



Monte Carlo vs. Analytic Algorithms in IROC Proton Lung Phantom



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IMAGING AND
RADIATION ONCOLOGY CORE
Global Leaders in Clinical Trial Quality Assurance

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AMERICAN COLLEGE OF
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Paige Taylor, M.S.
AAPM Annual Meeting
August 3, 2017

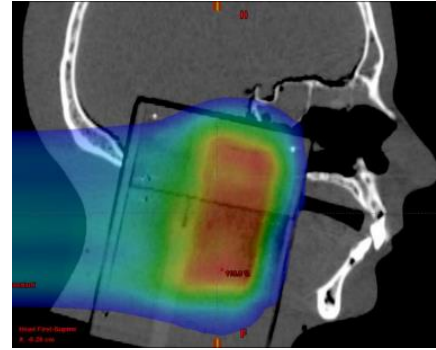
IROC's Mission

Provide **quality control programs** in support of the NCI's National Clinical Trial Network thereby **assuring high quality data** for clinical trials

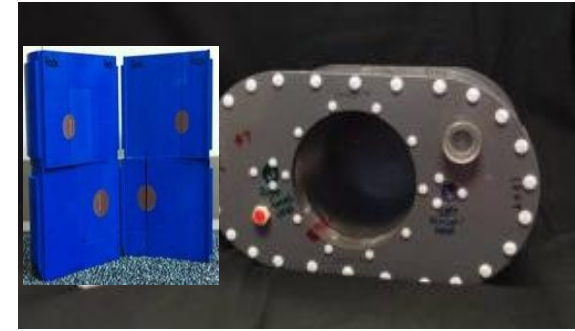
Proton Phantom Audits



Brain



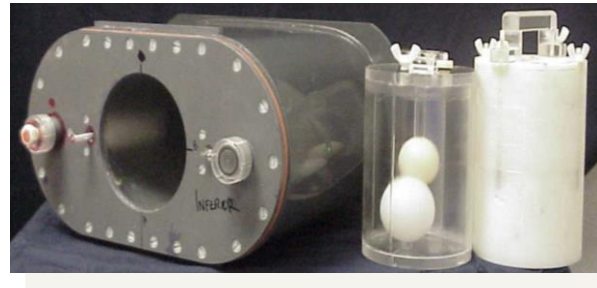
H&N



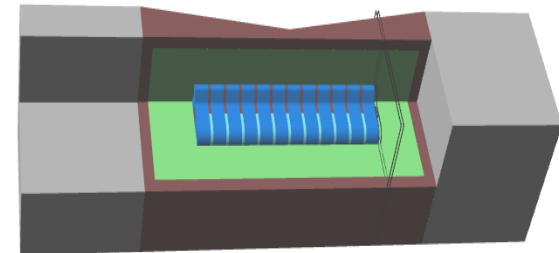
Liver



Lung/thorax



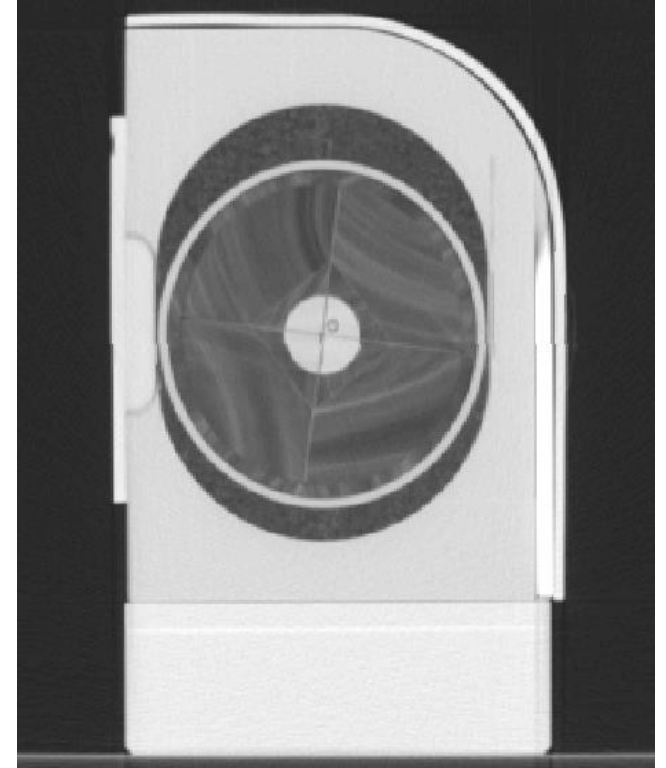
Prostate/pelvis



Spine

Proton Lung Phantom Design

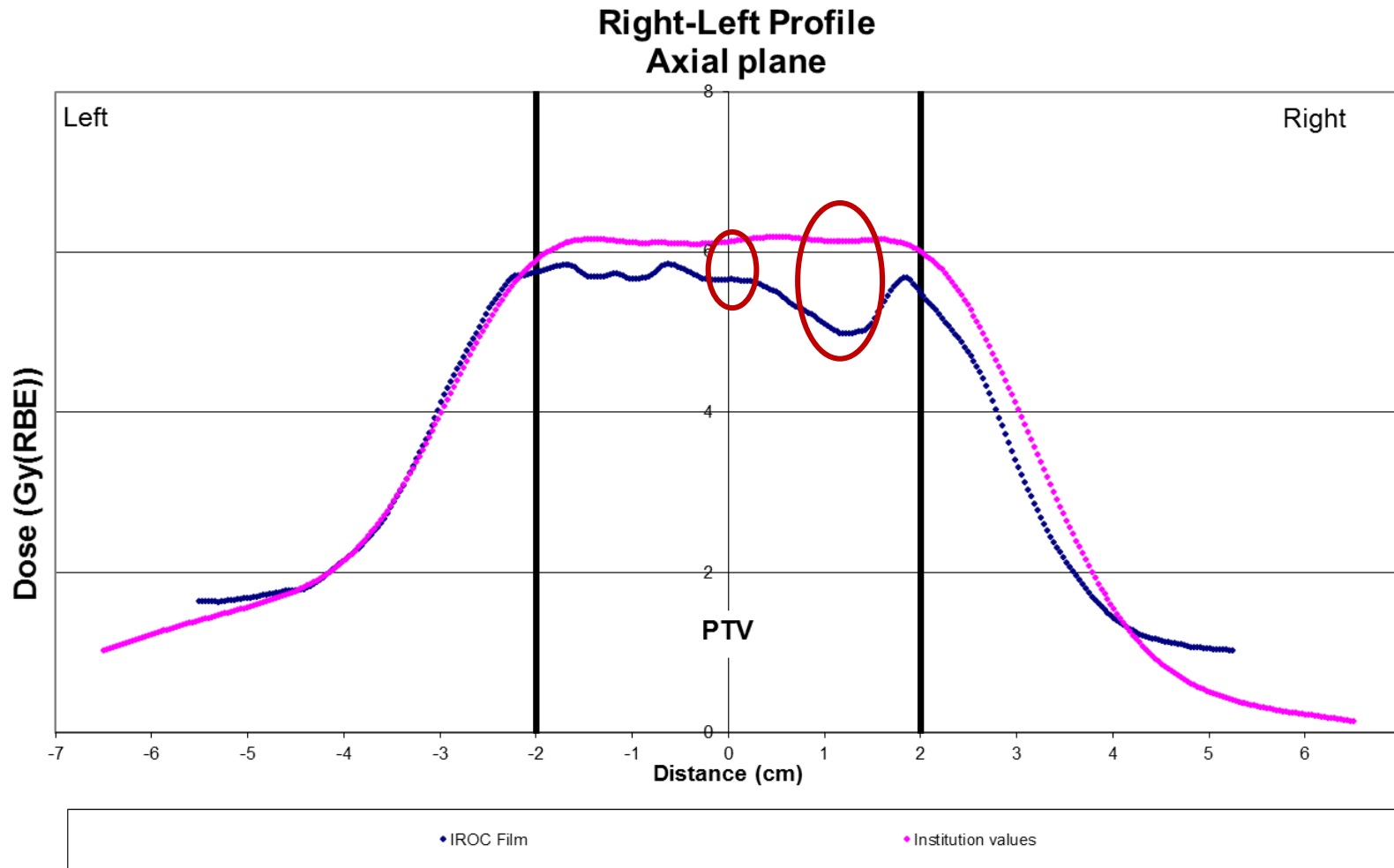
- Target moves behind “ribs”
- Low density heterogeneities
- Contains TLD and radiochromic film for absolute and relative dose comparison with TPS



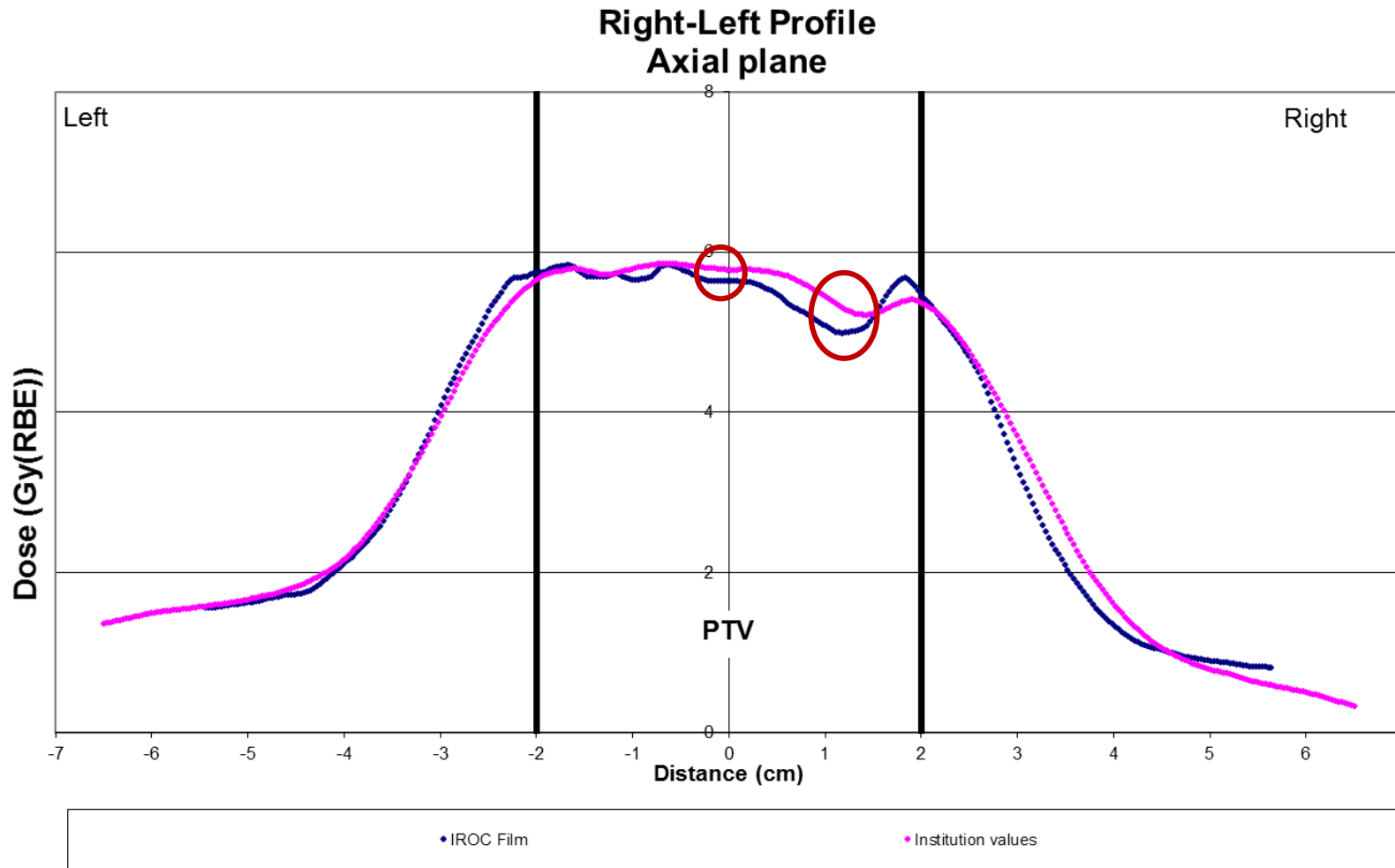
Proton Lung Phantom Concerns

- Lung phantom pass rate **63%**
 - Disagreement between measurements and TPS, both in absolute dose and shape of delivered dose to target
- Concerns about analytic (pencil beam) TPS algorithms
 - Subset of phantom plans recalculated using Monte Carlo algorithms

Lung Phantom Results: PB

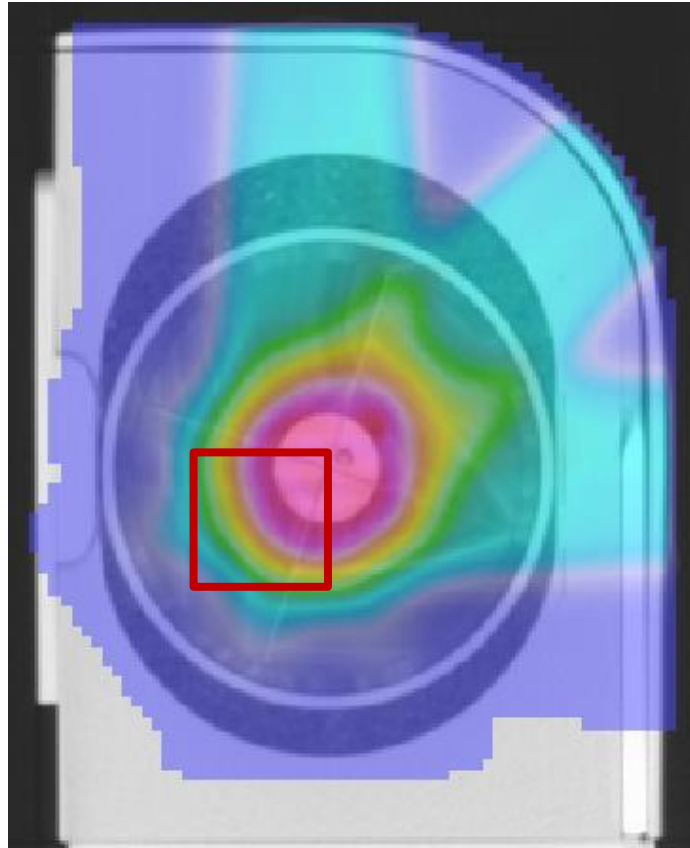


Lung Phantom Results: MC

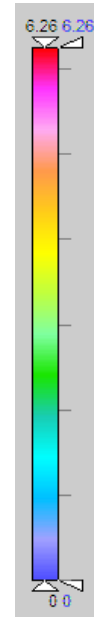
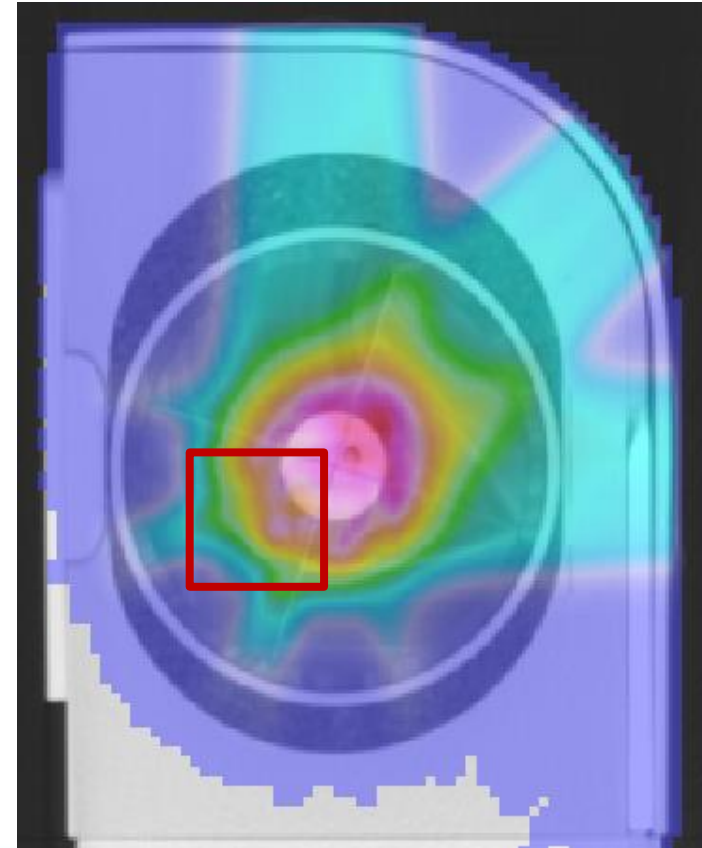


Lung Phantom Results

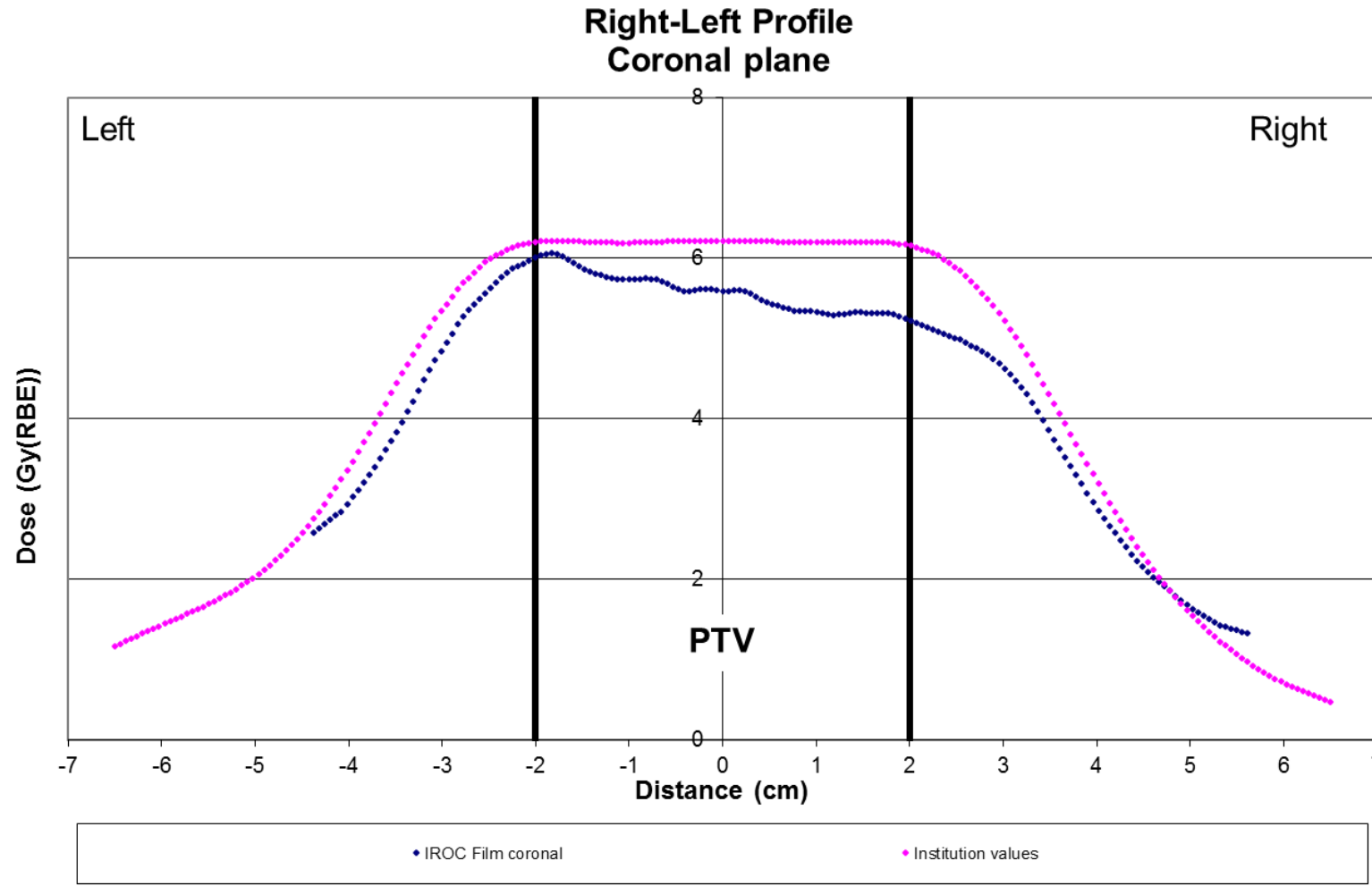
Pencil Beam original calc



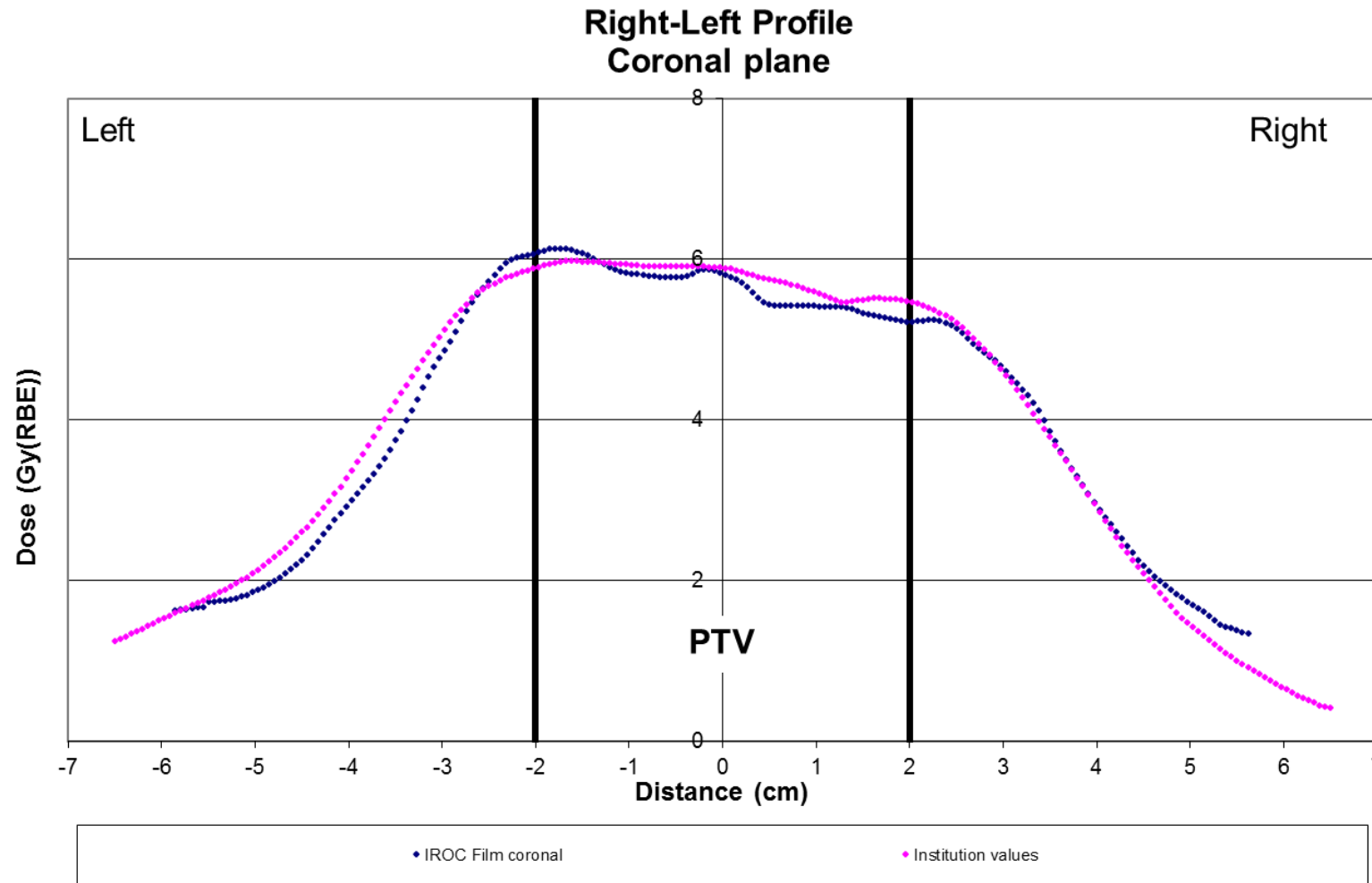
Monte Carlo recal



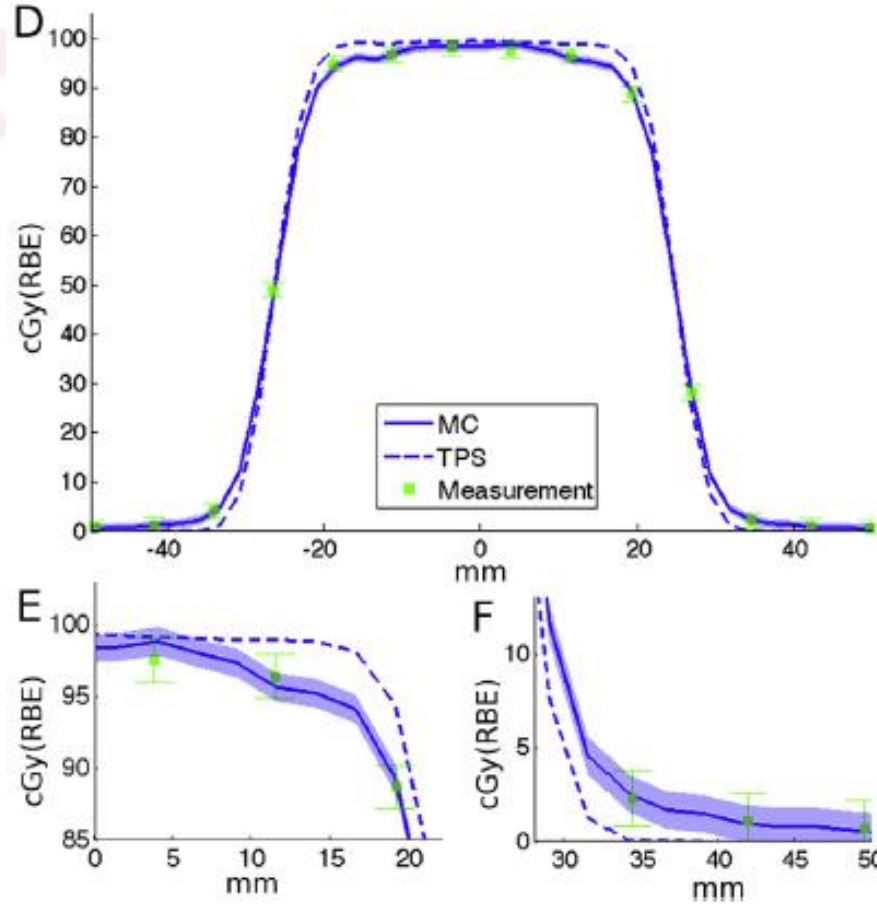
Lung Phantom 2: PB



Lung Phantom 2: MC



Proton Lung Treatment - MC



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Physics Contribution

Quantification of Proton Dose Calculation Accuracy in the Lung

Clemens Grassberger, MSc,^{*,†} Juliane Daartz, PhD,^{*} Stephen Dowdell, PhD,^{*} Thomas Ruggieri,^{*} Greg Sharp, PhD,^{*} and Harald Paganetti, PhD^{*}

^{*}Department of Radiation Oncology, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts; and [†]Center for Proton Radiotherapy, Paul Scherrer Institute, Villigen, Switzerland

Received Sep 20, 2013, and in revised form Feb 6, 2014. Accepted for publication Feb 14, 2014.

Proton Lung Phantom Results

- Discussed findings with NCTN clinical trial PIs
 - IROC recommending all proton centers explore MC for lung dose calcs
 - *Photon* lung trials do not allow pencil beam algorithms
 - Perhaps future enrollment for protons will require MC for lung??
- Article in press with the Red Journal

PB vs. MC in Other Disease Sites?

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Technological Advances

Results From the Imaging and Radiation Oncology Core Houston's Anthropomorphic Phantoms Used for Proton Therapy Clinical Trial Credentialing

Paige A. Taylor, MS, Stephen F. Kry, PhD, Paola Alvarez, MS, Tyler Keith, BS, Carrie Lujano, BS, Nadia Hernandez, BS, and David S. Followill, PhD

Department of Radiation Physics, University of Texas MD Anderson Cancer Center, Houston, Texas

Received Sep 26, 2015, and in revised form Jan 25, 2016. Accepted for publication Jan 29, 2016.

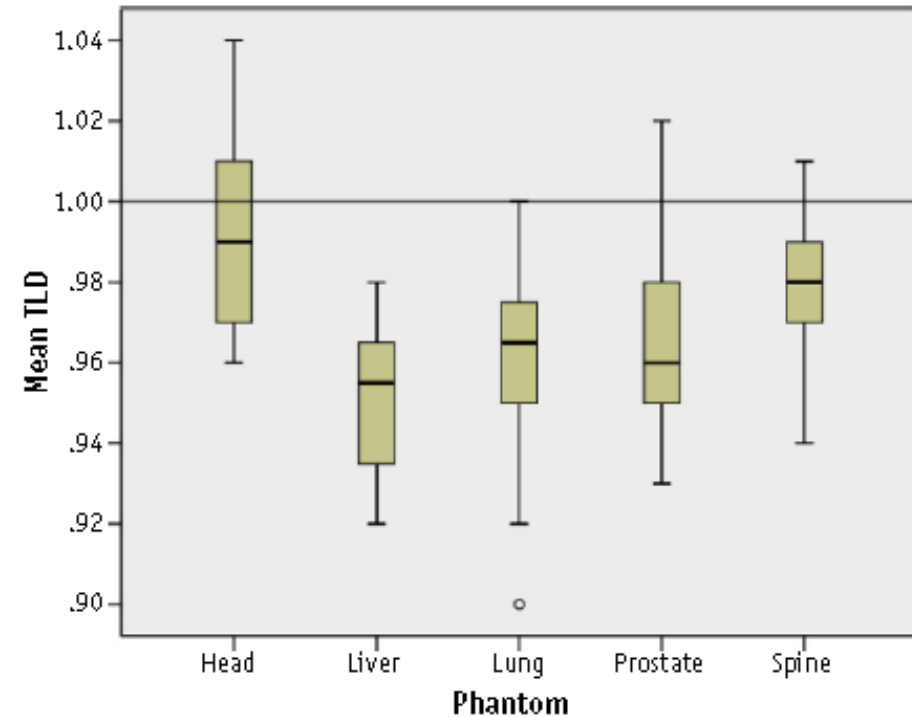


Fig. 2. Ratio of the TLD-measured dose to the dose predicted by the treatment planning system for each phantom type. *Abbreviation:* TLD = thermoluminescent dosimeters.

PB vs. MC in Other Disease Sites?

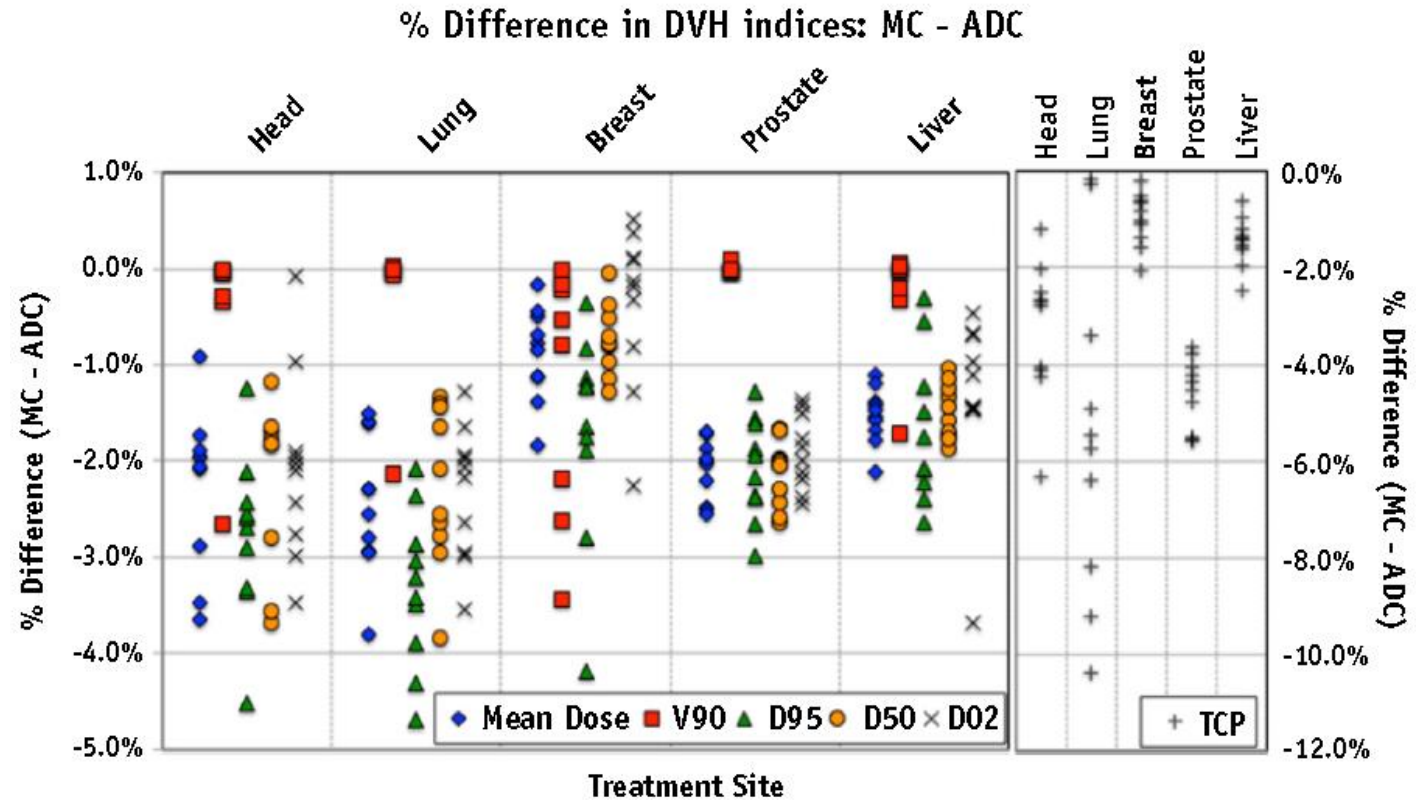
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Physics Contribution

Assessing the Clinical Impact of Approximations in Analytical Dose Calculations for Proton Therapy

Jan Schuemann, PhD, Drosoula Giantsoudi, PhD,
Clemens Grassberger, PhD, Maryam Moteabbed, PhD,
Chul Hee Min, PhD, and Harald Paganetti, PhD



Next Steps

- Investigating pencil beam algorithm accuracy in H&N and liver
 - H&N: High density (bone) and low density (nasal passages, oral cavity)
 - Liver: Low phantom pass rate
- BIG improvements seen with Monte Carlo *but* not all MC appears equal
 - Working with proton centers to look at different MC algorithms
 - RayStation, Eclipse AcurosPT, TOPAS, MCSquare

Questions?

