AAPM Proton Therapy Symposium

The ProCure Proton Therapy Systems

Niek Schreuder

August 3, 2013

ProCure Opened Four Facilities in 6 years

OKC – July 2009

CHI – October 2010

NJ – March 2012

SEA – March 2013

April 2007

Now

Procure physics Teams

ProCure	Niek Schreuder + Ben Harris + Anthony Wagner		
OKC	CHI	NJ	SEA
Yuanshui Zheng	**Mark Pankuch**	**Dennis Mah**	**Tony Wong**
Li Zhao	Brad Kreydick	Chin-Cheng Chen	Charles Bloch
Jeff Gao	Ben Foster	Chang Chang	Yixiu Kang
Eric Ramirez	Draik Hecksell	Sean Boyer	Jay Sani
Suresh Rana	Hazel Ramirez	Kendra Poole	Lindsay Runyan
Michael Rains	Steve Laub	Elisabeth Van Wie	Miguel Herrera
	Randy Tobias	Michael Moyers	
	Maggie Stauffer		
	April Matthews		

Other: Wen Hsi; Omar Zeidan; Anthony Mascia; Xiaoning Ding; Allie Tassen

Staff training

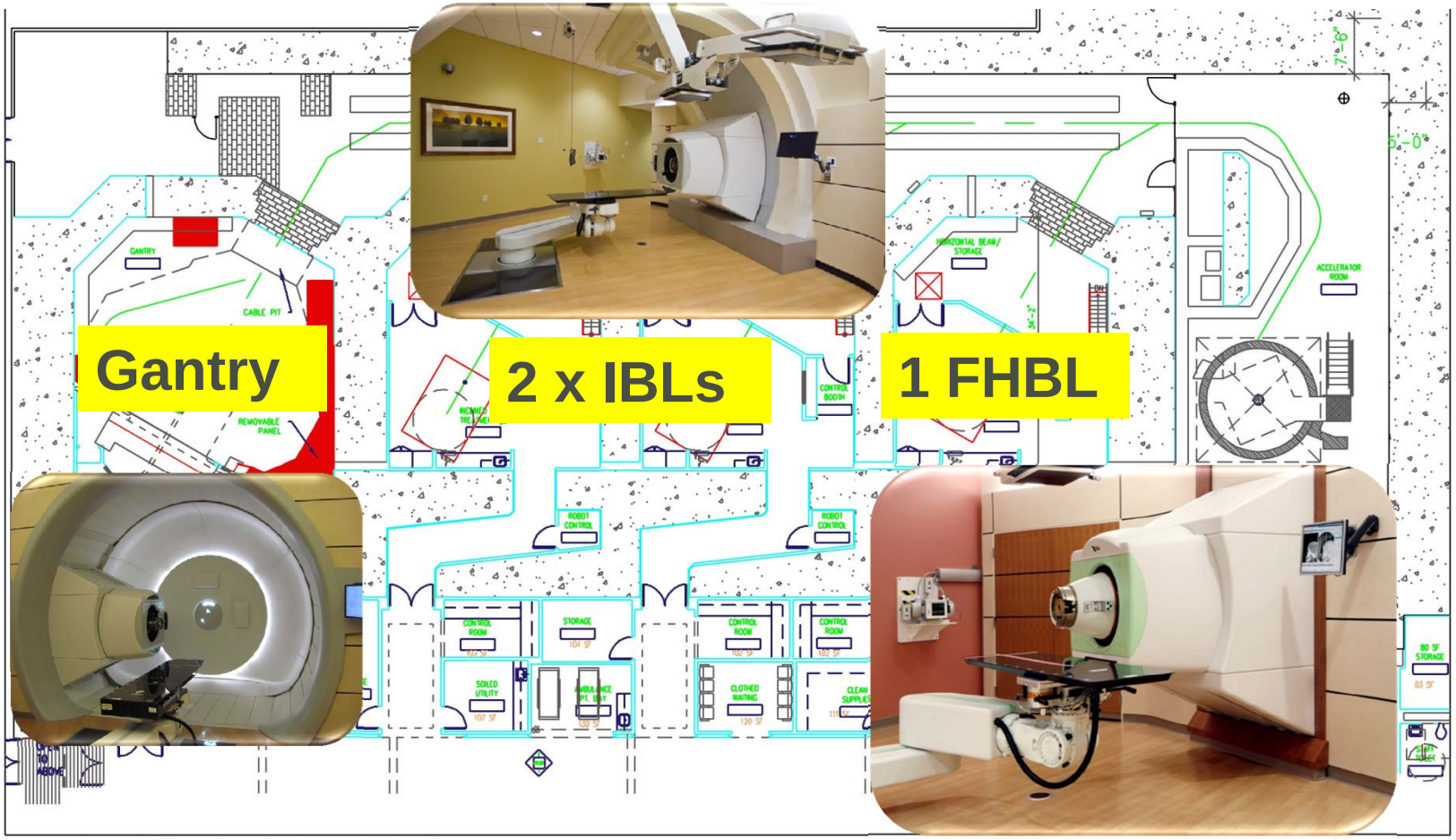
- **ProCure did “BEFORE THE JOB” training**
- **Even after the facility starts to treat we continue to do “before the job” training**
- **Why ?**
  - Training must be un-interrupted
  - Training must be focused
  - Training must be conducted by trained trainers
  - On the job training is in-effective
  - On the job training always takes second priority to clinical duties

The Training and Development Center

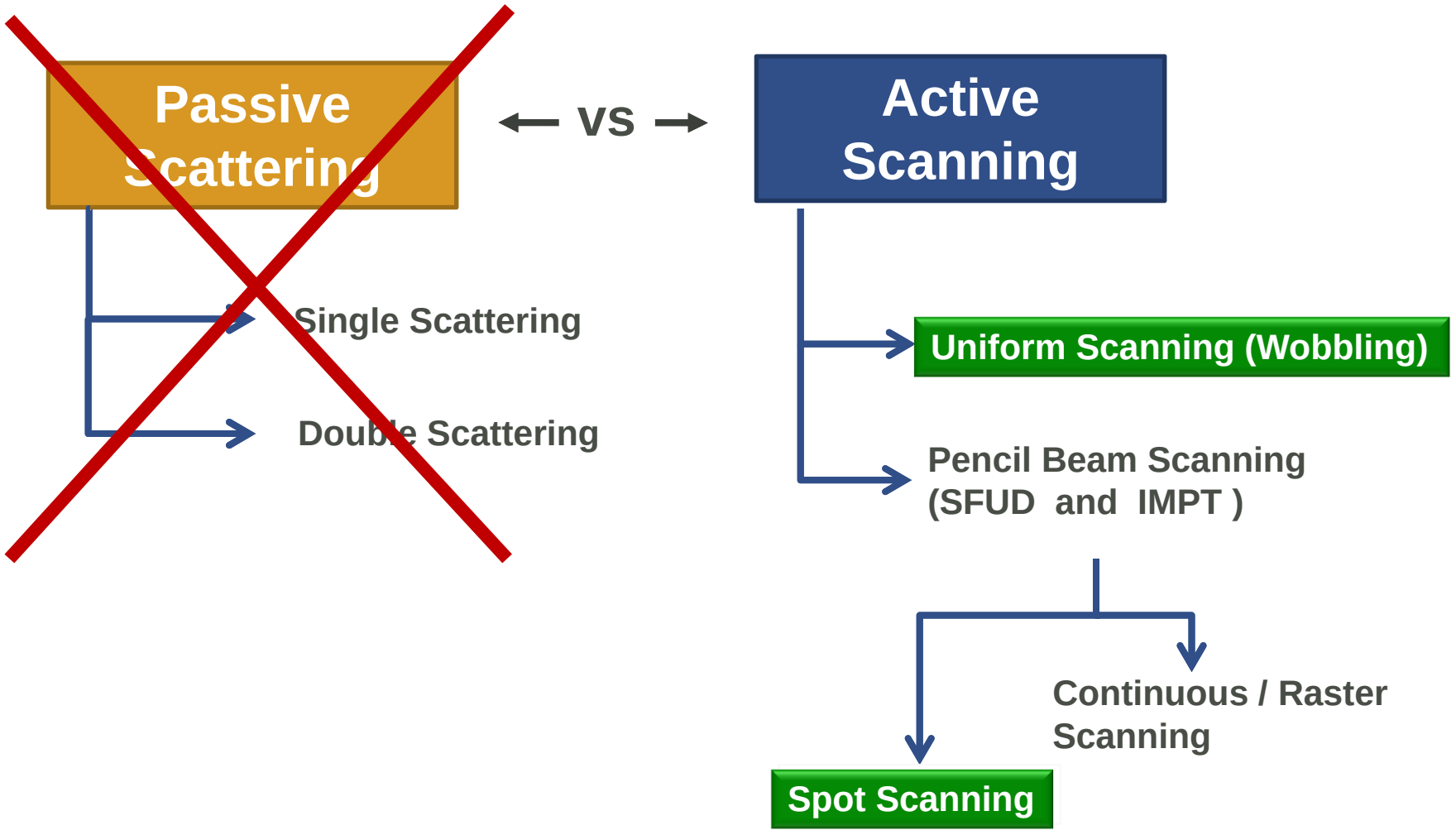
Bloomington – Indiana
A two room proton therapy center without protons

Building Design

- Structure treatment rooms according to patient mix



The ProCure systems - Beam Delivery



Commissioning A Proton Therapy System

- **Some groups pick everything that's on the menu**
  - Single scattering, Double scattering, Uniform scanning, Pencil beam scanning
  - Commissioning never stops
- **Hint – pick what you need and commission as much as you can before you start treatments.**
- **Every thing you pick from the menu needs to get commissioned**
- **ProCure ordered the minimum based on**
  - What we want to treat
  - What we need in the future

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Physics Commissioning Times – OKC – CHI - NJ

- Pre-commissioning spanned 1.5 years - work at the TDC
- OKC had some pending FDA approvals that caused uncertainties in the schedule
- The more you do it – the better you get at it
- Time to commission a room (weeks)

Room	OKC	CHI	NJ
Fixed	10	4	4
Inclined	6	4	4
Inclined	5	4	4
Gantry	6	5	5

Two 8 hour shifts per day – 5 days per week
The local Physicists do 30% of the work

The Key to Success:

Trimethylxanthine bolus 1 ℓ IV x 1, to run at 500cc/hr, repeat as necessary

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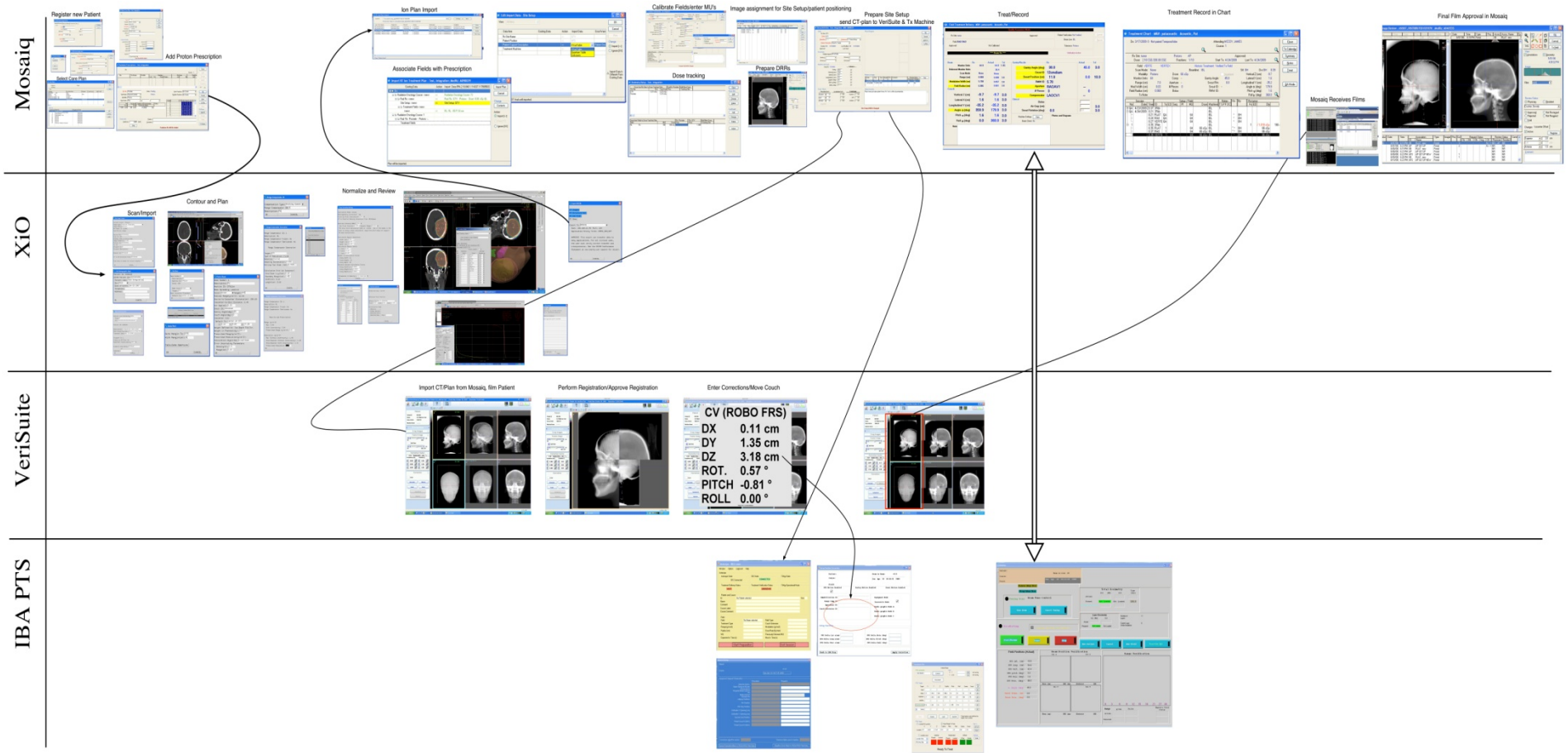
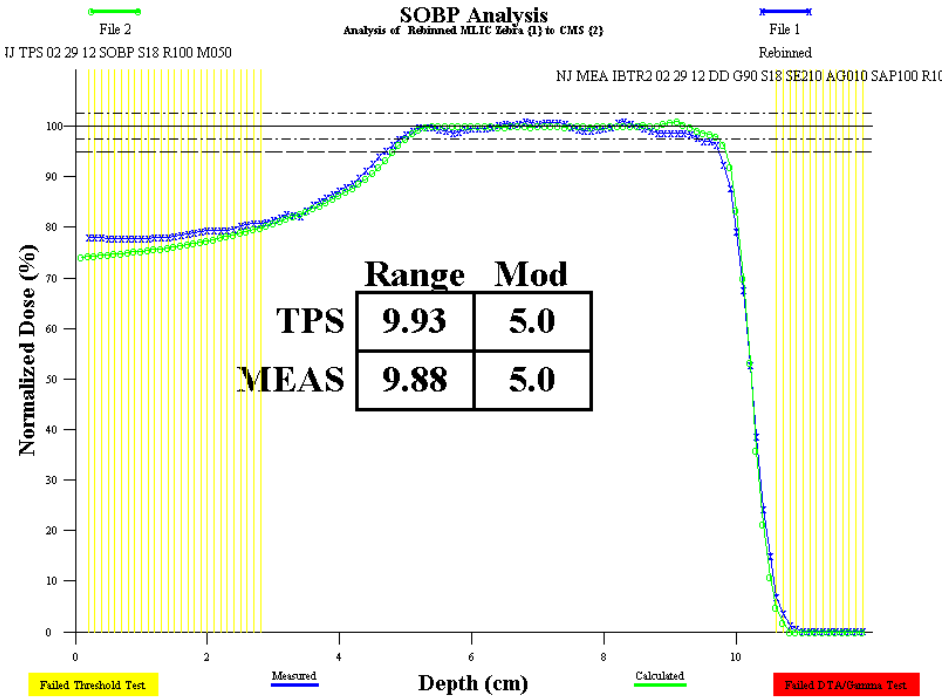
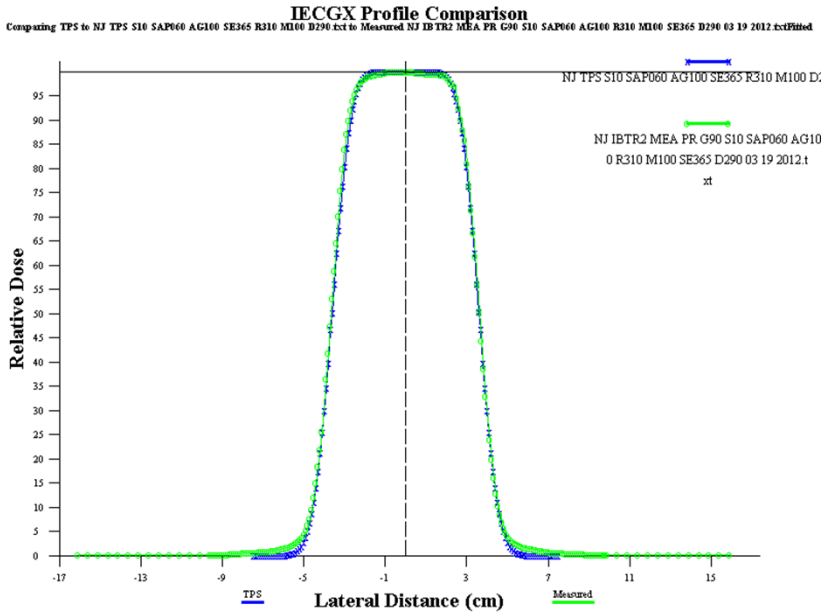
The Electronic workflow in a proton Clinic



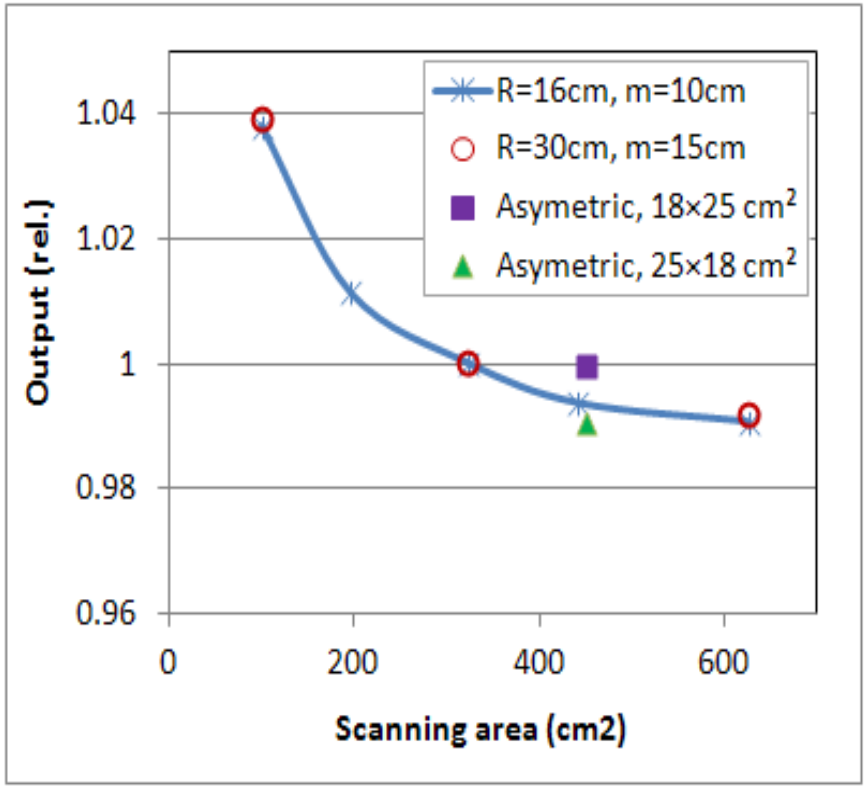
TPS Modeling - SOBP

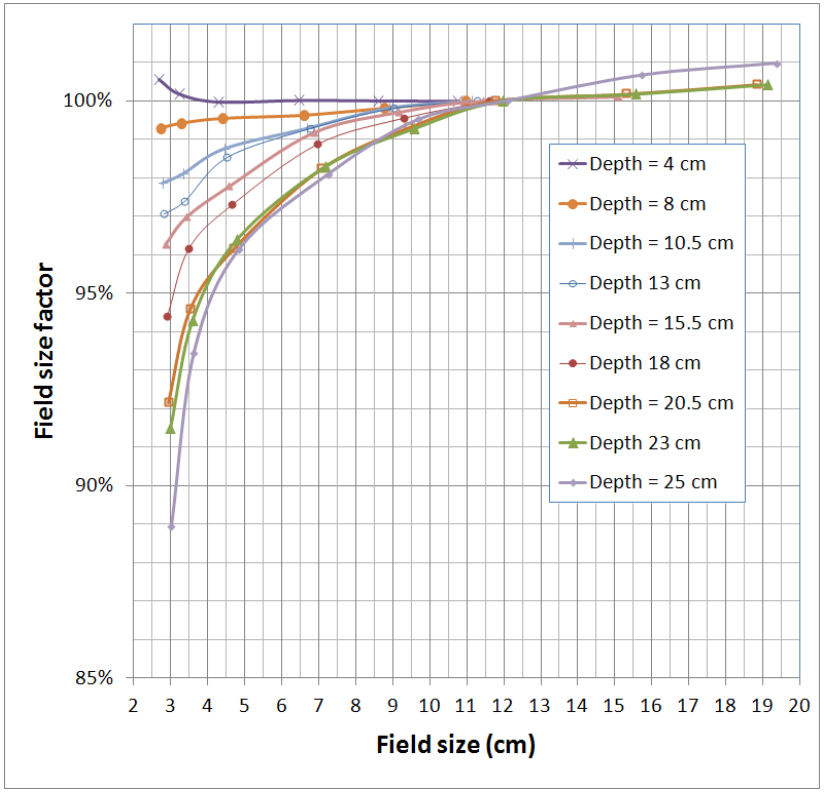


2%/2mm Gamma index criteria



Output Factor Modeling





Output factor as a function of: (a) beam scanning area, and (b) field size at various calibration depth. Both the beam scanning area and detailed field size effect were accounted for in the refined output model.

Output Factor Modelling

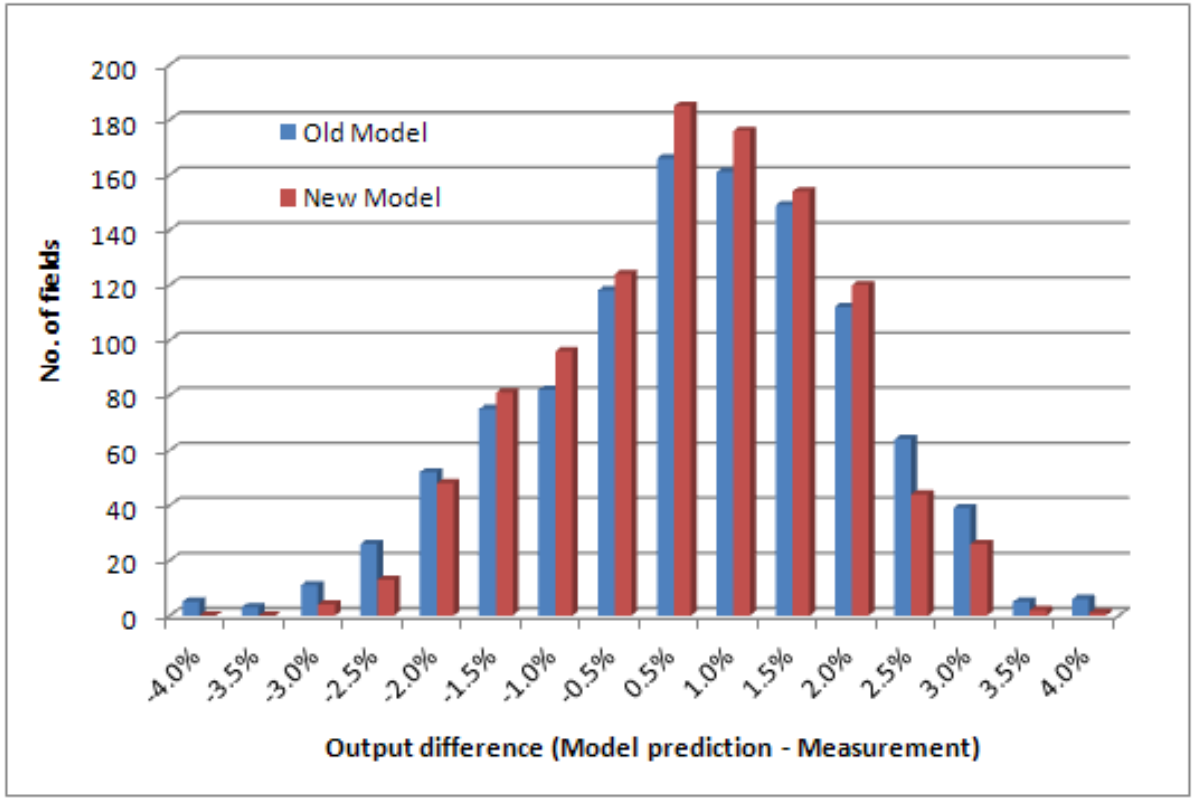
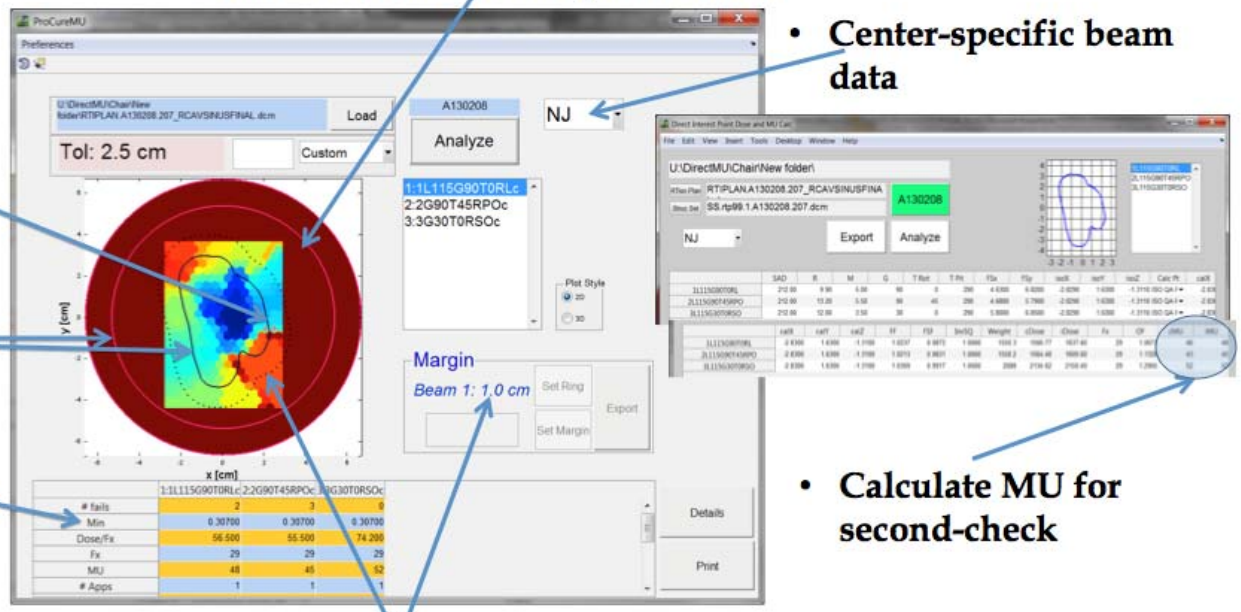


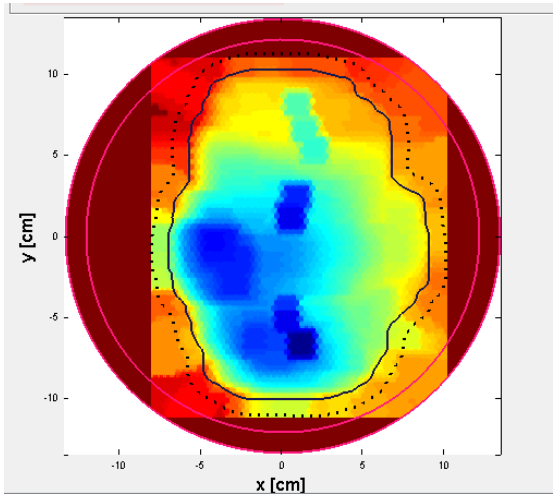
Figure 3. Differences between model-predicted output factors and those determined by measurements. In total, output factors for 1074 patient-specific fields were analyzed. The new model (refined model) predicted output factor within 2% for 91.6% of proton fields, 3% for 99.7% of proton fields.

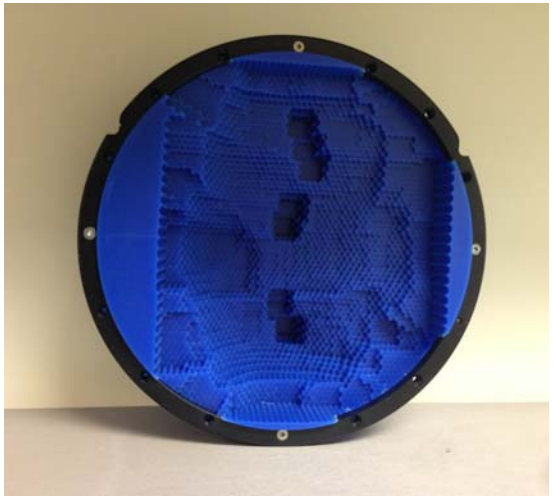
Compensator Inspector

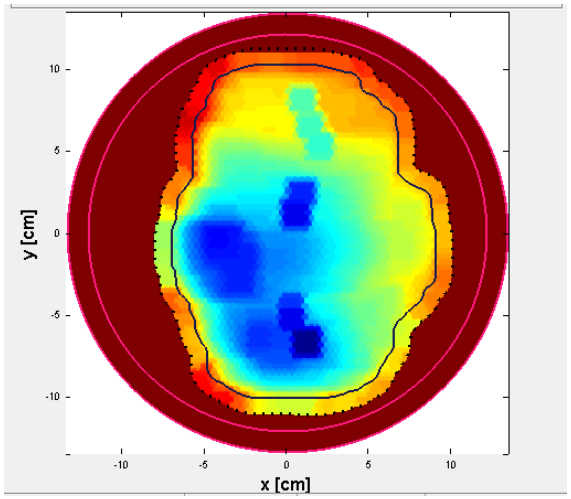
- Ensure compensators meet clinical protocols, e.g. ridge height
- Review aperture boundary within snout opening
- Ensure manufacturability by checking min and max height
- Avoid "islands" that might break off
- Center-specific beam data
- Calculate MU for second-check
- Adjust compensator milling margins for blow-out prevention and time-saving

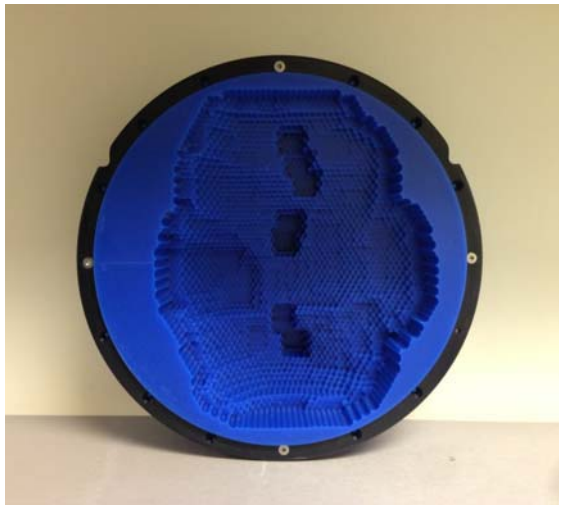


Compensator Blow-out Correction

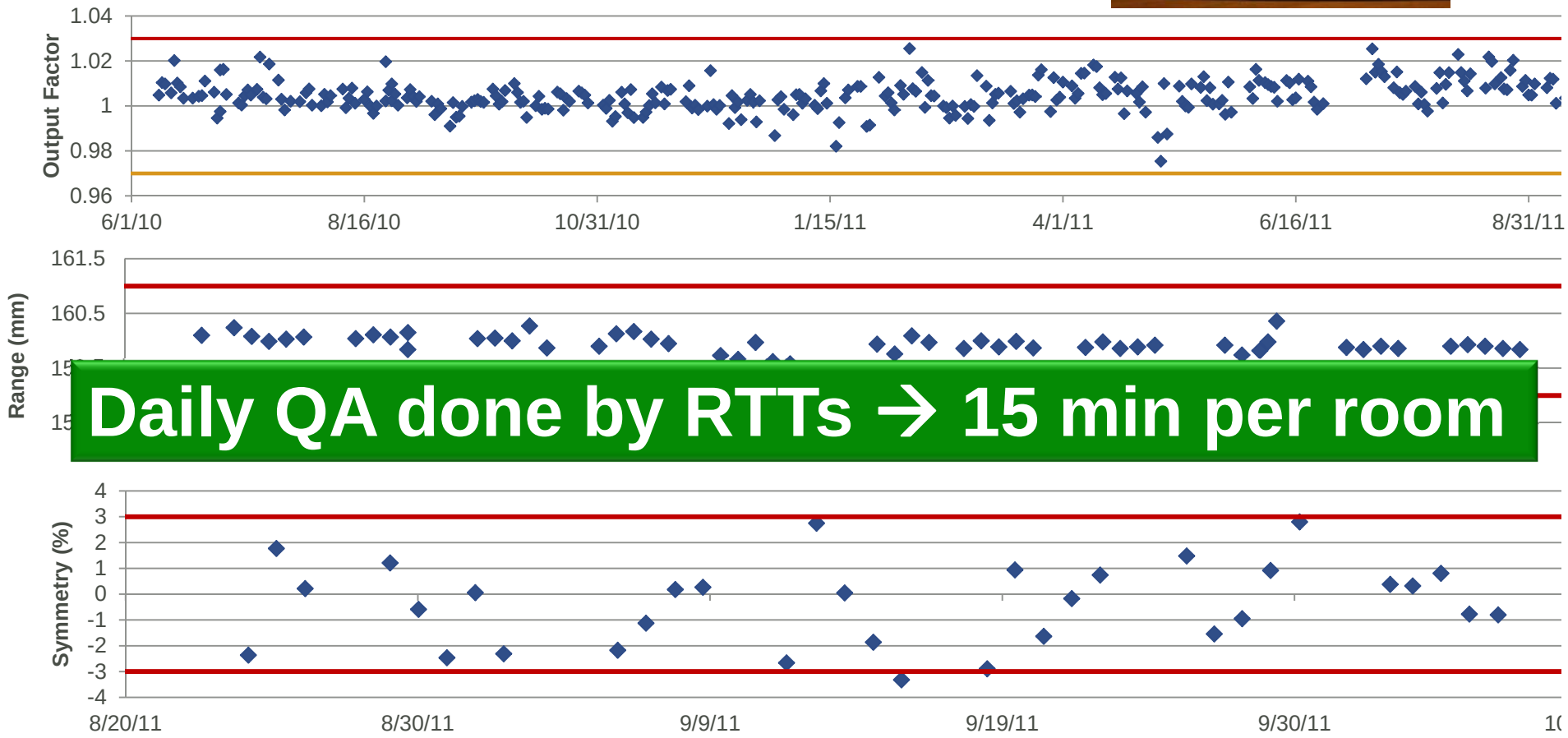






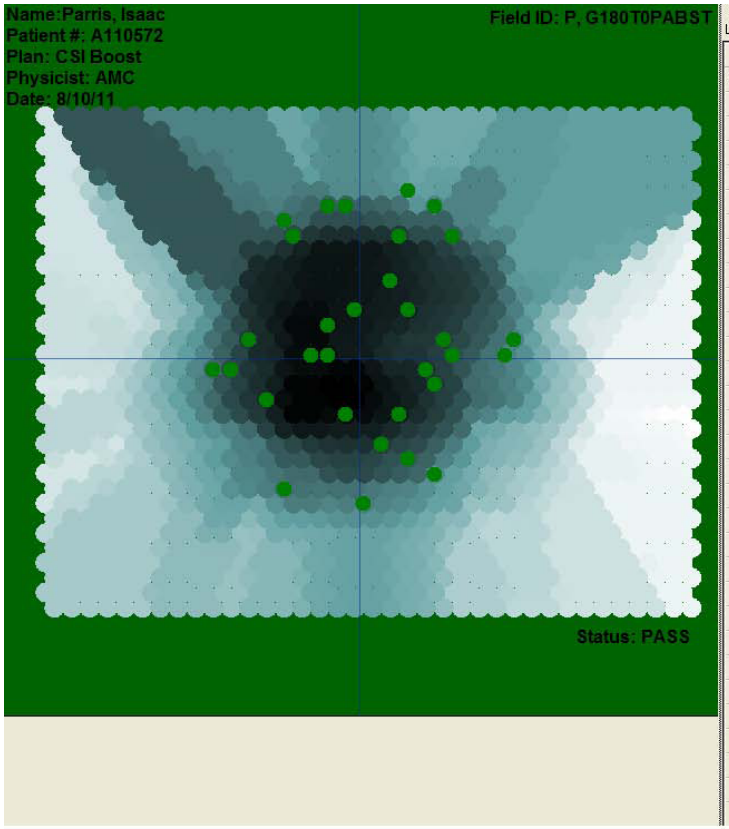


Daily QA Device



Daily QA done by RTTs → 15 min per room

Apertures + Compensators – Physical QA

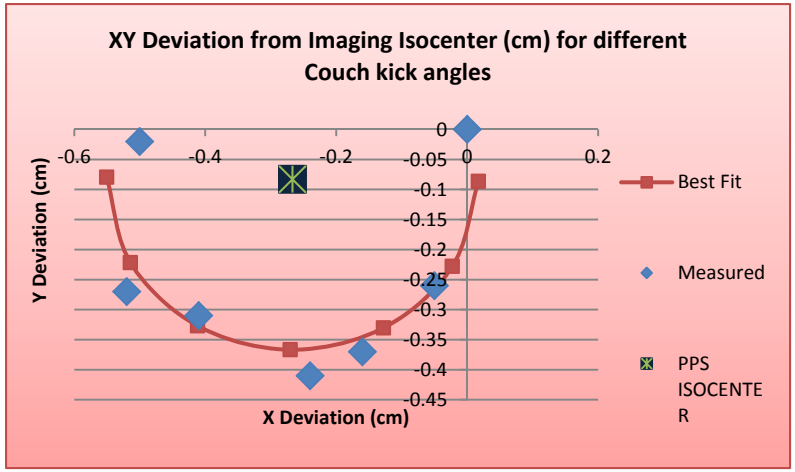


(-24.44, +47.83) : +33.27
Laser=0.01

	Number	Actual	Model	Delta
▶	1	7.9	7.61	-0.26
	147	27.7	27.59	-0.12
	146	20.6	20.17	-0.39
	144	16.5	16.30	-0.23
	145	12.9	12.97	0.03
	6	5.8	6.03	0.18
	7	7.7	7.36	-0.33
	8	8.8	8.48	-0.33
	9	9.9	9.94	0.04
	10	11.4	11.45	0.04
	11	17.7	17.31	-0.38
	12	21.3	21.08	-0.26
	13	15.4	14.95	-0.41
	14	16.0	16.16	0.17
	15	11.0	10.64	-0.36
	148	16.6	16.39	-0.23
	17	24.1	23.93	-0.20
	149	35.2	34.93	-0.29
	19	32.4	32.03	-0.34
	20	29.4	29.02	-0.40
	21	5.7	5.20	-0.47
	22	33.2	33.01	-0.15
	167	33.2	32.94	-0.30
	24	25.3	25.04	-0.25
	25	33.3	33.15	-0.18
	26	40.2	40.07	-0.13
	27	17.2	16.94	-0.28
	28	25.6	25.30	-0.30
	29	25.6	25.30	-0.32
	30	20.4	20.12	-0.29
	31	28.1	27.85	-0.21
	Max	**75.33**	**75.17**	**-0.16**
	Min	**3.54**	**3.07**	**-0.47**

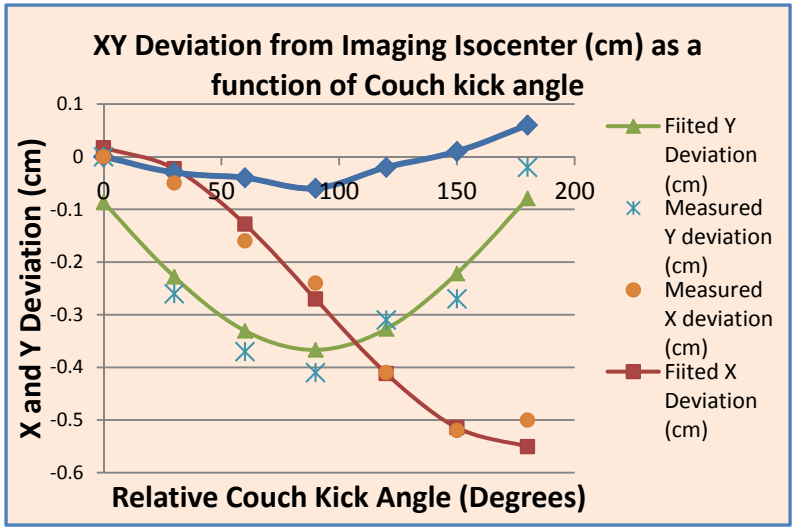
Automated Laser Scanner

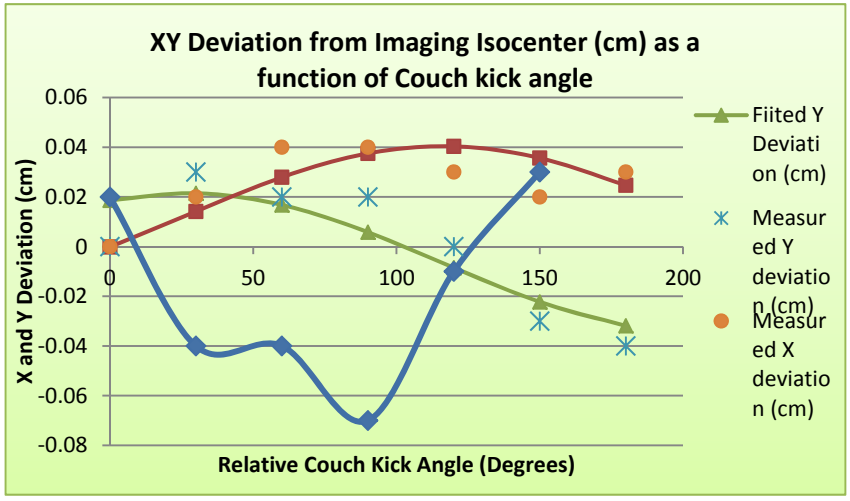
PPS accuracy



It does not matter how good your PPS is

– if the IGRT + PPS devices in the treatment room are not properly aligned all the efforts are wasted





Operational Statistics

Patient Load - 2013

	OKC	CHI	NJ	SEA
Start date – First Treatments	July 2009	November 2010	March 2012	March 2013
# Patients Completed to date	1200	1050	350	20
# Under Beam per day	50+	60+	60+	20+

Complexity Index - Averaged over all centers

	%	Fields / Fx
Simple	40	1
Intermediate	49	2.3
Complex	11	4.2
	Average =	2

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PBS patient Specific QA

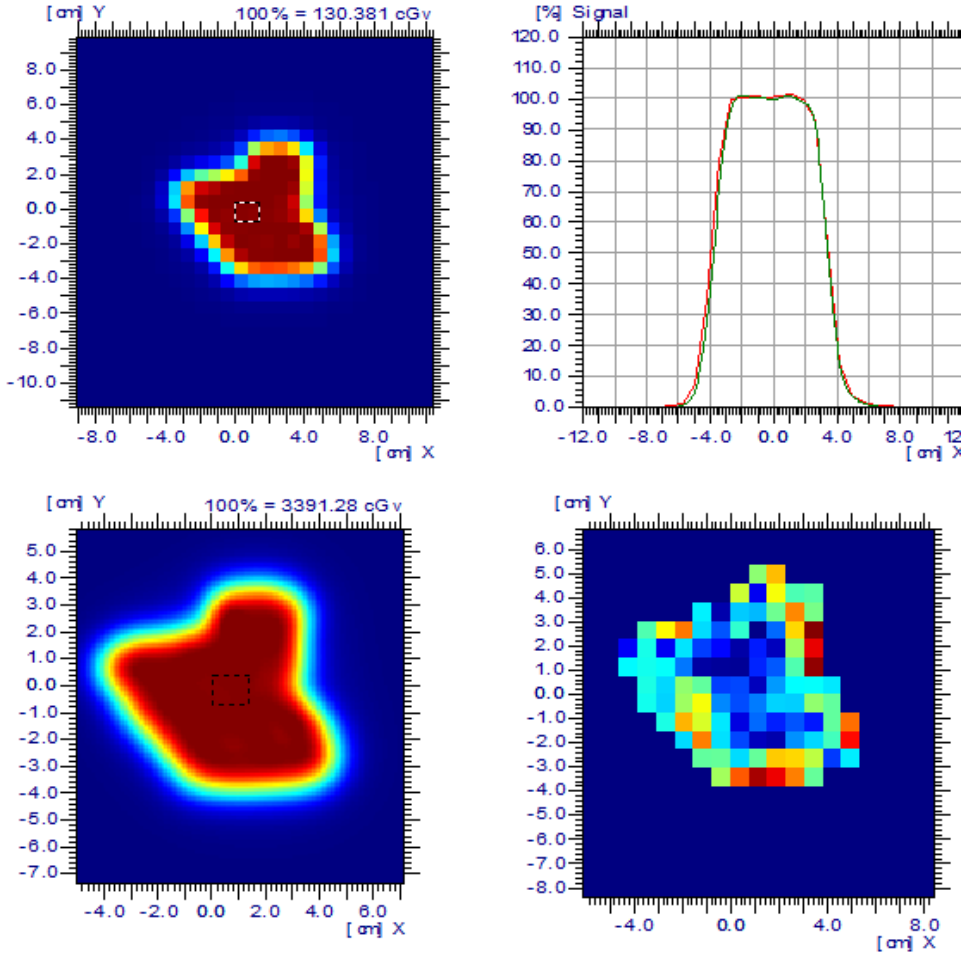
Average passing rate is 98.6% for 3mm / 3%

Max passing rate = 100%, min = 91%

45 patients, 2-5 fields per patient,

Total number of measurements = 348

Total passing at 95% or better = 334



Summary

- The more standardized things are the
  - more maintainable they become
  - Less Expensive to put in place
  - The faster they can get commissioned
  - Easier/Cheaper to operate
- Be careful when standardizing to ensure
  - Longevity and Ballistic advantages
  - Cost-Effectiveness
  - Maintainability
- Before the Job training work very well
- Training is not easy and requires sincere dedication

ProCure

Opened July 2009
ProCure Proton Therapy Center, Oklahoma City, OK
5901 W. Memorial Road
Oklahoma, OK 73142

Opening 2011
Proton Therapy Center, Chicago, IL
4455 Weaver Parkway
Warrenville, IL 60555

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