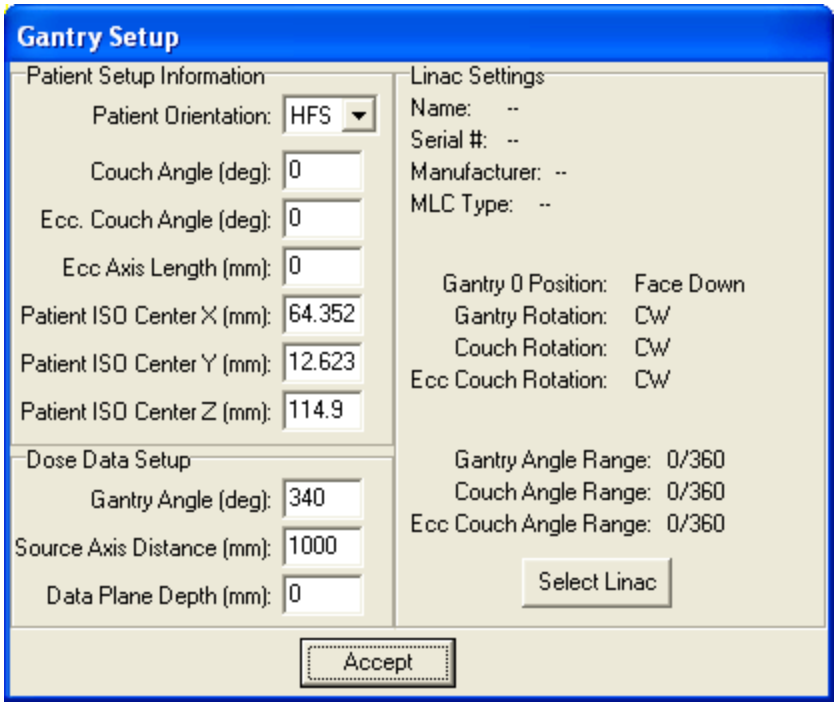
1 STEP



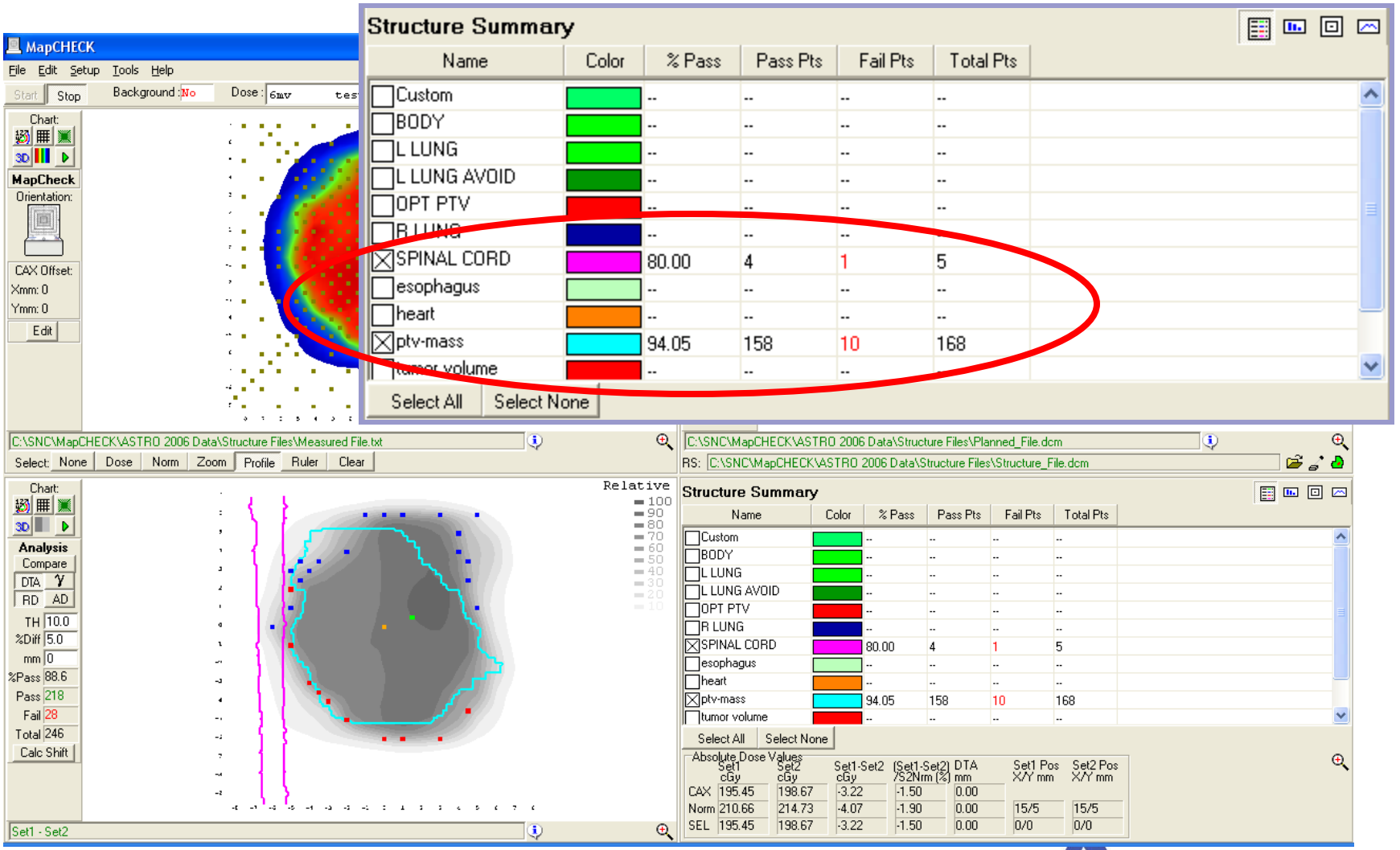
2 STEP



3 STEP



Structure Results



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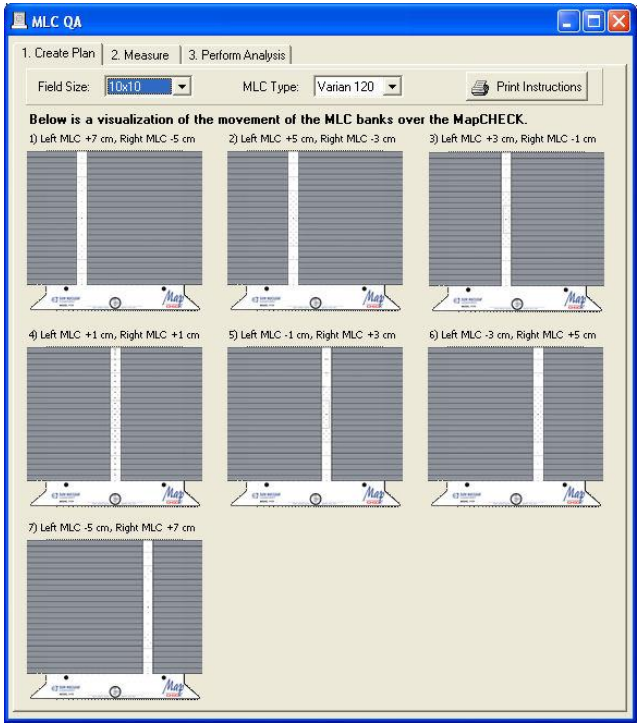
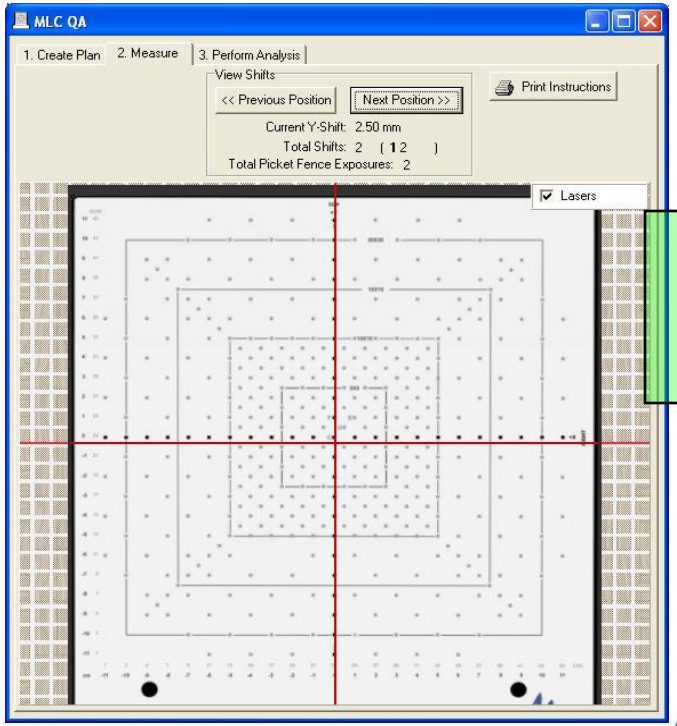
MLC QA

Quantitative Results

1) Picket Fence Plan
2) Measure Picket Fence
3) View Results





MLC Analysis

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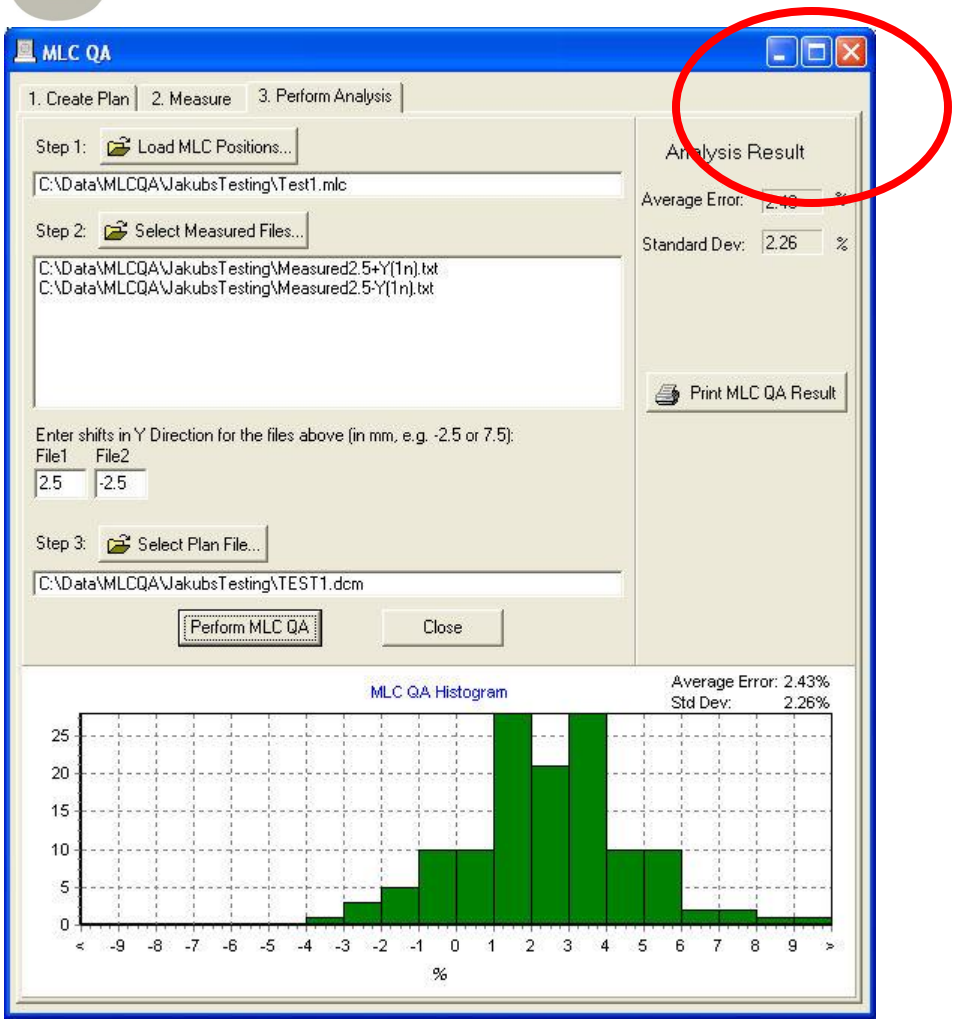
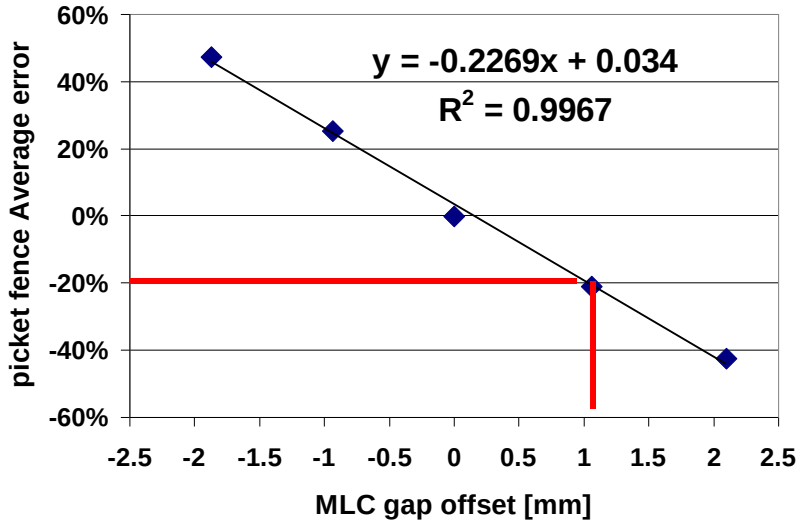
MLC Analysis

3 STEP





"A 1mm MLC error equates to a MapCHECK measured error of 20%"

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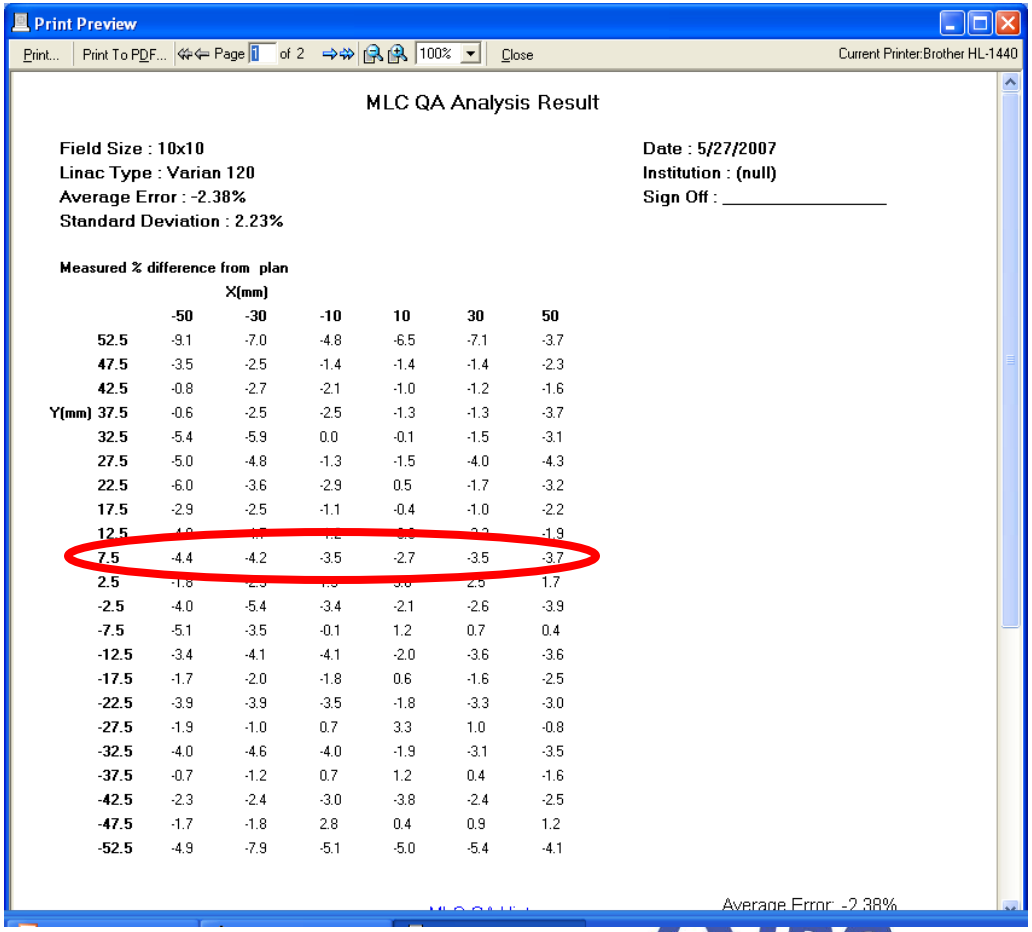
MLC: Leaf by Leaf

Analysis data for each leaf pair



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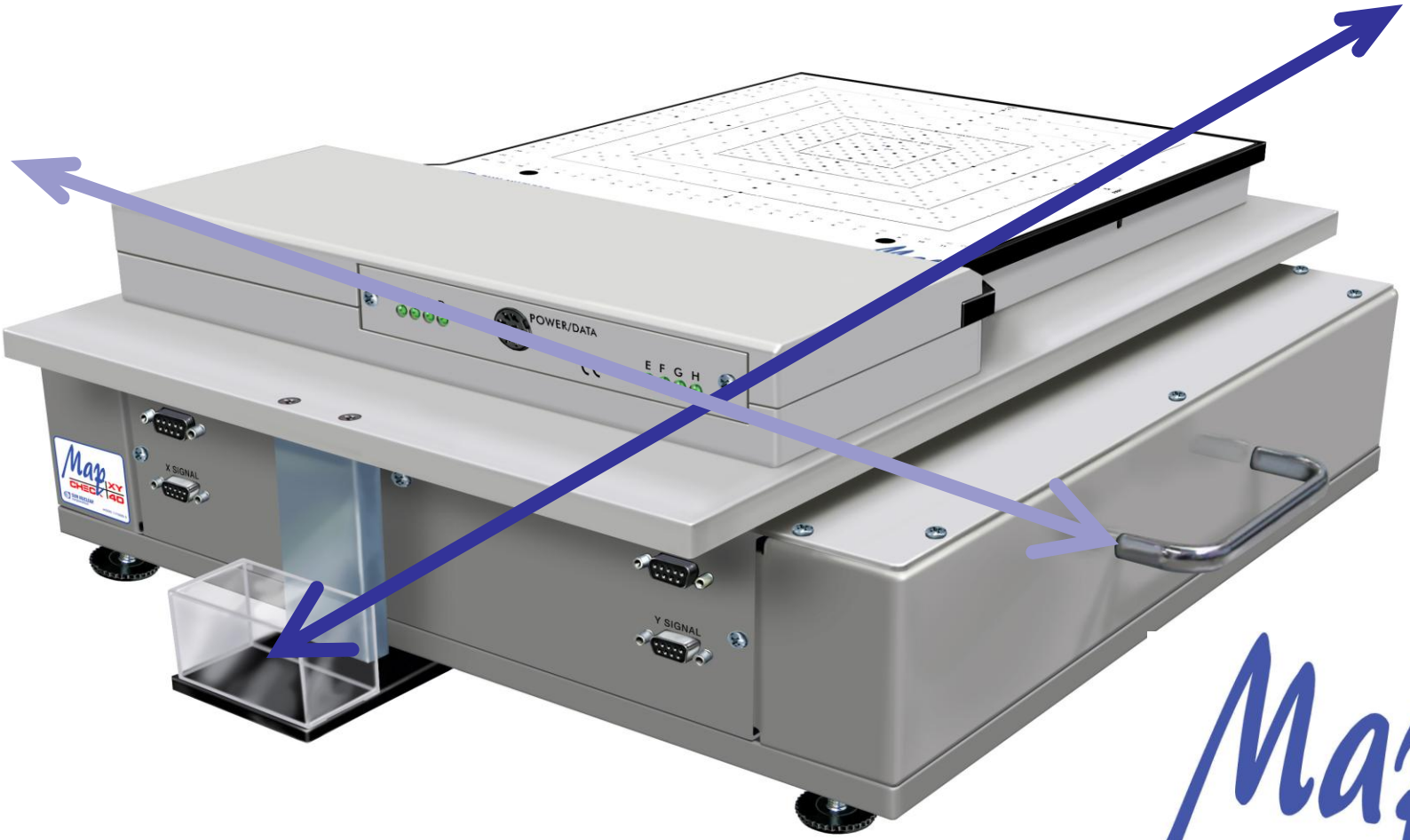
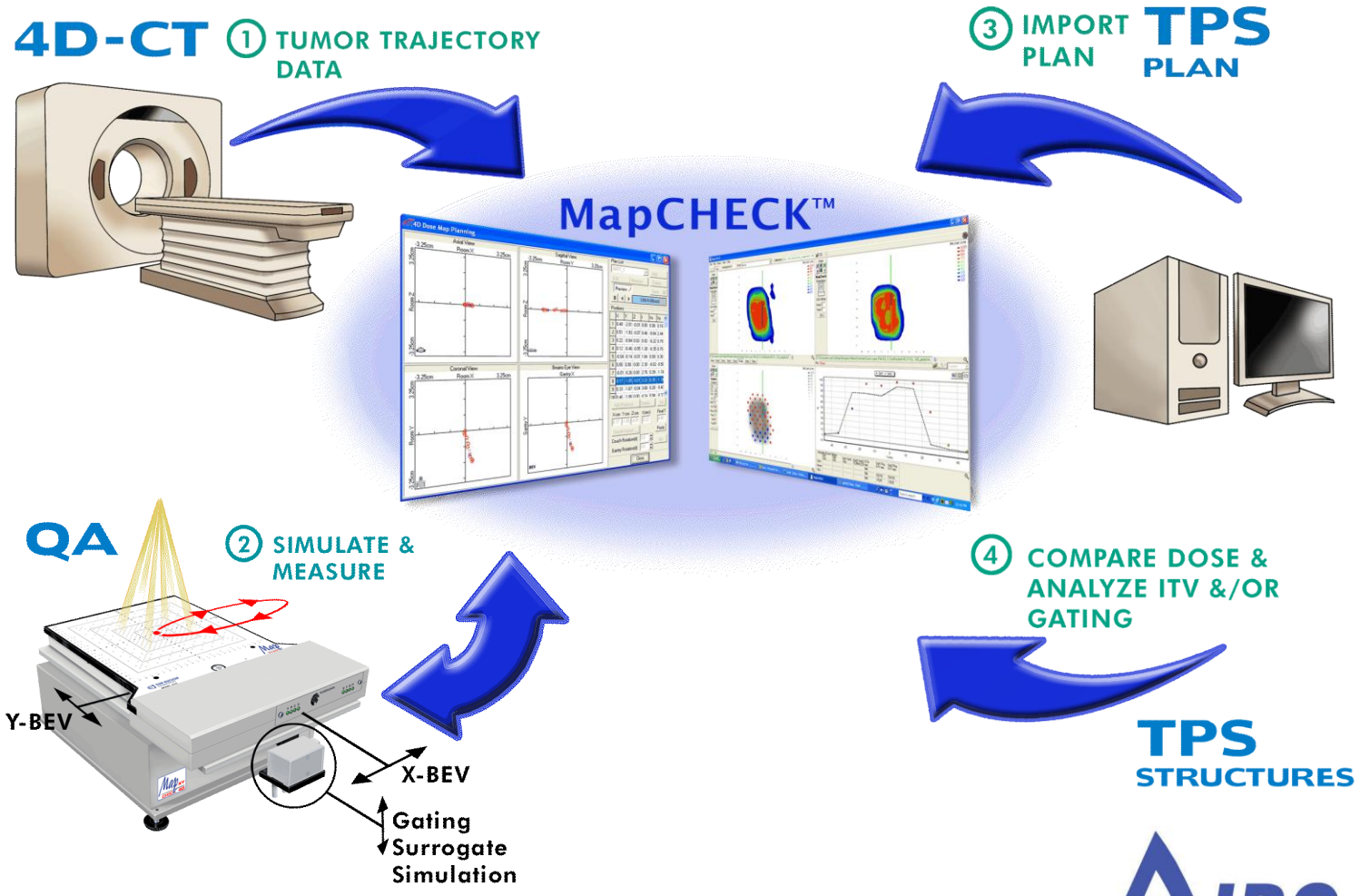
MapCHECK XY/4D

Respiratory Motion/Gating QA



XY/4D Workflow



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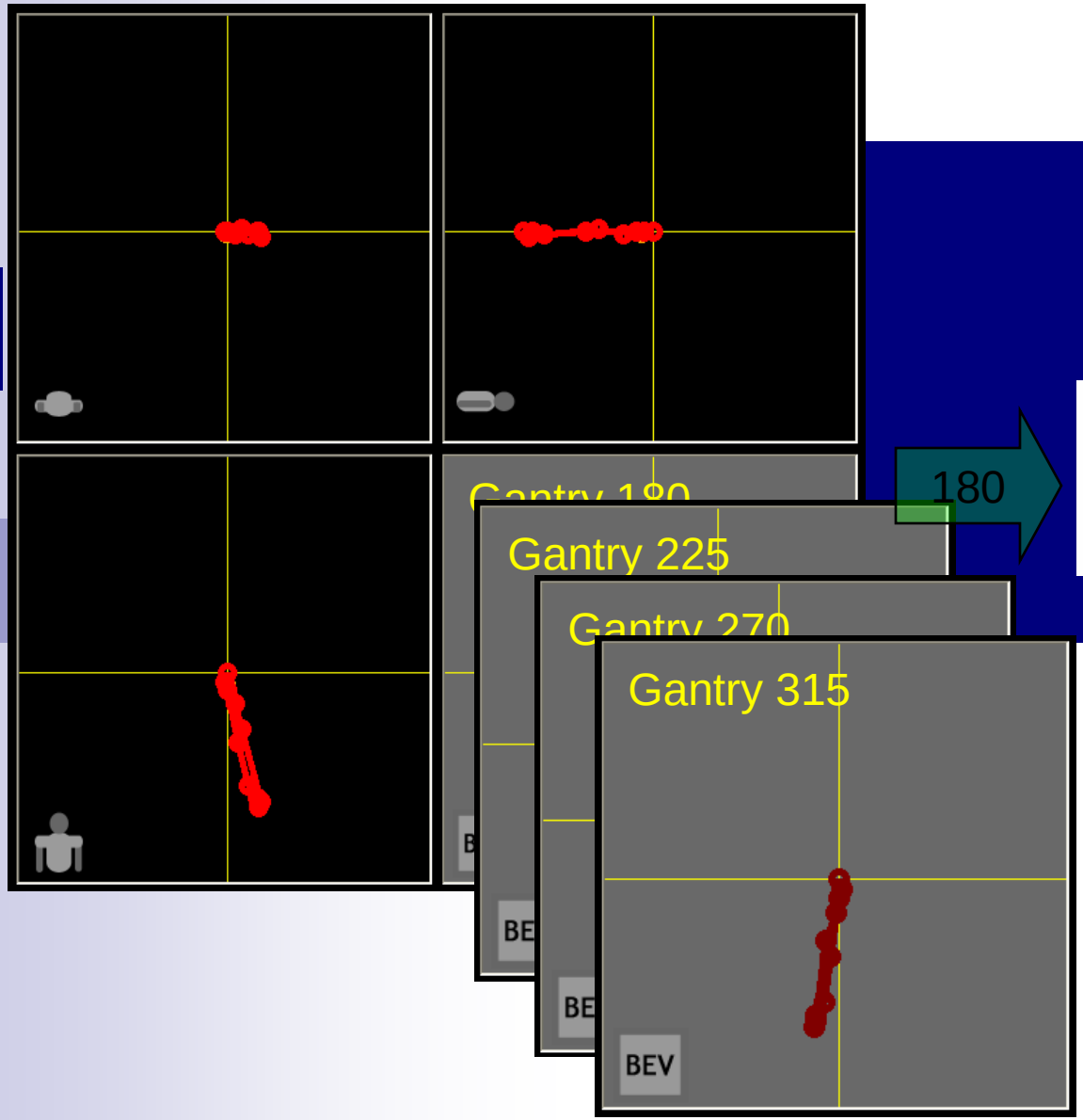
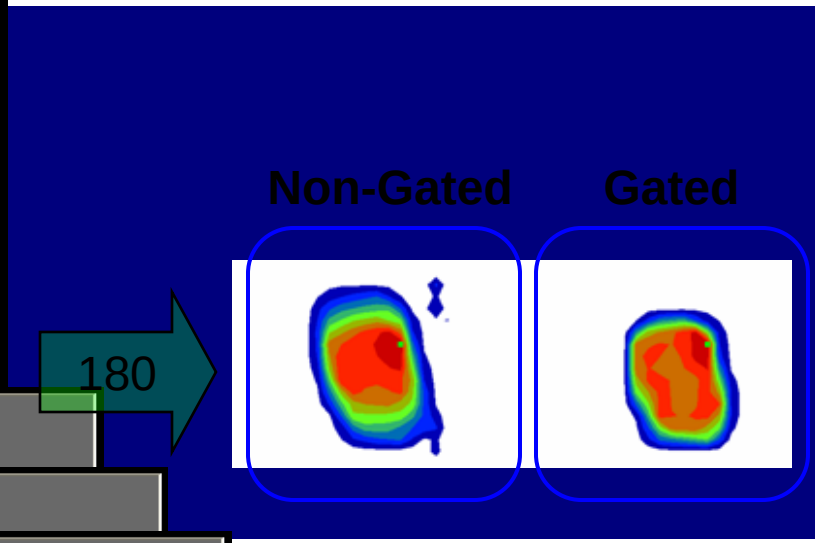
BEV Motion





Motion is Beam Geometry Specific

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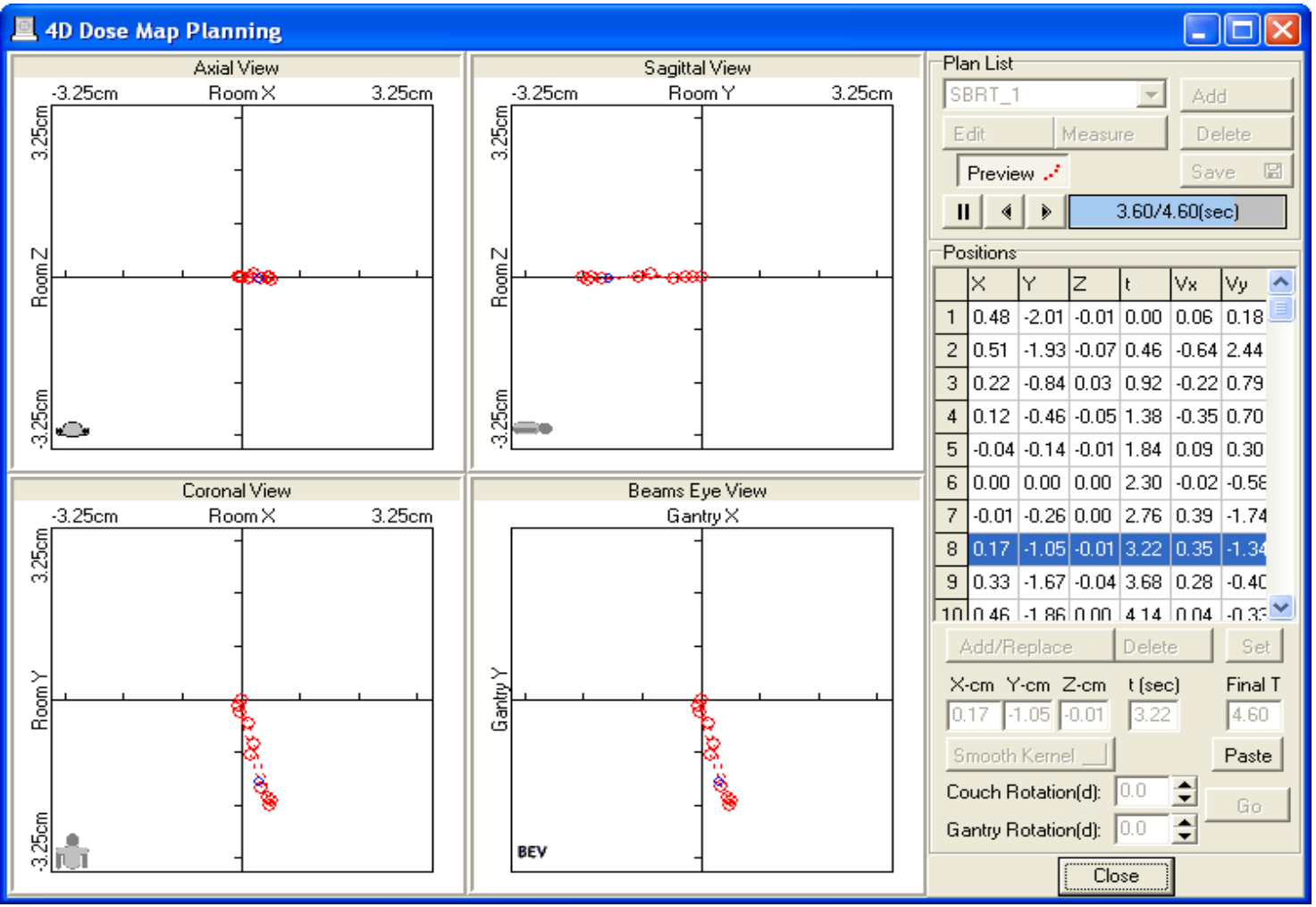
XY/4D Interface



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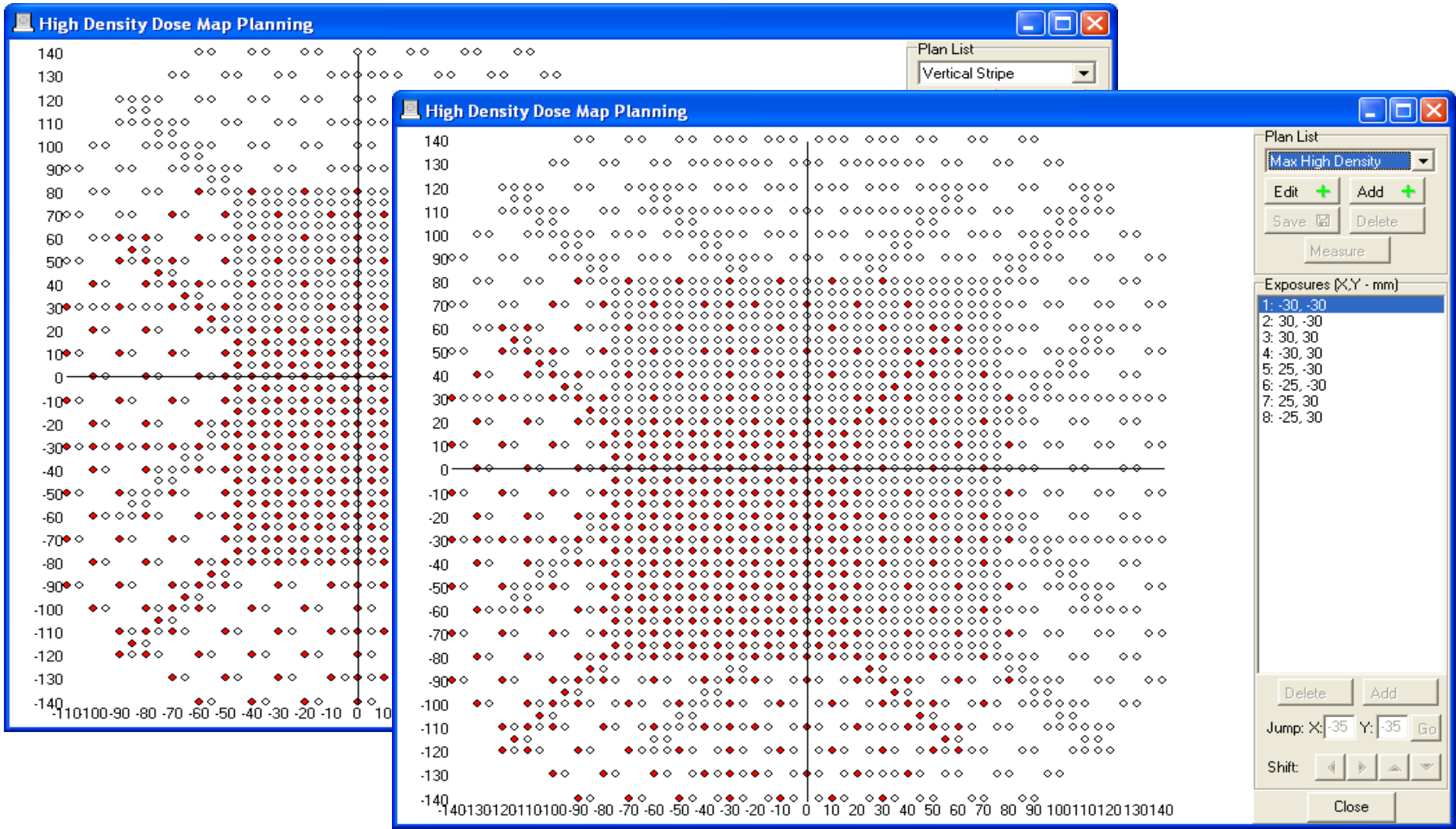
XY: Increase Field Size, Density



XY/4D Applications

- Beam gating qualification
- Study impact to moving targets (Structures, ITV, PTV)
- Increase data density, field size
- Supports:
  - Varian RPM
  - Siemens/Elekta Pressure Belt

- Publications
  - **“On the dose to a moving target while employing different IMRT delivery mechanisms”**
    - Eric D. Ehler, Benjamin E. Nelms, Wolfgang A. Tomé
      Radiotherapy & Oncology Journal of the ESTRO, Volume 83, Issue 1, pg. 49-56, April 2007
  - **“Quality assurance device for four dimensional intensity modulated or stereotactic body radiation therapy and respiratory gating using patient specific intrafraction motion kernels”**

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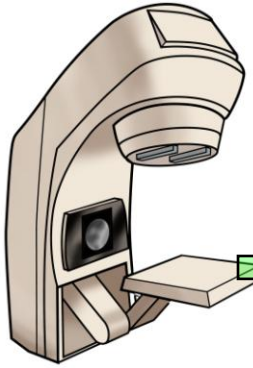
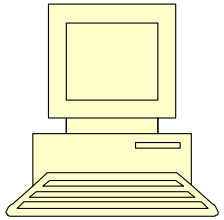
EPIDose Workflow



Raw
Images

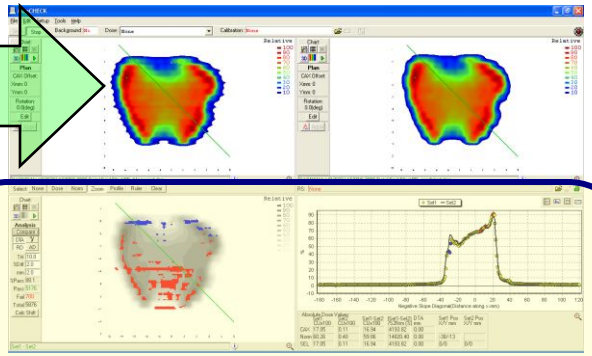


TPS
Dose

EPIDose

**Physics
Modeling
Module**

Dose



**QA Comparison in
MapCHECK**

Baseline
Absolute
Dose Data

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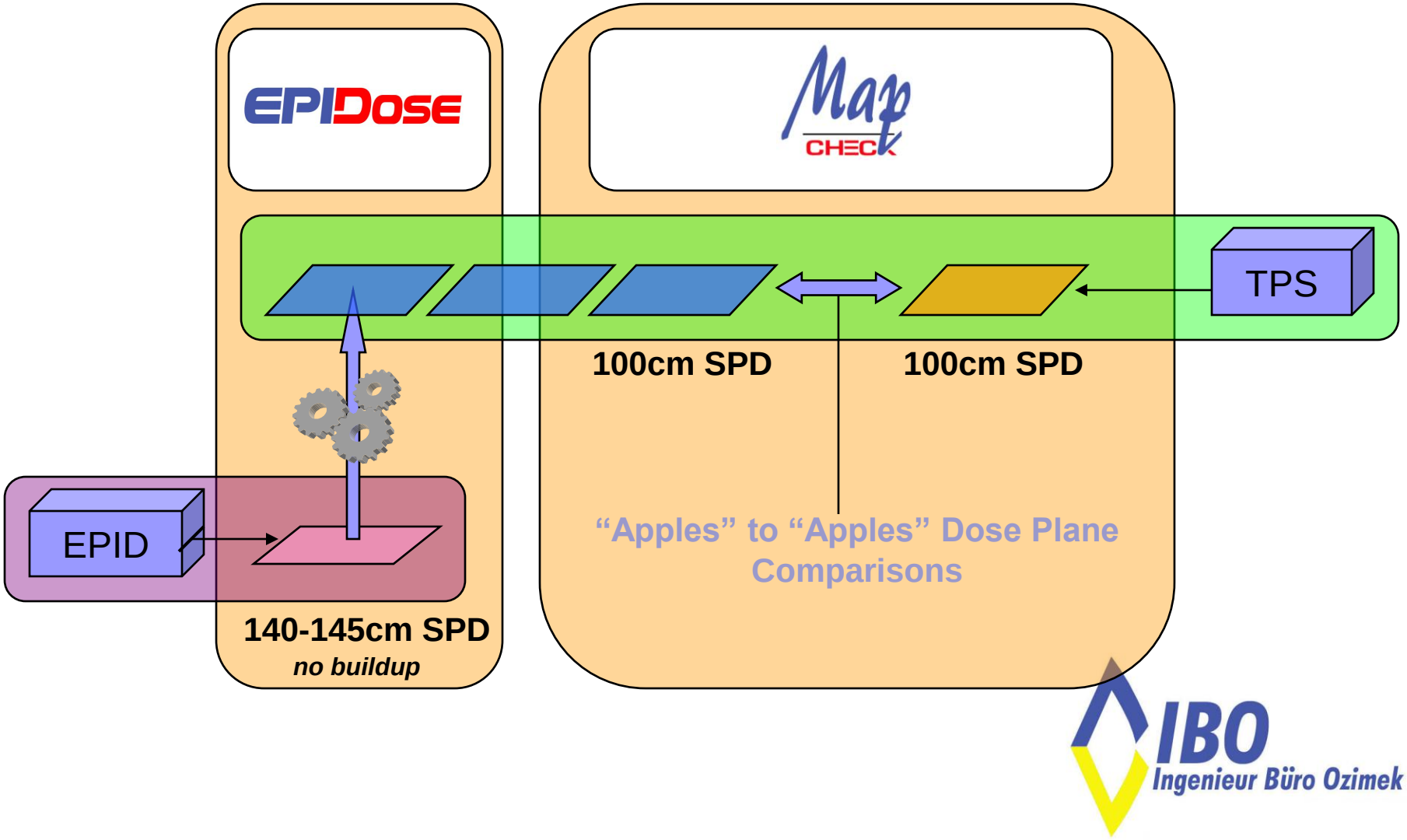
From Image to Dose



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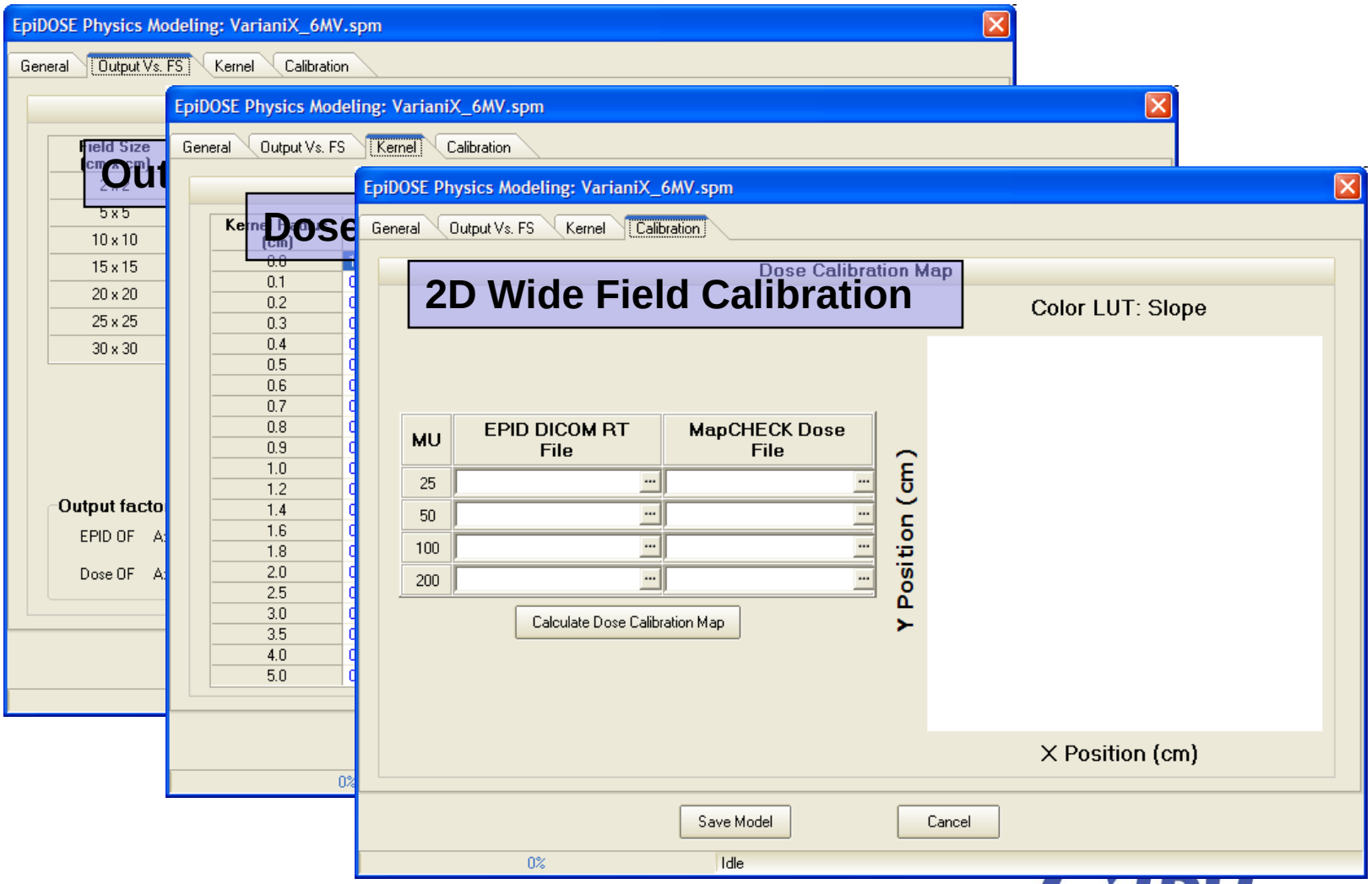
EPID Physics Modeling



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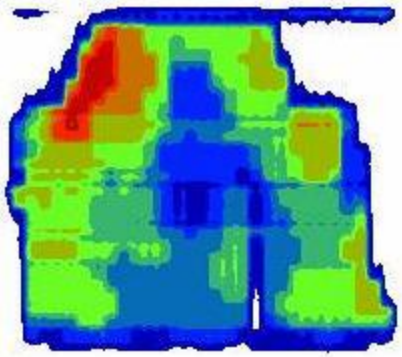
EPID QA

The result?

EPIDose physics model smartly accounts for differences between EPID response and tissue dose

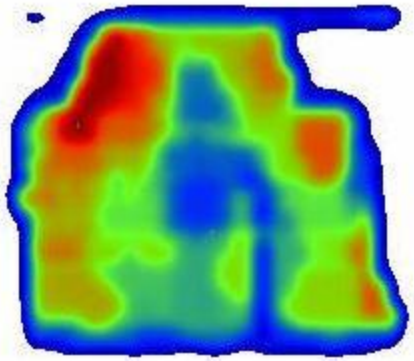
EPID image



EPIDose

EPID to Dose Conversion Algorithms

EPID dose



New Arrays

PROFILER

SunBeam radiosurgery

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