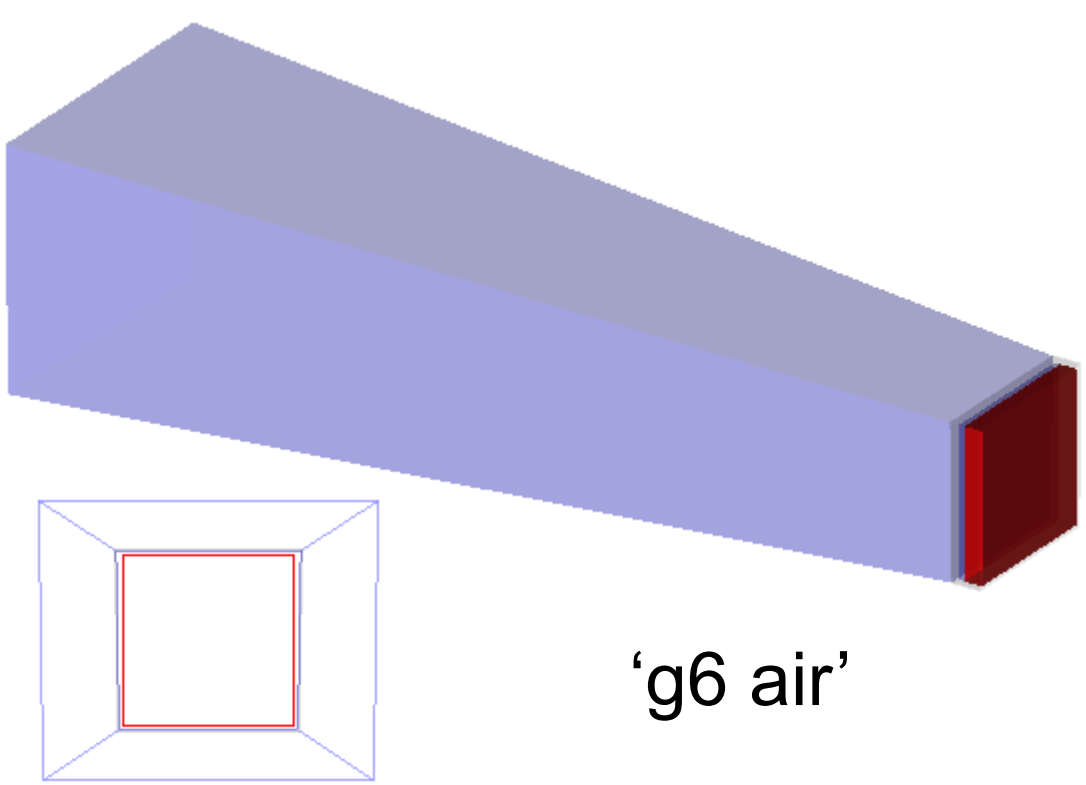
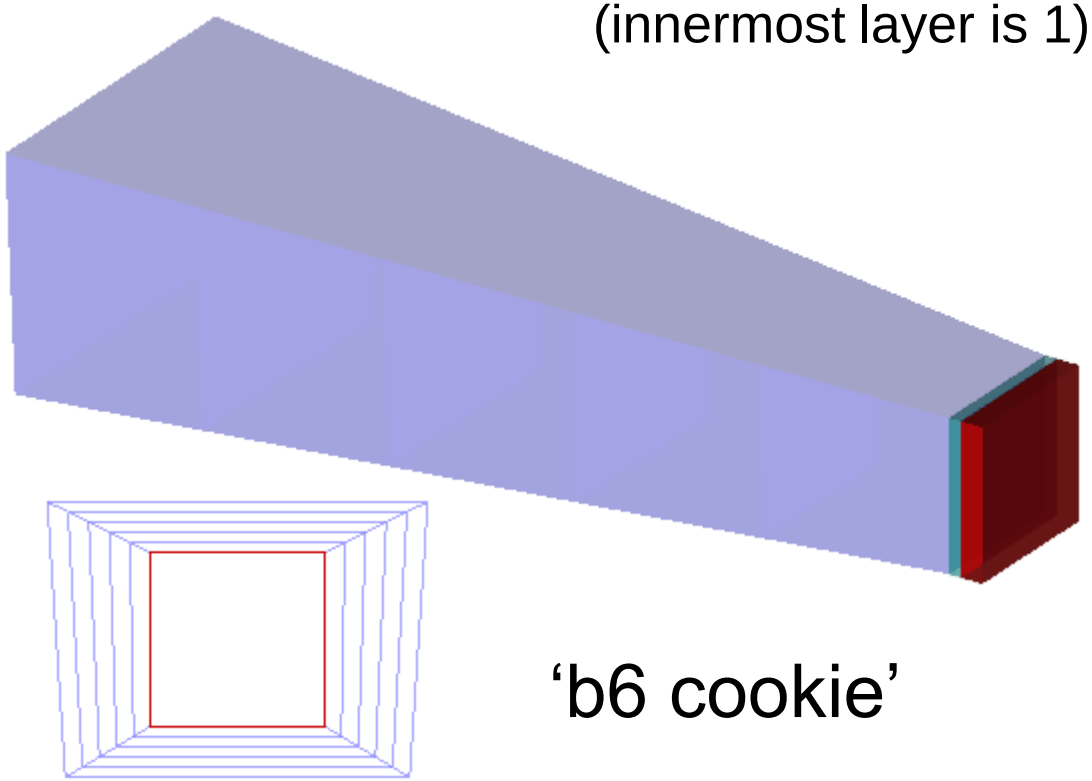
- Generating optical photons (450 nm) at input face of light guides
  - Flat in φ, flat in cos(θ)
  - Limited to θ = 26.7 degrees
- 0.5 mm air gap or 1.0 mm silicone cookie
- Count photons that reach SiPM face

‘b’ – BIC
‘g’ – GlueX
‘#’ – layer number
(innermost layer is 1)

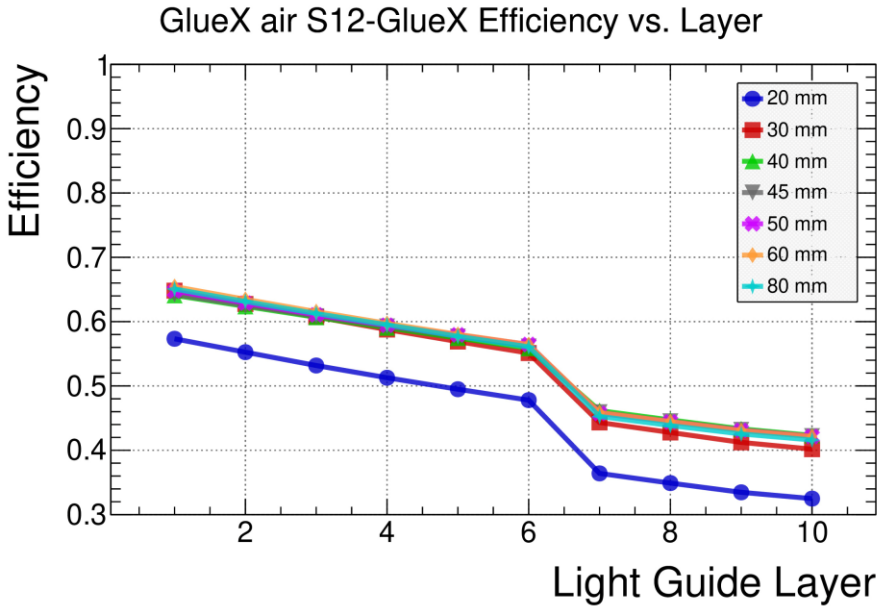


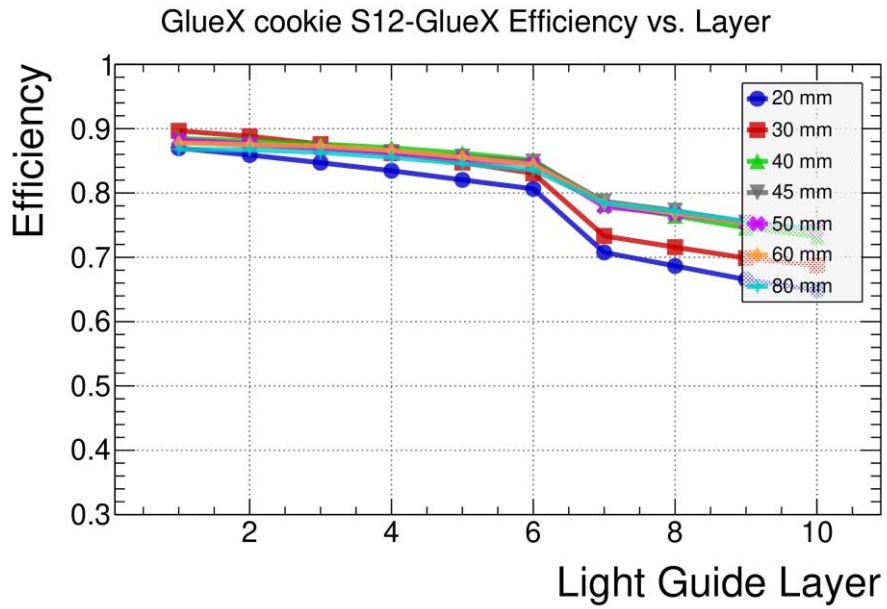
‘g6 air’

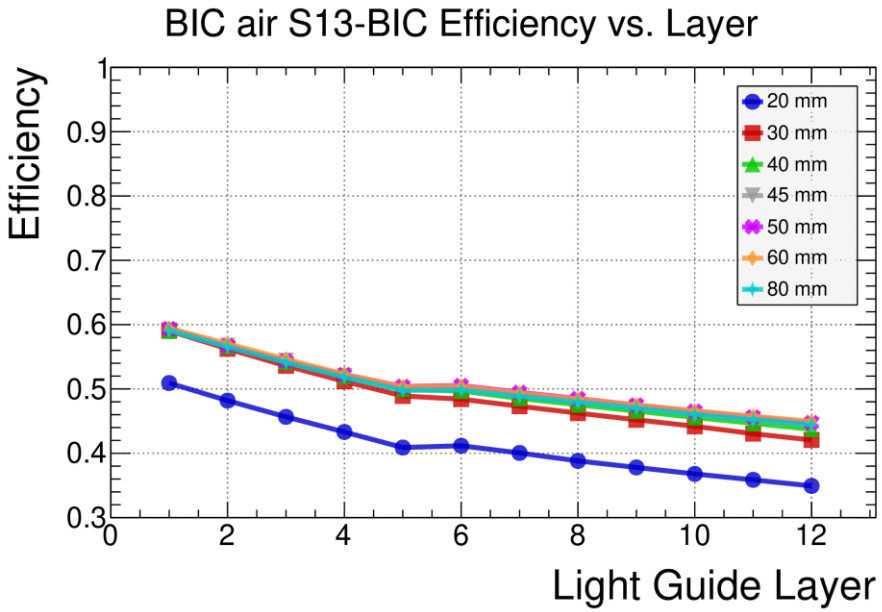


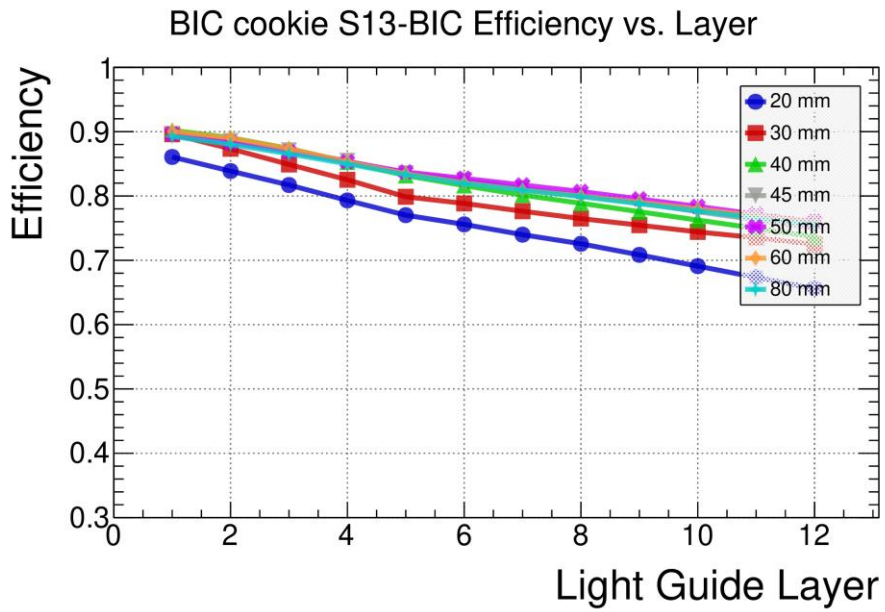
‘b6 cookie’

Efficiencies





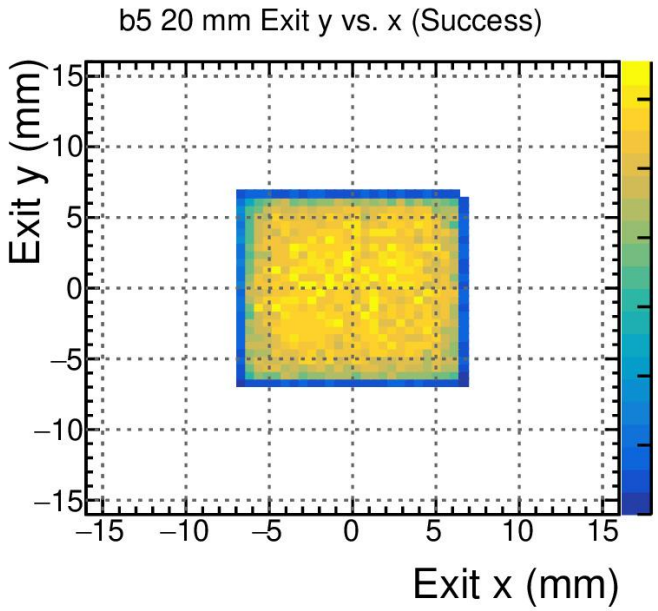


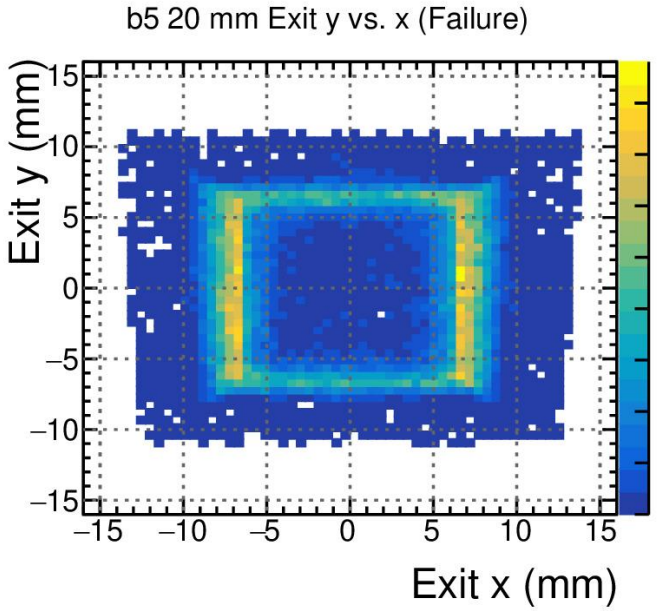


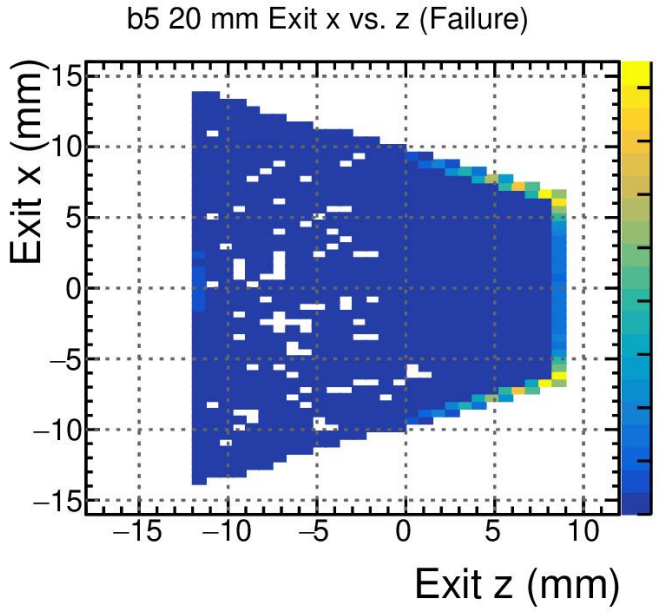
50 mm Efficiencies

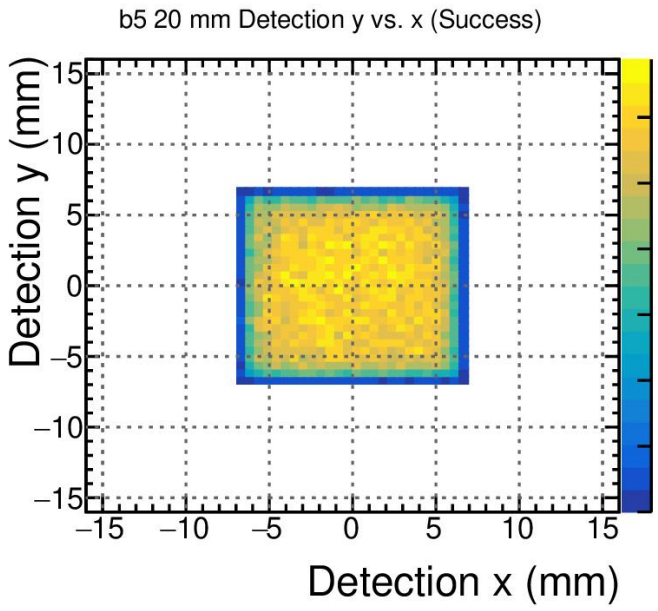
Layer #	GlueX air	GlueX cookie	BIC air	BIC cookie
1	0.647	0.883	0.594	0.896
2	0.629	0.877	0.567	0.883
3	0.611	0.868	0.543	0.869
4	0.594	0.861	0.522	0.853
5	0.579	0.852	0.504	0.837
6	0.564	0.845	0.505	0.827
7	0.457	0.779	0.495	0.817
8	0.444	0.767	0.485	0.807
9	0.431	0.753	0.475	0.795
10	0.421	0.742	0.465	0.784
11	–	–	0.456	0.772
12	–	–	0.448	0.760

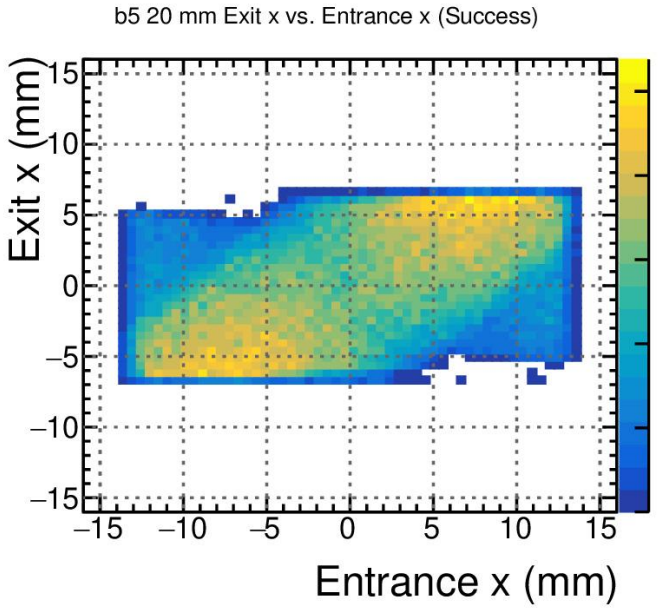
Light Mixing – BIC cookie

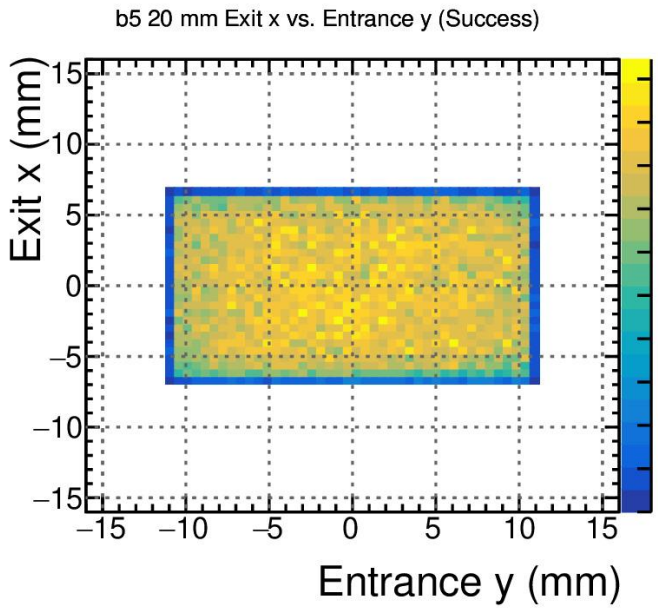




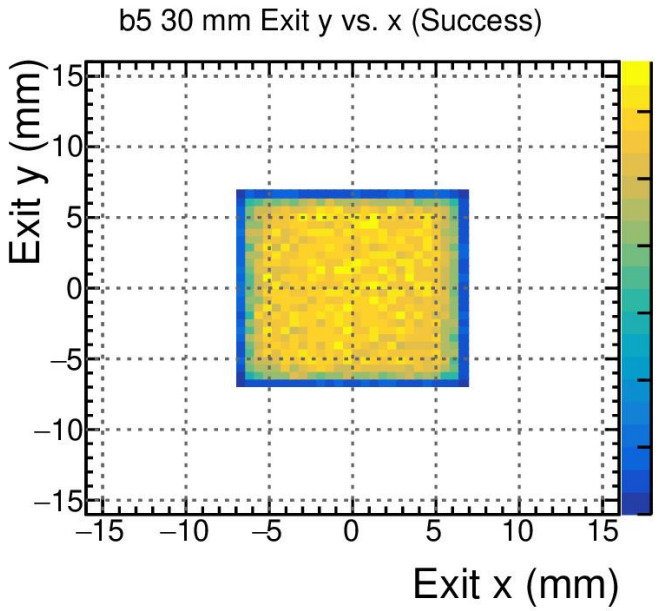


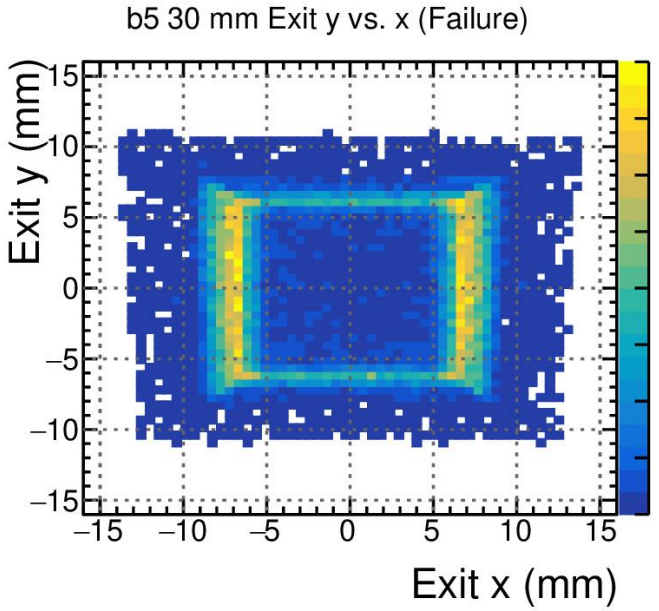


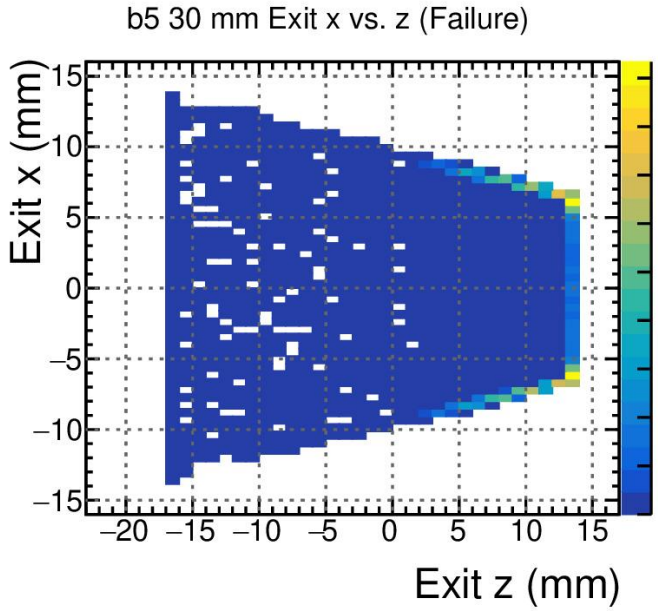


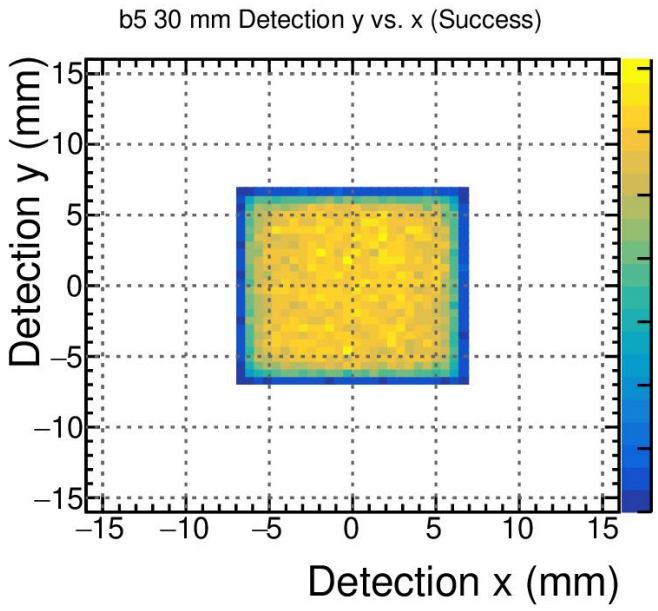


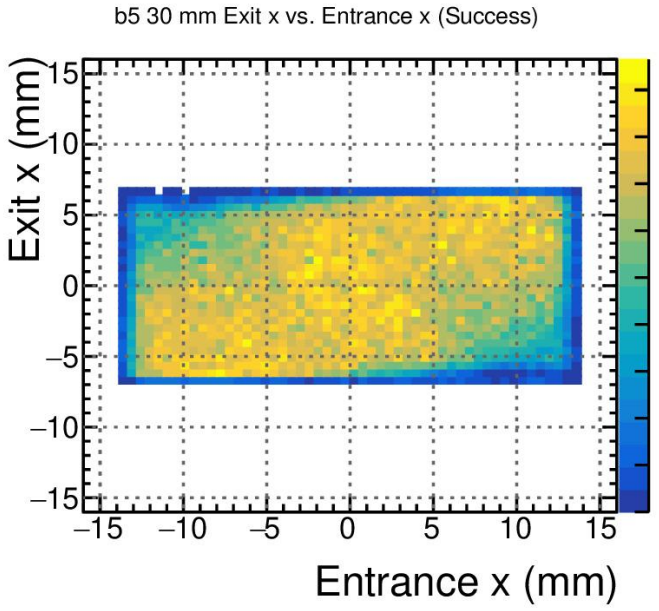
Light Mixing – BIC cookie

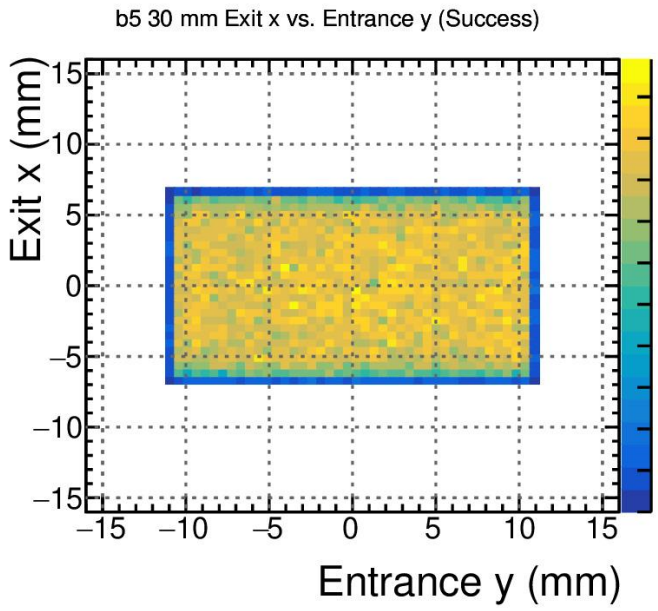




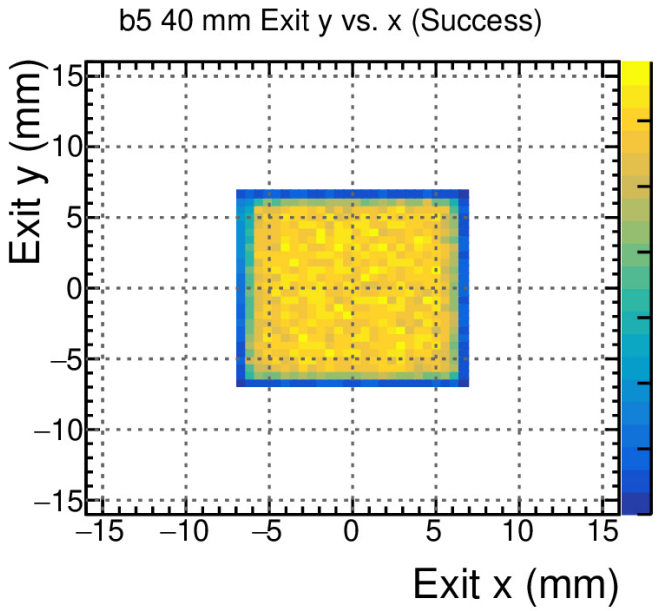


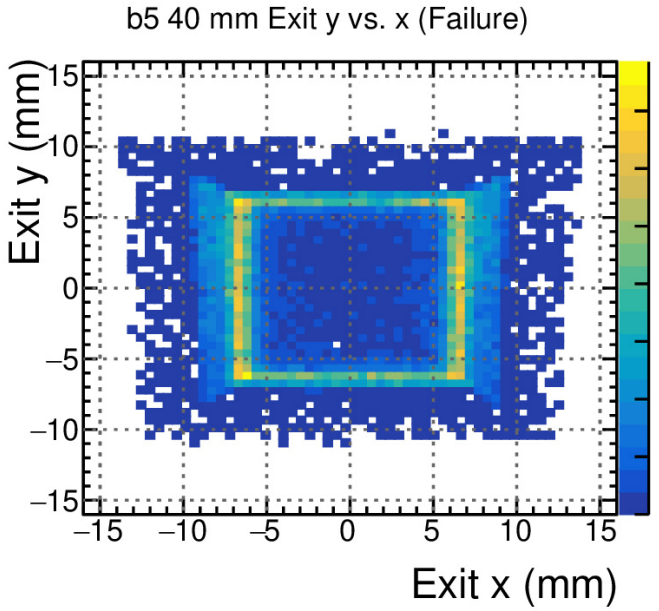


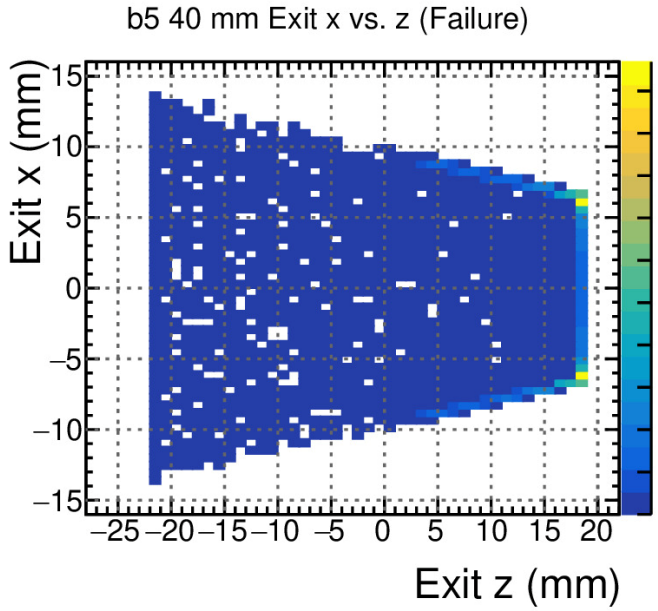


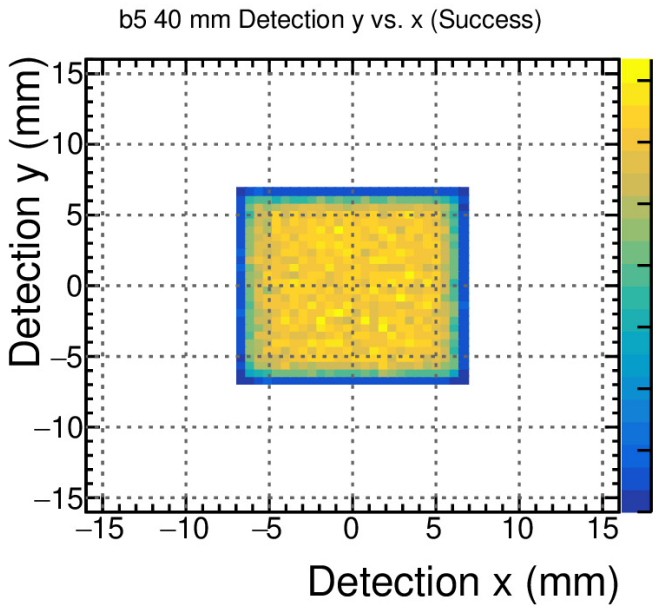


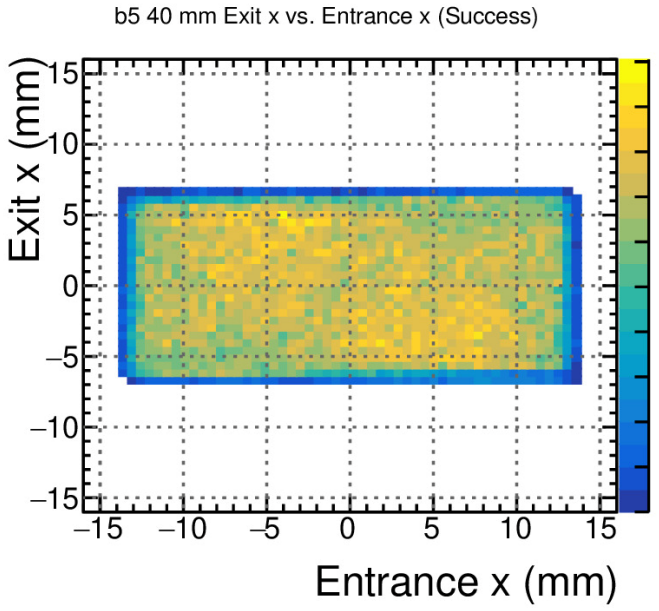
Light Mixing – BIC cookie

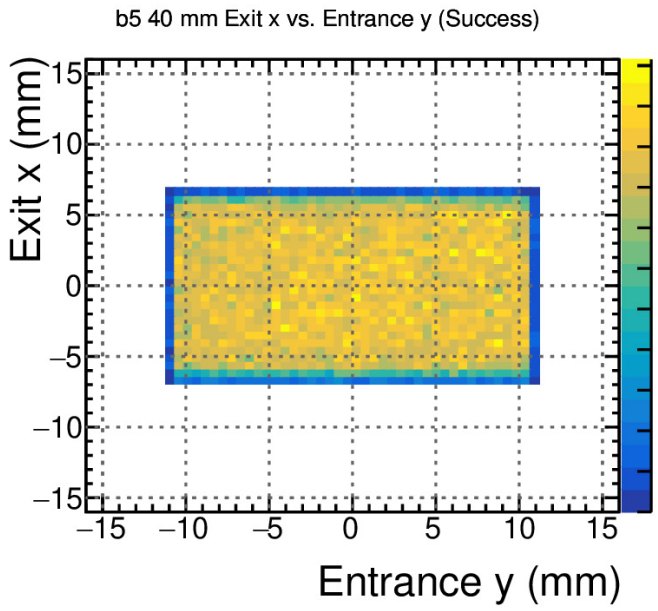




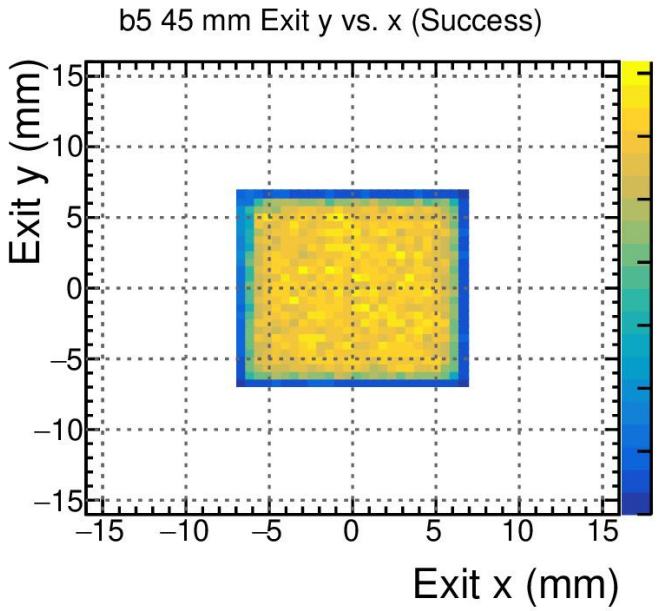


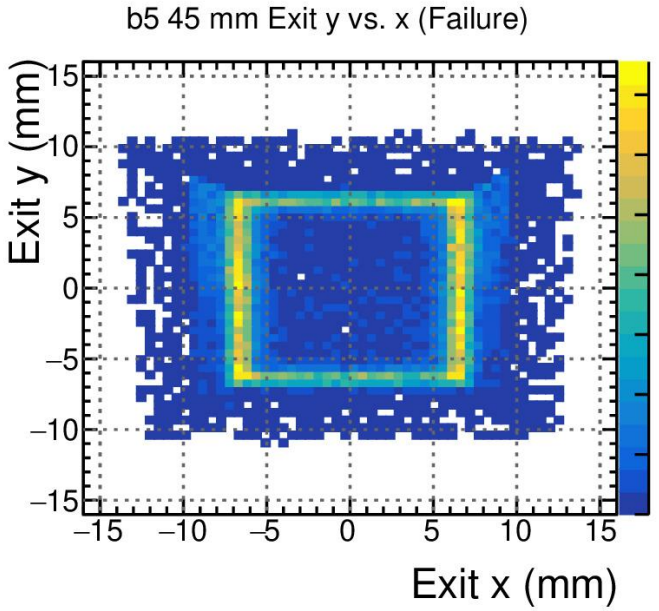


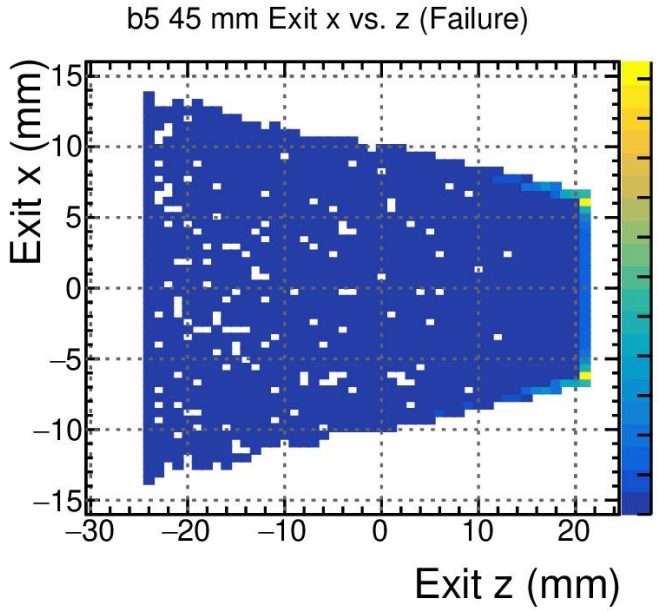


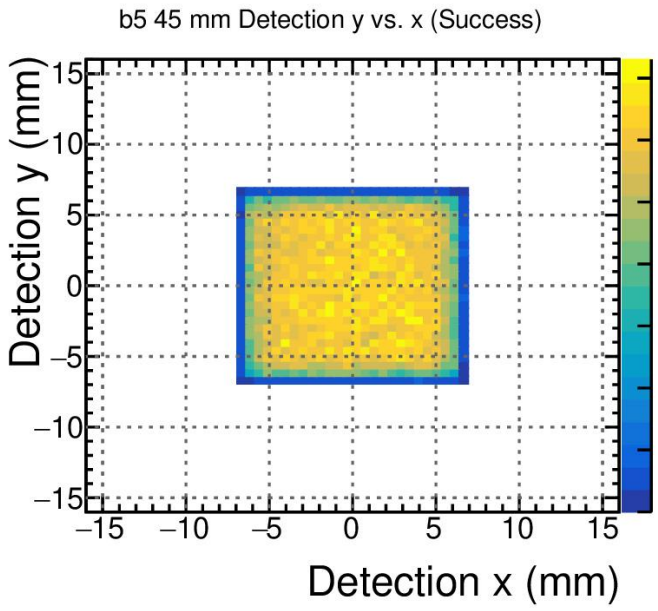


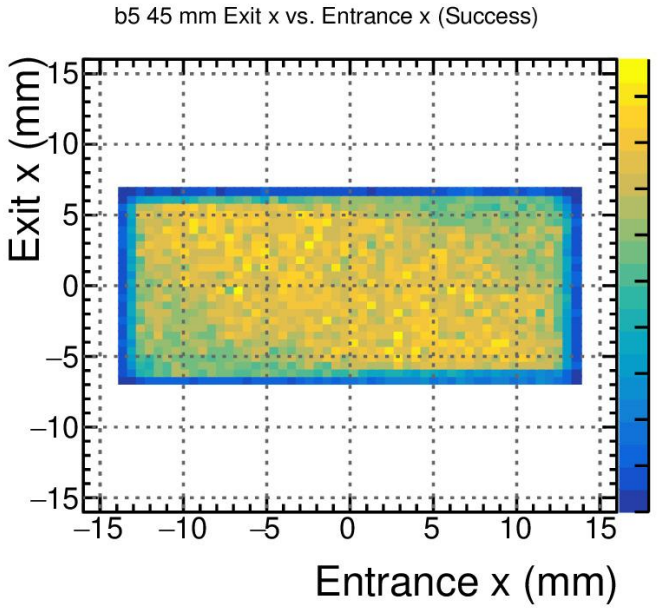
Light Mixing – BIC cookie

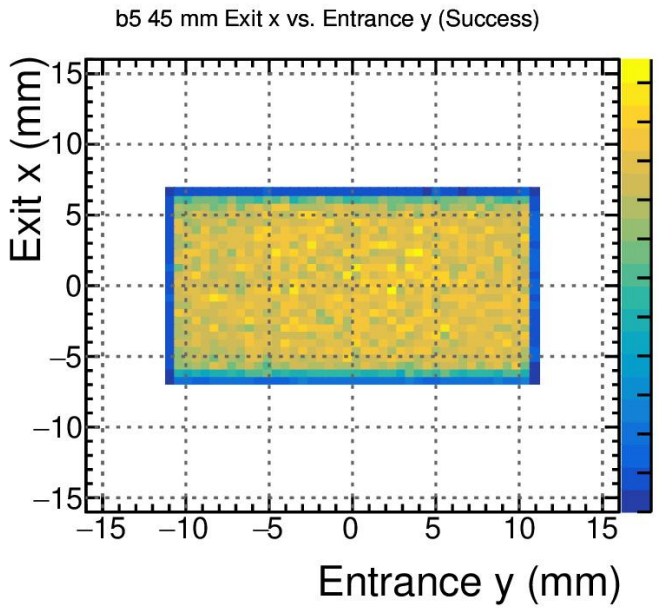




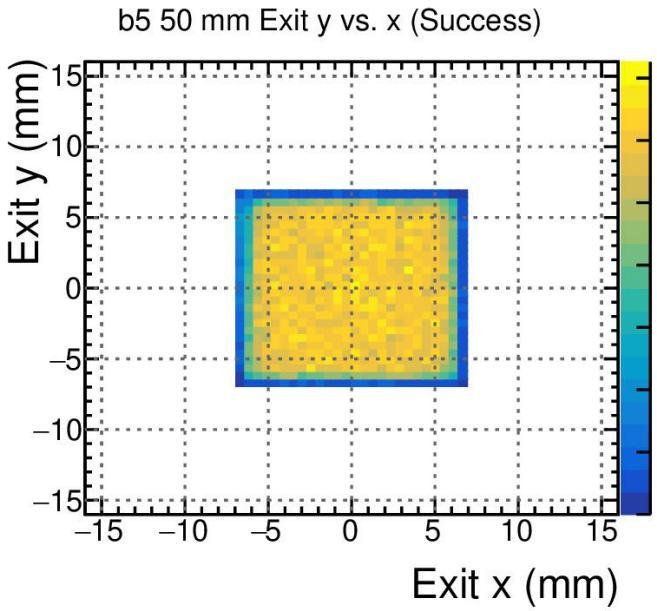


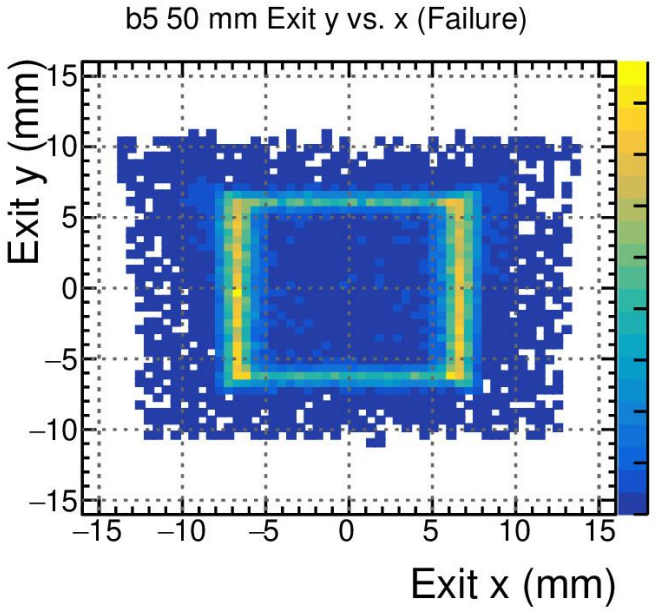


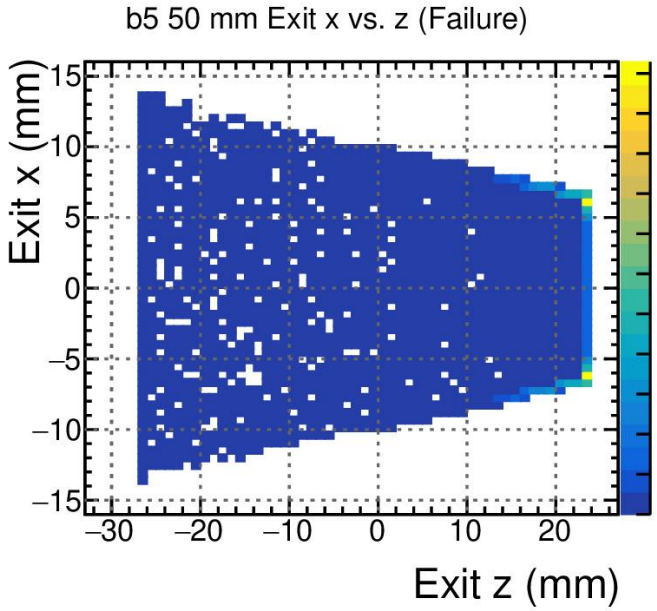


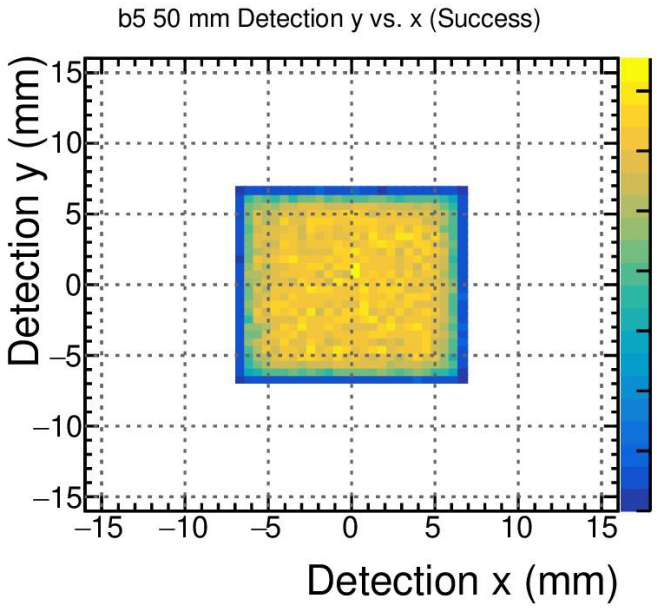


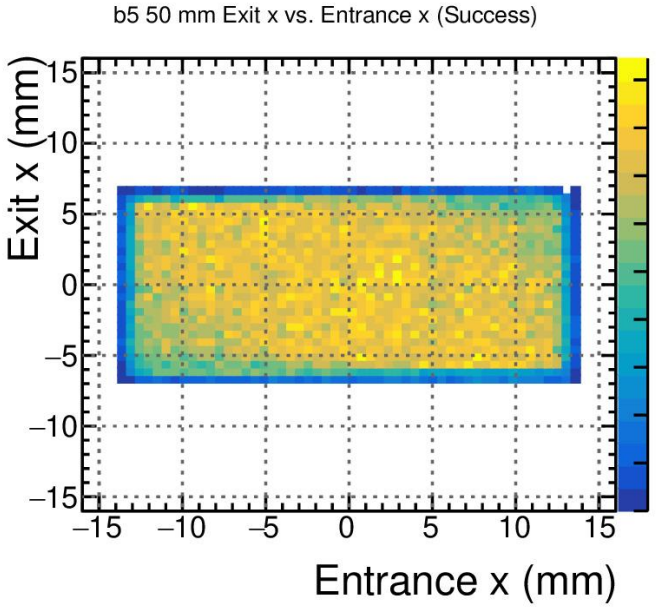
Light Mixing – BIC cookie

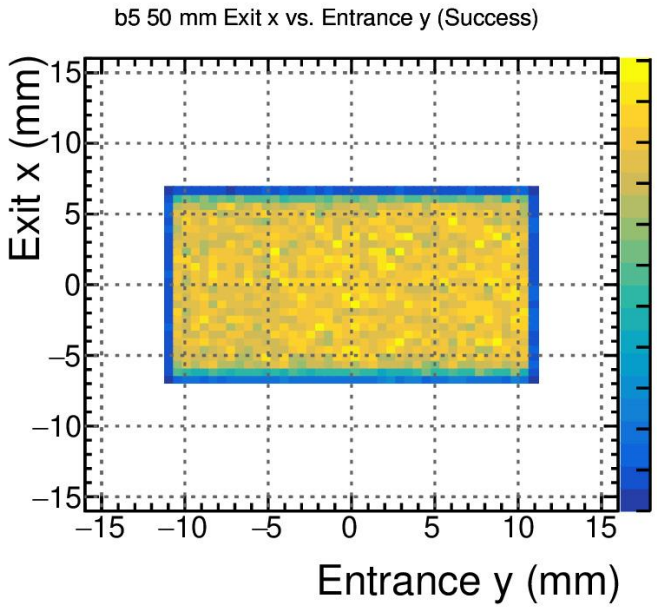




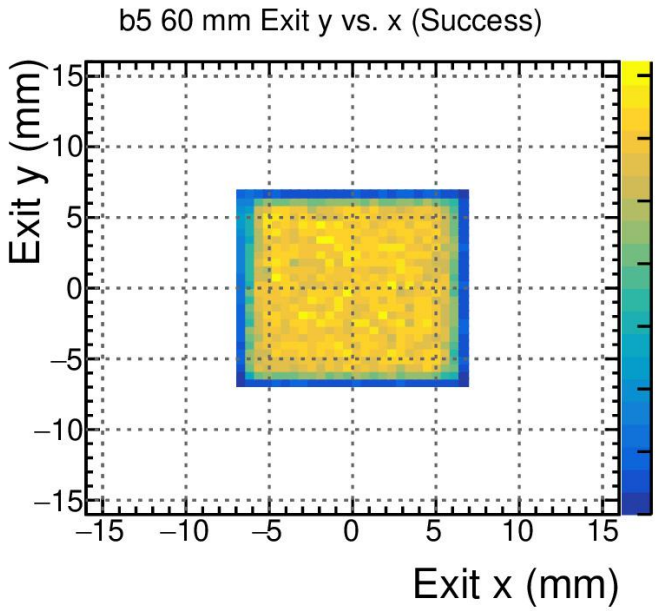


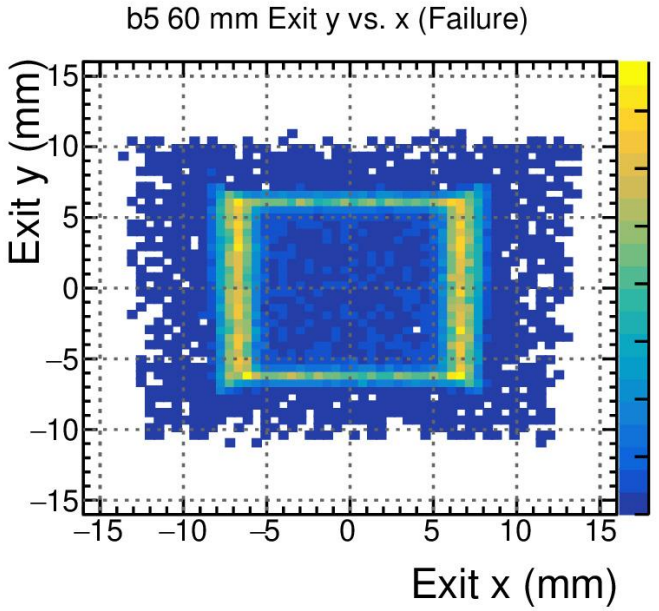


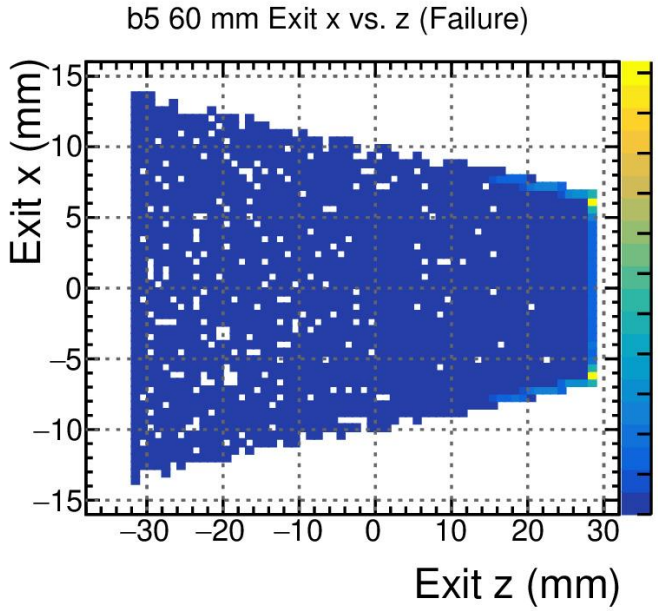


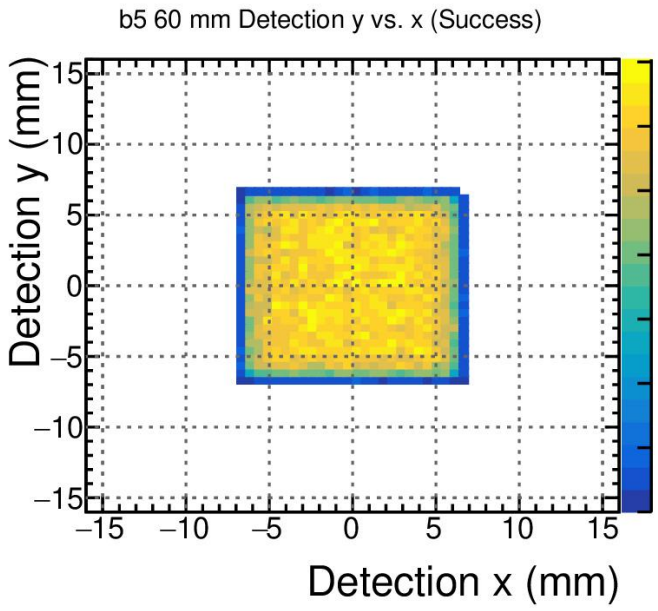


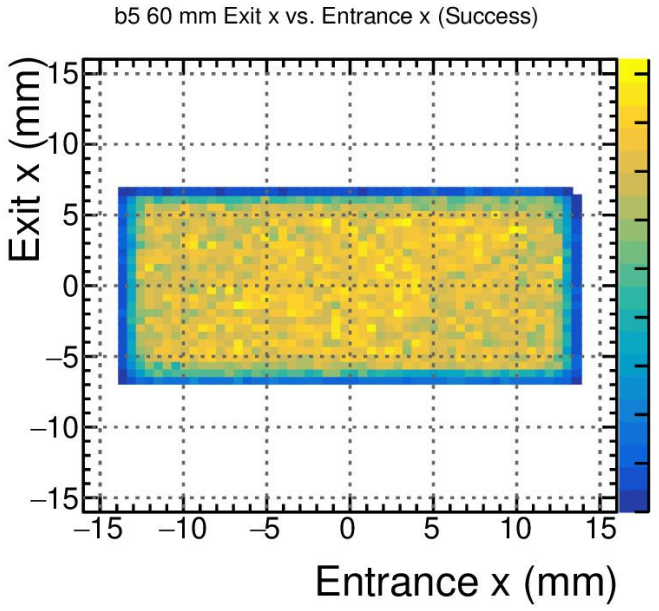
Light Mixing – BIC cookie

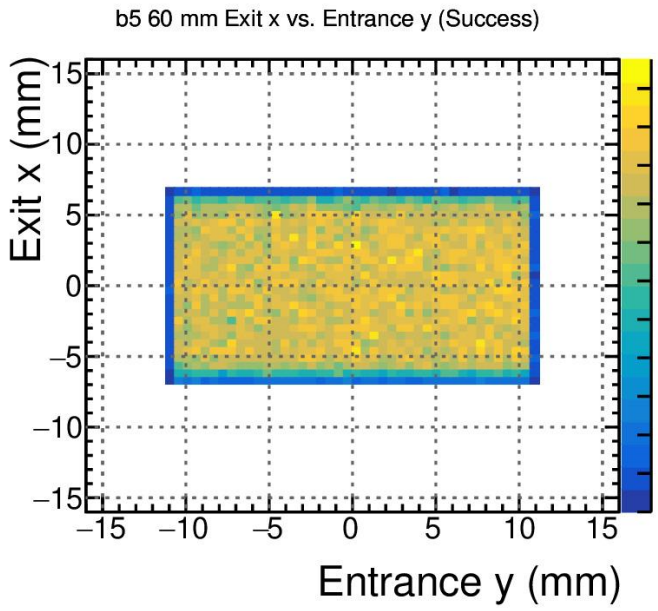




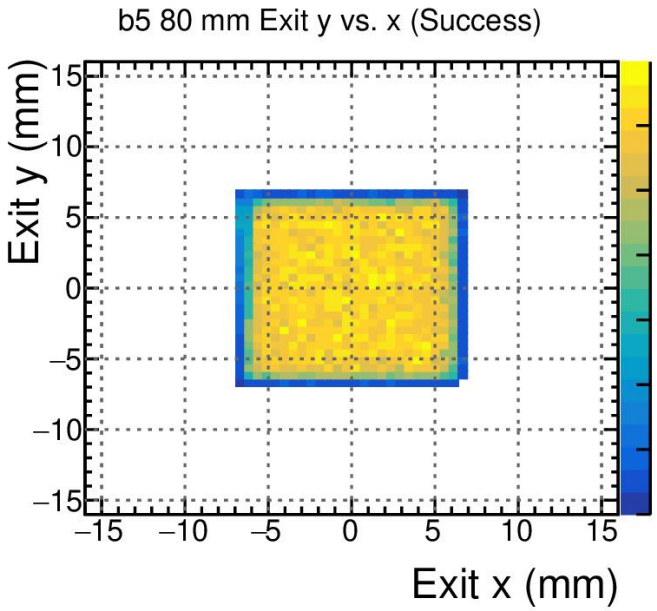


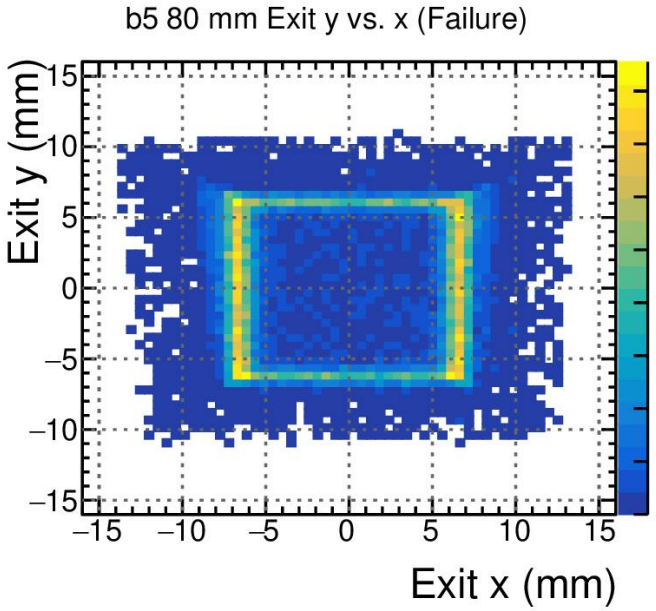


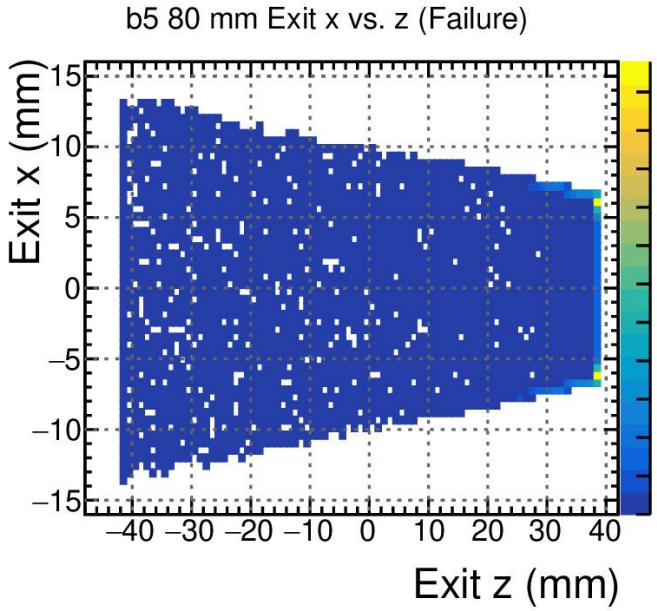


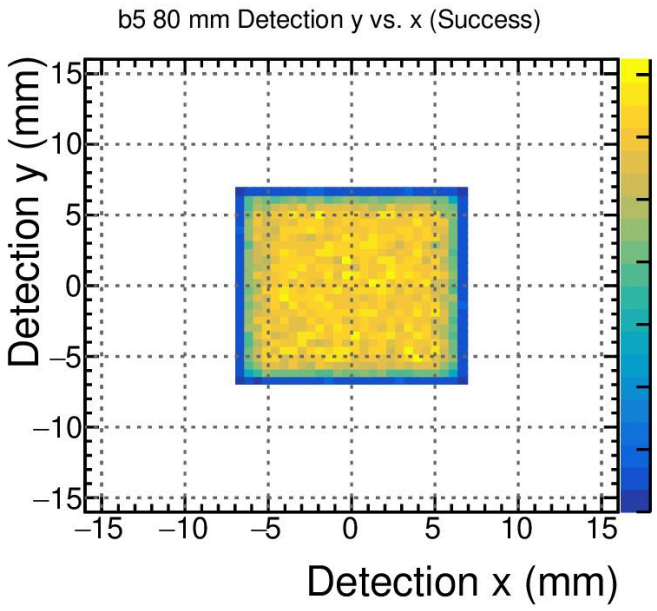


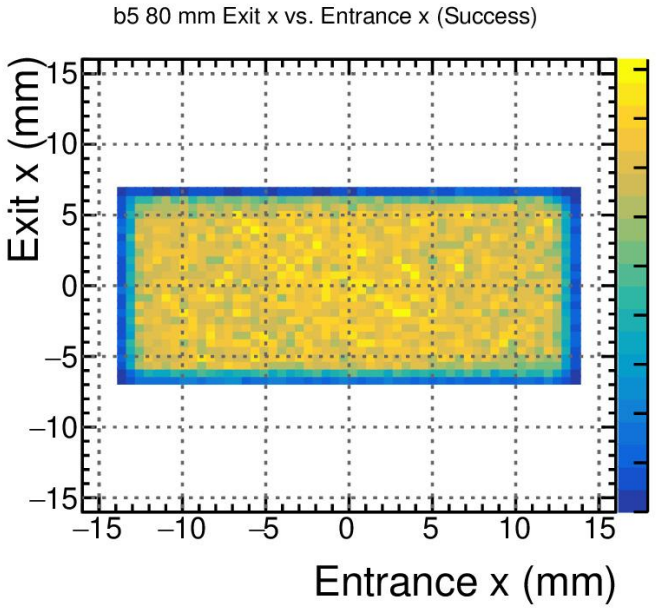
Light Mixing – BIC cookie

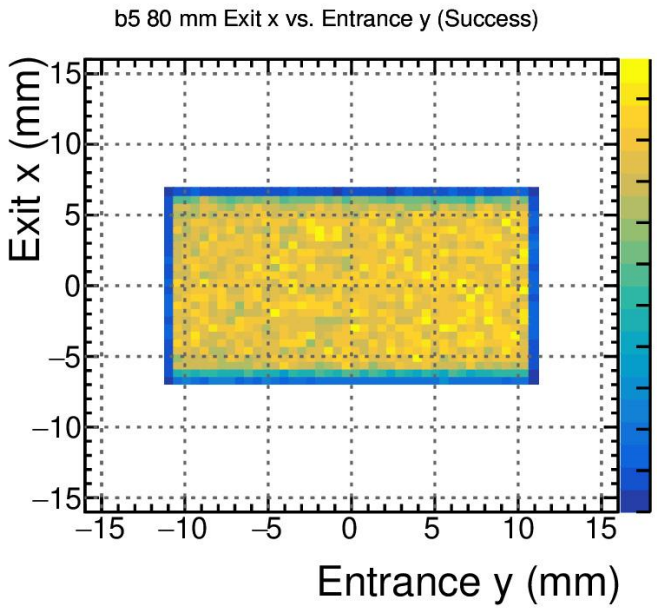




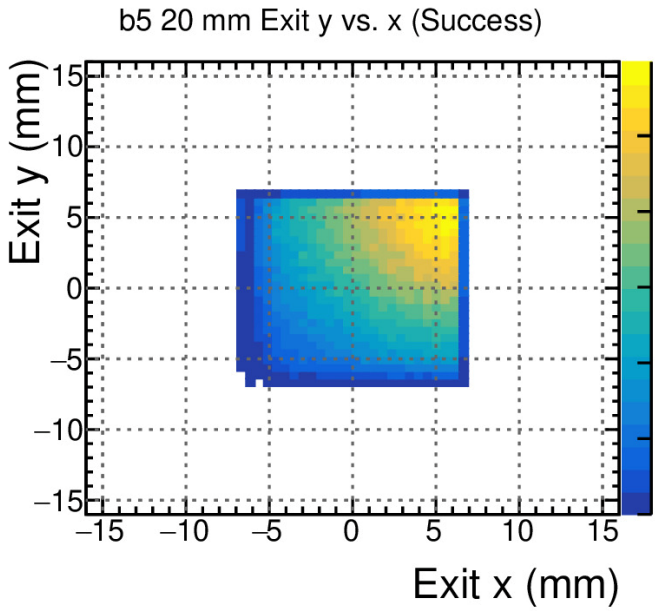


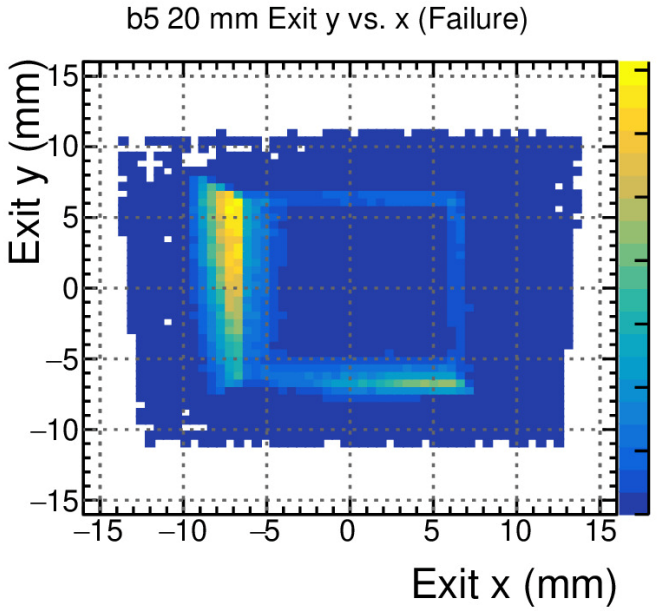


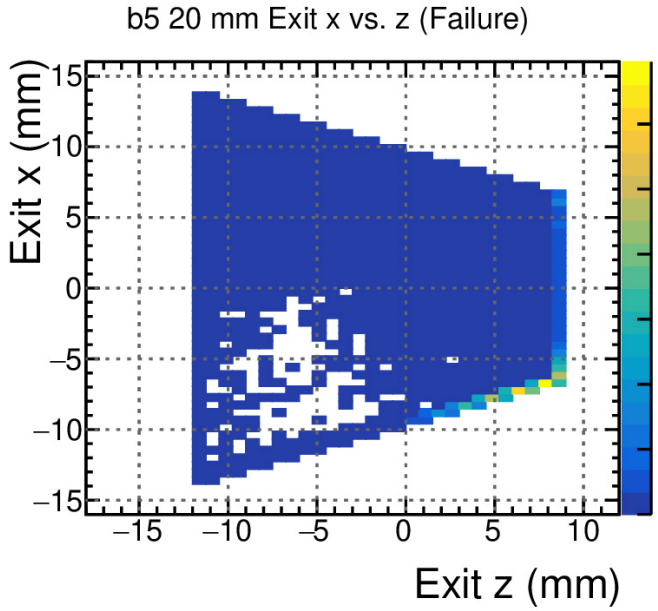


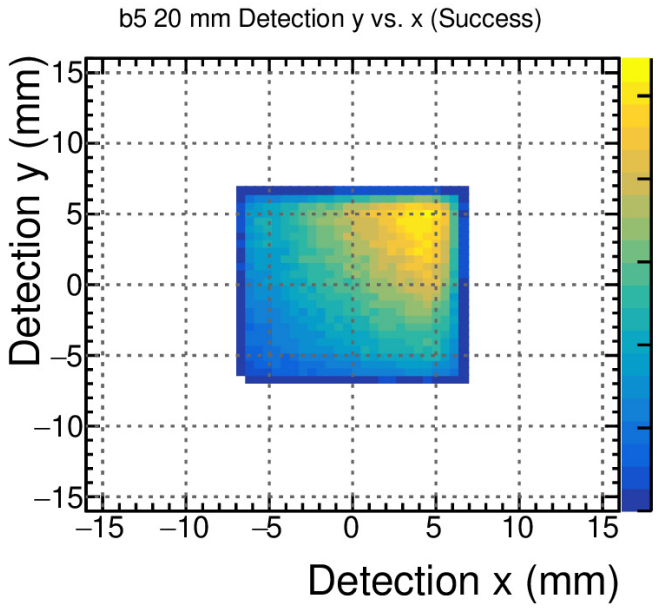


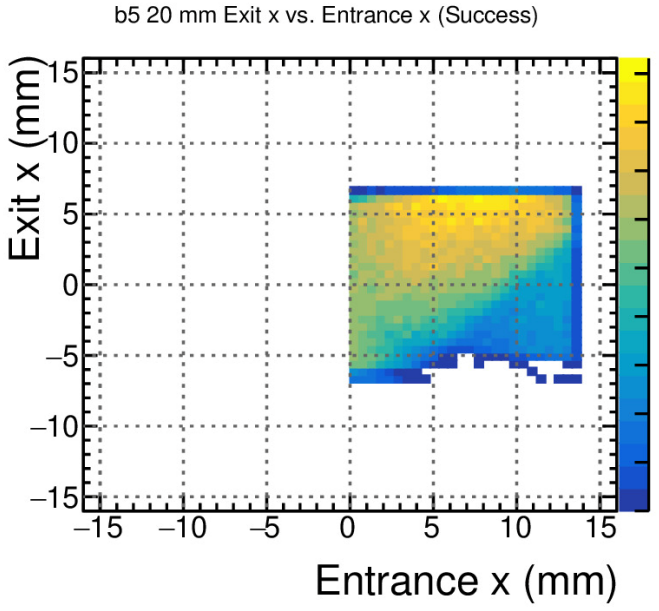
Light Mixing – BIC cookie (single-quadrant source)

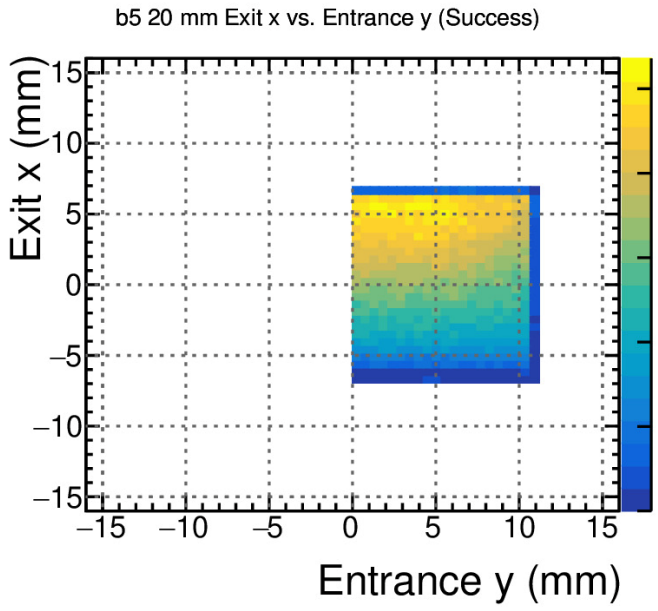




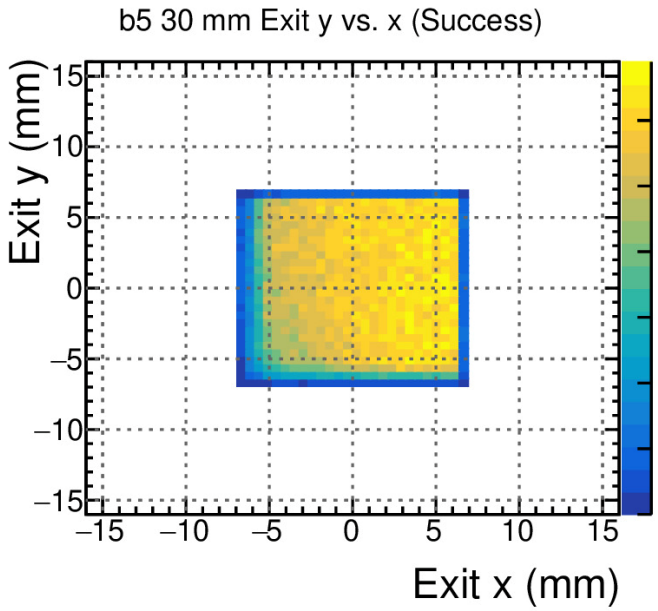


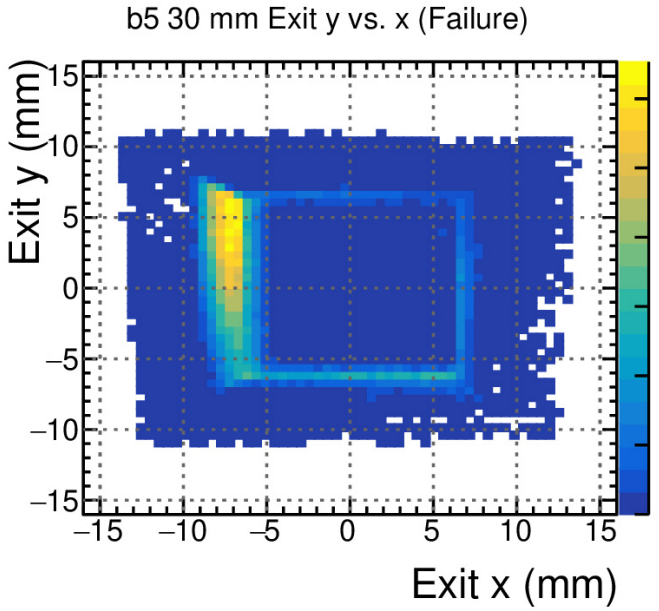


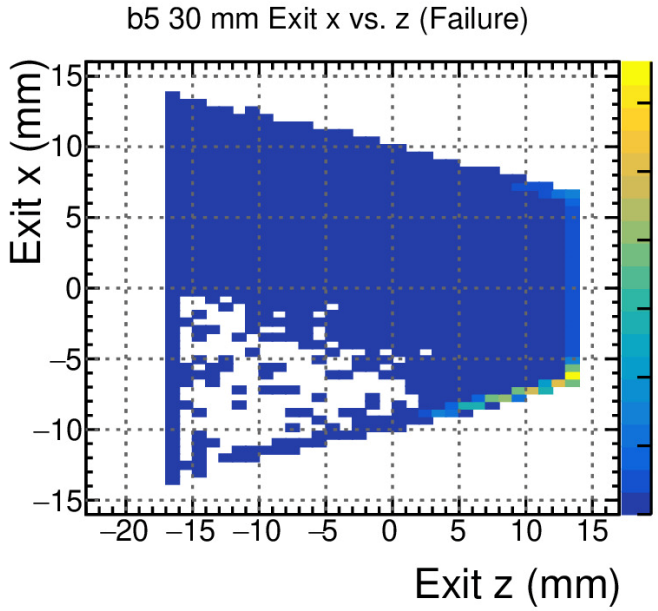


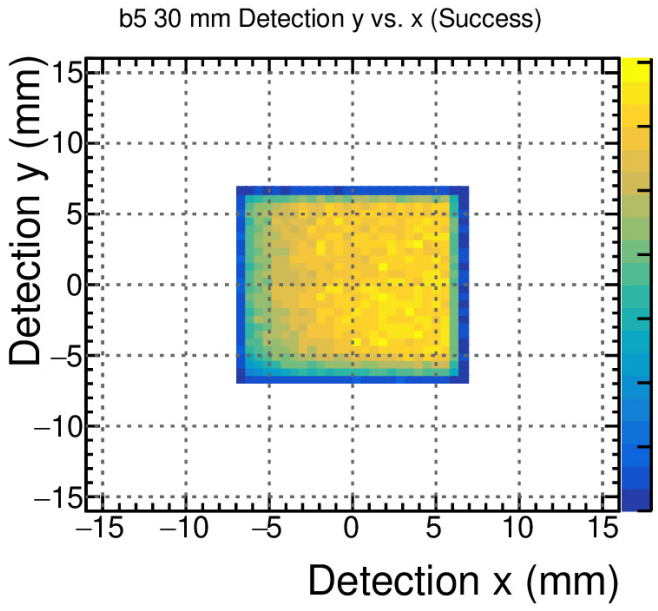


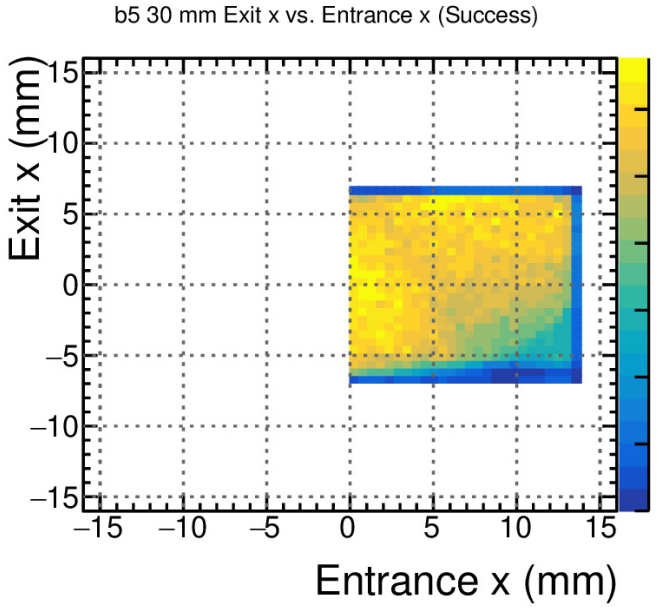
Light Mixing – BIC cookie (single-quadrant source)

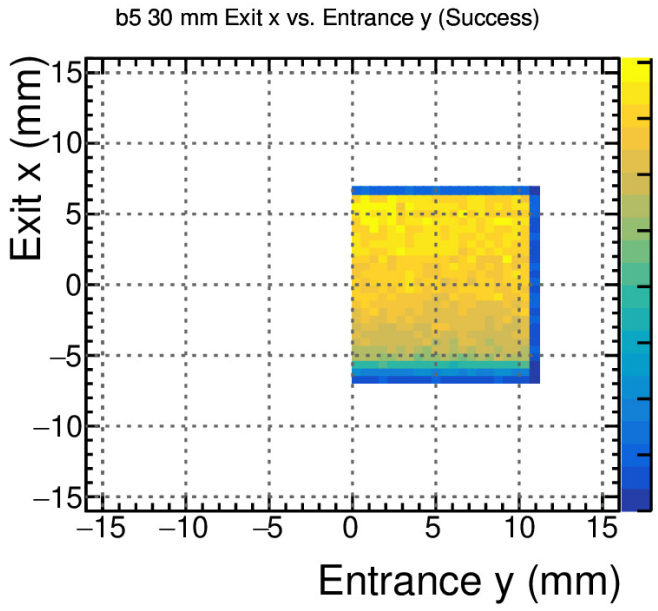




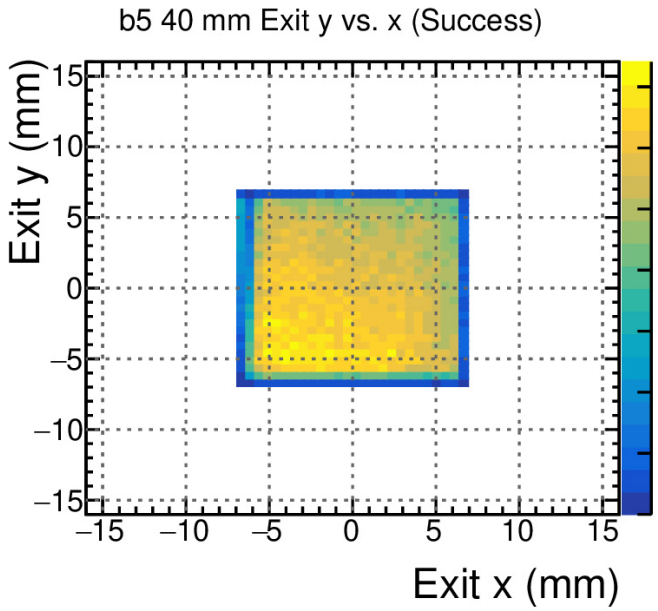


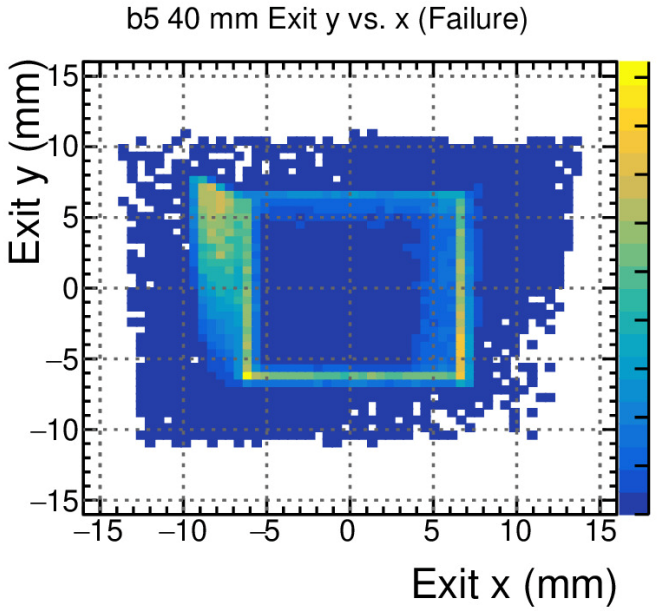


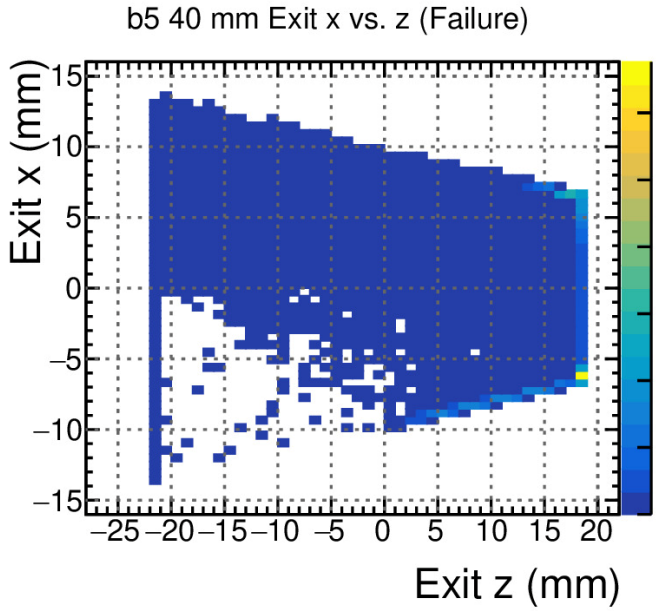


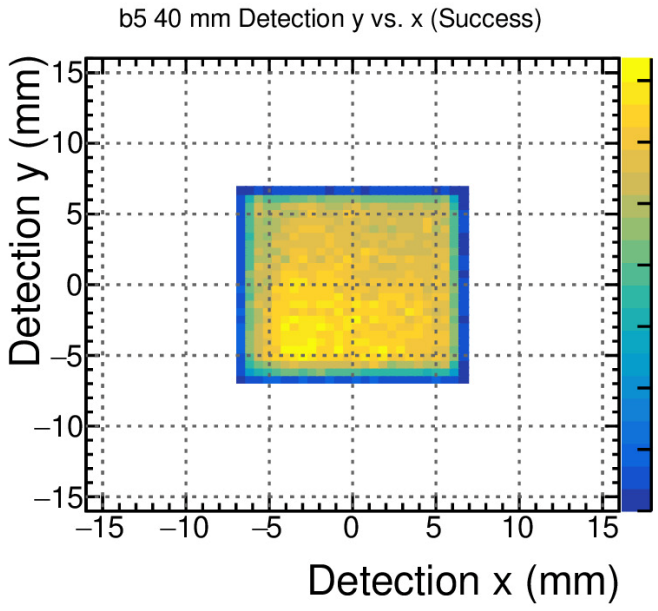


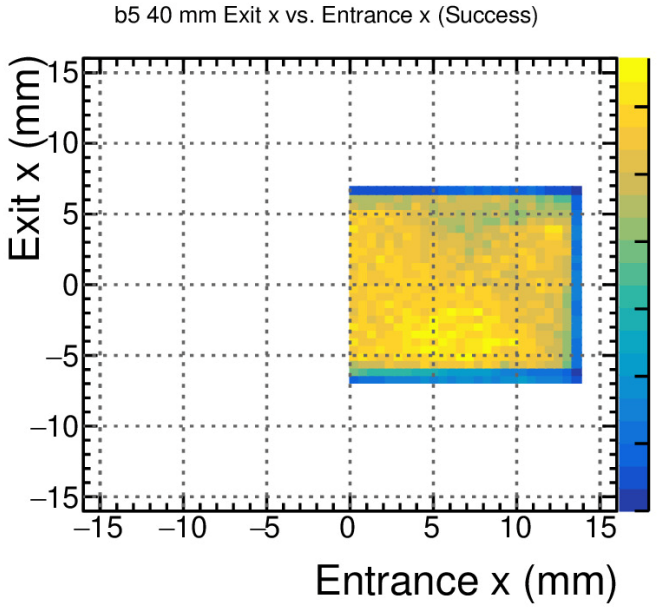
Light Mixing – BIC cookie (single-quadrant source)

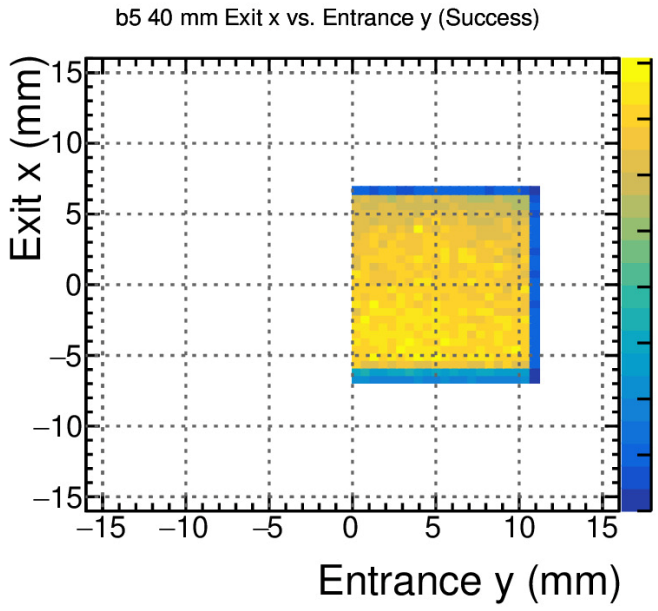




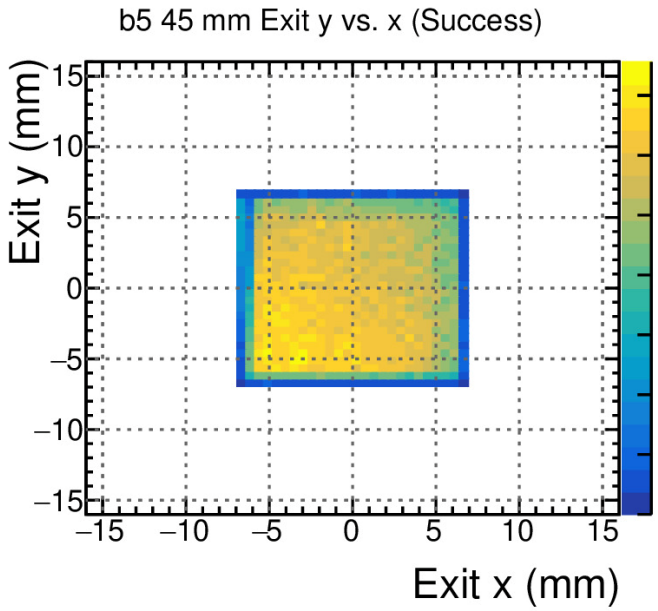


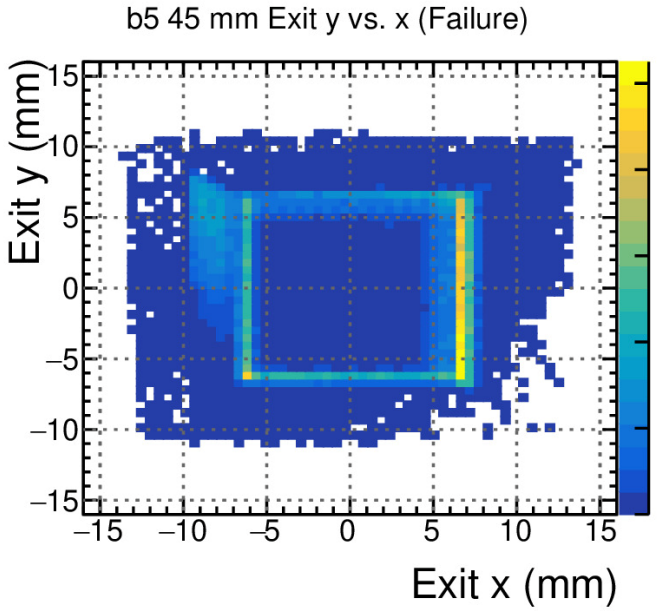


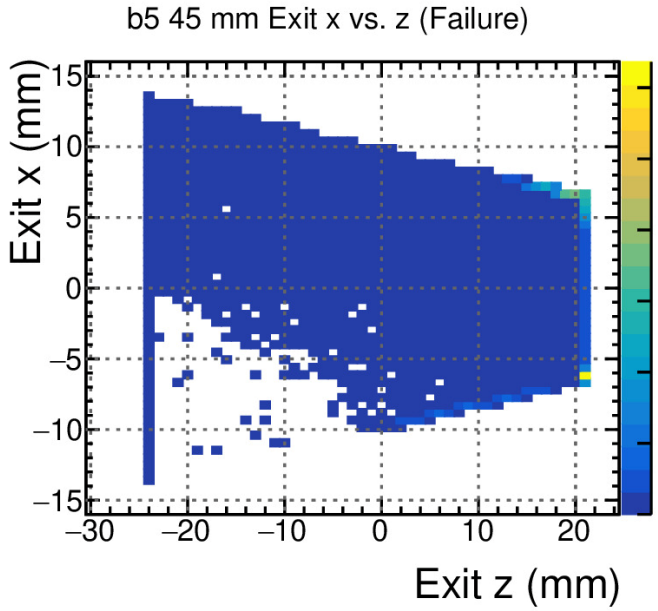


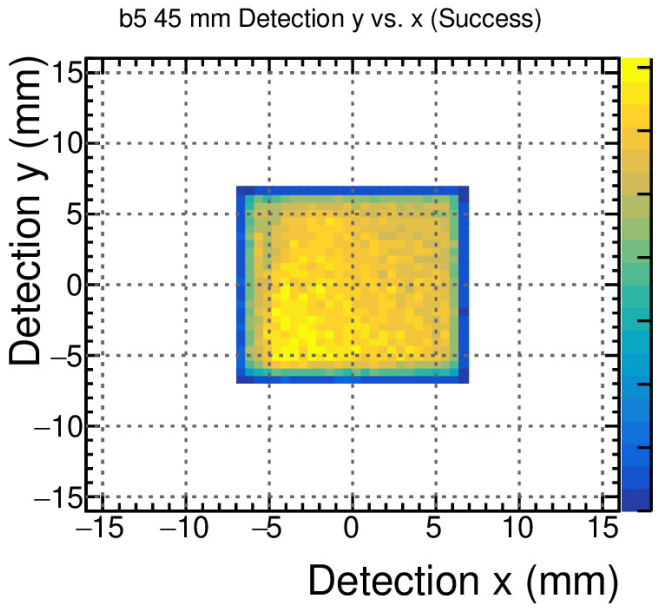


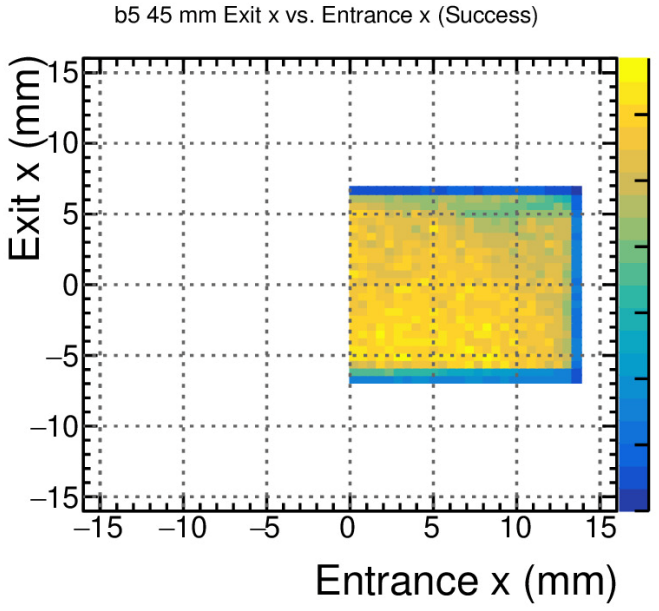
Light Mixing – BIC cookie (single-quadrant source)

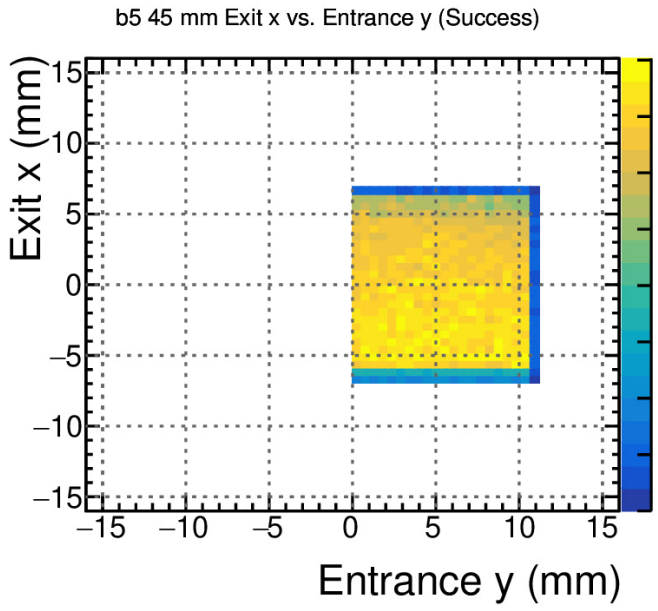




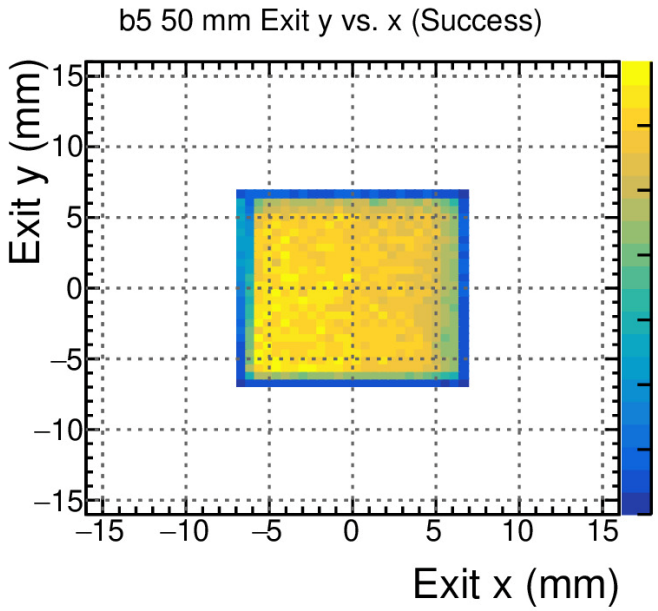


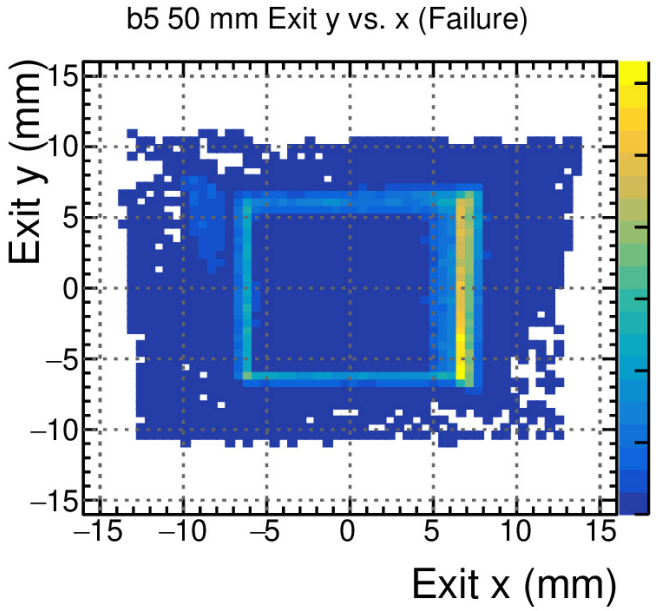


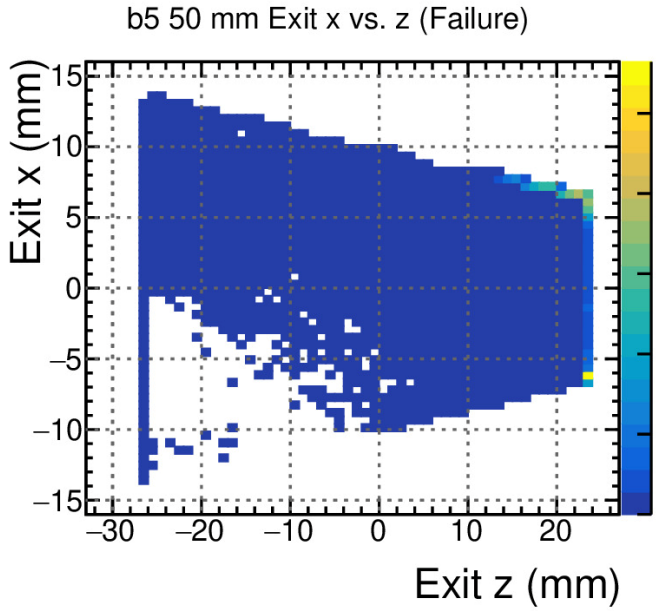


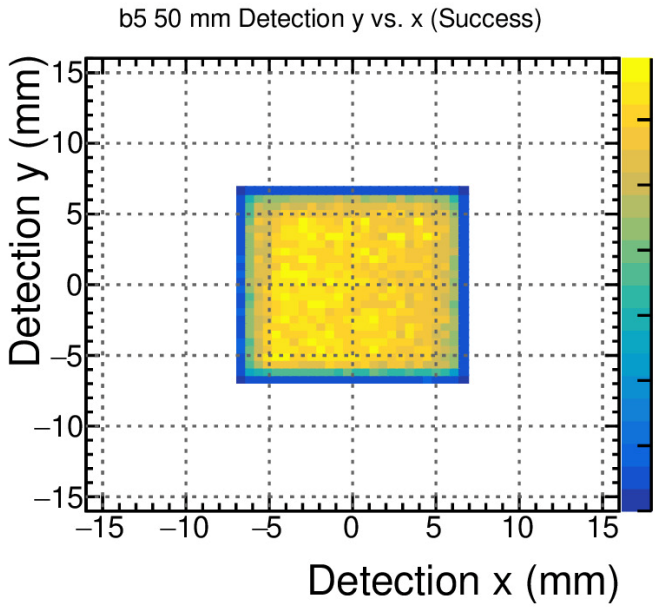


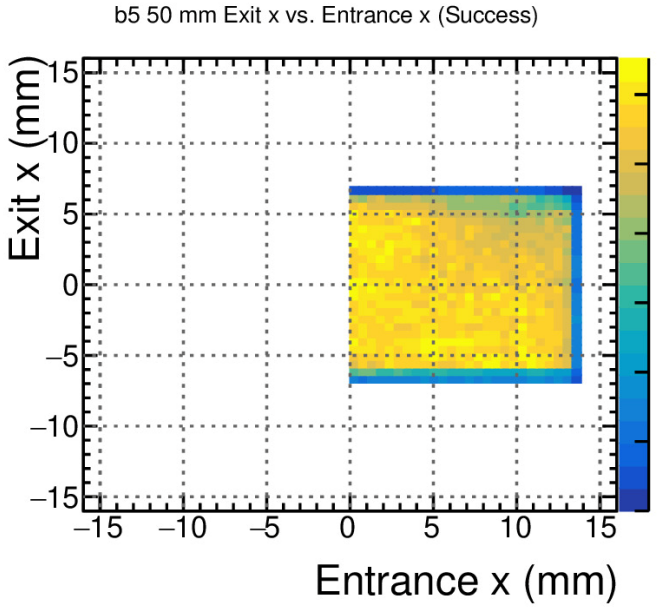
Light Mixing – BIC cookie (single-quadrant source)

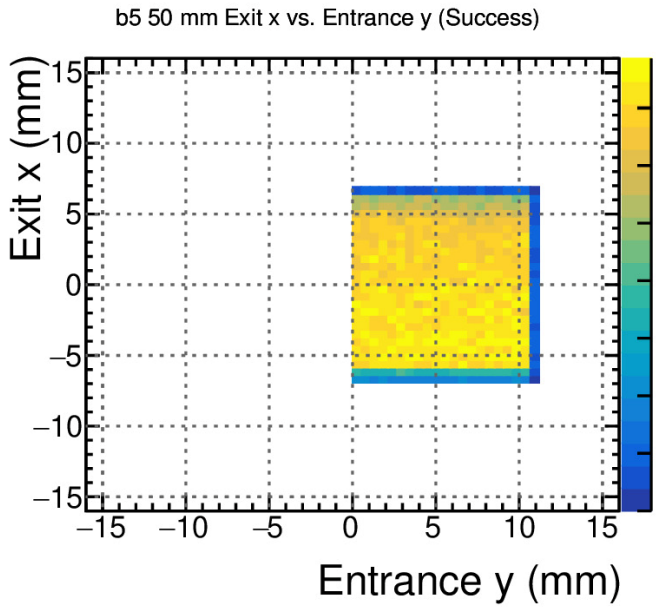




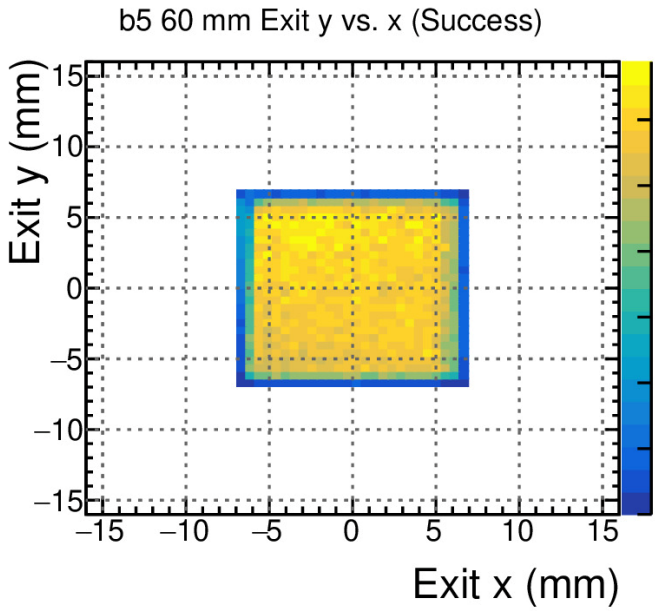


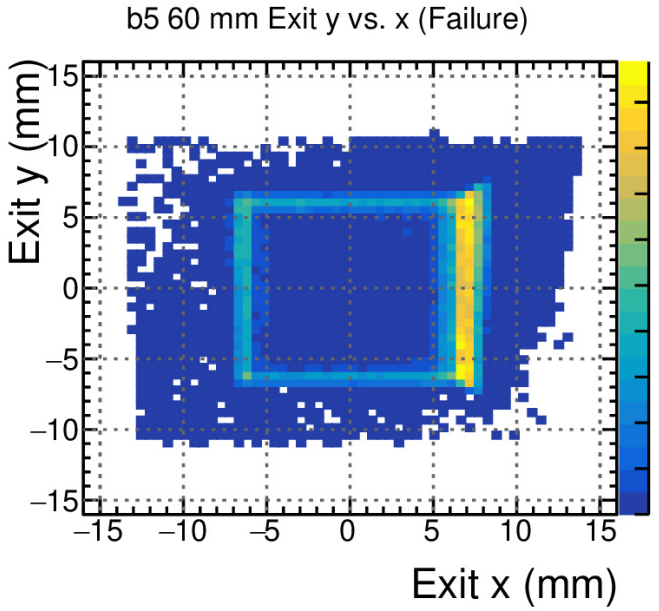


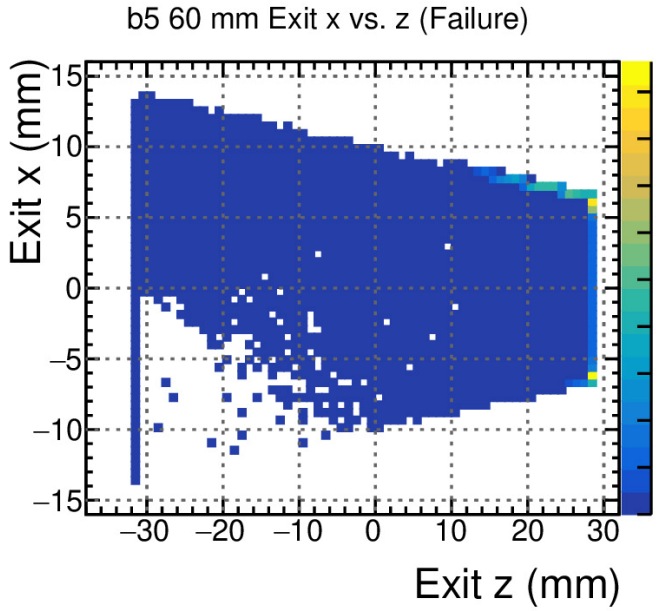


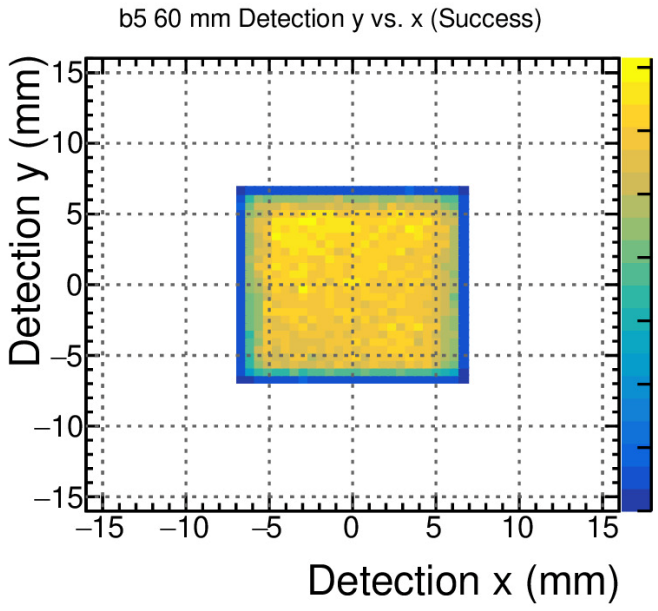


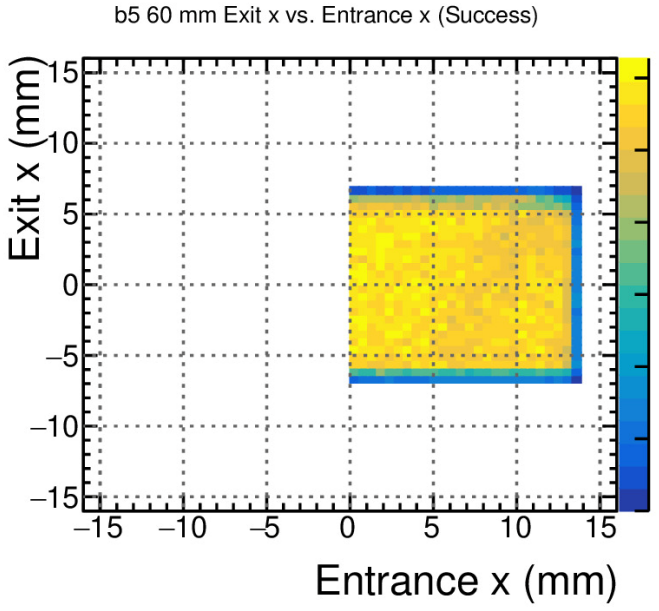
Light Mixing – BIC cookie (single-quadrant source)

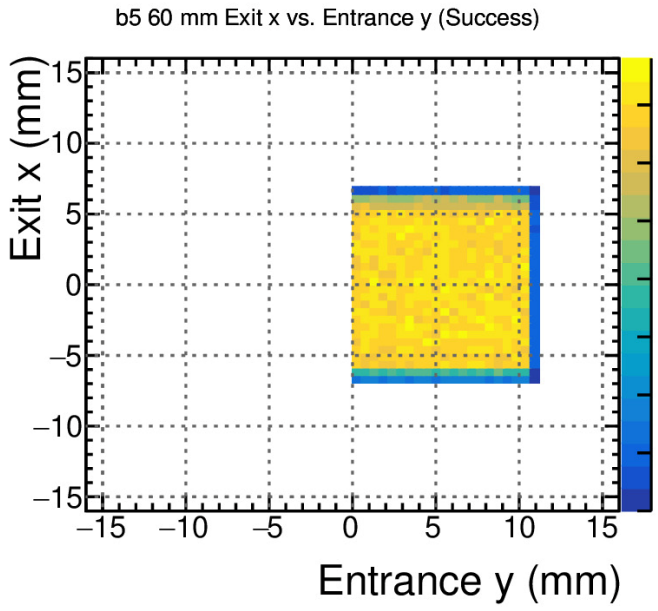




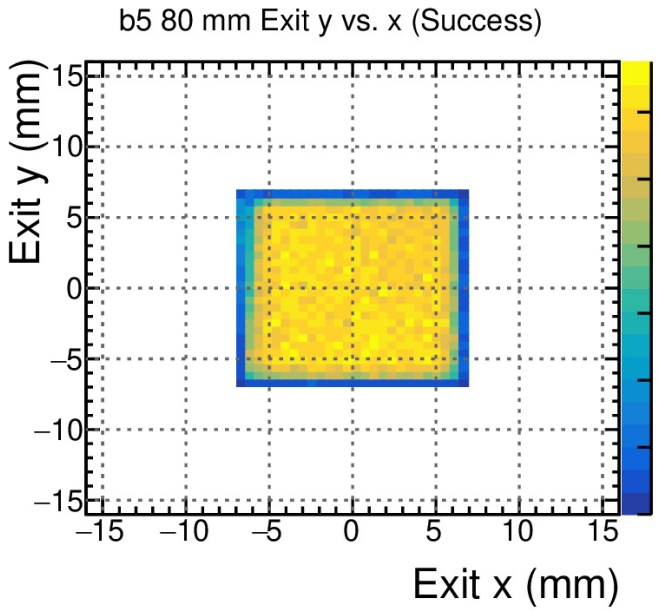


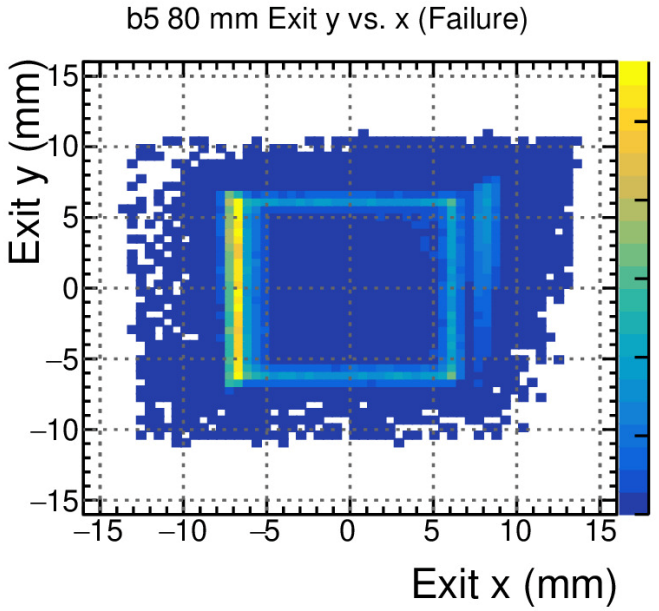


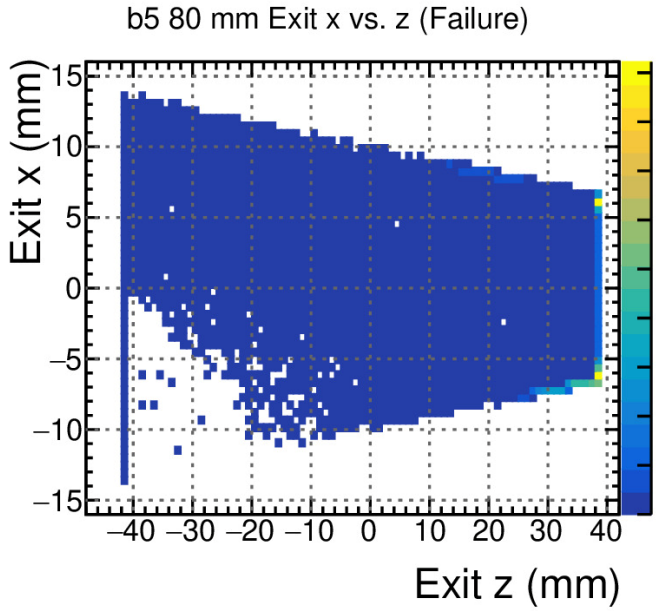


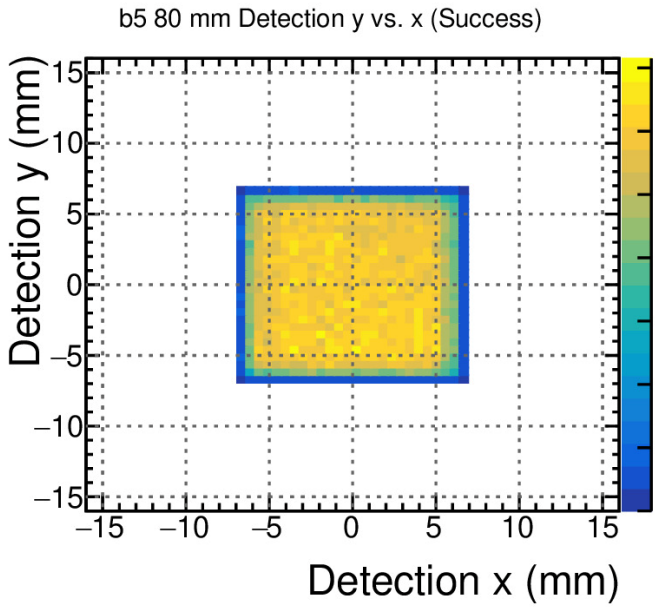


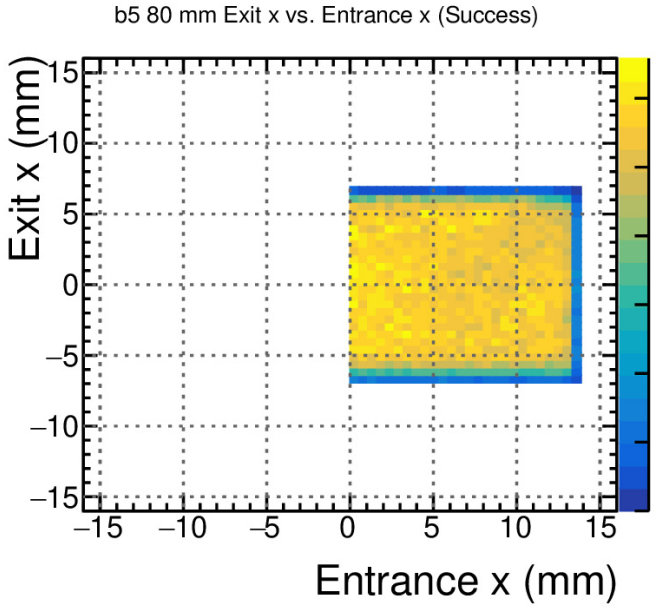
Light Mixing – BIC cookie (single-quadrant source)

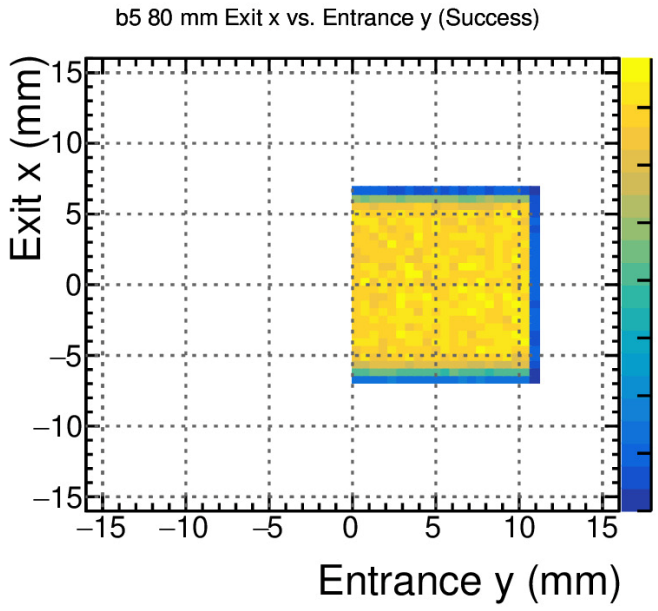




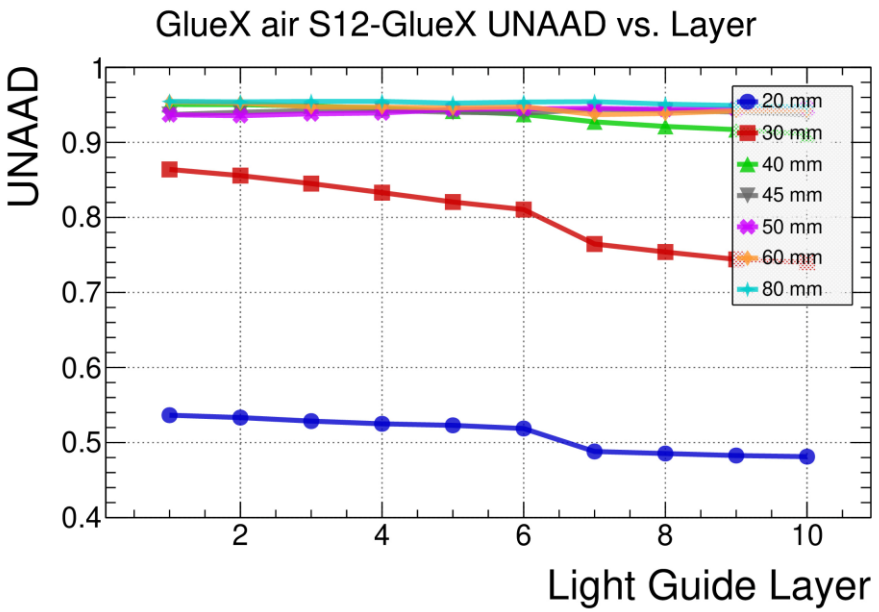


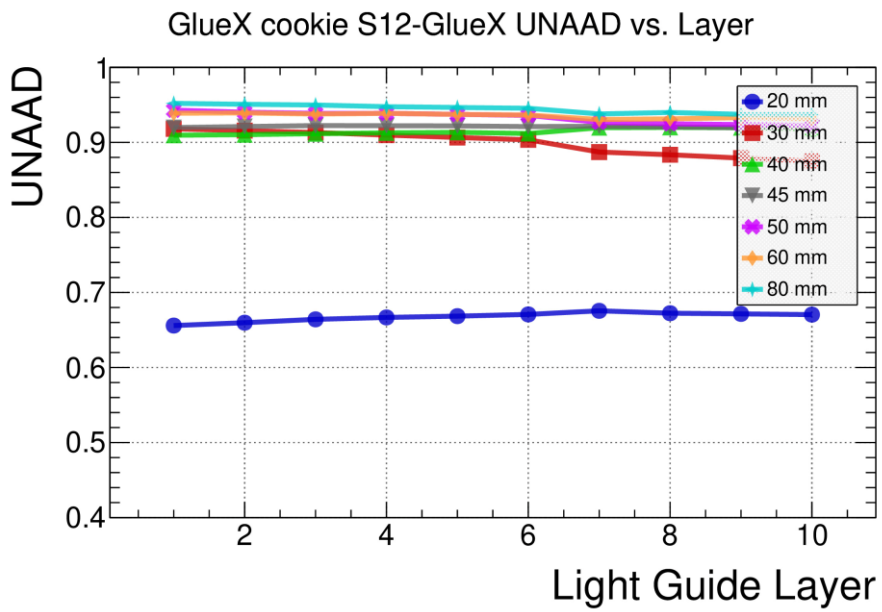


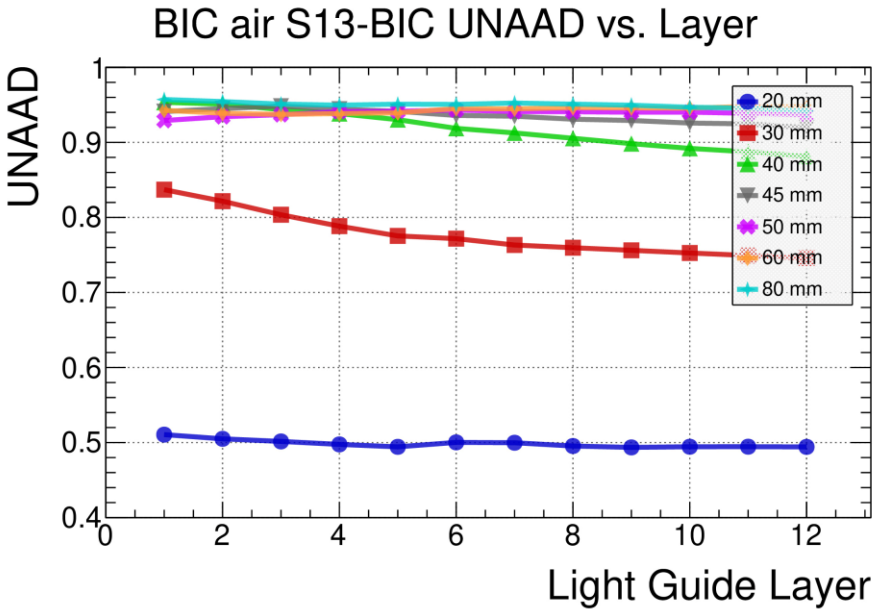


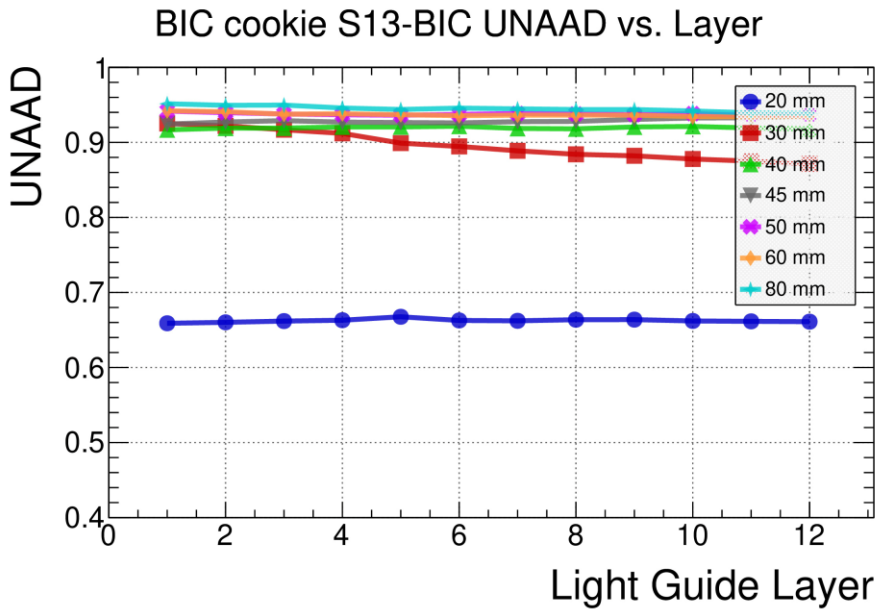


Light Mixing – UNAAD (single-quadrant source)

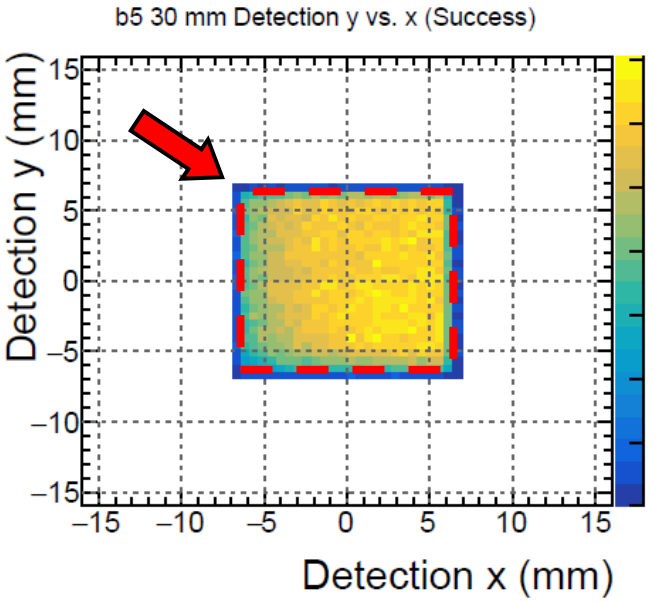








- Normalized Absolute Average Deviation
- Metric for flatness of inner SiPM pixels



$$1 - \frac{1}{N \cdot \overline{Y}} \sum_{i=1}^{N} |Y_i - \overline{Y}|$$

UNAAD - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3745492/

Conclusions

- ~30% more efficient with silicone cookie than with air gap
- Efficiency begins to drop off at 40 mm length for outer layers
- Spatial correlations between input and detected photons are strong below 40 mm length
- 45 – 50 mm appears reasonable for efficiency and light mixing so far
- Ongoing simulations looking at using 6x6 SiPMs and smaller light guides rather than the 13x13 arrays