

THE UNIVERSITY OF TEXAS

MD Anderson
~~Cancer Center~~

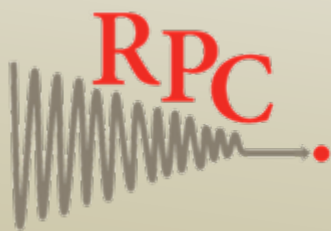
Making Cancer History[®]

**Design and verification of a heterogeneous proton
equivalent thorax phantom for use in end-to-end
assessment of pencil beam proton therapy**

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Purpose

To implement a phantom that can assure institutions can deliver clinically comparable and consistent radiation doses in proton therapy for lung cancer.



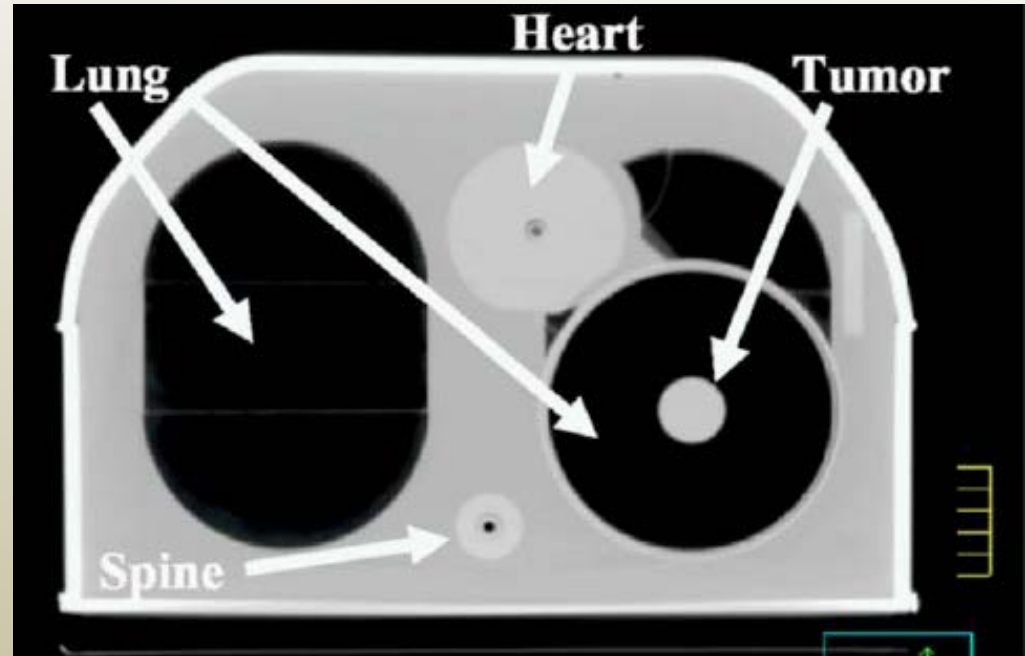
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Current phantom

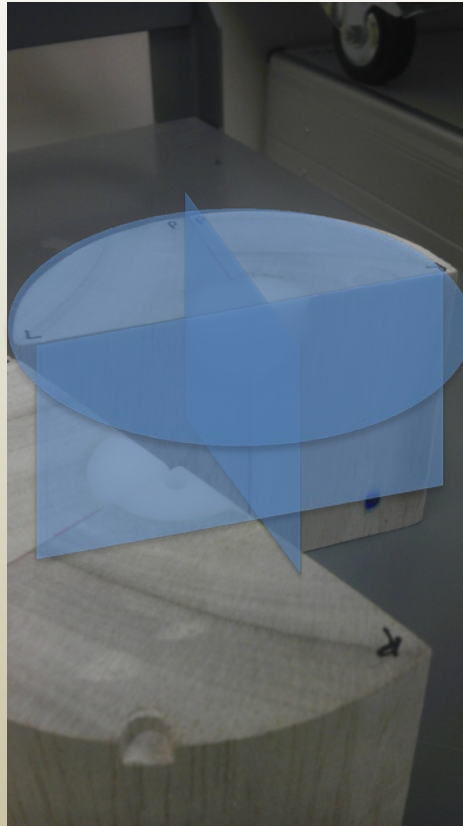


(Blatnica, 2011)



(Followill et al., 2007)

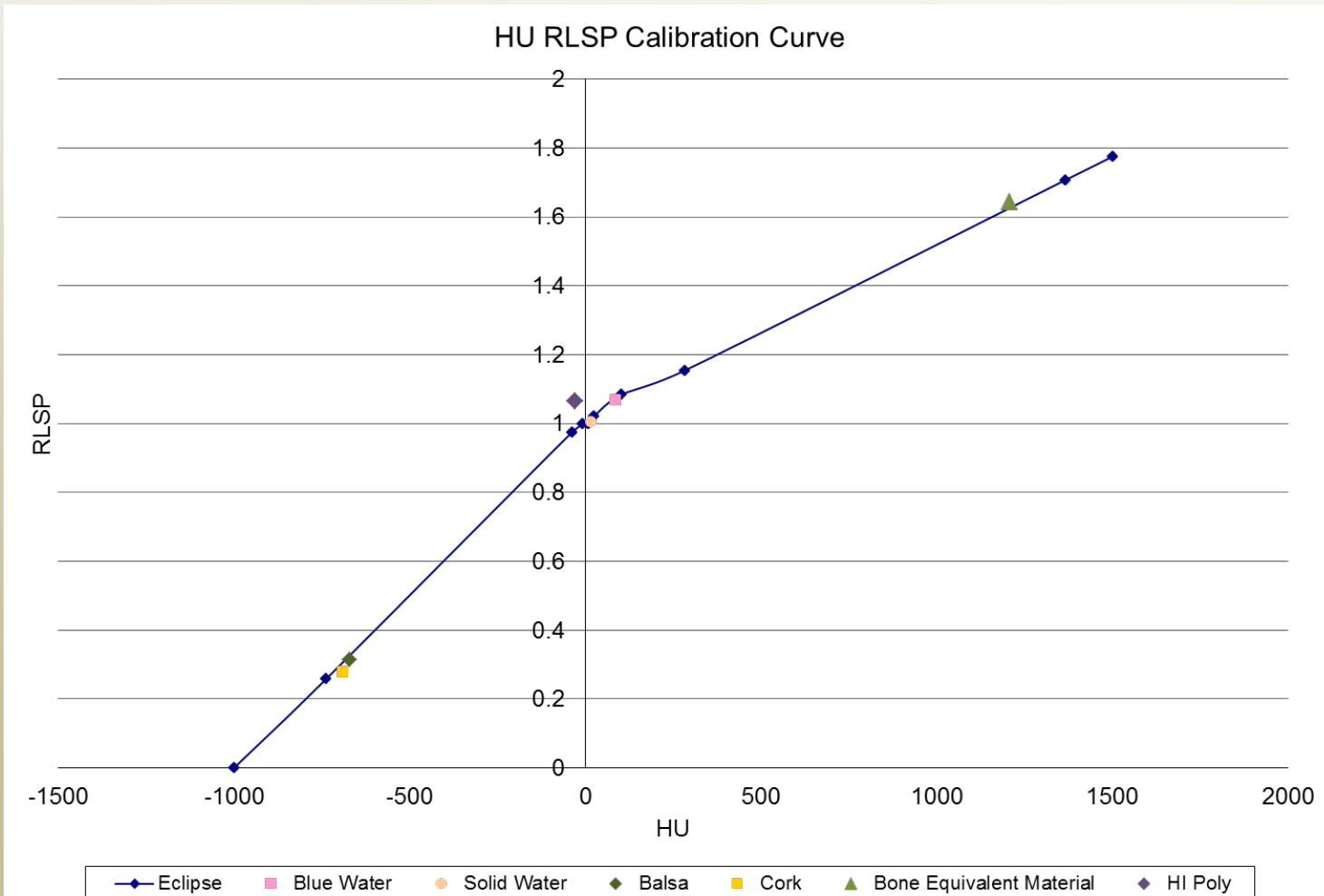
Insert



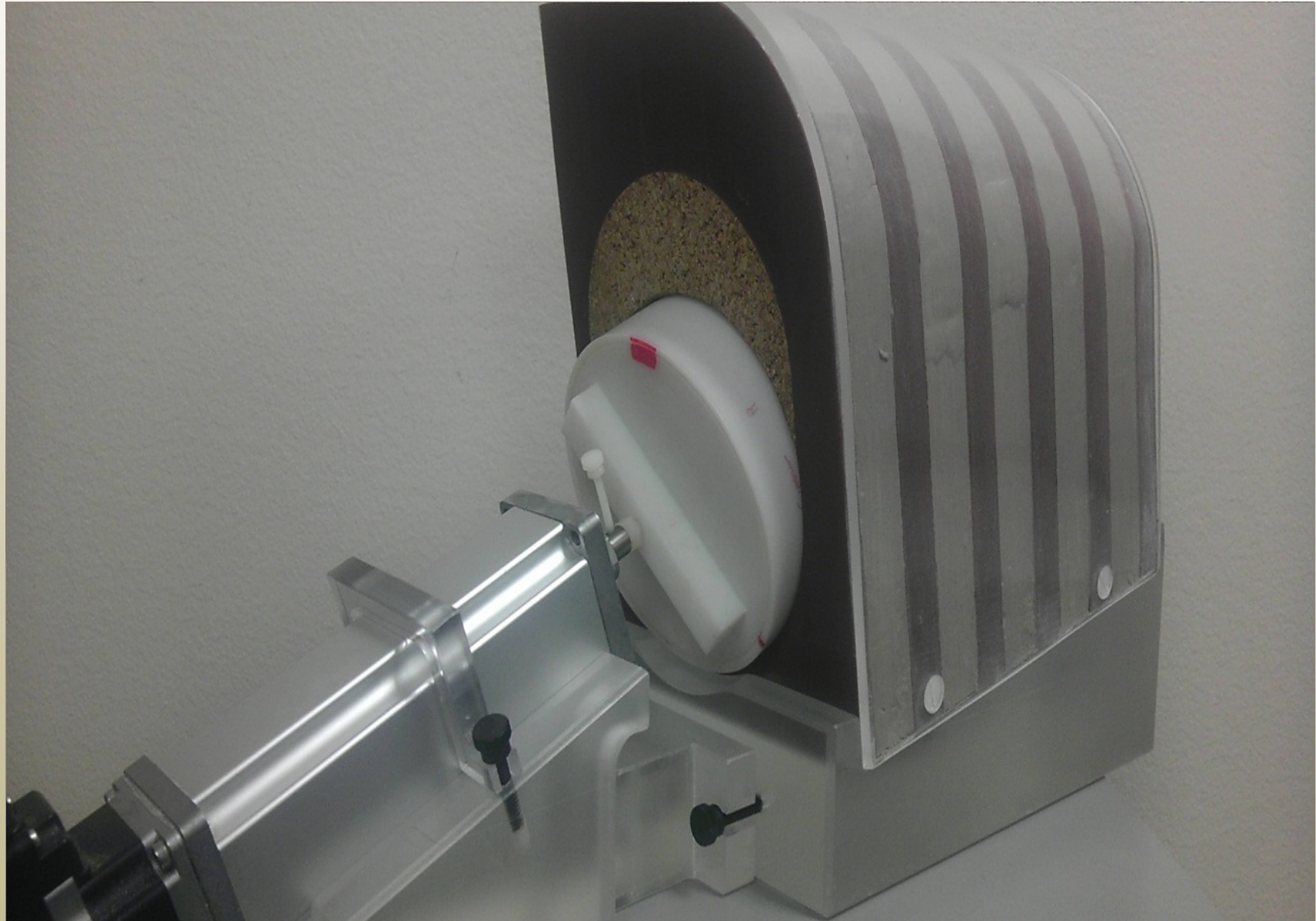
- **Designed to minimize air gaps**
- **High impact polystyrene target and shell**
- **Balsa surrounding**
- **Three film planes, two TLD**

Determination of bone equivalent material

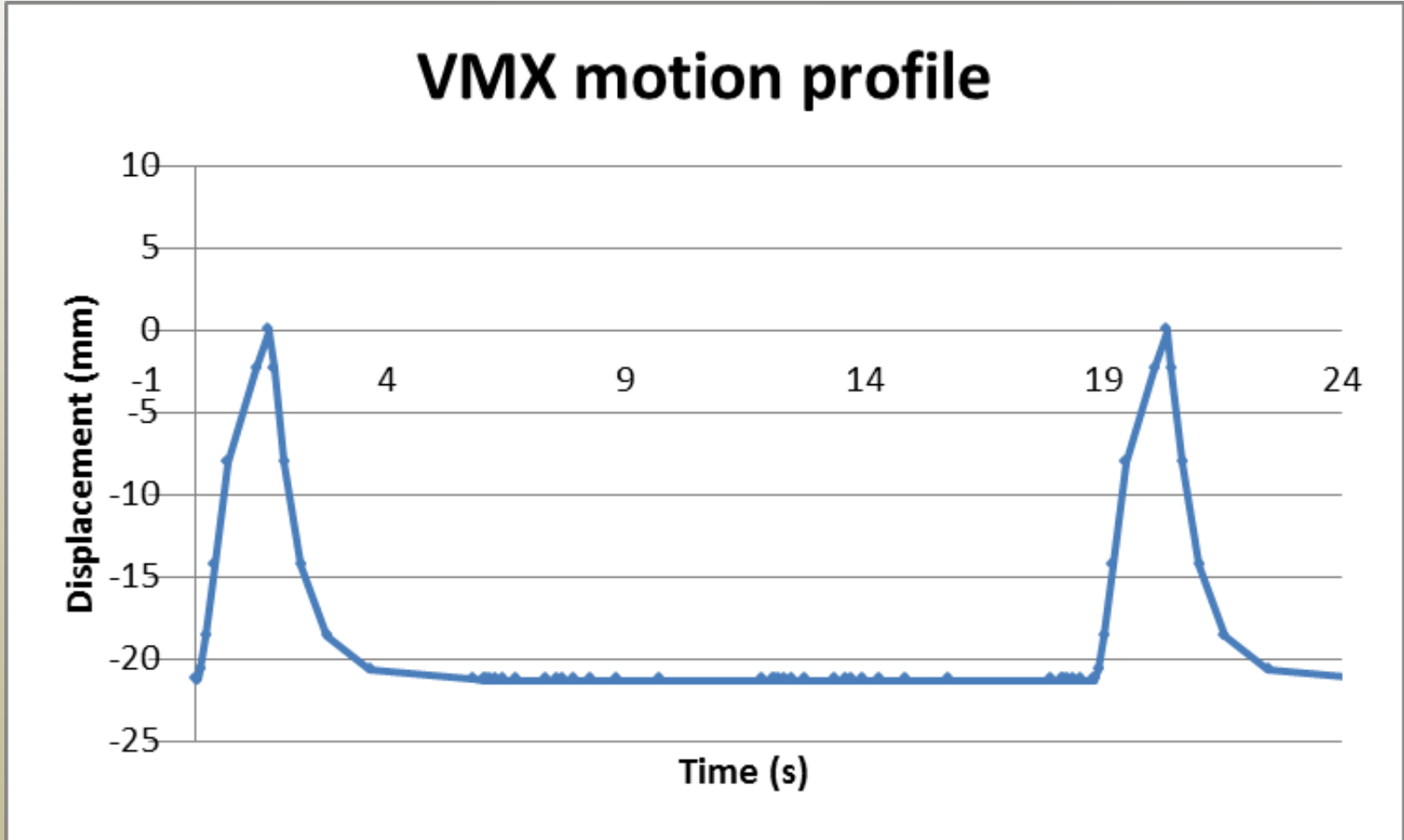
$$RLSP = \frac{(R_{80,w} - R_{80,m})}{t_m}$$



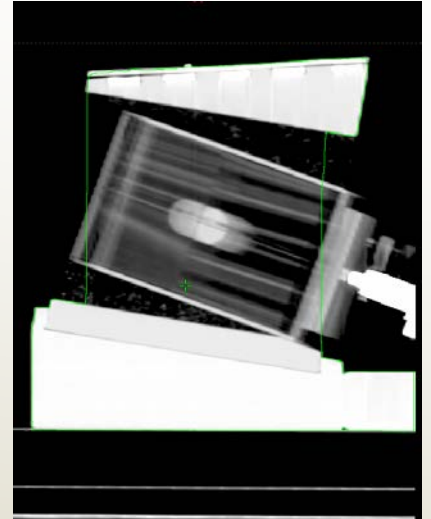
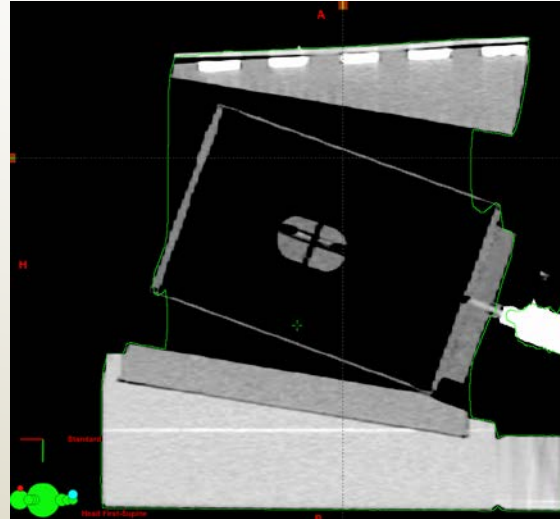
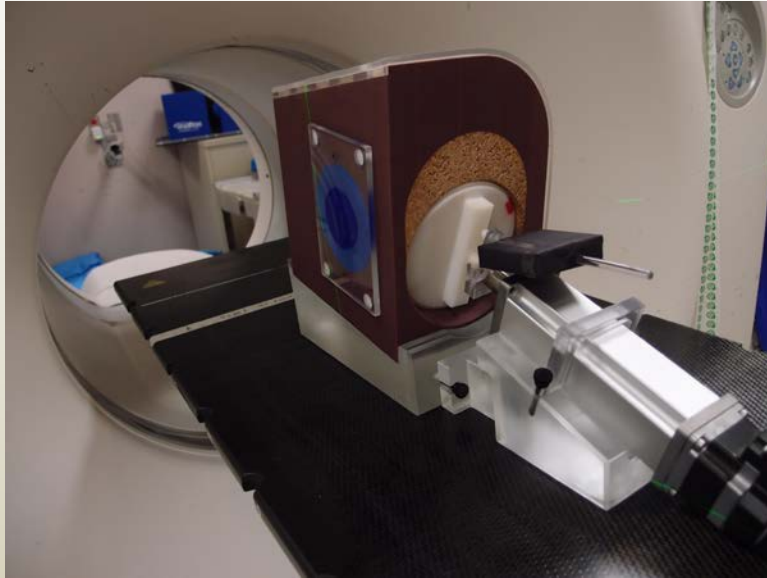
Design of phantom



Insert motion

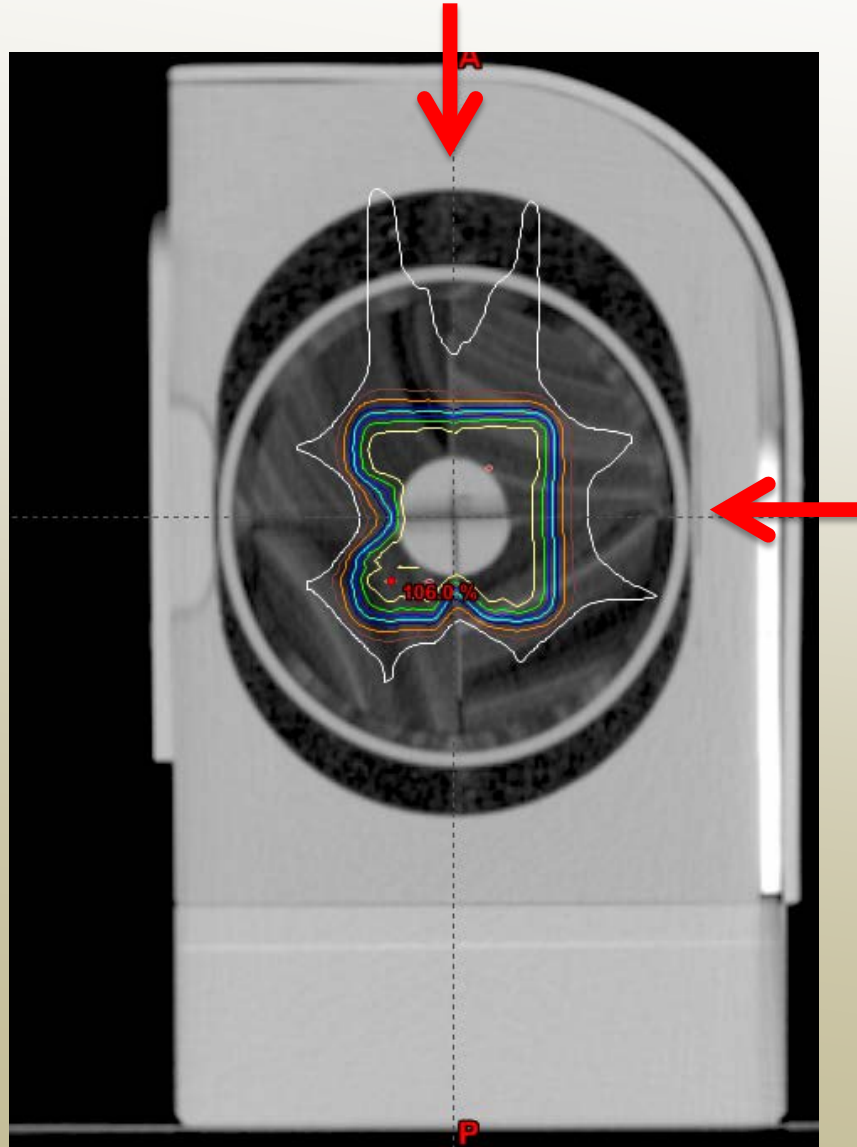


Imaging



- 3D CT for breath hold
- 4D CT for free breathing

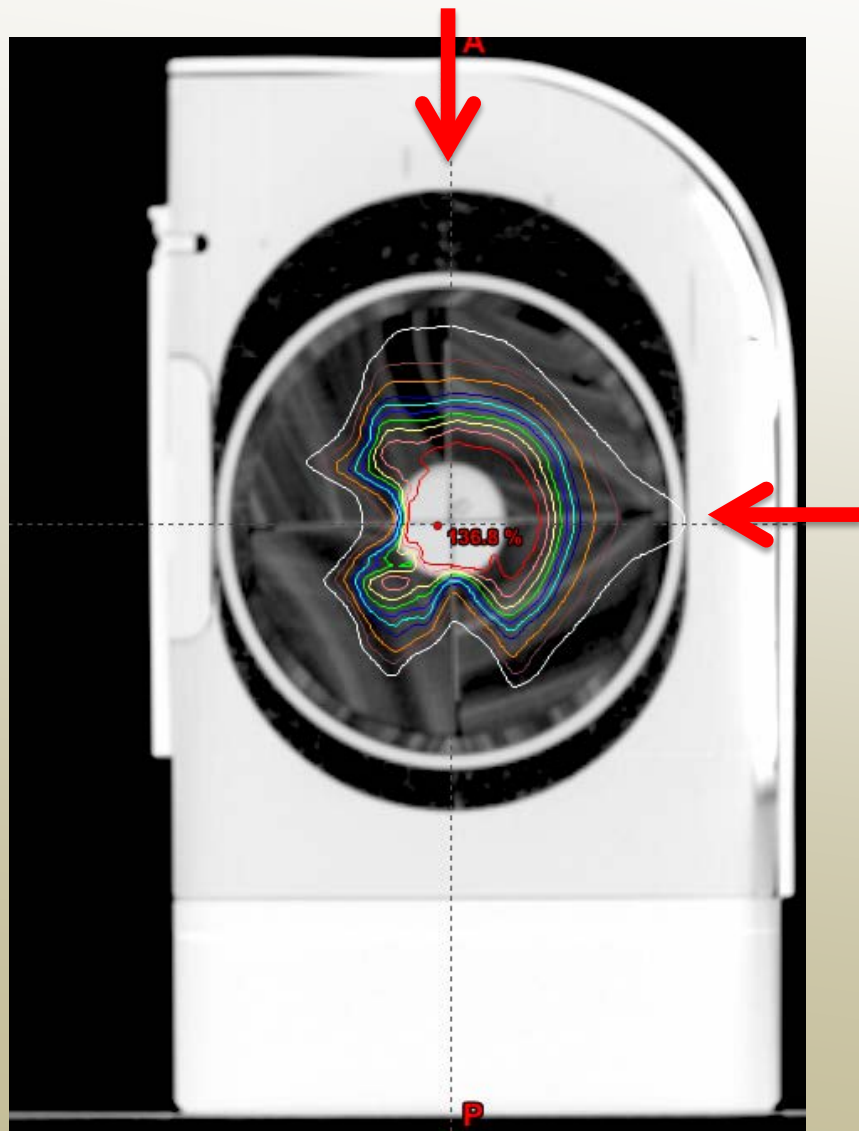
Treatment Plans



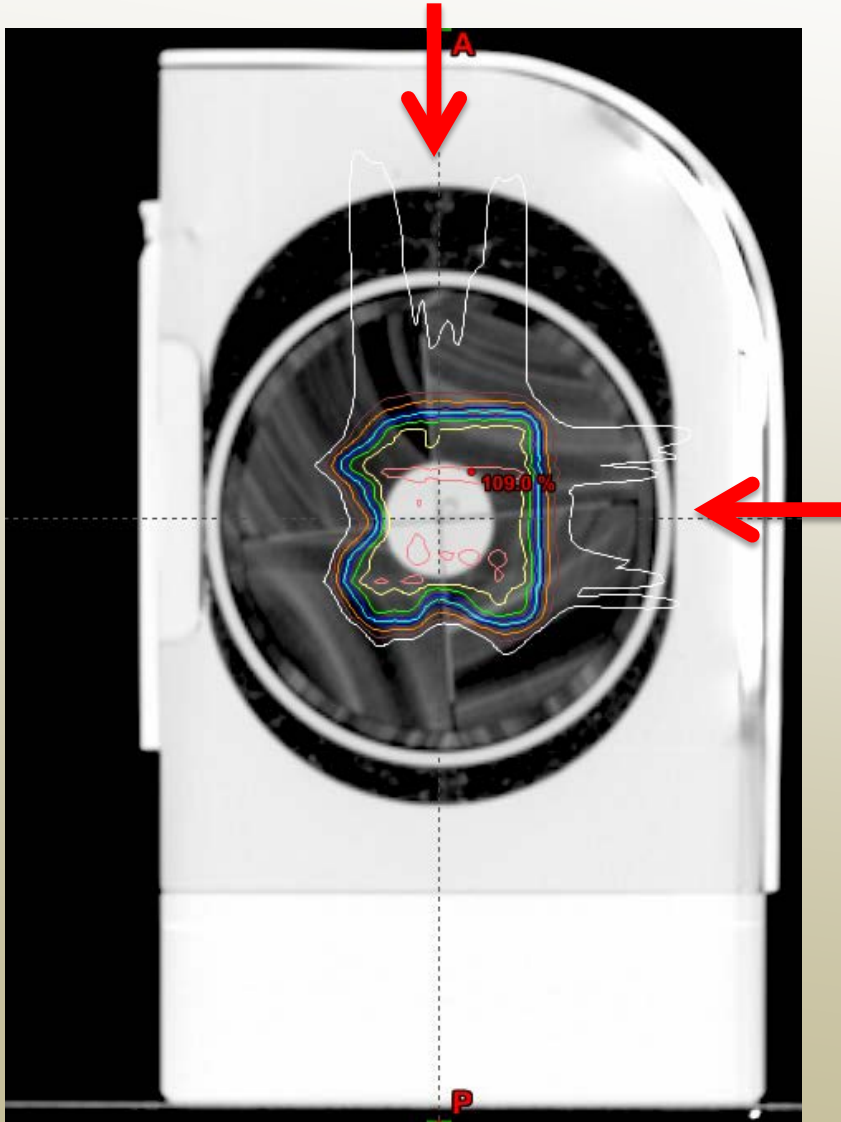
- 4 plans were made
 - **PSBH**
 - SS2cm
 - PSFB
 - SS1.5cm

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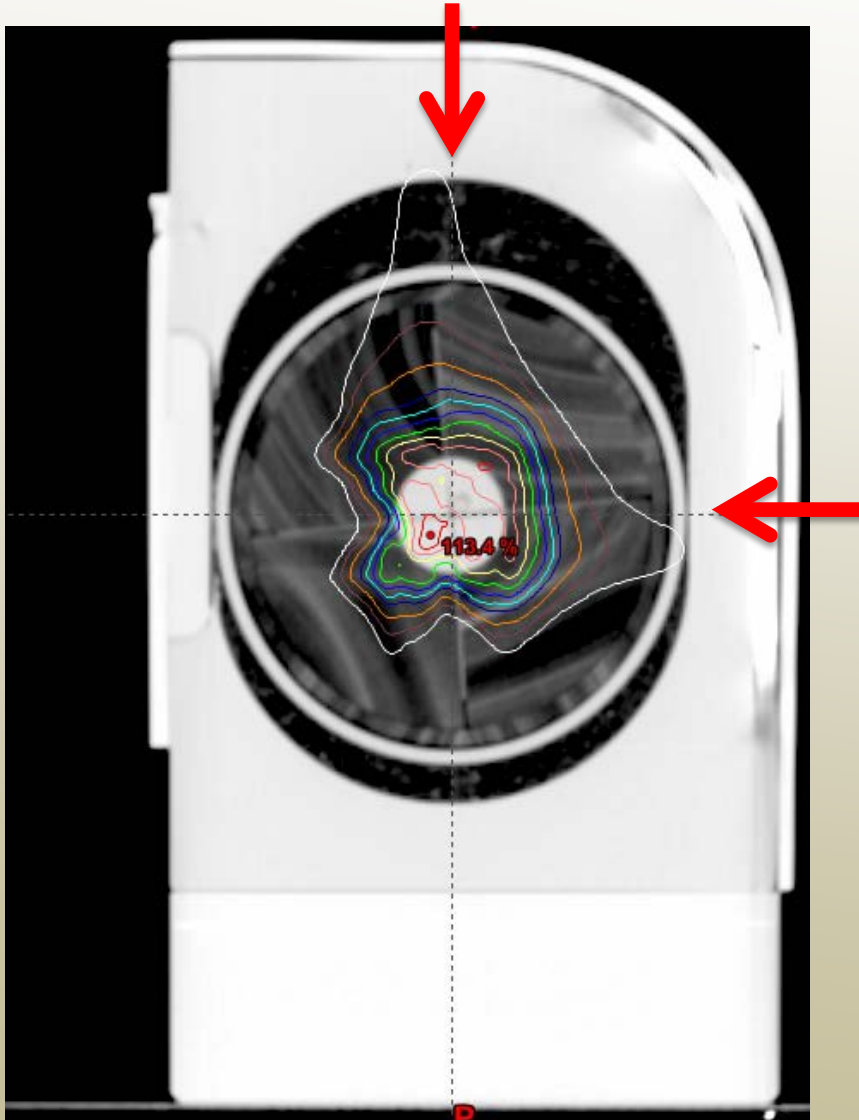


Treatment Plans



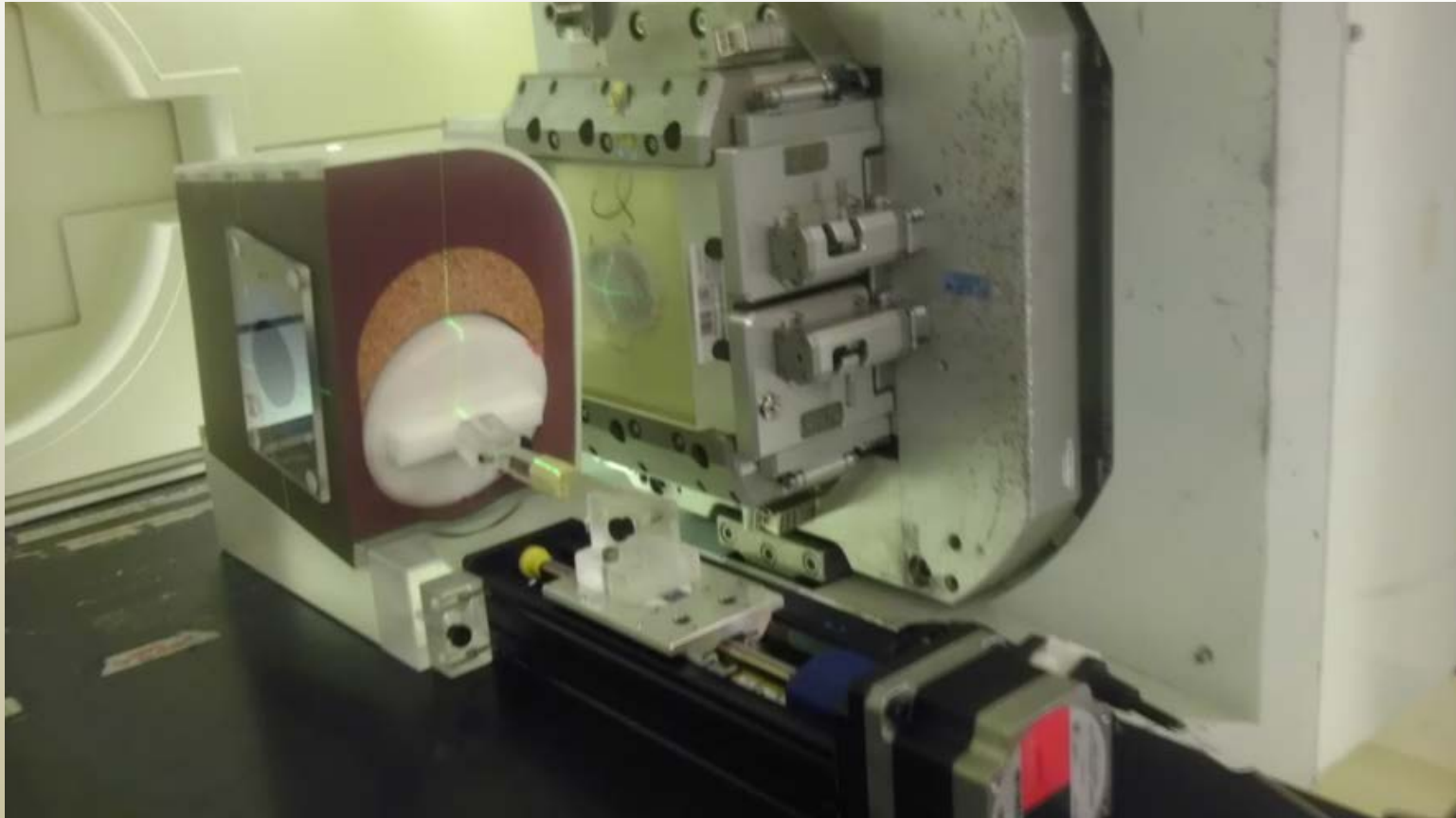
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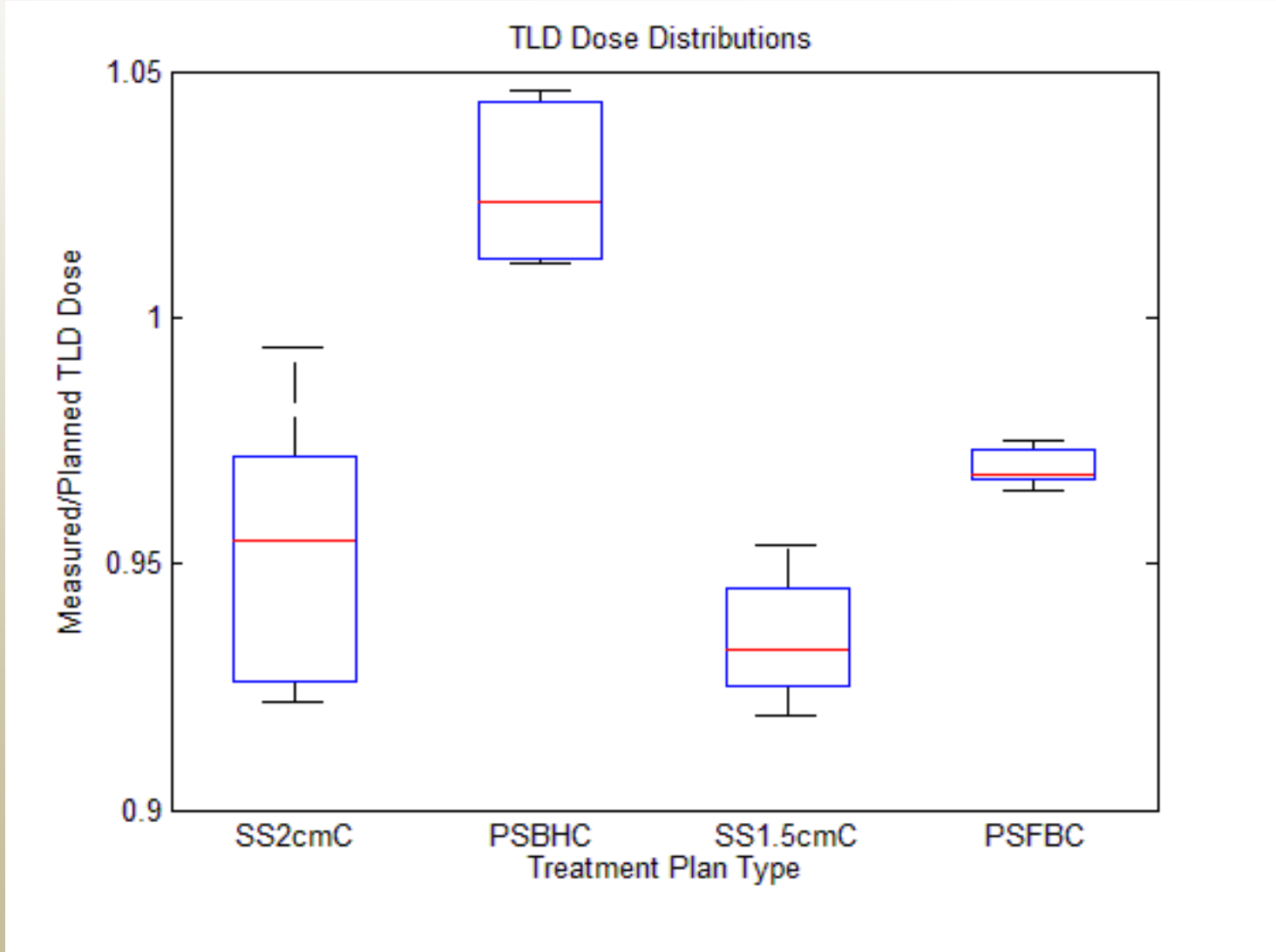


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 - **SS1.5cm**

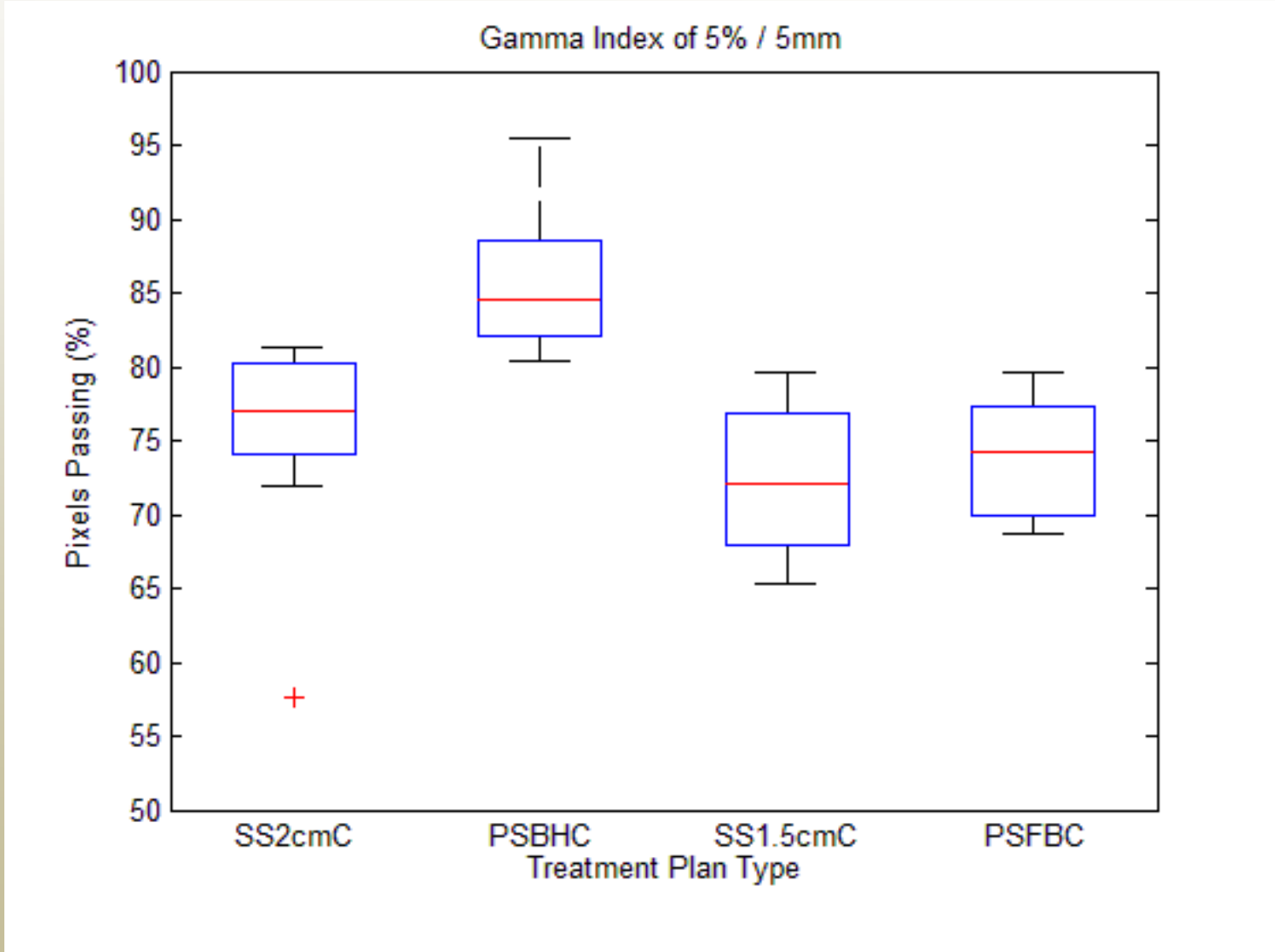
Treatment Setup



Results: TLD



Results: Film



Conclusions

- **The bone equivalent clay, and other phantom materials were found to simulate anatomy**
- **A phantom was developed with proton equivalent materials**
- **The phantom demonstrated the ability to be used as an end-to-end quality assurance tool for the credentialing of proton centers to clinical trials for lung cancer**

Future work

- **The current target material generated 10% reduction in gamma pass percentages**
 - **Should be accounted for by replacement**
- **More irradiations are needed to determine appropriate TLD, film and institution pass criteria**

Thank you

MD Anderson proton parameters

- **Spill length: 0.5 – 5s (PS)**
- **Spill length: 0.5 – 4.4s (SS)**
- **Energy / range resolution: 0.4MeV / 0.1g/cm²**
- **Spot size: 5 mm – 14.5 mm**