

The RPC's Evaluation of Advanced Technologies



ATC Steering Committee
October 2, 2008
Geoffrey S. Ibbott, Ph.D.
and
RPC Staff



RPC

Radiological Physics Center
Excellence through Quality Assurance

- <http://rpc.mdanderson.org>

THE UNIVERSITY OF TEXAS
MD ANDERSON
CANCER CENTER
Making Cancer History®

Supported by:
NCI grants CA10953 and CA81647



RPC's Conventional Monitoring

- 💡 Annual checks of machine output
 - ◆ 1,532 institutions, 13,729 beams measured with TLD (2006)
- 💡 On-site dosimetry reviews
 - ◆ 50 institutions visited (150 accelerators measured)
- 💡 Credentialing
 - ◆ Phantoms, benchmarks, questionnaires, rapid reviews
- 💡 Treatment record reviews
 - ◆ Review for GOG, NSABP, NCCTG, RTOG (brachy)
- 💡 Independent recalculation of patient dose
 - ◆ Continue to find errors

Credentialing

Why?

- Education
- Evaluate ability to deliver dose
- Improve understanding of protocol

Reduce deviation rate

General Credentialing Process

- ★ Previous patients treated with technique
- ★ Facility Questionnaire
- ★ Knowledge Assessment Questionnaire
- ★ Benchmark case or phantom
- ★ Electronic data submission
- ★ RPC QA & dosimetry review
- ★ Clinical review by radiation oncologist

Feedback
to
Institution

Credentialing Information on our Web Site



RPC Radiological Physics Center
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Office Hours:
8 A.M. to 5 P.M.
M-F Central time.
Holidays

Services
Forms
Publications
Brachy Sources
Research/TG-51
Upcoming Meetings



Credentialing

Open: [RTOG 0617](#) Phase III intergroup trial randomizing NSCLC patients to conventional RT versus high-dose conformal RT. Also: [RTOG 0618](#), [RTOG 0621](#), [RTOG 0622](#), [RTOG 0623](#), [RTOG 0630](#) and [GOG 0238](#) are ready for you to become credentialed.

Proton Therapy Questionnaire New requirement of all proton facilities participating on NCI sponsored clinical trials

New Phantom Requirements: The RPC has begun requiring electronic submissions of all phantom irradiations. [\[more\]](#)

NCI Guidelines: Click here for the latest NCI guidelines on the use of [protons](#) and [IMRT](#) in clinical trials.

Radiation exposures from CT: A new article in the [New England Journal](#) by David Brenner and Eric Hall calls attention to the recent increase in utilization of CT and the corresponding increase in dose. [\[more\]](#)



Radiation Dosimetry Services offers mailed dosimeters and anthropomorphic phantoms for dosimetry QA.



AAPM 2008

[abstracts](#)



Challenges in Credentialing Institutions and Participants in Advanced Technology Multi-institutional Clinical Trials Geoffrey S. Ibbott Ph.D., David S. Followill Ph.D., H. Andrea Molineu M.S., Jessica R. Lowenstein M.S., Paola E. Alvarez M.S. and Joye E. Roll C.M.D.



Publication on Physics of Clinical Trials We recommend AAPM Report 86 for physicists who want to know more about the conduct of clinical trials and their physics and QA requirements.



Short Courses Physics courses related to therapeutic radiology offered at the University of Texas M. D. Anderson Cancer Center.



The ADCL at M. D. Anderson Cancer Center is fully accredited for external beam and brachytherapy calibrations. [FAQ about ADCL](#)

Contact us
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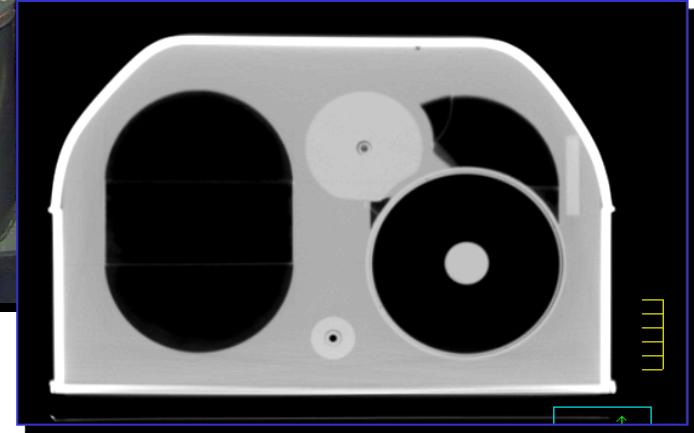
Updated on: 11/2/2007
You are visitor #44115.



RPC Phantoms



prostate IMRT: 4, incl. prosthesis



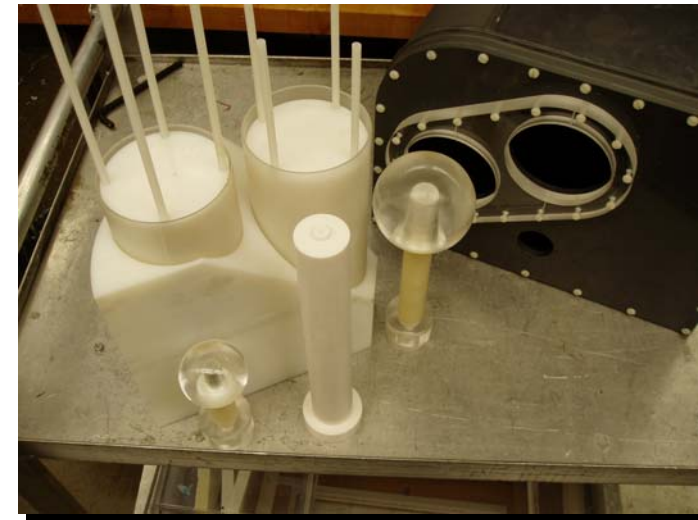
thorax SBRT: 9 phantoms



H&N IMRT: 31 in service

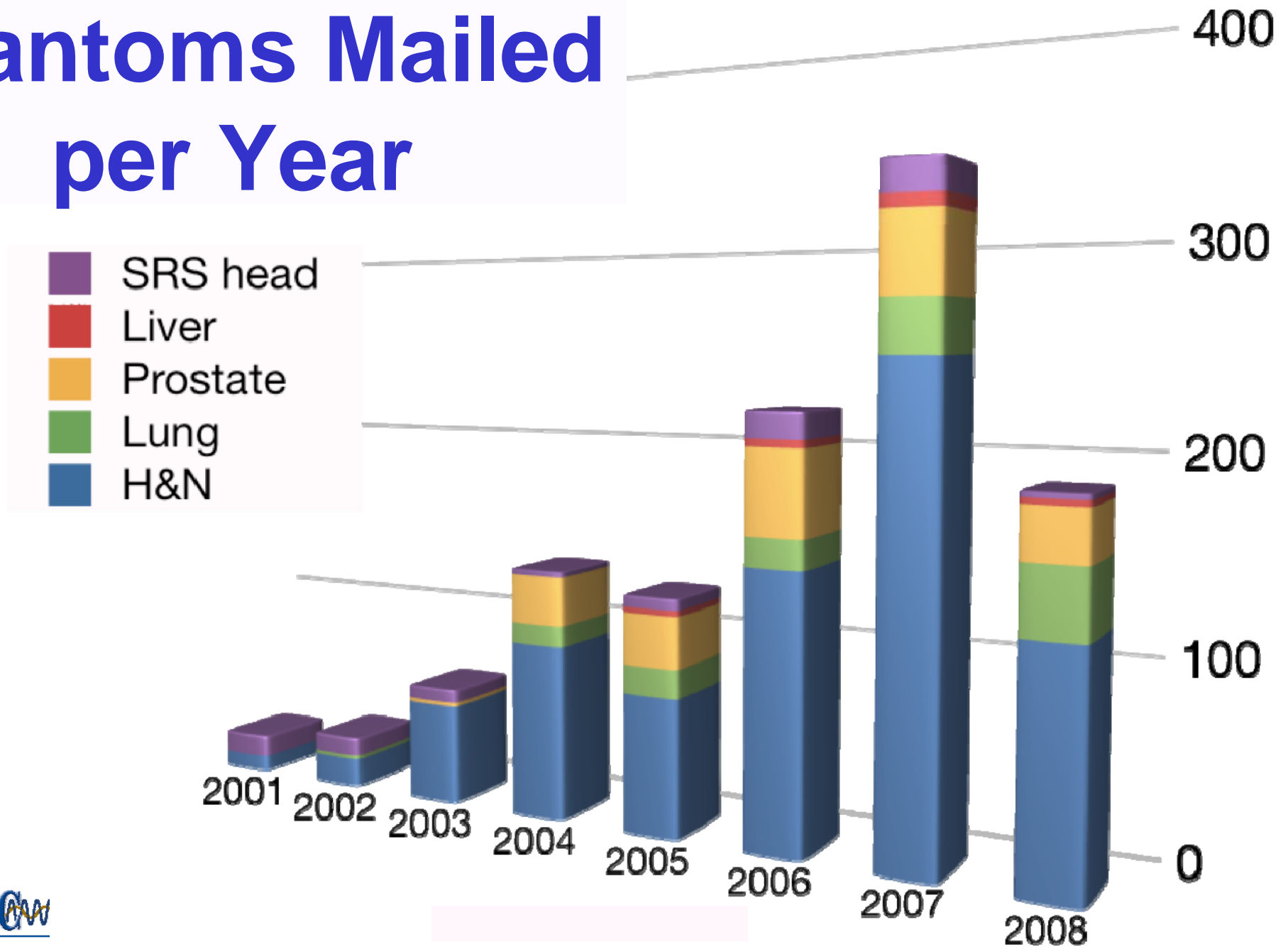


SRS: 2 in service, others sent by RDS

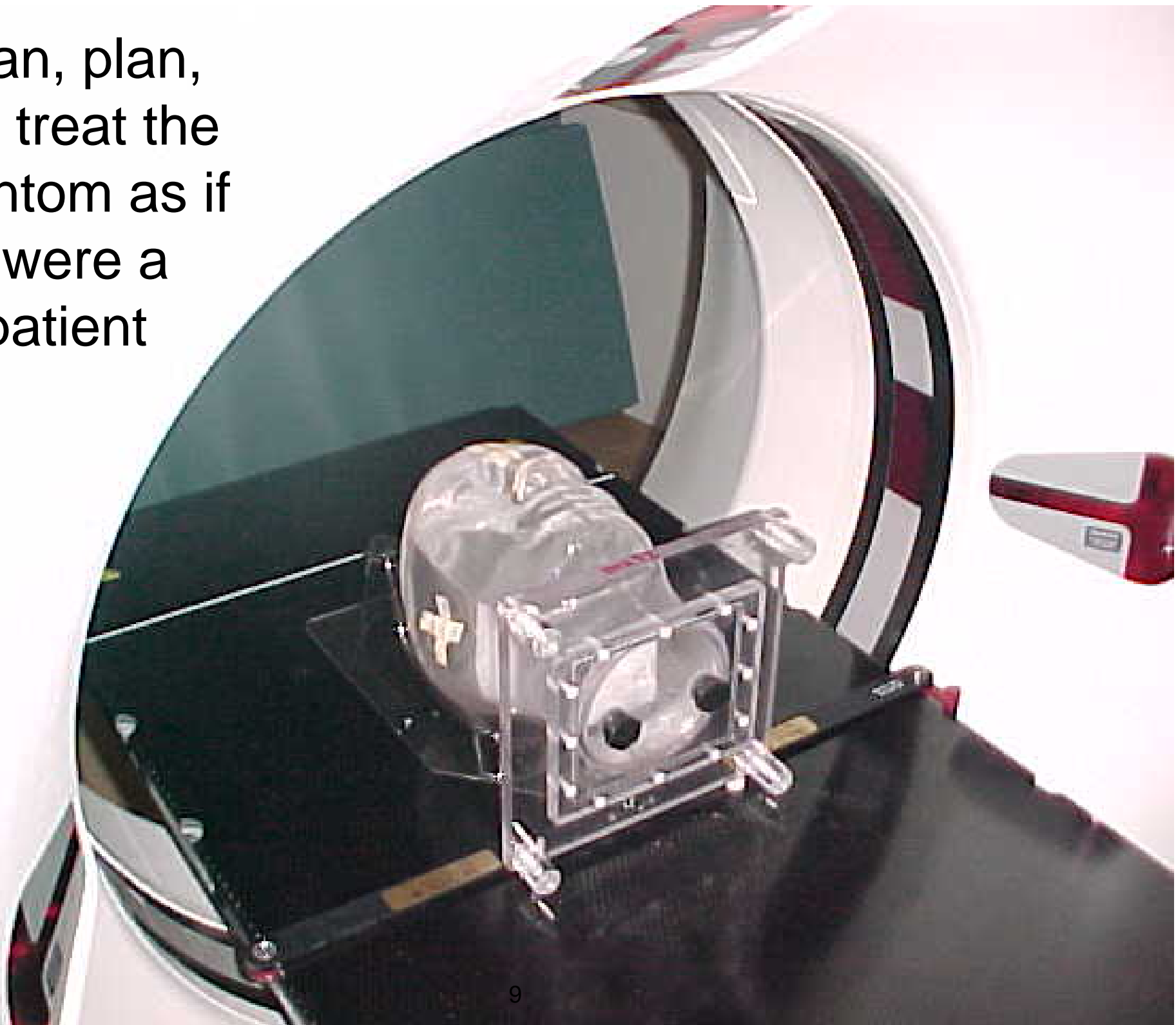


liver SBRT: 2, incl. motion

Number of Phantoms Mailed per Year

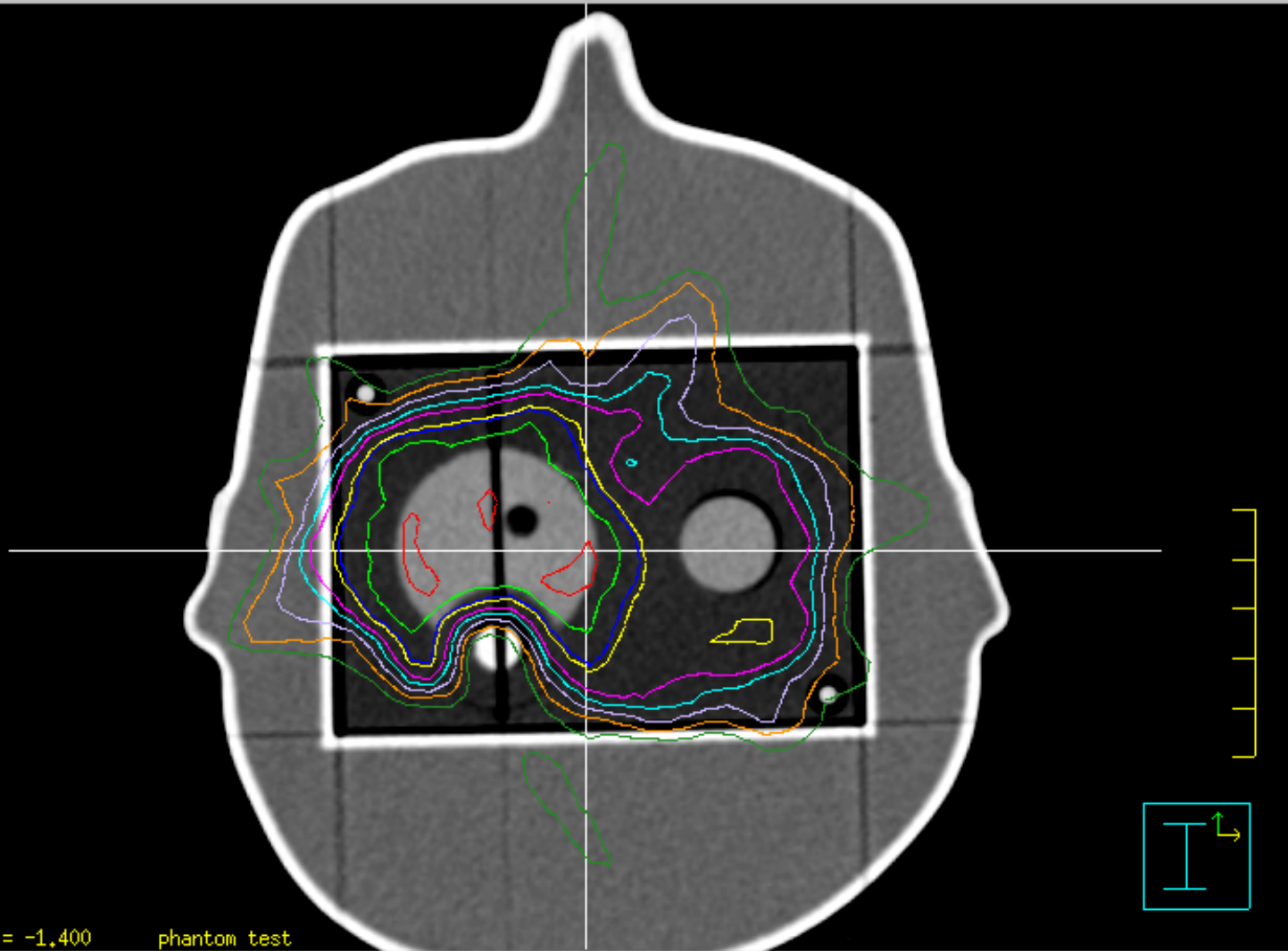


Scan, plan,
and treat the
phantom as if
it were a
patient



Absolute

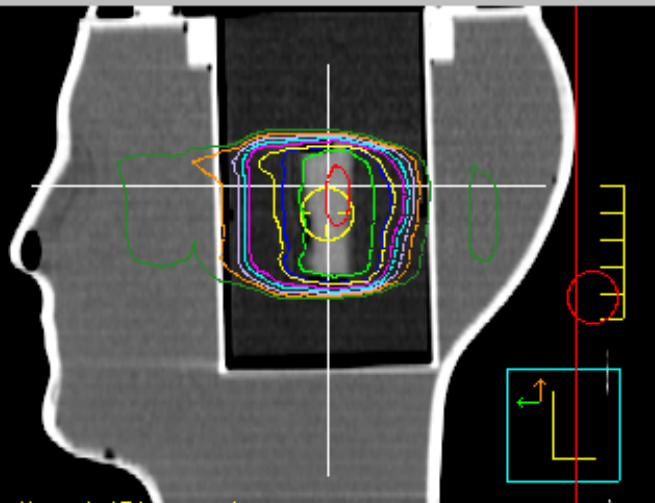
- 700,0 cGy
- 660,0 cGy
- 614,0 cGy
- 600,0 cGy
- 540,0 cGy
- 502,0 cGy
- 450,0 cGy
- 400,0 cGy
- 350,0 cGy



Slice 83: Z = -1.400 phantom test

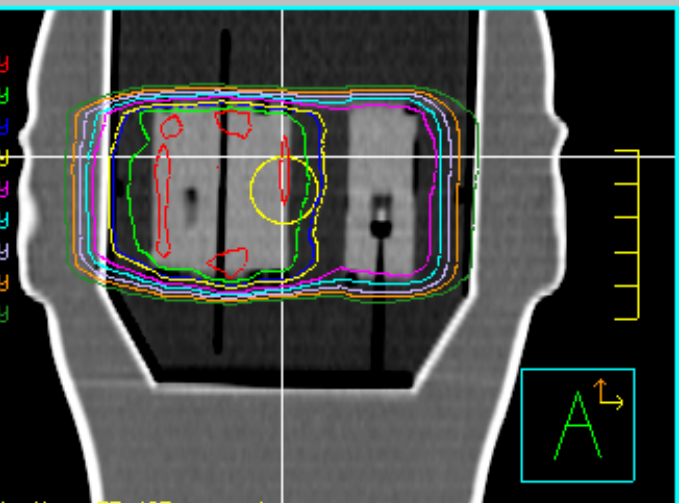
Absolute

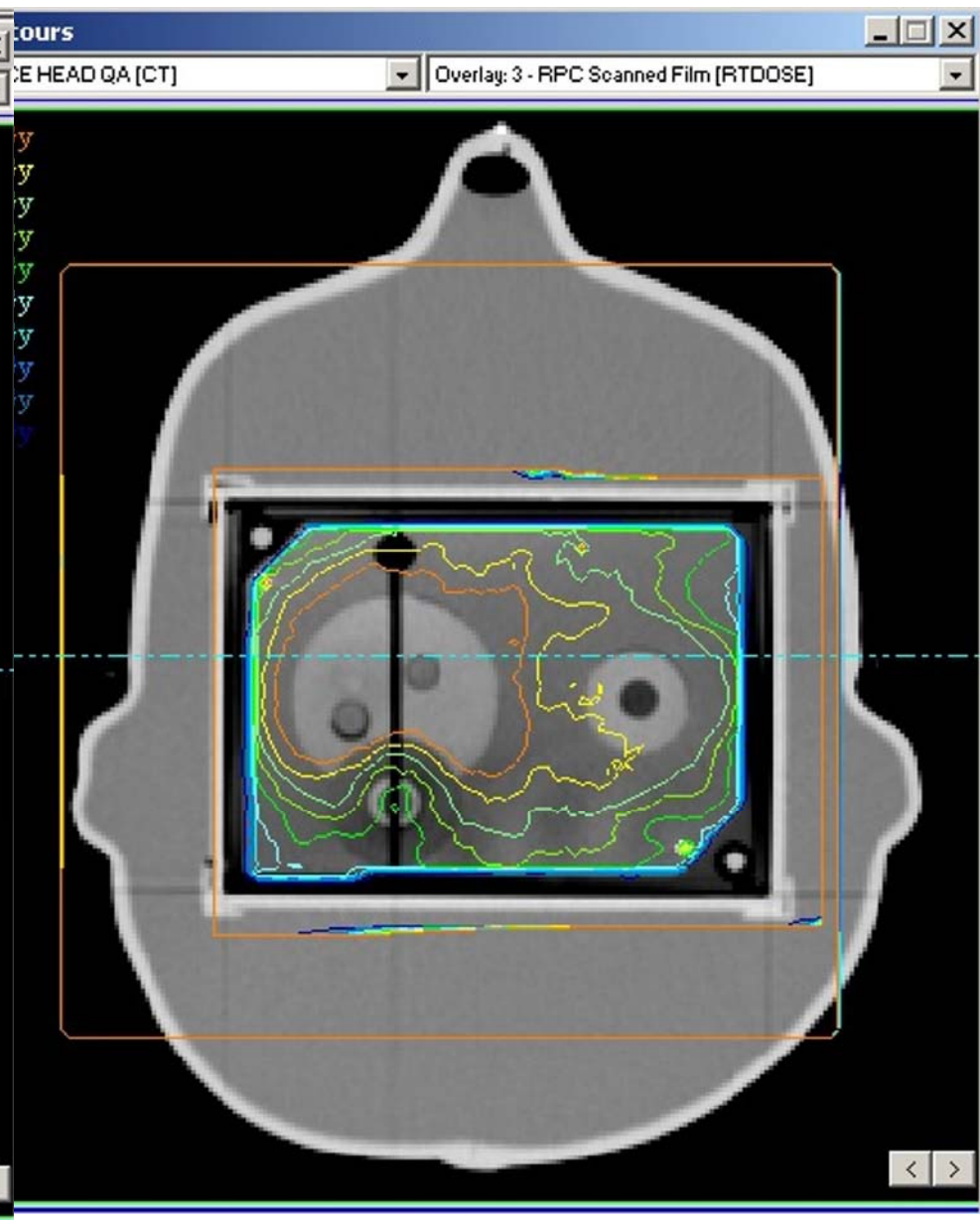
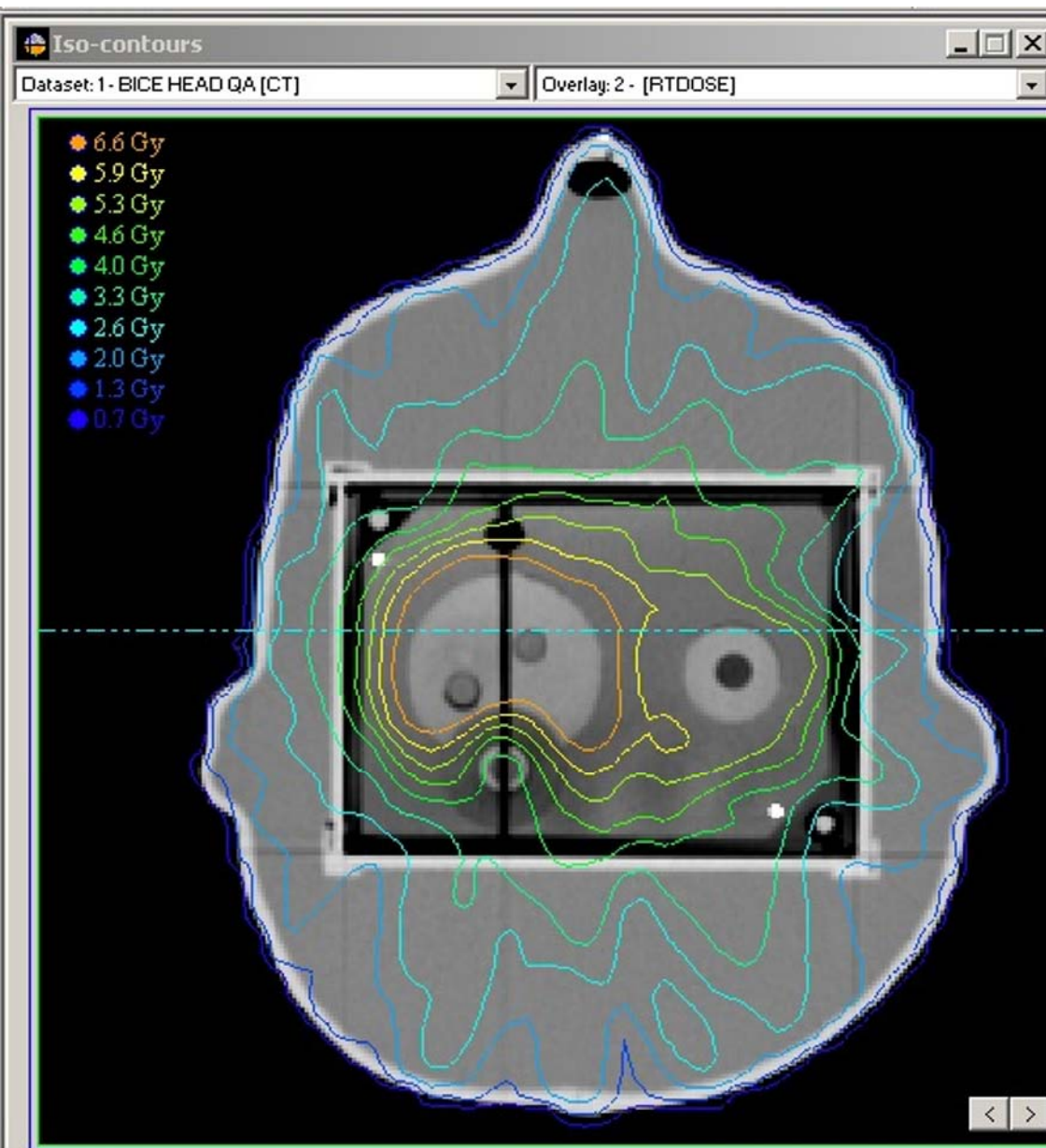
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Absolute

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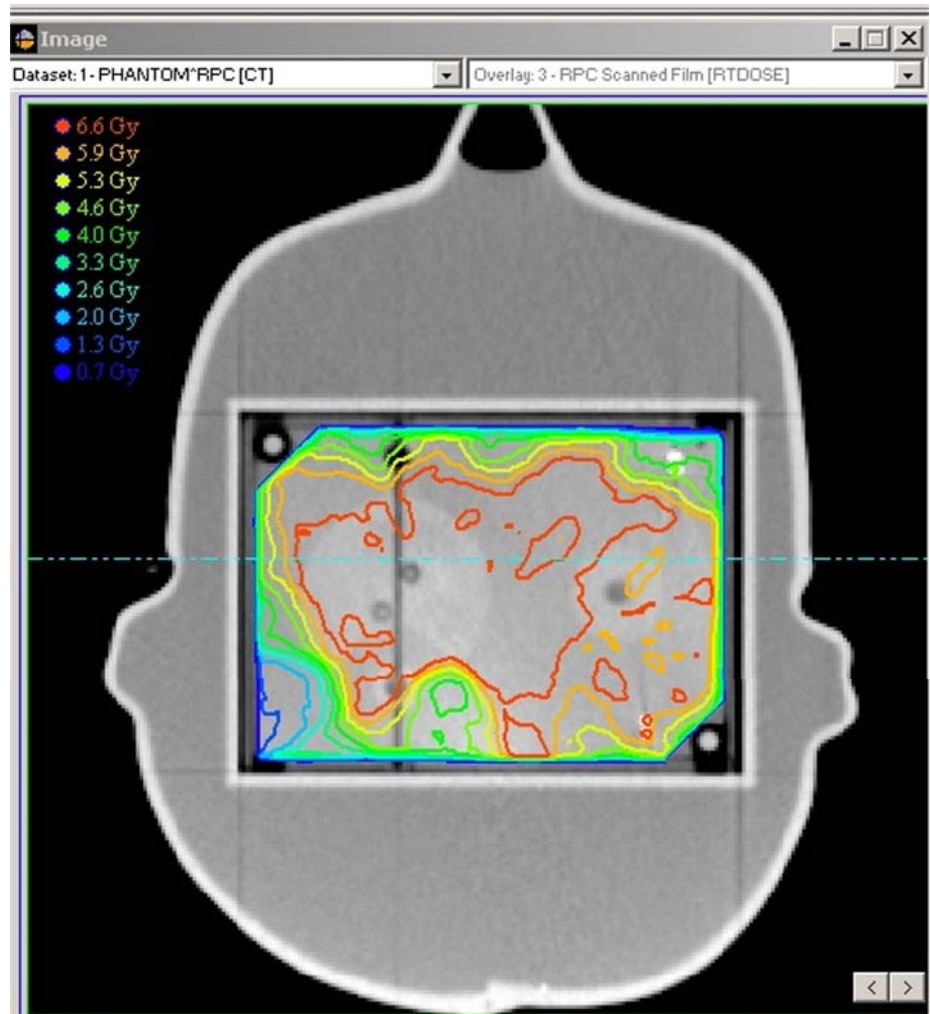
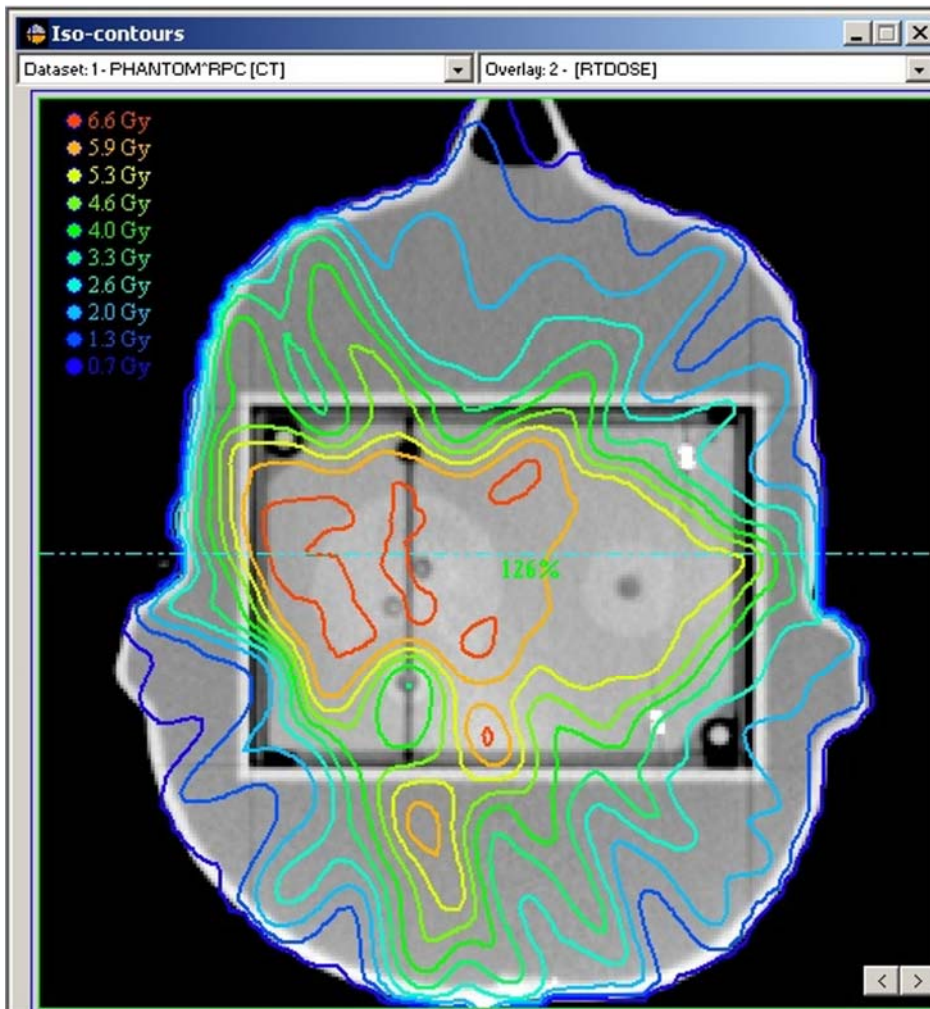


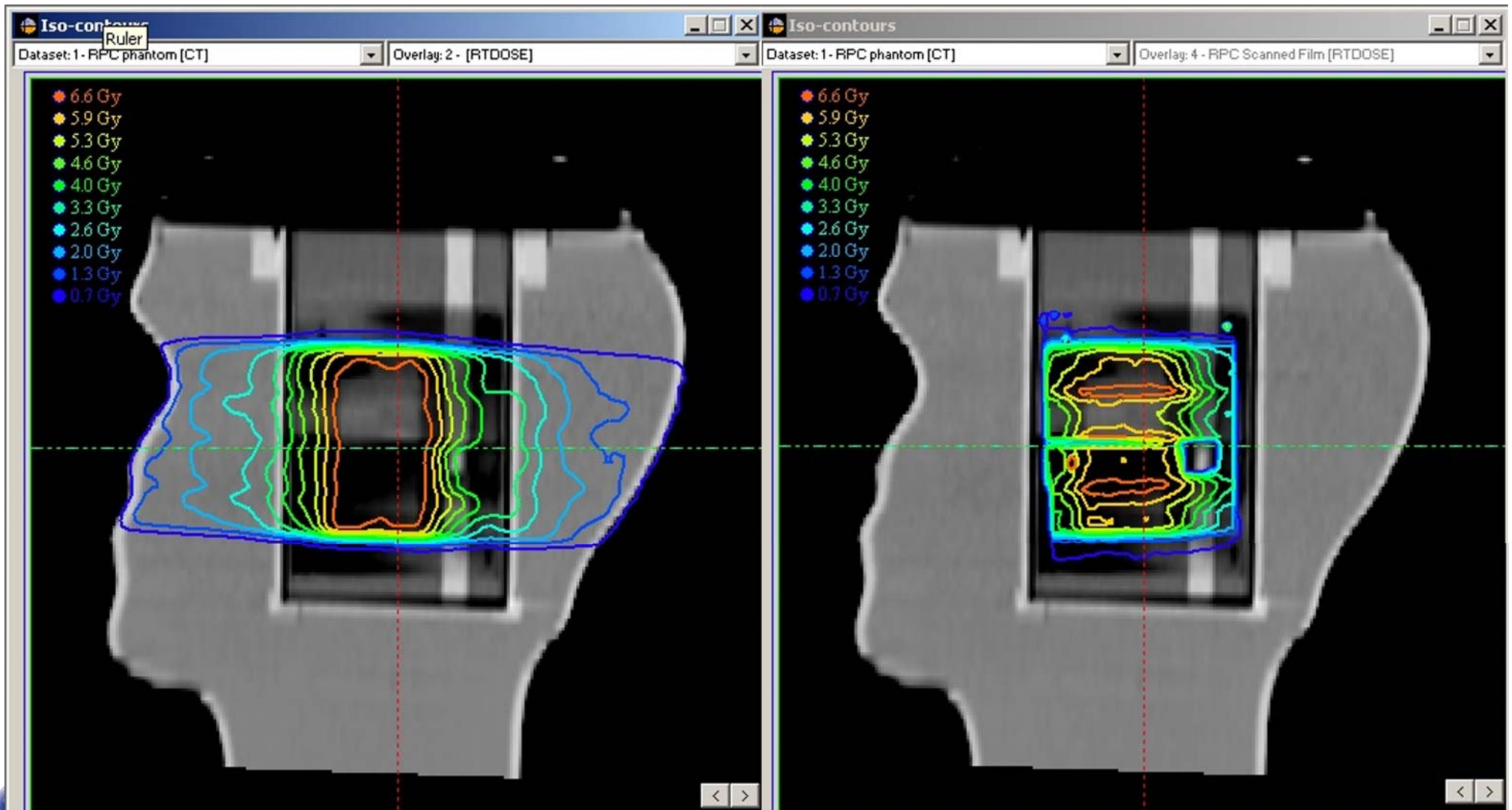


Phantom Results

Comparison between institution's plan and delivered dose.
Criteria for agreement: 7% or 4 mm DTA (or 5%/5mm)

Site	Technique	Irradiations	Acceptable irradiations	Institutions acceptable
H&N	IMRT	558	425	377
Pelvis	IMRT	109	89	74
Lung	SBRT/IMRT	55	42	35
Liver	SBRT	13	6	6
Benchmark	IMRT	89 (19)	55 (18)	





HN results grouped by accelerator manufacturer

Linear Accelerator Manufacturer	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
BrainLab	100	5	0	0	0
Elekta	60	35	11	2	1
Siemens	71	56	10	2	4
TomoTherapy	73	22	5	1	0
Varian	80	301	39	8	14
Total		419	65	13	19

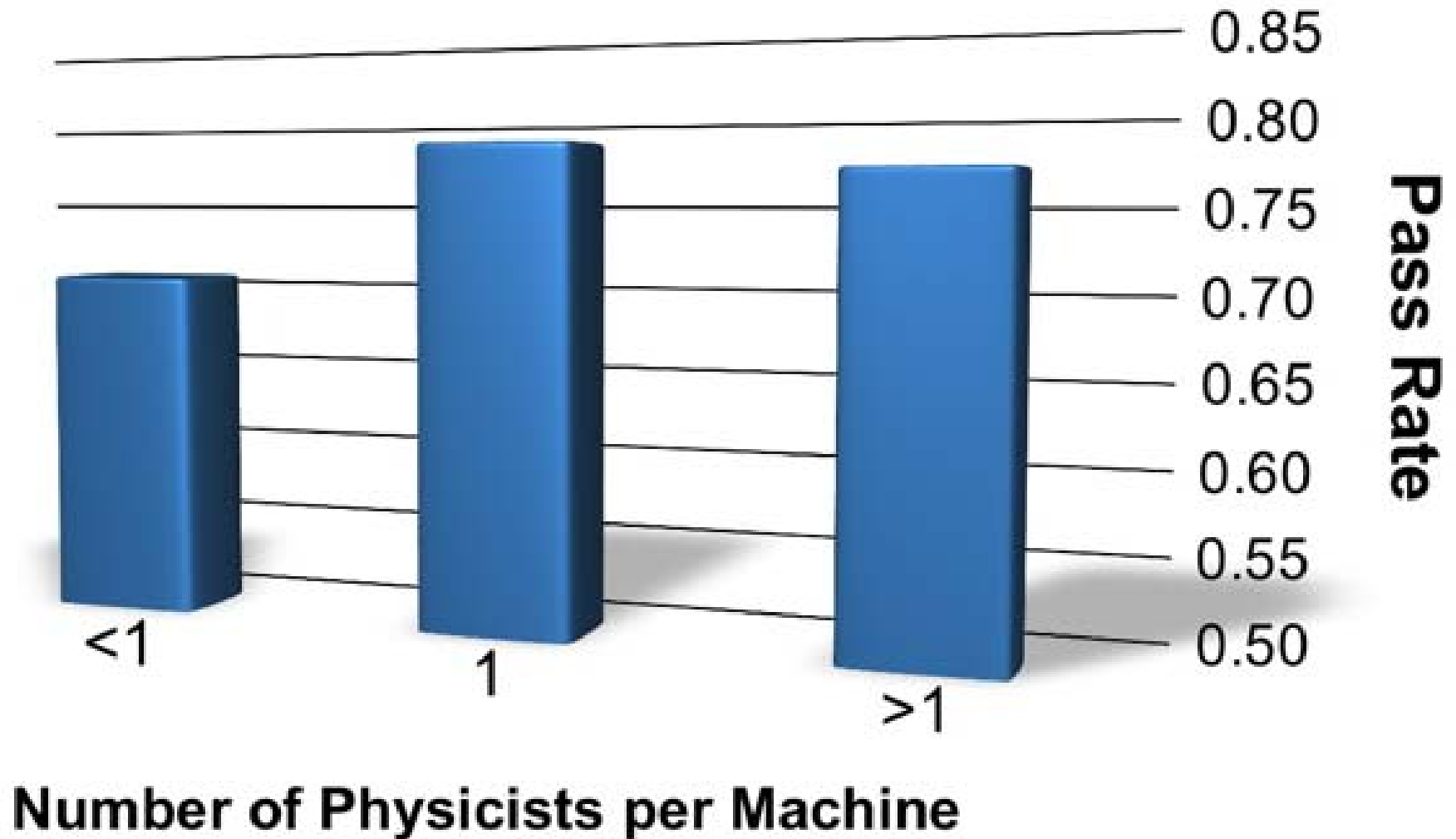
HN results grouped by TPS

Treatment planning system	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
Corvus	75	32	7	0	1
Eclipse	85	114	10	4	3
Pinnacle	73	168	33	4	8
TomoTherapy	73	22	5	1	0
XiO	73	59	7	4	5
Other	79	24	3	0	2
Total		419	65	13	19

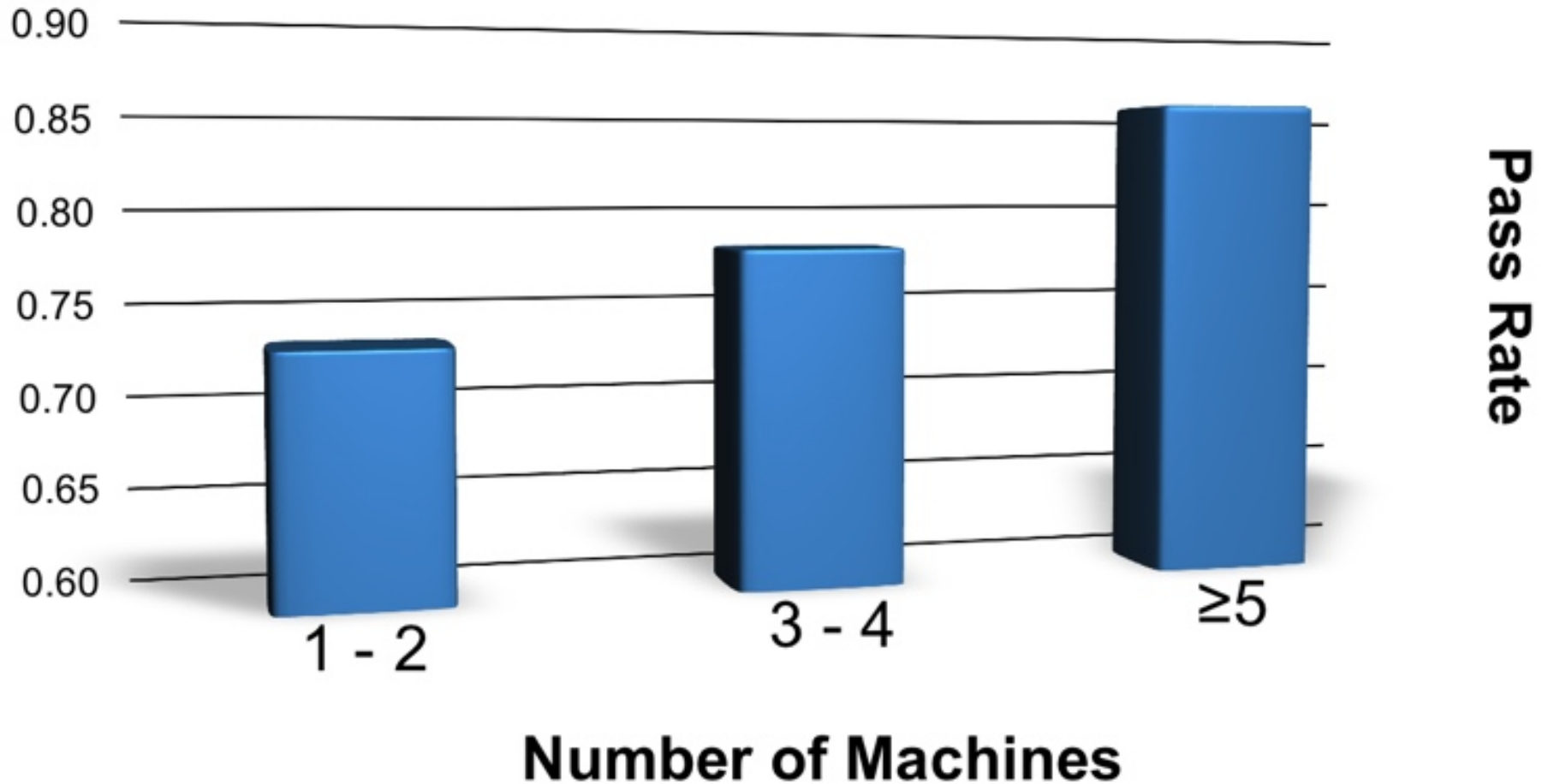
HN results grouped by technique

IMRT technique	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
Dynamic MLC	87	110	9	2	3
IMAT	50	12	5	0	1
Segmental	74	279	47	10	15
TomoTherapy	76	17	3	1	0
Experimental	0	1	1	0	0
Total		419	65	13	19

Pass Rate vs. Physicists

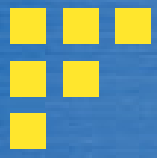


Pass Rate vs. Machines

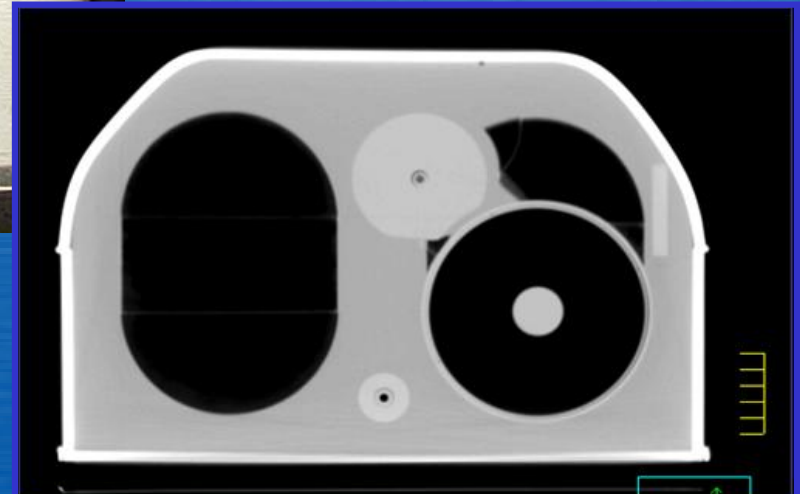


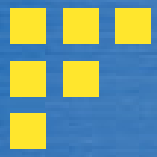
Explanations for Failures

Explanation	Minimum # of occurrences
incorrect output factors in TPS	1
incorrect PDD in TPS	1
IMRT Technique	3
Software error	1
inadequacies in beam modeling at leaf ends (Cadman, et al; PMB 2002)	14
QA procedures	3
errors in couch indexing with Peacock system	3
equipment performance	2
setup errors	7

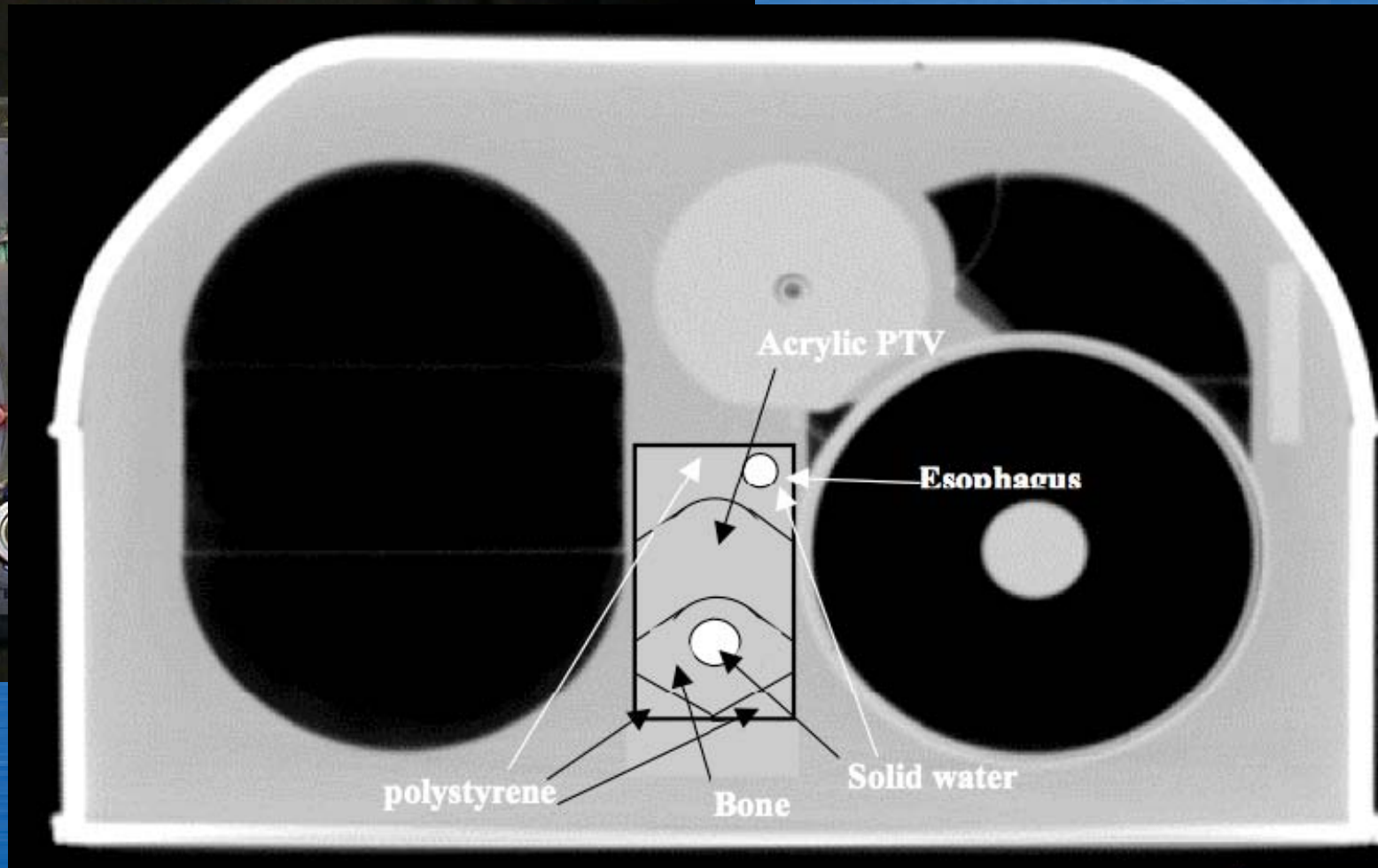
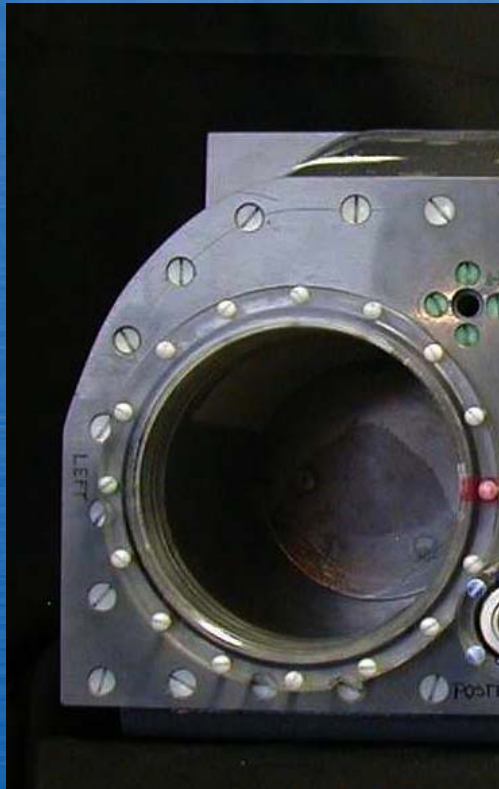


Thorax Phantom

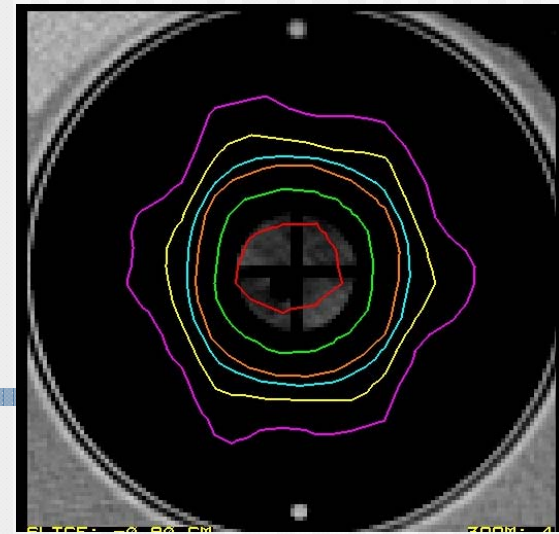




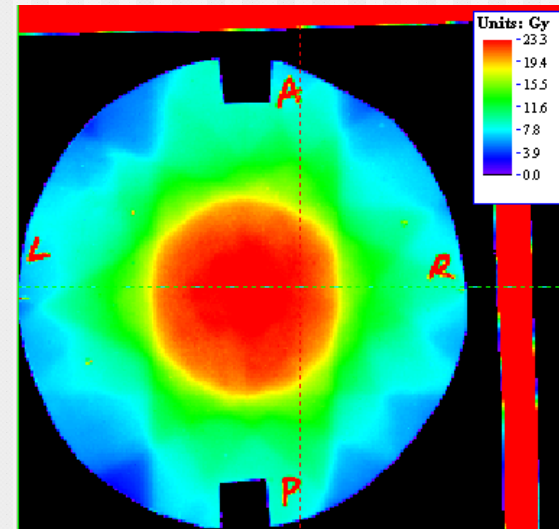
Spine Phantom



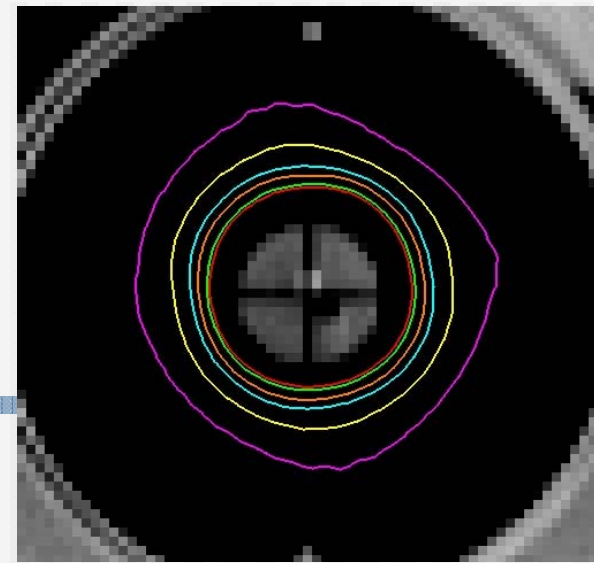
Convolution R-L Profile



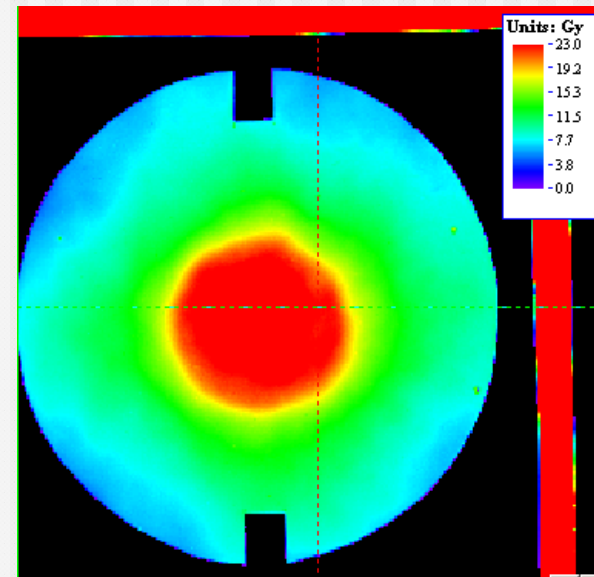
QuickTime™ and a decompressor are needed to see this picture.



Pencil-Beam profile

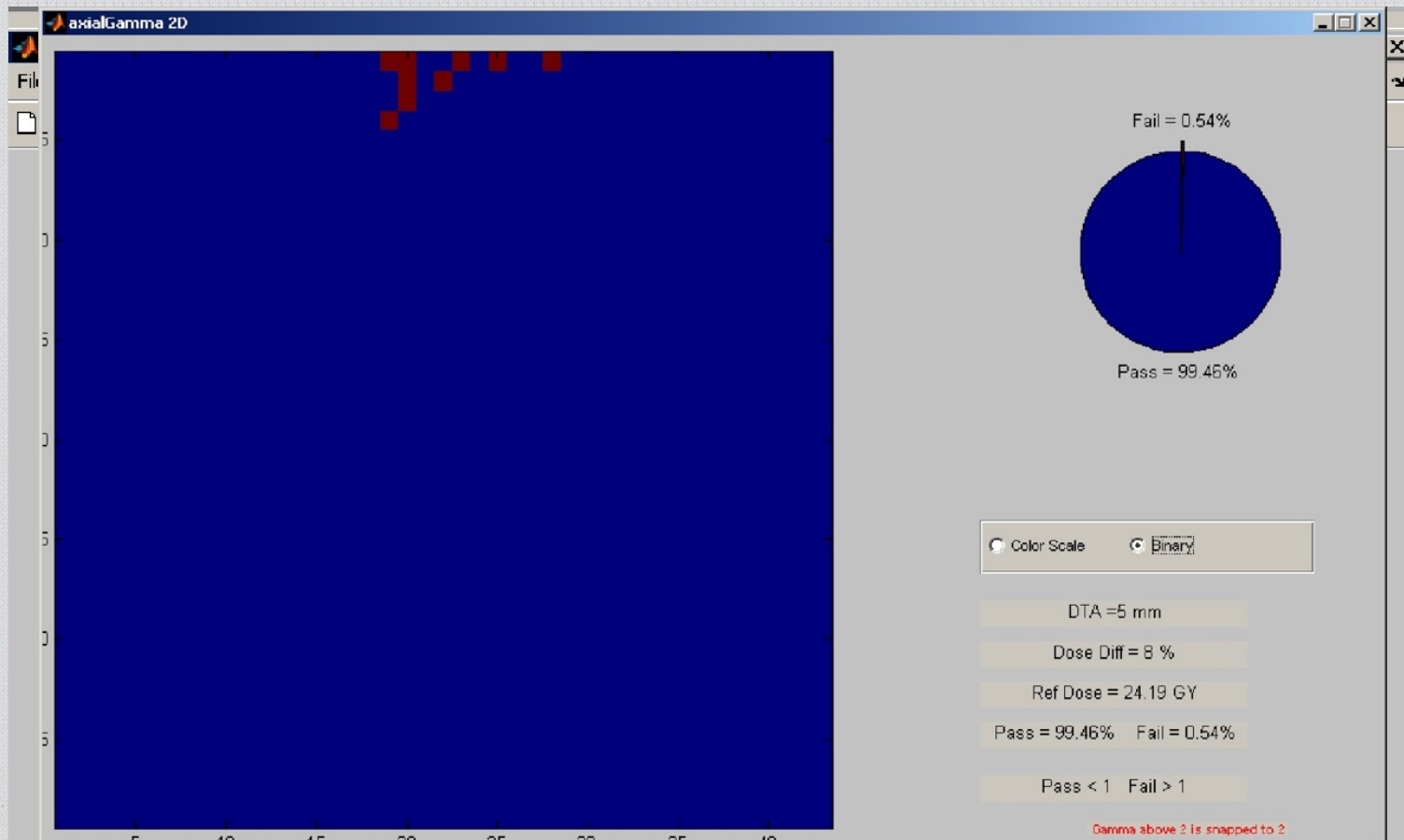


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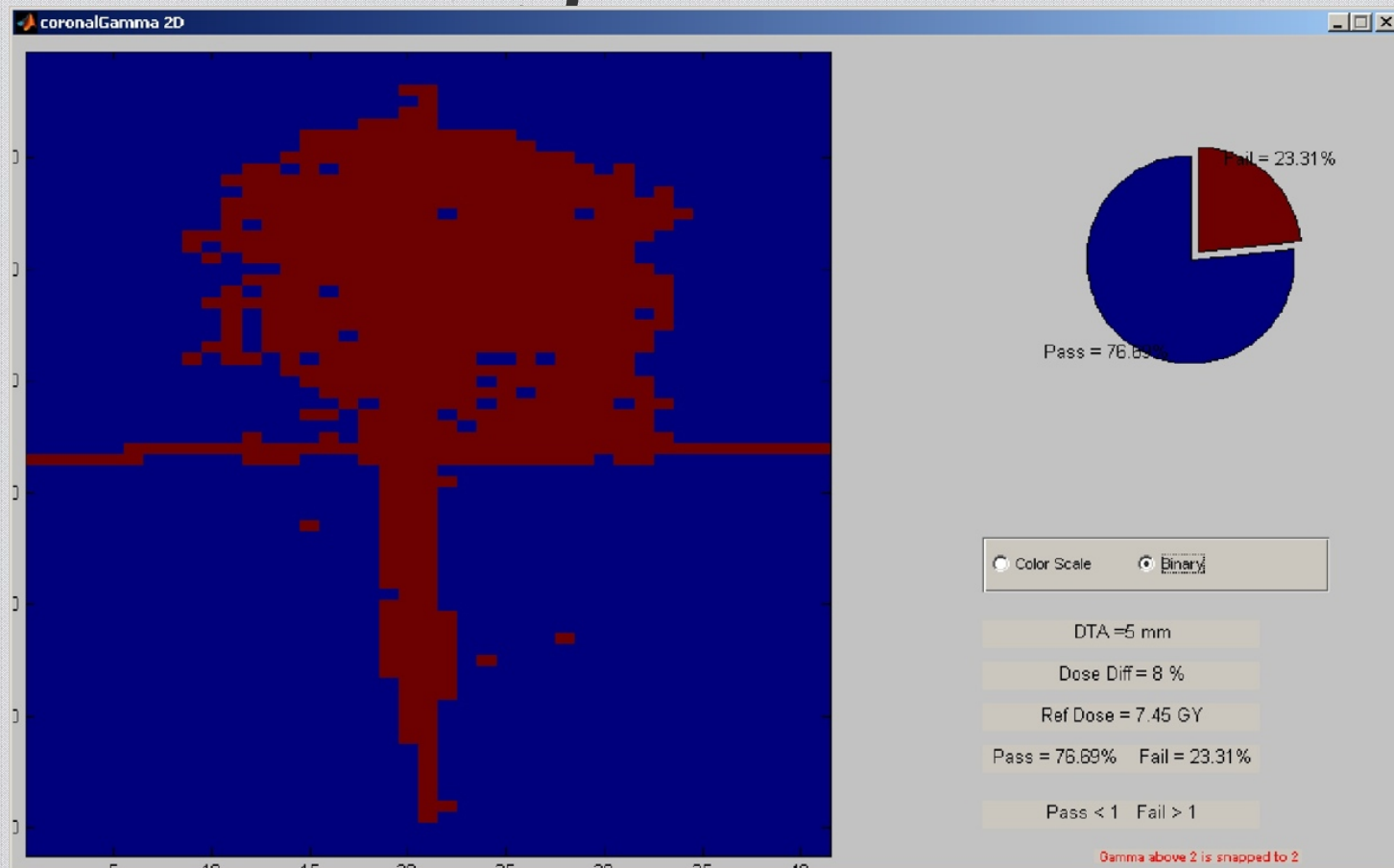


2D Gamma Index Evaluation

“Good” Irradiation



2D Gamma Index Evaluation Failing Irradiation



Evaluation

Criteria: 5% / 5 mm over PTV

Percent of pixels passing: 90% - Axial

80% - Coronal

80% - Sagittal

Results

Systems with “good” algorithms, passing original criteria:

25/29 irradiations passed 2D Gamma Index

Systems with “poor” algorithms, passing original criteria:

3/18 irradiations passed 2D Gamma Index

0413 / B-39 Reviews

Review Type	Number
PBI	1566
WBI	1572
Patients with completed reviews	1085
Rapid Reviews	337
Timely Reviews	565
Open Reviews	145
Random Reviews	38
DVA Scores	
Per Protocol	924
Minor corrections	157
Major corrections	3
Repeat Timely Reviews	1



0413 / B-39 Reviews

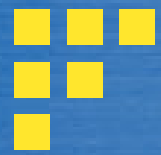
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Random Reviews	38
DVA Scores	
Per Protocol	924
Minor corrections	157
Major corrections	3
Repeat Timely Reviews	1

The screenshot displays a medical software interface with the following components:

- Top Bar:** Shows system information including "Wed 9:10 PM", "gibbott", and a user ID "v.05120801".
- Image View:** A CT scan slice with overlaid isodose contours in various colors (red, green, blue, yellow).
- Isodose Contours Panel:** Includes checkboxes for isodose levels: 34 Gy (checked), 36 Gy (checked), 39 Gy (unchecked), and 42 Gy (unchecked).
- Structures Panel:** Lists anatomical structures with checkboxes: BREAST_CNTR, BREAST_IPSI, CTV, HEART, LUNG_CNTR, LUNG_IPSI, PTV, PTV_EVAL, SKIN, SURG_BED, and THYROID. Most are checked.
- DVH Panel:** Shows DVH (Dose-Volume Histogram) settings for "ITC" and "PTV". A graph plots "Volume, (cc)" on the y-axis (0 to 500) against "Dose, (Gy)" on the x-axis (0 to 50). The curve shows a sharp drop-off around 35 Gy.
- Summary Table:**

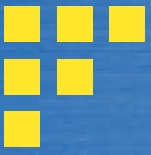
Plan ID	Vol ≥ Ref	Max	Min	Mean
fx1hetero	88.50 %	40.20 Gy	0.00 Gy	35.90 Gy

Total Volume: 499.16 cc
Conformity Index = 0.559
- Bottom Bar:** Shows a "Zoom: 2" indicator and a "Corinthian Sailing Club.url" link.



RPC Monitoring of Proton Facilities

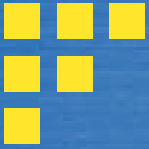
- Questionnaire developed by QARC
- TLD audits of basic calibration
- Dosimetry review visits
- Dose delivery evaluation with anthropomorphic phantoms



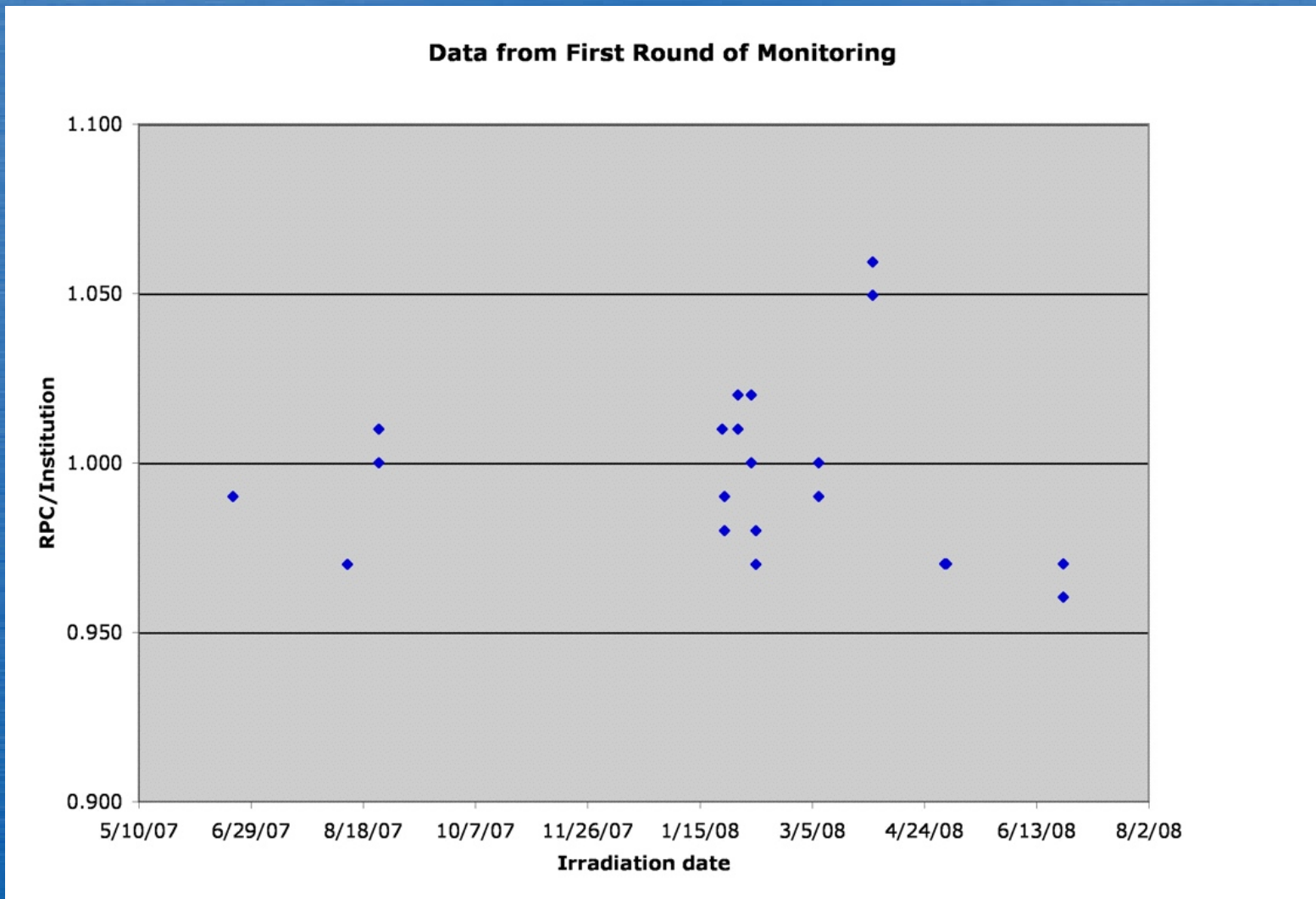
TLD Audits

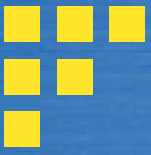
- RPC evaluated TLD system under many conditions of energy, modulation, residual range, field size





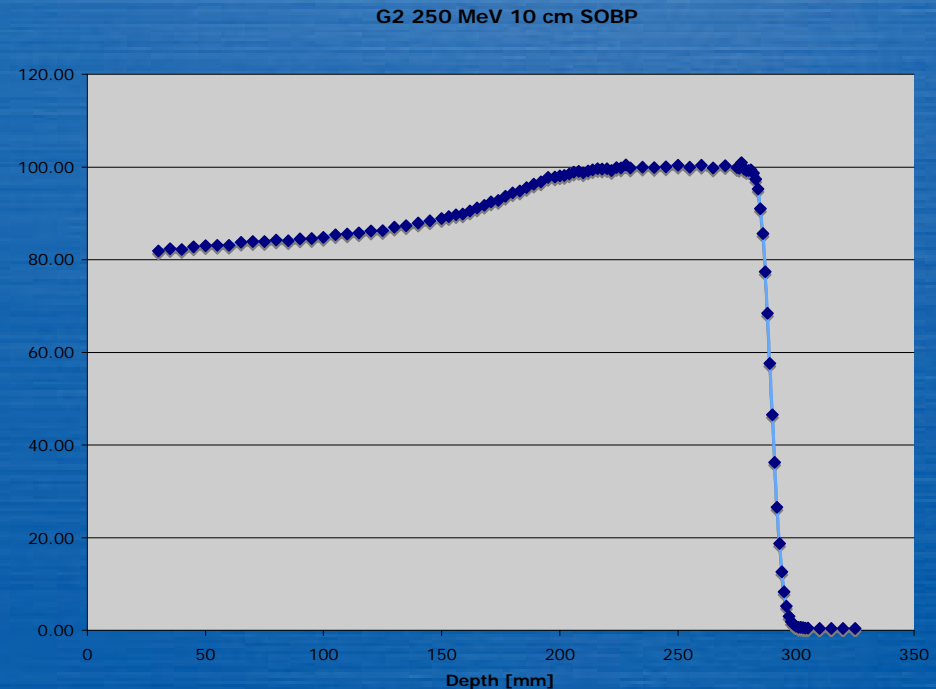
First Round of Monitoring

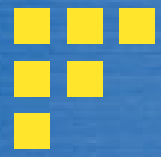




Dosimetry Review Visits

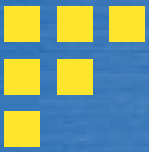
- Comparison with institution data:
 - Reference calibration
 - Representative %depth dose, range
 - Representative profiles
 - Output dependence on
 - Snout size, distance
 - SSD
 - Aperture size
 - Energy, range shift
 - Modulation





Dosimetry Review Visits [cont'd]

- Image guidance, patient alignment
 - Evaluate imaging system with IGRT phantom
- QA Procedures
 - Daily
 - Monthly



Anthropomorphic Phantoms

