

Cherenkov Imaging: Clinical Experience with DoseRT

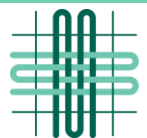
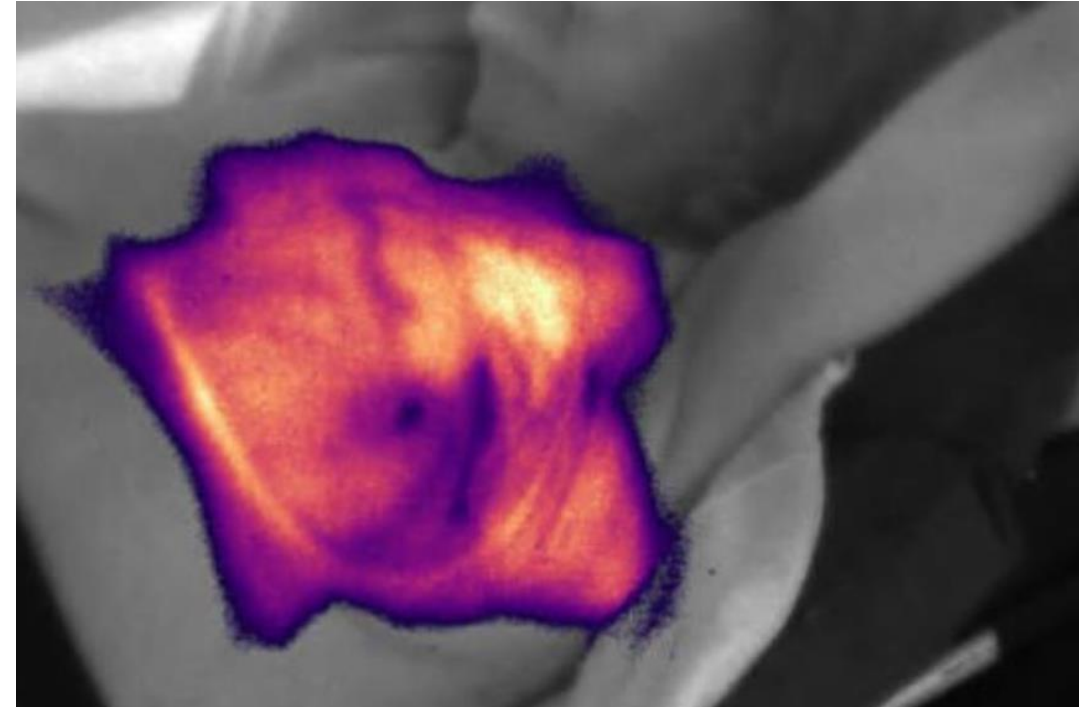
Daniel Alexander, PhD

Geisel School of Medicine at Dartmouth

Dartmouth Health

2025 AAPM VisionRT Event

Washington DC



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DEPARTMENT of
**Radiation Oncology
& Applied Sciences**

July 26, 2025

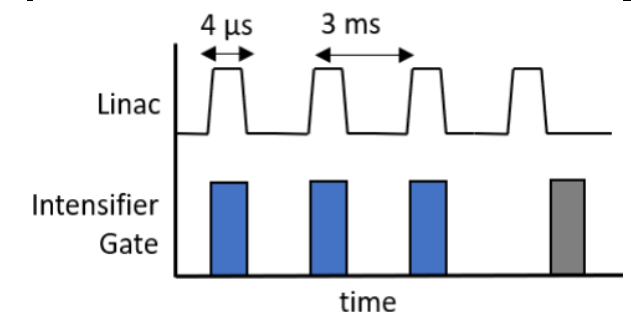
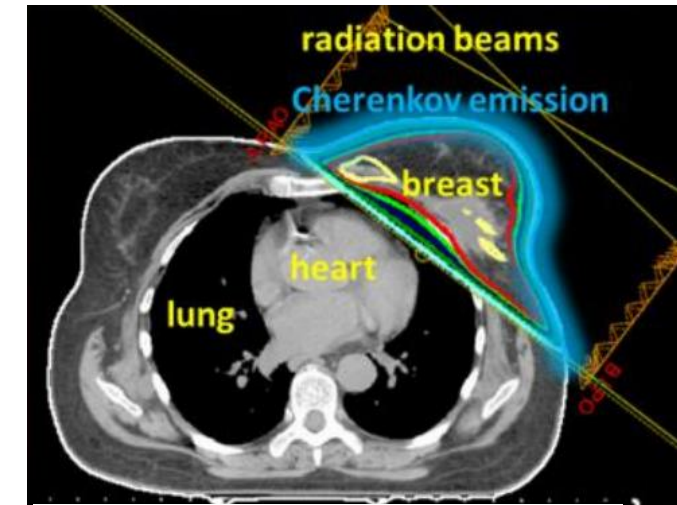
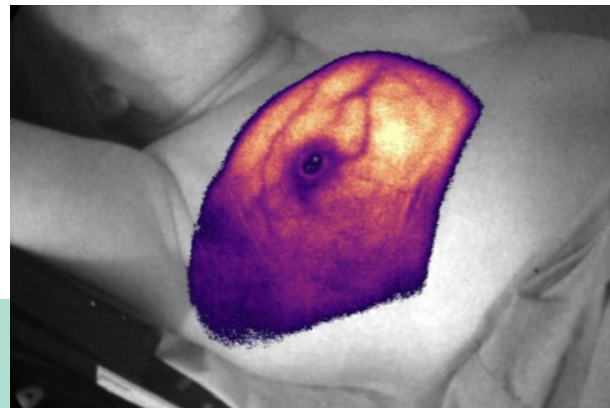
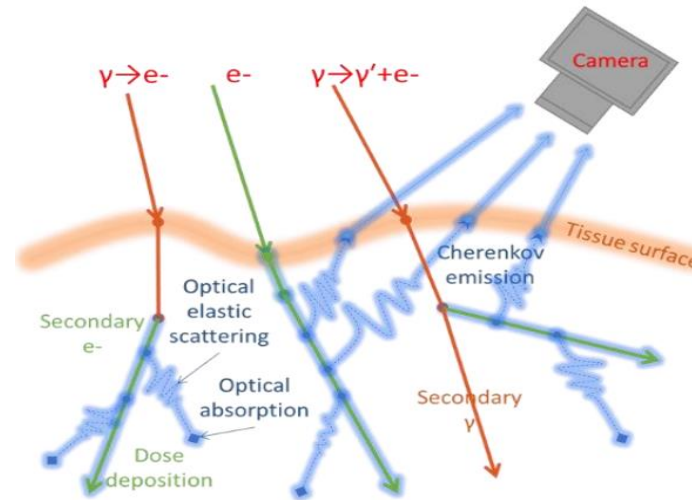
Disclosures

- I received partial travel sponsorship and an honorarium from Vision RT

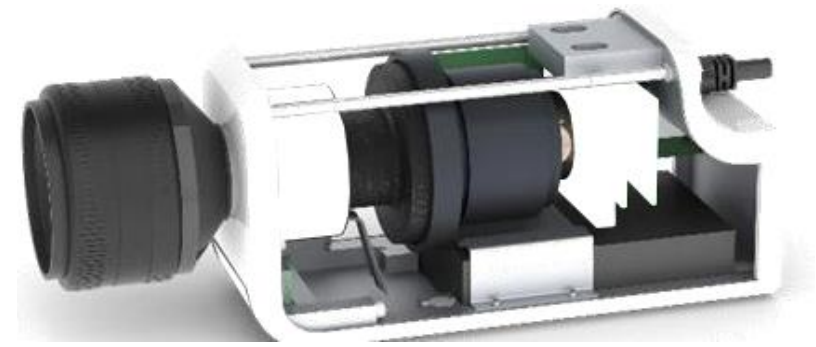
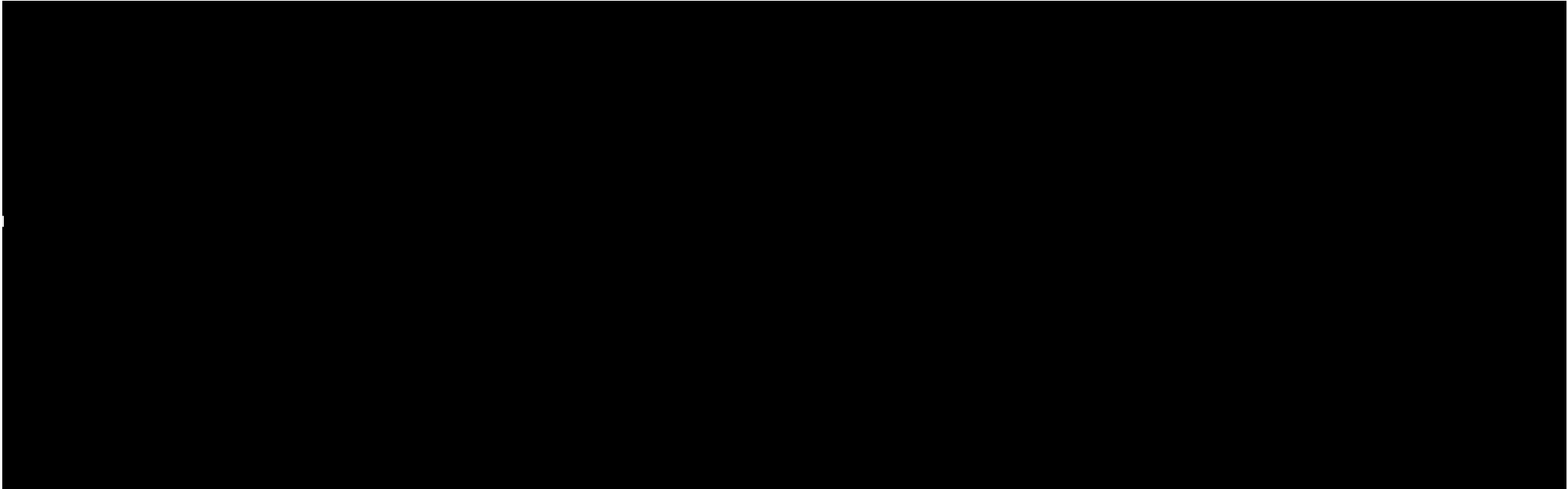


What is Cherenkov Imaging?

- **Cherenkov radiation** is optical light which is emitted from sufficiently high-energy charged particles passing through a dielectric medium
- **Cherenkov imaging** is a technique where intensified cameras are used to image this light from patients undergoing RT
 - Intensity of photons emitted is directly related to dose deposition
 - Cherenkov photons penetrate ~1 cm in tissue
 - Cameras are time-gated to the linac pulses to allow for single-photon level imaging with the ambient room lights on



DoseRT: Visualization of superficial dose delivery via Cherenkov emission



Cherenkov Imaging at Dartmouth Health



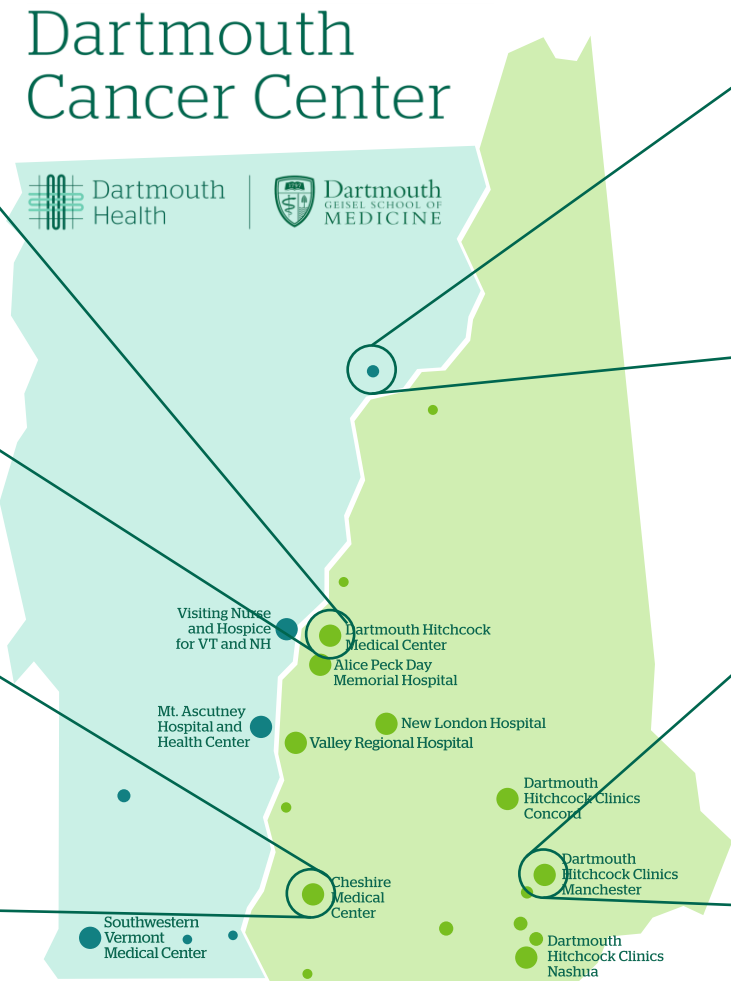
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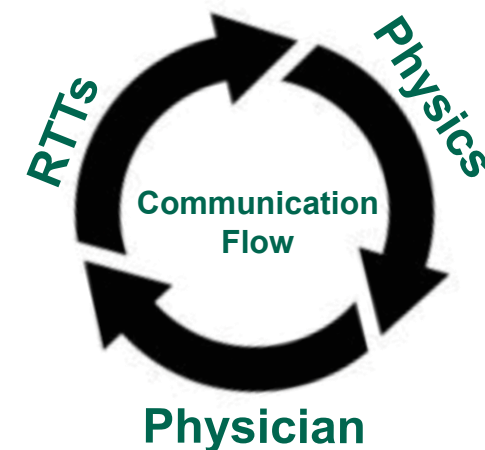
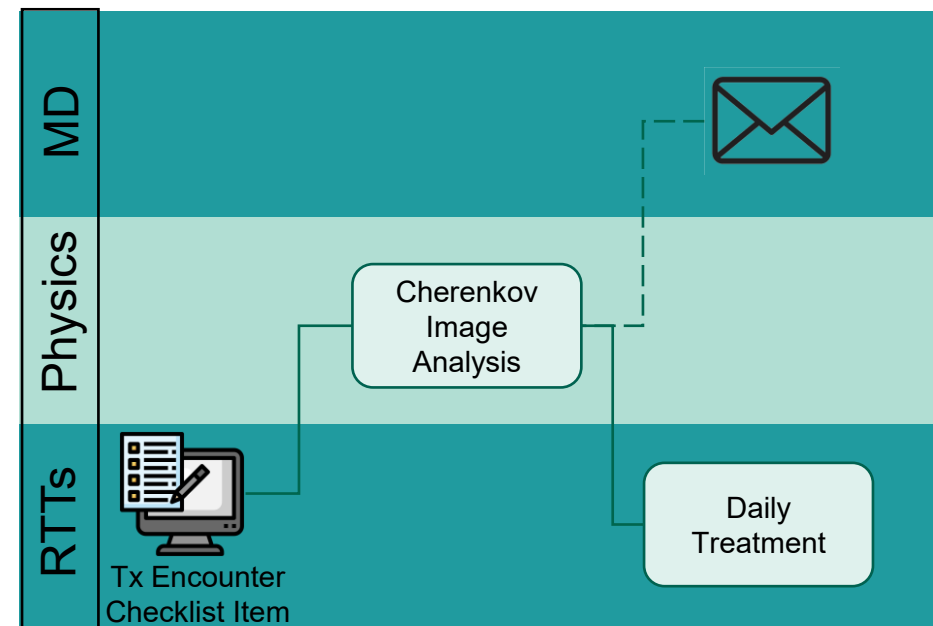
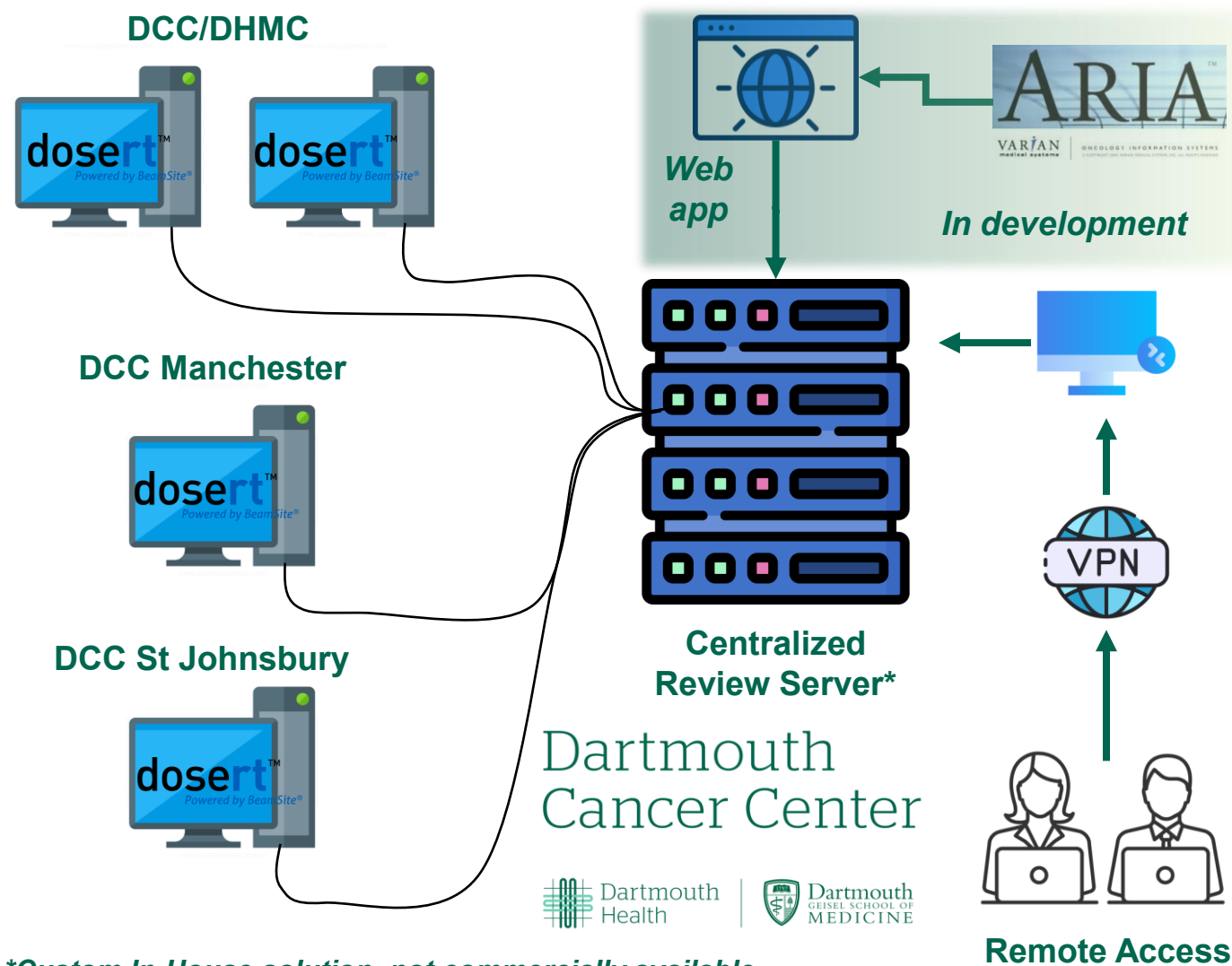


Dartmouth Cancer Center - Manchester NH
*Coming August 2025
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DoseRT Layout at DHMC



Workflows and Infrastructure Supporting Cherenkov Imaging at Dartmouth



Published Clinical Evidence – Initial Experience at Dartmouth

2021 – Prospective, 64 Patients

INTERNATIONAL JOURNAL OF
RADIATION ONCOLOGY • BIOLOGY • PHYSICS ASTRO

PHYSICS CONTRIBUTION • Volume 109, Issue 5, P1627-1637, April 01, 2021

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Initial Clinical Experience of Cherenkov Imaging in External Beam Radiation Therapy Identifies Opportunities to Improve Treatment Delivery

[Lesley A. Jarvis, MD, PhD](#) ^{*} [Rachael L. Hachadorian, MS](#) [†] [Michael Jermyn, PhD](#) [†] [Petr Bruza, PhD](#) [†] [Daniel A. Alexander, MS](#) [†] [Irwin I. Tendler, PhD](#) [†] [Benjamin B. Williams, PhD](#) ^{*†} [David J. Gladstone, ScD](#) ^{*†} [Philip E. Schaner, MD, PhD](#) ^{*} [Bassem I. Zaki, MD](#) ^{*} [Brian W. Pogue, PhD](#) [†] [Show less](#)

[Affiliations & Notes](#) [Article Info](#)

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Notable findings:

1. Observation of dose to contralateral breast
2. Observation of extraneous dose to nearby tissues or extremities
3. Nonideal bolus positioning

2022 – Retrospective, 622 patients

pro practical radiation oncology ASTRO

BASIC ORIGINAL REPORT • Volume 13, Issue 1, P71-81, January-February, 2023

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One Year of Clinic-Wide Cherenkov Imaging for Discovery of Quality Improvement Opportunities in Radiation Therapy

[Daniel A. Alexander, PhD](#) ^{a,†} [Savannah M. Decker, BS](#) ^{a,b,†} [Michael Jermyn, PhD](#) ^{a,b} [Petr Bruza, PhD](#) ^{a,b} [Rongxiao Zhang, PhD](#) ^{a,c,d} [Erli Chen, MS](#) ^e [Tatum L. McGlynn, BS](#) ^d [Rory A. Rosselot, BS](#) ^d [Jae Lee, BA](#) ^d [Melanie L. Rose, MD](#) ^d [Benjamin B. Williams, PhD](#) ^{a,c,d} [Brian W. Pogue, PhD](#) ^{a,b,f} [David J. Gladstone, ScD](#) ^{a,c} [Lesley A. Jarvis, MD, PhD](#) ^{c,d} [Show less](#)

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- a Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire
- b Dose Optics LLC, Lebanon, New Hampshire
- c Geisel School of Medicine, Dartmouth College, Hanover, New Hampshire
- d Dartmouth Cancer Center, Lebanon, New Hampshire

Notable findings:

1. Observation of dose to contralateral breast (planned and unplanned)
2. Observation of extraneous dose to nearby tissues or extremities
3. Nonideal bolus positioning

2022 –Community Implementation

tipsRO Technical Innovations and Patient Support in Radiation Oncology

FULL LENGTH ARTICLE • Volume 24, P1-5, December 2022 • Open Access

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Clinical implementation of the first Cherenkov imaging system in a community-based hospital

[Erli Chen](#) ^a [Brian W. Pogue](#) ^b [Petr Bruza](#) ^b [Daniel A. Alexander](#) ^b [Nancy L. Andino](#) ^a [Savannah M. Decker](#) ^b [Danielle M. Gaudet](#) ^a [David J. Gladstone](#) ^{b,c} [Melinda J. Lake](#) ^a [Steven R. Levene](#) ^a [Jennifer L. Michelson](#) ^a [Hila L. Robinson](#) ^a [Debra N. Stallings](#) ^a [John E. Starkey](#) ^a [Lesley A. Jarvis](#) ^{c,d} [Show less](#)

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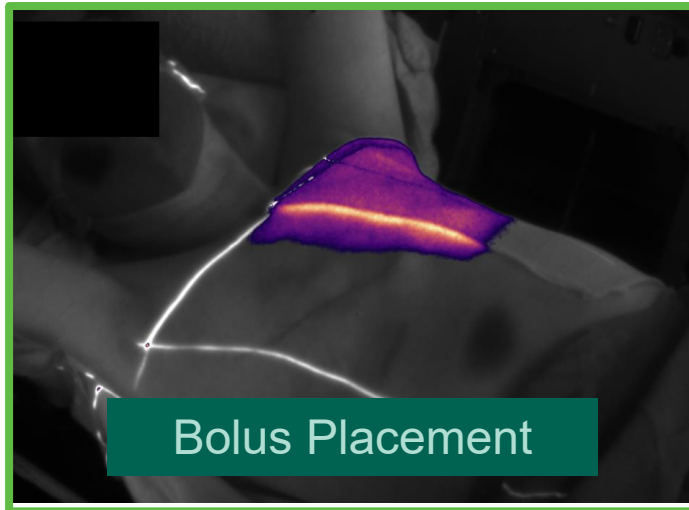
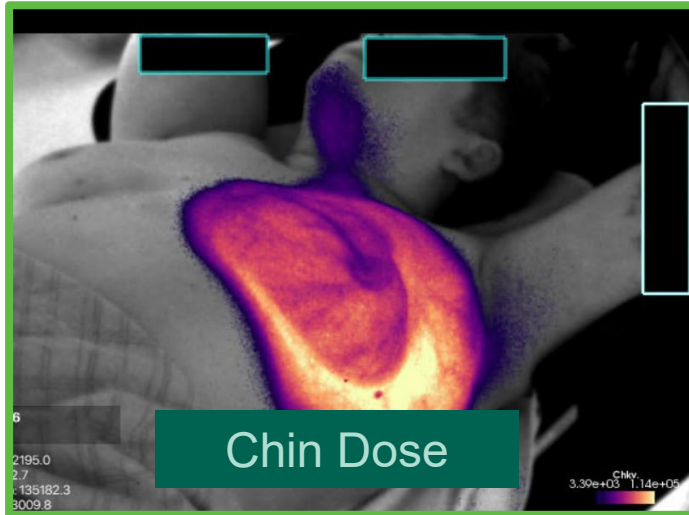
- a Cheshire Medical Center – Dartmouth Health
- b Thayer School of Engineering at Dartmouth

Notable findings:

1. Observation of dose to contralateral breast
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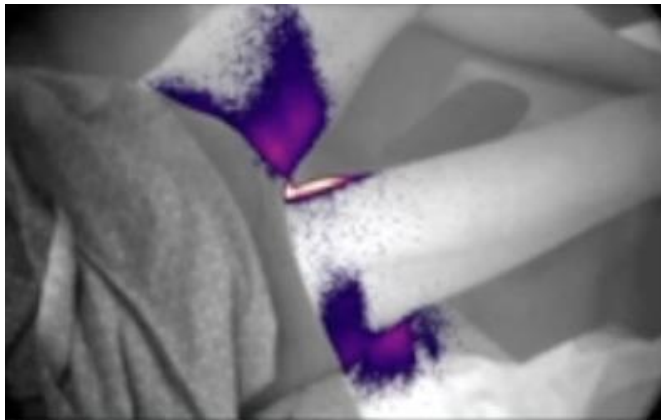
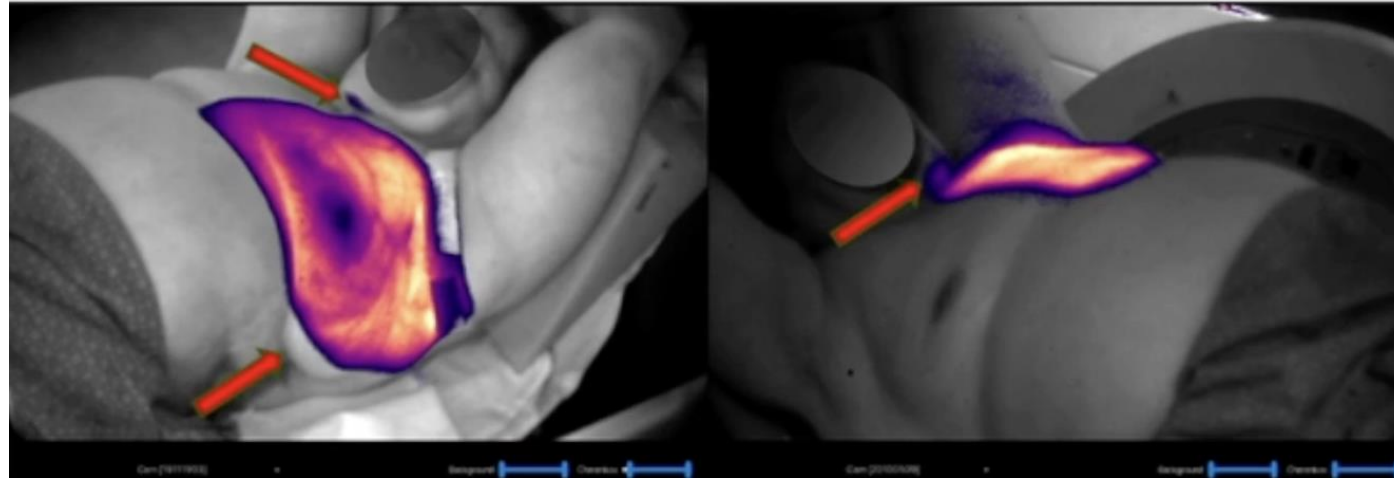


Examples from these studies



- We knew these issues existed in our network as of 2021, but it remained to be seen how Cherenkov imaging would be used once widely available

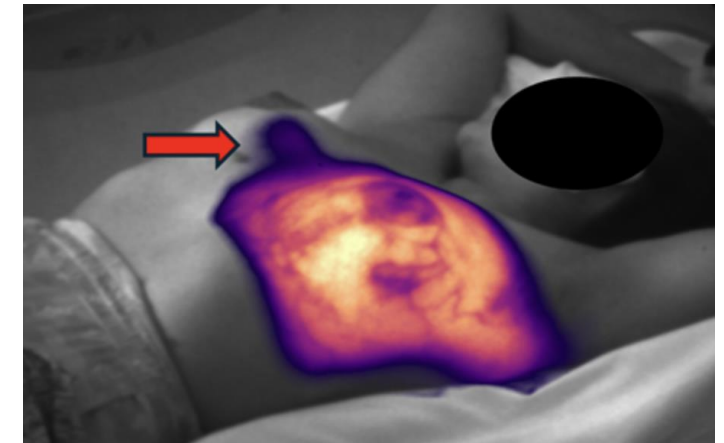
A few years later, other clinics have Dose RT....



Tallhamer

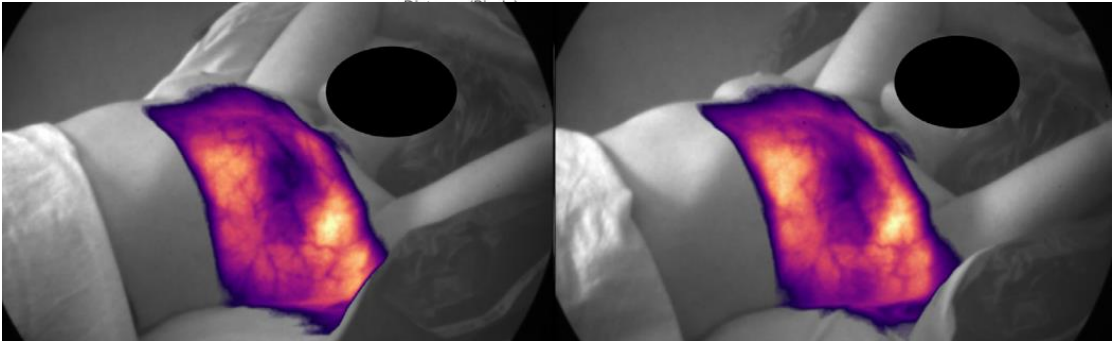
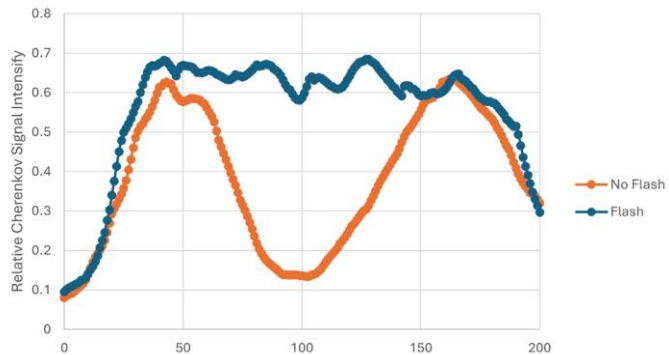
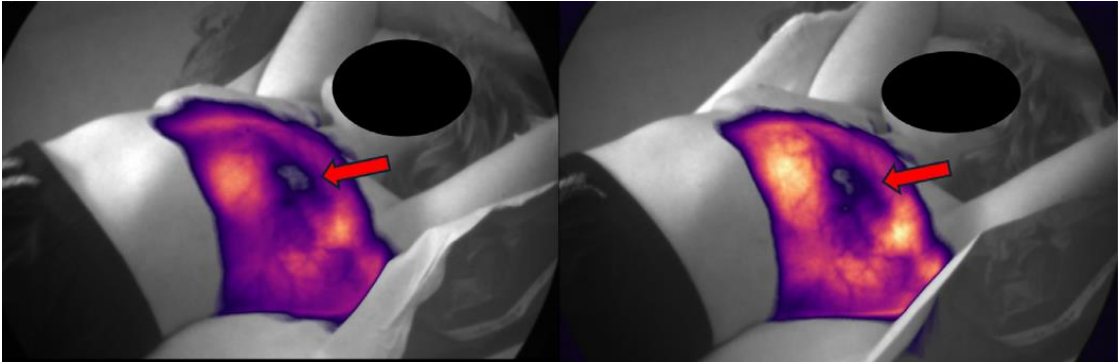


Robinson



...and are reporting very similar findings!

Outside the Academic Setting, Clinical Physicists are Improving Treatments with Cherenkov Imaging



advances in radiation oncology ASTRO

TEACHING CASE · Volume 10, Issue 7, 101798, July 2025 · [Open](#)

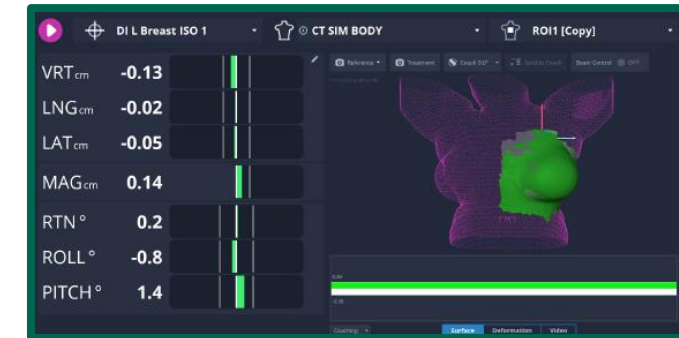
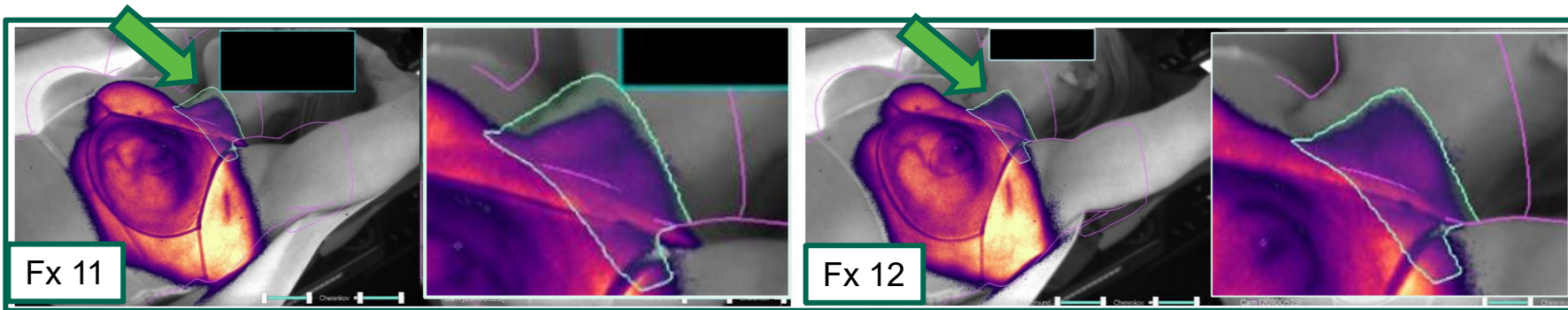
Optimizing Breast Cancer Radiation therapy With Volumetric Modulated Arc Therapy and Skin Flash: A Case Study Using Deep Inspiration Breath Hold and Cherenkov Imaging

[Adi Robinson, PhD](#) ^a  · [Michael Tallhamer, MS](#) ^b · [Amber Orman, MD](#) ^a

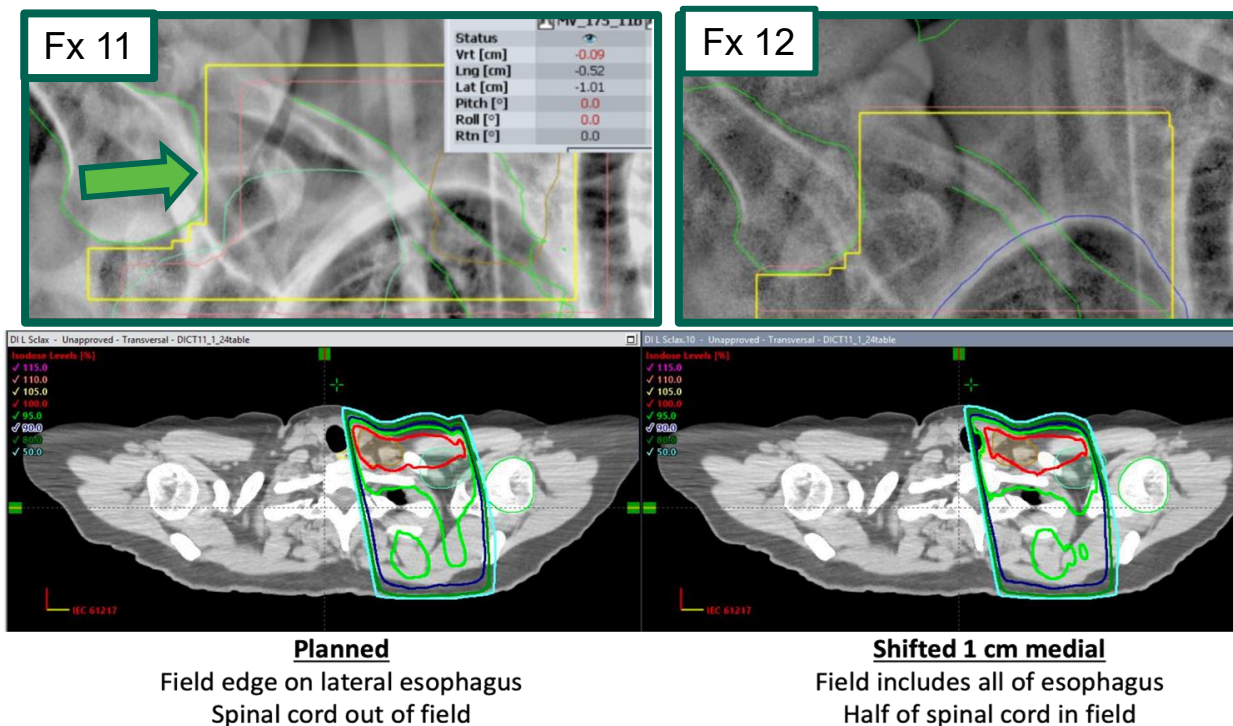


Fraction	TLD reading (cGy)	TPS estimate (cGy)
2 (no flash)	105	146
3 (flash)	133	137

Case Study: DoseRT corroborates non-ideal sclav alignment



* Plan overlay is not a commercially available feature



- Left sided breast patient, treated tangents + sclav fields w/ DIBH
- By week two, patient reported symptoms of esophagitis
- Covering MD over holiday noticed lateral misalignment on sclav port films
- DoseRT also highlighted non-ideal alignment that day
- Jaw was adjusted medially to block the esophagus, and pt was reimaged the next two days, highlighting much better alignment
- Key: Port Films are not taken every day!

Pushing Cherenkov Imaging Forward: Further Investigation of Contralateral Breast Dose – *EDUCATE* Trial Evaluating Dose Using Cherenkov And scintillation TEchnology

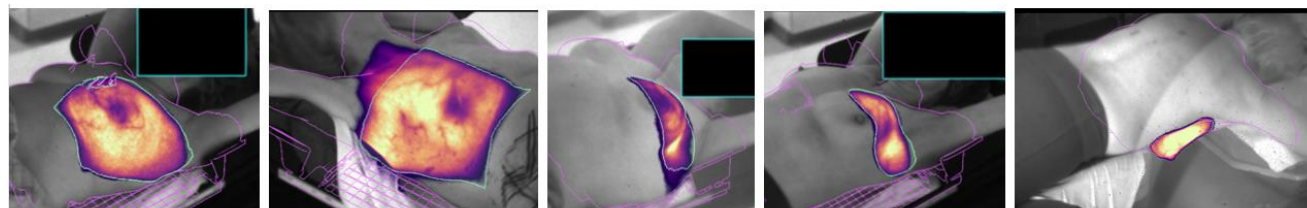


Matous, MD



Jarvis, MD PhD

Motivated by WECARE Study - CBD in excess of 1 Gy in young patients is associated with elevated risk of a subsequent contralateral breast cancer



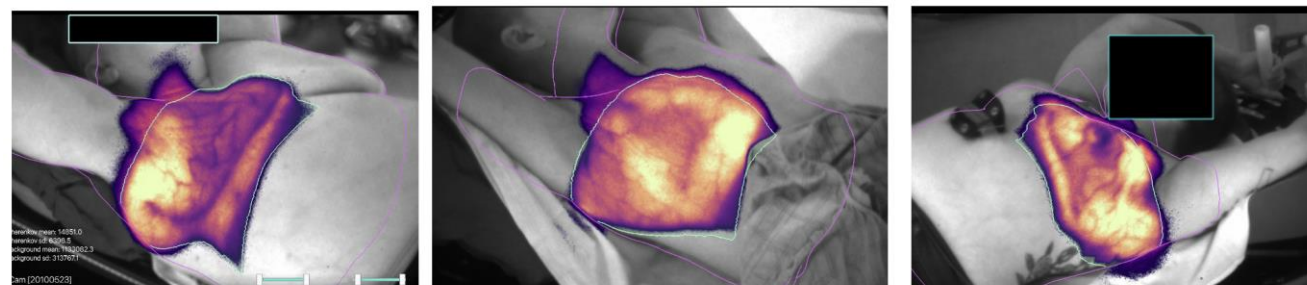
Whole Breast
with Tangents

Whole Breast
Tangents
+ RNI

Accelerated
Partial Breast
Irradiation (aPBI)
with VMAT

Partial Breast
"Mini Tangents"

Prone Tangents



Planned CBD

Unplanned CBD

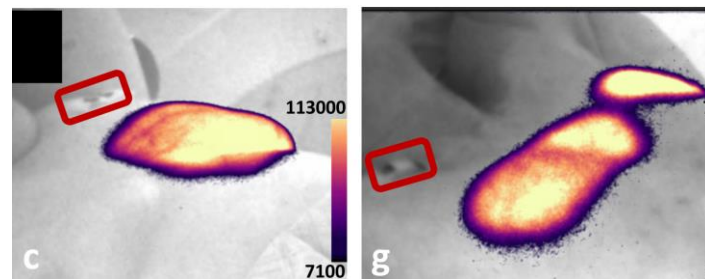
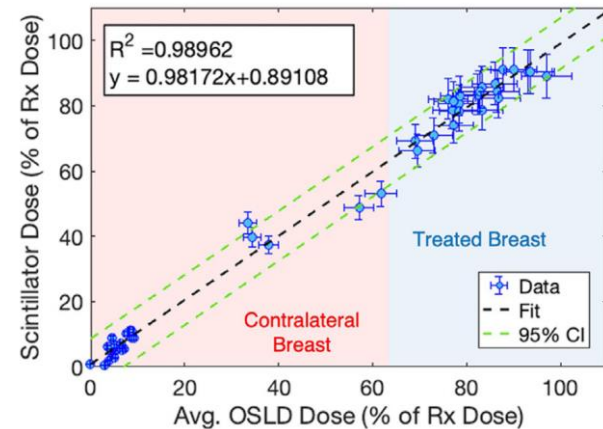
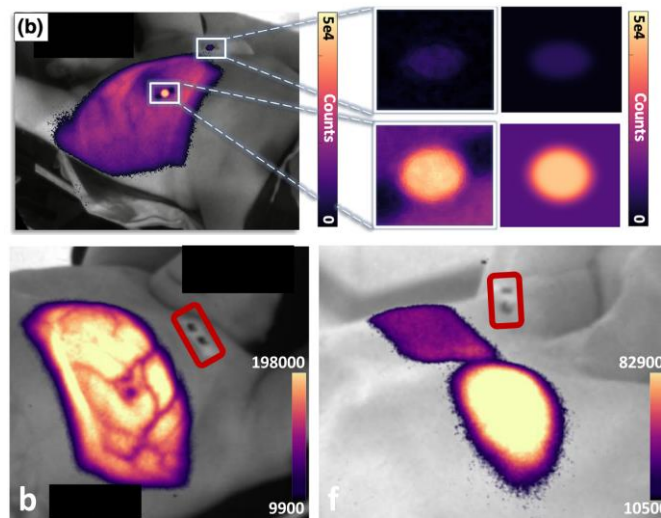
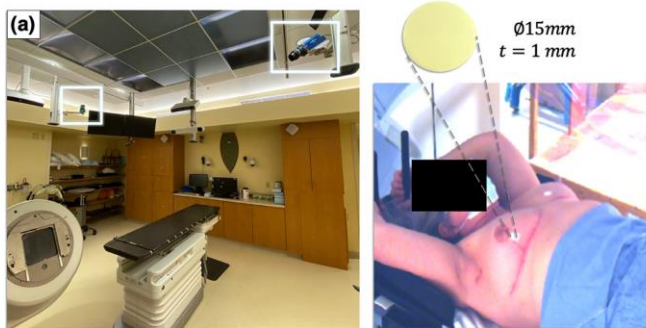
Combination of planned &
unplanned CBD

- Active Trial at DCC
- Goal of *EDUCATE* is to:
 - Establish the incidence of CBD in routine clinical practice
 - Quantify CBD using Cherenkov-image-guided in vivo dosimetry
 - To determine the root causes of CBD (planned vs unplanned)
- Initial Findings:
 - Images for 129 unique patients over 1854 fractions reviewed over 6 months
 - CBD was identified during treatment delivery for 40 unique patients, and was unplanned in 10% of cases
 - 27% of patients under 50 had CBD appreciated on Cherenkov imaging
 - Doses ranged from 0.25-2 Gy per fraction

Pushing Cherenkov Imaging Forward: Cherenkov Imaging guides dosimeter placement, and cameras can be used to measure dose



Decker, PhD



INTERNATIONAL JOURNAL OF RADIATION ONCOLOGY • BIOLOGY • PHYSICS ^{ASTRO}

CLINICAL INVESTIGATION • Volume 121, Issue 2, P365-374, February 01,

2025

Visual Dose Monitoring for Whole Breast Radiation Therapy Treatments via Combined Cherenkov Imaging and Scintillation Dosimetry

Savannah M. Decker, PhD • Petr Bruza, PhD • Rongxiao Zhang, PhD [†] • Brian W. Pogue, PhD • David J. Gladstone, ScD ^{†,‡} • Lesley A. Jarvis, MD, PhD ^{†,‡}

phiRO Physics and Imaging in Radiation Oncology

ORIGINAL RESEARCH ARTICLE • Volume 32, 100642, October 2024 • Open

Access

Cherenkov imaging combined with scintillation dosimetry provides real-time positional and dose monitoring for radiotherapy patients with cardiac implanted electronic devices

Savannah M. Decker ^{a,1} • Allison L. Matous ^{b,1} • Rongxiao Zhang ^{a,c} • David J. Gladstone ^{a,b} • Evan K. Grove ^d • Benjamin B. Williams ^b • Michael Jermyn ^{a,e} • Shauna McVorrnan ^b • Lesley A. Jarvis ^b Show less

Check out this talk: **“You Can’t Unsee It”: Clinical Scintillation Imaging Enables First Localized Comparison between In Vivo dosimetry Measurements and the Treatment Plan** Megan Clark, PhD, Session: TU--1120-204 - Therapy Physics

Scientific Session: Advances in Dosimetry Tuesday 11:30 AM

Conclusions

- Cherenkov imaging provides a visualization of dose delivery on the patient surface in real time
- The images are available every day, and are shown to reflect the setup quality seen on x-ray imaging in the highlighted cases
- Installs at independent institutions reveal similar findings
- Dartmouth is leveraging DoseRT to iterate with RTTs and MDs to improve setup and plan quality by seen the treatment through a new lens
- On the research side, Cherenkov imaging is being used to guide in vivo dosimeter placement, monitor contralateral breast dose, and much more (physiological sensing, FLASH treatment monitoring, morphological feature-based setup accuracy, etc.)

Thank you!



Daniel.A.Alexander@Hitchcock.org



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