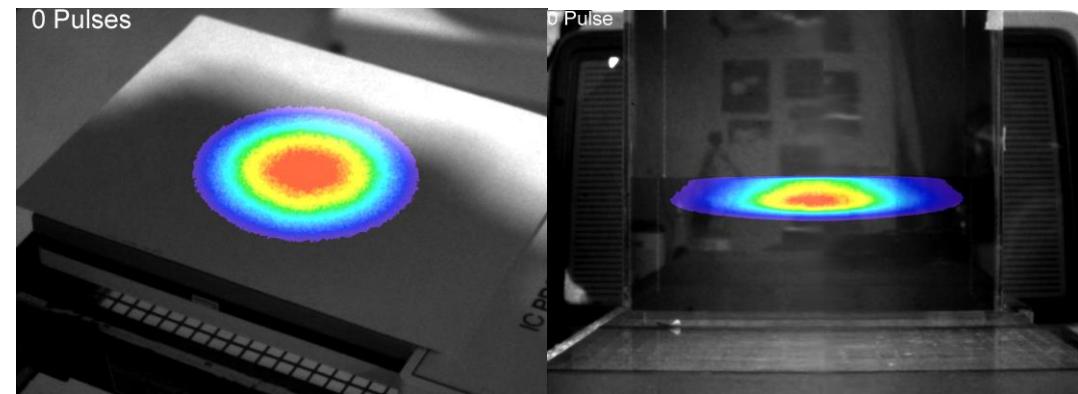




# Spatiotemporal Dose Characterization of an Electron FLASH Beam from a LINAC via Radioluminescence and Cherenkov Imaging

Electron FLASH Beam Single Pulse Imaging



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<sup>2</sup> Department of Medicine, Radiation Oncology, Geisel School of Medicine

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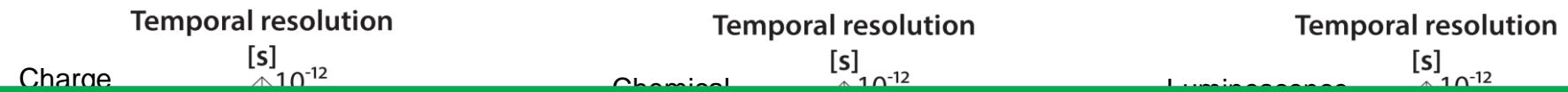
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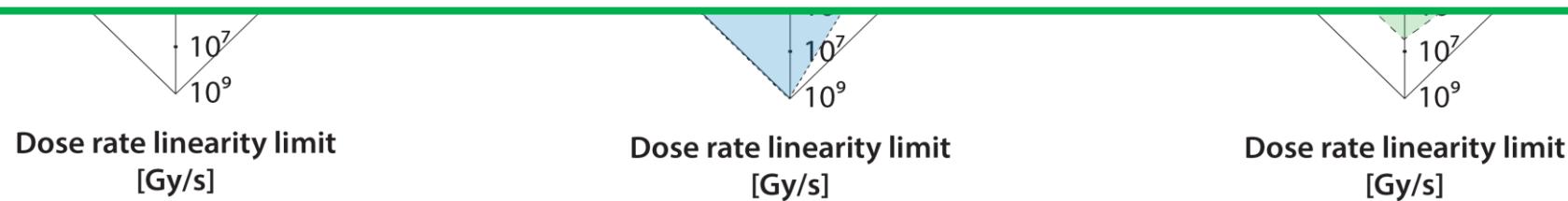
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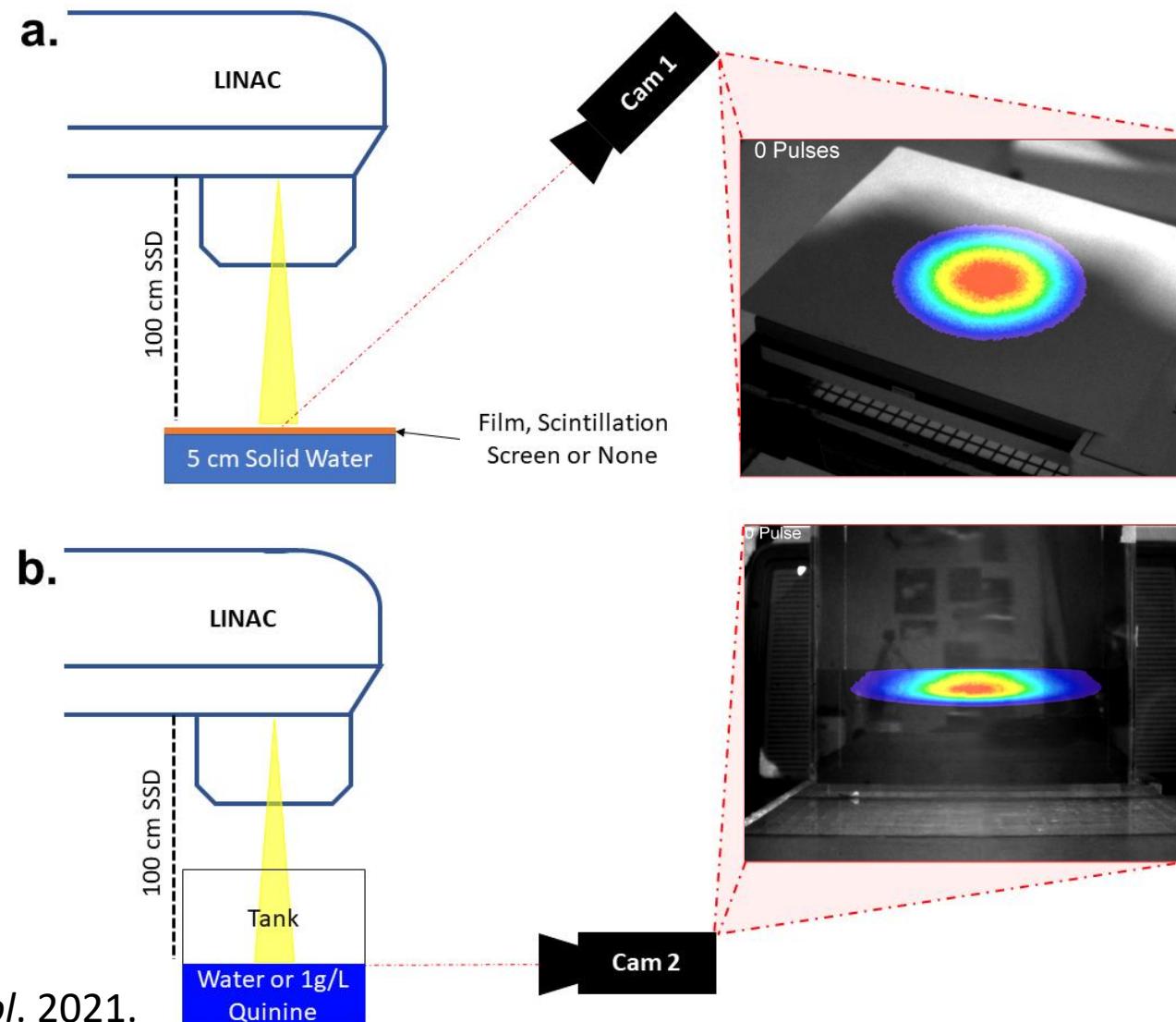
# Radioluminescence Imaging at High Spatio-temporal Resolution



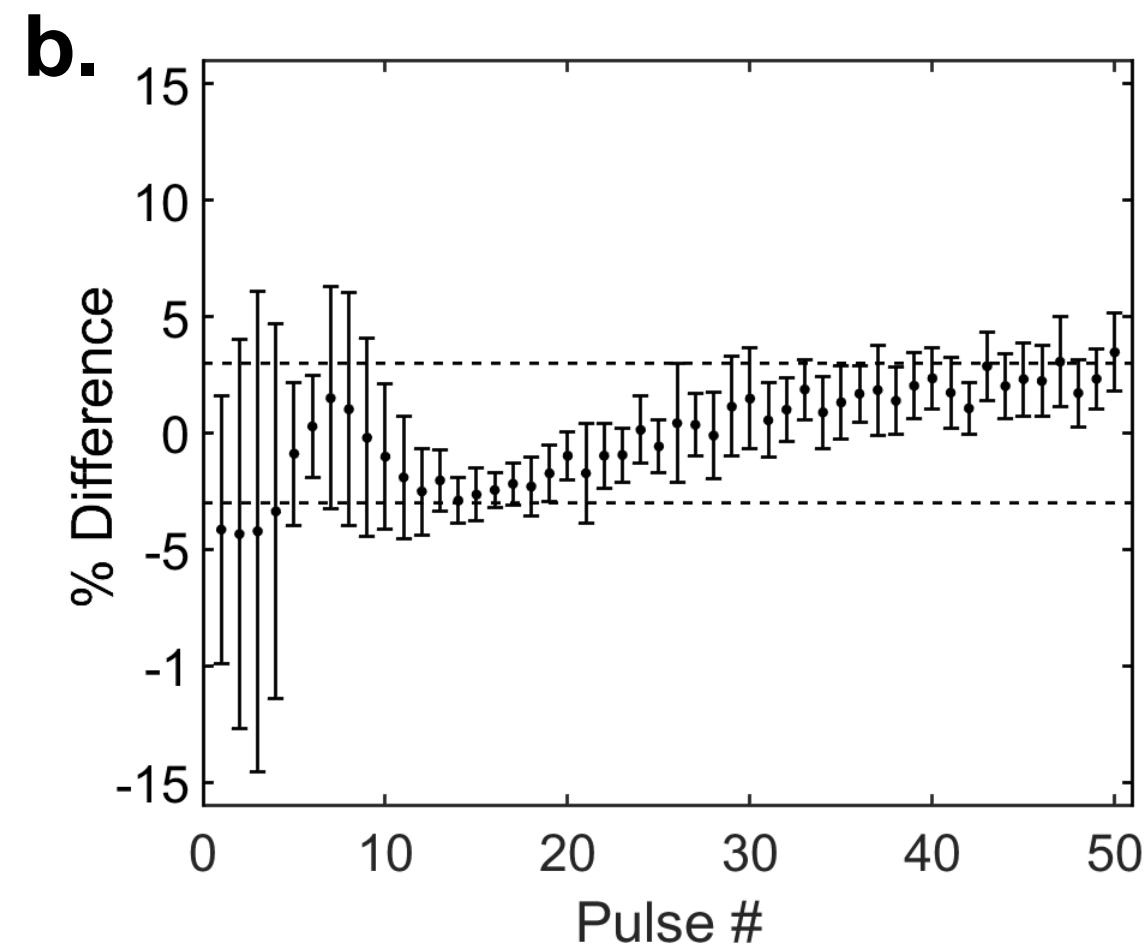
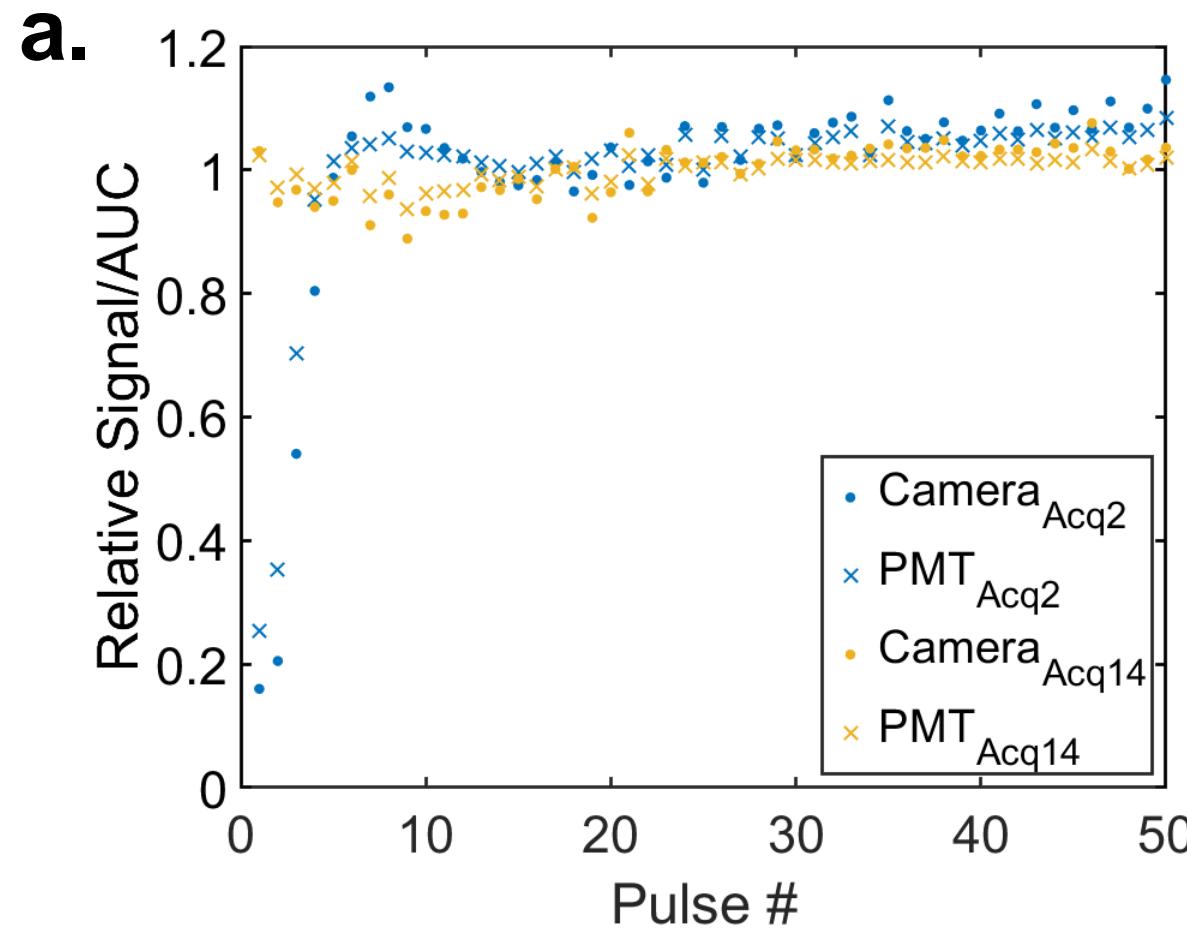
Purpose: Develop a dosimetry tool to characterize an eFLASH beam via luminescence imaging at submillimeter, single pulse resolution.



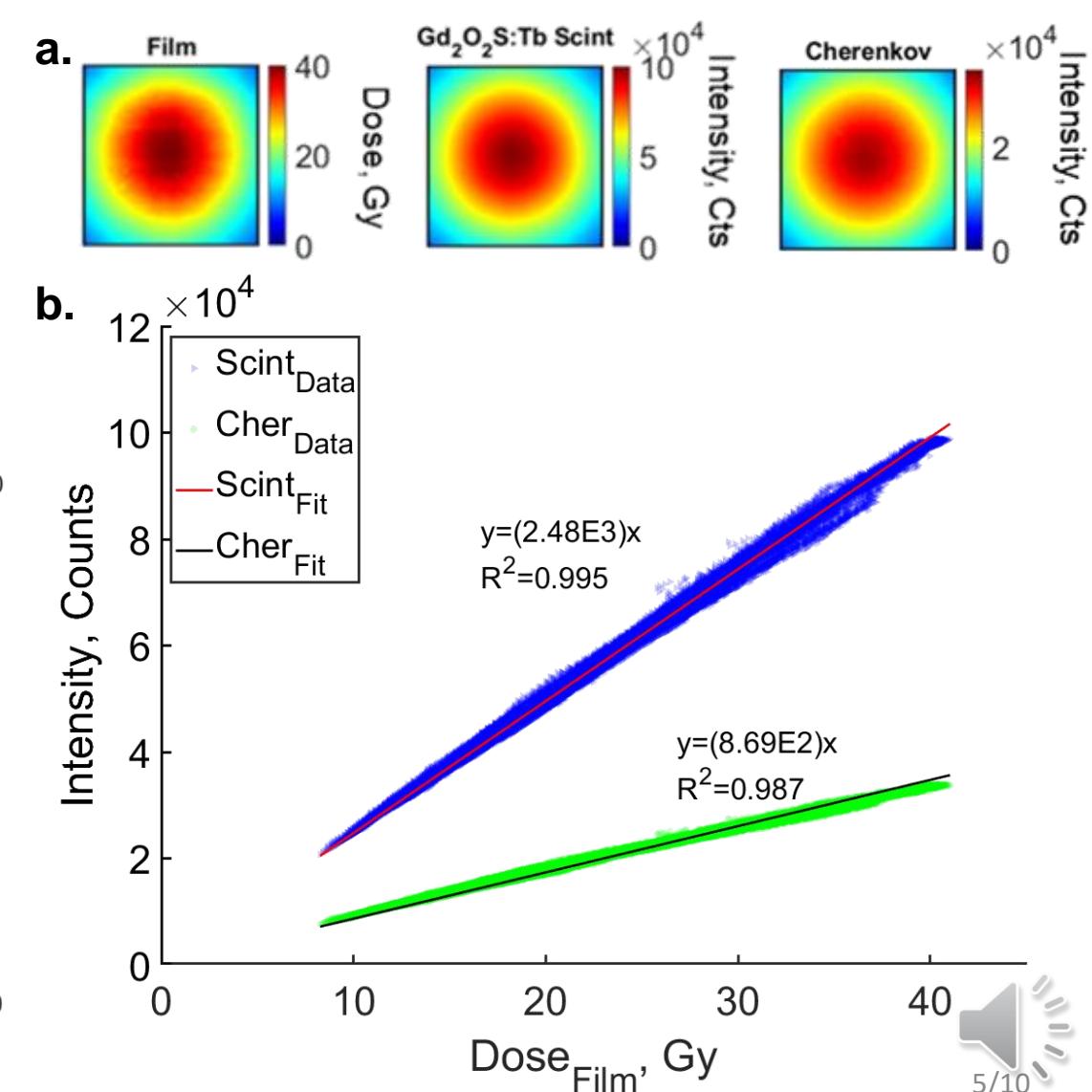
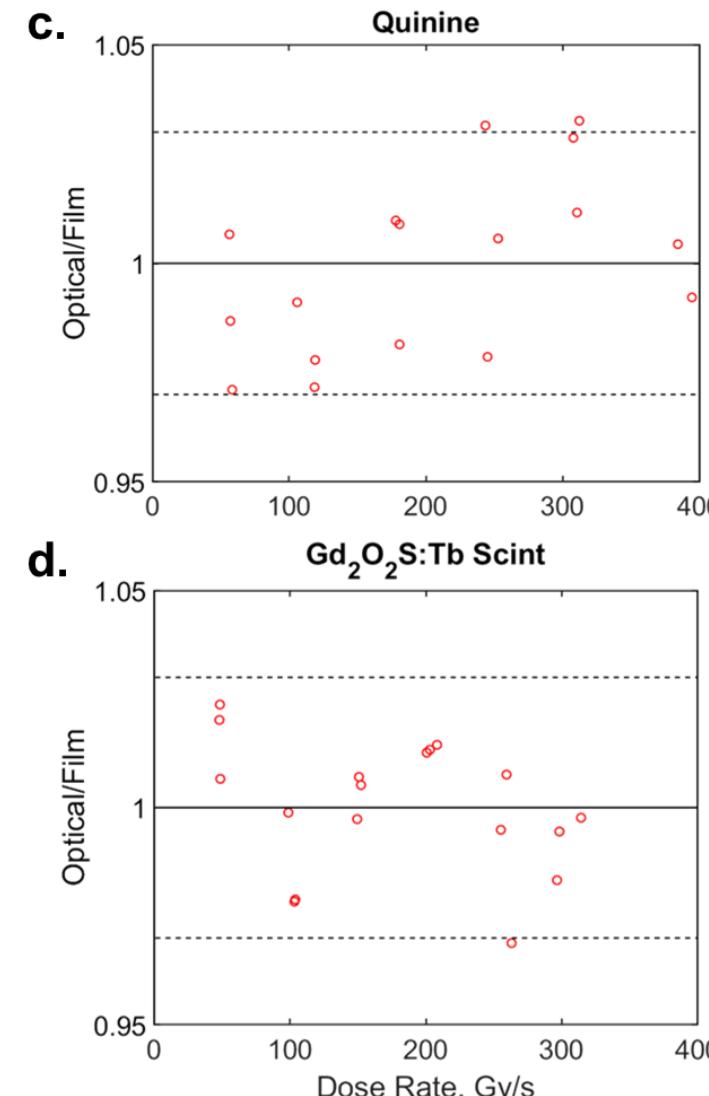
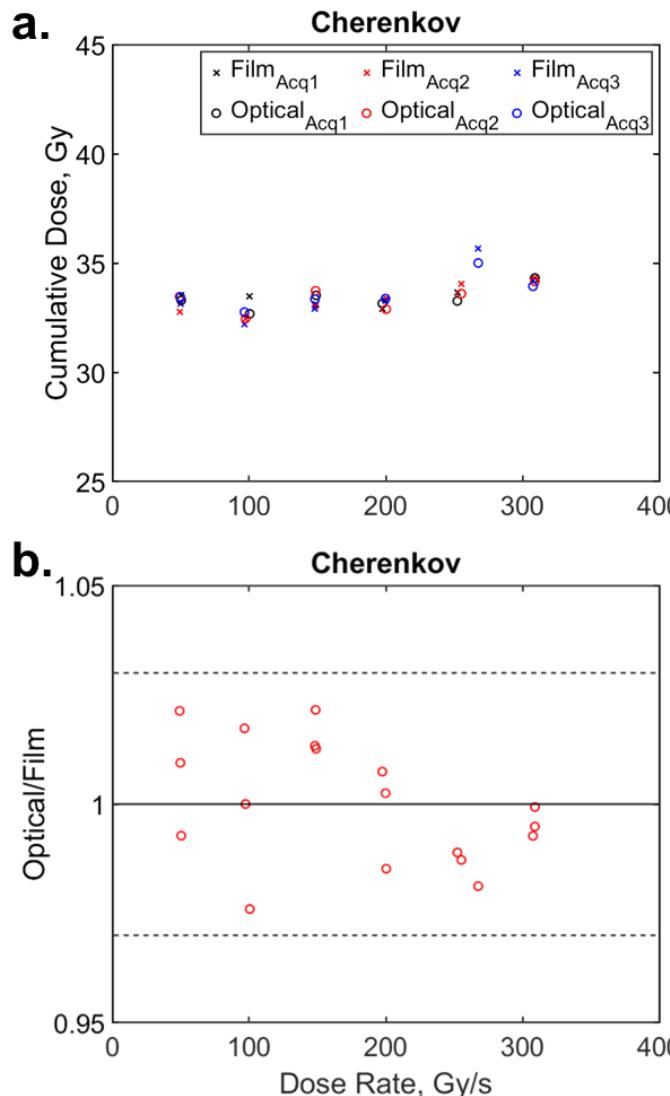
# Cherenkov/Scintillation Imaging Set up



# Verification of Imaged Beam Output: Single Pulses

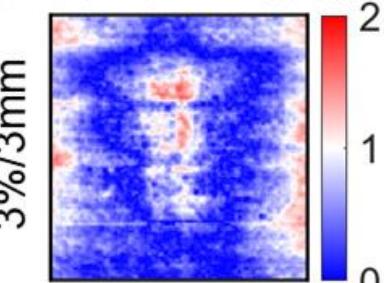


# Dose and Dose Rate Independence at UHDR

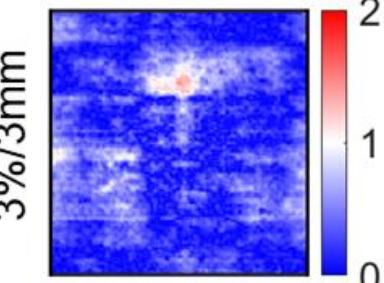


# Surface Profile

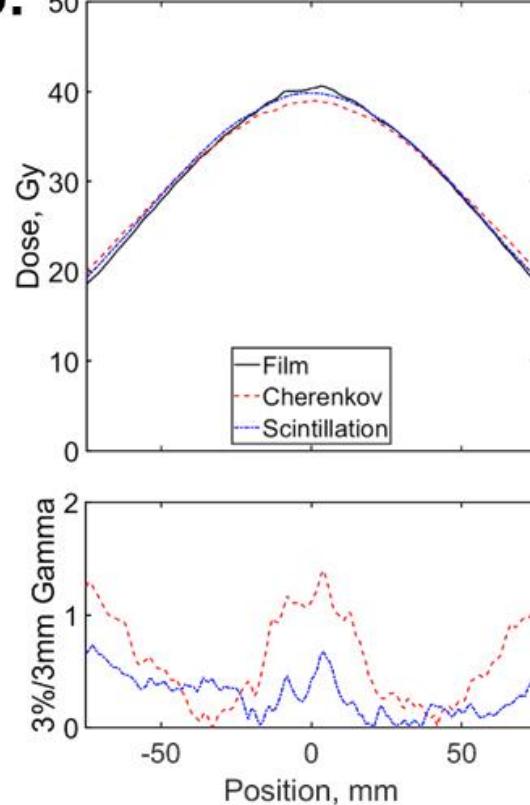
a. Cherenkov PR= 88.8%



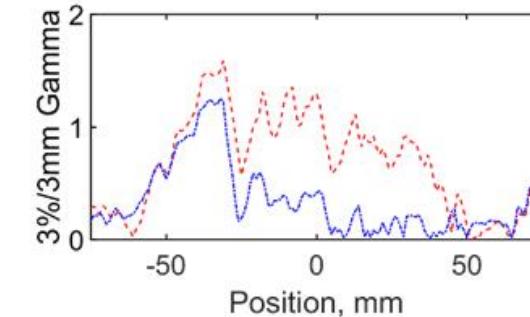
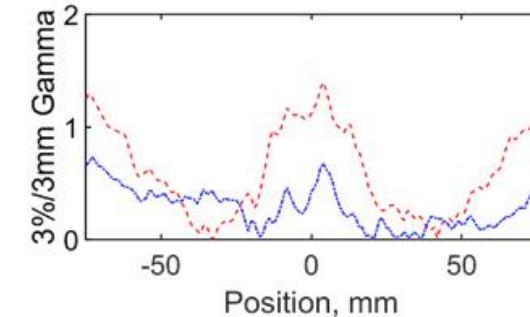
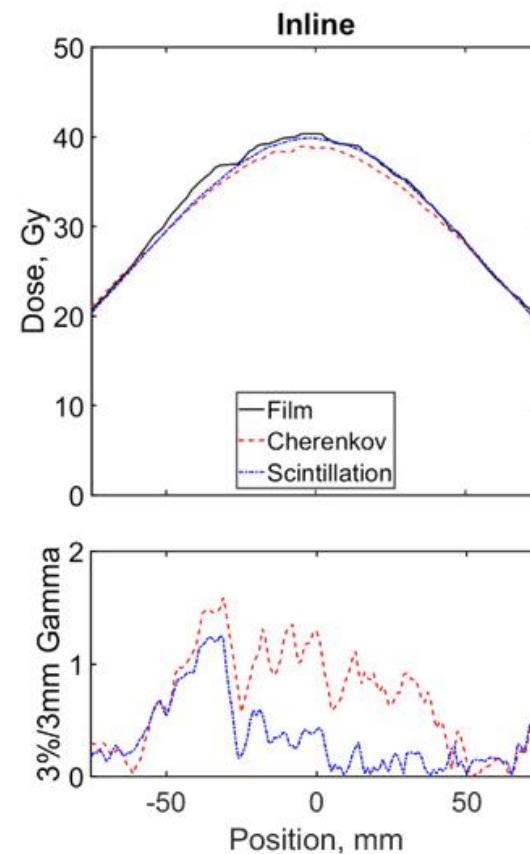
Scintillation PR= 98.9%



b. Crossline

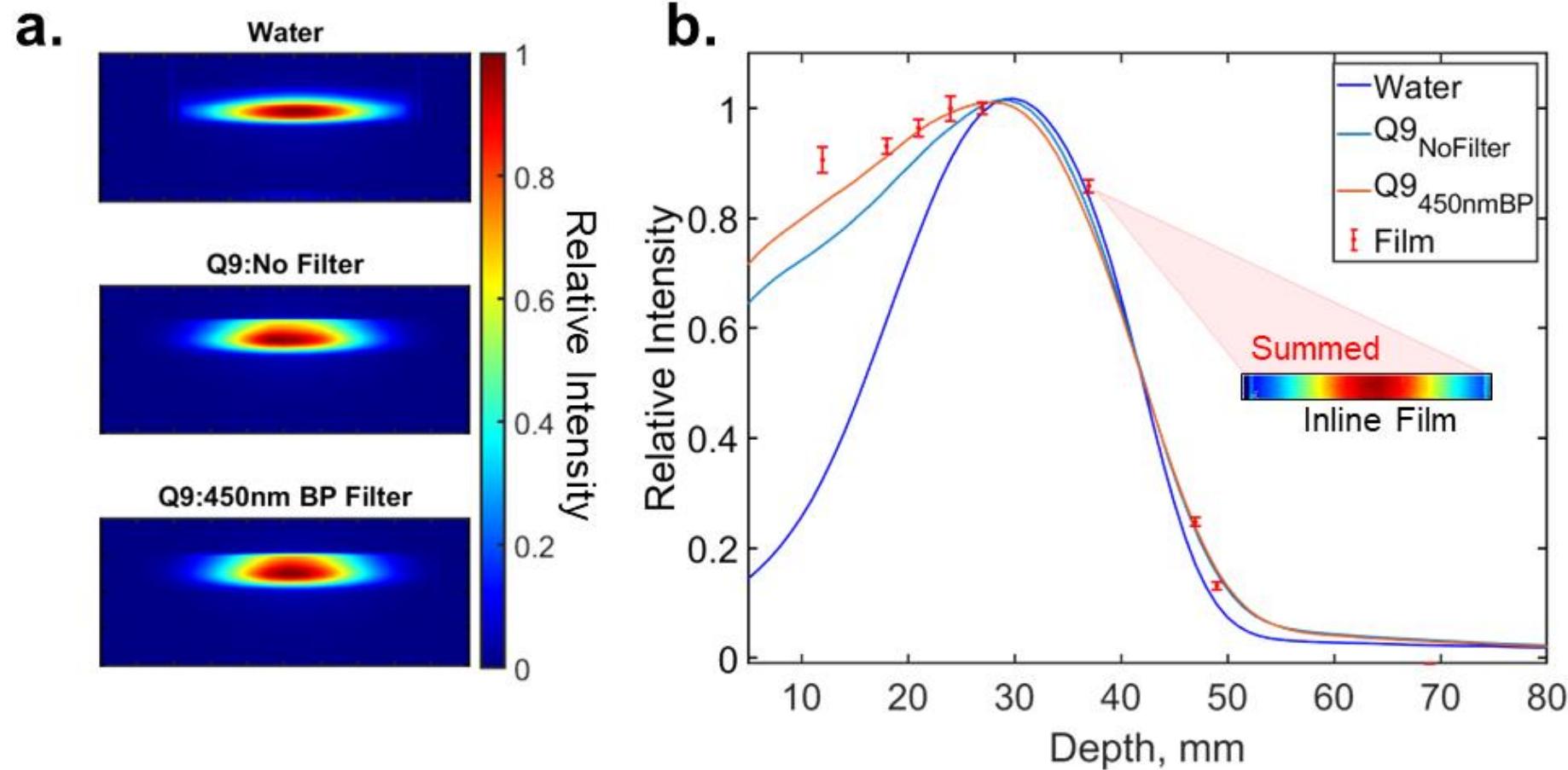


Inline



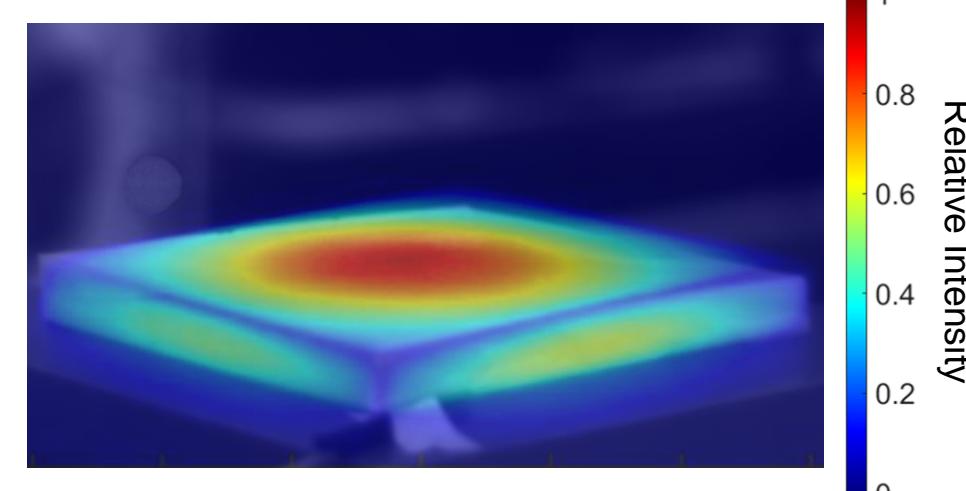
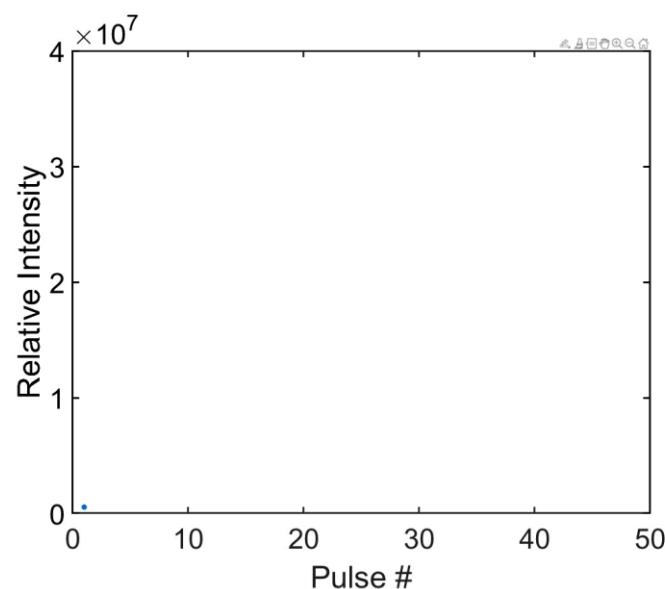
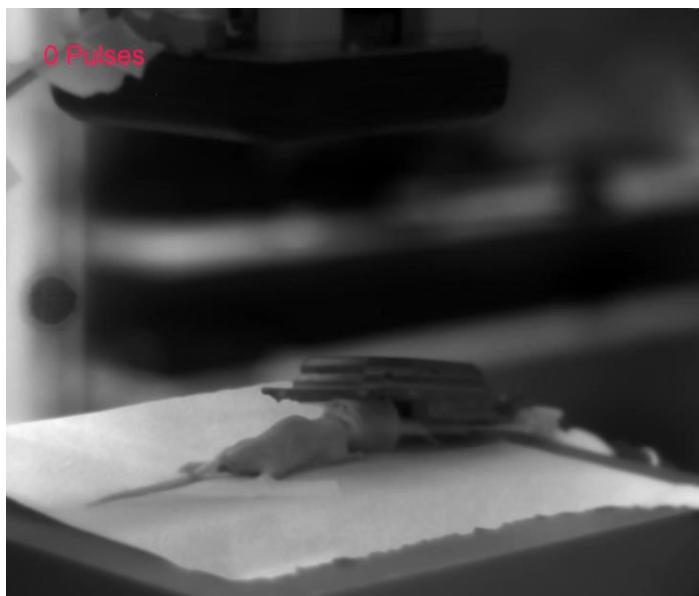
Beam Parameter	Scint. Value	Film Values
Output, Gy	$39.3 \pm 0.5$	$39.5 \pm 0.8$
Shift <sub>x</sub> , mm	$0.86 \pm 0.02$	$2.46 \pm 0.07$
Shift <sub>y</sub> , mm	$-0.70 \pm 0.02$	$-1.56 \pm 0.10$
FWHM <sub>x</sub> , mm	$147.7 \pm 0.1$	$151.2 \pm 0.6$
FWHM <sub>y</sub> , mm	$150.1 \pm 0.1$	$151.4 \pm 0.6$
Symmetry <sub>x</sub> , %	$2.15 \pm 0.02$	$1.29 \pm 0.02$
Symmetry <sub>y</sub> , %	$2.74 \pm 0.02$	$2.00 \pm 0.02$
Flatness, %	$65.6 \pm 0.4$	$66.5 \pm 0.4$

# Projected Depth Dose Profile

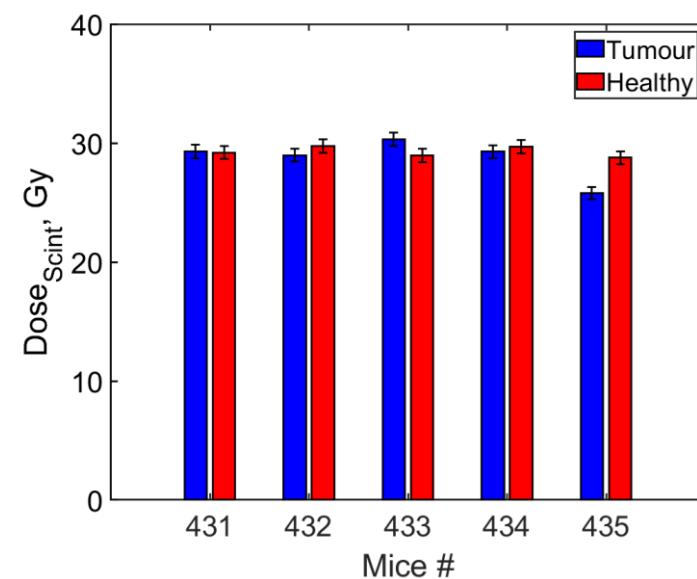
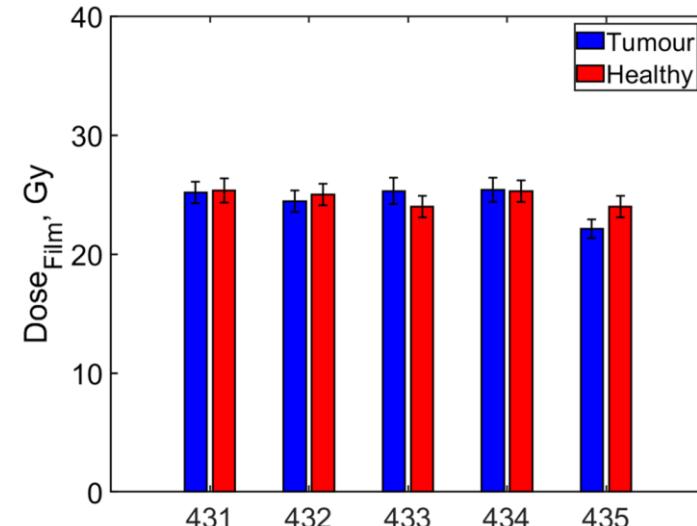
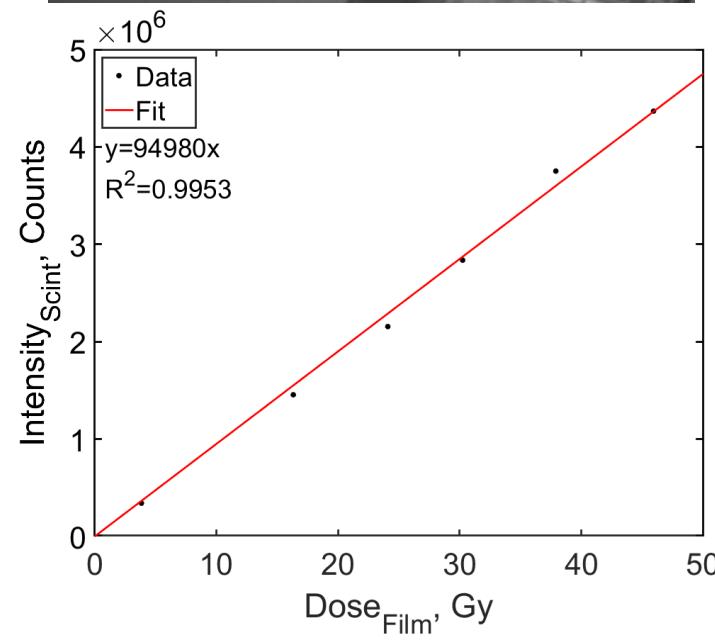
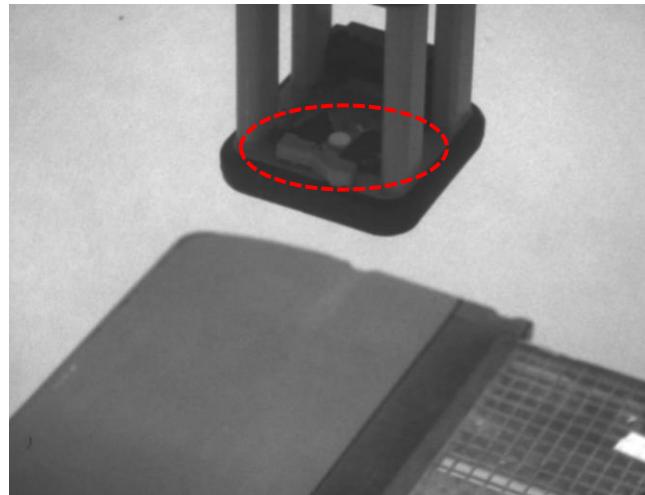




# Future Work: In Vivo Dosimetry



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# Radioluminescence/Scintillation for Dosimetry

- Cherenkov and scintillation response was **linear with dose and dose rate** above 300 Gy/s.
- Radioluminescence surface images agreed with film (generally within 3% for scintillation and within 5% for Cherenkov).
- Accurate depth profile imaging required spectral removal of Cherenkov.
- **Single pulse beam profiles** were imaged with **submillimeter pixel resolution** (<0.5 mm).
- Future Work: In Vivo Dosimetry
  - Field and Dose verification from Cherenkov Emission
  - Dose verification with scintillation-based point dosimeters
- Publication: Rahman M et al. *Phys Med Biol.* 2021.



# Acknowledgements

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Lesley Jarvis



Philip E. Schaner



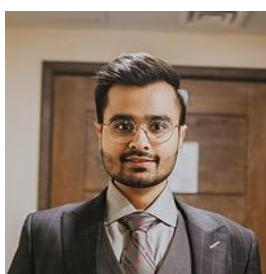
P. Jack Hoopes



Kayla Duval



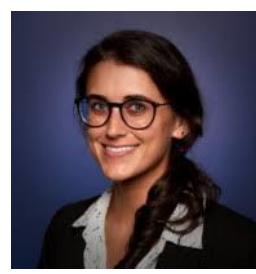
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**DOSE OPTICS**  
Visualize radiation therapy  
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