

# NEW PERFORMANCE STANDARD: GAFCHROMIC FILM BASED DOSIMETRY SYSTEM

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# IDEAL DOSIMETRY FOR IMRT/SRS

- ✗ Absolute dose measurement
- ✗ Precise and accurate
  - + Better level than the delivery
- ✗ Wide dynamic range
- ✗ Energy and dose rate independent
- ✗ Flexible positioning
  - + Any depth and angle

# NEW THERAPY MODALITIES

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- ✗ Trends in radiation therapy/surgery
  - + Less fractions
  - + Higher doses per fraction
  - + Tighter conformity
  
- ✗ Trending to a higher value on
  - + Spatial resolution
  - + Dynamic range

# PATIENT SPECIFIC DOSE VERIFICATION

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- ✗ Individual field

- + Fixed and rotating angles
- + Composite calculation

- ✗ Composite field

- + Like patient receiving the radiation
- + True end-to-end test

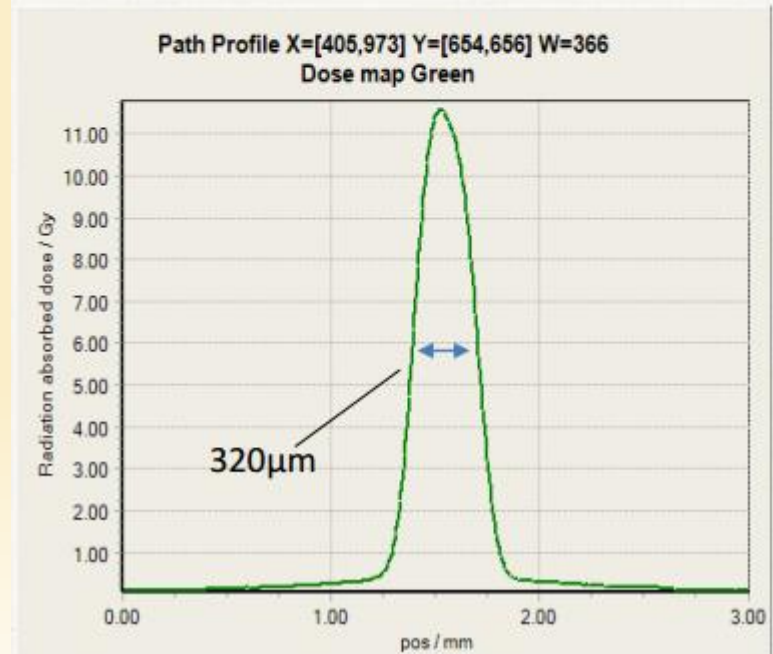
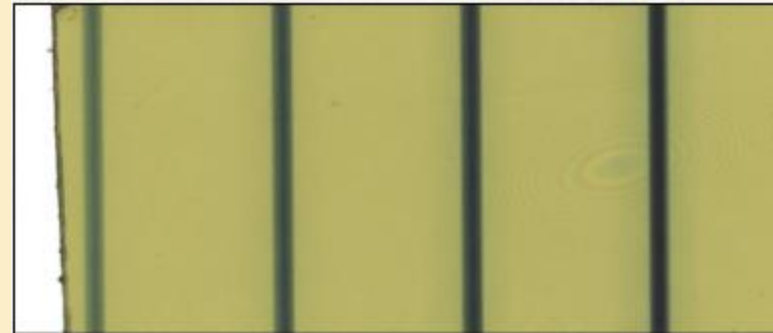
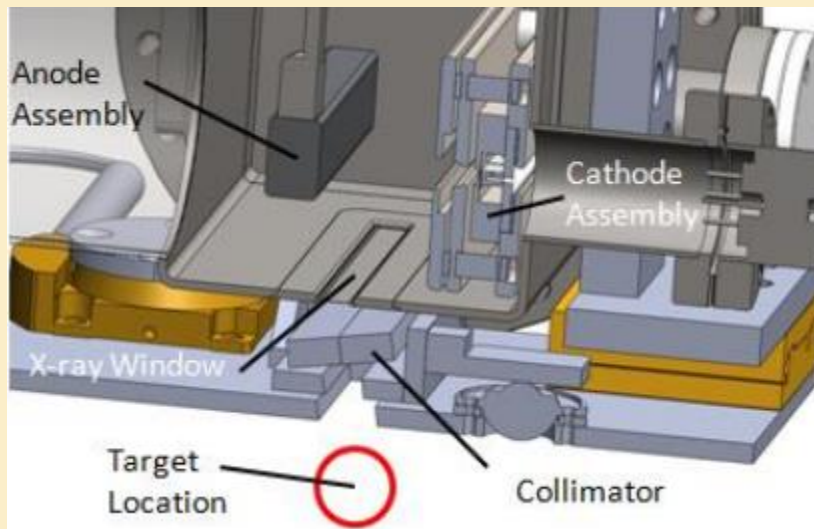
# GAFCHROMIC FILMS

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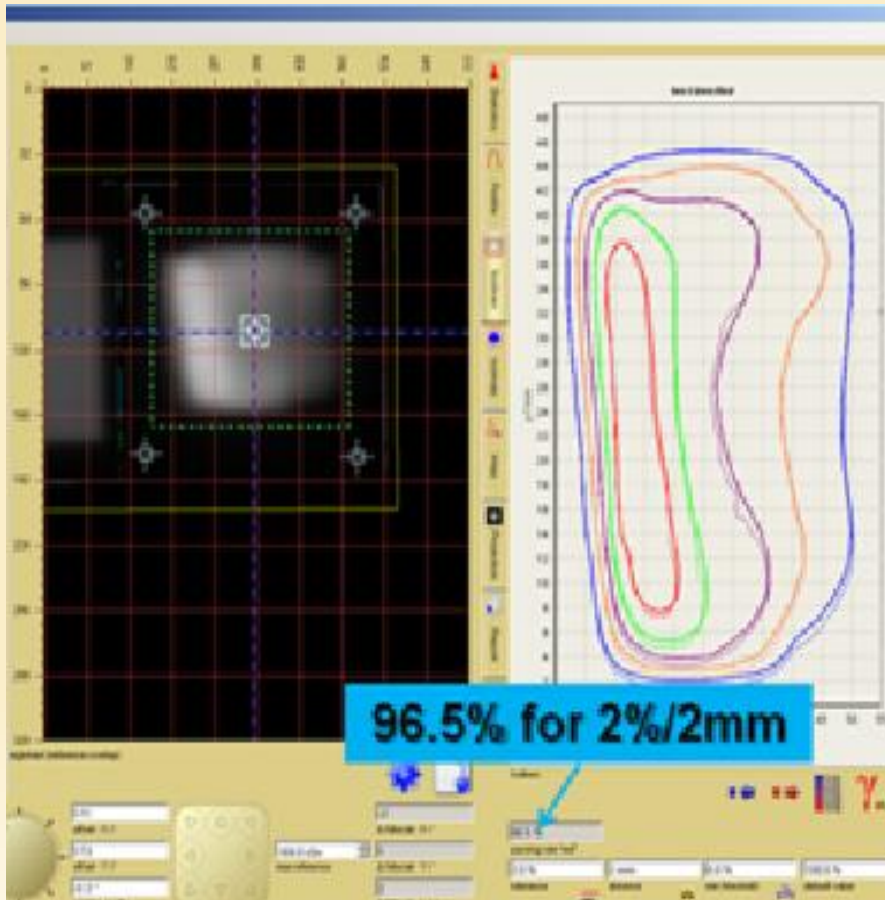
- ✗ Not your old wet film
  - + No processing
  - + Handle in light
  - + Cut to size
  - + Bend to shape
  - + Immerse in water
- ✗ Wide dynamic range
- ✗ High spatial resolution

New Software and Protocol make film use much more accurate and friendly

# SMALL FIELD – HIGH SPATIAL RESOLUTION

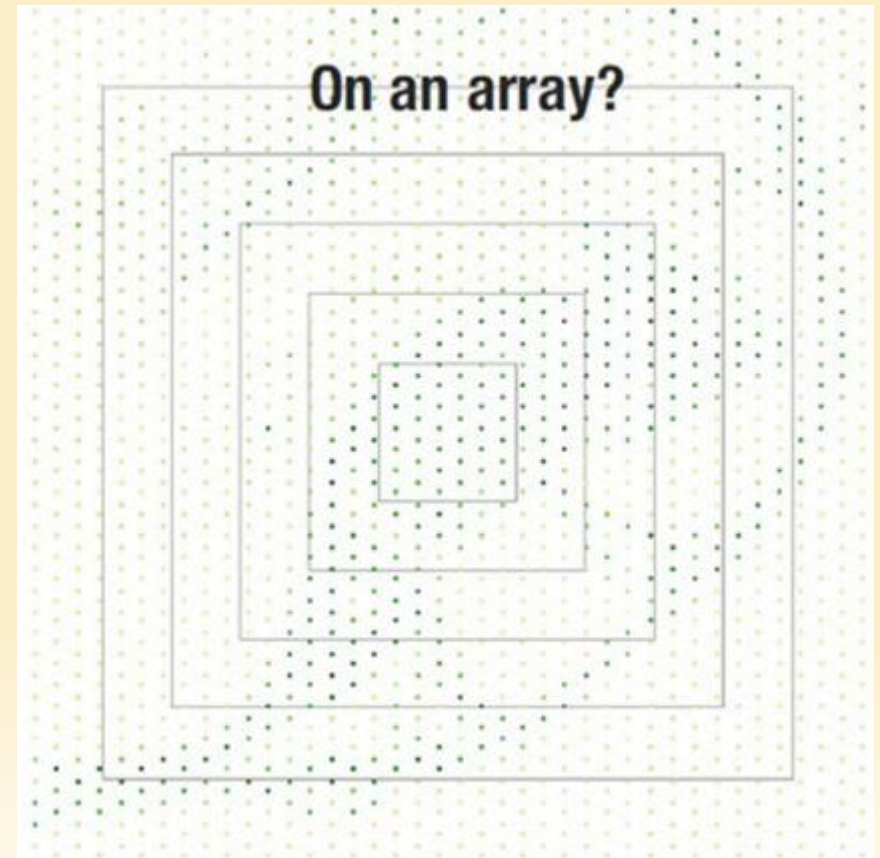


# SMALL FIELD DOSIMETRY CHALLENGES

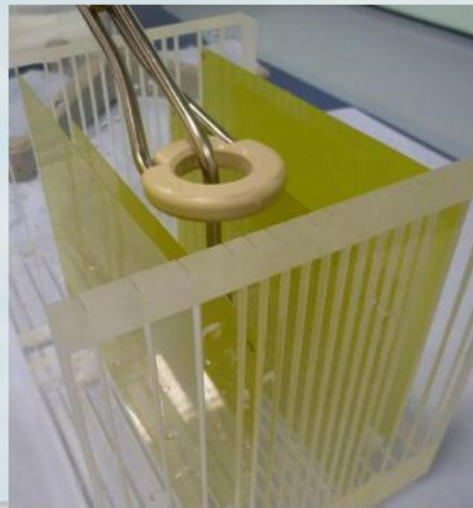
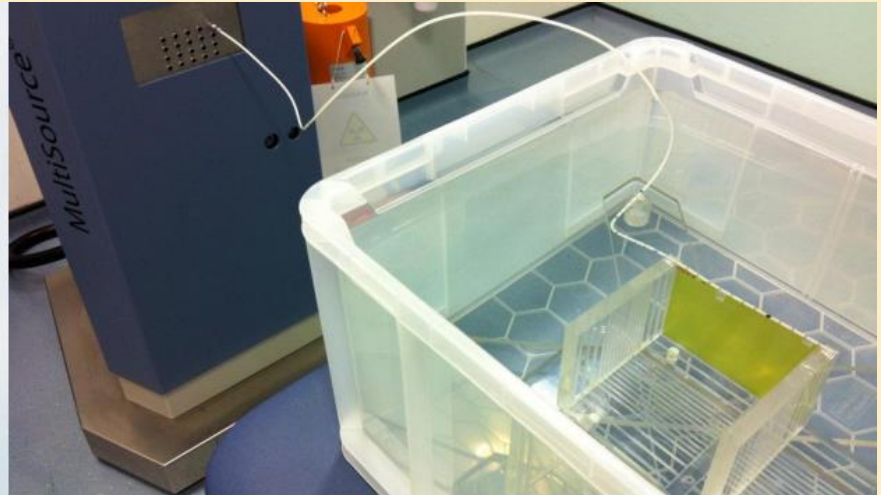
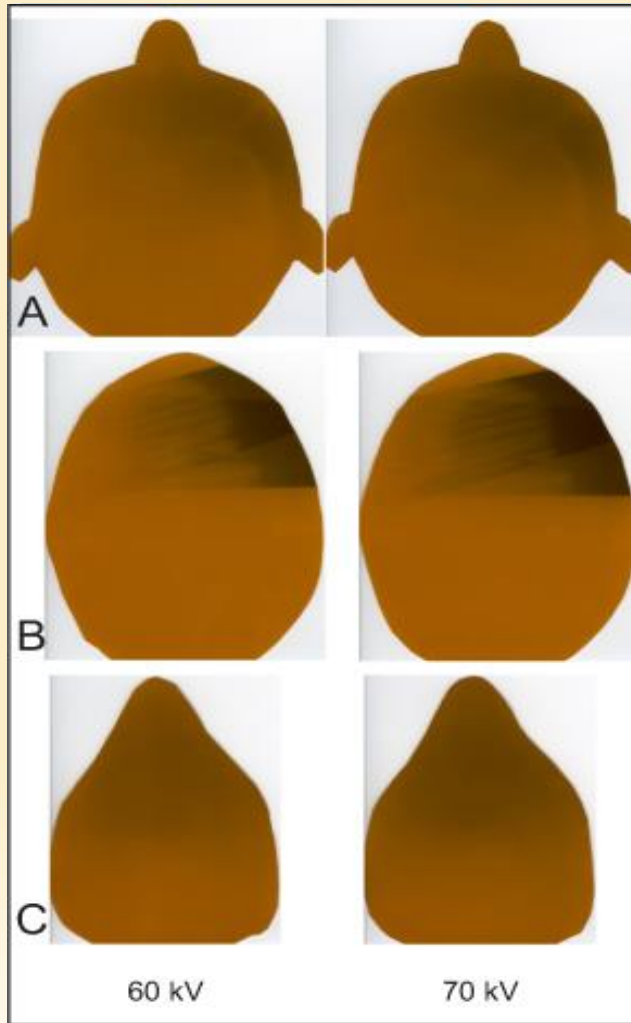


- ✗ In the first try
  - + Low passing rate with film
  - + Good passing rate with MapCheck
- ✗ Wrong beam profile
- ✗ Second try after corrected beam profile
  - + High 90% gamma at 2%/2mm with film
  - + No difference with MapCheck

# HOW DO YOU CAPTURE CHAMELEON

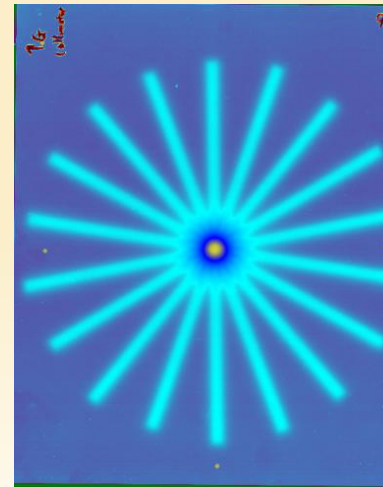
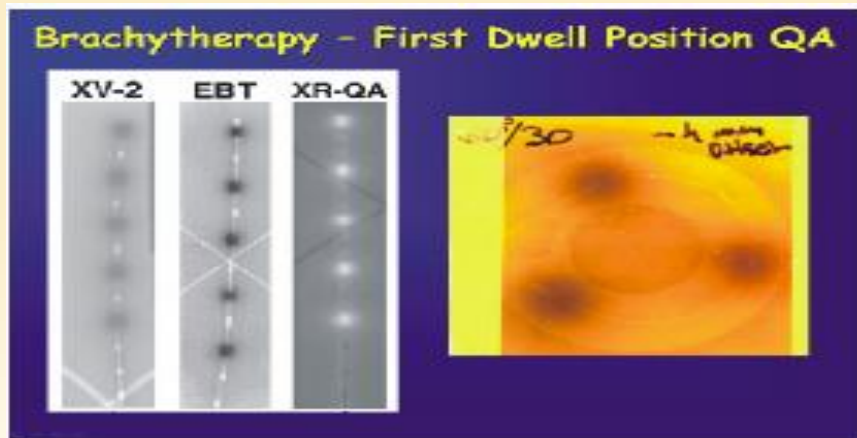
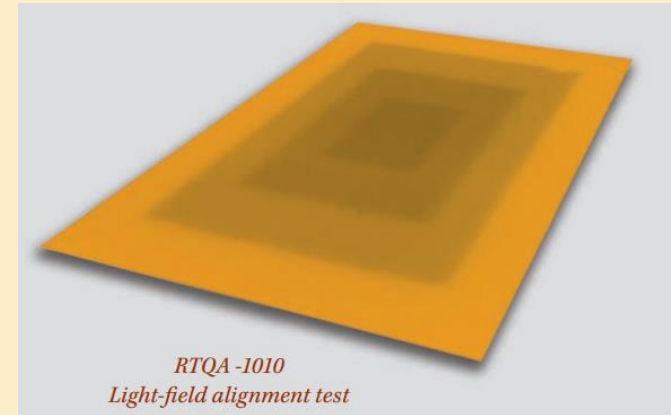


# MANY USES OF THE FILMS



# WHAT FOR BEAM LOCATION?

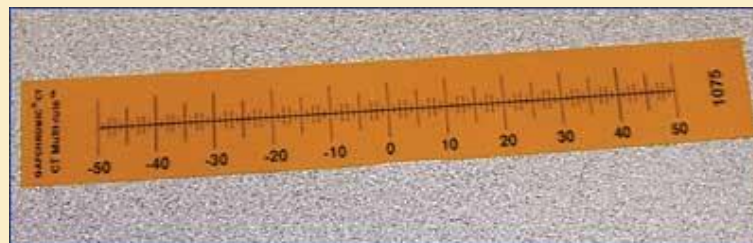
- Radiotherapy (MV photons, electrons, protons)
  - RTQA2 - 2 cGy to 8 Gy
- Radiology (kV photons)
  - XRQA2 - 1 mGy to 20 cGy
  - XRCT2 - 1 mGy to 20 cGy
  - XRM2 - 1 mGy to 20 cGy



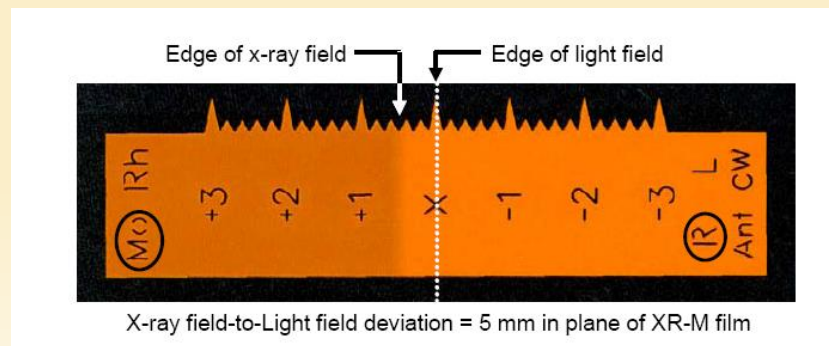
# PRODUCT OFFERINGS - RADIOLOGY



+ XR-CT

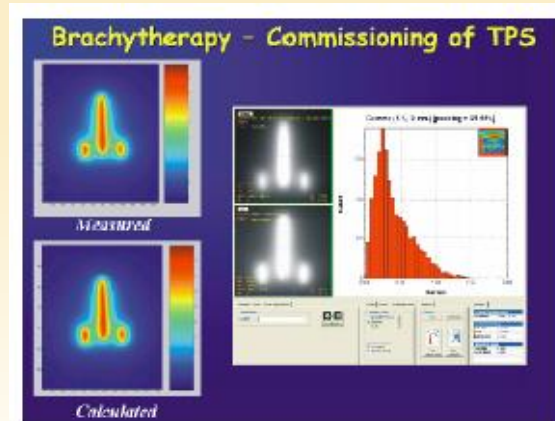
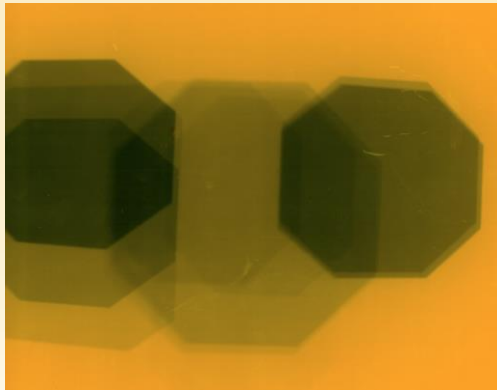


+ XR-M

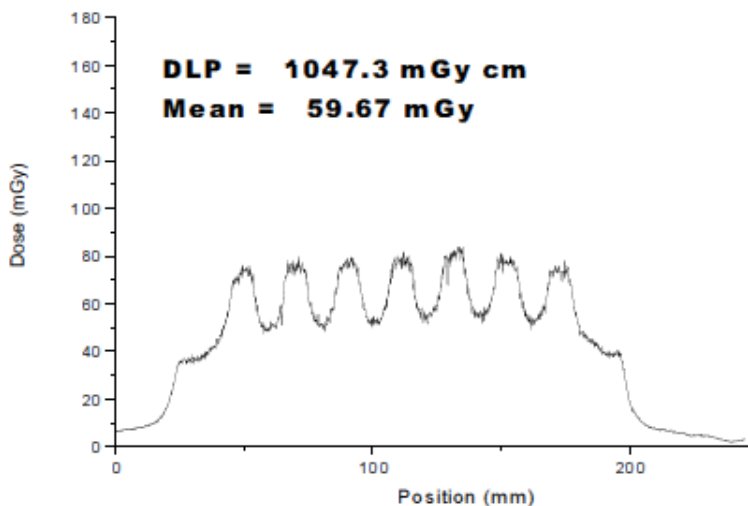


# WHAT FOR DOSE MEASUREMENT?

- Radiotherapy (MV photons/electrons/protons)
  - EBT2, EBT3 and EBT3+ - 1 cGy to >40 Gy
  - MD-V3 - 2 Gy to 100 Gy
  - HD-V2 - 10 Gy to 400 Gy
- Radiology (kV photons)
  - XR-RV3 - 5 cGy to 15 Gy
  - XRQA2 - 1 mGy to 20 cGy



# CT DOSE MEASUREMENT WITH XR-QA2



Pelvis Phantom

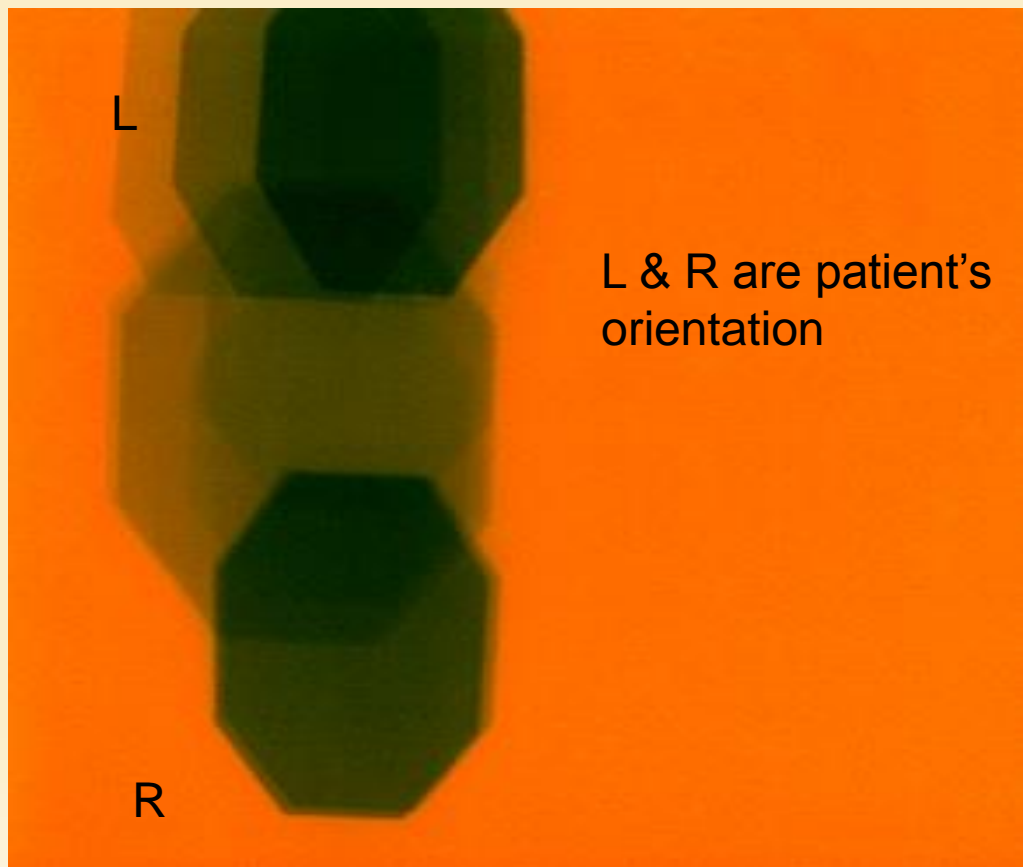
120 kVp  
Wedge L – 120 mm  
200 mA – 313 mAs  
PITCH 0.641

Toshiba Aquilion 64

Queensway Carleton Hospital January 2009

Nagi Sharoubim, Engineer  
Slobodan Devic, Ph.D., MCCPM

# DOSE MONITORING WITH GAFCHROMIC XR-R



- Immediate visualization of patient exposure – magnitude and location
- Detailed dose distribution

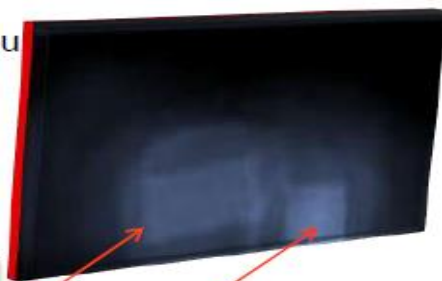
# PEAK SKIN DOSE WITH GAFCHROMIC XR-R

6

Dosimétrie in vivo

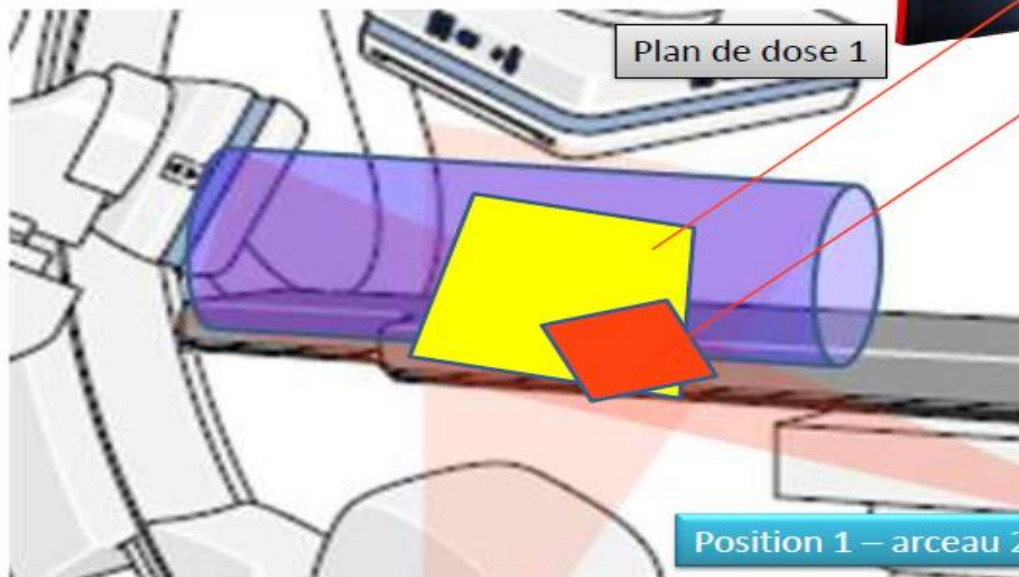


Cumul à la peau  
du patient



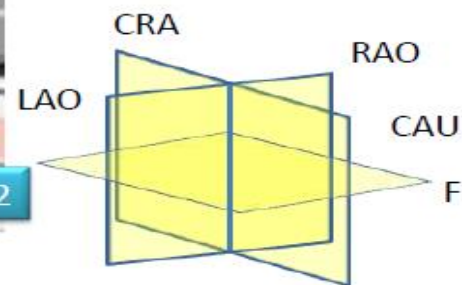
Plan de dose 1

Plan de dose 2



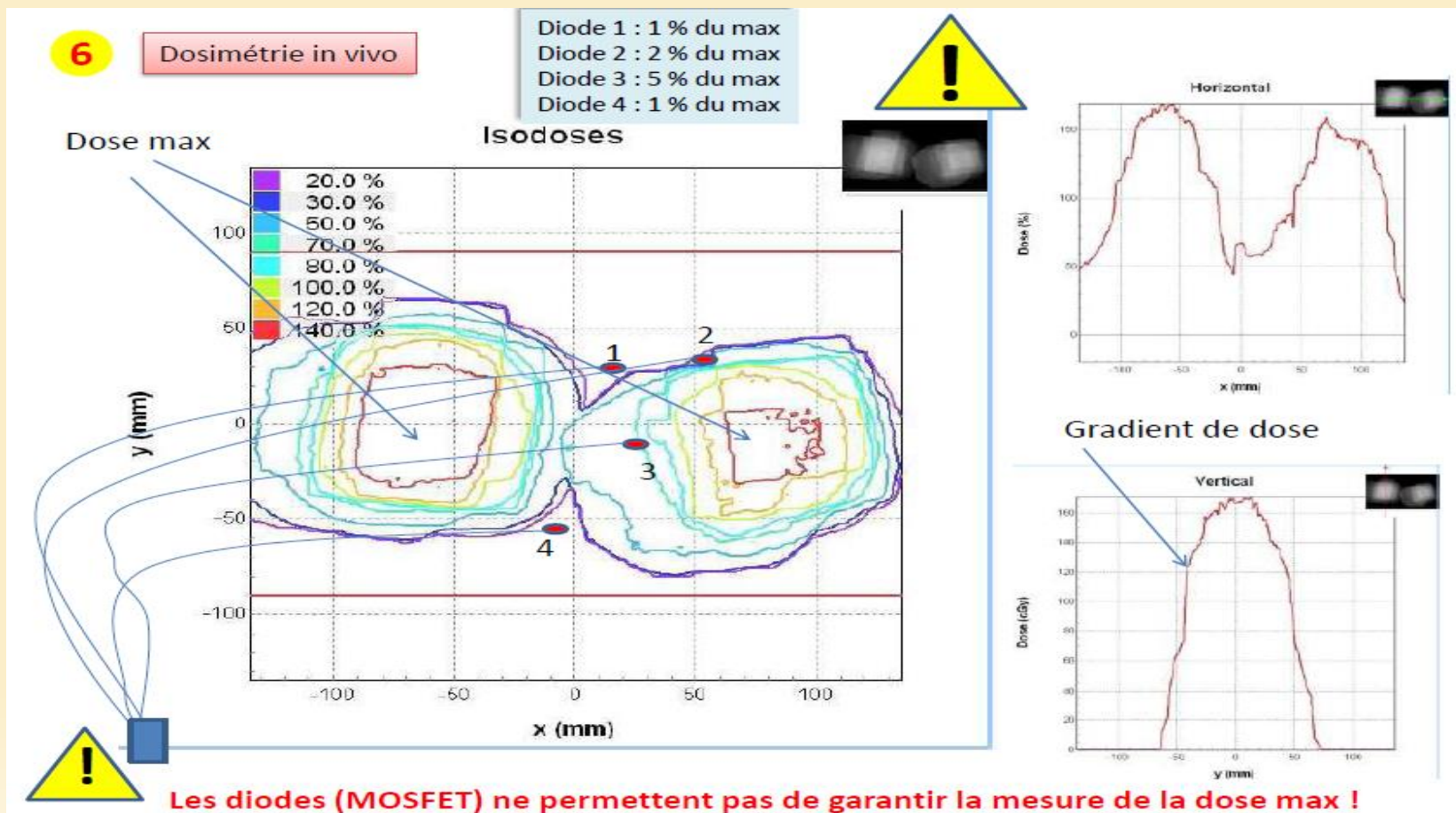
Position 1 – arceau 2

Position 1 – arceau 1



\*Provided by Les Hopitaux Universitaires de Strasbourg, used with permission

# COMPARISON OF GAFCHROMIC XR-R VS. DIODES



\*Data provide by Les Hopitaux Universitaires de Strasbourg, used with permission

# PRESENT/FUTURE OF FILM DOSIMETRY

**Film is**  
~~**a hassle**~~  
*snap*

- ✗ Post-exposure waiting
- ✗ Film artifacts
- ✗ Scanner artifacts
- ✗ Environmental

How we turn film use from  
a hassle to  
a snap?

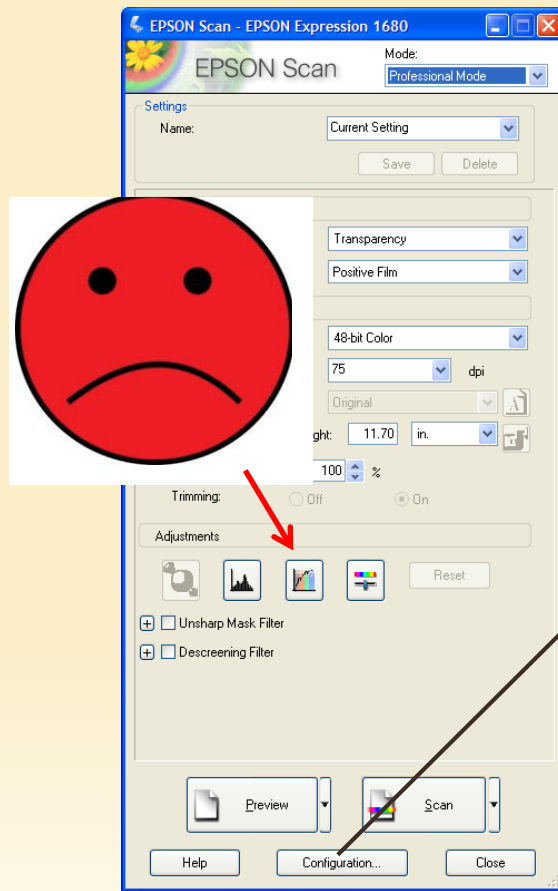
**GafChromic**

**ASHLAND**

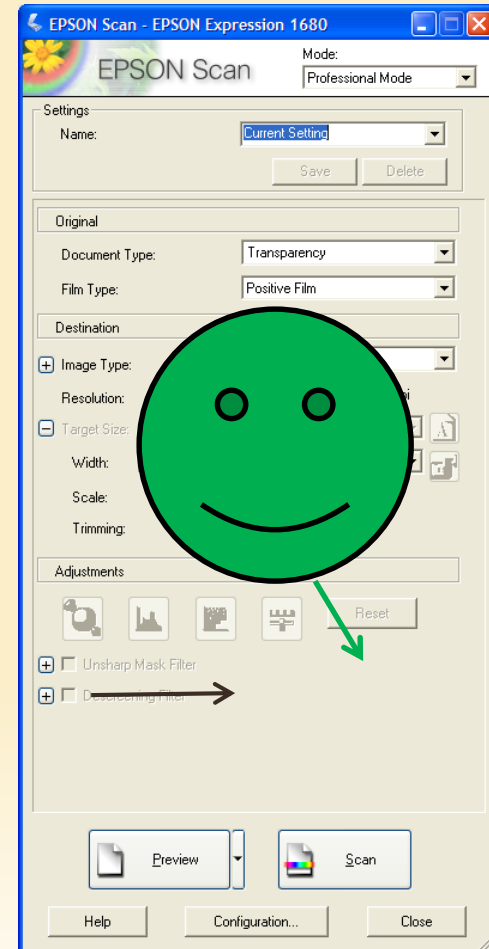
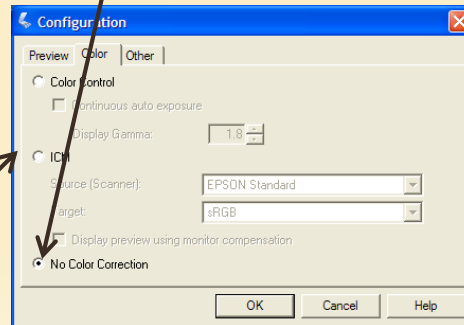
**GafChromic**

**ASHLAND**

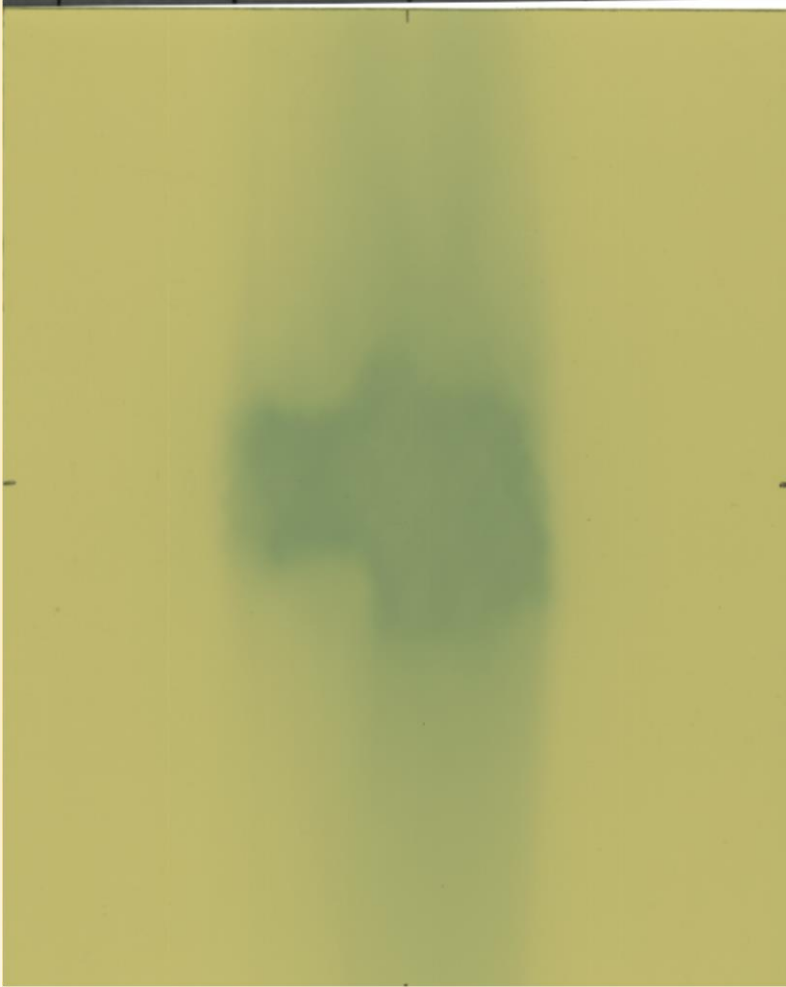
# WHAT DO I NEED TO KNOW ABOUT SCANNING? DISABLE ALL THE IMAGE ADJUSTMENT FEATURES



Check  
"No Color Correction"



# IMAGE COLOR CORRECTION

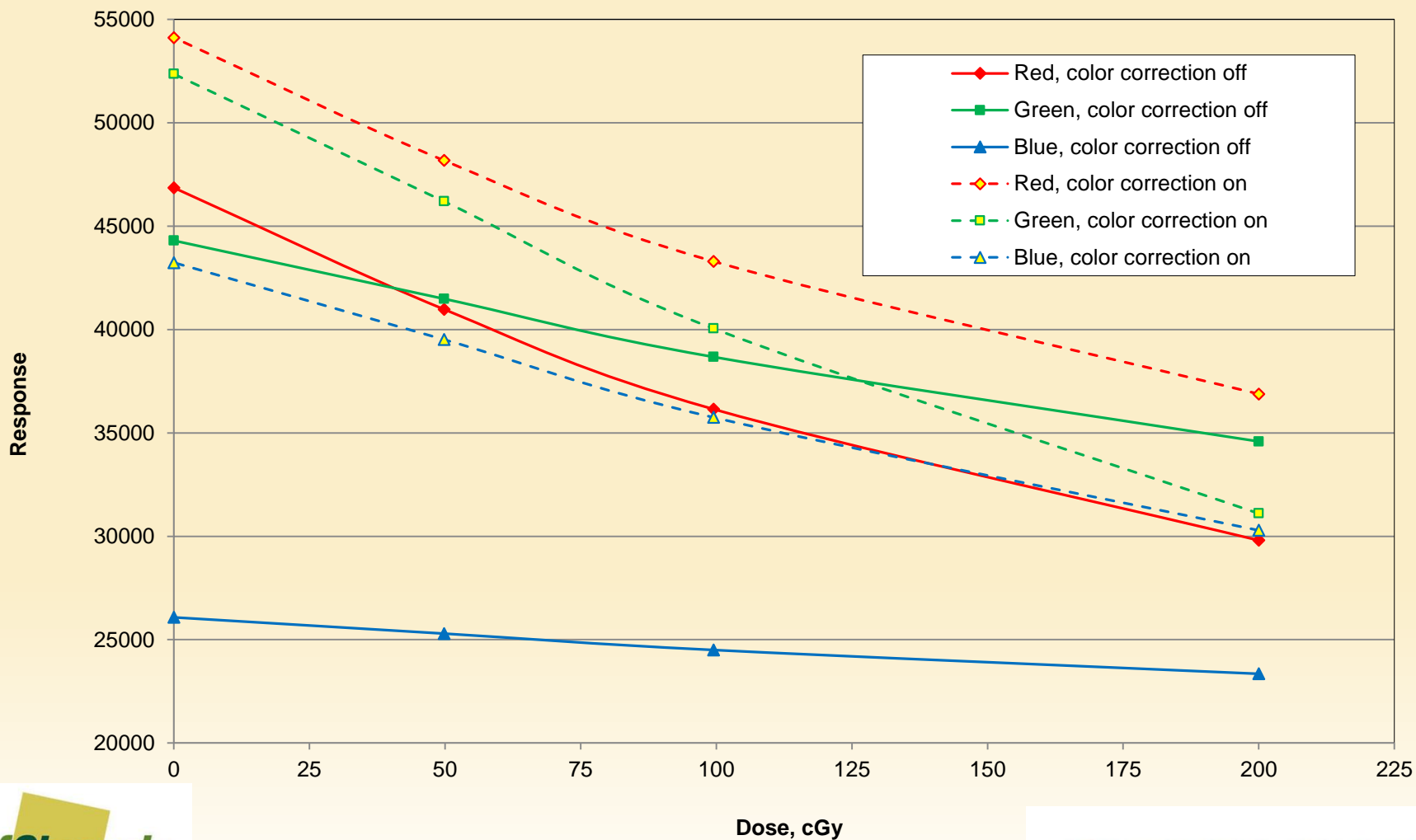


No color correction

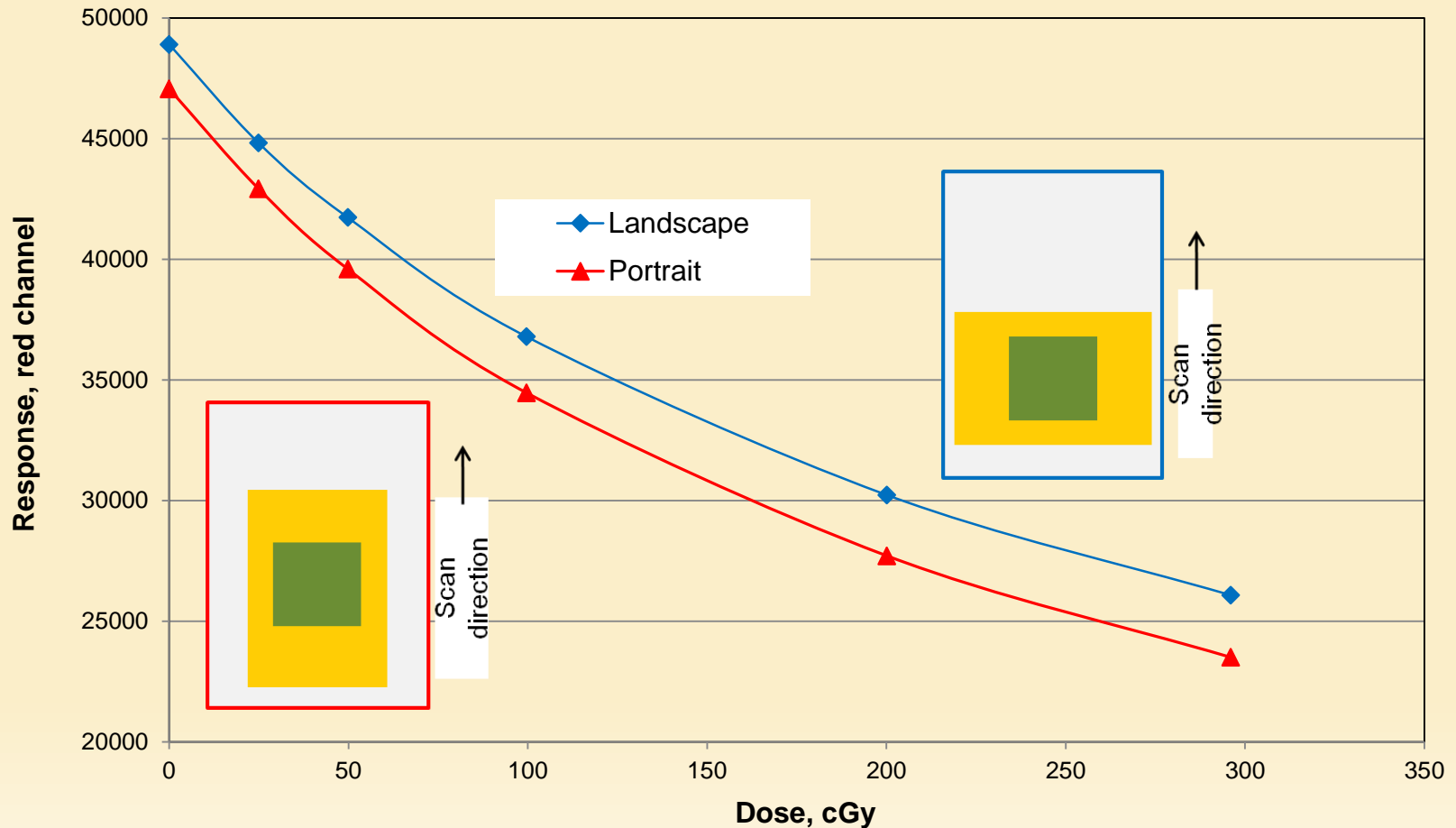


Color correction active

# CALIBRATION – EFFECT OF COLOR CORRECTION



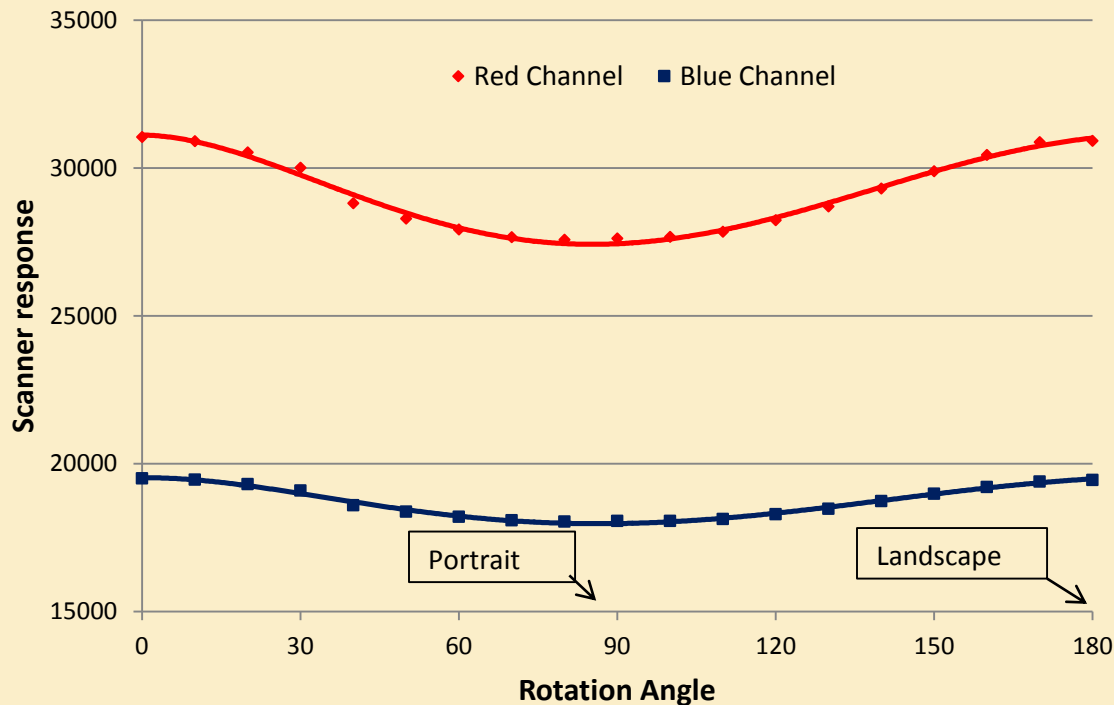
# ORIENTATION DEPENDENCE



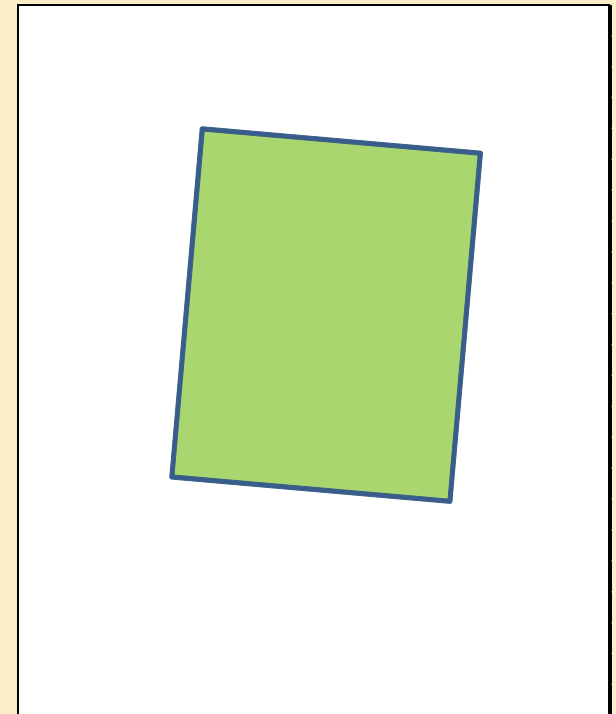
- Either orientation is usable
- But don't mix orientations!

# ORIENTATION DEPENDENCE

Angular Dependence of EBT2



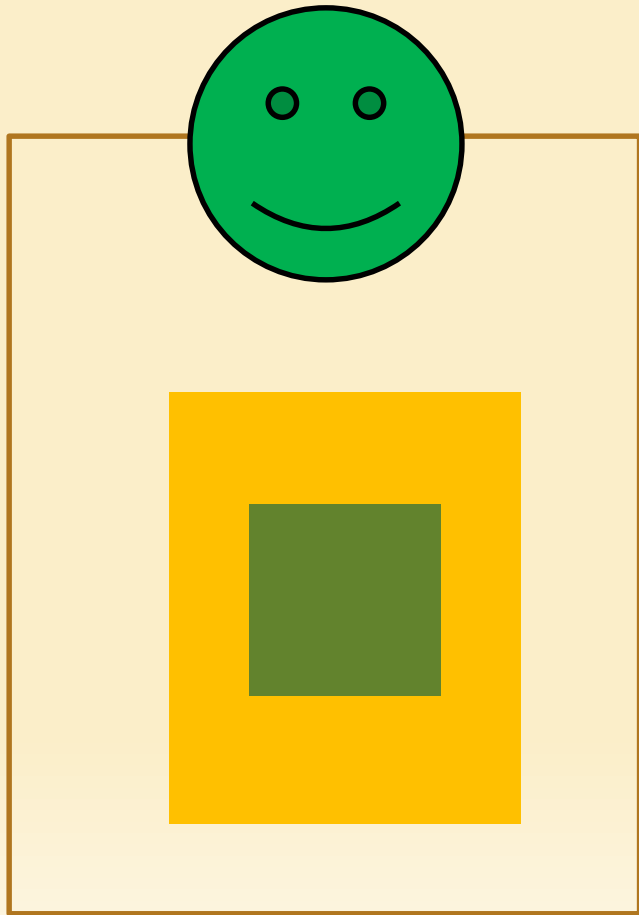
Response error is ~0.05% per degree  
Dose error ~0.15% per degree



5° misalignment on scanner

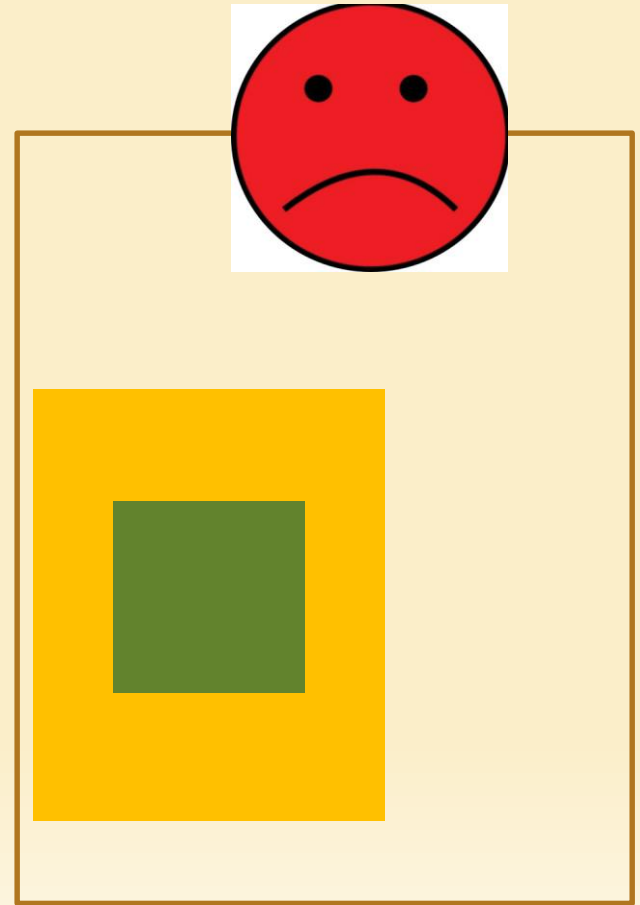
Conclusion: Misalignment is unlikely to cause significant error

# FILM PLACEMENT ON THE SCANNER



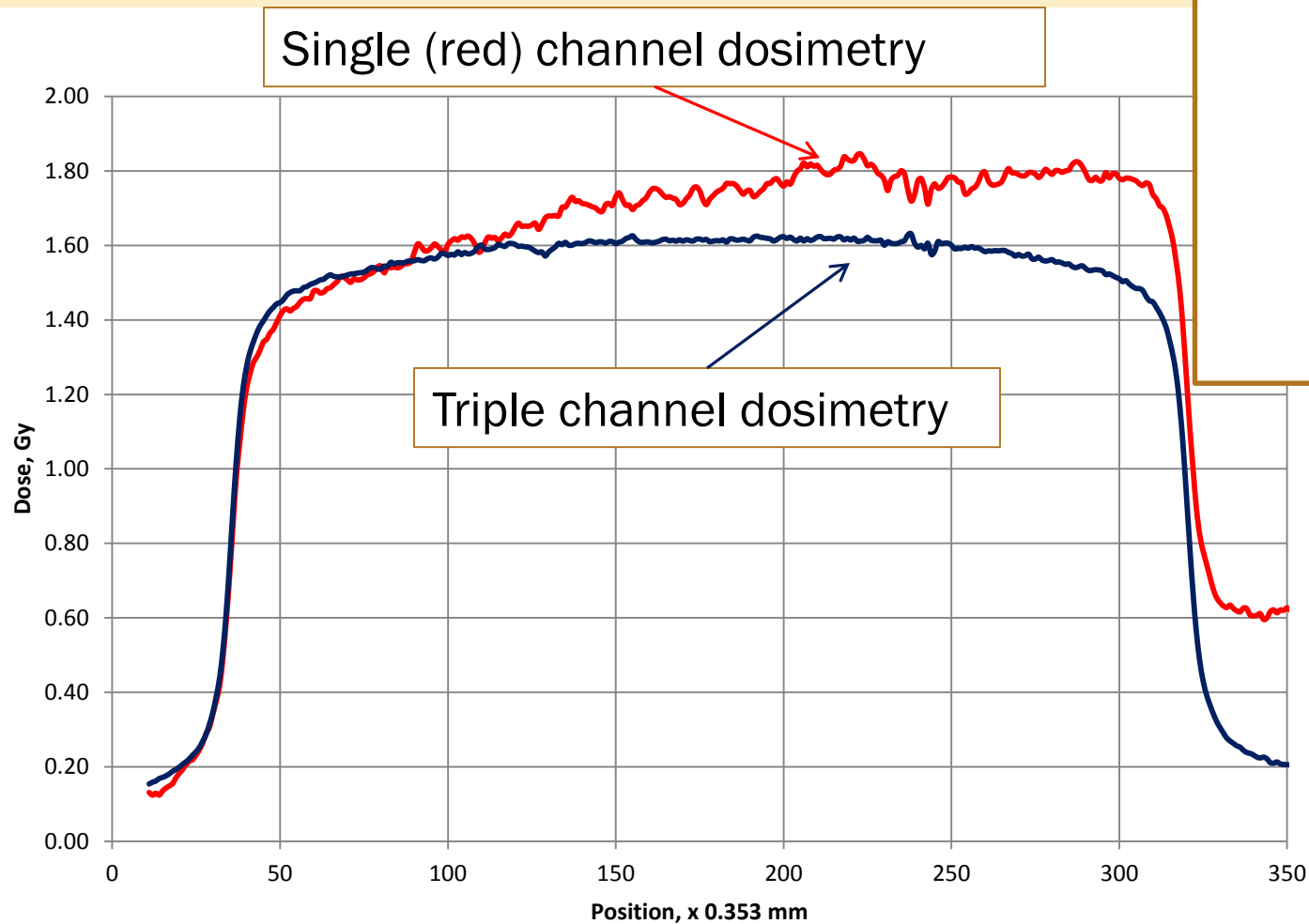
Central placement

↑  
Scan direction

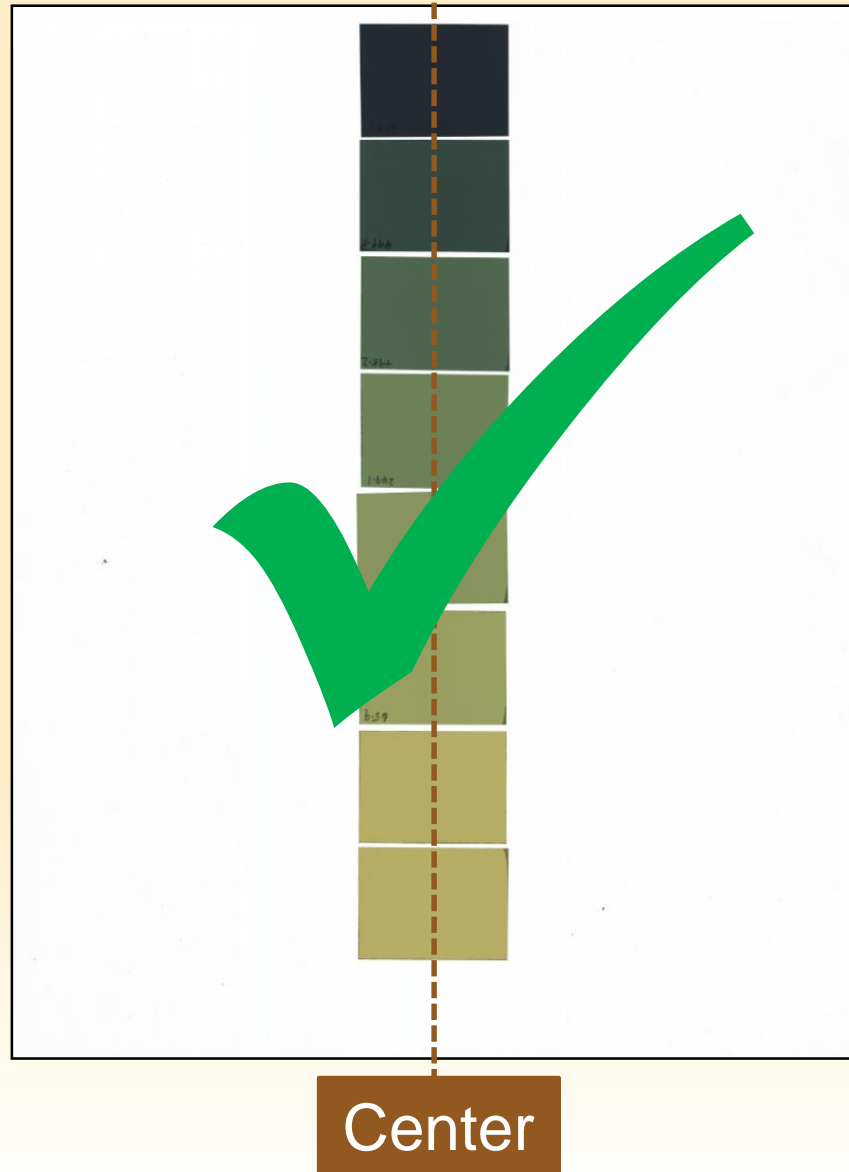


Lateral placement

# EFFECT OF FILM LATERAL DISPLACEMENT



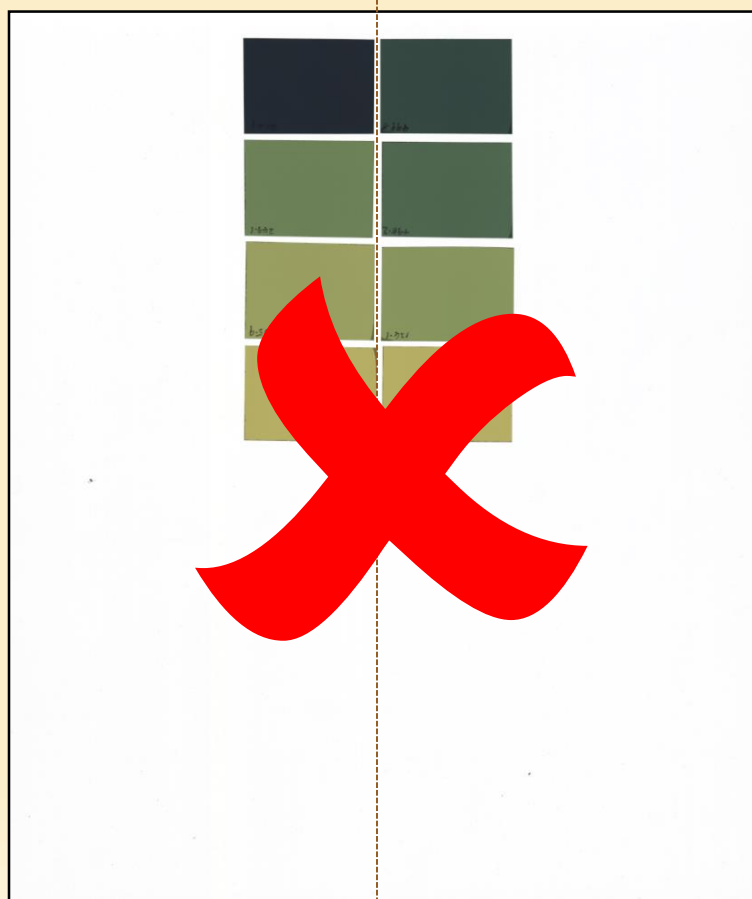
# CORRECT PLACEMENT FOR SCANNING



Scan  
direction

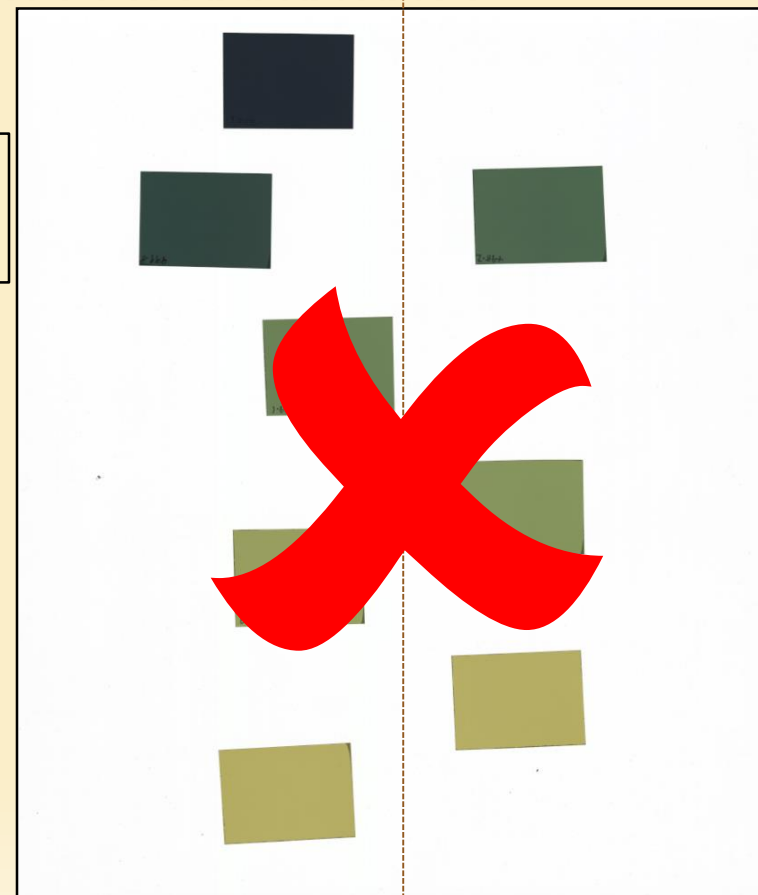


# INCORRECT PLACEMENT FOR SCANNING



Center

Scan  
direction



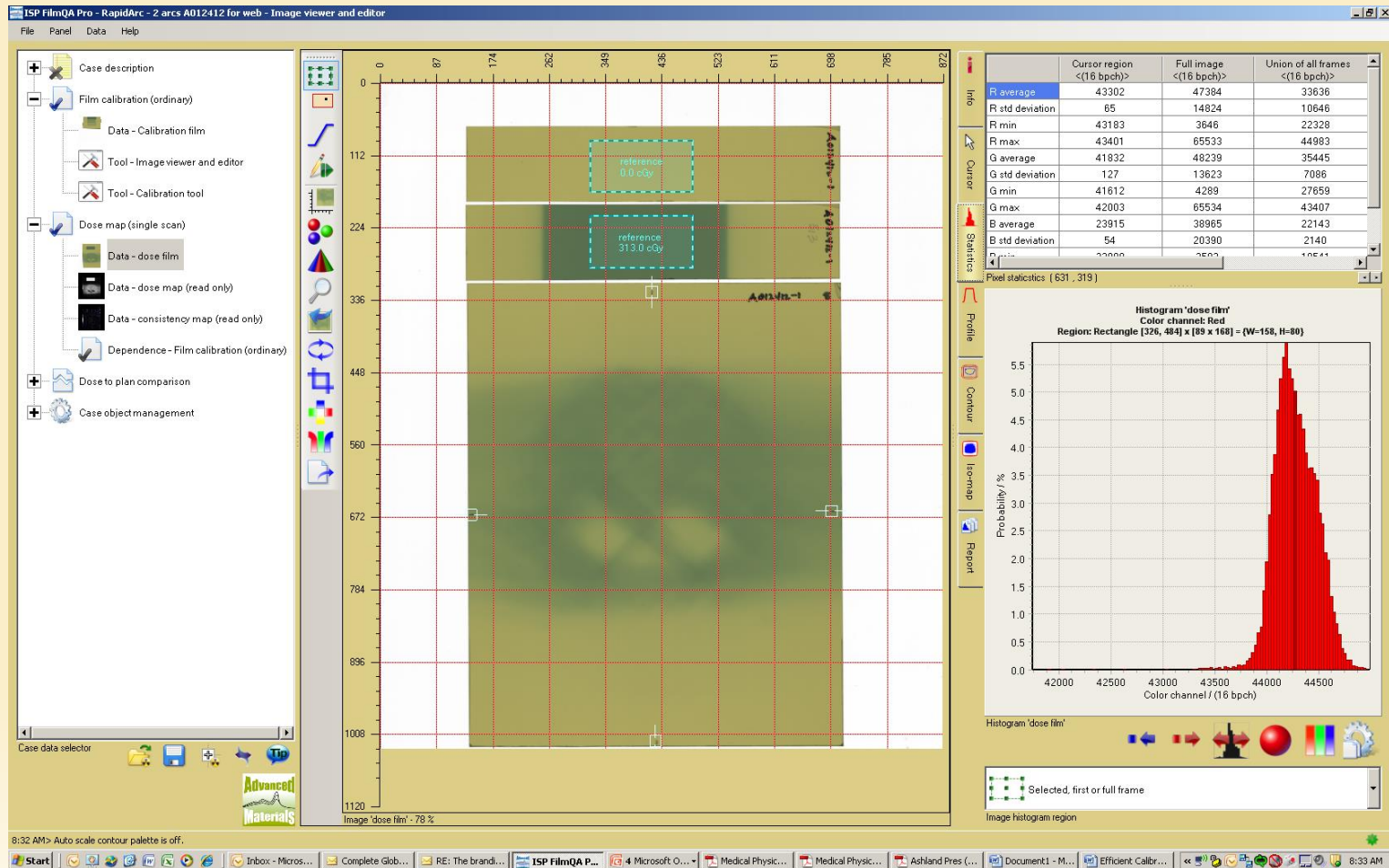
Center

# PERCEIVED DIFFICULTIES OF USING FILMS

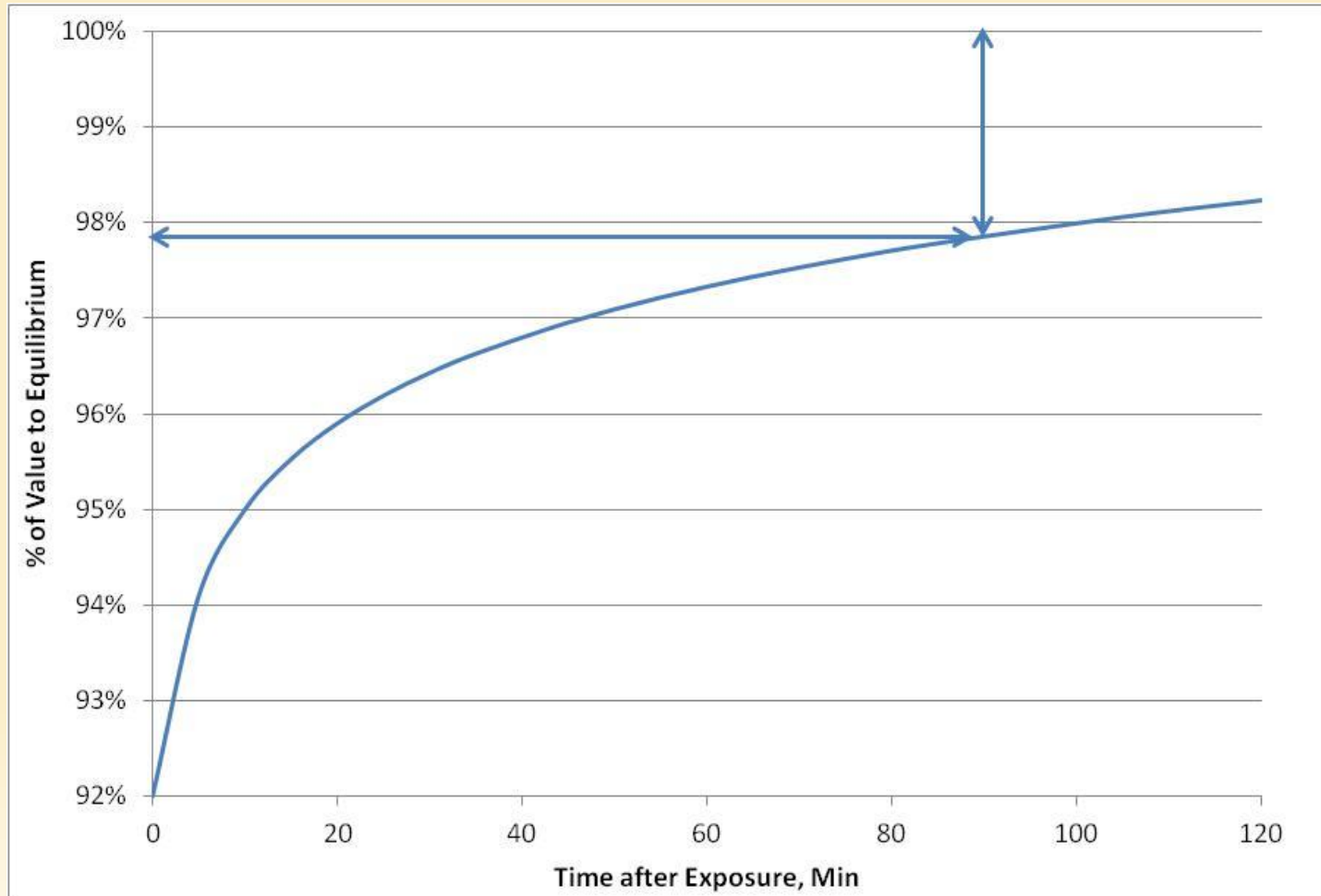
- ✗ Waiting time after exposure
  - + Post-exposure film density change
- ✗ Scanning variations
  - + Inter-scan variation
  - + Ambient temperature/moisture change
- ✗ Multiple calibrations
  - + Film aging
  - + Photon energy

SOLUTION:  
ONE SCAN PROTOCOL

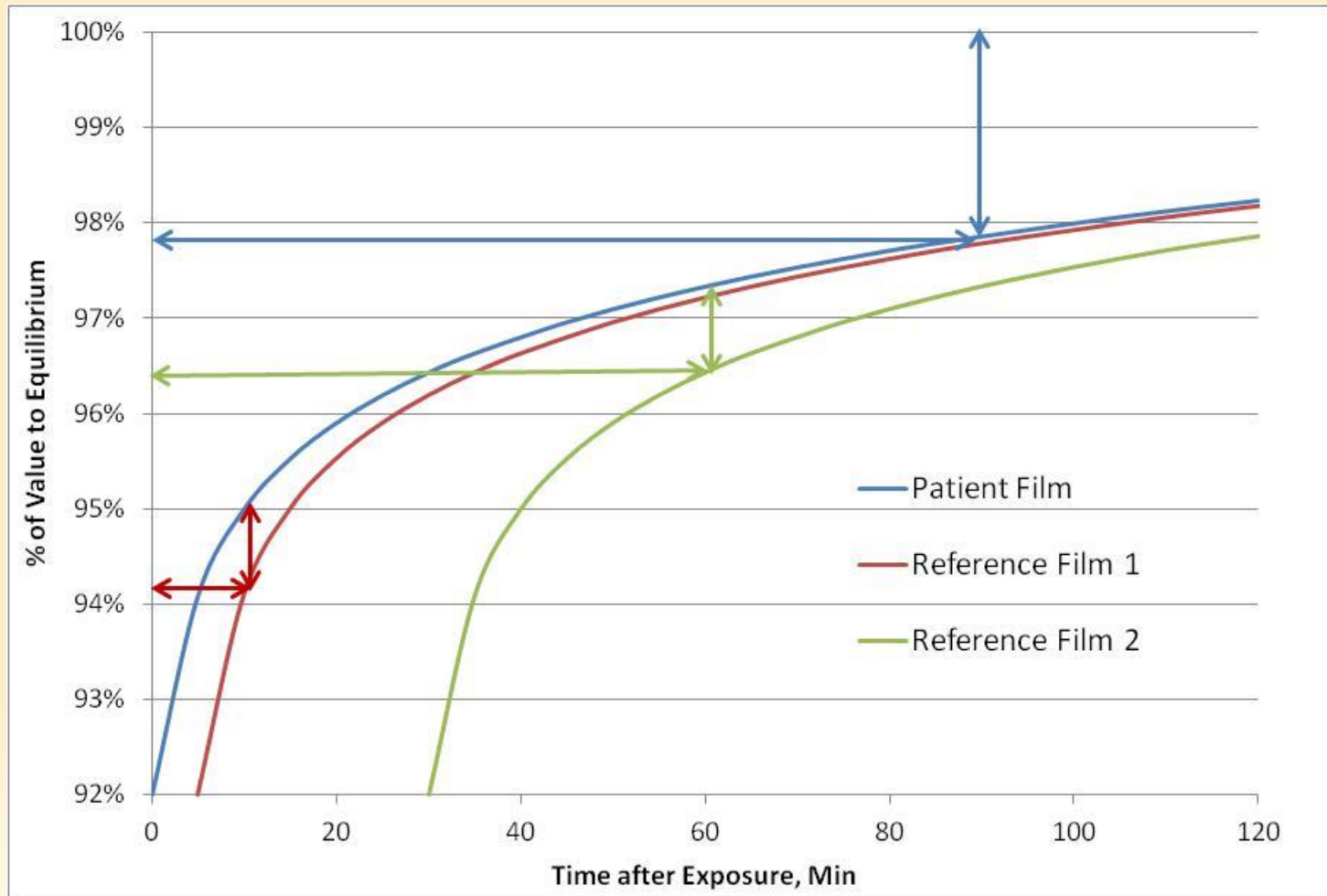
# ONE SCAN DOSIMETRY: DOSE RESCALING



# DEALING WITH POST EXPOSURE DENSITY GROWTH

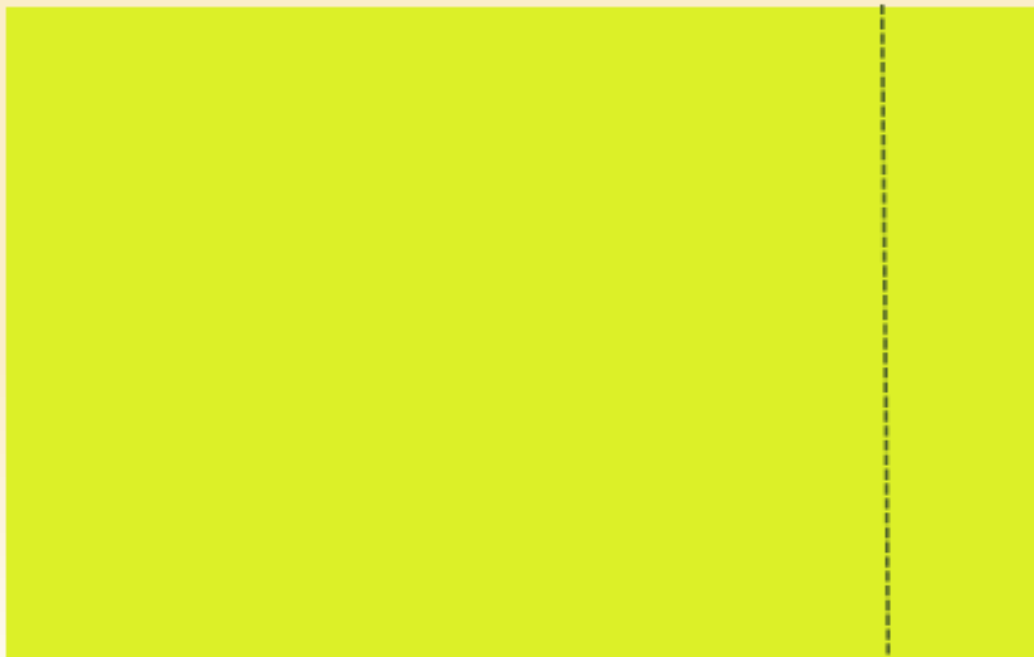


# REDUCE POST-EXPOSURE WAIT WITH ONE SCAN



# WHAT IS EBT3+?

- ✗ EBT3 film in a special format
  - + Matched application film and reference strip
  - + 20.3 x 24.1 cm<sup>2</sup> sheet and 3.8 x 20.3 cm<sup>2</sup> strip
  - + Provided for “One-scan” dosimetry protocol



# NEW PERFORMANCE STANDARD

Film is  
~~time-consuming.~~  
*quick*

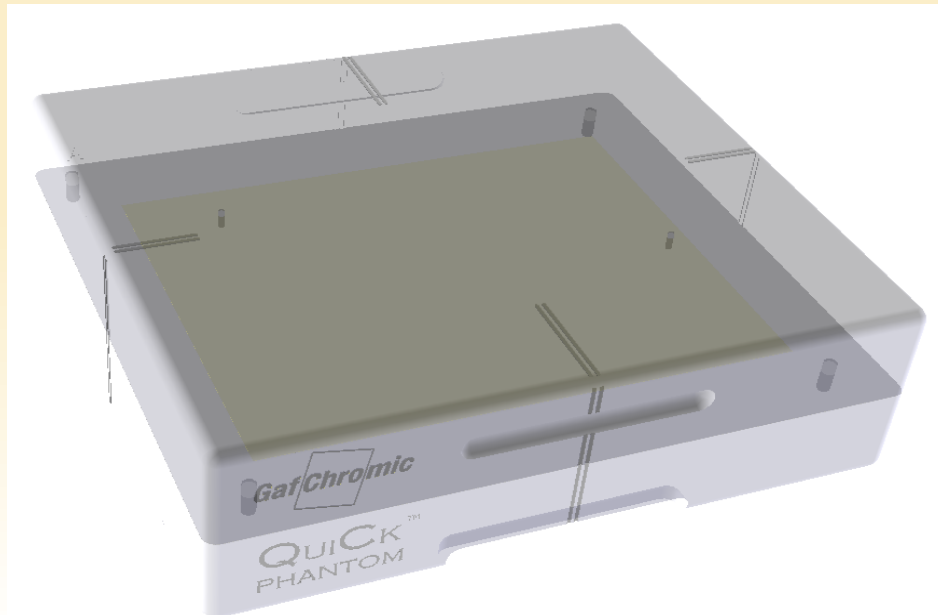
**GafChromic**

**ASHLAND**

## Why One-scan dosimetry?

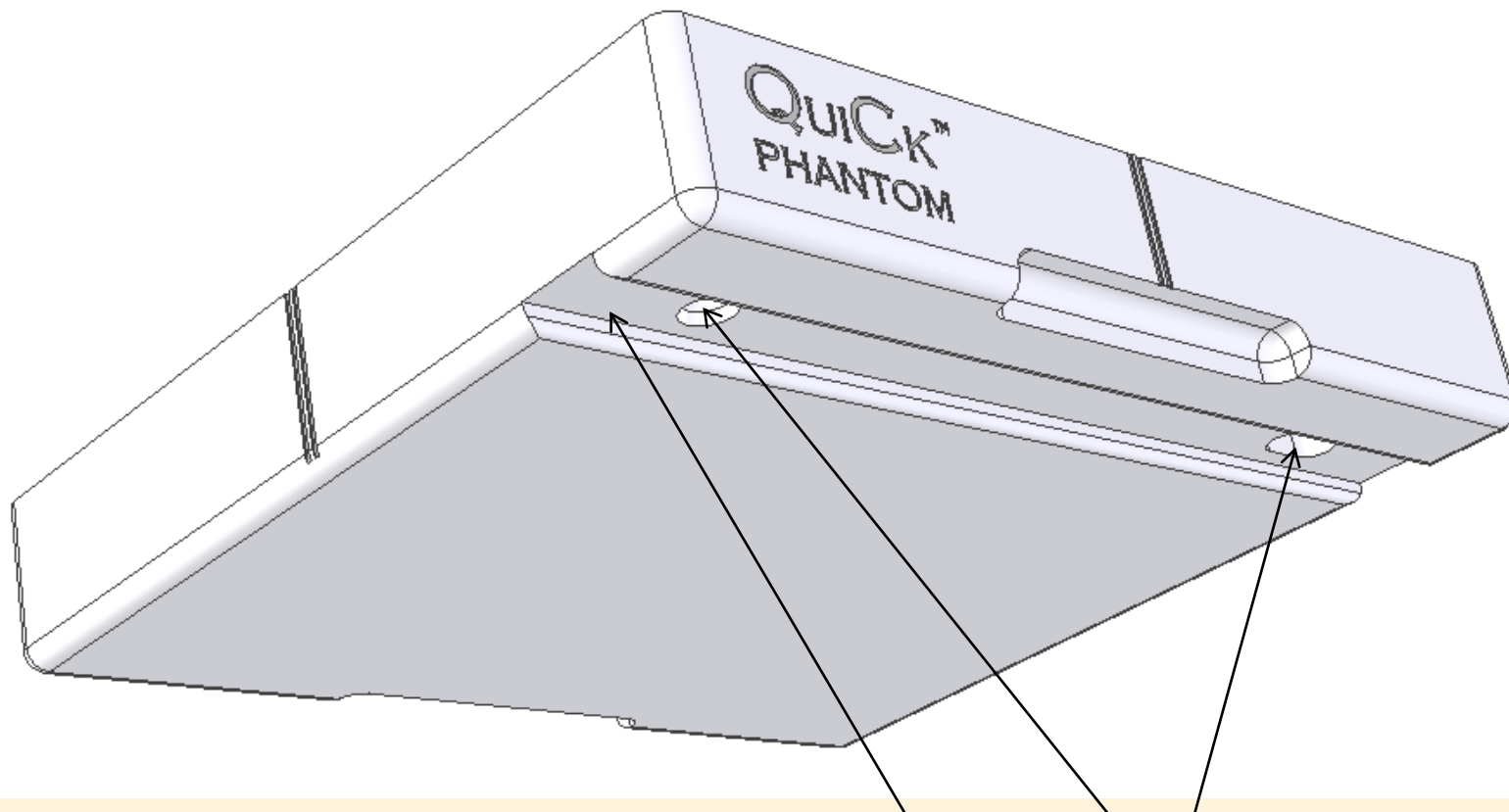
- Fast – results in minutes
  - Less exposures and scanning
- Uncomplicated
  - Easy use
- Economical
  - Less film consumption
- Reliable and Accurate
  - Multi-Channel Dosimetry

# NEW GAFCHROMIC QUICK PHANTOM



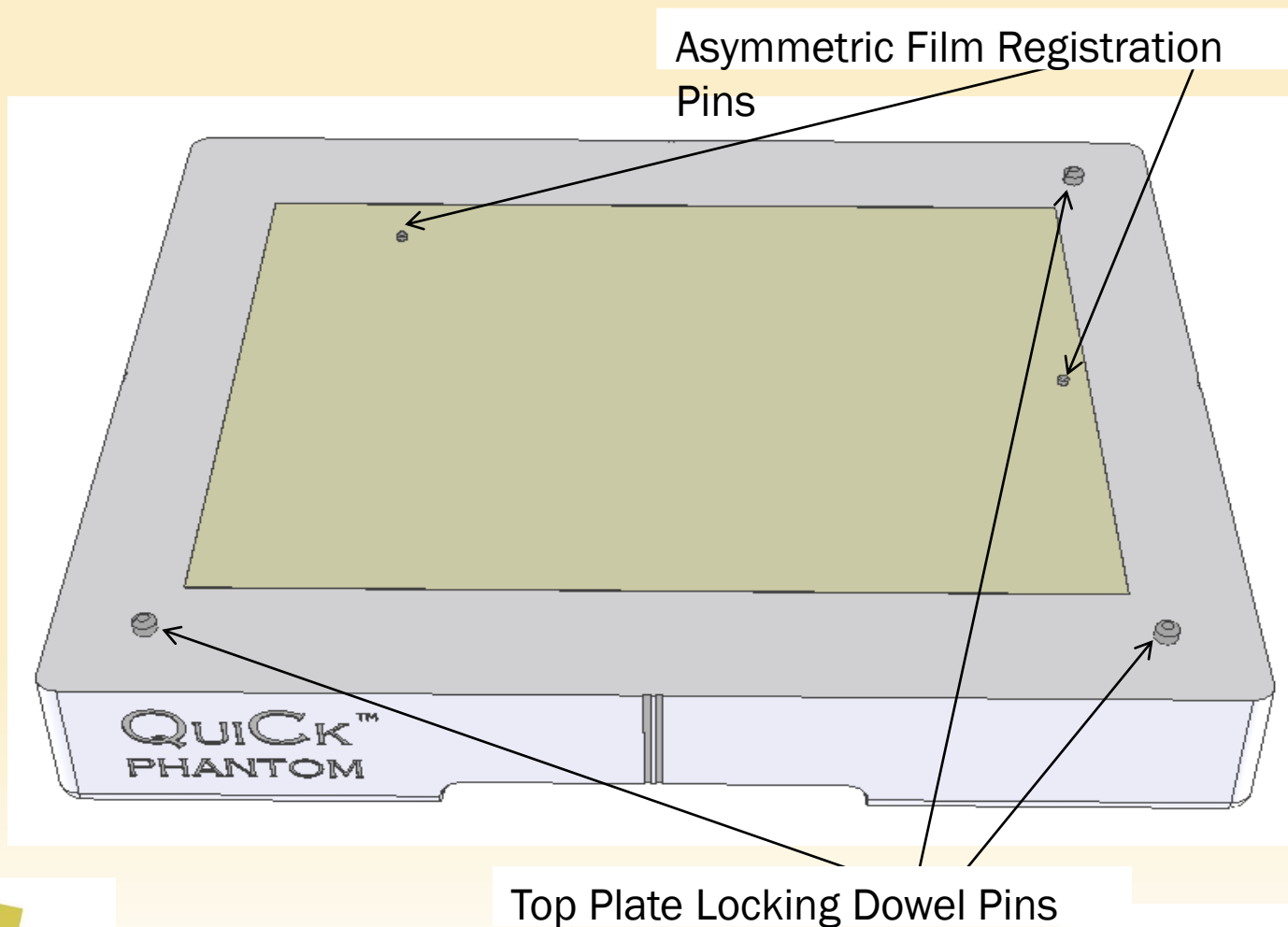
**ASHLAND.**

# NEW GAFCHROMIC QUICK PHANTOM



Groove and two holes to fit standard two Pin patient positioning index bar

# NEW GAFCHROMIC QUICK PHANTOM



# NEW GAFCHROMIC FILM DOSIMETRY

- ✗ Multi-channel dosimetry corrects/mitigates film and scanner artifacts
- ✗ One scan protocol
  - + Inter-scan variability/environmental effects are avoided
  - + Post-exposure timing rules are relaxed
  - + No concern whether a calibration is still valid
- ✗ Quick Phantom for quick and accurate film positioning and easy analysis flow
- ✗ Simpler, Faster, and More Accurate

# FUTHER QUESTIONS?

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## ✖ For more information

+ [www.gafchromic.com](http://www.gafchromic.com)

+ [www.FilmQAPro.com](http://www.FilmQAPro.com)

+ [www.FilmQAXR.com](http://www.FilmQAXR.com)

## ✖ Contact us

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+ [xiangyu@ashland.com](mailto:xiangyu@ashland.com)

WITH THE NEW PROTOCOL AND OUR EFFORTS

