Film Cut-out In-Vivo Dosimetry in Total Skin Electron Treatment

Dariia Hozhenko[1], Shanice Manning[1], David Solis[1,2], David Perrin[2], Andrew McGuffey[1,2]
[1]Physics Department, Louisiana State University, Baton Rouge, LA
[2]Mary Bird Perkins Cancer Center, Baton Rouge, LA

MARY BIRD PERKINS CANCER CENTER

LSU

2026 JULY 19–22 VANCOUVER, BC JOINT AAPM | COMP MEETING

Connect with me on LinkedIn

MOTIVATION AND BACKGROUND

In vivo dosimetry ensures the dose actually delivered matches the prescribed treatment.

Current challenges:

- High cost and labor demands of **TLD systems**
- Limited availability of **OSLDs**
- Barriers for **new clinics** and those in **resource-limited regions**

These limitations raise concerns about **accessibility and equity** in patient care.

Need: Affordable, sensitive, accurate, conformal, and easy-to-process dosimeters.

This study evaluates **film cut-out (FCO) dosimeters** for **total skin electron therapy (TSET)** and proposes a **clinic-ready commissioning workflow** - offering an accessible, high-throughput, and high-quality dosimetry solution for global clinical use.

Figure 1: *Total skin electron treatment (TSET) setup for the left anterior oblique (LAO) position.*

Spaced 60° apart, treatment includes six positions: ANT, POST, LAO, RAO, LPO, and RPO.

For each position, two beams delivered at gantry angles of 270° ± 18.5° (6MeV) or 270° ± 17.5° (9MeV).

To enhance dose uniformity, patient positioned 25 cm behind a half-inch clear Lexan scatter plate.

Distance from isocenter to scatter plate was 234 cm.

RESULTS

Skin Dose Uniformity

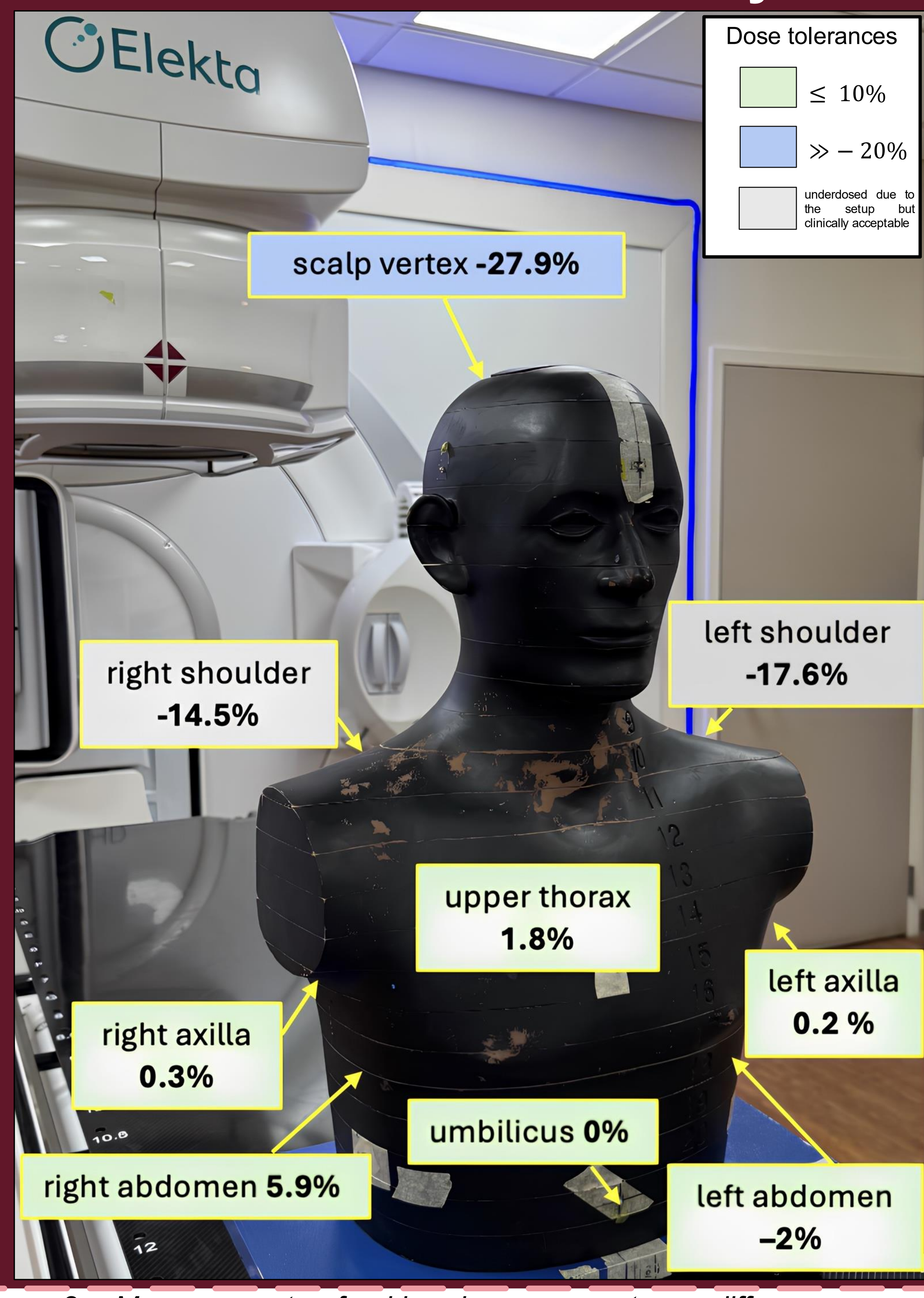

Figure 2: *Measurement of skin dose percentage differences on an anthropomorphic phantom RANDO using FCO dosimeters for a 6MeV electron beam. The umbilicus served as the reference point (0%), with its dose determined using both a single FCO and a single OSLD dosimeters. All other measured locations, expressed as percentage differences relative to this reference, were found to be well within clinical tolerance limits.*

FCO vs Ion Chamber Beam Profiles

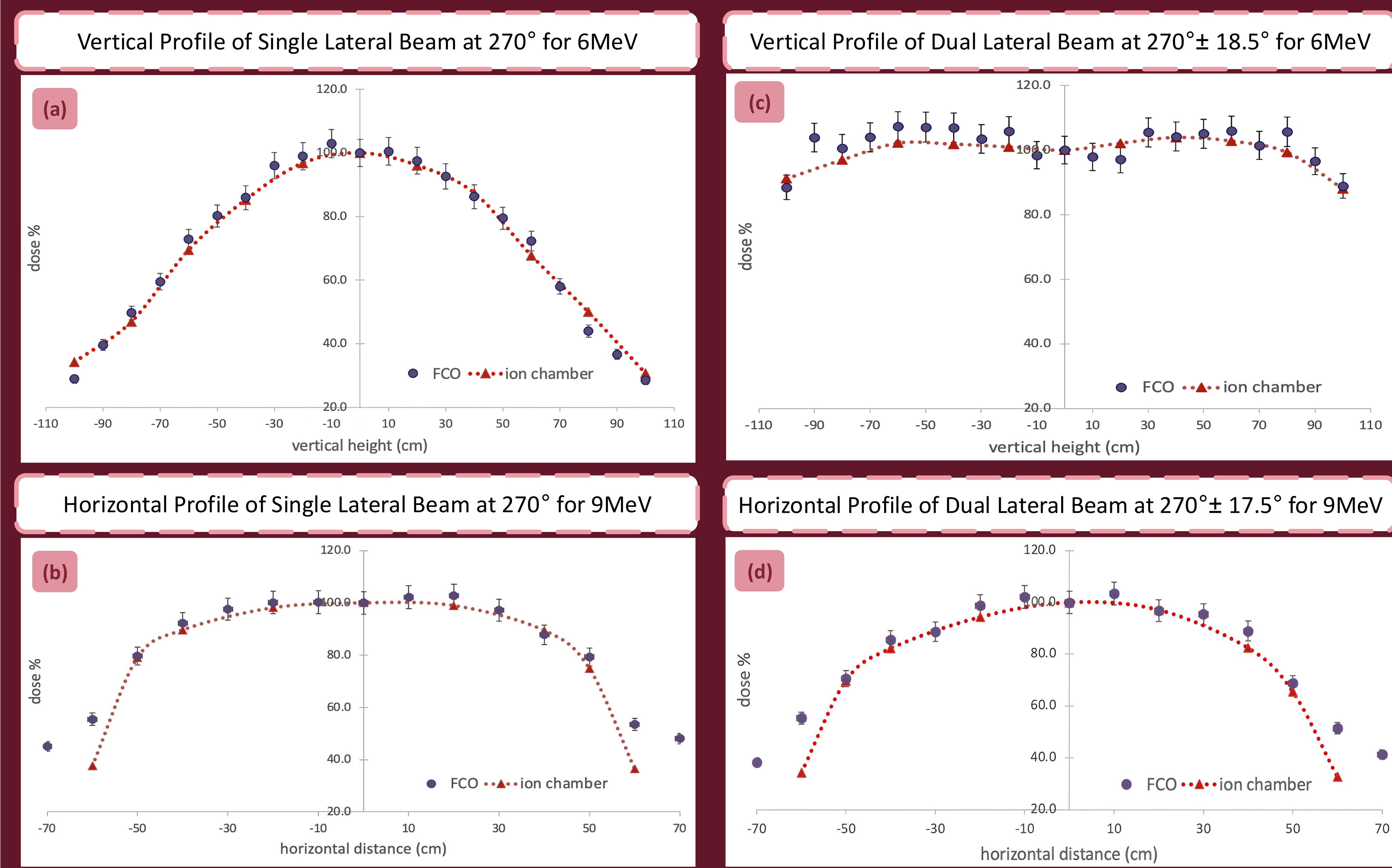

Figure 3:

(a) FCO and ion-chamber measurements show close correspondence, confirming lateral symmetry and reproducible beam output.

(b) FCO dosimeters show excellent agreement with ion-chamber measurements, both exhibiting symmetric distribution with well-defined central maximum.

(c) FCO dosimeters in agreement with ion-chamber show that combined oblique fields produce broadened, uniform dose region, indicating effective dose summation and improved homogeneity.

(d) Dual-beam configuration yields enhanced lateral uniformity and maintains strong agreement between FCO and ion-chamber results, supporting the suitability of FCO for quantitative beam characterization.

METHODS

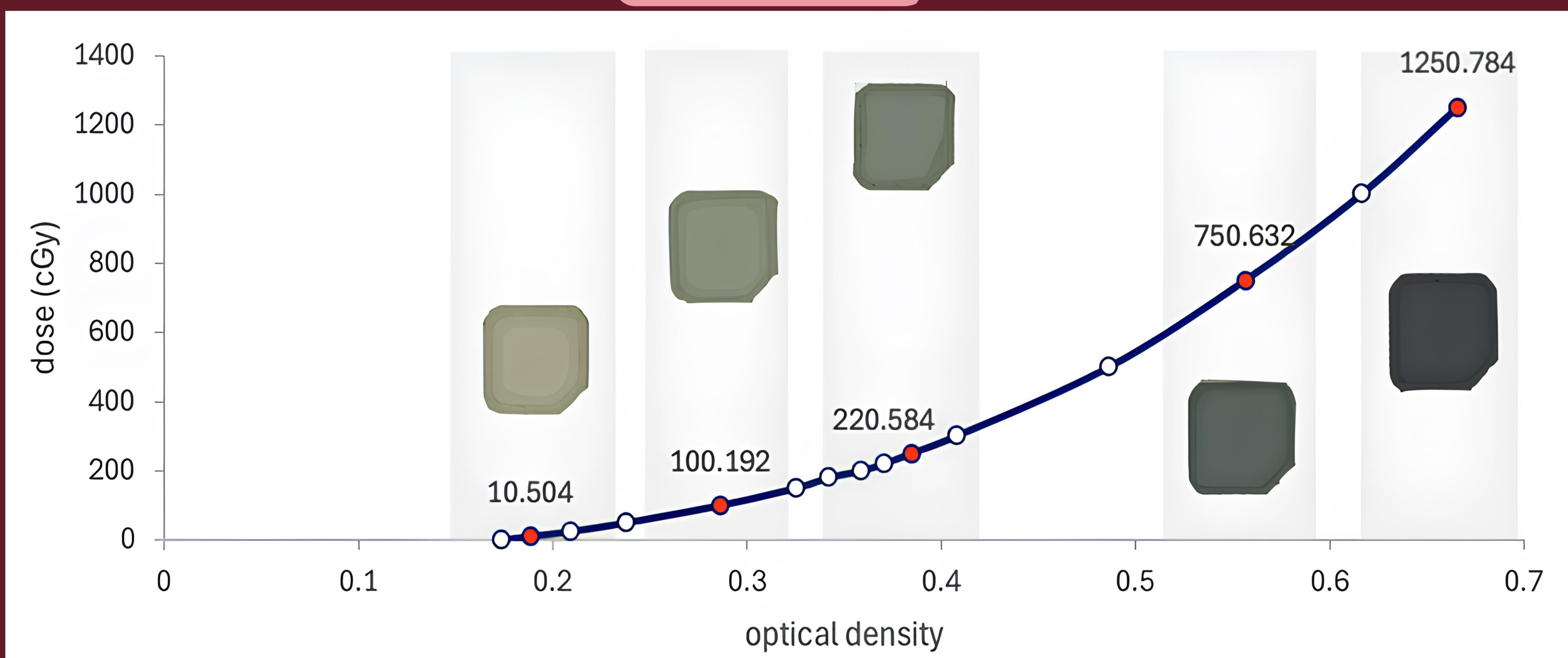

Figure 4: *Dose calibration curve for GAFCHROMIC™ EBT3 film. Calibration data was acquired by a 6MV photon beam, 10x10 cm² field size at 10 cm depth (90 cm SSD). Films were scanned 24 hours post-irradiation to ensure color stability. The resulting curve plots known absorbed dose (cGy) as a function of measured optical density.*

RESULTS CHECKLIST

- ✓ Absolute dose agreed with ion-chamber data within 2.5% in a TSET field behind the scatter plate
- ✓ 6MeV and 9MeV energy agreement, high dose accuracy → 2.5% FCO vs 10% OSLD
- ✓ Superb for dose uniformity verification
- ✓ Low-cost verification with minimal workflow burden $0.3/ FCO vs $27/ OSLD

Acknowledgements

The authors would like to thank the Mary Bird Perkins Cancer Center Department of Medical Physics, physicists, residents, students, and staff, for their support and contributions to this project.

References

Bassi, S., Cummins, D., & McCavana, P. (2020). Energy and dose dependence of GafChromic EBT3-V3 film across a wide energy range. Reports of Practical Oncology and Radiotherapy, 25, 60–63. https://doi.org/10.1016/j.rpor.2019.12.007

Lewis, D., & Devic, S. (2015). Correcting scan-to-scan response variability for a radiochromic film-based reference dosimetry system. Medical Physics, 42(10), 5692–5701. https://doi.org/10.1118/1.4929563

Perrin, D. (2025). *BR1 Versa (S/N 157566): High dose rate electrons commissioning report* [Unpublished internal report]. Mary Bird Perkins Cancer Center. Karzmark, C. J. (Chairman), Anderson, J., Buffa, A., Almond, P., Fraass, B., Biggs, P., Dally, E., Johnsen, S., Fessenden, P., Khan, F., Hogstrom, K., Loevinger, R., Johnson, P., Kao, M., Nath, R., Svensson, G., Wright, K., Morton, R., Palos, B., Nunan, C., Podgorsak, E., & Reft, C. (1987). *Total skin electron therapy: Technique and dosimetry* (AAPM Report No. 23). American Association of Physicists in Medicine / American Institute of Physics.

Lin, L. (2010, March 1). Release report for BR1 Elekta Infinity HDRTSE [Internal report]. Mary Bird Perkins Cancer Center.