

## PURPOSE / OBJECTIVES

To characterize the in-water percent depth dose (PDD) curve and dose profiles of the novel Y-90 planar source (Liberty Vision, Portsmouth, NH)[1] for treating ocular melanoma using Gafchromic EBT3 films and 3D-printed film holders.

## MATERIAL & METHODS

A low-cost desktop 3D printer (Ender 3 v2) and the TinkerCAD software were used to design and fabricate the film holders with Polylactic Acid (PLA) filament and 0.4 mm nozzle. EBT3 film sheet was cut into 3x4 cm<sup>2</sup> (size of the holding space of the film holders) pieces. Films were calibrated (0-10 Gy) on a Truebeam in our institution. In-water PDD (normalized to depth 1 mm from the source surface) and profile measurements were performed with these film sheets irradiated by a Y-90 planar source (6mm in diameter). In-film PDD curve was also measured using a stack of 18 cut films. Following AAPM TG-235 recommendations[2], irradiated films were processed and scanned using an Epson-10000XL flat-bed scanner. The dose distribution was then determined from the calibration curve

## RESULTS

Measured printing accuracy was within 0.5 mm. Exponential fit ( $y = A_1 e^{-x/t_1}$ ) of the in-water PDD curve yielded a R2 of 0.998. In-film PDD curve has a faster dose fall-off due to its higher density. However, after applying a scaling factor of 1.4, the in-film PDD agreed well with the in-water PDD (Correlations Coefficient=0.9993). Profiles were acquired at depths of 0.14, 1.28, 3.28 mm corrected for film thickness. Full-width-half maximum (FWHM), calculated from RIT V6.8, were 5.191±0.014, 5.436±0.076, 7.29±0.37 mm, respectively.

## CONCLUSION

This is the first experimental study on the dose distribution of the novel Y-90 planar source for ocular melanoma brachytherapy. The 3D-printed film holders demonstrated effectiveness in acquiring PDD and dose profile curves. The in-film measurement is easy to implement but requires a scaling factor of 1.4 for conversion to in-water measurement.

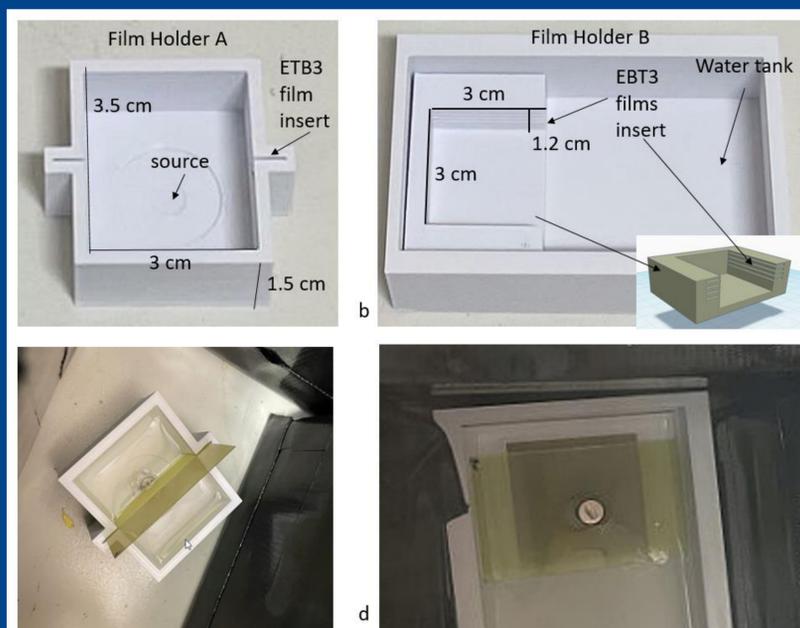


Figure 1 Schematic design of two types of 3D-printed film holders for PDD curve (a) & (c) and profile measurement (b) & (d). Film holder A has an inner dimension of 3x3.5x1.5 cm which is filled with water during measurement and Y-90 planar source sits in the center. The film insert is 0.6 mm width to allow minimum displacements. Film holder B sits in a 3d-printed water container and is capable of measuring profiles at 0, 1, 3, 5, 7 mm depths. At each depth, the film insert is 0.6 mm height. Source will sit in contact with the first film piece during measurement.

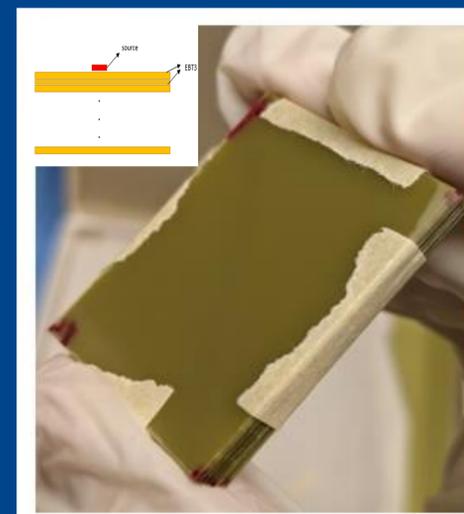


Figure 2 Illustration of PDD measurement with a stack of film pieces. Source sits on the top of first film piece during measurements. The thickness of EBT3 films were verified to be within 2% of the nominal thickness. When generating PDD curve, the nominal thickness of 0.28 mm was used.

Figure 4 Isodose distribution using film holder B at depths of a) 0.14 mm, normalized to 495.33 cGy, b) 1.28 mm, normalized to 192.7 cGy, and c) 3.28 mm, normalized to 45.09 cGy. All depths were corrected for film thickness.

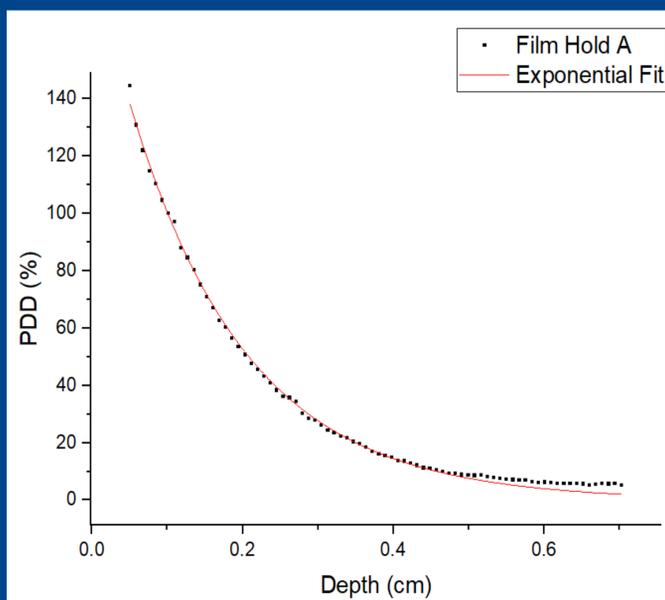
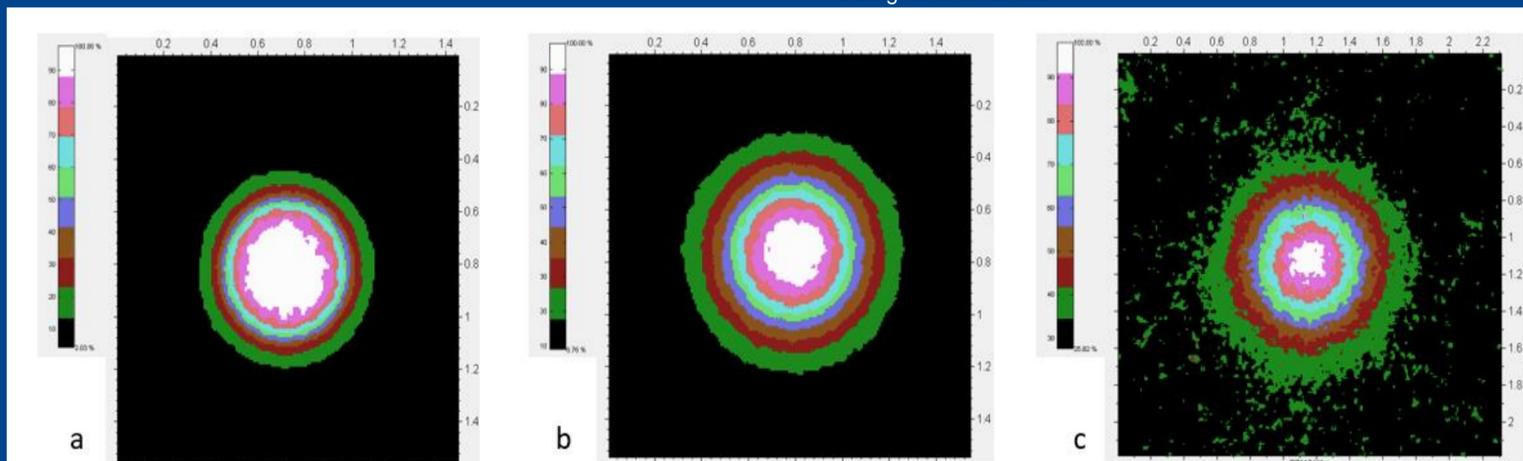
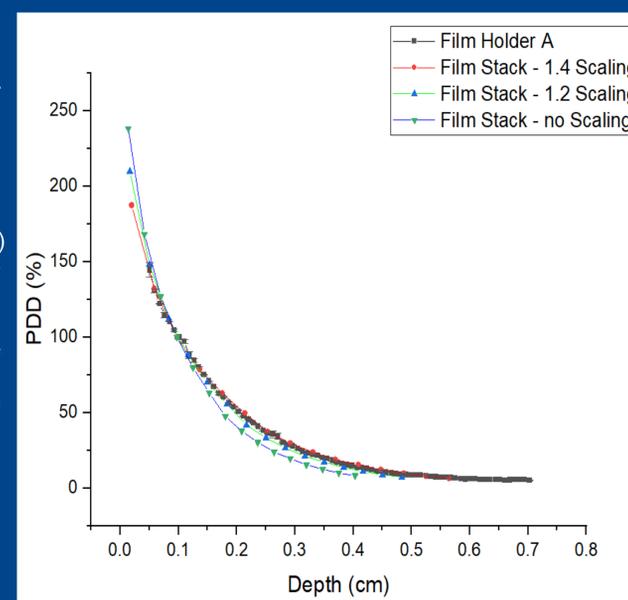


Figure 3 a) PDD curve using 3D-printed film holder A with curve fitting,  $y = A_1 e^{-x/t_1}$ , where  $A_1 = 191.43 \pm 1.46$  and  $t_1 = 0.155 \pm 0.001$ . b) Comparison of PDD curves (a scaling factor of 1, 1.2 and 1.4 in distance were presented). Person correlation is shown to be 0.9993 with a scaling of 1.4 in distance.



## REFERENCE

- [1] "iWand General Overview." Liberty Vision
- [2] Niroomand-Rad, A. et al. (2020), Med. Phys., 47: 5986-6025.

## CONTACT INFORMATION

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