

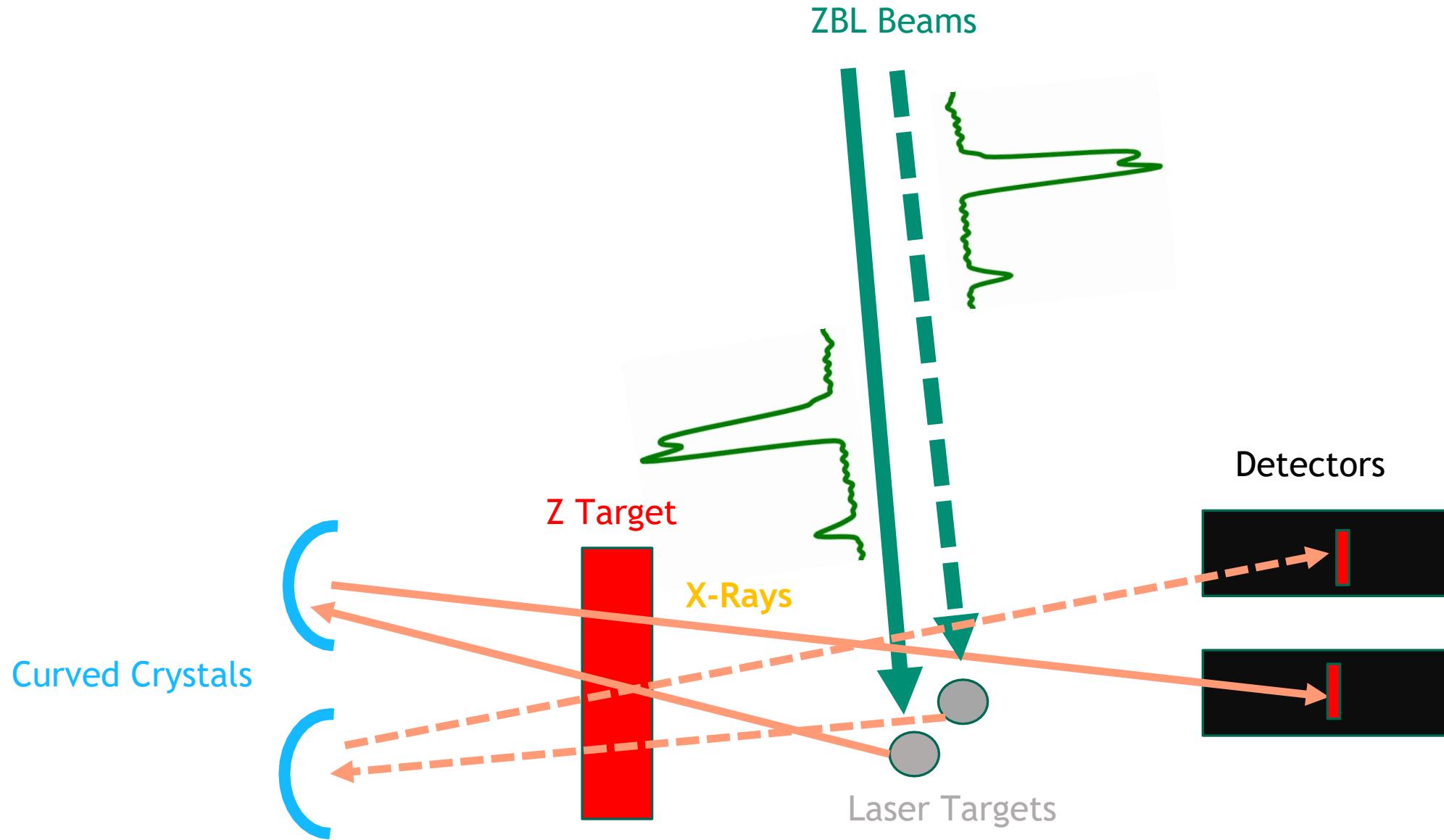


## Development of multiframe time-gated x-ray backlighting for the Z Facility.

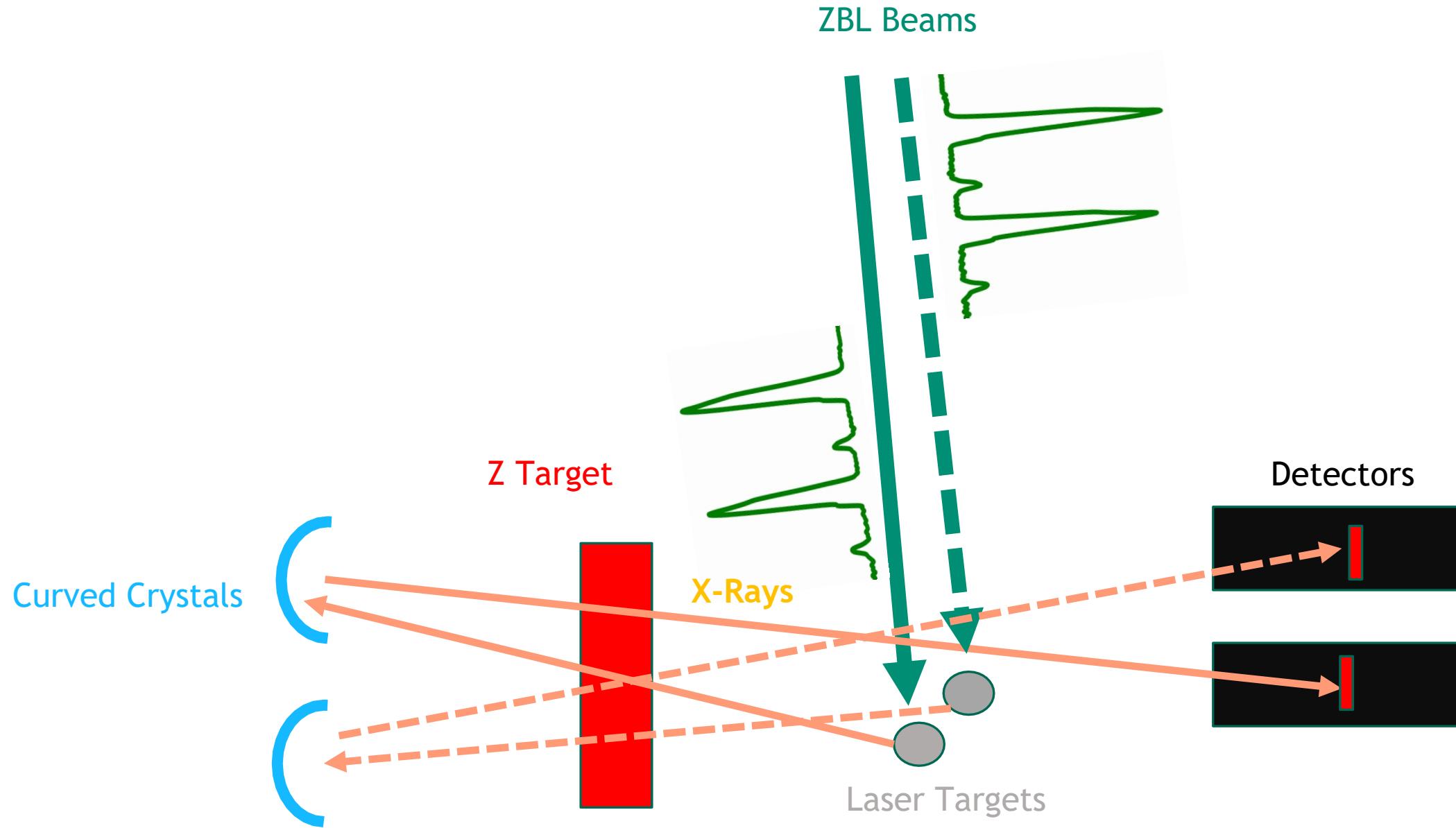
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Quinn Looker	Patrick Rambo	Robert Speas
Shane Speas	Mark Kimmel	

Currently bent crystal imaging on Z can provide 2 angularly separated radiograph frames.



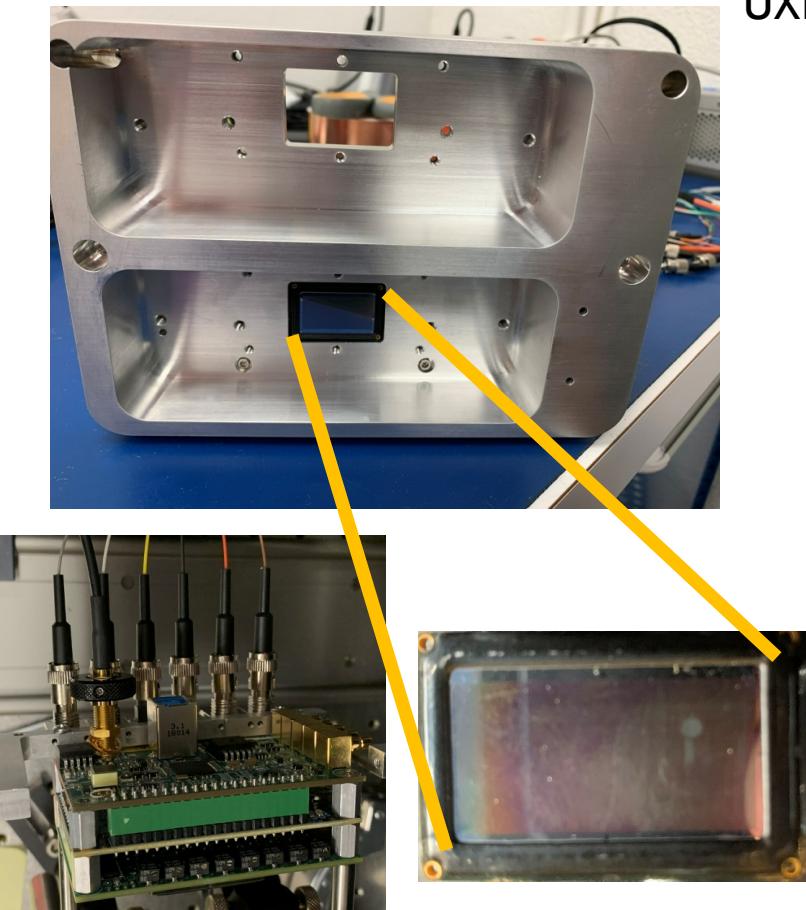
We envision having multiple laser pulses along each existing ZBL line of site.



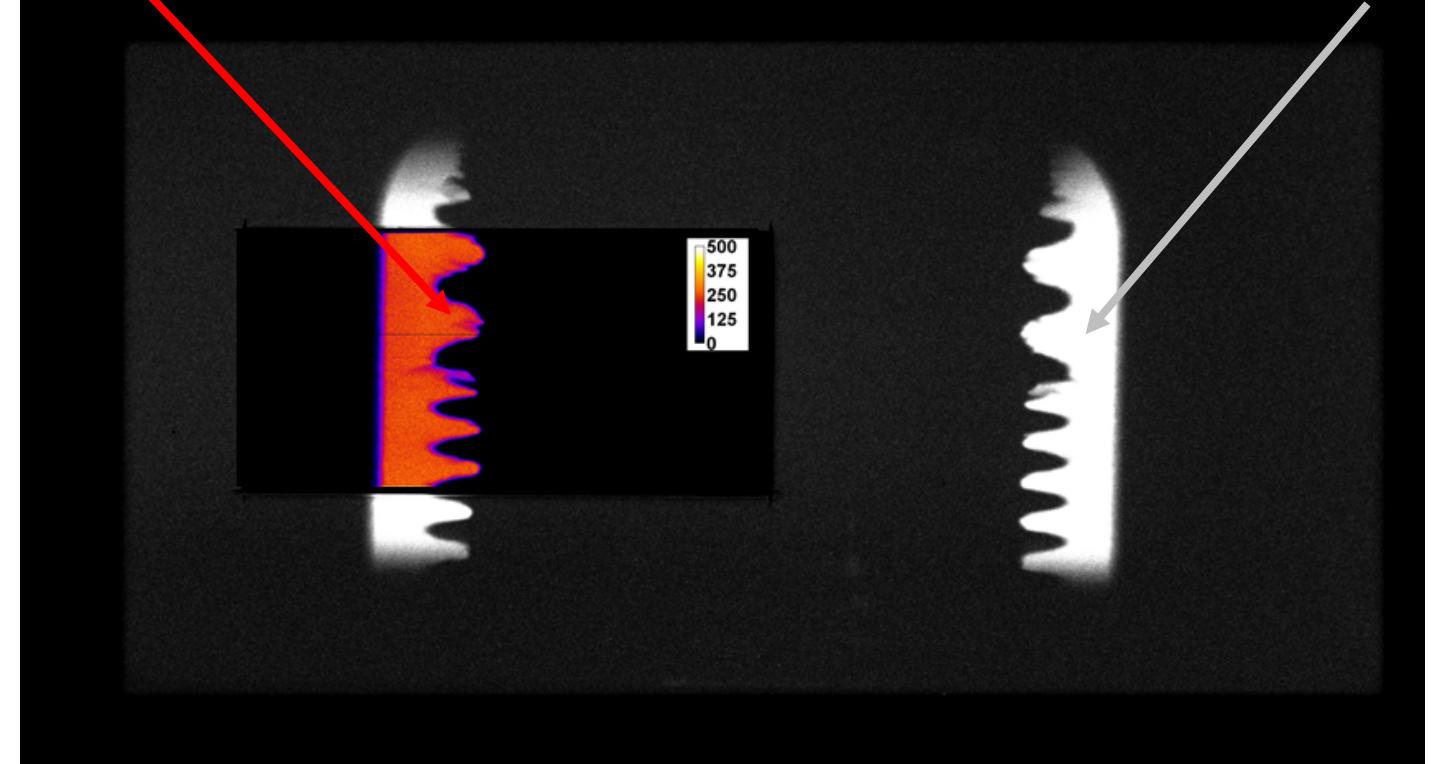
Gated radiography has been used many times on Z, but the full capabilities of the camera are not being used.



The UXI cameras are capable of recording 4 images in a burst. We are currently only recording a single image. Originally this was needed to combat EMI, but improvements in shielding and electronics have allowed us to more aggressively time inside the center of the machine. All that remains is x-ray source development.



UXI image

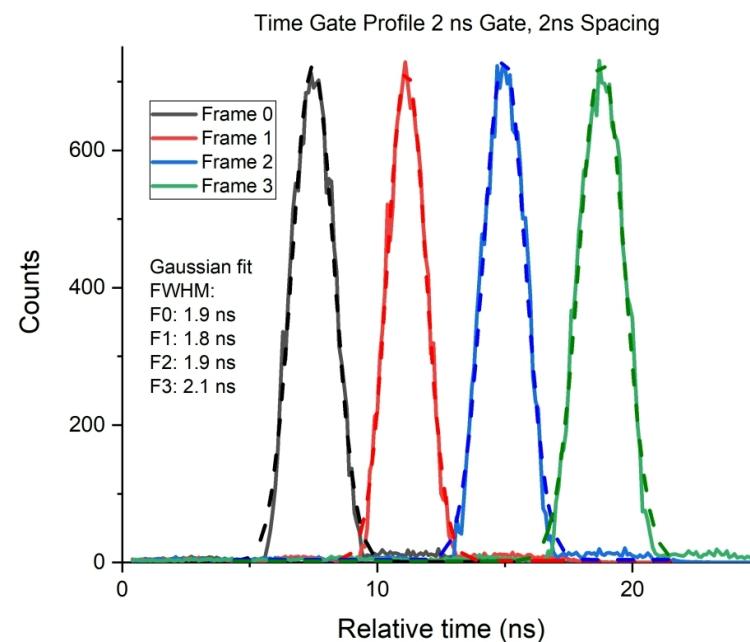


Combined UXI (color) and IP (greyscale) radiograph from Z3614

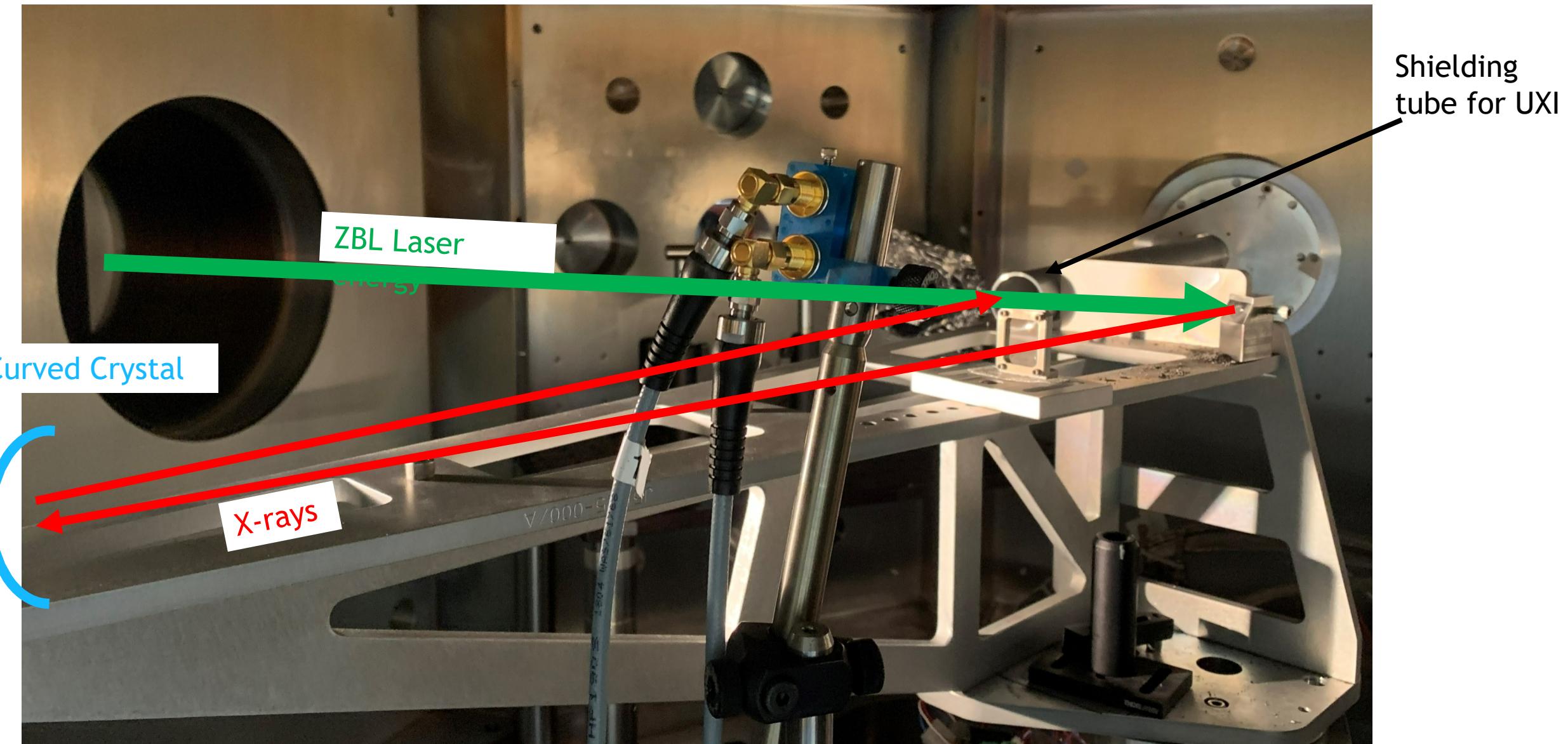
# Basics of the UXI based backlighter camera (Icarus sensor)



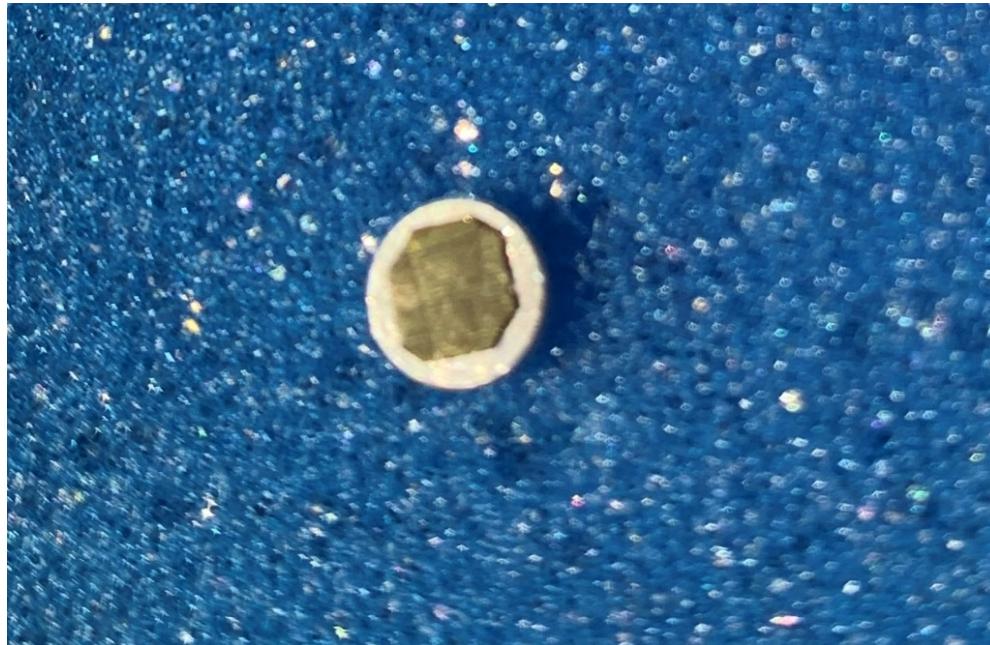
Frames	Frame length (ns)	Interframe time (ns)	Pixel array	Pixel Pitch	Diode Material
4 (8 ½ frames)	2 - 38	4 - 40 (1-37)	1024x512 (1024x256)	25 microns	Si



We have performed tests in Jemez looking at radiographs produced by multiple ZBL pulses striking a single target.



We are using solid Mn pucks to make sure there is enough material for 2 laser strikes.

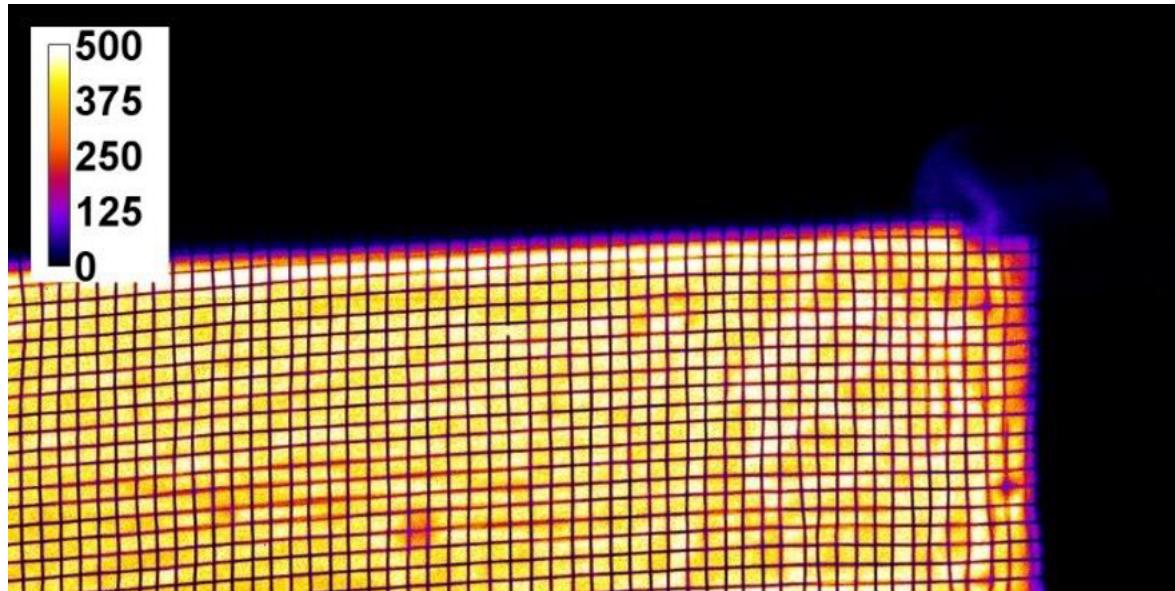


Z target (foil glued to Al disk)

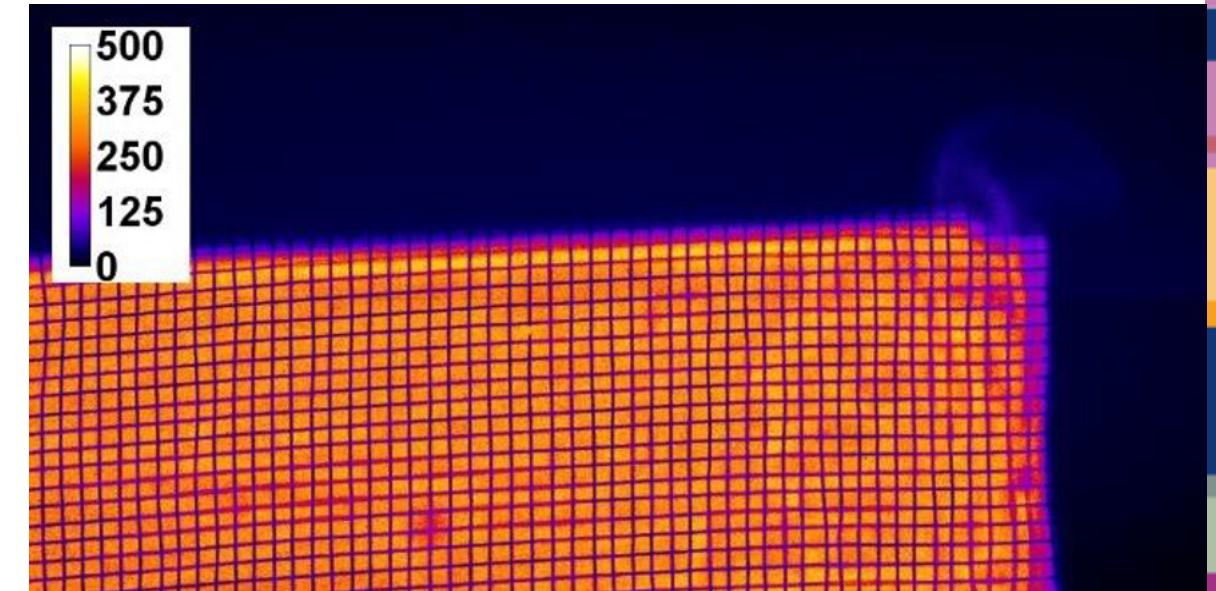


New target (solid puck)

Utilizing the UXI camera we can get 2 frames from ZBL laser strikes on a single target.

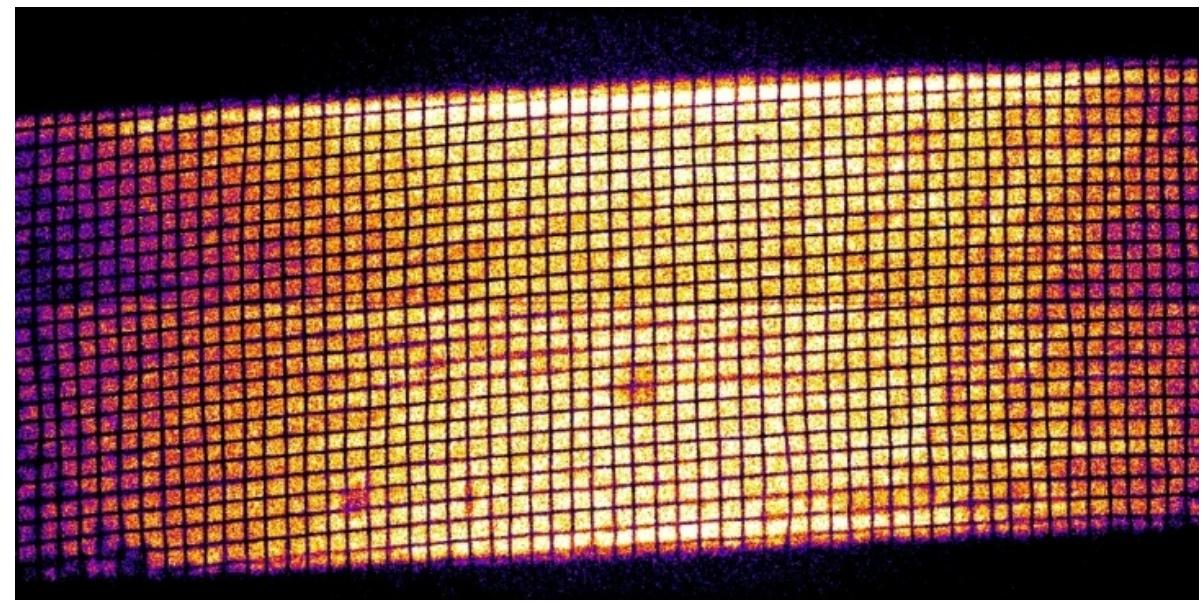
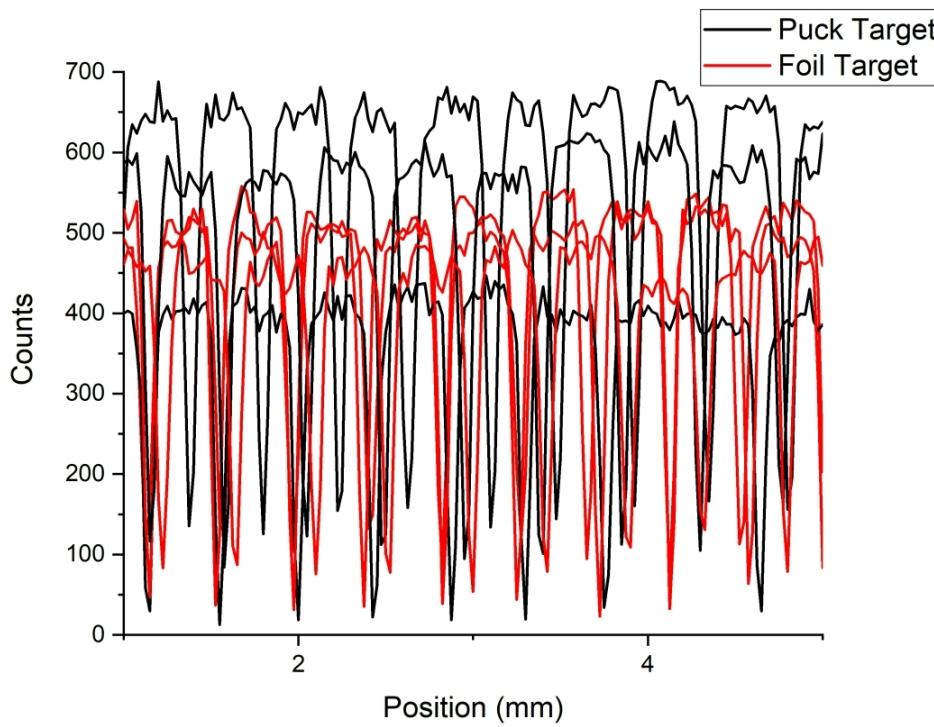


1<sup>st</sup> Frame

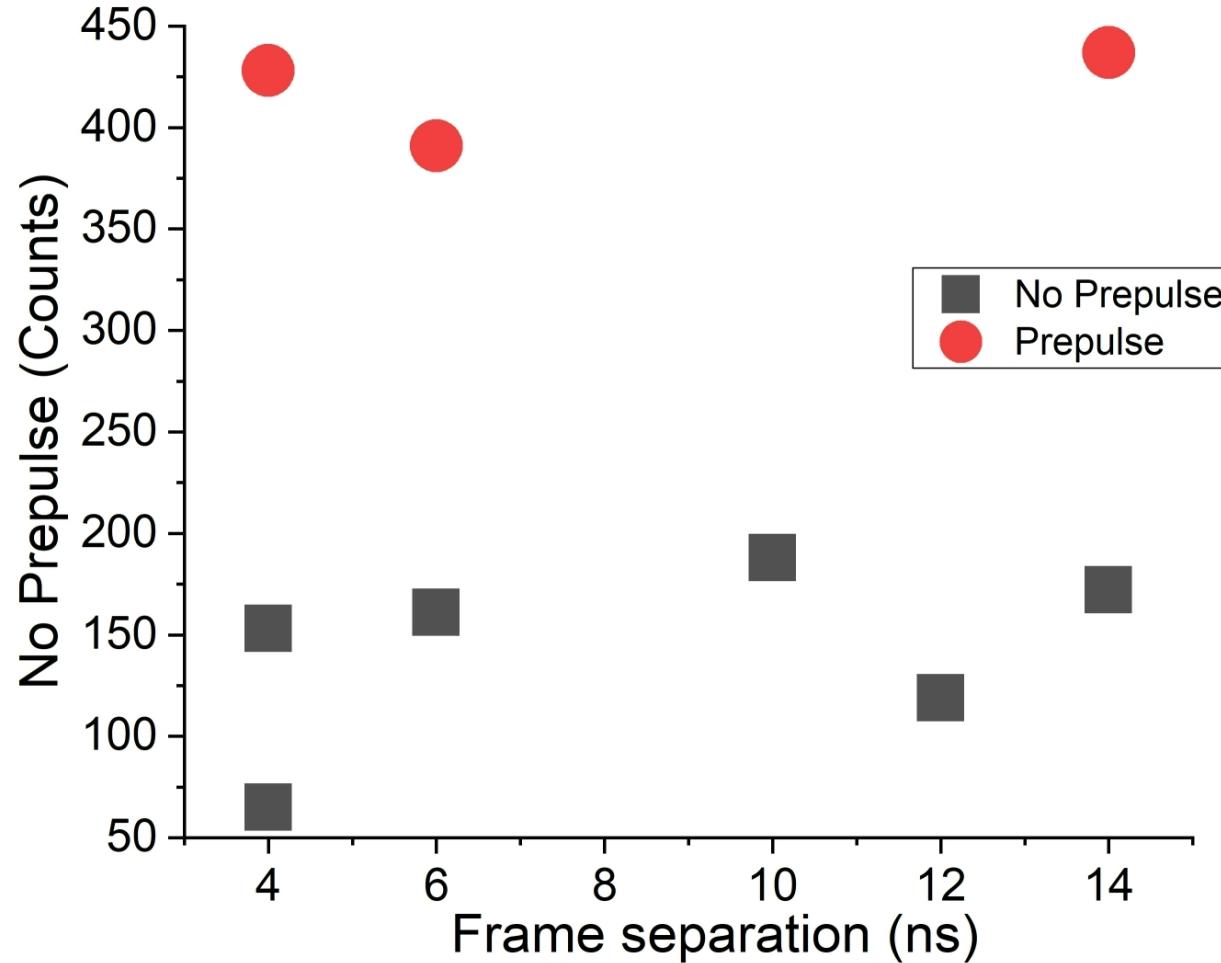


2<sup>nd</sup> Frame

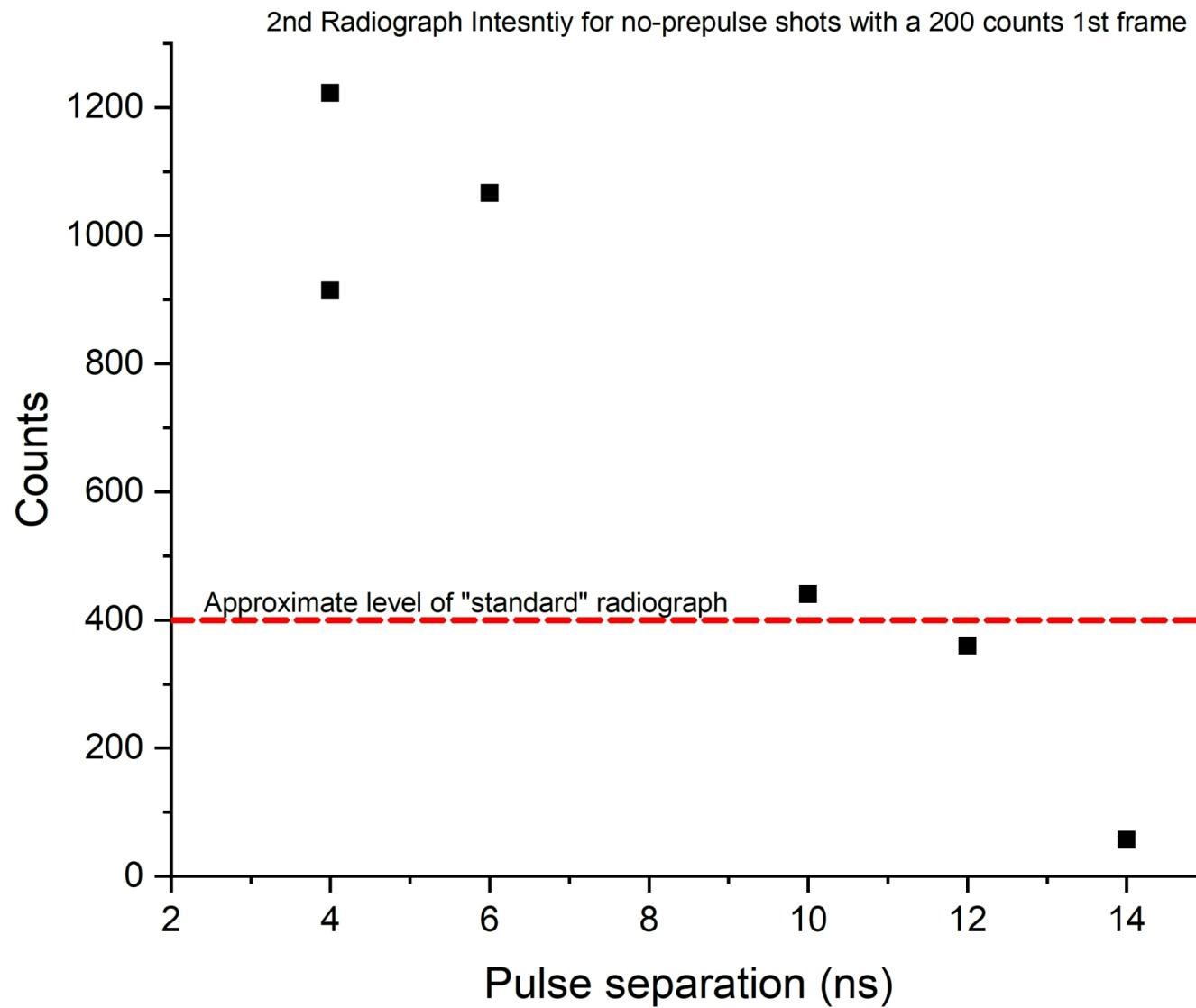
We have performed tests in Jemez comparing puck and foil targets.



The 1<sup>st</sup> frame intensity groups around 200 or 400 counts depending on the presence of a prepulse.

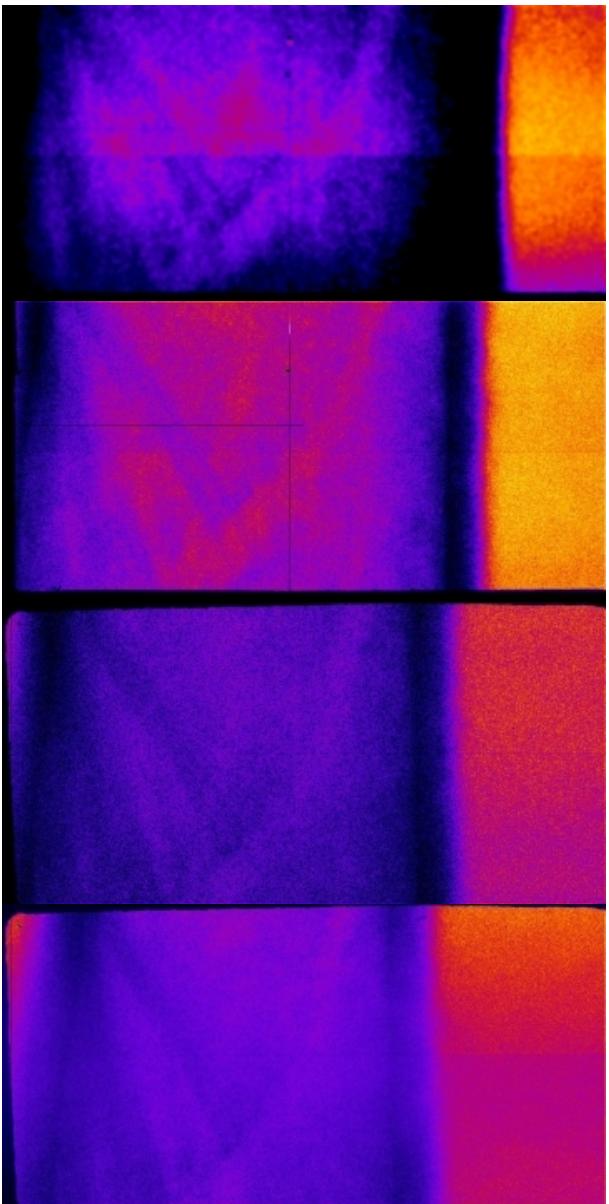


The effect of using a full ZBL pulse as a pre-pulse peaks at early times and then trails off.



Z 3707 provided a proof of principle for multi-frame radiography.

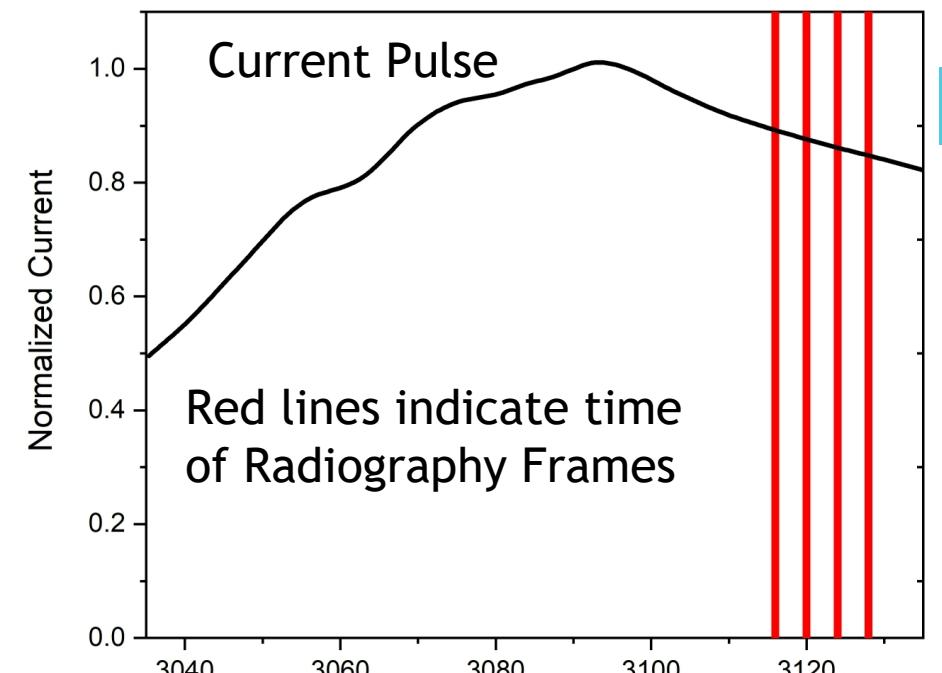
Frame 1  
(t=3116)



Frame 2  
(t=3120)

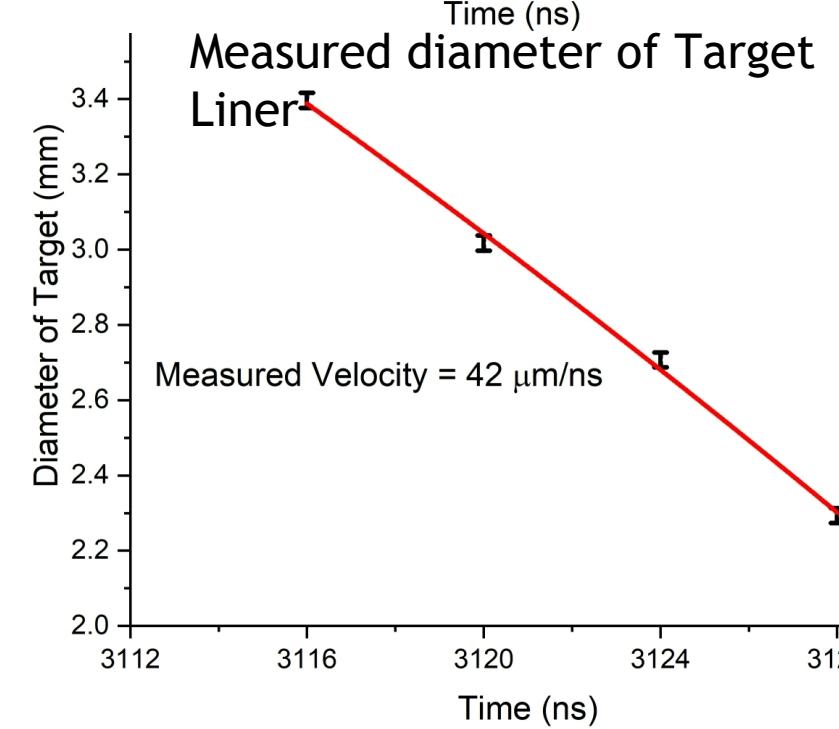
Frame 3  
(t=3124)

Frame 4  
(t=3128)



Current Pulse

Red lines indicate time  
of Radiography Frames



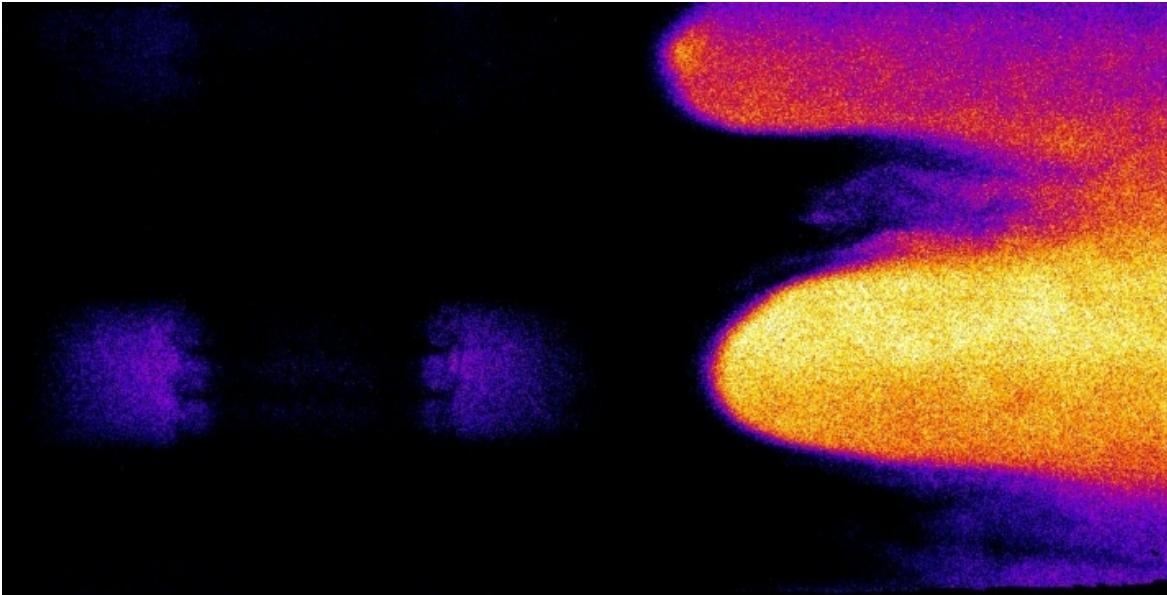
Measured diameter of Target  
Liner

Measured Velocity = 42  $\mu$ m/ns

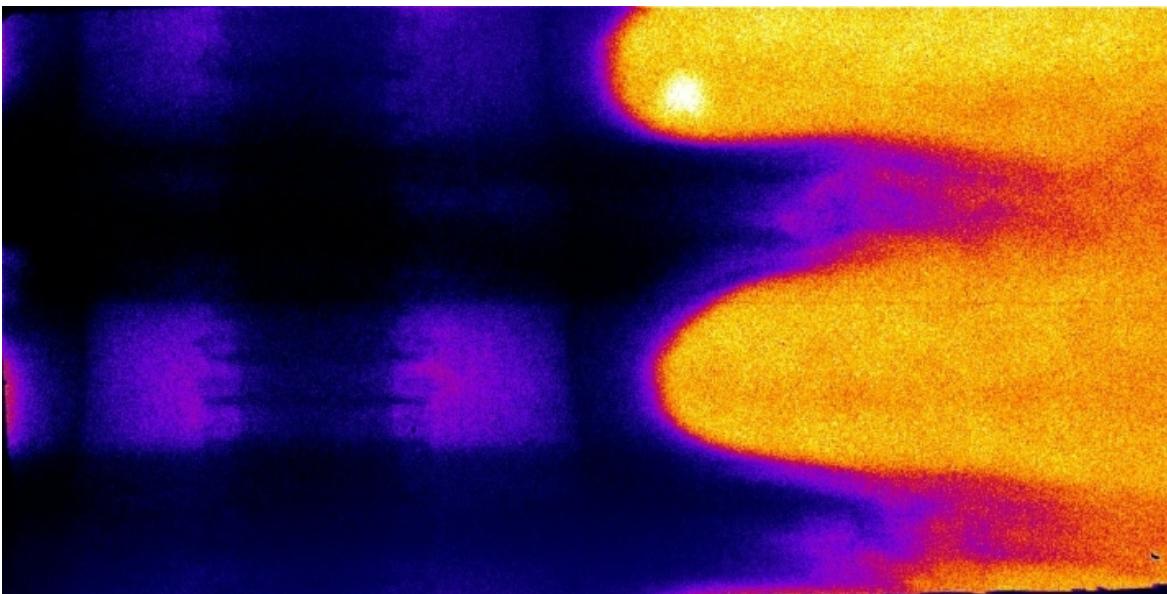
We acquired 2 frames of radiography on a single camera on another shot.



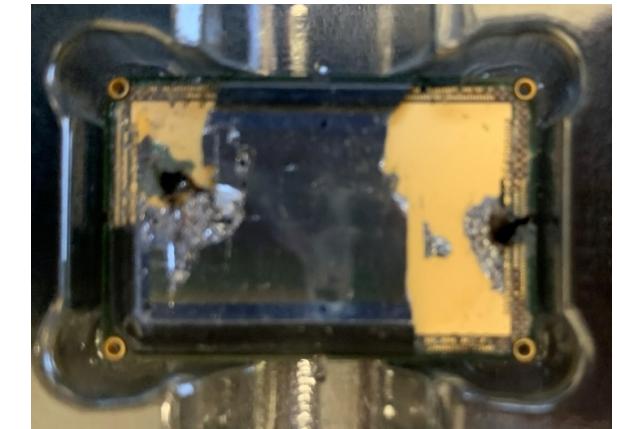
Frame 1  
(t=3192)



Frame 2  
(t=3196)



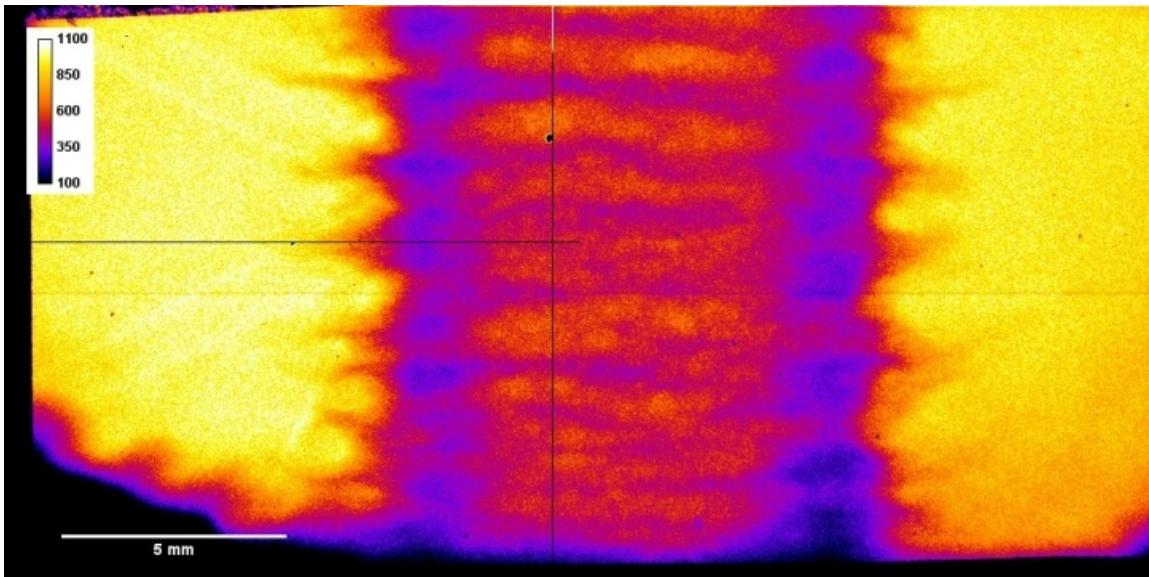
Unfortunately, the other camera took 2 debris bullets



The brightness of the Z3707 radiograph was ~7x-30x dimmer than that of a standard gated radiograph (Z3585), showing we need more development.

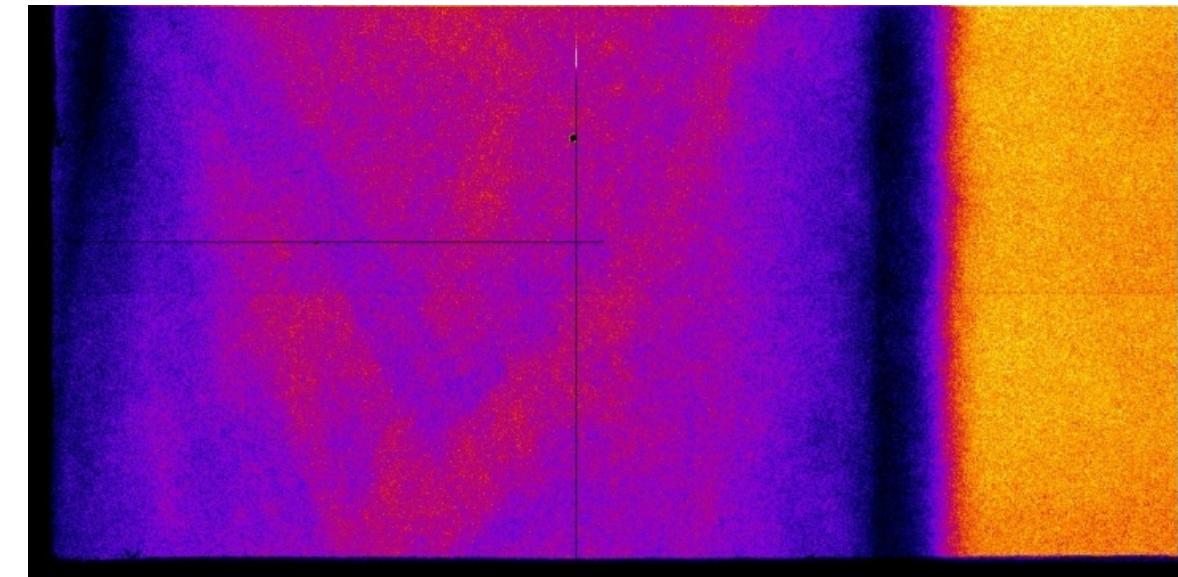


Based on laser-only testing we would have expected the multi-frame radiographs to be **0.5x-2x** the brightness of the standard radiograph, instead they were significantly dimmer, barely registering on the detector and not meeting scientific quality thresholds.



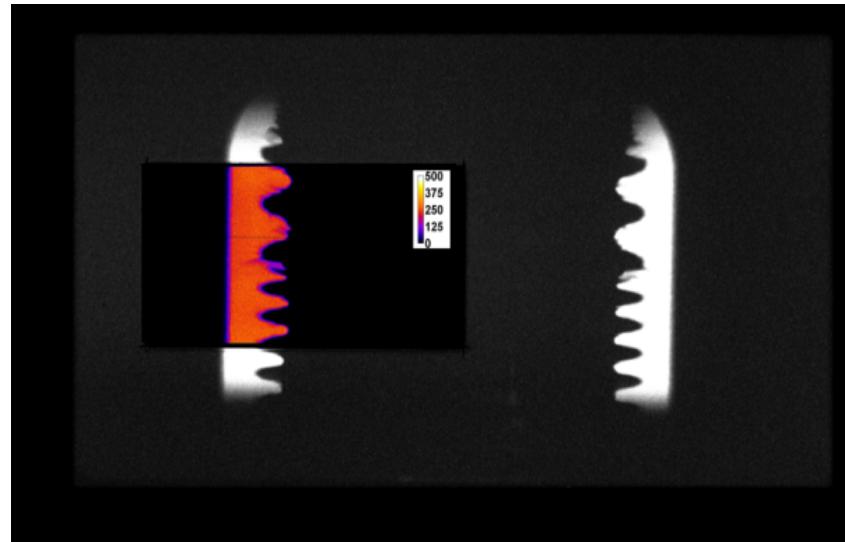
Z3585:

- 980 Counts mean in 100% transmission area



Z3707 2<sup>nd</sup> frame:

- 131 Counts mean in 100% transmission area
- Other frames lower (lowest 32 counts)



ZBL Beams

