

Improving efficiencies with MapRT

David Parsons

12/1/2023

SGRT Europe 2023

Outline

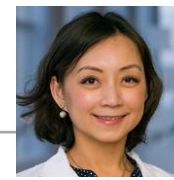
- **Why non-coplanar treatments and increased safety risk**
- **MapRT: what is it and workflow**
- **Accuracy and historical comparison**
- **Dosimetric advantages for lung SAbR**



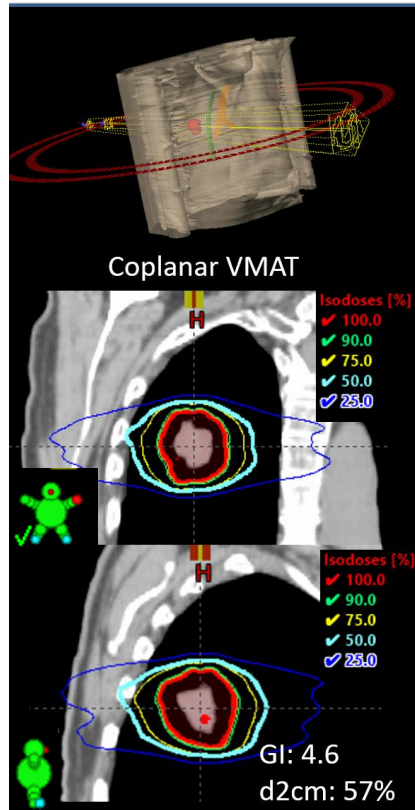
Respect tumor coverage and “Dose Compactness” constraints

- These characterize (define) SAbR
- High dose conformality, d2cm, low gradient index (GI)
- Designed to require **many beams, many angles**, spread out entrance dose, etc...
- Effectively, **isotropic dose falloff**

SAbR Planning: Lung Beam Orientation



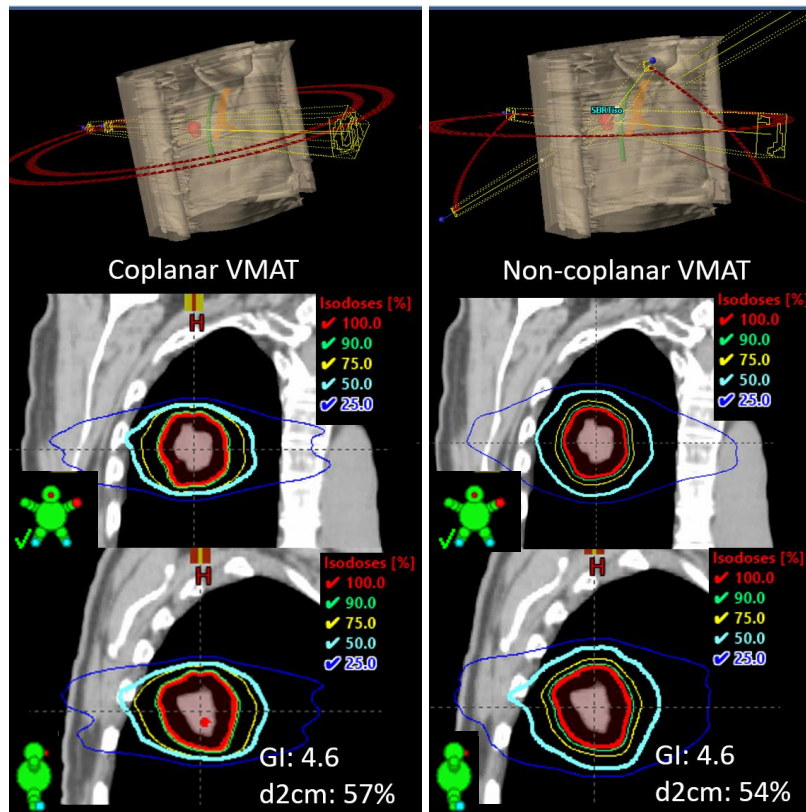
Mu-Han Lin, Ph.D.
Medical Physicist



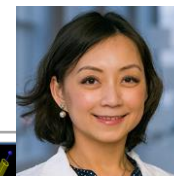
SAbR Planning: Lung Beam Orientation



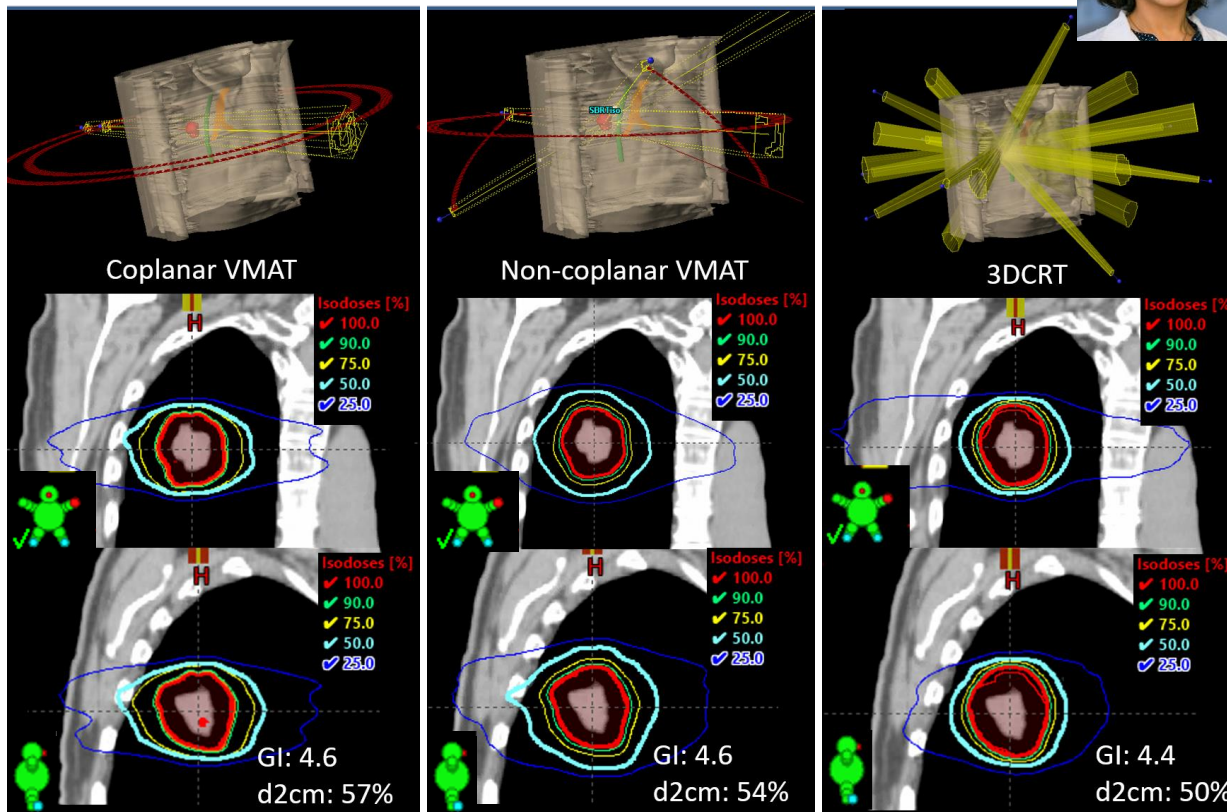
Mu-Han Lin, Ph.D.
Medical Physicist



SAbR Planning: Lung Beam Orientation



Mu-Han Lin, Ph.D.
Medical Physicist



Currently this is mostly a manual process



Fields

ID - Name	Technique	FieldSize X1/X2 (cm)	FieldSize Y1/Y2 (cm)	Isocenter (cm)	Gantry (deg)	Collimator (deg)	Couch (deg)
1 - <input type="checkbox"/> Pass <input type="checkbox"/> Fail	SRS STATIC-Static	1.9 / 1.8	2.3 / 2.3	0.00, 0.00, 0.00	180.1	0.0	0.0
2 - <input type="checkbox"/> Pass <input type="checkbox"/> Fail	SRS STATIC-Static	2.8 / 1.1	2.4 / 2.4	0.00, 0.00, 0.00	230.0	0.0	10.0
3 - <input type="checkbox"/> Pass <input type="checkbox"/> Fail	SRS STATIC-Static	3.1 / 0.6	2.5 / 2.3	0.00, 0.00, 0.00	270.0	0.0	345.0
4 - <input type="checkbox"/> Pass <input checked="" type="checkbox"/> Fail	SRS STATIC-Static	3.1 / 0.6	2.4 / 2.5	0.00, 0.00, 0.00	270.0	0.0	15.0
5 - <input type="checkbox"/> Pass <input type="checkbox"/> Fail	SRS STATIC-Static	2.6 / 1.3	2.3 / 2.2	0.00, 0.00, 0.00	315.0	0.0	0.0
6 - <input type="checkbox"/> Pass <input type="checkbox"/> Fail	SRS STATIC-Static	1.9 / 1.8	2.7 / 2.1	0.00, 0.00, 0.00	15.0	90.0	90.0

Not every risk can be evaluated



UT Southwestern Medical Center

Angle Check Request

Patient: [REDACTED] MRN: [REDACTED]
Initiated By: Mai, Trinh
Initiated Date: September 21st, 2022 - 4:59pm GMT -05:00
Attn. Phys: Westover, M.D., Ph. D., Kenneth D

Planning

Plan Name
LungR

Machine

TrueBeam2 - EROC

Status

- Initial Check
- Re-Check

Start Date

September 23rd, 2022

Planning Comments

new doc with new suggested iso & gantry are in mosaic

Angle Verification

Table Vertical

13.8

Table Lateral

0

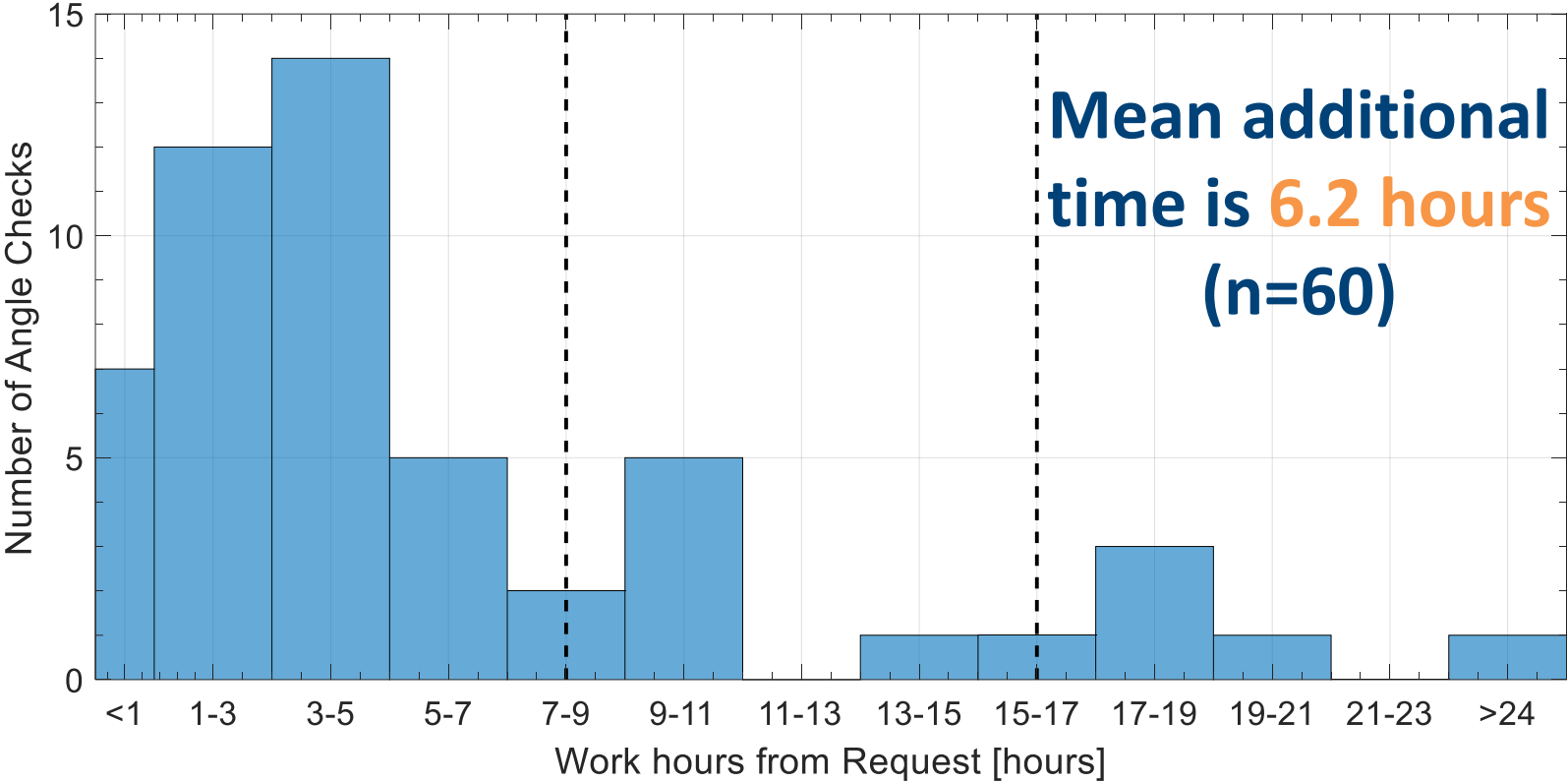
Table Longitudinal

118.62

Angle Verification Comments

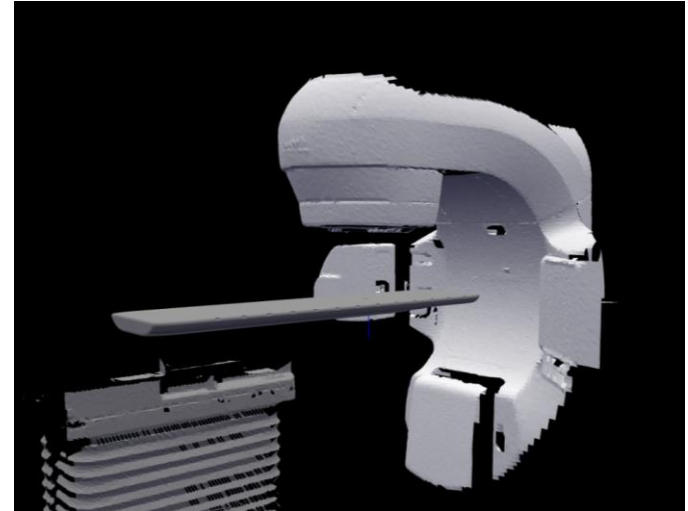
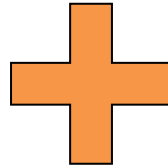
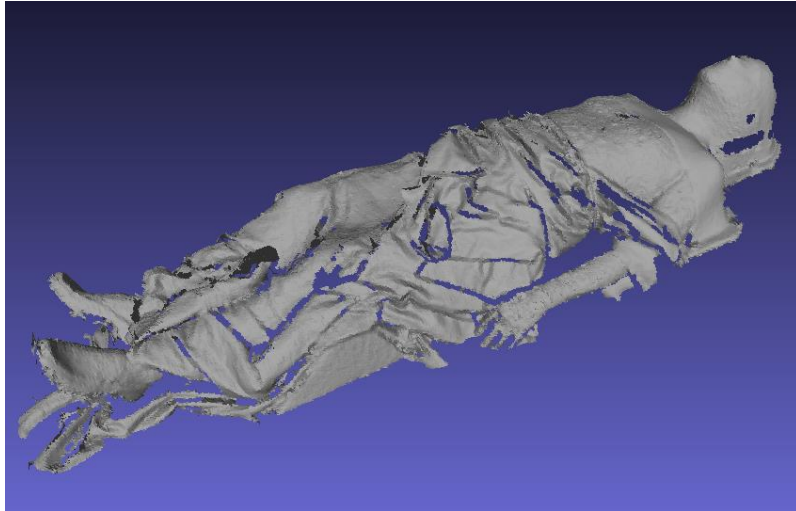
all clear, watch L elbow - wg

Manual clearance checks adds to planning time



MapRT

- MapRT is a SGRT virtual clearance mapping software



MapRT

- MapRT is a SGRT virtual clearance mapping software
- Consists of 2 Horizon cameras in the CT vault

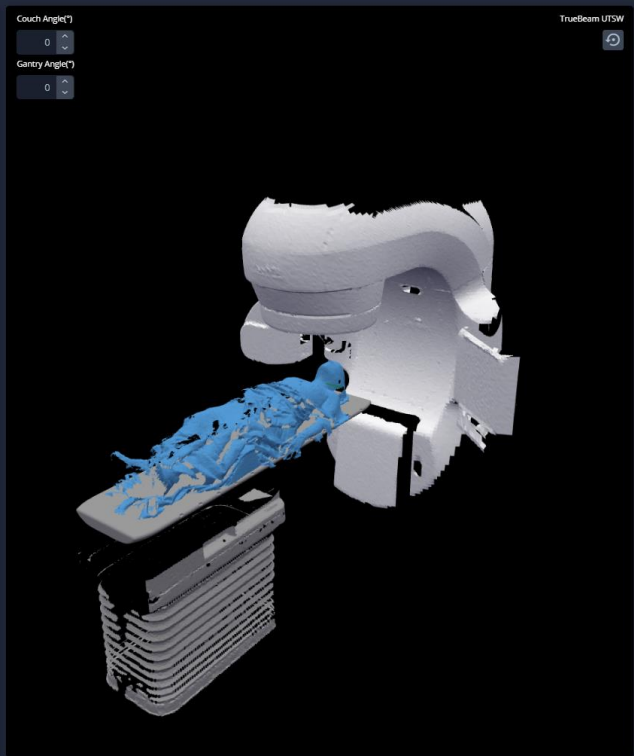
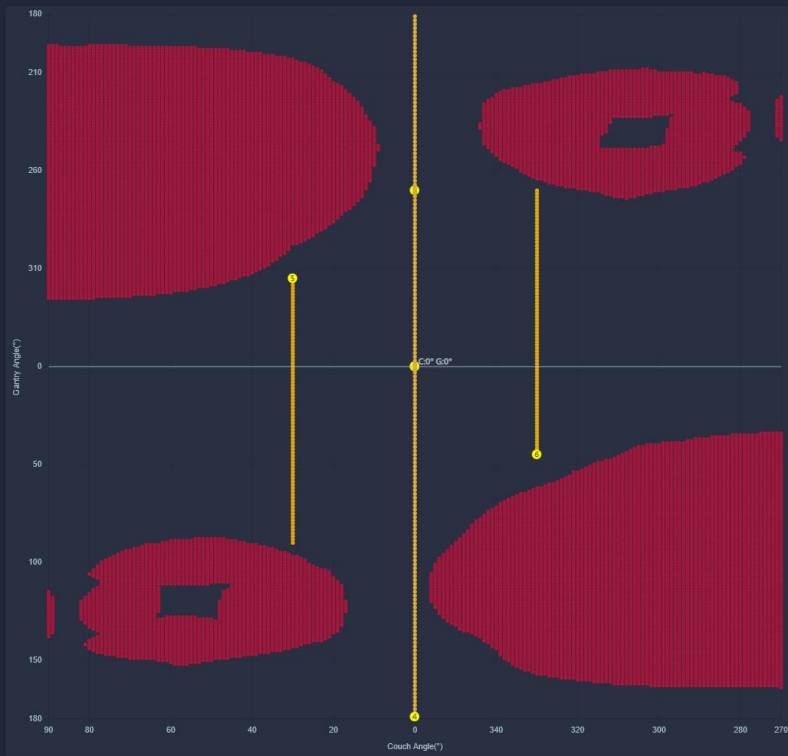


MapRT

Larynx 4250

Status	#	ID	Type	Gantry	Couch	Direction
●	1	CT01	Static	0°	0°	—
●	2	A	Static	0°	0°	—
●	3	B	Static	270°	0°	—
●	4	1	Arc	179° to 181°	0°	CC
●	5	2	Arc	315° to 90°	30°	CW
●	6	3	Arc	45° to 270°	330°	CC

Imported Dicom parameters

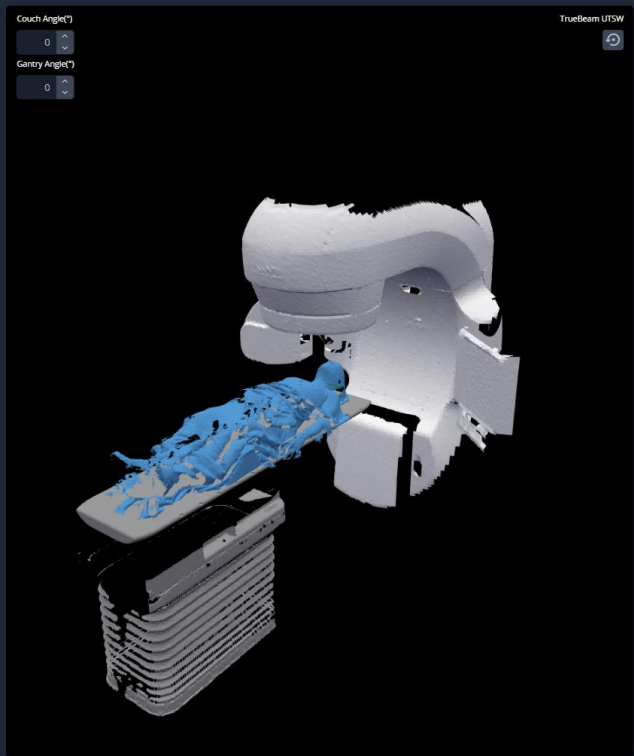
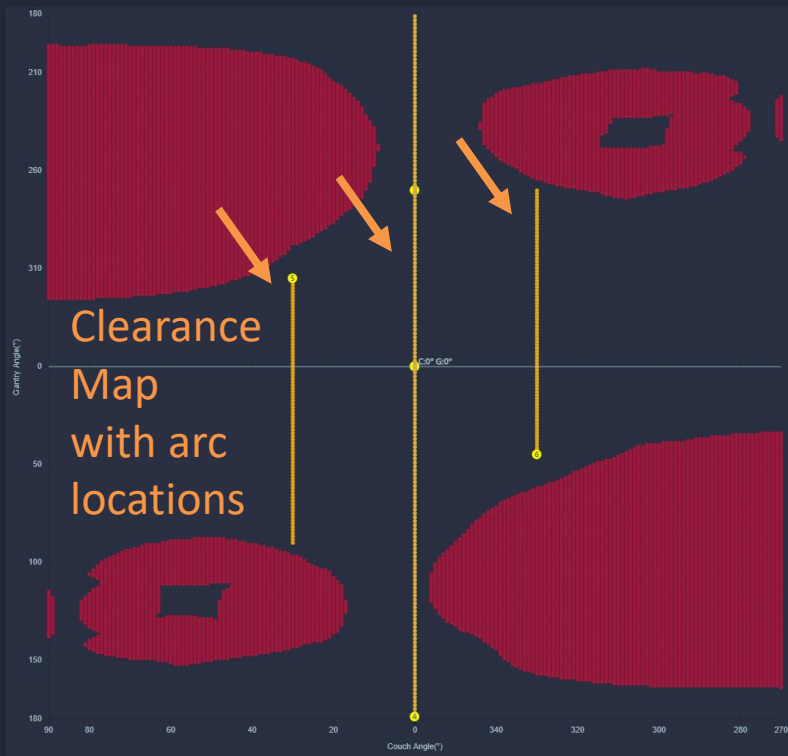


MapRT

Larynx 4250

Status	#	ID	Type	Gantry	Couch	Direction
✔	1	CT01	Static	0°	0°	—
✔	2	A	Static	0°	0°	—
✔	3	B	Static	270°	0°	—
✔	4	1	Arc	179° to 181°	0°	CC
✔	5	2	Arc	315° to 90°	30°	CW
✔	6	3	Arc	45° to 270°	330°	CC

Imported Dicom parameters



MapRT

Larynx 4250

Status	#	ID	Type	Gantry	Couch	Direction
●	1	CT01	Static	0°	0°	—
●	2	A	Static	0°	0°	—
●	3	B	Static	270°	0°	—
●	4	1	Arc	179° to 181°	0°	CC
●	5	2	Arc	315° to 90°	30°	CW
●	6	3	Arc	45° to 270°	330°	CC

Imported Dicom parameters

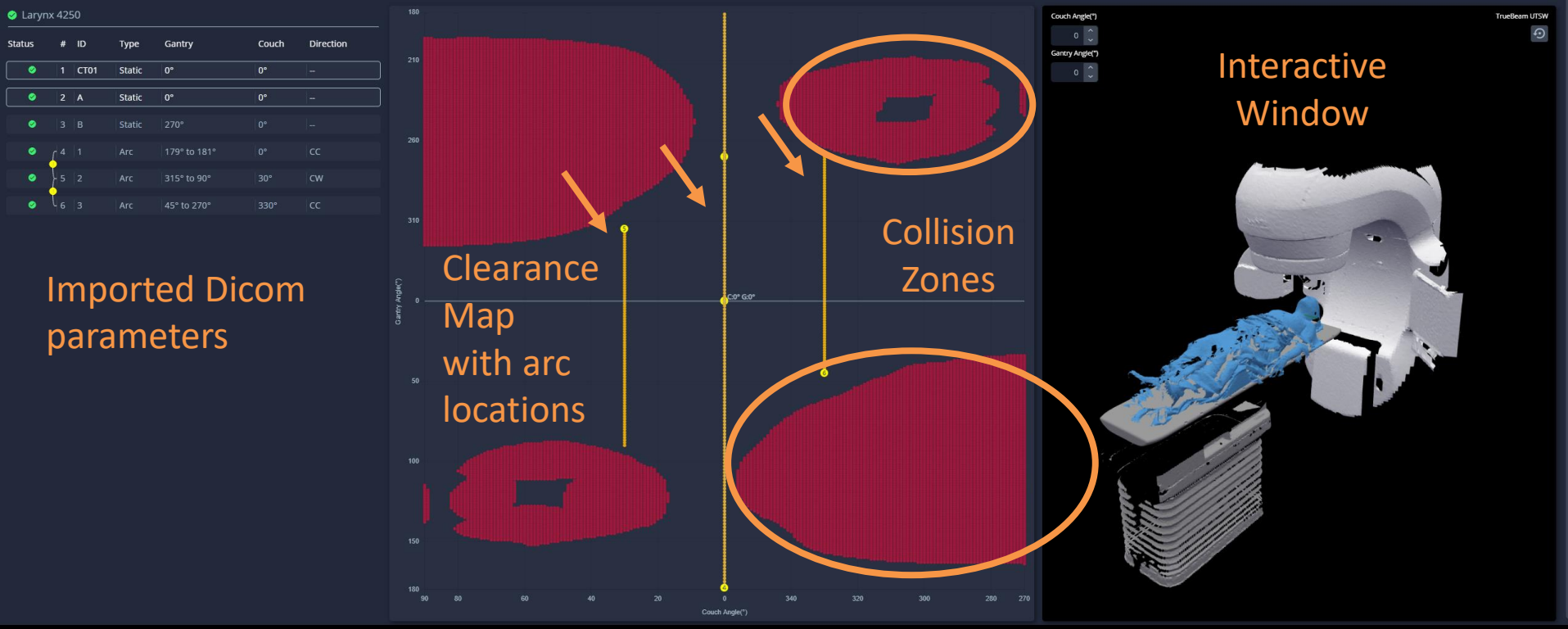
Clearance Map with arc locations

Collision Zones

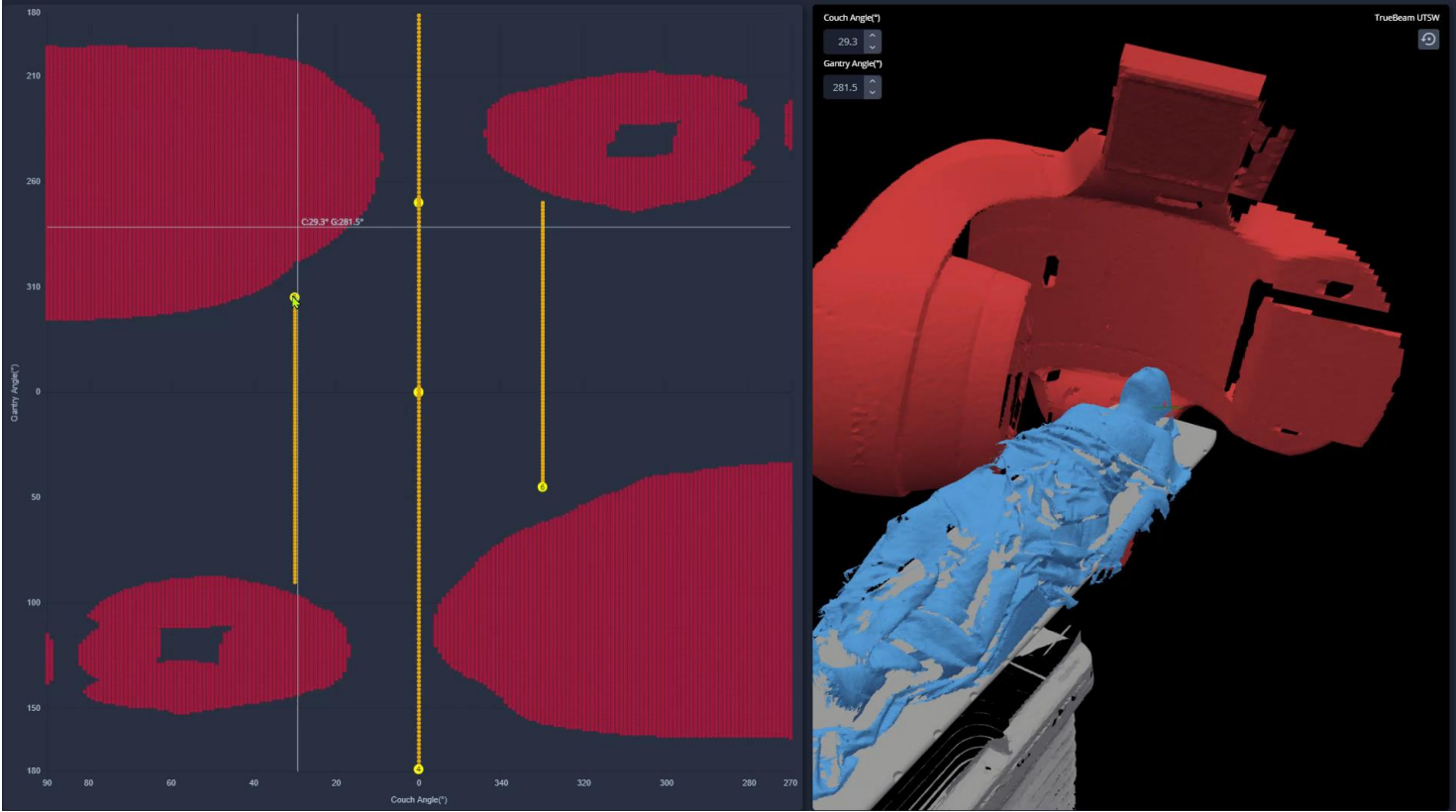
Couch Angle (°)
0
Gantry Angle (°)
0

TrueBeam LINAC

MapRT



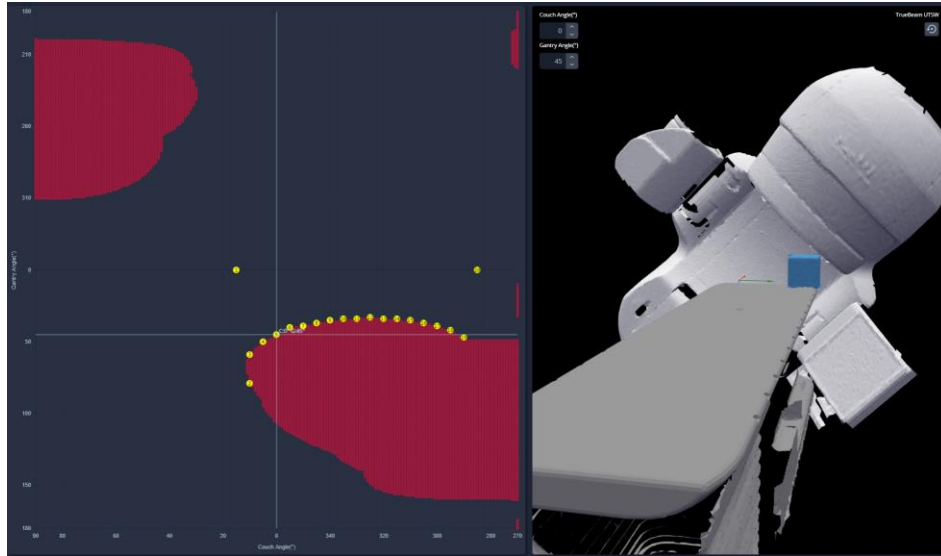
MapRT



What is the accuracy?



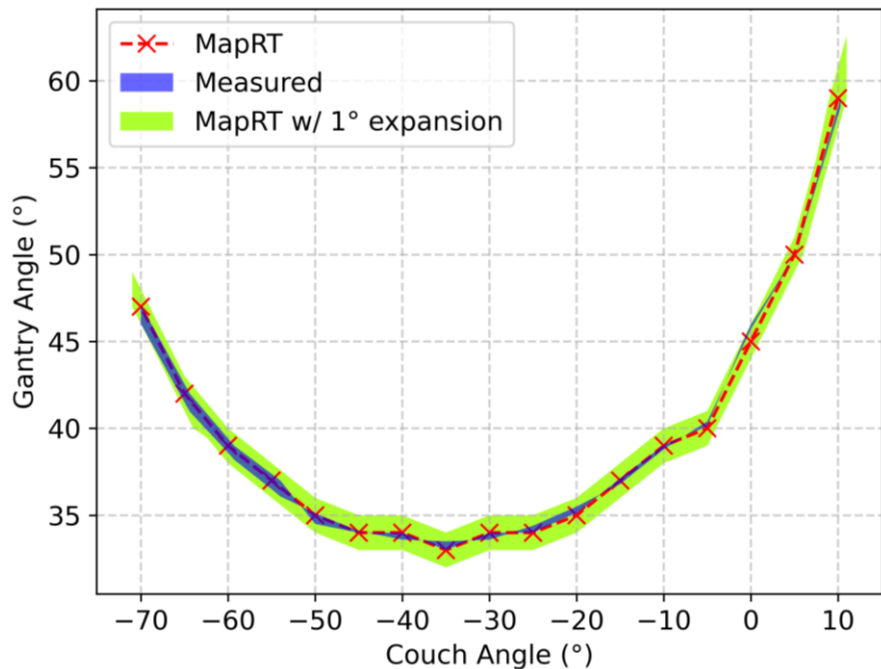
Siqui Wang, Ph.D.
Physics Resident



Clearance accuracy is within $\pm 1^\circ$



Siqui Wang, Ph.D.
Physics Resident



How does it compare to manual checks?



Siqu Wang, Ph.D.
Physics Resident

60 SAbR and non-coplanar brain patients at UTSW

Method	Clearance Agreed	Clearance Disagreed	Success Ratio
Physical Angle Check	55	5	91.7%
MapRT			

How does it compare to manual checks?



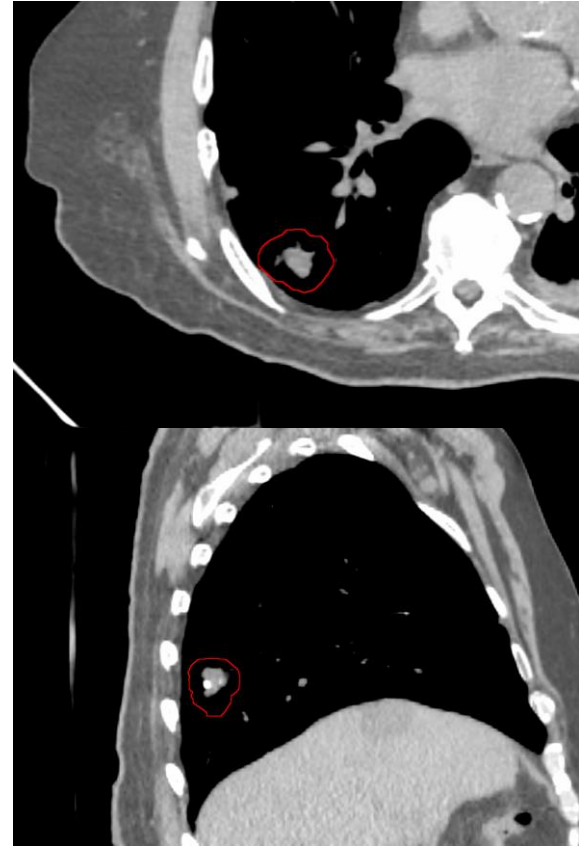
Siqu Wang, Ph.D.
Physics Resident

60 SBRT and non-coplanar brain patients at UTSW

Method	Clearance Agreed	Clearance Disagreed	Success Ratio
Physical Angle Check	55	5	91.7%
MapRT	60	0	100%

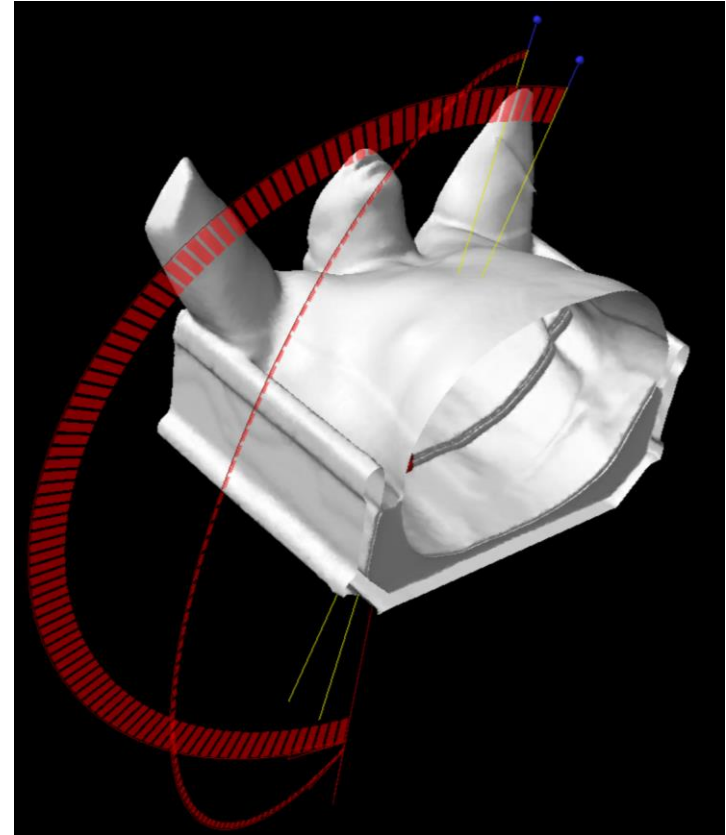
How this is done in practice

- 74-year-old female
- 17.6 cm³ right lung lesion
- SAbR candidate with 60Gy in 5Fx
- 2 partial arc treatment was chosen

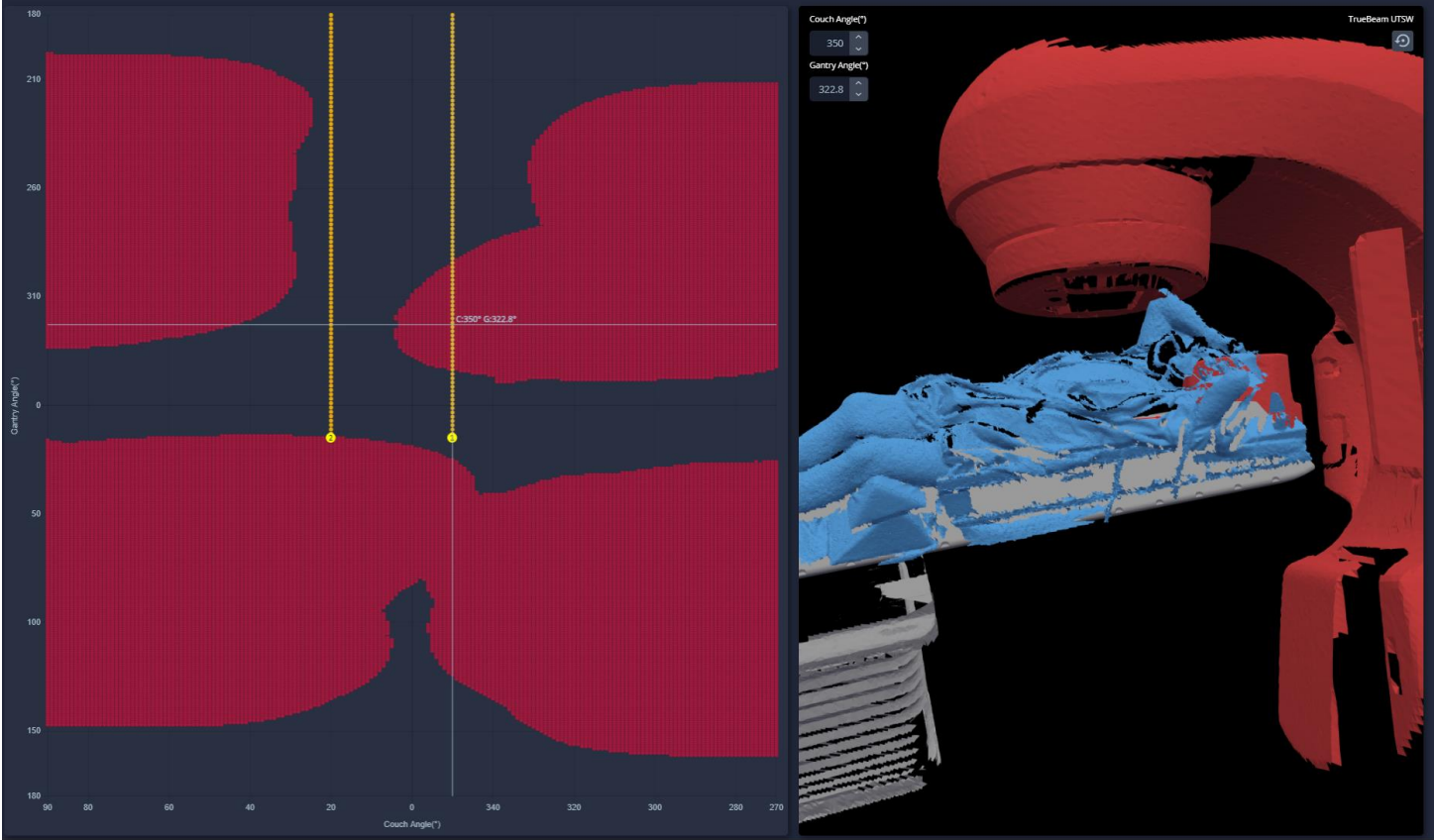


How this is done in practice

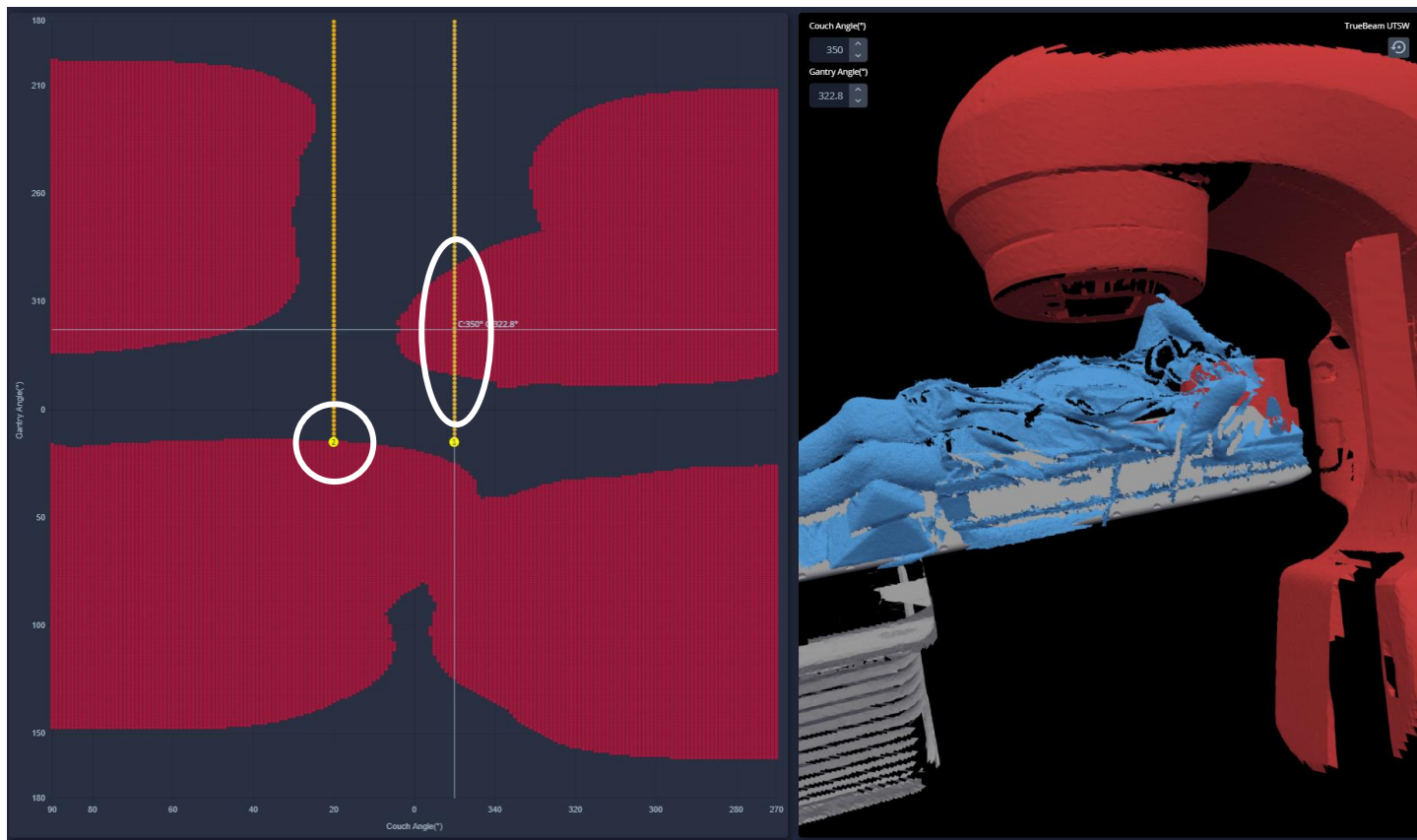
- 74-year-old female
- 17.6 cm³ right lung lesion
- SAbR candidate with 60Gy in 5Fx
- 2 partial arc treatment was chosen



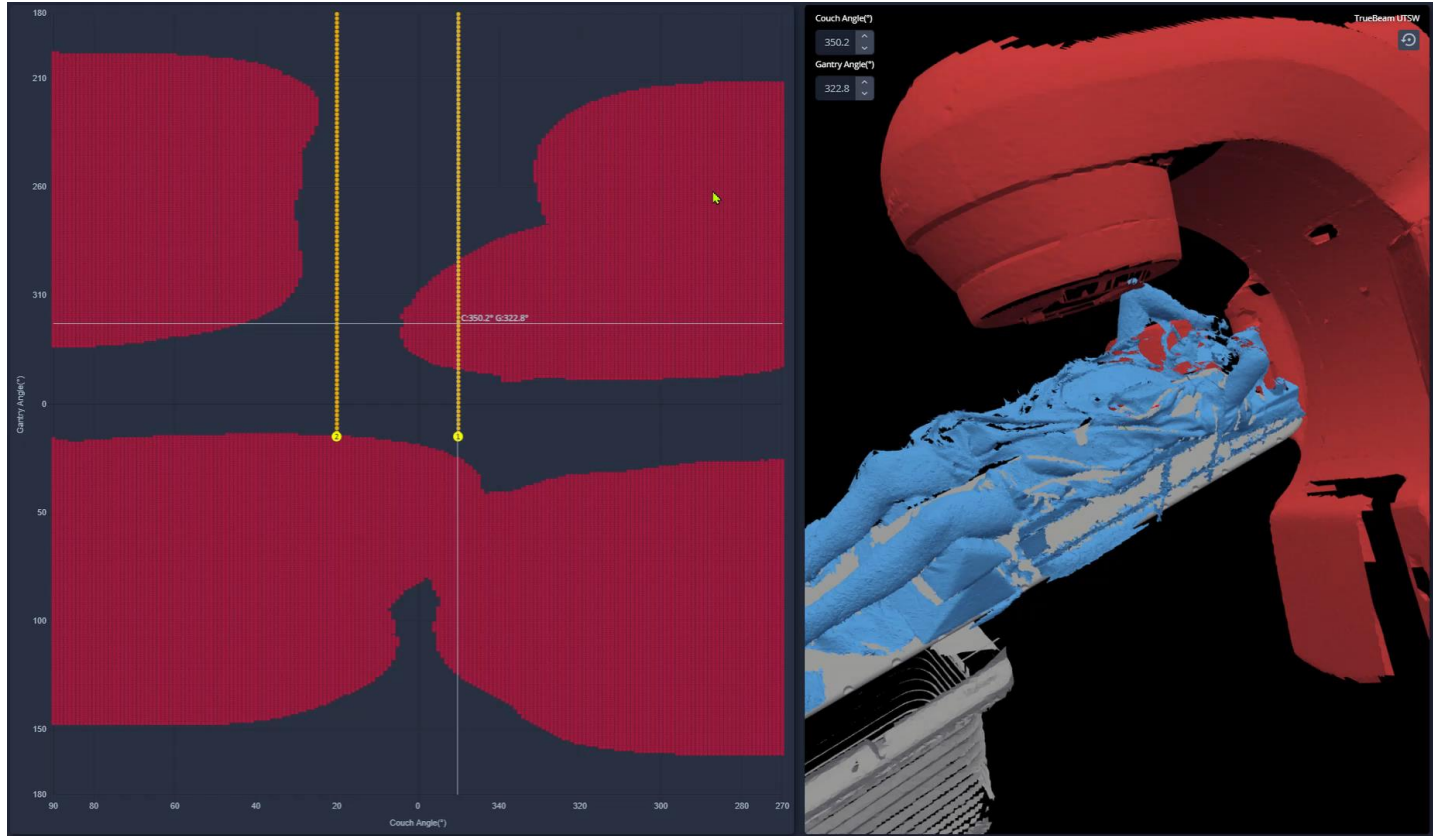
Enter MapRT



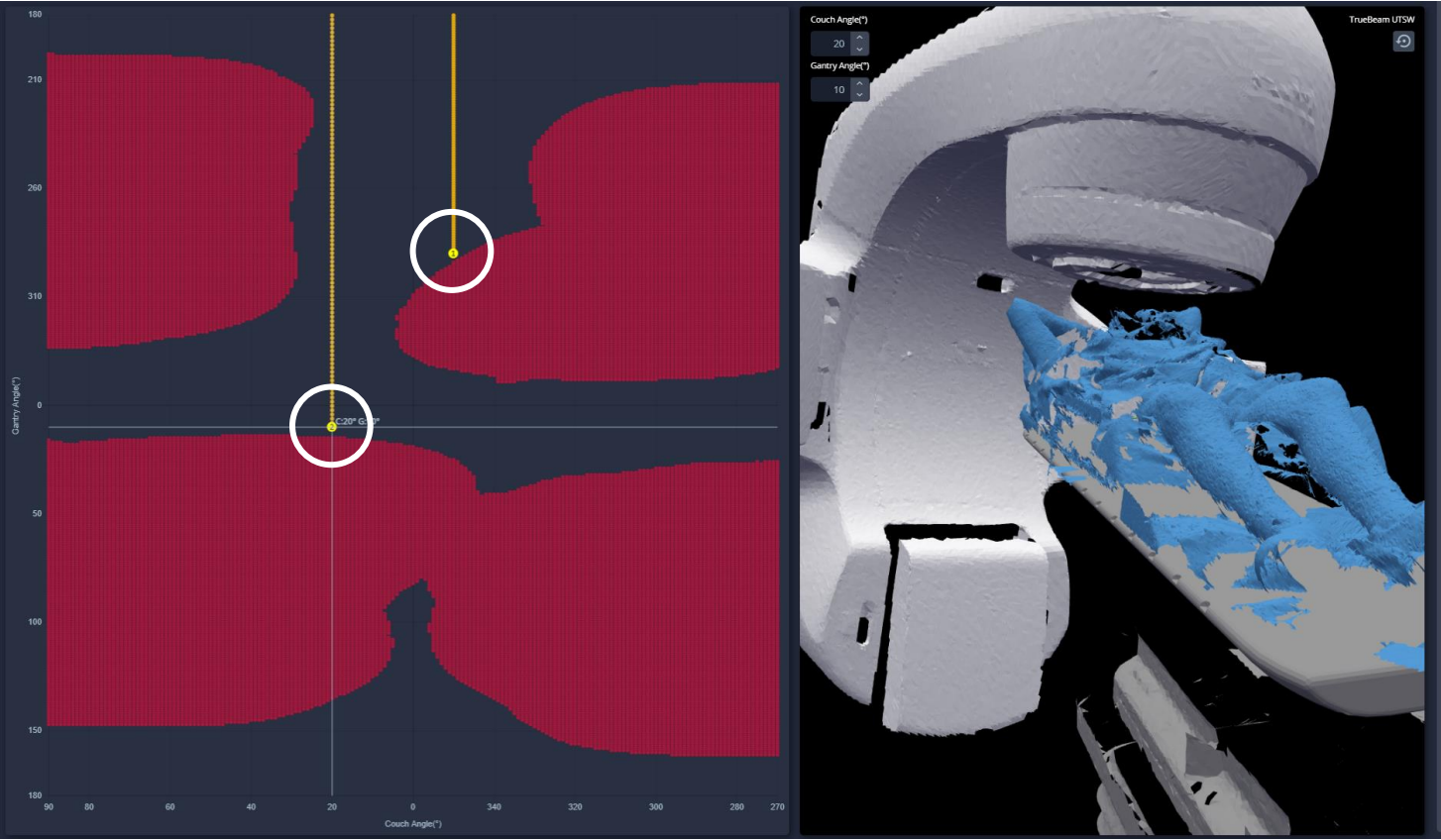
Identify the trouble spots



Adjust the areas of interest



Check the revise the field arrangement



Resulting comparison

Coplanar

$$CI_{\text{Paddick}} = 0.89$$

$$GI_{50\%} = 4.54$$

$$GI_{25\%} = 28.5$$

5688 MU

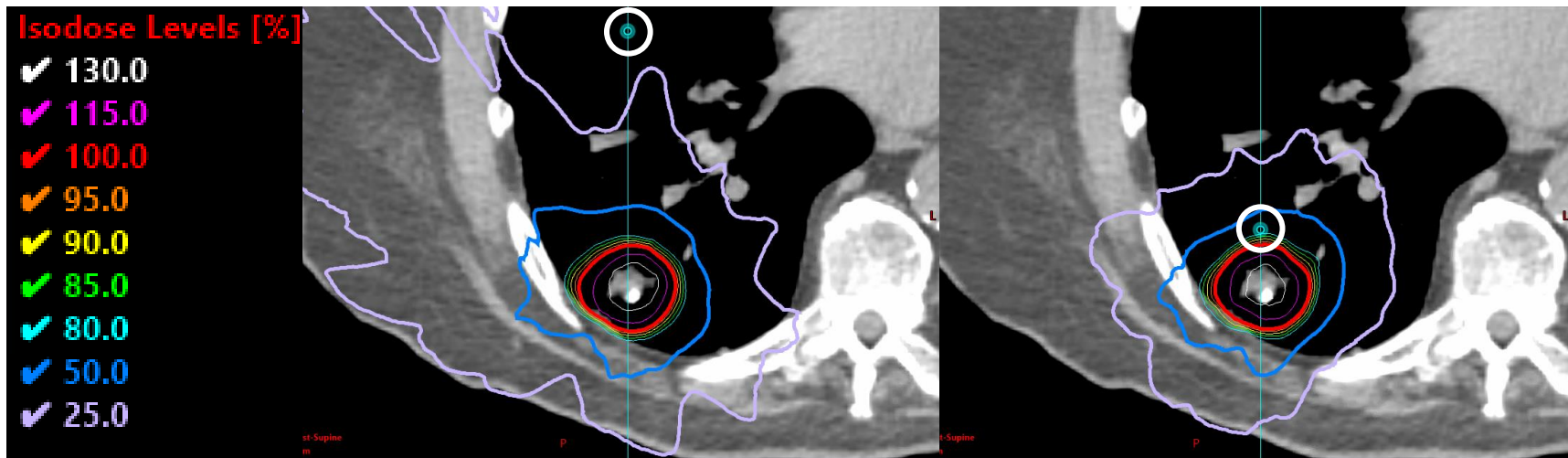
Non-coplanar

$$CI_{\text{Paddick}} = 0.91$$

$$GI_{50\%} = 4.30$$

$$GI_{25\%} = 15.1$$

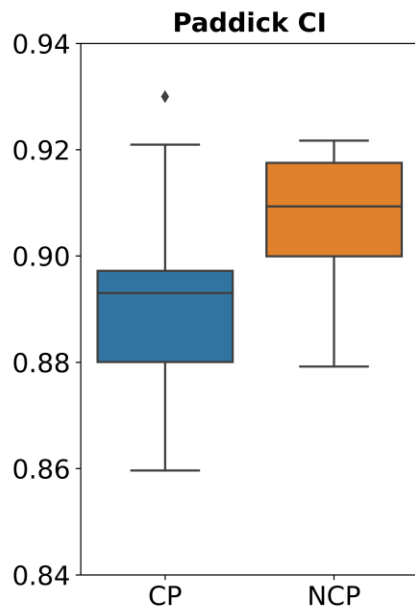
4061 MU



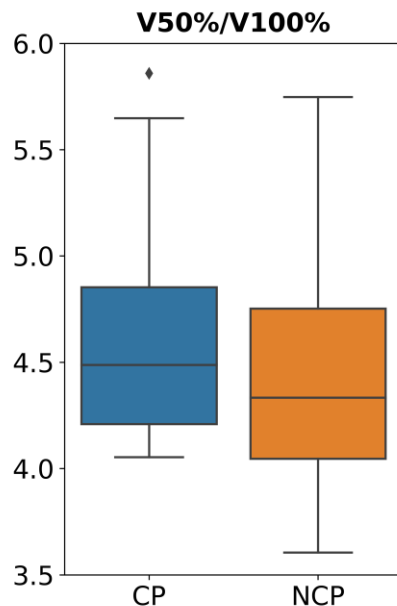
Over 20 lung SAbR patients



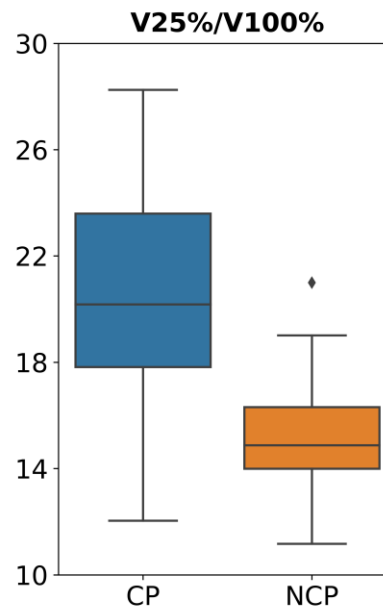
Siqiu Wang, Ph.D.
Physics Resident



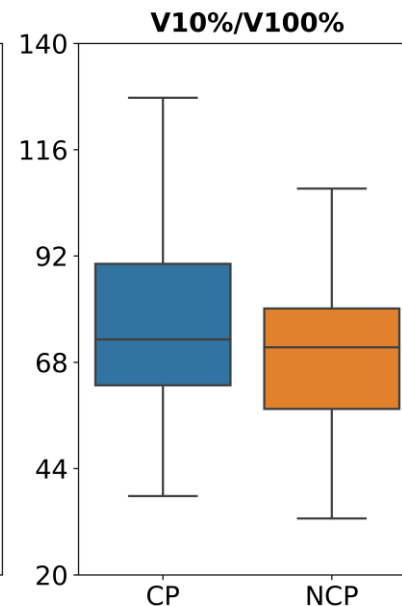
$p = 0.001$



$p = \text{n.s.}$



$p < 0.001$

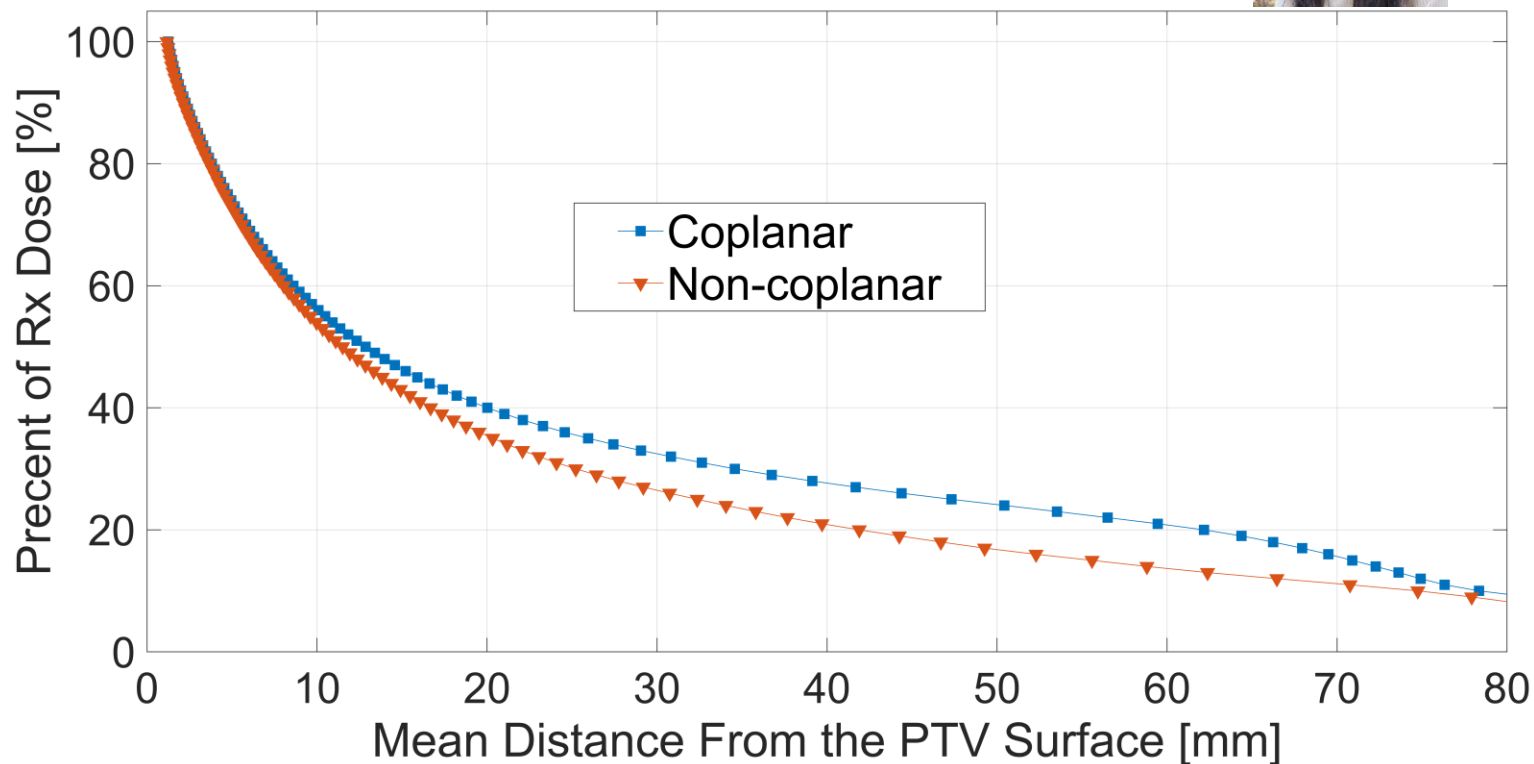


$p = \text{n.s.}$

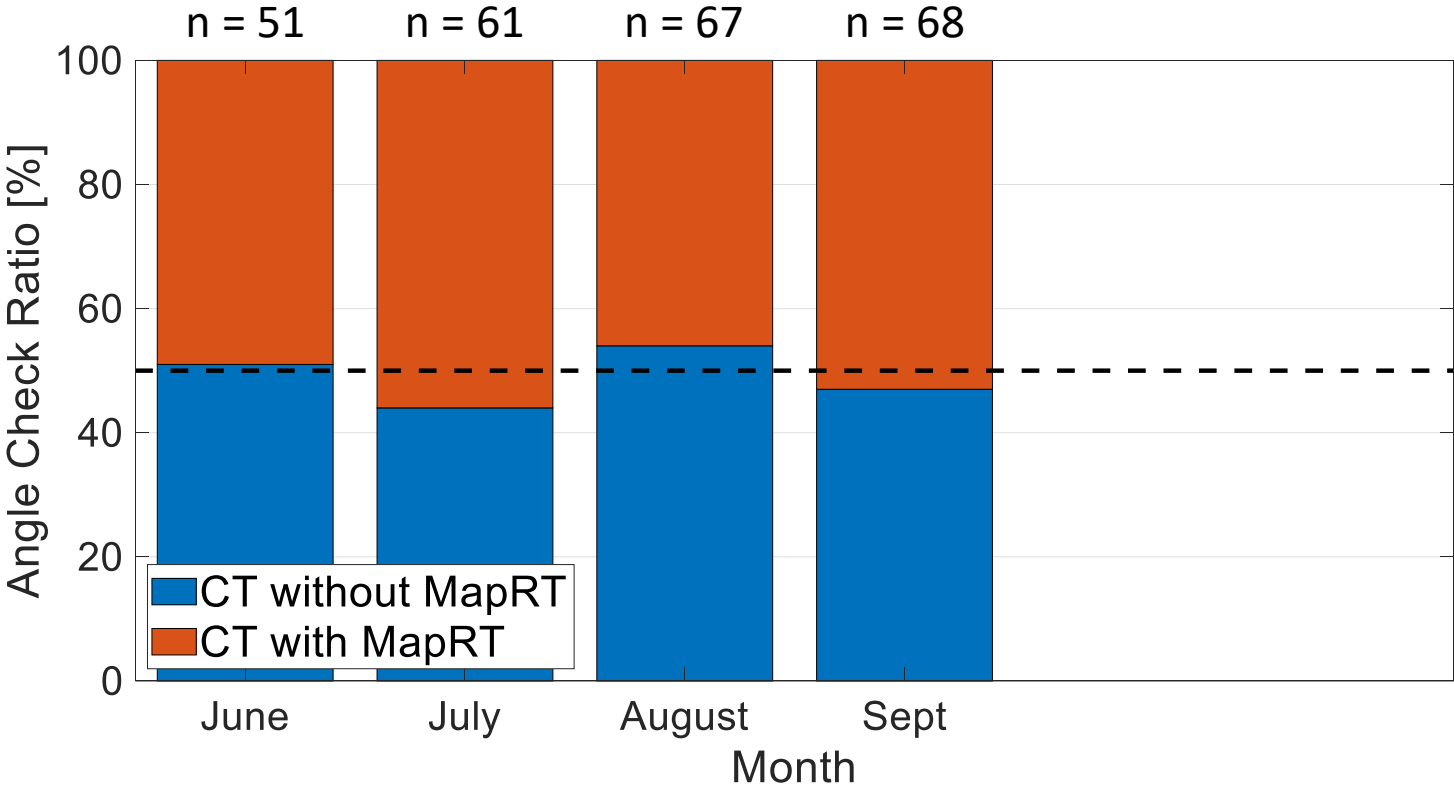
Over 20 lung SAbR patients



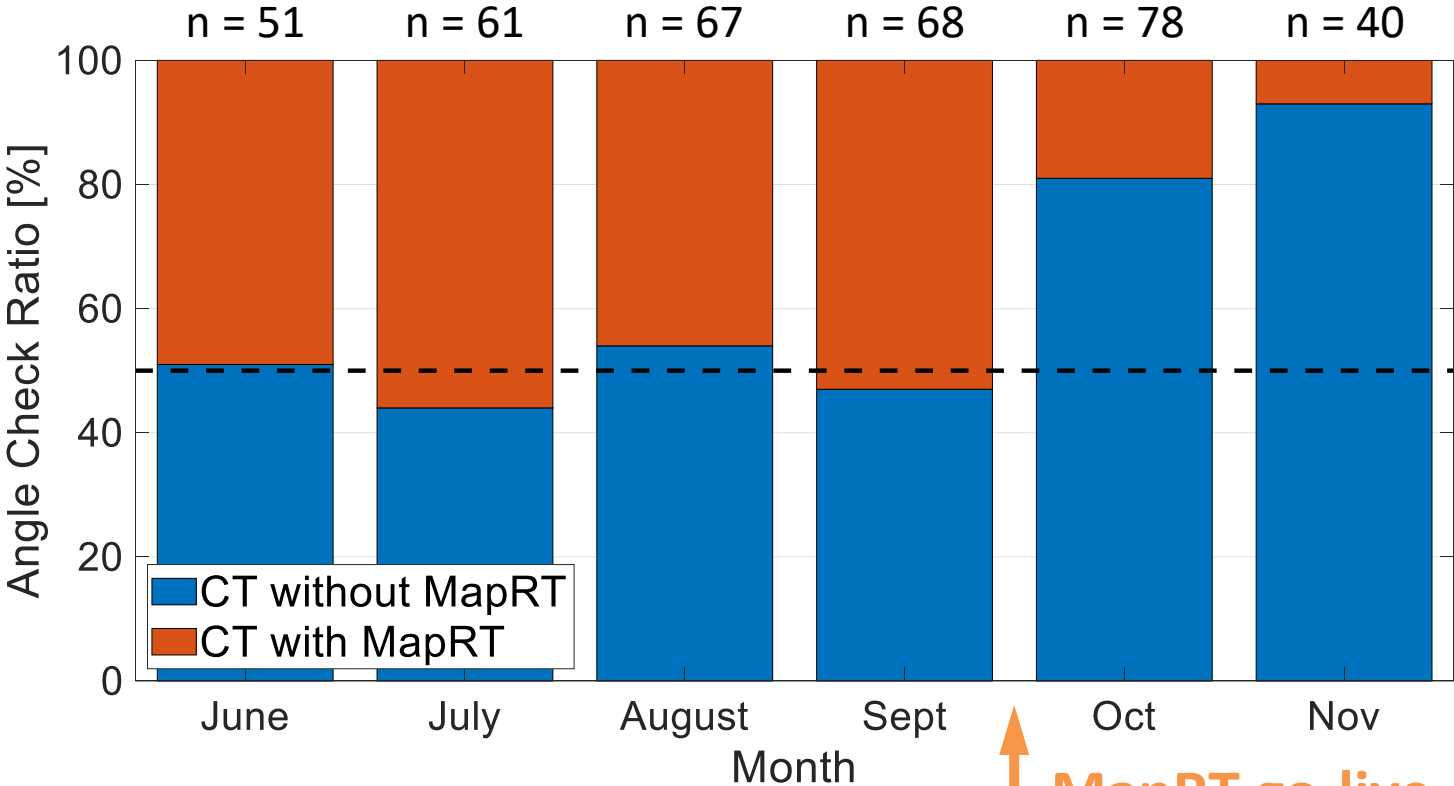
Siqui Wang, Ph.D.
Physics Resident



Going Live with MapRT – Historical Trend

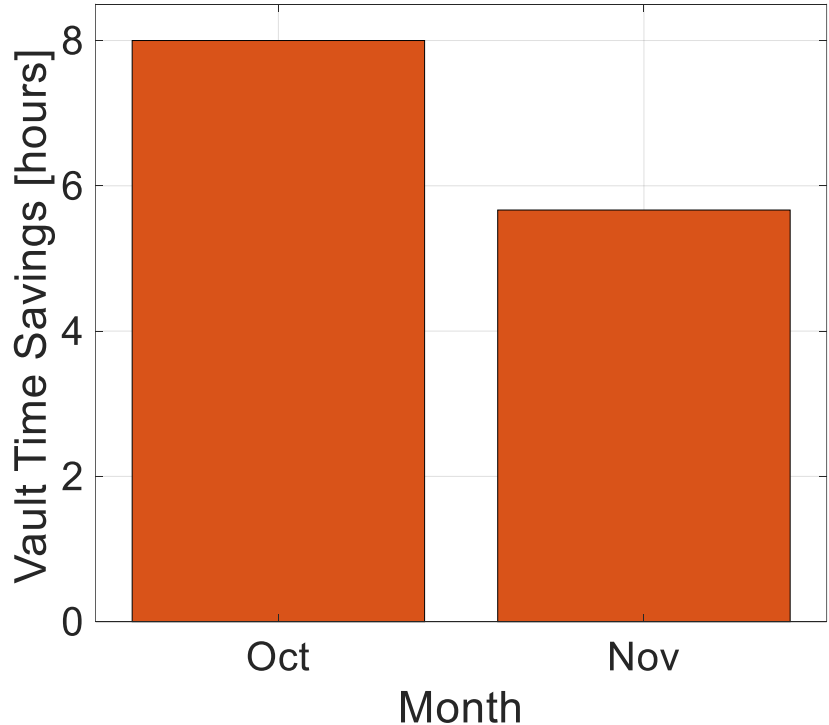


Going Live with MapRT – Rapid Decrease



Estimated in-vault time savings

- We estimate that in
 - October we should have had **~125** angle checks
 - November we should have had **~75** angle checks
- This equals to an estimated in-vault time savings of
 - **8.0** hours in October
 - **5.7** hours in November



Summary

- **MapRT is a novel SGRT clearance mapping software**
- **More accurate than manual clearance checks**
- **Greatly reduces the planning time**
- **Saves in-vault time**
- **Improved dosimetry**
- **In short, MapRT enables confidence in non-coplanar treatments**

Acknowledgments

- Andrew Godley
- David Sher
- Eric Chambers
- Siqui Wang
- Yesenia Gonzalez
- Xinran Zhong
- Liyuan Chen
- Kara James
- Jennifer Cleaton
- Lindsy Seaux
- Phu Ho
- Rashad Campbell
- Gannon Arnold
- Jordan Getchell
- Weihan Lee
- Jeff Dubas
- Romona Frame
- Hung Ho