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Title: Multi-Probe 23A: Post shot Data and Analysis

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Multi-Probe 23A: Post shot Data and Analysis

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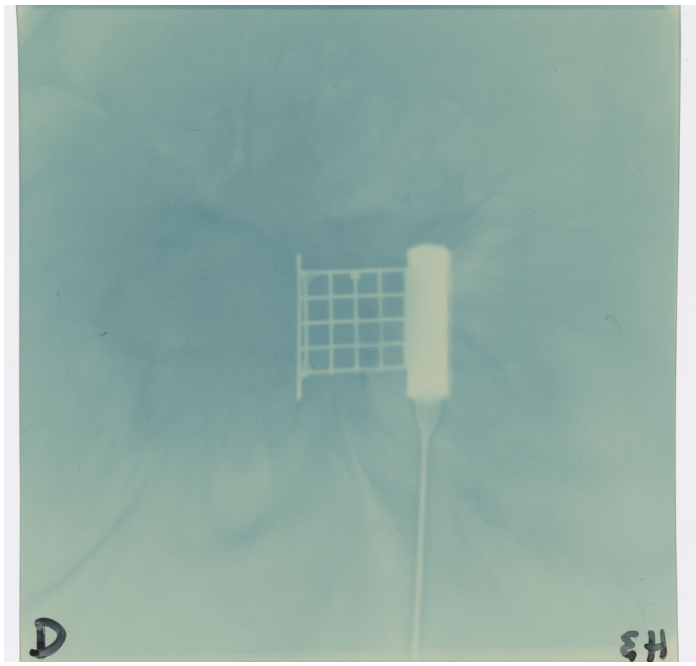

Abstract

The Multi-Probe 23A experiments took place on the Omega EP laser in December 2022. The experiments consisted of shots alternating between Omega EP's two short-pulse laser beams to generate proton and deuteron beams from a variety of film and foam targets. The backlighter was used in the *pitcher series*, in which deuteron beams were generated to develop a pitcher for a pitcher-catcher neutron radiographic source. The sidelighter was used in the *shielding series*, in which proton beams was generated, and a metal shield, XBLK, was used to mitigate crosstalk between the proton target and image plates located perpendicularly to the proton beam axis. For the pitcher series, we found that we were able to generate a deuteron beam with CD film, but not CD foam, targets. For the shielding series, we found that 6 mm Al vastly outperformed similar thicknesses of Cu and Ta at mitigating the crosstalk, suggesting that electrons, rather than x-rays, are the primary source of crosstalk.

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Goals

The experiment had three primary and three secondary goals.

The primary goals of the experiment were to:

1. Characterize deuteron beam for pitcher concepts used in neutron generation **(Pitcher series)**
2. Mitigate crosstalk on x-ray image plates generated from the proton source using XBLK **(Shielding series)**
3. Measure x-ray energy and angular distribution for various target configurations **(Both series)**

The secondary goals of the experiment were to:

1. Characterize proton beam from Kapton film as radiographic source **(Shielding series)**
2. Determine difference between 500 and 600 nm Kapton targets, if any **(Shielding series)**
3. Interrogate pre-pulse plasma using 4w probe **(Pitcher series)**

Results

Results for the three primary goals of the experiment:

1. Deuteron beams were measured for the CD film target, but only protons were observed for the CD foam targets. Further analysis is needed to determine why deuterons were not observed for the CD foam targets **(Pitcher series)**
2. Al shields outperformed Ta and Cu shields for mitigating the crosstalk. This suggests that the crosstalk is dominated by electrons, not x-rays **(Shielding series)**
3. X-ray spectra were obtained with BMXS-55, the other IP diagnostics on NTA 11/13 were often saturated **(Both series)**

Results for the three secondary goals of the experiment:

1. Radiographs were obtained using Kapton and CD films. Analysis will be performed to determine the quality of the radiographs **(Shielding series)**
2. Initial analysis indicates the 500 nm Kapton targets yielded more consistent radiographs than the 600 nm Kapton targets (500 + 100 nm pieces of tape) **(Shielding series)**
3. Initial analysis suggests that the 4w probe did not yield any useful data, likely due to the small size of the pre-plasma **(Pitcher series)**

Summary of shot day

Shot List

General shot information

Shot number	Beam	Shot RID	Time	Laser Energy (J)
1	BL	38058	10:23	236
2	SL	38059	11:13	132.7
3	BL	38060	11.53	238.5
4	SL	38061	13:02	136.7

5	BL	38062	13:35	467.9
6	SL	38063	14:47	278
7	BL	38064	15:50	472
8	SL	38065	16:55	274.7
9	BL	38066	17:37	472.5
10	SL	38067	19:05	281.6
11	BL	38068	19:49	478.9
12	SL	38069	20:40	279.3

Laser Parameters

Shot number	**Beam**	**Laser Energy (J)**	**Laser Spot Size (R_{80}, μm)**	**Pulse Length (ps)**	**Intensity (W/cm^2)**	**A_0**
1	BL	236	18.3	0.7	2.56361E+19	4.6
2	SL	132.7	18.1	0.7	1.47352E+19	3.5
3	BL	238.5	15.8	0.7	3.47549E+19	5.3
4	SL	136.7	18.1	0.7	1.51794E+19	3.5
5	BL	467.9	16.1	0.7	6.56665E+19	7.3
6	SL	278	17.4	0.7	3.34033E+19	5.2
7	BL	472	15.6	0.7	7.05562E+19	7.6
8	SL	274.7	17.9	0.7	3.11885E+19	5.1
9	BL	472.5	15.5	0.7	7.15453E+19	7.7
10	SL	281.6	18	0.7	3.16177E+19	5.1
11	BL	478.9	16.5	0.7	6.39911E+19	7.2
12	SL	279.3	17.8	0.7	3.20681E+19	5.1

Shot notes:

Shot number	**Comment**
1	Darkroom tech noted image plate saturation too much to scan, even with sensitivity at 1000. they will erase it for 5 s then rescan
2	First 2 IP on NTA11 were erased for 5 s
3	Pixel size scan parameter was wrong on first scan of TPIE. no clear D trace
4	6 mm Cu in XBLK, no erasing on NTA behind XBLK
5	X-ray films erased for 10 s
6	10 mm Ta in XBLK, no erasing on NTA behind XBLK
7	Switch target to CD foil, try to see deuteron, x-ray films erased for 10 s
8	6 mm Al in XBLK, no erasing on NTA behind XBLK
9	TPIE detector to 50 cm ONLY this shot (Checking if deuterons become visible, i.e. if over-filtered. Appears not the case. Final Al filter had been omitted up to this point.)
10	XBLK: 2 mm Ta 6 mm Al. Swap first RCF stack filter from Cu for 100 μm Al for rest of day.
11	TPIE filter changed to attenuate $^{+6}$C in high energy range (200 μm filter) - note no x-ray hole in filter
12	XBLK: 1 mm Ta 6 mm Al

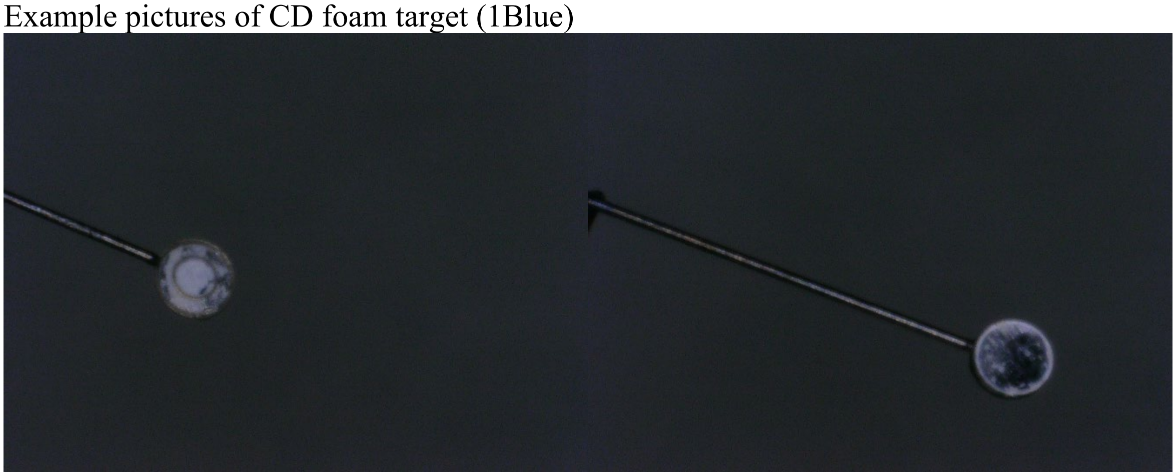
Targets

Targets used

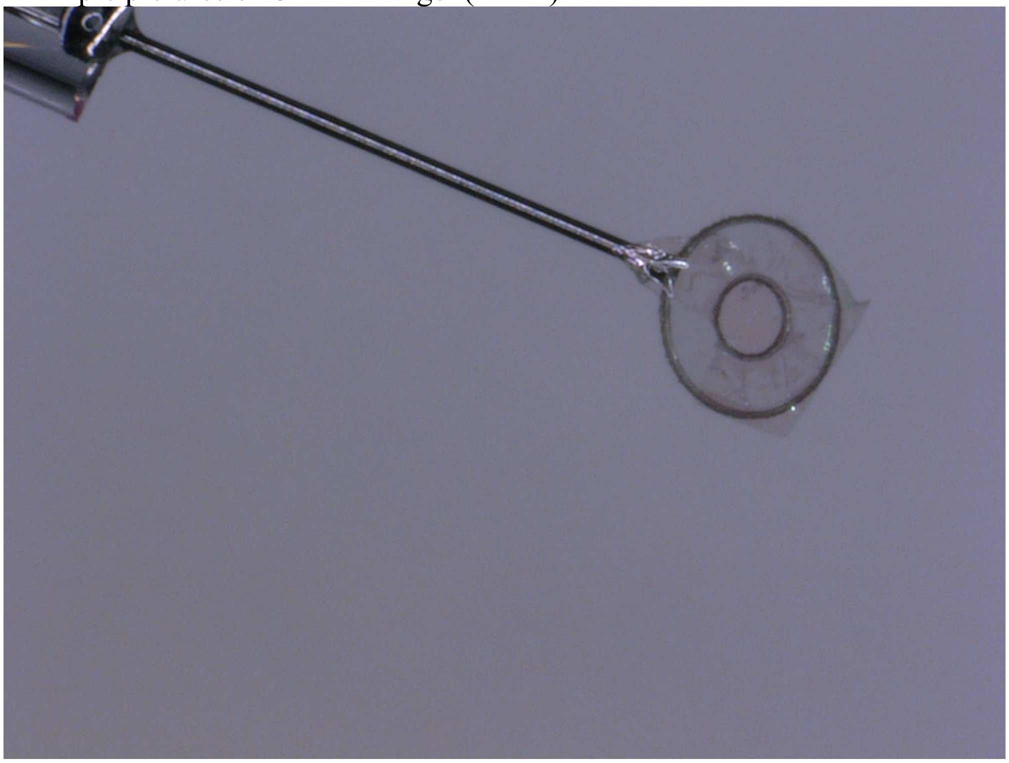
Shot number	Beam	Target used	Target material	Target thickness/density
1	BL	FOAM_1 1RED	CD foam + Al	20µm thick, 25mg/cc
2	SL	MP-23A_Pro-1_200	Kapton foil	600nm
3	BL	FOAM_2 1Blue	Al + CD foam	20µm thick, 25mg/cc
4	SL	MP-23A_Pro-2_300	Kapton foil	500nm
5	BL	FOAM_1 2RED	CD foam + Al	20µm thick, 25mg/cc
6	SL	MP-23A_PRO-1_201	Kapton foil	600nm
7	BL	CD Film 14Orange	CD film	500nm
8	SL	MP-23A_Pro-2_301	Kapton foil	500nm
9	BL	CD Foam/Al 3Red	CD foam + Al	20µm thick, 25mg/cc
10	SL	CD Film 2Pink	CD film	500nm
11	BL	CD Film 7Blue	CD film	500nm (film folded over tiny bit)
12	SL	CD Film 6Orange	CD film	300nm

Sample Target Pictures

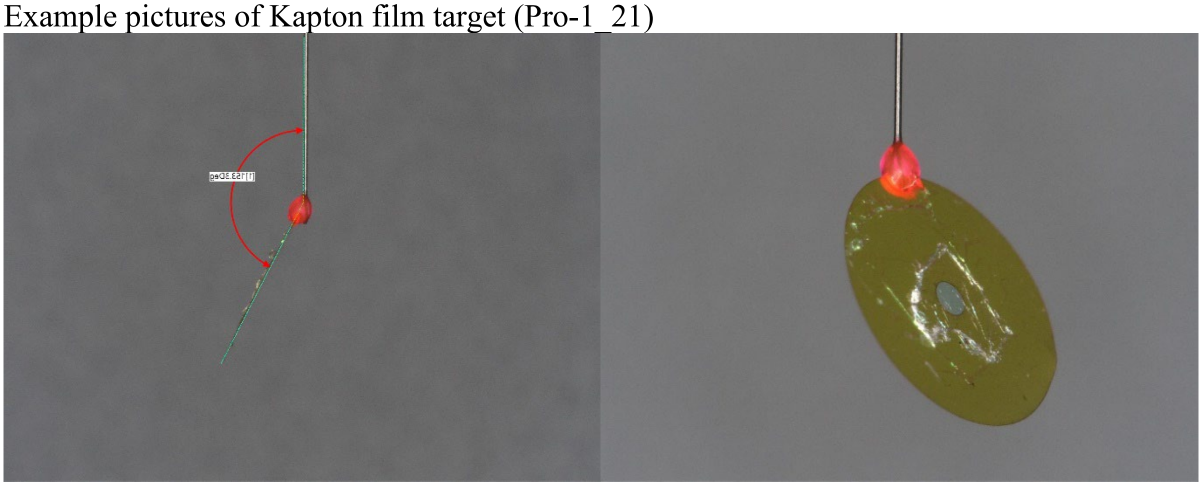
Example pictures of CD foam target (1Blue)



Example pictures of CD film target (2Pink)

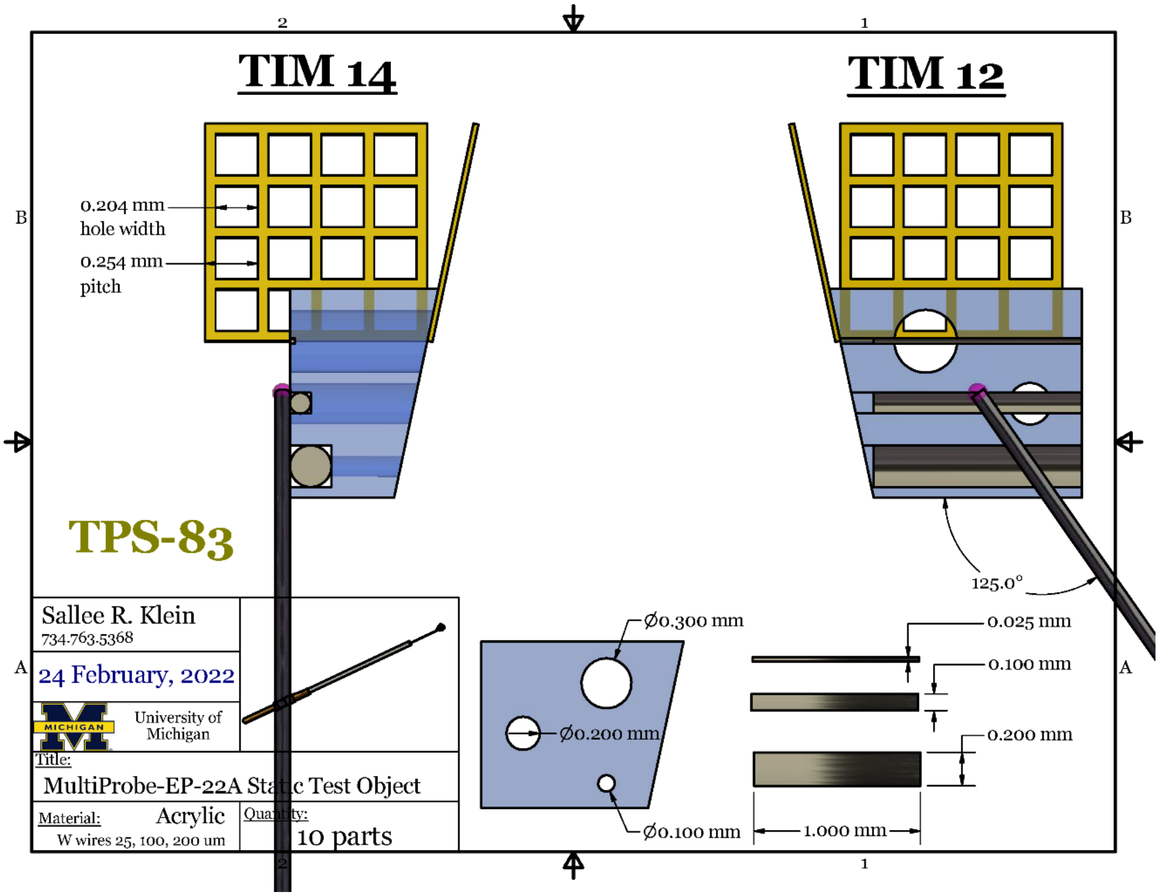


Example pictures of Kapton film target (Pro-1_21)



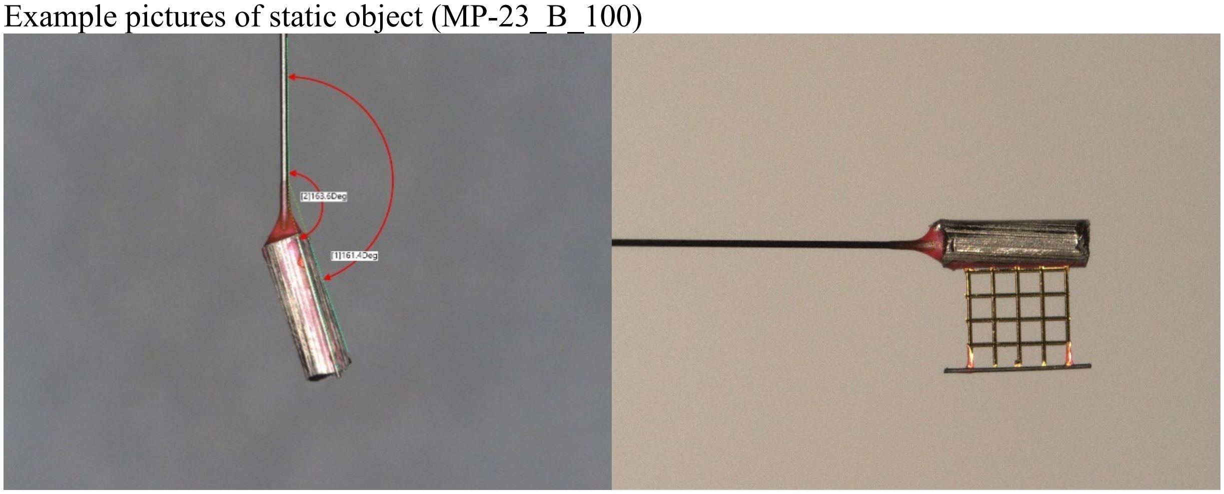
Static test object

Engineering drawing



Example pictures of static object

Example pictures of static object (MP-23_B_100)



Diagnostics

Instruments Used

	FULL IP SET	
TIM	Shielding Series (Sidelighter)	Pitcher Series (Backlighter)
10	X-Ray Shield (LANL)	-------------
11	Image Plate Stack	Image Plate Stack
12	-------------	TPIE
13	Image Plate Stack	Image Plate Stack
14	Dual NTA with RCF/image plate stacks	Dual NTA with IP/PROBIES
TPS7	Sidelighter (x ray thin film) target	Proton source (CH/CD foil/foam)
TPS 83	Static test object	-------------
Fixed	Shielding Series (Sidelighter)	Pitcher Series (Backlighter)
55	BMSX-55	BMSX-55
30, 71	-------------	4w shadowgraphy + interferometer + AFR

The full diagnostic set was fielded on some shots, and reduced on others to minimize load on dark room.

	MINIMUM IP SET	
TIM	Shielding Series (Sidelighter)	Pitcher Series (Backlighter)
10	X-Ray Shield (LANL)	-------------
11	-------------	-------------
12	-------------	TPIE
13	-------------	-------------
14	Dual NTA with RCF/image plate stacks	Dual NTA with --/PROBIES
TPS7	Sidelighter (x ray thin film) target	Proton source (CH/CD foil/foam)
TPS 83	Static test object	-------------
Fixed	Shielding Series (Sidelighter)	Pitcher Series (Backlighter)
55	-------------	-------------
30, 71	-------------	4w shadowgraphy + interferometer + AFR

Definitive information about IP pack, RCF film pack, and step wedges

X-ray Image Plate Pack:

X-ray diagnostics consisted of a combination of IP stacks on TIM NTAs and on BMXS-55. The full suite of x-ray diagnostics was not fielded on all shots, but rather a particular selection of shots to cover a wide range of laser & target parameter space.

For the **sidelighter shots** (shielding series), when we use the FULL IP SET, we had IP stacks on TIM-11, TIM-13, and TIM-14 (orthogonal NTA), and used BMXS-55 as well. For the MINIMUM IP SET, we will only have an IP stack on TIM-14 (orthogonal NTA) to determine the effectiveness of XBLK.

For the **backlighter shots** (pitcher series), when we use the FULL IP SET, we had IP stacks on TIM-11, TIM-13, and TIM-14 (normal NTA), and used BMXS-55 as well. For the MINIMUM IP set, we had no x-ray diagnostics.

For **BMXS-55**, we used the LLE Standard MeV Pack. Note that the BMXS diagnostic does have a set of magnets included. (two magnets, 2″x1″x0.5″, with surface fields of 3723 G are separated by about 0.5″ to 1″).

BMXS IP Cartridge MeV Filter List		
Layer	Filter Thickness (mm)	Filter Material
1	5	Teflon
2	5	Teflon
3	0.1	Al
4	0.5	IP-1
5	0.1	Ti
6	0.5	IP-2
7	0.1	Fe
8	0.5	IP-3
9	0.1	Cu
10	0.5	IP-4
11	0.1	Mo
12	0.5	IP-5
13	0.15	Ag
14	0.5	IP-6
15	0.5	Sn
16	0.5	IP-7
17	0.5	Ta
18	0.5	IP-8
19	1.56	Au
20	0.5	IP-9
21	1	Pb
22	0.5	IP-10
23	2	Pb
24	0.5	IP-11
25	3	Pb
26	0.5	IP-12
27	4	Pb
28	0.5	IP-13
29	6.4	Pb
30	0.5	IP-14

The angles between each x-ray diagnostic & proton beam are listed below.

Sidelighter:

Diagnostic	Angle relative to proton beam	Angle relative to x-y plane
TIM-11	88.47 (shifted slightly or retracted)	51 above
TIM-13	82.87 (shifted slightly or retracted)	63 below
TIM-14	90	0
BMXS-55	150	0

Backlighter:

Diagnostic	Angle relative to proton beam	Angle relative to x-y plane
TIM-11	128 (shifted slightly or retracted)	51 above
TIM-13	117	63 below
TIM-14	90	0
BMXS-55	60	0

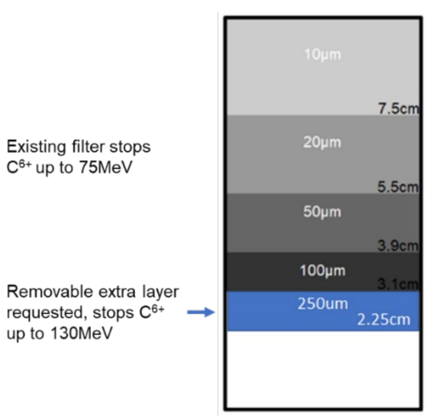
On the **NTAs**, we used the LANL_6_IP_stack:

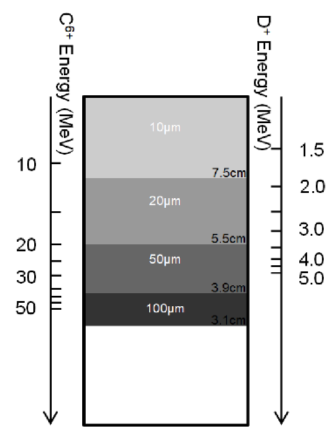
Layer	IP #	Material	Thickness (mm)	Total Thickness (mm)	Notes
1		Al	0.1	0.1	
2		Mylar	4	4.1	Mylar cut in half laterally (or vertically)
3	1	MS-IP	0.44	4.54	
4		Cu	0.25	4.79	
5	2	MS-IP	0.44	5.23	
6		Cu	1	6.23	
7	3	MS-IP	0.44	6.67	
8		Cu	1	7.67	
9	4	MS-IP	0.44	8.11	
10		Ta	1	9.11	
11	5	MS-IP	0.44	9.55	
12		Ta	2	11.55	
13	6	MS-IP	0.44	11.99	
14		Cu	0.5	12.43	Wrap sides in 0.5 mm Cu too

For **PROBIES,** we used the same RCF stack as used in MP21A.

LANL_75MeV_PROBIES - Pack Assembly by Layer						
Layer	**Film Layer**	**Material**	**Thickness [µm]**	**Running Thickness total [µm]**	**Running Thickness total [mm]**	**Minimum Proton Energy[MeV]**
1		**PROBIES**				
2		Sn	100	100	0.1	
3	1	Film (HD-V2)	105	205	0.205	4.5
4		Sn	500	705	0.705	
5	2	Film (HD-V2)	105	810	0.81	13.8
6		Sn	500	1310	1.31	
7	3	Film (HD-V2)	105	1415	1.415	19.9
8		Sn	500	1915	1.915	
9	4	Film (HD-V2)	105	2020	2.02	24.8
10		Sn	500	2520	2.52	
11	5	Film (HD-V2)	105	2625	2.625	29.1
12		Sn	500	3125	3.125	
13	6	Film (HD-V2)	105	3230	3.23	32.9
14		Sn	1000	4230	4.23	
15	7	Film (HD-V2)	105	4335	4.335	39.5
16		Sn	1000	5335	5.335	
17	8	Film (MD-V3)	260	5595	5.595	45.6
18		Sn	1000	6595	6.595	
19	9	Film (MD-V3)	260	6855	6.855	51.2
20		Sn	1000	7855	7.855	
21	10	Film (MD-V3)	260	8115	8.115	56.3
22		Sn	1000	9115	9.115	
23	11	Film (EBT3)	280	9395	9.395	61.2
24		Sn	1500	10895	10.895	
25	12	Film (EBT3)	280	11175	11.175	67.9

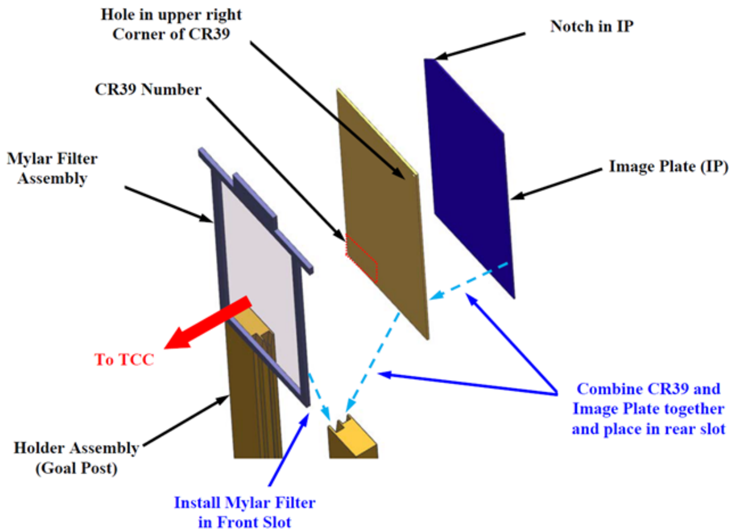
For **TPIE**, we used a differential Al filter to stop C^{6+} without attenuating D^+ as they have overlapping traces. The filter on the left below was requested as a modification to Arnold Schwemmlein's filter, but due to miscommunication the unmodified filter on the right was used (image and table describing the filter are from Schwemmlein's dissertation). For shot 11 Graeme Scott's filter with 250 µm Al over the entire unfiltered lower portion of the IP.





Aluminum thickness (µm)	C^{6+} minimum energy (MeV)	D^+ minimum energy (MeV)
10	12.0	0.80
20	22.5	1.25
50	46.5	2.25
100	75.0	3.50

The Al differential filter was within the mylar filter assembly and SR-IP with to detect the ions (CR39 was not used).



The **TPIE** parameters were as follows:

- Pinhole (∅) 250 µm
- IP in P1 at 10 cm (shot 8 had IP in P2 at 50 cm)
- 5.6 kG magnet
- 10 kV/cm electric field (electrodes set to -5 kV and +5 kV)
- Pixel size: 50 µm

Radio Chromic Film (RCF) Filter Pack

For the sidelighter shots (shielding series), we used an RCF stack within the TIM-14 dual NTA. The RCF stack was used for proton radiography of the static object. This RCF stack (below) is was also fielded in MP22A. On the right lists the minimum proton energy required to reach a given RCF layer.

Layer	Material	Thickness (mm)	Total Thickness (mm)
1	Cu	0.05	0.05
2	HDV2	0.11	0.16
3	Sn	0.5	0.66
4	HDV2	0.11	0.77
5	Sn	0.5	1.27
6	HDV2	0.11	1.38
7	Sn	0.5	1.88
8	HDV2	0.11	1.99
9	Sn	0.5	2.49
10	HDV2	0.11	2.6
11	Sn	0.5	3.1
12	HDV2	0.11	3.21
13	Sn	0.5	3.71
14	HDV2	0.11	3.82
15	Sn	1	4.82
16	HDV2	0.11	4.93
17	Sn	1	5.93
18	HDV2	0.11	6.04
19	Sn	1	7.04
20	HDV2	0.11	7.15
21	Sn	1	8.15
22	MDV3	0.26	8.41
23	Sn	1	9.41
24	MDV3	0.26	9.67
25	Sn	1	10.67
26	MDV3	0.26	10.93
27	Sn	1	11.93
28	MDV3	0.26	12.19

Film #1: 3.9 MeV
Film #2: 13.1 MeV
Film #3: 18.9 MeV
Film #4: 23.7 MeV
Film #5: 28.0 MeV
Film #6: 31.8 MeV
Film #7: 35.3 MeV
Film #8: 41.5 MeV
Film #9: 47.1 MeV
Film #10: 52.3 MeV
Film #11: 57.4 MeV
Film #12: 62.2 MeV
Film #13: 66.8 MeV
Film #14: 71.1 MeV

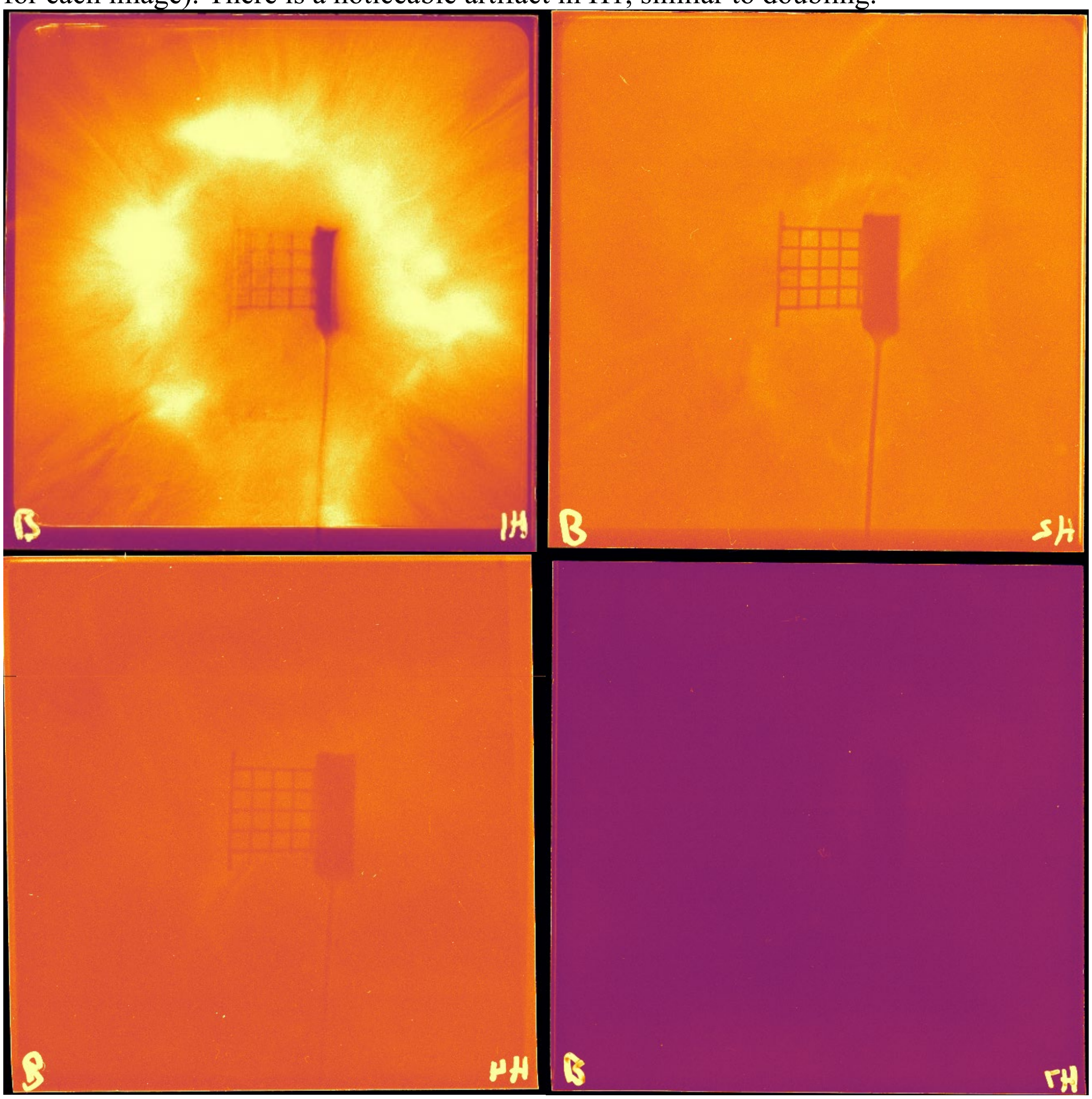
The Cu filter (layer 1) was swapped out for 100 µm Al for shots 10 & 12.

Diagnostic Measurements

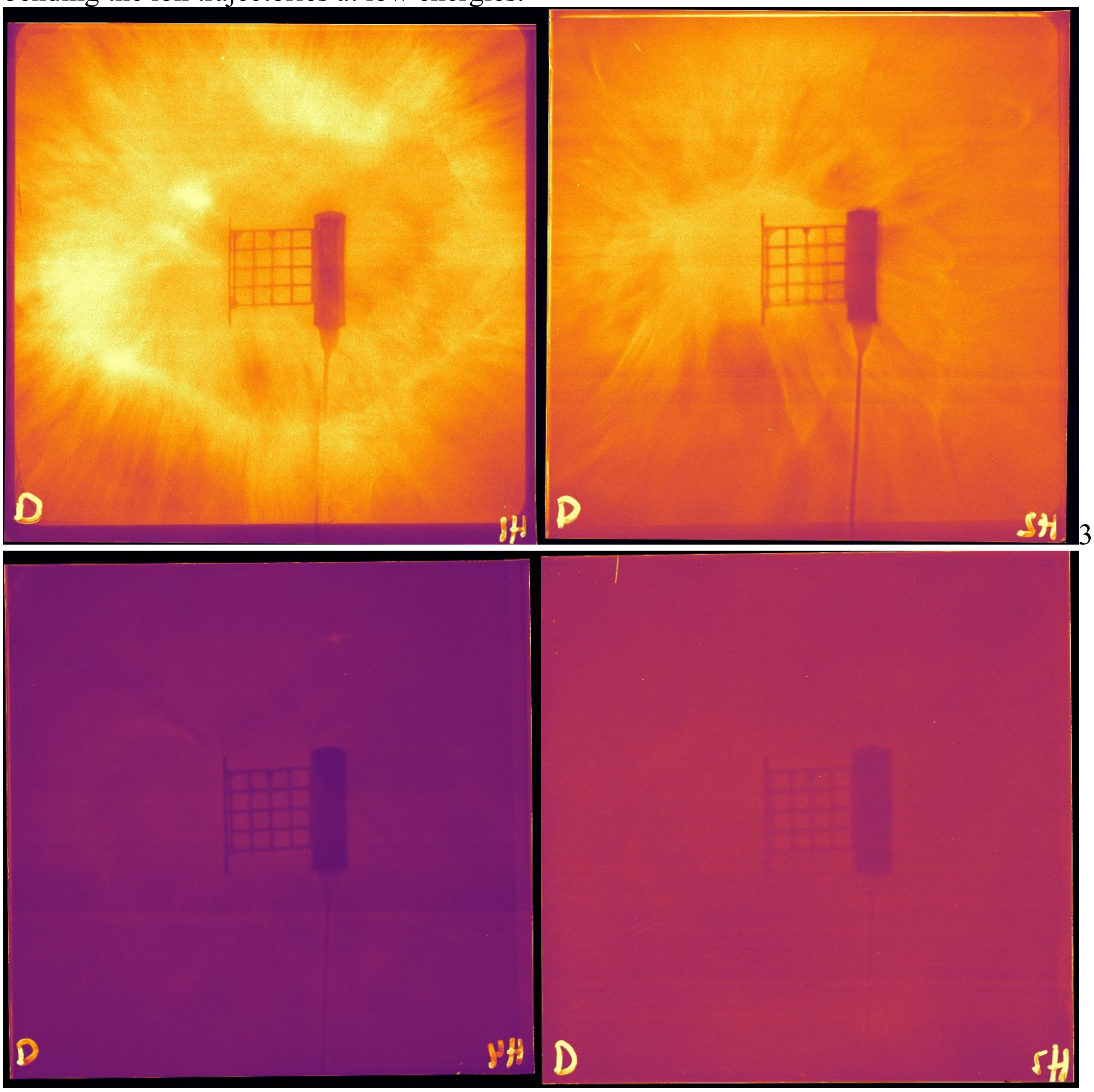
Proton radiography

A qualitative assessment of the protons radiographs is given here as the quantitative assessment is in progress. On most shots, the proton radiographs appear to be of good quality. There does not appear to be a significant difference in proton energy when reducing Kapton thickness from 600 nm to 500 nm, but there was less “doubling” of images observed with the 500 nm Kapton targets. The CD film targets also appear to provide a more uniform beam profile for lower energies as compared to the Kapton targets. Below are a few examples of the proton radiographs that have been scanned with a microdensitometer; flatbed scans of radiographs for all shots are provided in the appendix.

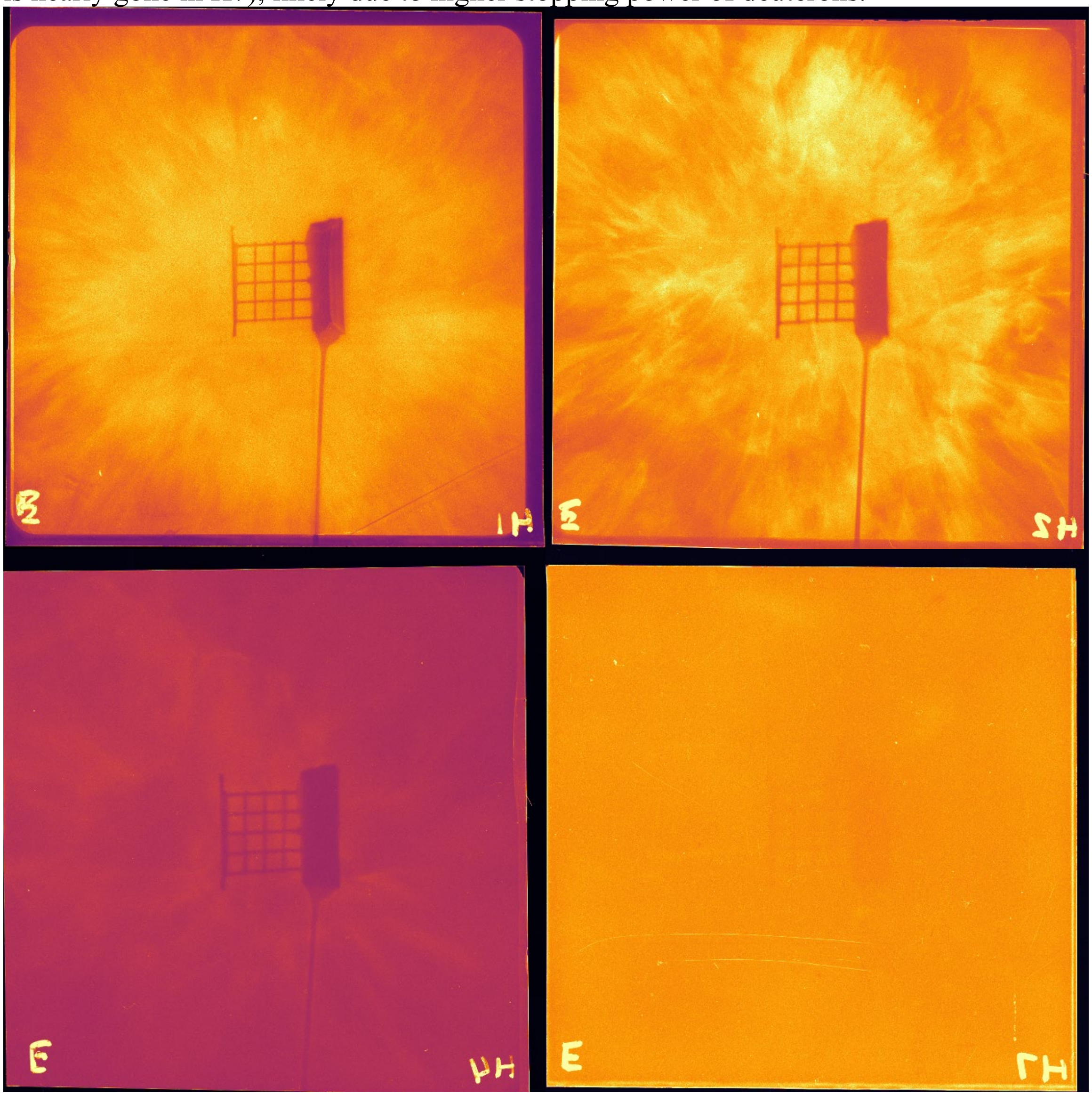
Shot 38059 (600 nm Kapton, 125 J), films H1, H2, H4, H7 (note relative brightness is rescaled for each image). There is a noticeable artifact in H1, similar to doubling.



Shot 38065 (500 nm Kapton, 250 J), films H1, H2, H4, H7. Note that there is no longer substantial doubling on the first piece of film. There is some interesting transparency of the thick 500 μm tungsten wire on the first film. This may be related to charging of the tungsten wire, bending the ion trajectories at low energies.



Shot 38067 (500 nm CD film, 250 J), films H1, H2, H4, H7. Note less noticeable "halo" about center of shot as compared to Kapton film. Not as penetrating as Kapton shot of 38065 (contrast is nearly gone in H7), likely due to higher stopping power of deuterons.



XBLK results

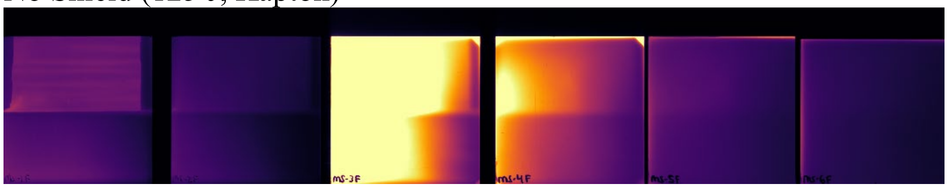
6 shots total on SL with NTA in TIM-14:

- No shield (125 J, Kapton)*
- 6 mm Cu (125 J, Kapton)
- 10 mm Ta (250 J, Kapton)
- 6 mm Al (250 J, Kapton)*
- 2 mm Ta + 6 mm Al (250 J, CD film)*

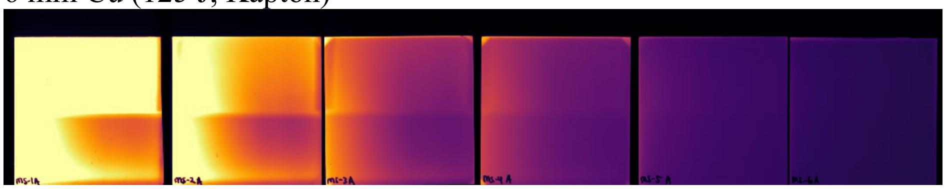
- 1 mm Ta + 6 mm Al (250 J, CD film)*
  * = BMXS on for shot

Raw NTA data behind XBLK

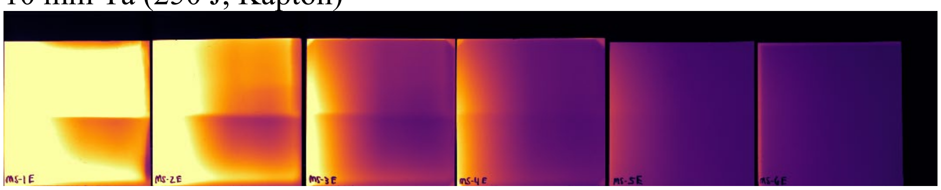
No Shield (125 J, Kapton)



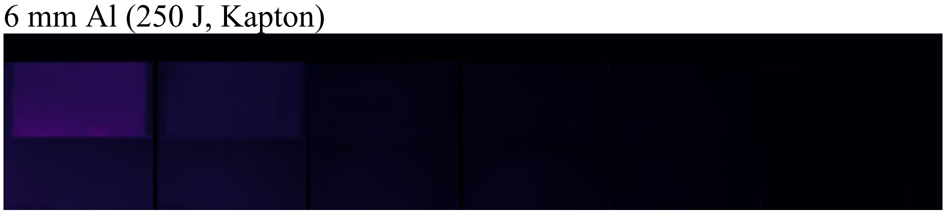
6 mm Cu (125 J, Kapton)



10 mm Ta (250 J, Kapton)



6 mm Al (250 J, Kapton)



6 mm Al + 2 mm Ta (250 J, CD Film)

6 mm Al + 1 mm Ta (250 J, CD Film)

Surprisingly, the Al shield vastly outperformed Ta and Cu shields. This result suggests that the crosstalk may be due to electrons < 5 MeV. These electrons will tend to convert to x-rays more efficiently within the higher Z shield materials like Ta and Cu, while being scattered or stopped with much lower x-ray production in Al. Higher energy electrons would not be consistent with the observations as they would penetrate the Al directly. High energy x-rays would not be stopped by the Al, and x-rays with sufficiently low energies to be stopped in the Al would not penetrate or generate sufficient secondary electrons within the Ta/Cu to explain the data.

Further analysis will be performed to determine whether the source of the crosstalk is indeed these <5 MeV electrons. This will be done by unfolds of the NTA data (simultaneous electron & x-ray unfolding) and through modeling with MCNP.

TPIE & PROBIES results

TPIE and PROBIES were fielded on 6 shots (PROBIES filter was not included on the last shot). Surprisingly, deuteron signals appear below threshold for all of the CD foam targets, while a clear deuteron traces were generated by the CD films. It is not clear what mechanism is preventing deuterons from being detected for the CD foam targets. Potential explanations include:

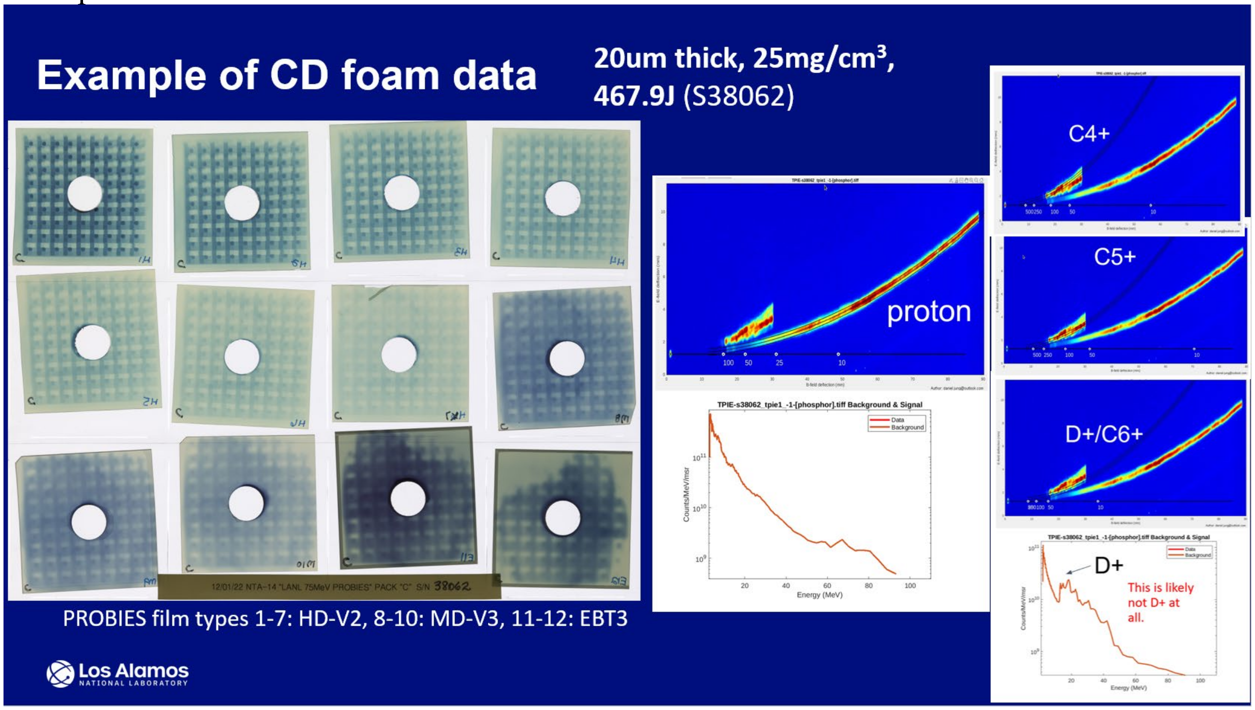
1. D-D fusion burning up the deuterons (fielding neutron detectors could confirm this)
2. Loss of deuterium in target due to high humidity conditions (unlikely given the 96% deuterium content in the CD foam precursor)
3. Preferential acceleration of protons on surface of foams over deuterons (unlikely due to detection of D for CD film, and the presence of high energy $C^{4+,5+}$ in foam TPIE measurements)

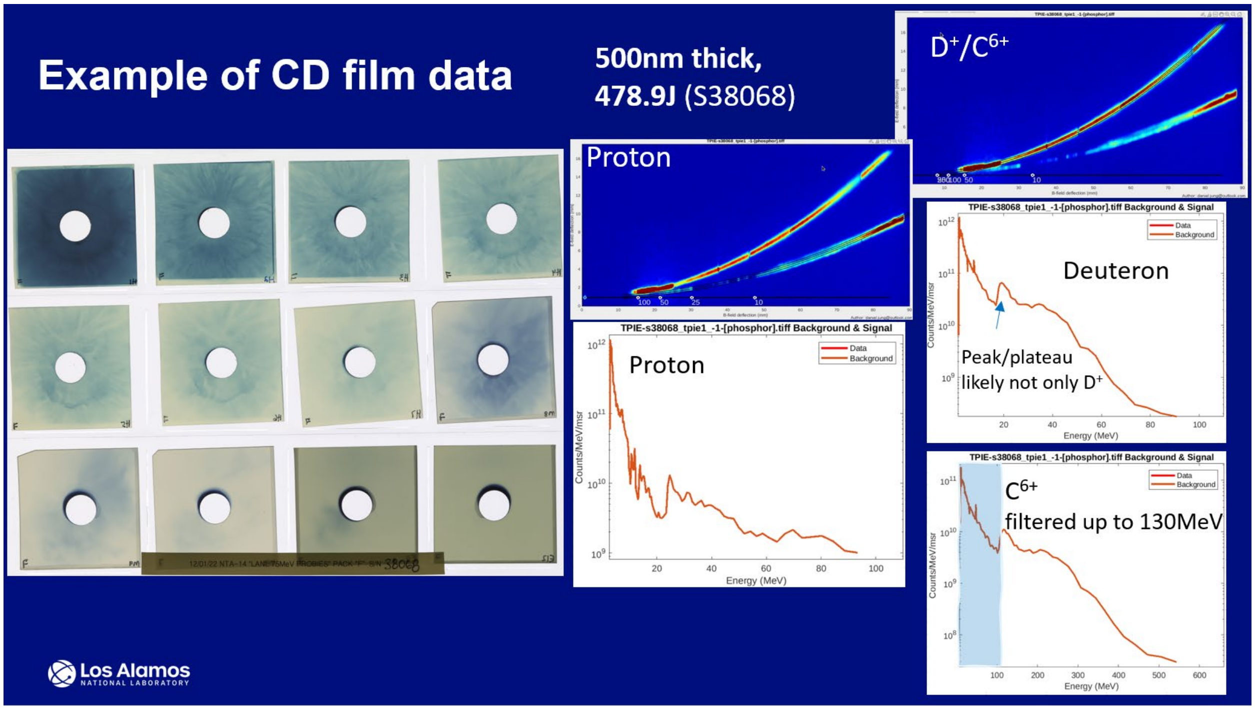
Analysis of TPIE data is ongoing, but the table below shows initial observations.

Shot/Target	**Energy**	**Proton E_{max}**	**Deuteron E_{max}**
38058/**foam**	236 J	~55-90 MeV	Not detected
38060/**foam**	238.5 J	~50-90 MeV	Not detected
38062/**foam**	467.9 J	~80-90 MeV	More likely C^{6+}
38066/**foam**	472.5 J	~80-90 MeV	Offset filter, clear C^{6+} observed
38064/**film**	472 J	~80-90 MeV	80 MeV? C^{6+} contamination above 20 MeV*
38068/**film**	478.9 J	~80-90 MeV	80 MeV? C^{6+} contamination above 20 MeV*

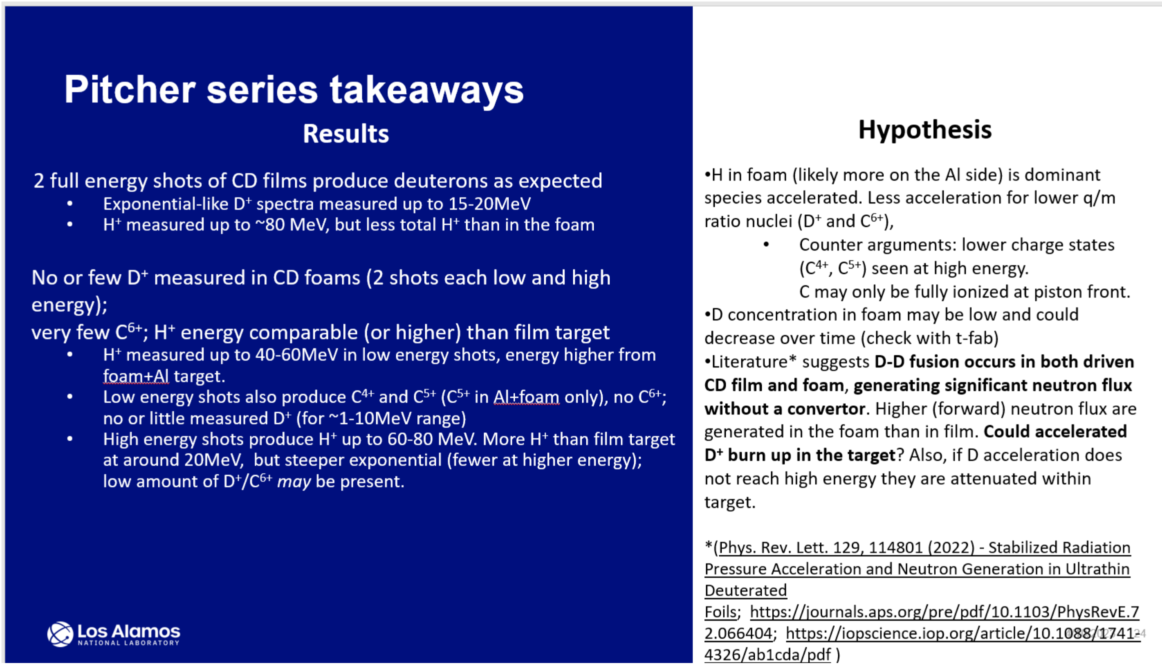
*TNSA-like exponential spectrum up to ~20MeV

Examples of PROBIES and TPIE data for CD foam and film shots.



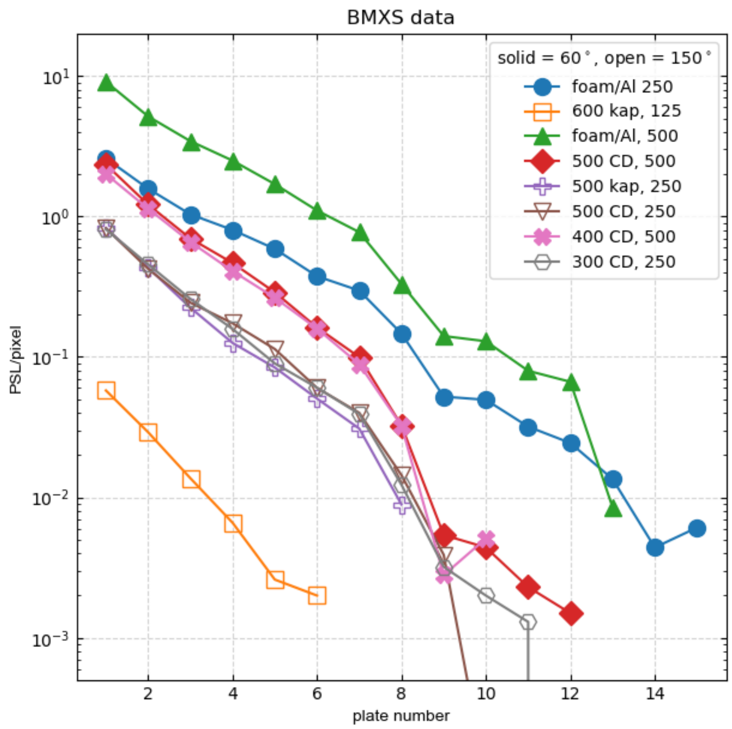


This analysis is not yet quantitative as it does not yet include the effects of the energy shift due to the differential Al filter on IP response.



BMXS-55 data

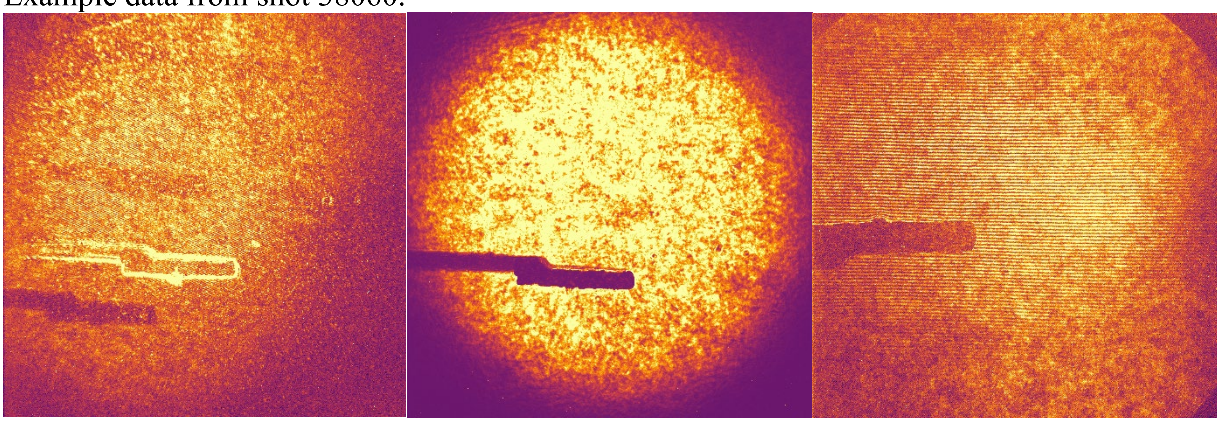
Image plate PSL values for BMXS-55 on each shot. Background subtraction performed, and PSL values < 0 are removed. Preliminary unfolds of the x-ray spectra for each shot are provided in the appendix. Note that these preliminary unfolds use NIST databases to build response matrices rather than MCNP (would not trust unfolds >1 MeV).



4w probe

No clear signature of the pre-plasma was observed with the 4w probe.

Example data from shot 38060.



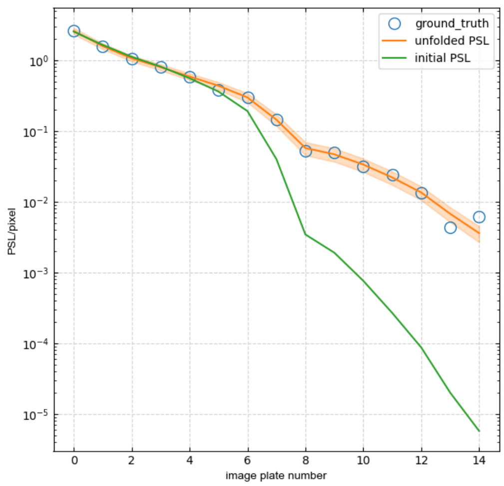
Acknowledgements

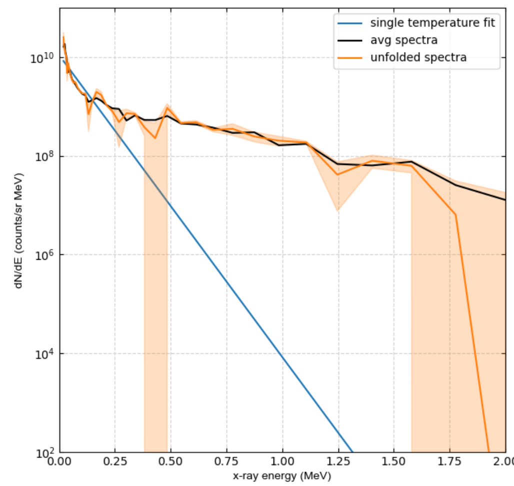
This work was supported by the U.S. Department of Energy through the Los Alamos National Laboratory (LANL). LANL is operated by Triad National Security, LLC, for the National Nuclear Security Administration of the U.S. DOE (Contract No. 89233218CNA000001). This work was initiated under the LANL LDRD 20180732ER program and continued under OES ADP.

Appendices

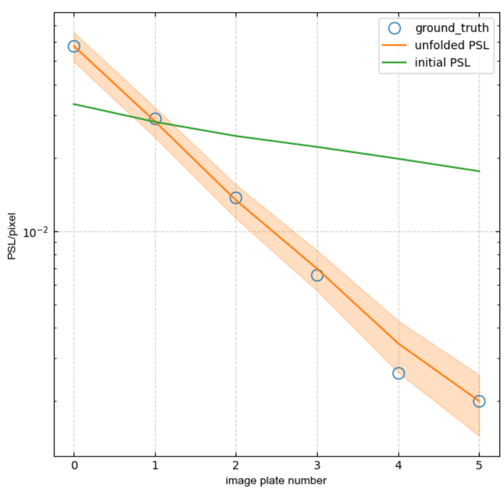
Appendix A: BMXS spectral unfolds

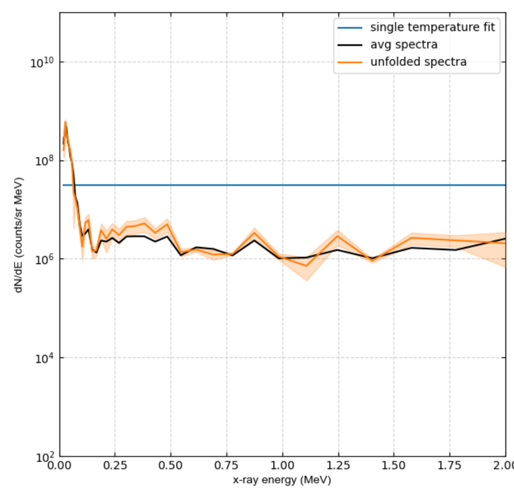
Shot 38058:



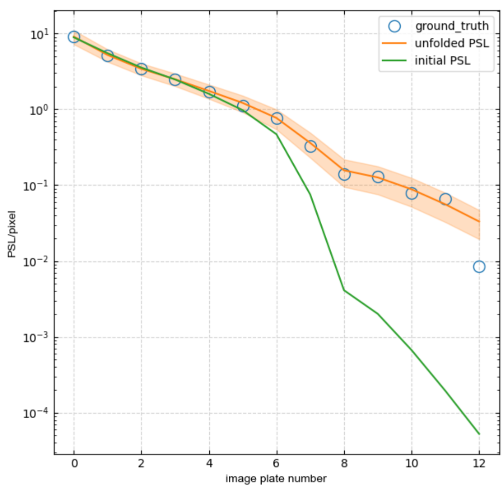


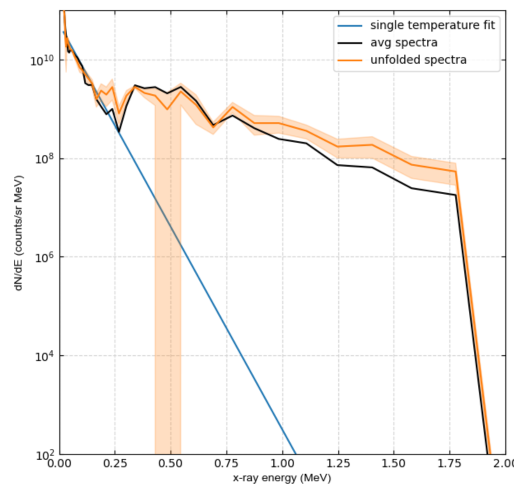
Shot 38059:



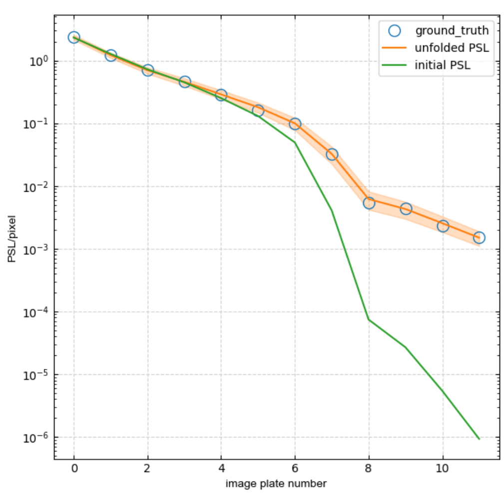


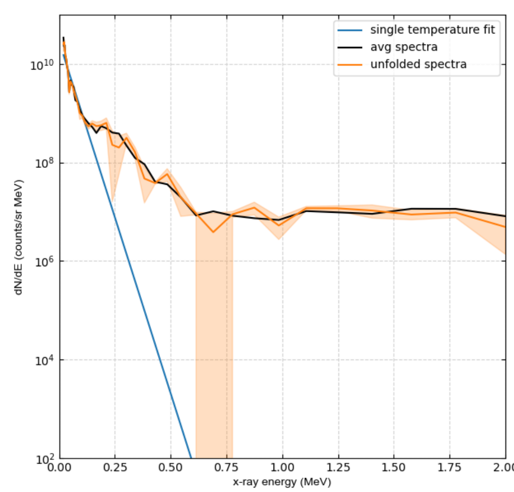
Shot 38062:



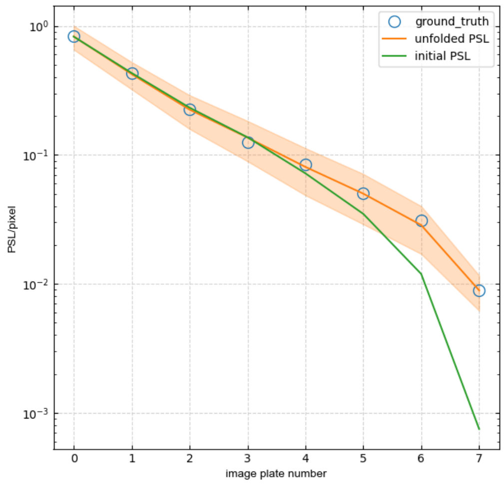


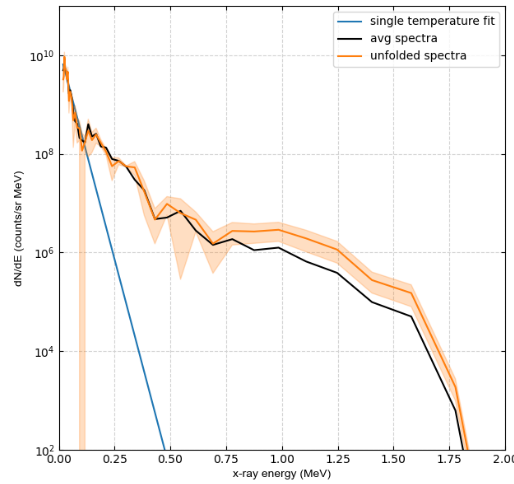
Shot 38064:



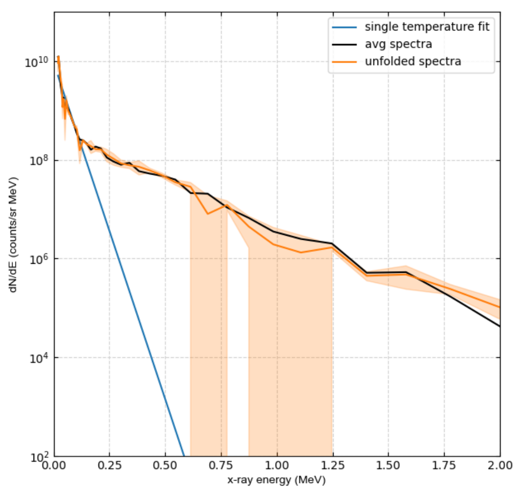


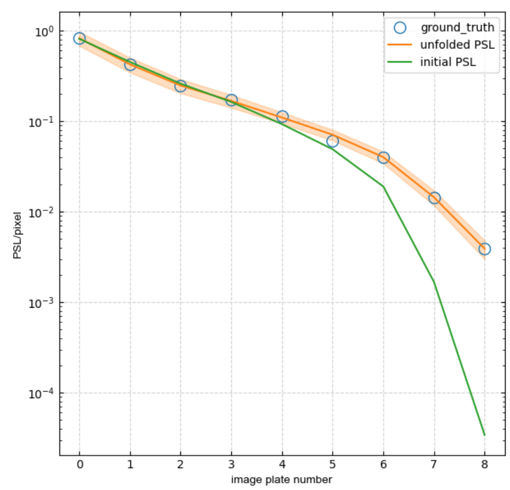
Shot 38065:



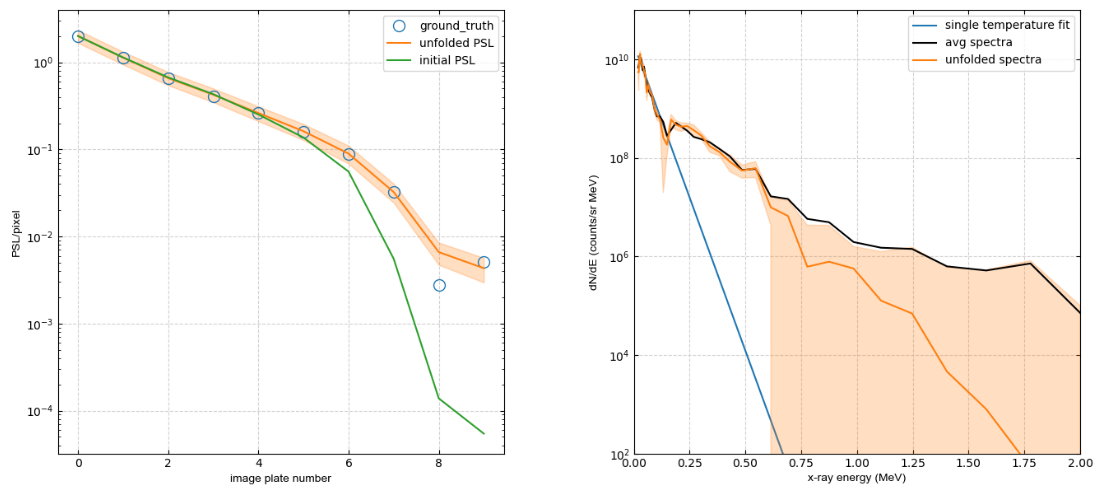


Shot 38067:

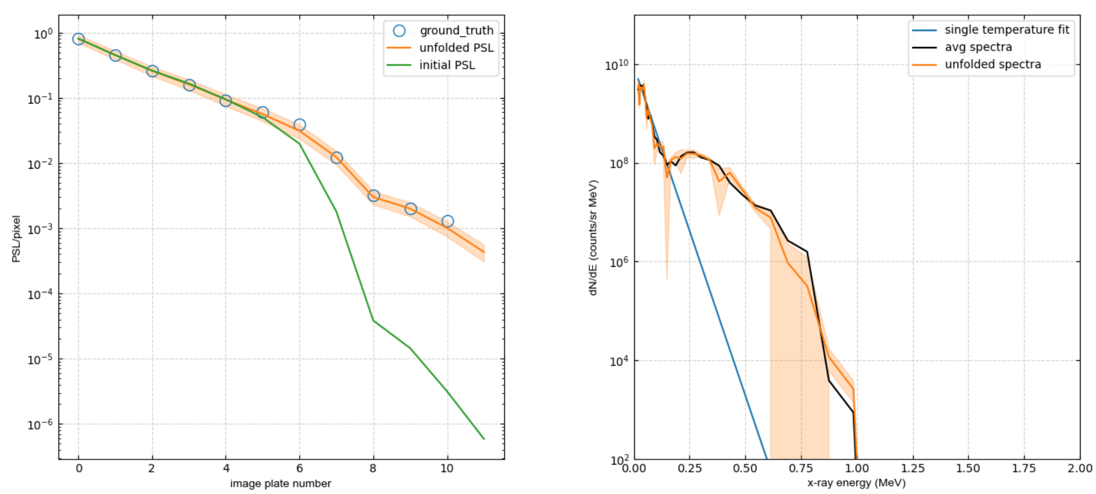




Shot 38068:

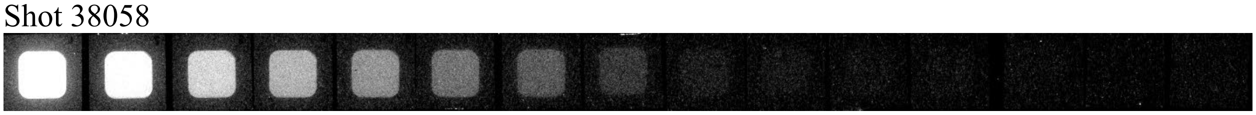


Shot 38069:

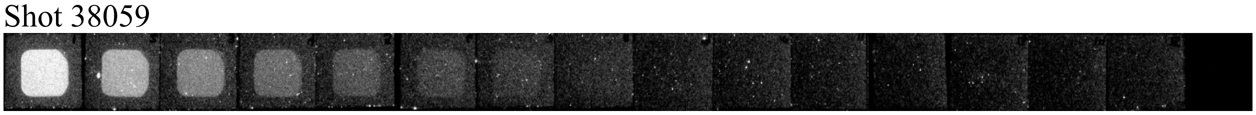


BMXS raw data

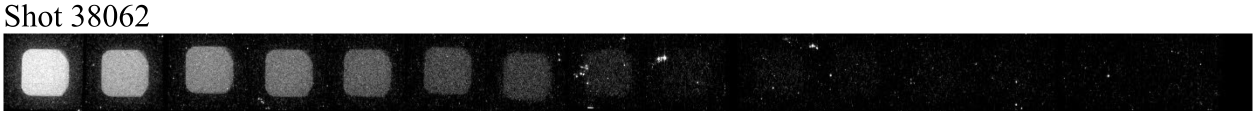
Shot 38058



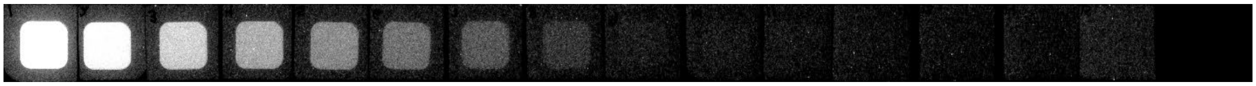
Shot 38059



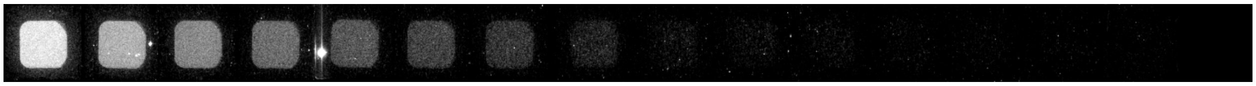
Shot 38062



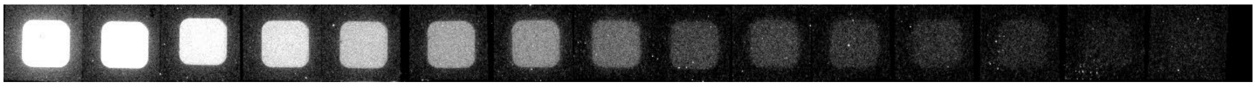
Shot 38064



Shot 38065

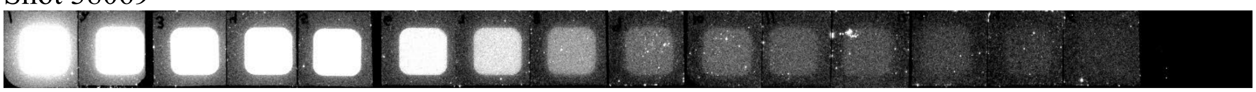


Shot 38067



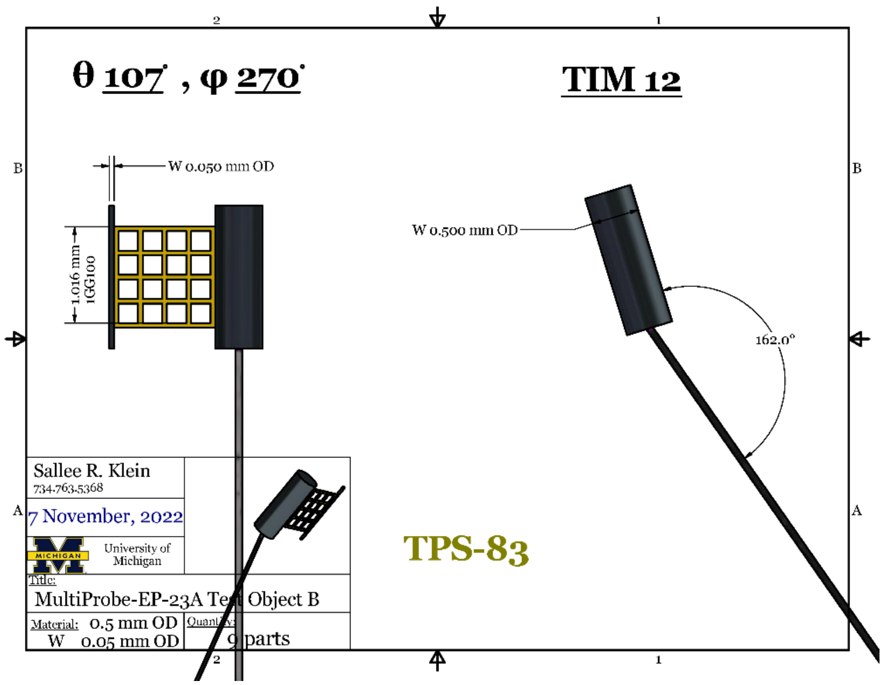
Shot 38068

Shot 38069

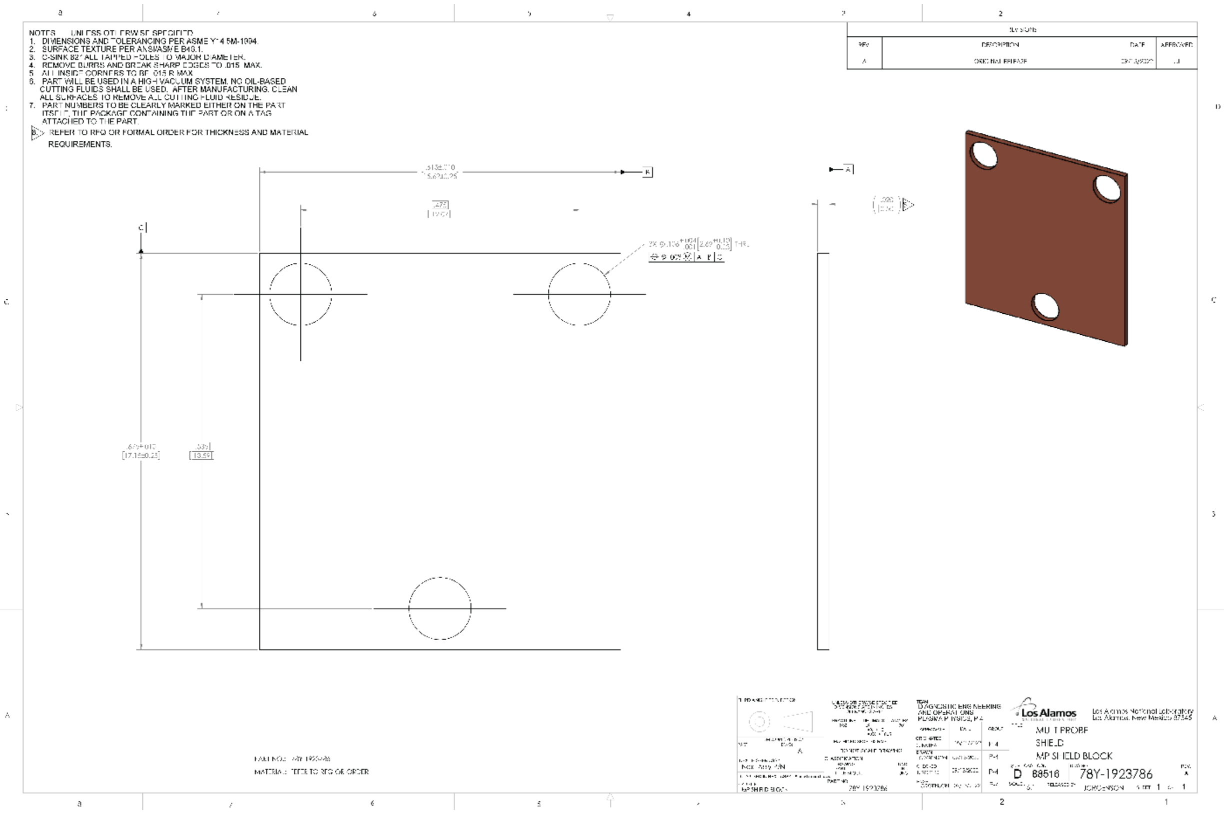


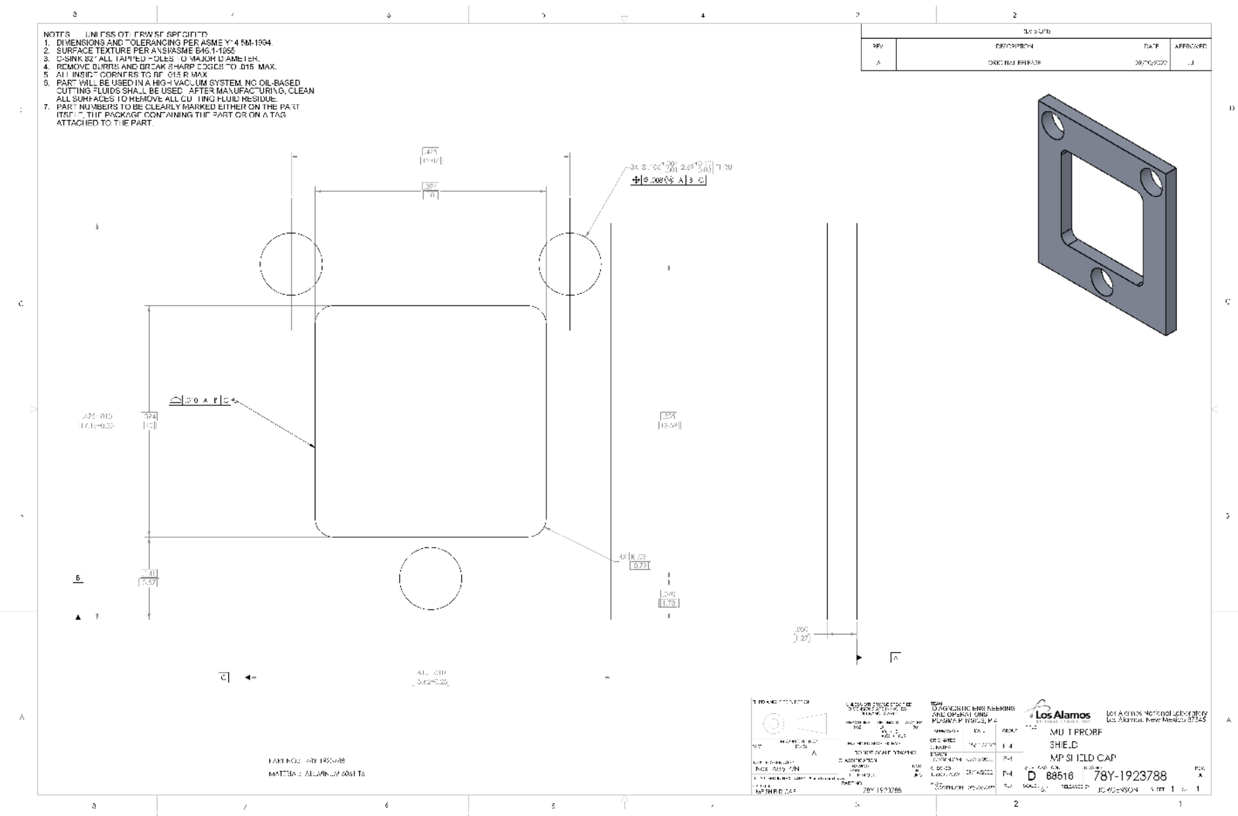
Appendix B: Target Drawings

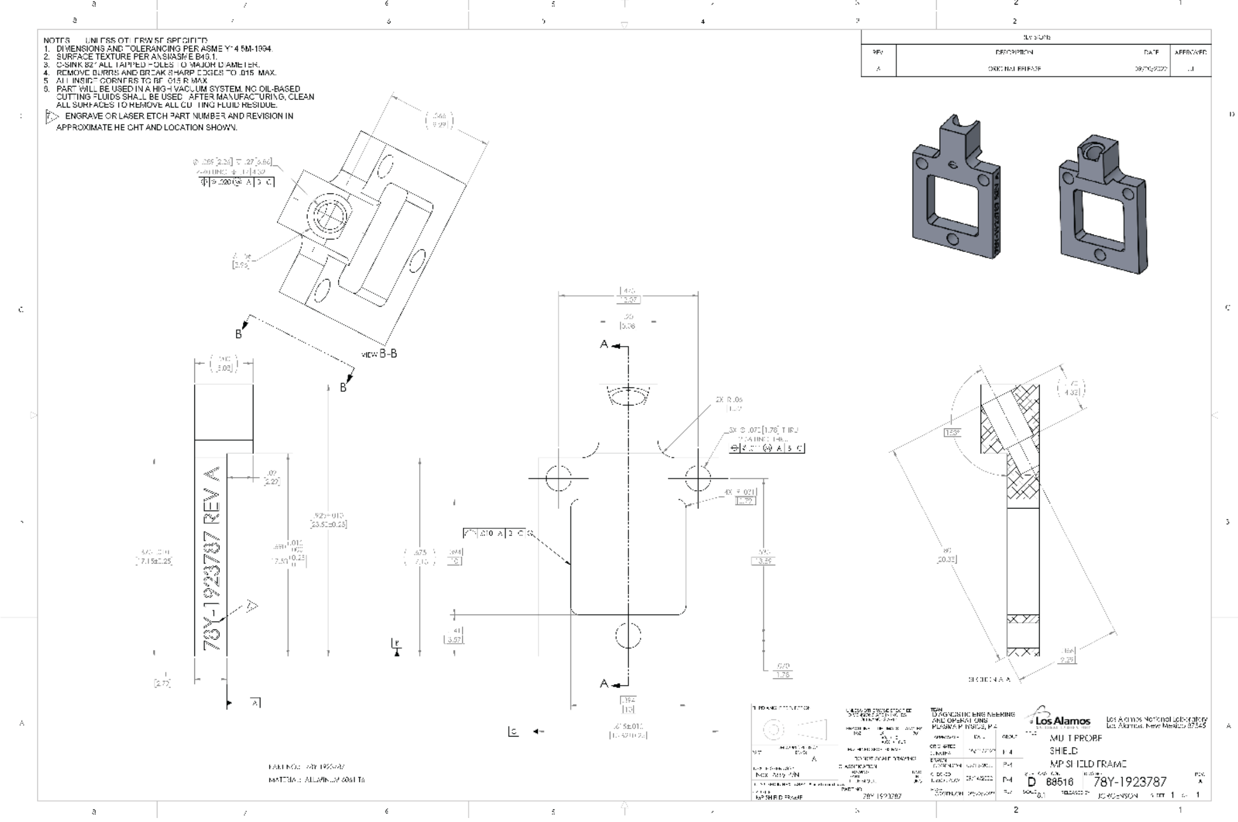
Drawing of the static object.

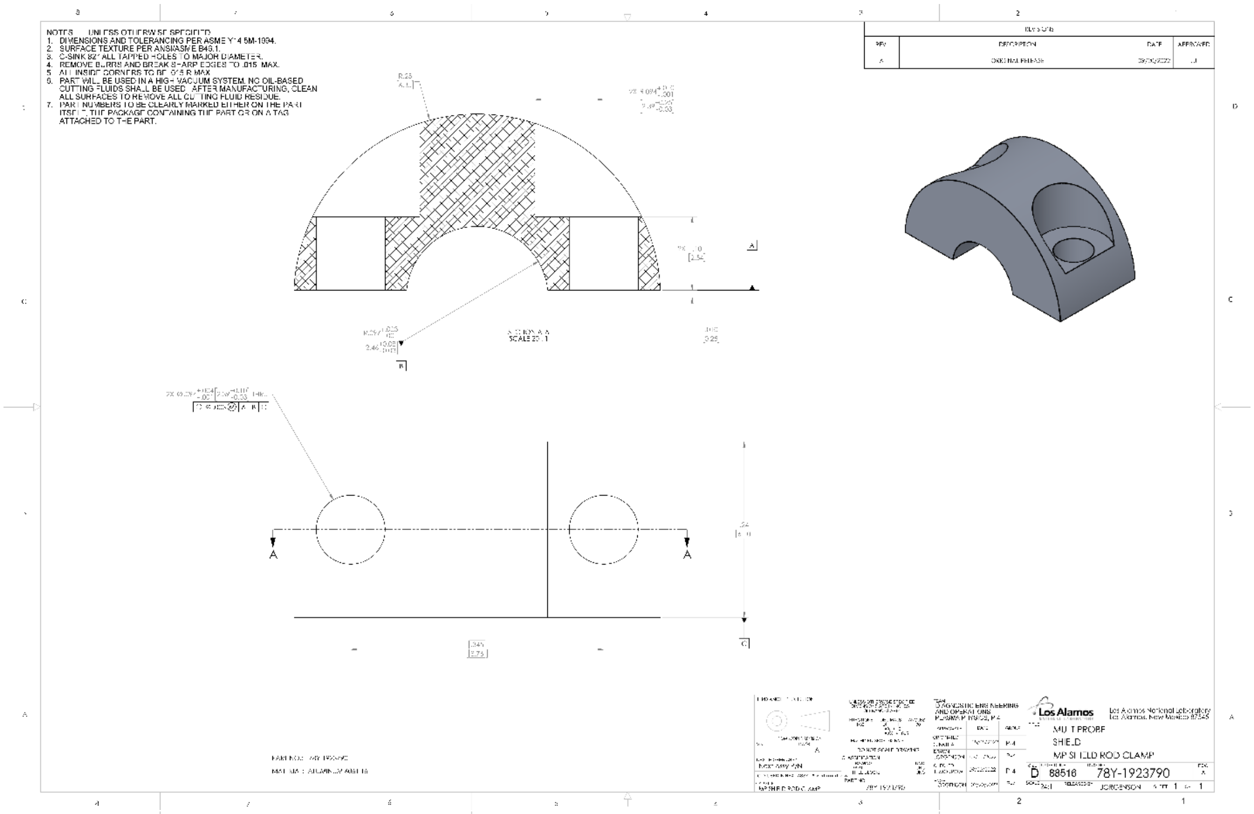


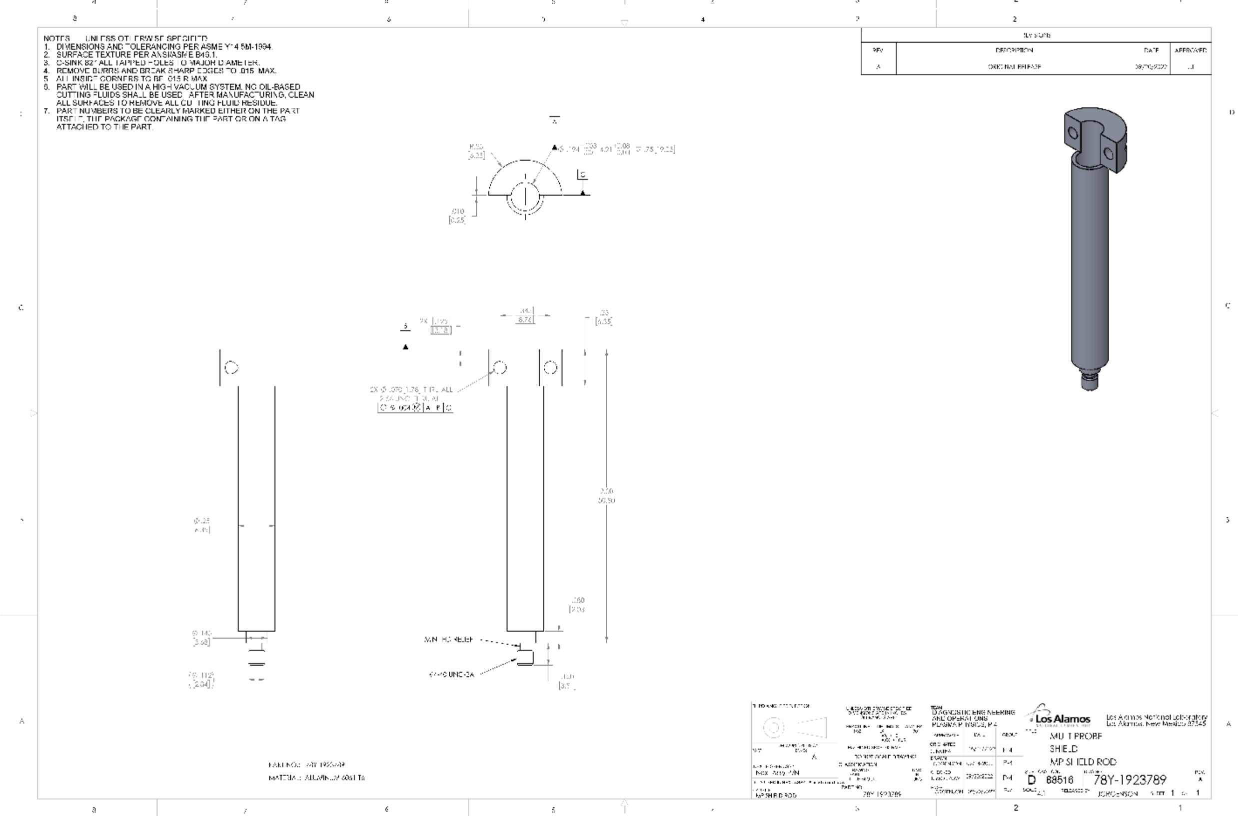
Drawing of the XBLK.


NOTES: UNLESS OTHERWISE SPECIFIED
1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994.
2. SURFACE TEXTURE PER ANSI/ASME B46.1.
3. C-SINK 82° ALL TAPPED HOLES TO MAJOR DIAMETER.
4. REMOVE BURRS AND BREAK SHARP EDGES TO .015 MAX.
5. ALL INSIDE CORNERS TO BE .015 R MAX.
6. PART WILL BE USED IN A HIGH VACUUM SYSTEM. NO OIL-BASED CUTTING FLUIDS SHALL BE USED. AFTER MANUFACTURING, CLEAN ALL SURFACES TO REMOVE ALL CUTTING FLUID RESIDUE.
7. PART NUMBERS TO BE CLEARLY MARKED EITHER ON THE PART ITSELF, THE PACKAGE CONTAINING THE PART OR ON A TAG ATTACHED TO THE PART.
8. REFER TO RFQ OR FORMAL ORDER FOR THICKNESS AND MATERIAL REQUIREMENTS.
DIAGNOSTIC ENGINEERING AND OPERATIONS PLASMA PHYSICS, P-4
Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545
MULTI PROBE
SHIELD
MP SHIELD BLOCK
D 88516
78Y-1923786
A
JORGENSON
SHEET 1 OF 1

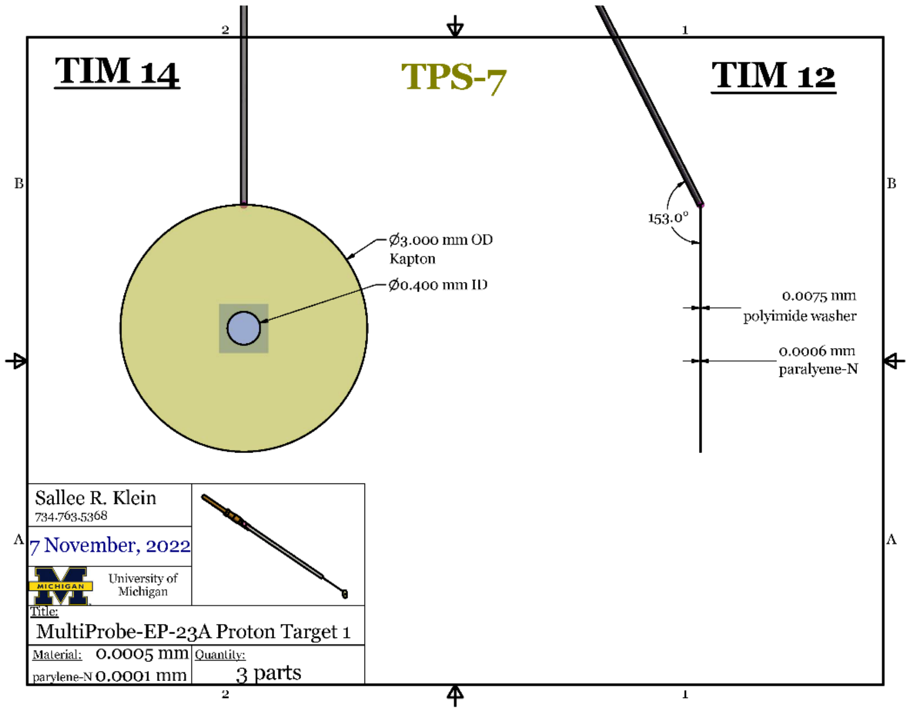

NOTES: UNLESS OTHERWISE SPECIFIED
1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994.
2. SURFACE TEXTURE PER ANSI/ASME B46.1-1985
3. C-SINK 82° ALL TAPPED HOLES TO MAJOR DIAMETER.
4. REMOVE BURRS AND BREAK SHARP EDGES TO .015 MAX.
5. ALL INSIDE CORNERS TO BE .015 R MAX.
6. PART WILL BE USED IN A HIGH VACUUM SYSTEM. NO OIL-BASED CUTTING FLUIDS SHALL BE USED. AFTER MANUFACTURING, CLEAN ALL SURFACES TO REMOVE ALL CUTTING FLUID RESIDUE.
7. PART NUMBERS TO BE CLEARLY MARKED EITHER ON THE PART ITSELF, THE PACKAGE CONTAINING THE PART OR ON A TAG ATTACHED TO THE PART.
Los Alamos
Los Alamos National Laboratory Los Alamos, New Mexico 87545
MULTIPROBE
SHIELD
MP SHIELD CAP
D 88516 78Y-1923788


NOTES: UNLESS OTHERWISE SPECIFIED
1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1994.
2. SURFACE TEXTURE PER ANSI/ASME B46.1.
3. C-SINK 82° ALL TAPPED HOLES TO MAJOR DIAMETER.
4. REMOVE BURRS AND BREAK SHARP EDGES TO .015 MAX.
5. ALL INSIDE CORNERS TO BE .015 R MAX.
6. PART WILL BE USED IN A HIGH VACUUM SYSTEM. NO OIL-BASED CUTTING FLUIDS SHALL BE USED. AFTER MANUFACTURING, CLEAN ALL SURFACES TO REMOVE ALL CUTTING FLUID RESIDUE.
ENGRAVE OR LASER ETCH PART NUMBER AND REVISION IN APPROXIMATE HEIGHT AND LOCATION SHOWN.
VIEW B-B
78Y-1923787 REV A
SECTION A-A
Los Alamos
Los Alamos National Laboratory Los Alamos, New Mexico 87545
MULTIPROBE
SHIELD
MP SHIELD FRAME
D 88516 78Y-1923787

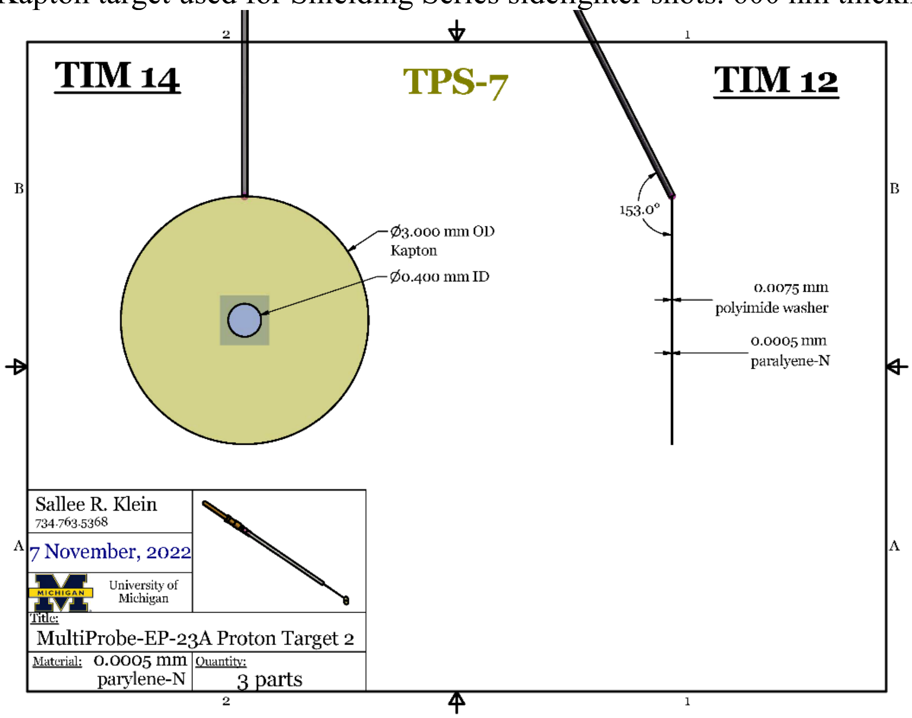




Drawing of the targets.

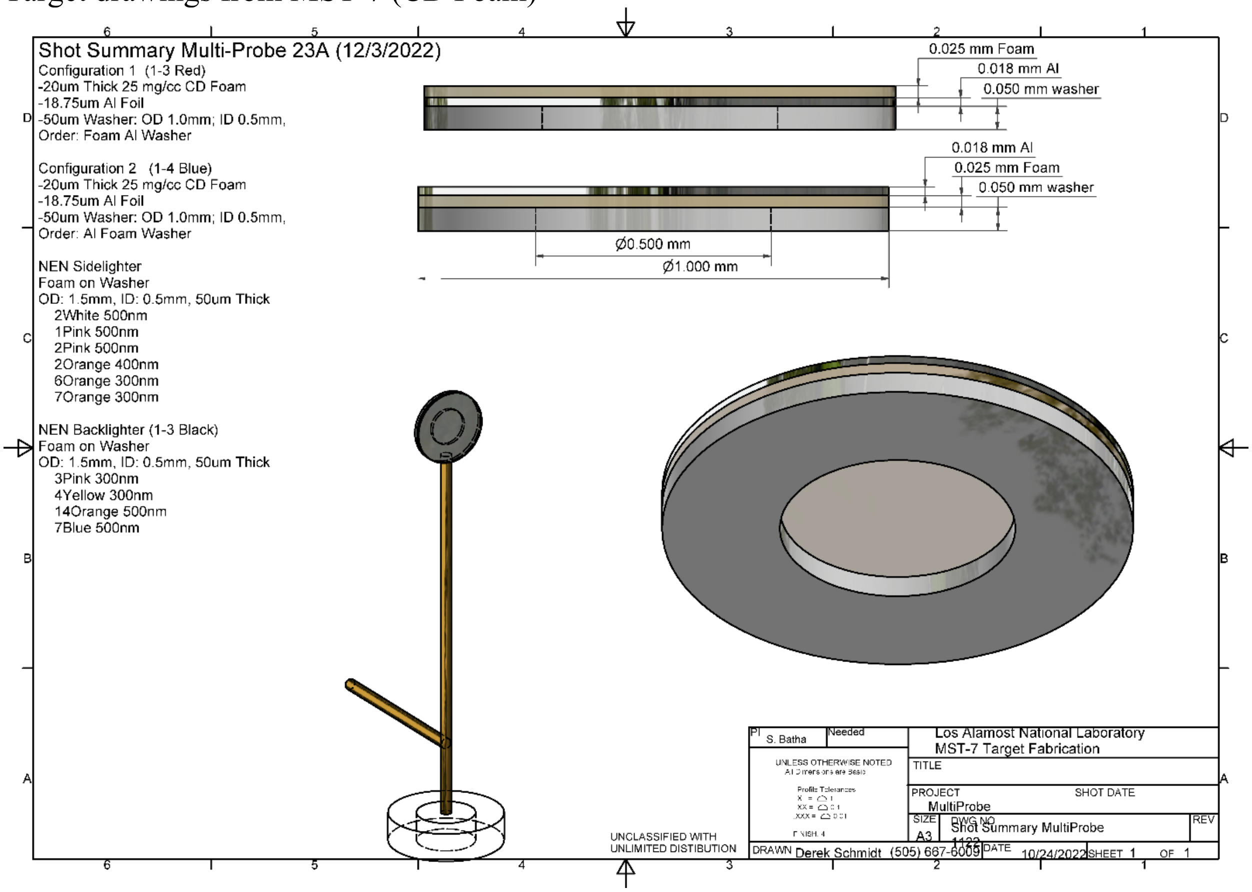


Kapton target used for Shielding Series sidelighter shots. 600 nm thickness. Held with TPS-7



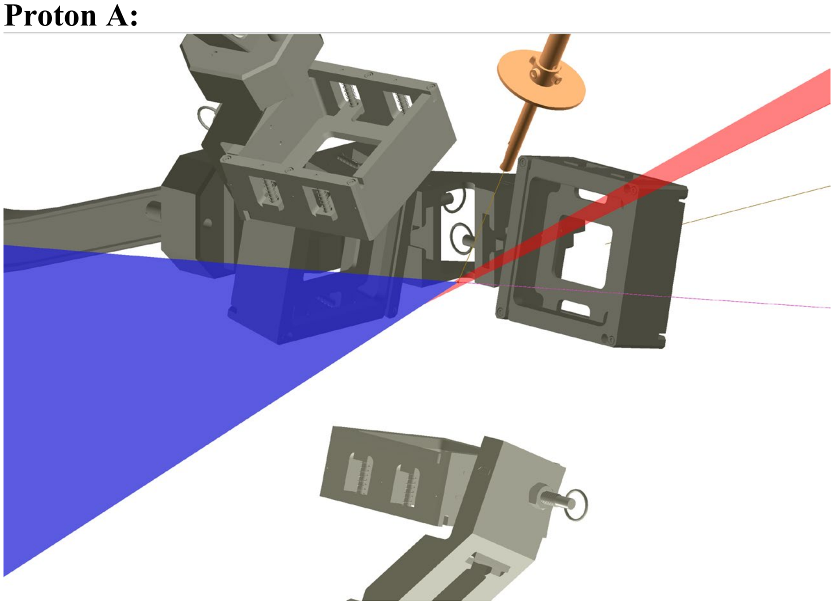
Kapton target used for Shielding Series sidelighter shots. 500 nm thickness. Held with TPS-7

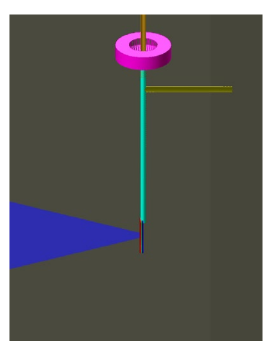
Target drawings from MST-7 (CD Foam)



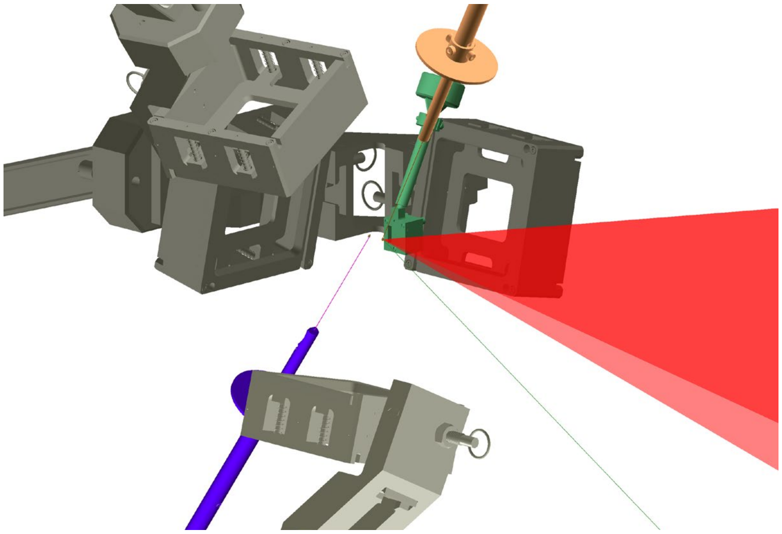
Appendix B: VisRad layouts

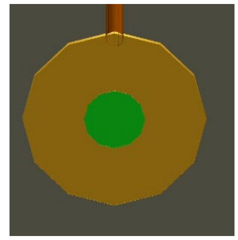
Proton A:

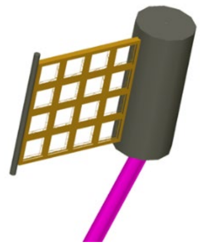




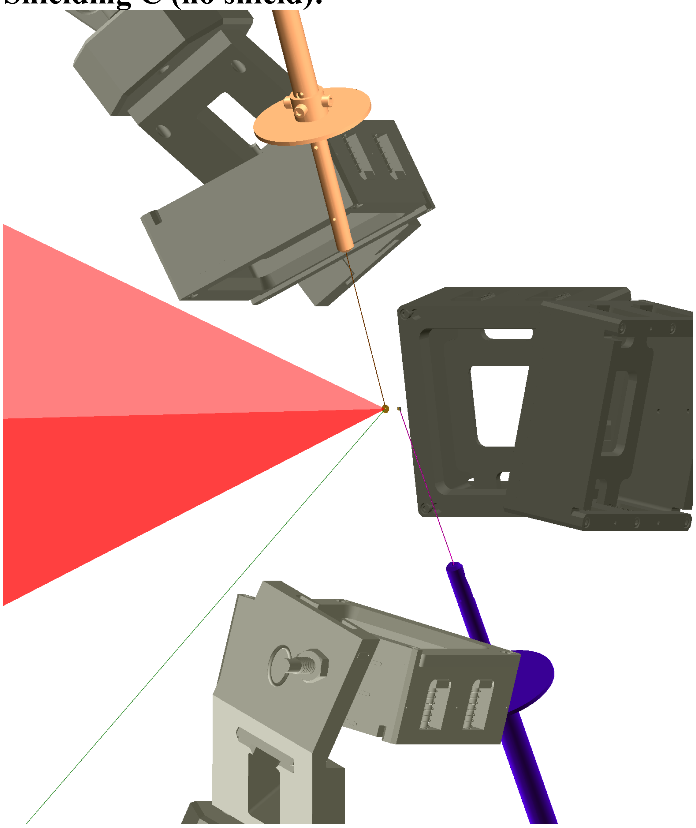
Shielding B:







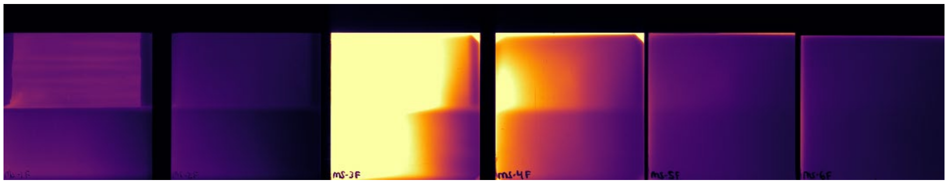
Shielding C (no shield):



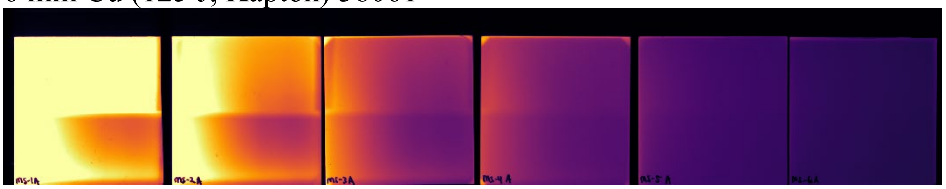
Appendix C: Raw IP and RCF images from the day

Image plate data

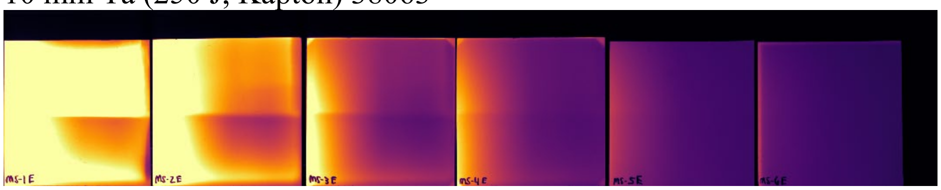
NTA-14 (XBLK)
No Shield (125 J, Kapton) 38059



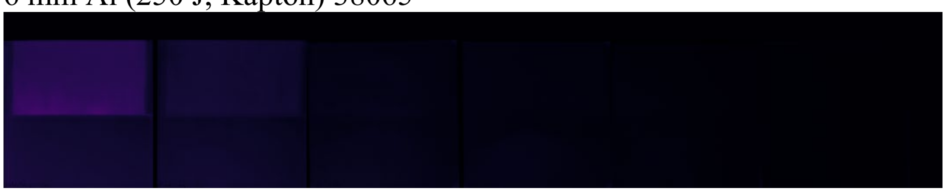
6 mm Cu (125 J, Kapton) 38061



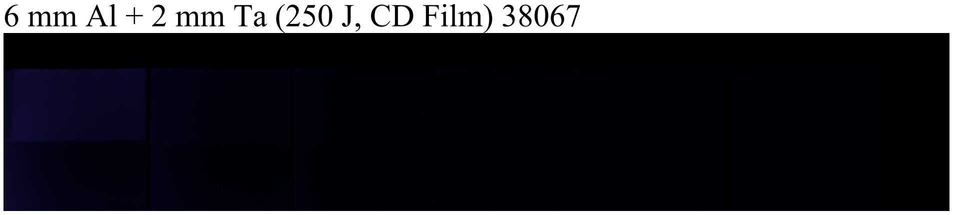
10 mm Ta (250 J, Kapton) 38063



6 mm Al (250 J, Kapton) 38065

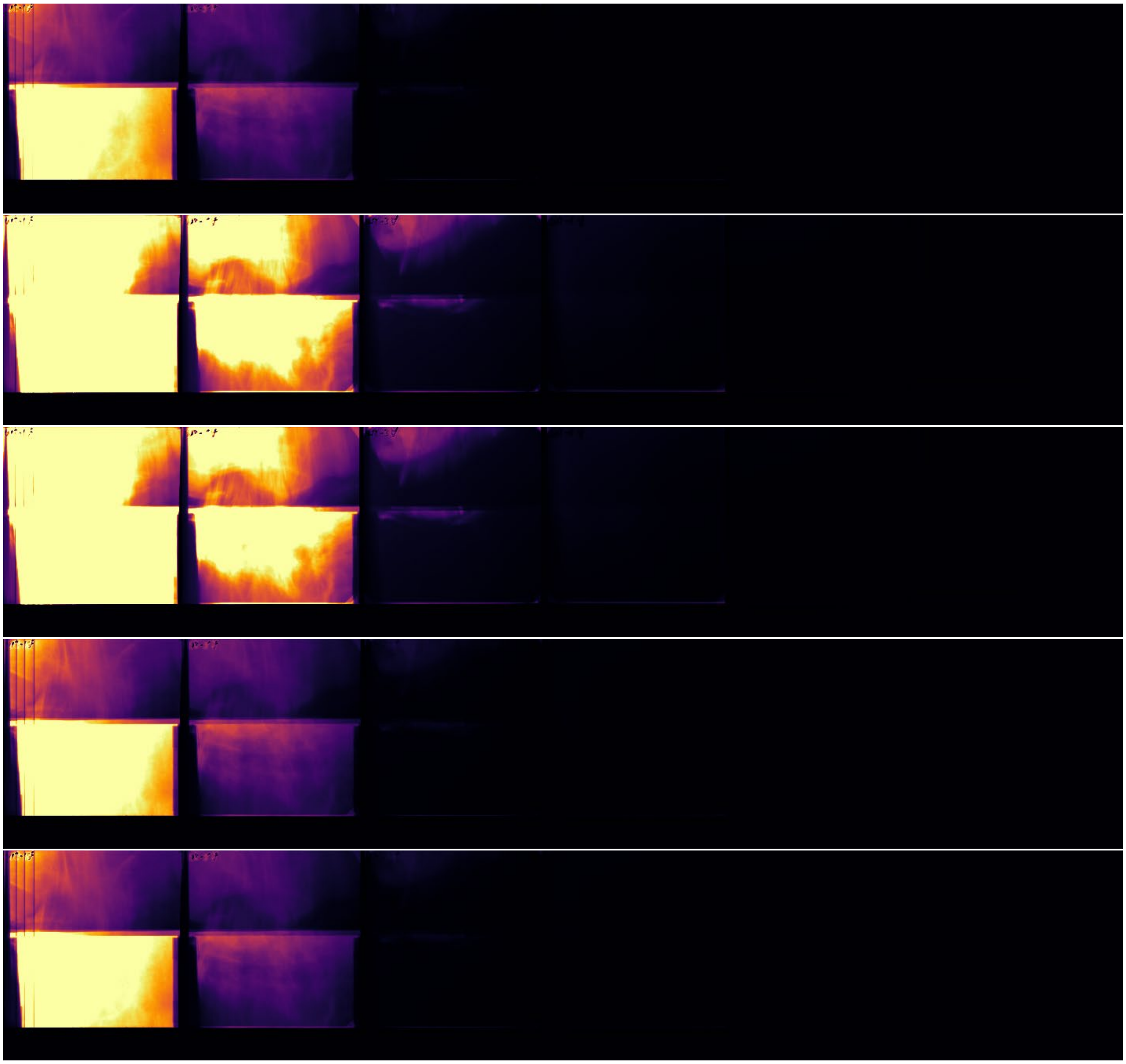


6 mm Al + 2 mm Ta (250 J, CD Film) 38067

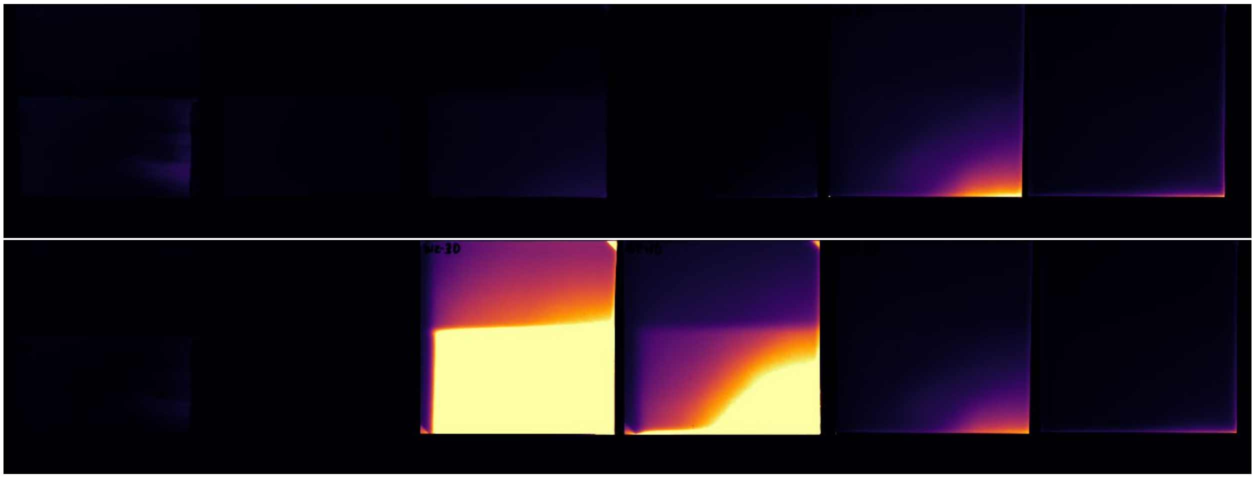


6 mm Al + 1 mm Ta (250 J, CD Film)

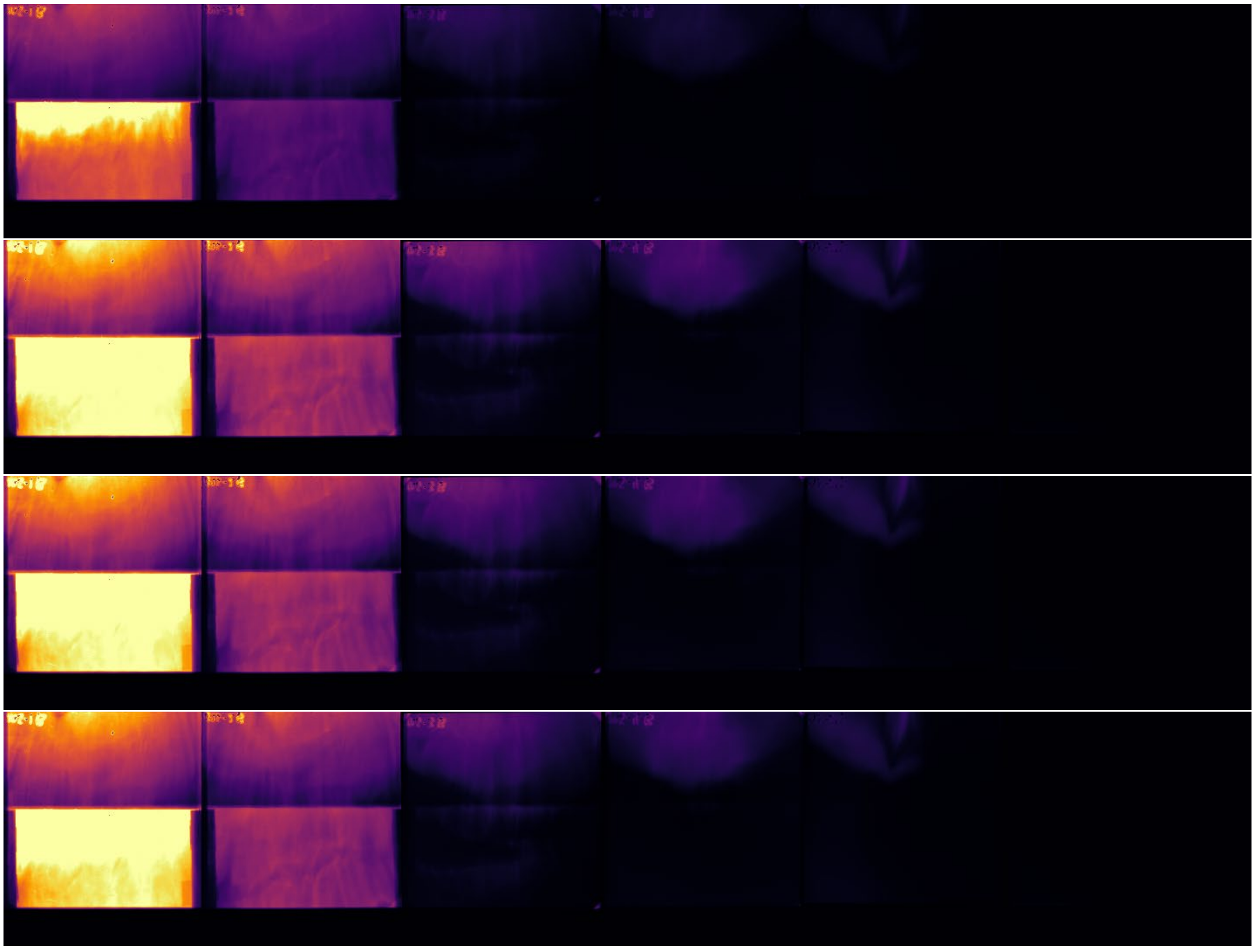
NTA11 data (Note: many, if not all, required the IPs to be erased for ~10 seconds prior to scanning. Also they are upside down)
38058

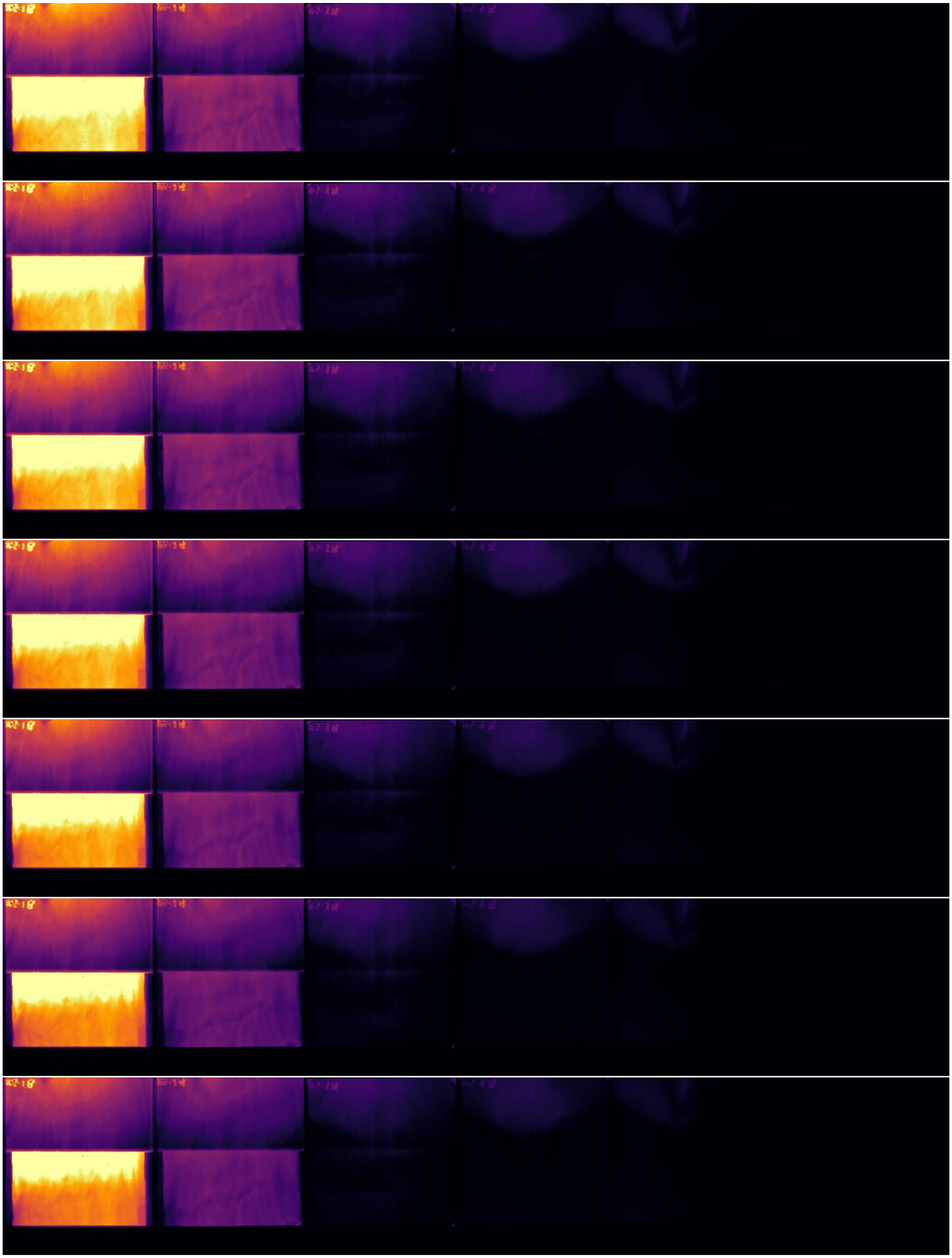


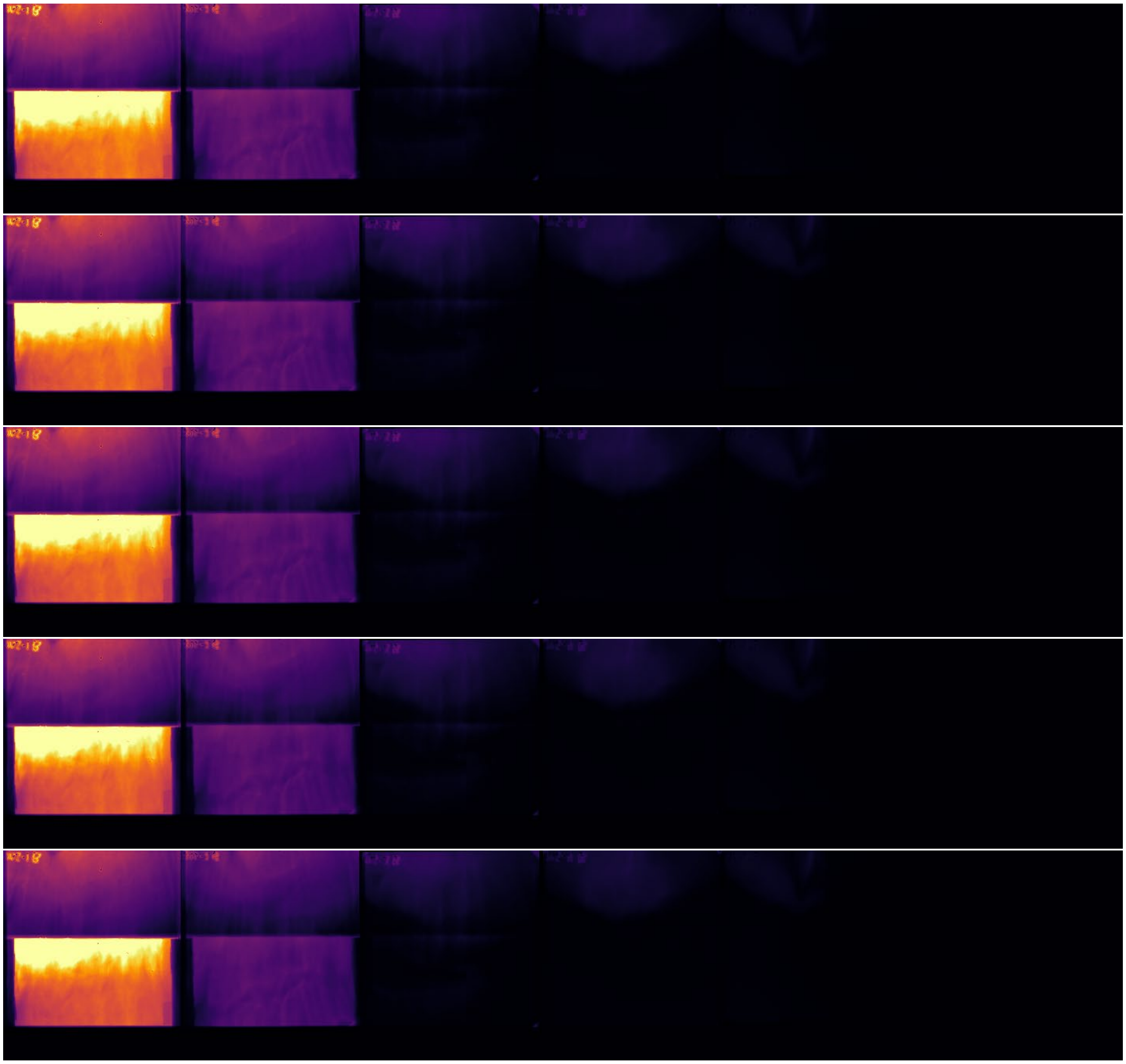
38059



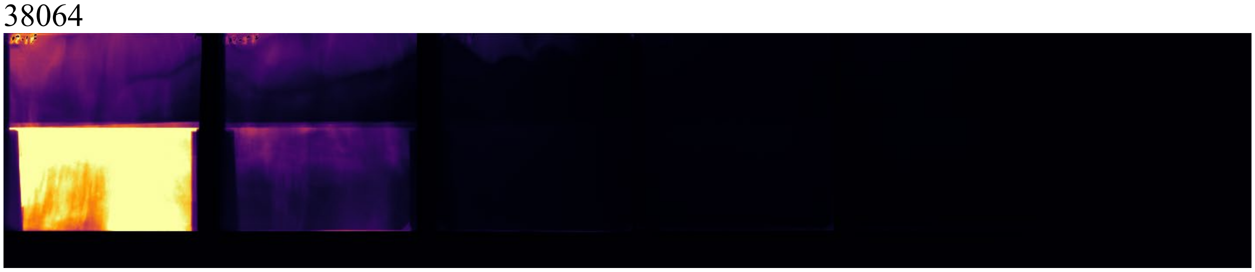
38062





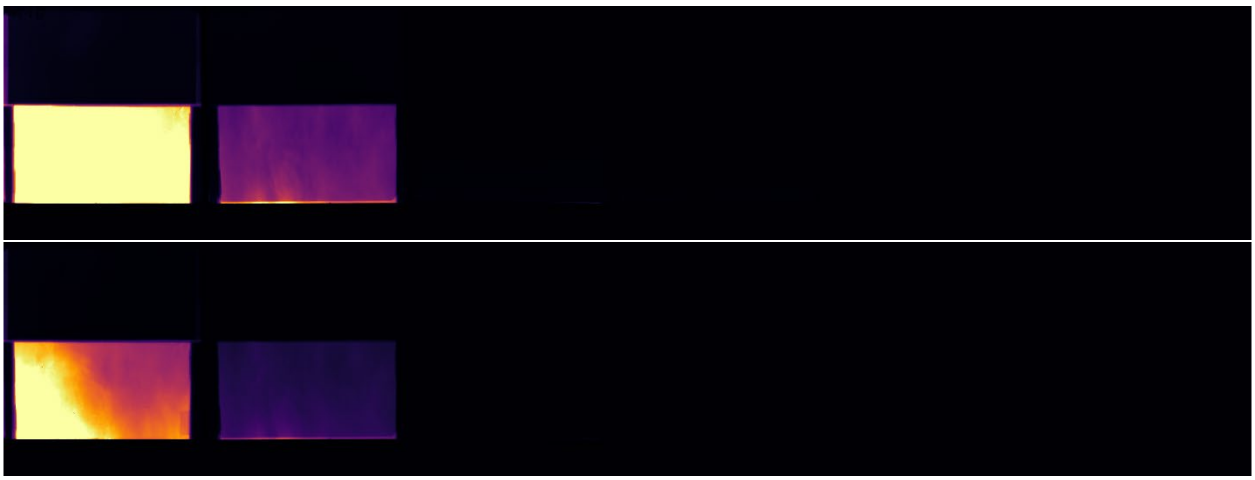


38064



38065

NTA13
38058



38059

38062

38064

38065

TPIE data

38058

38060

38062

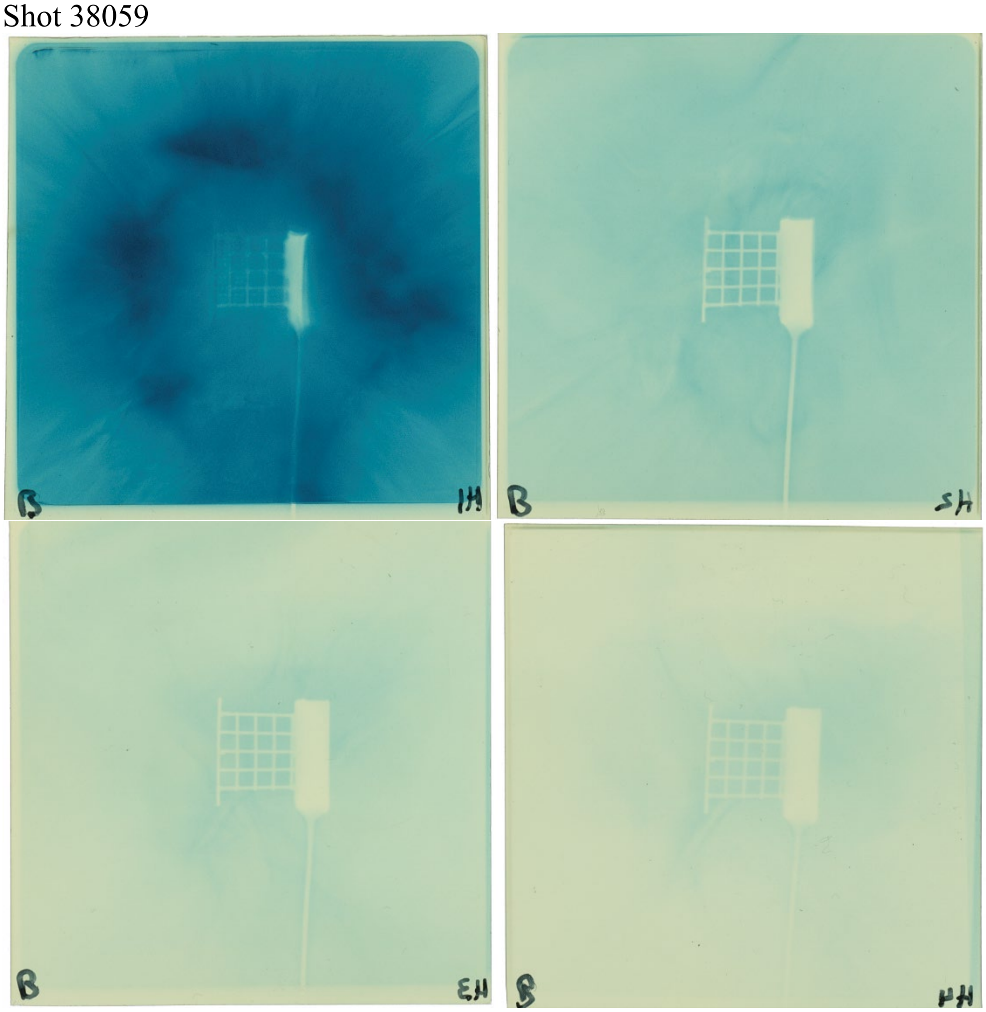
38064

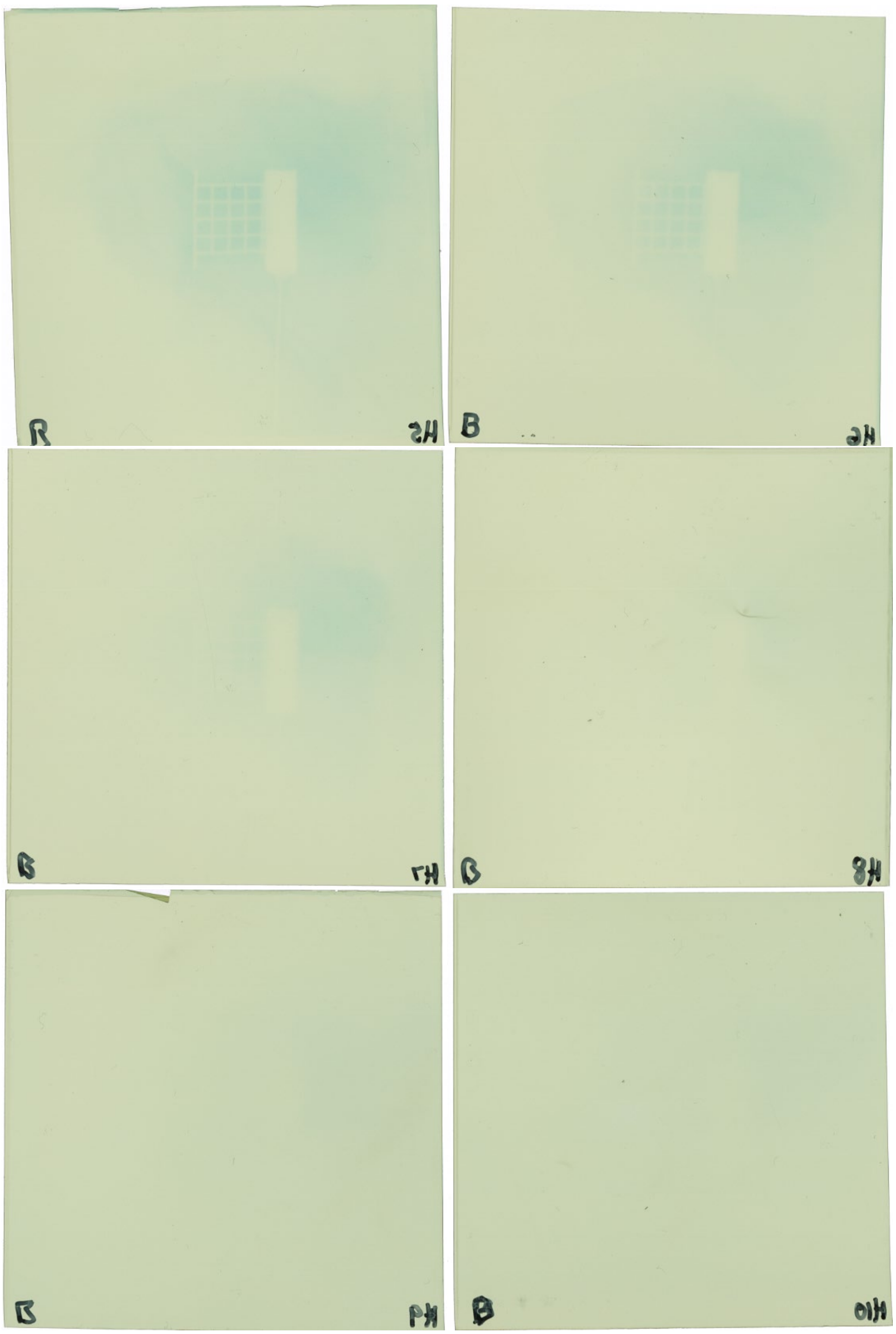
38066

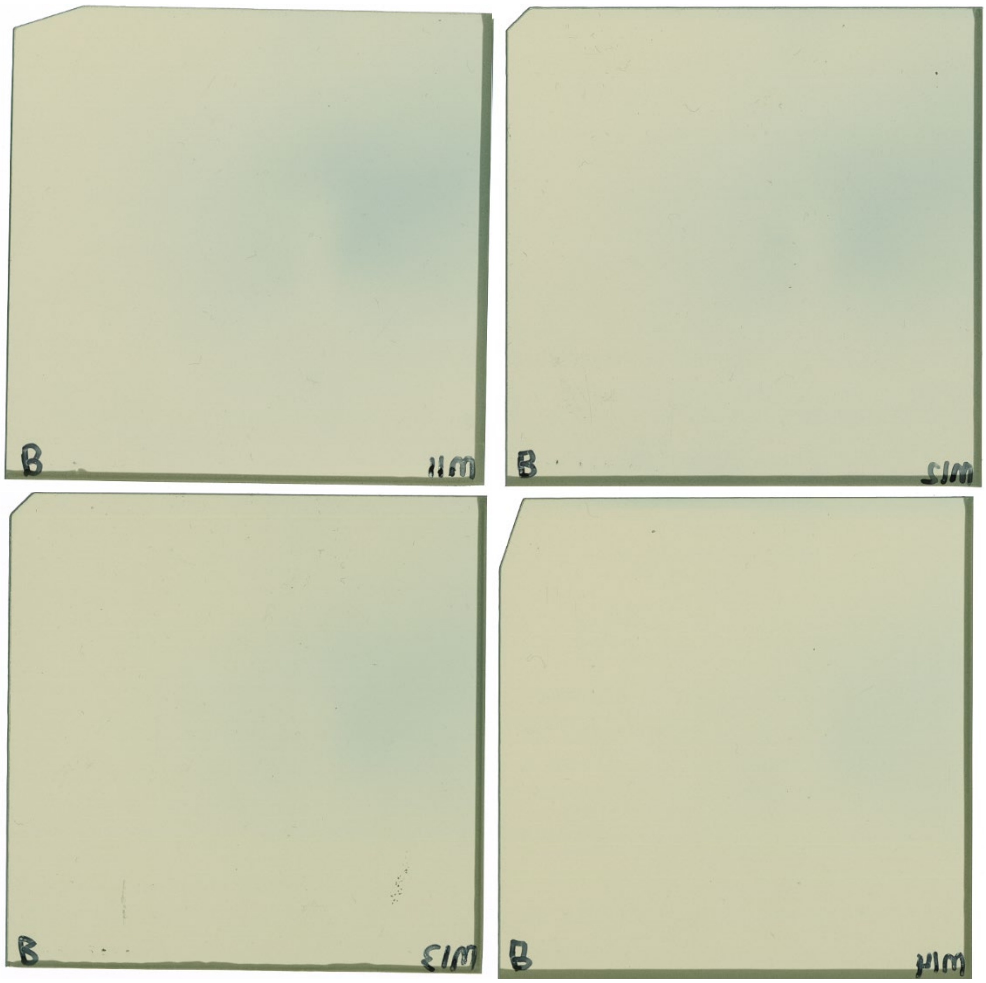
38068

RCF radiographs

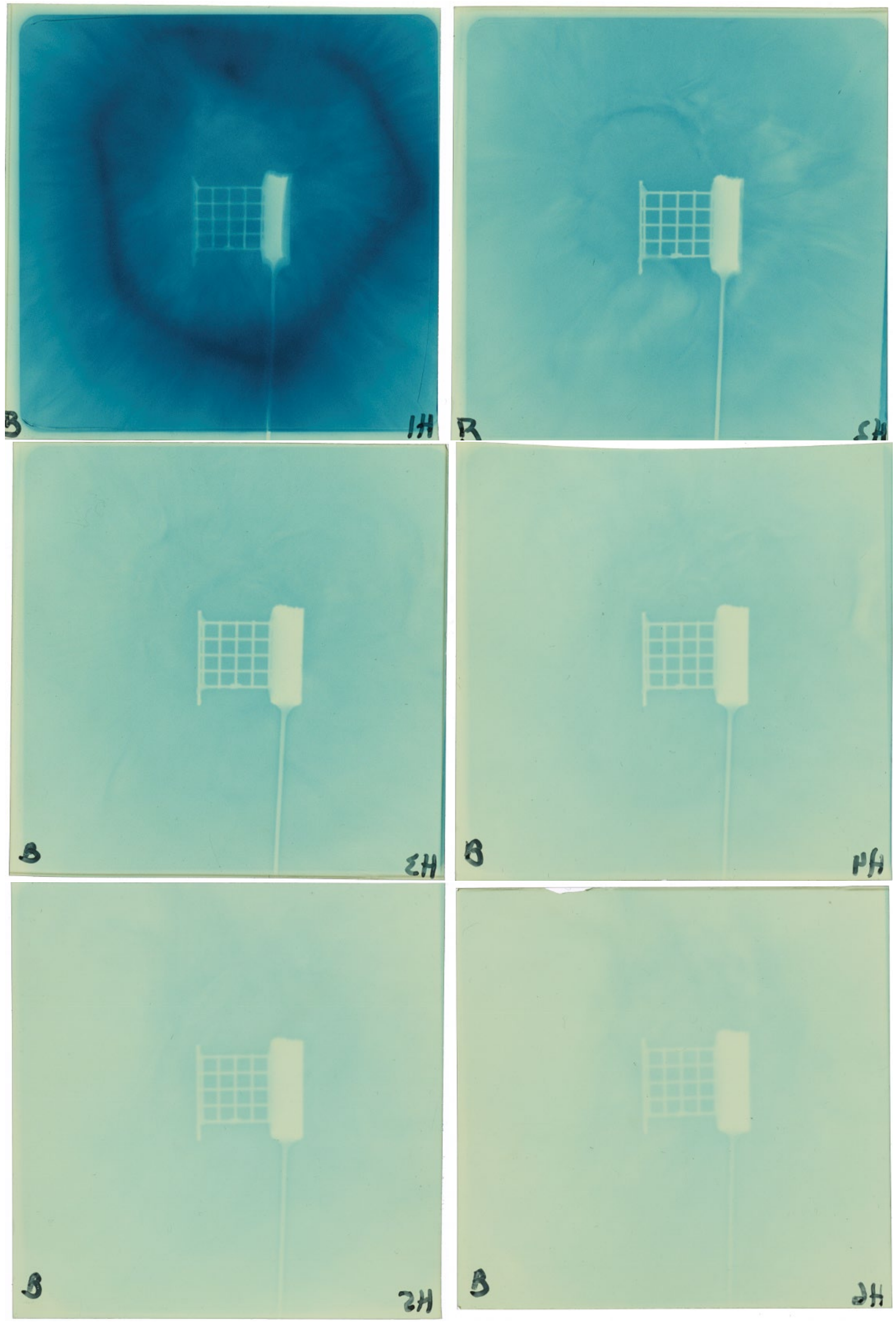
Shot 38059

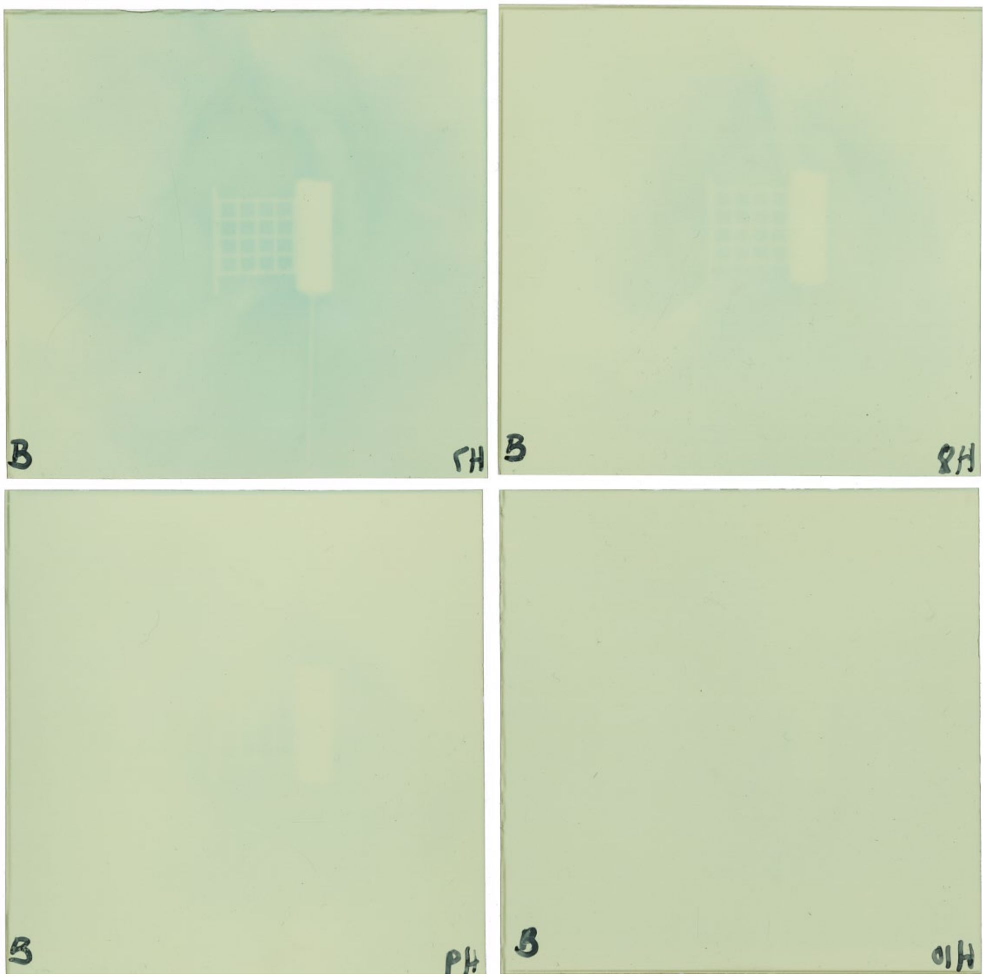


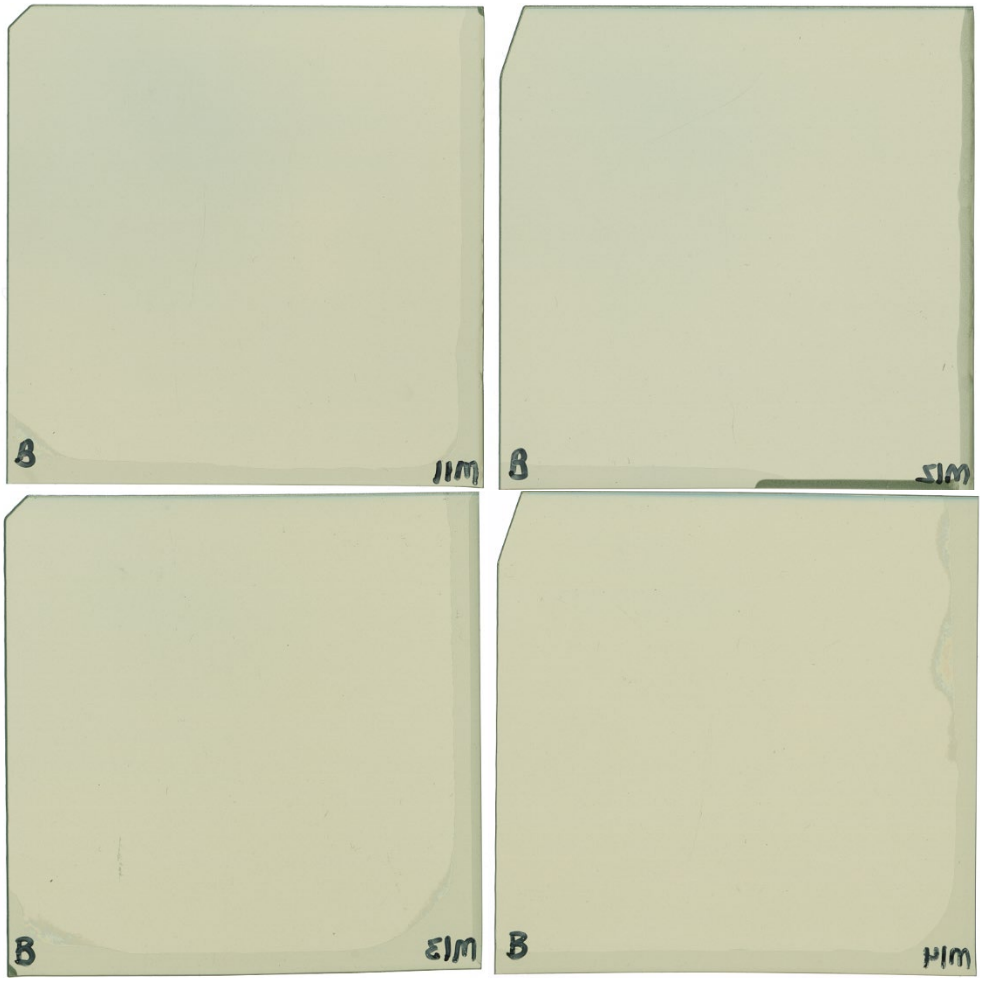




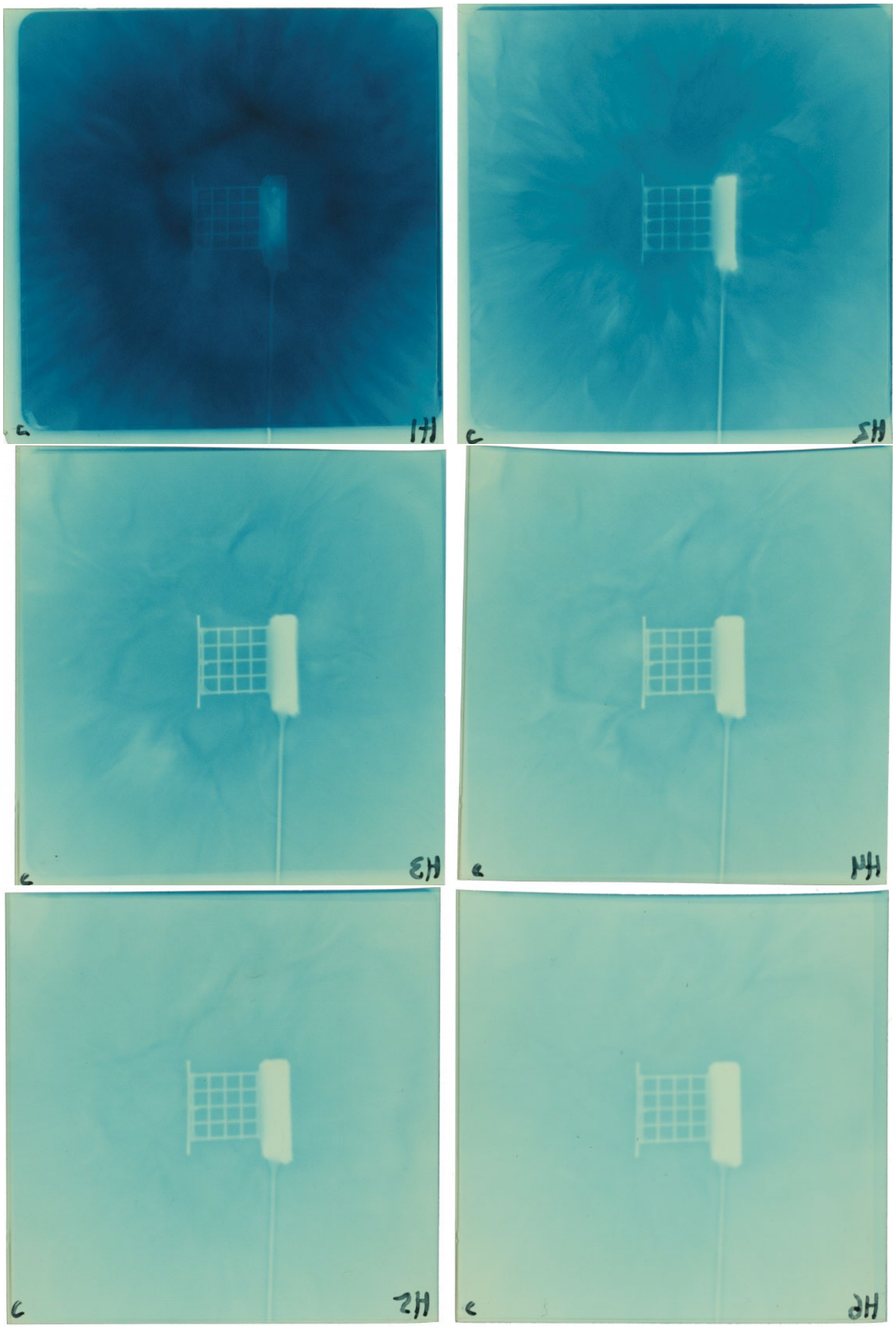
Shot 38061

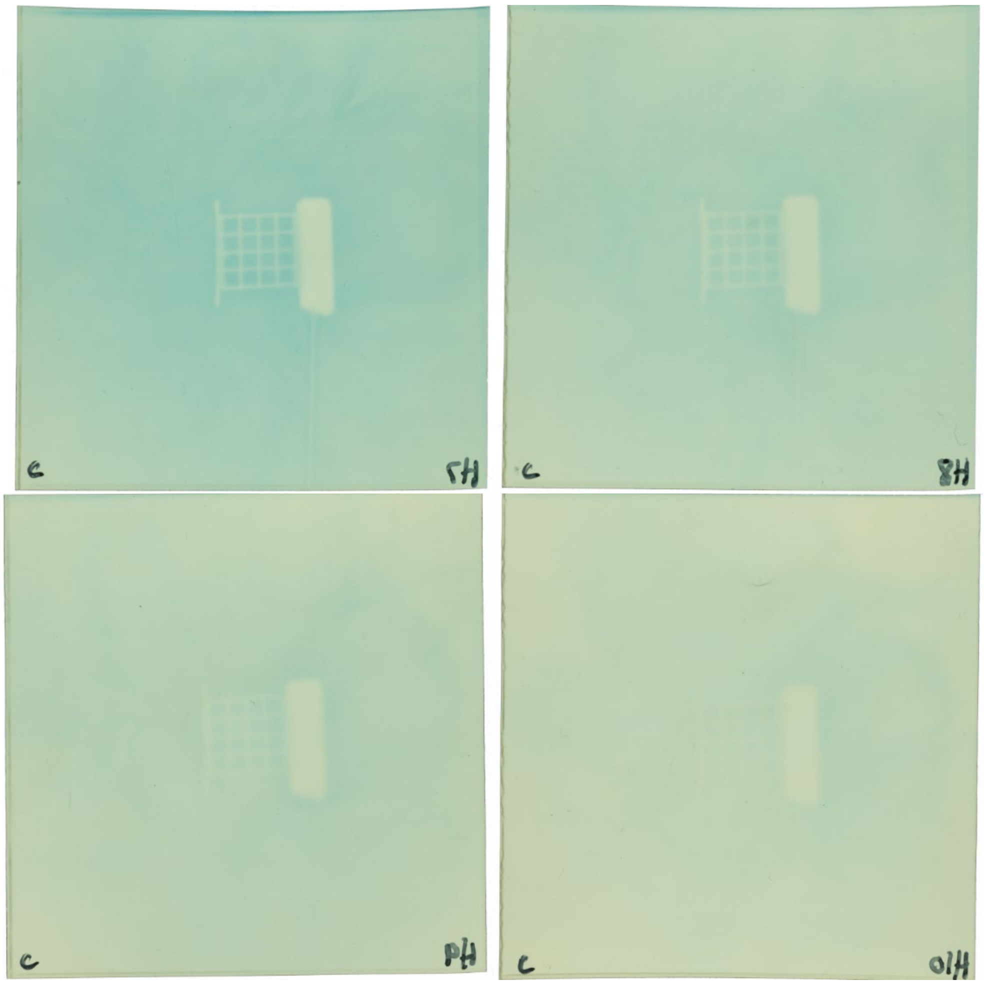


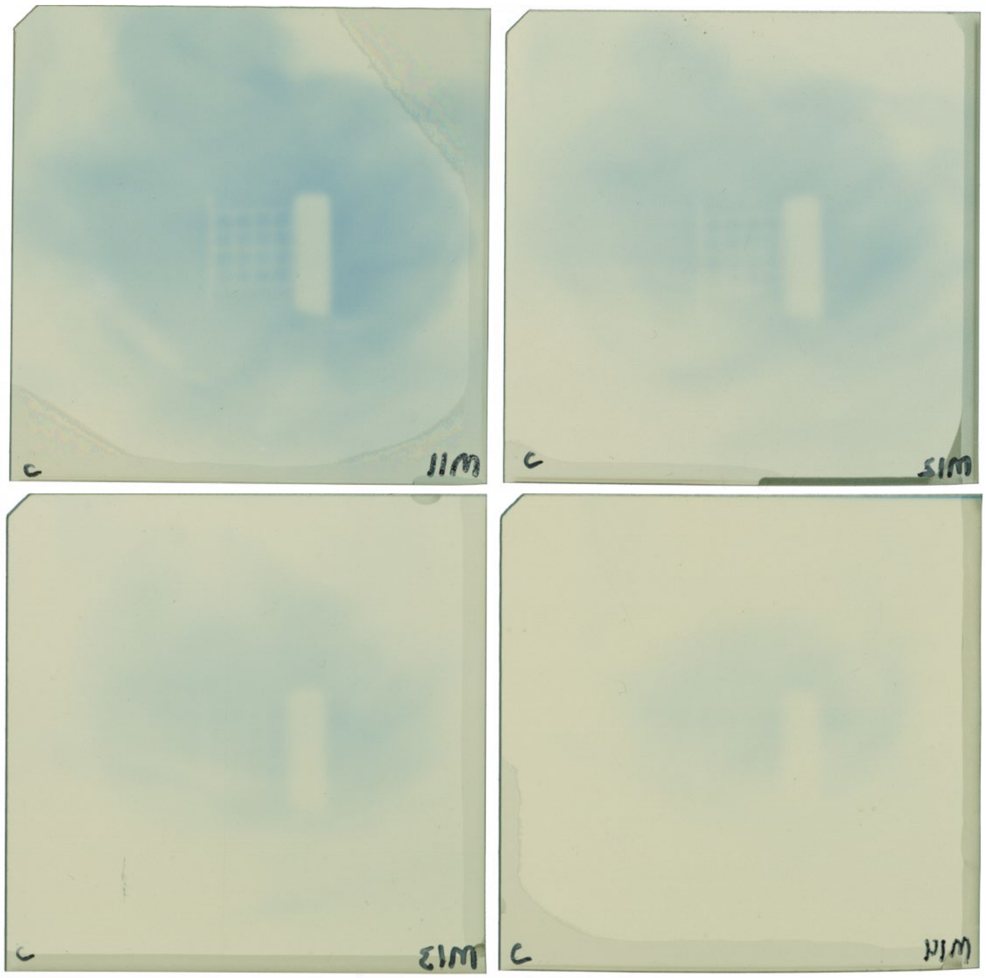




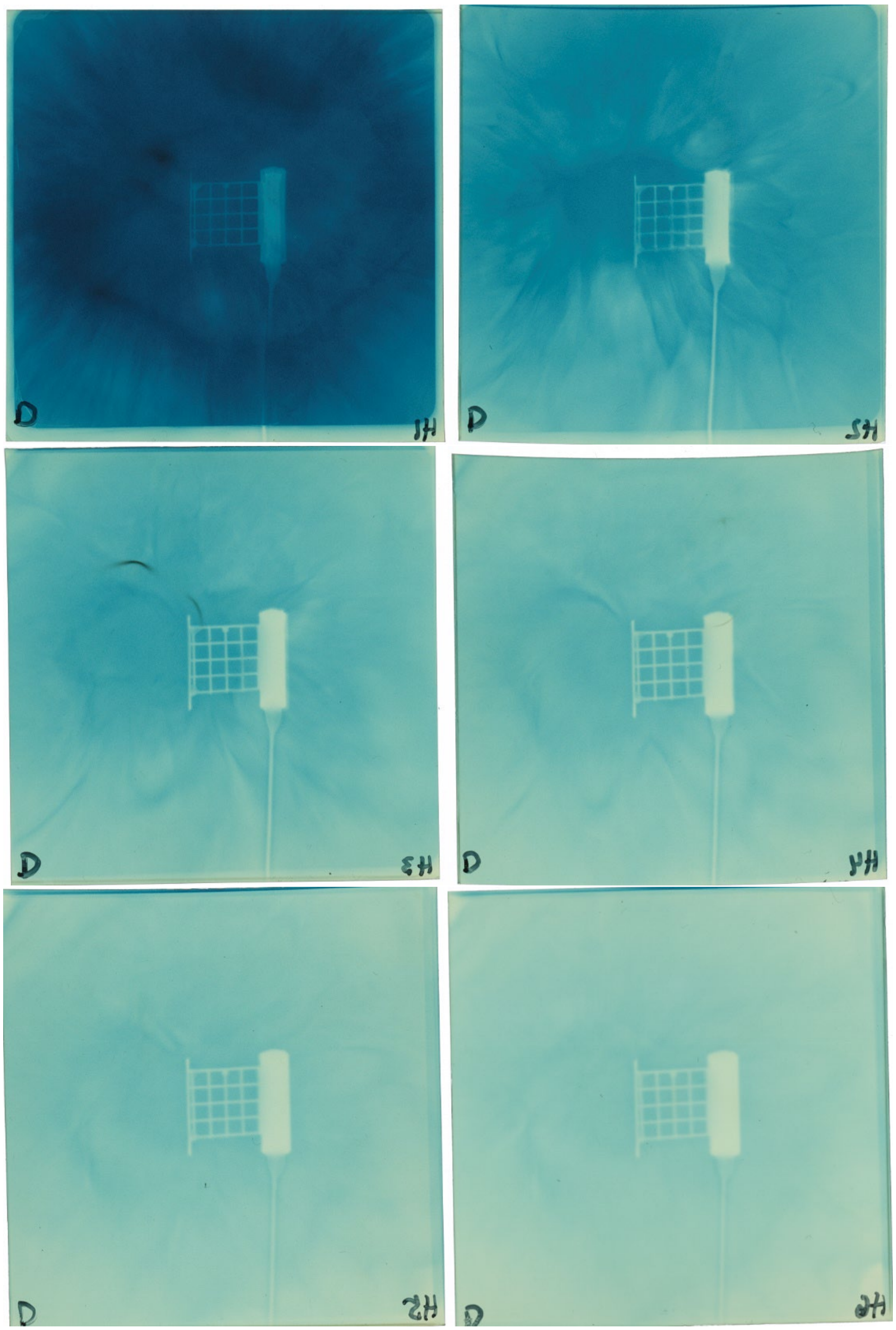
Shot 38063

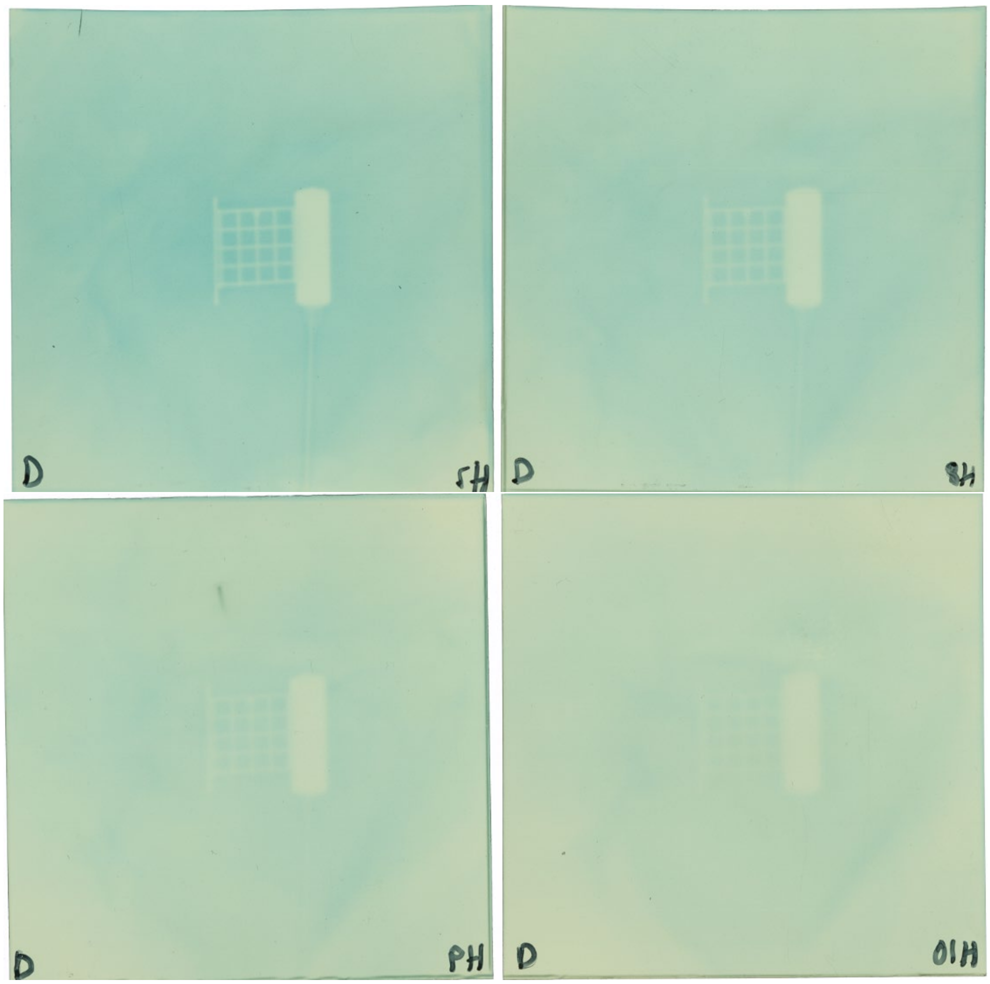


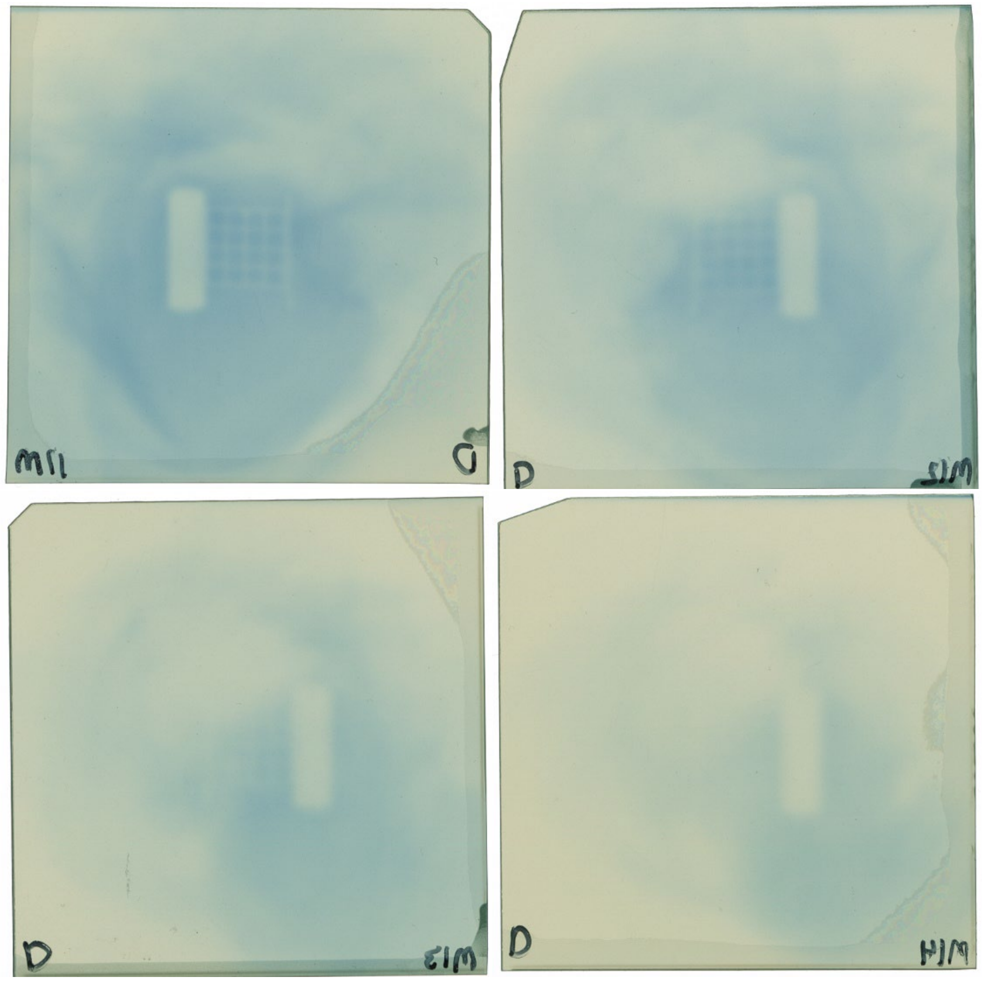




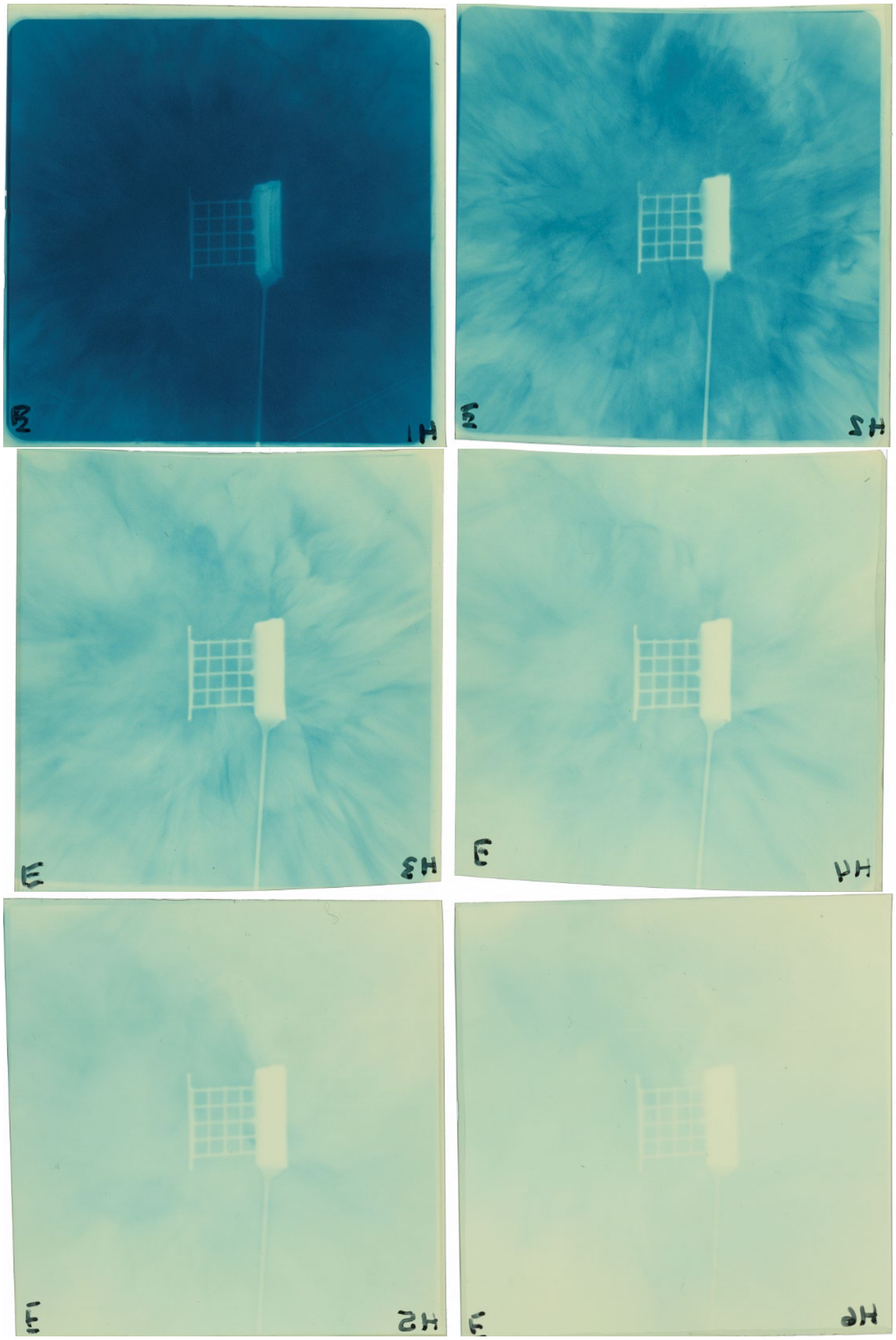
Shot 38065

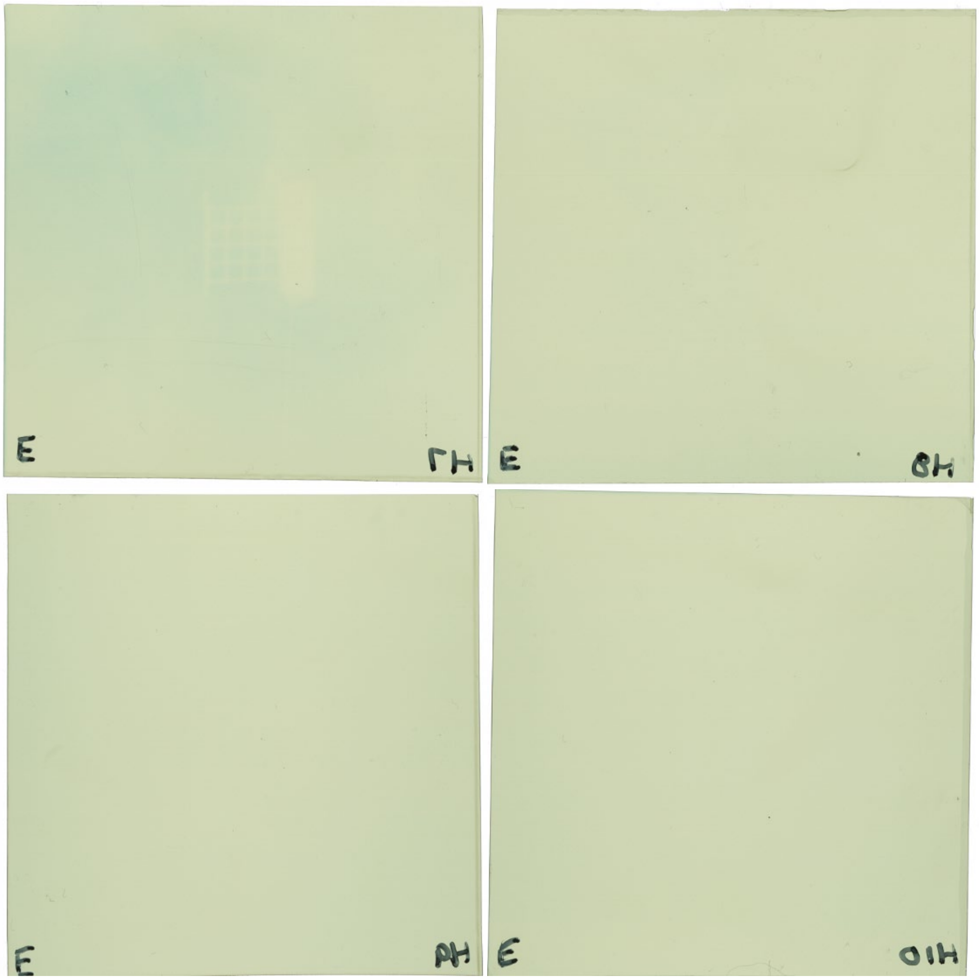


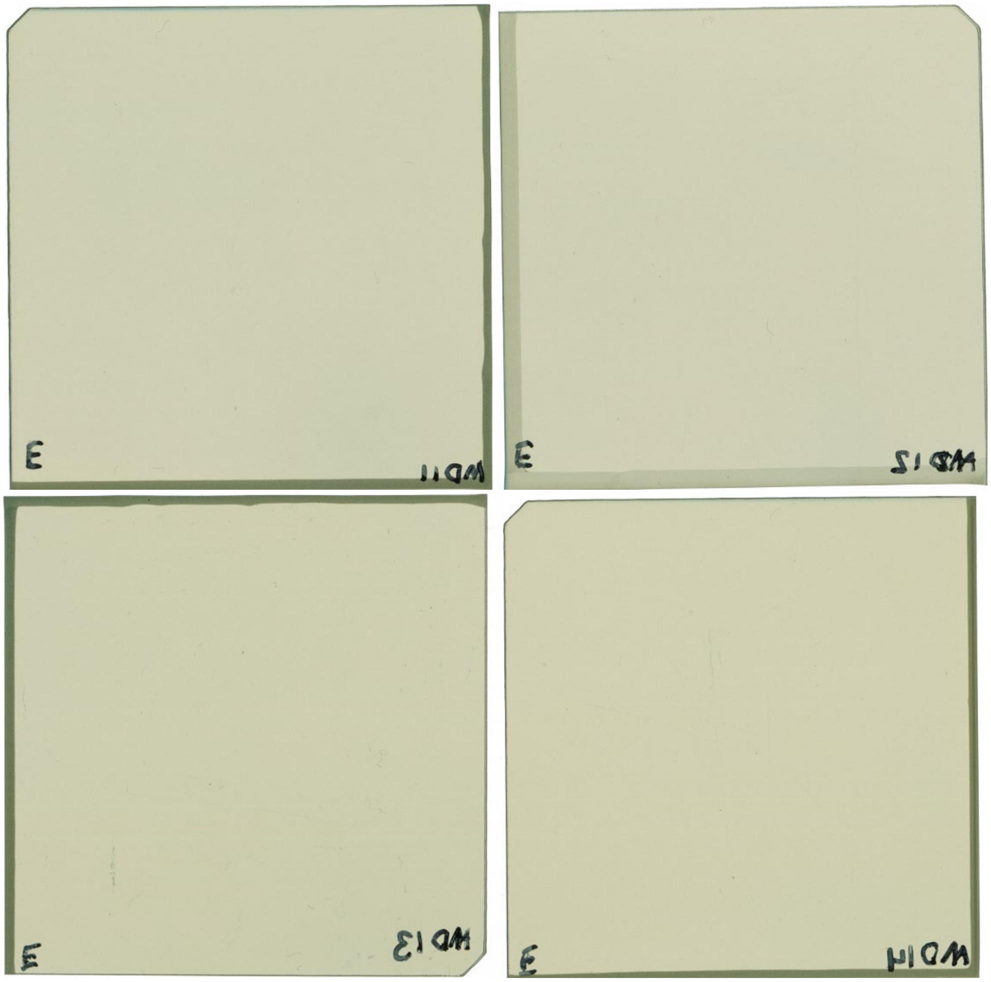




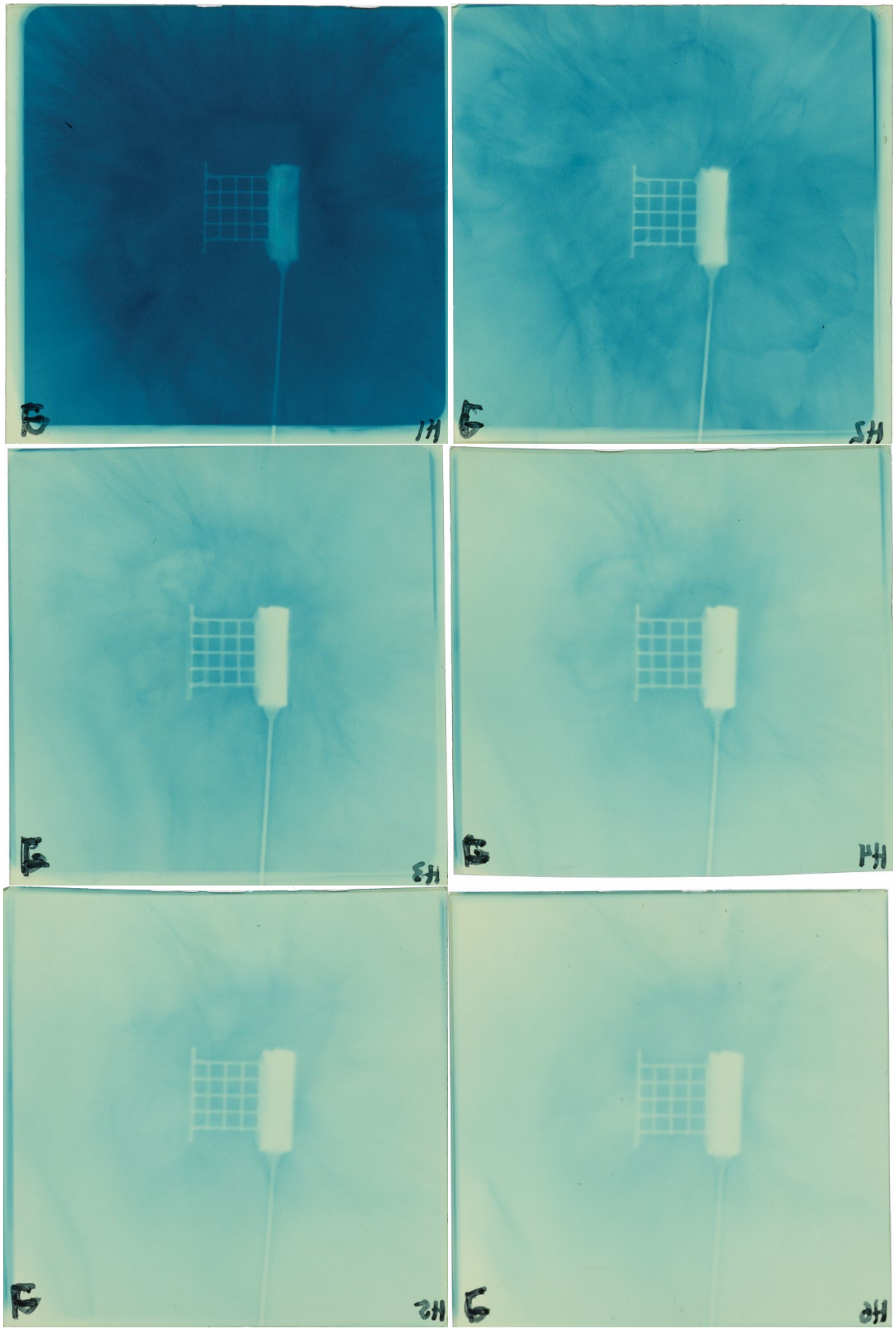
Shot 38067

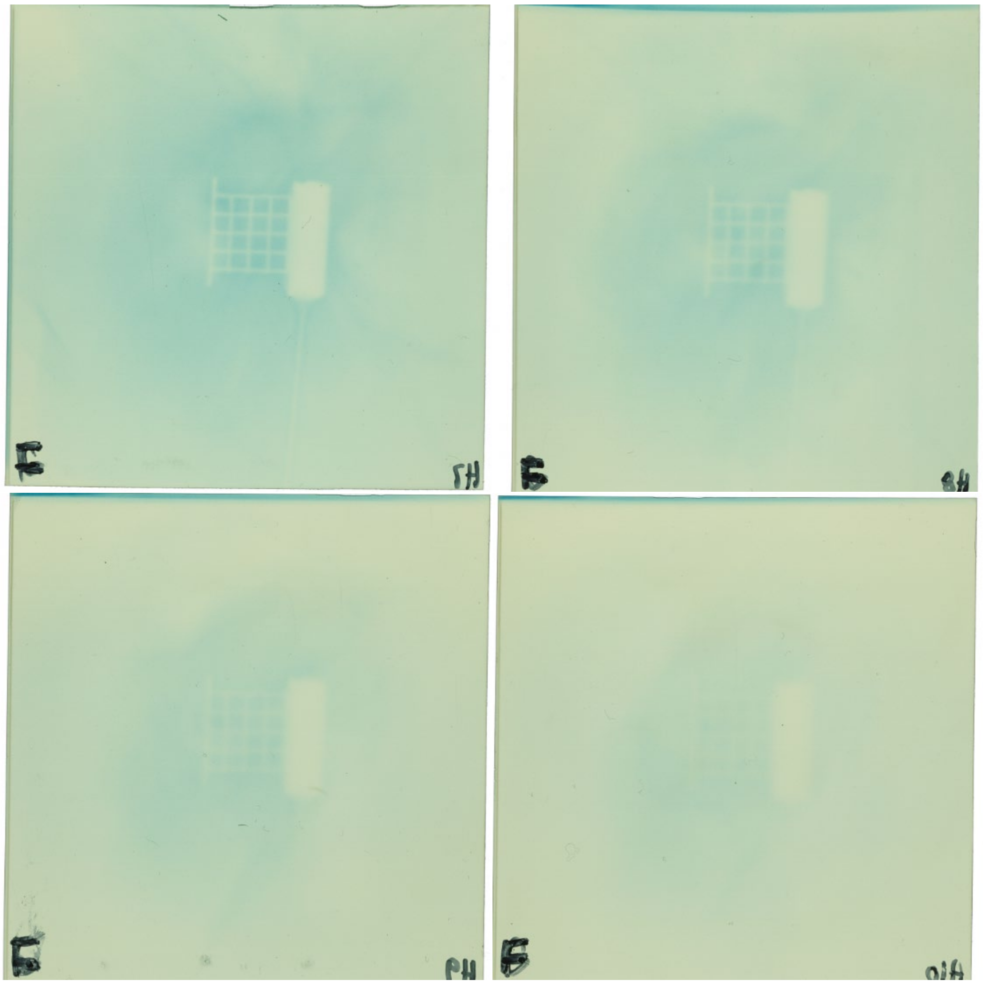


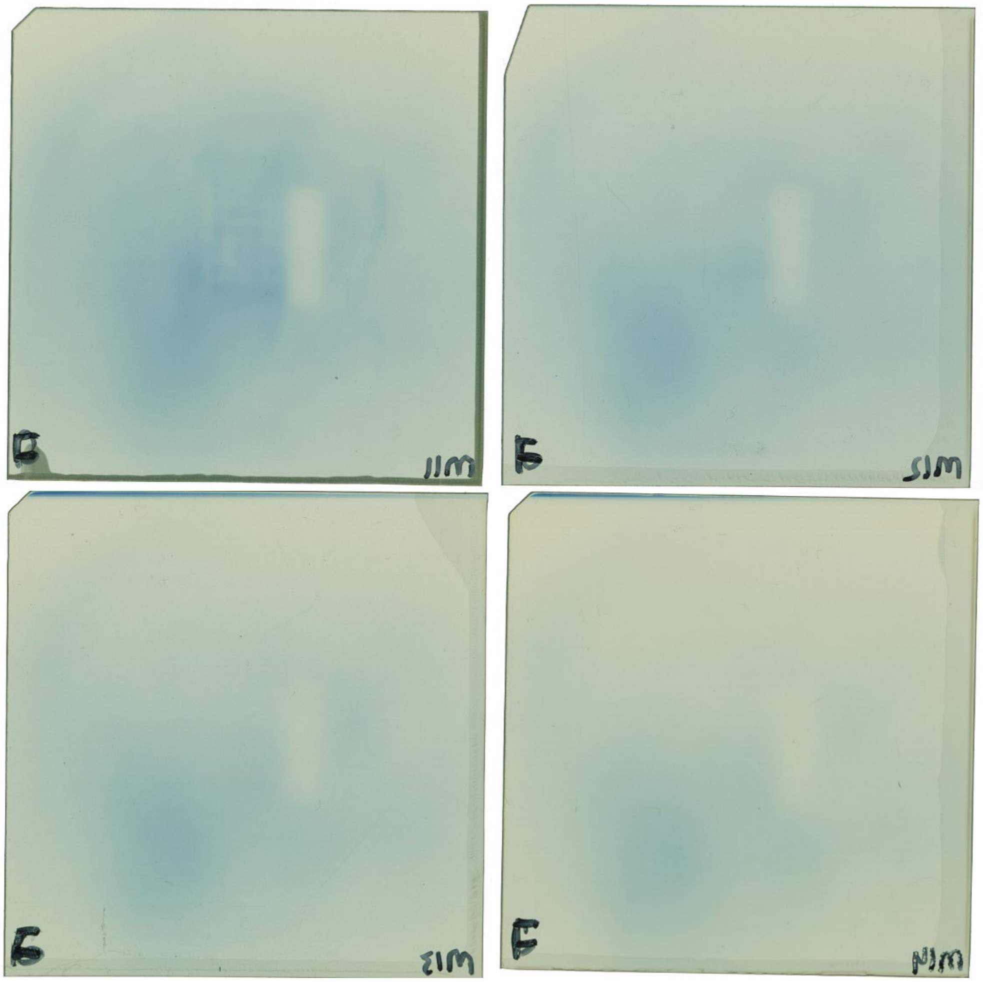




Shot 38069

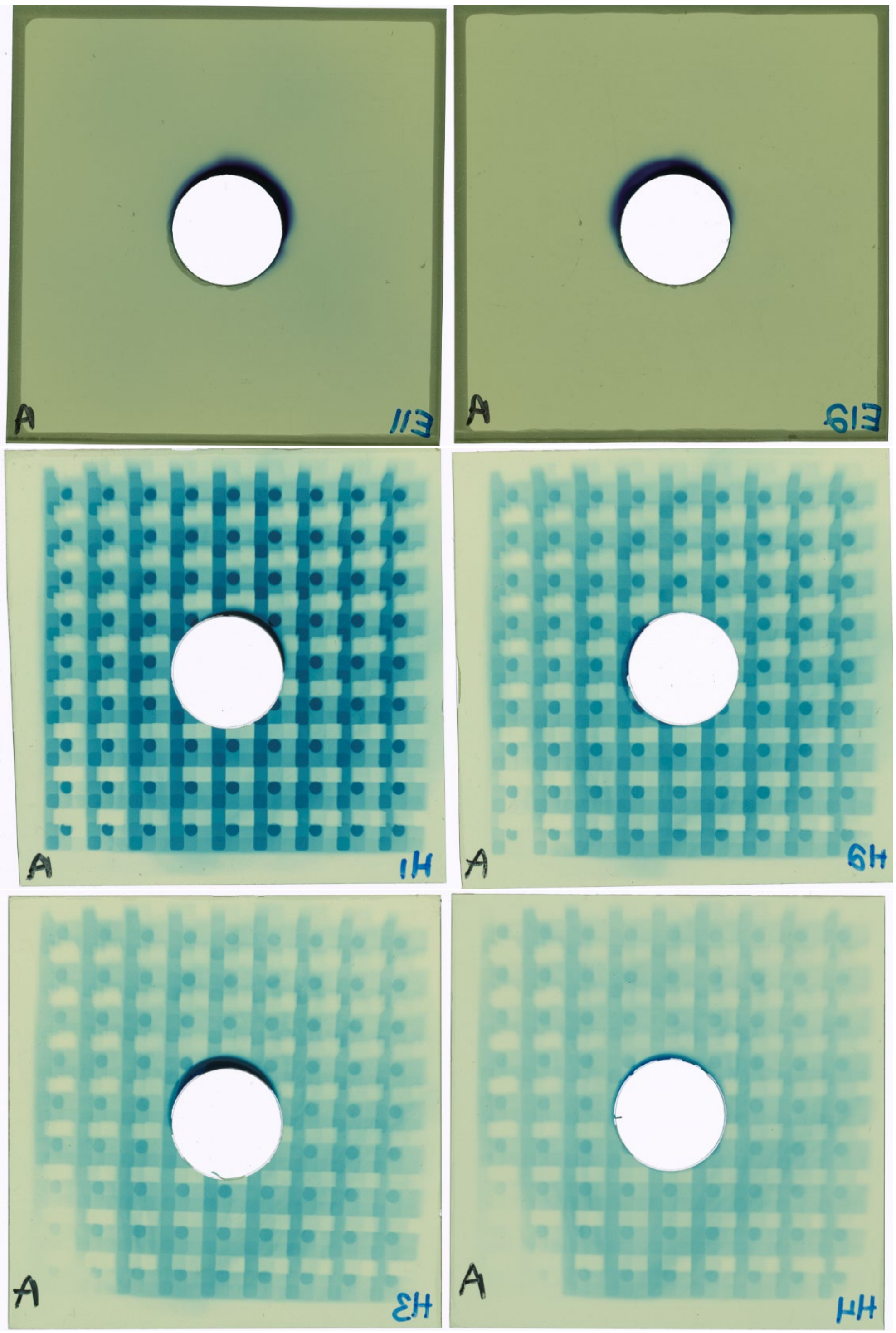


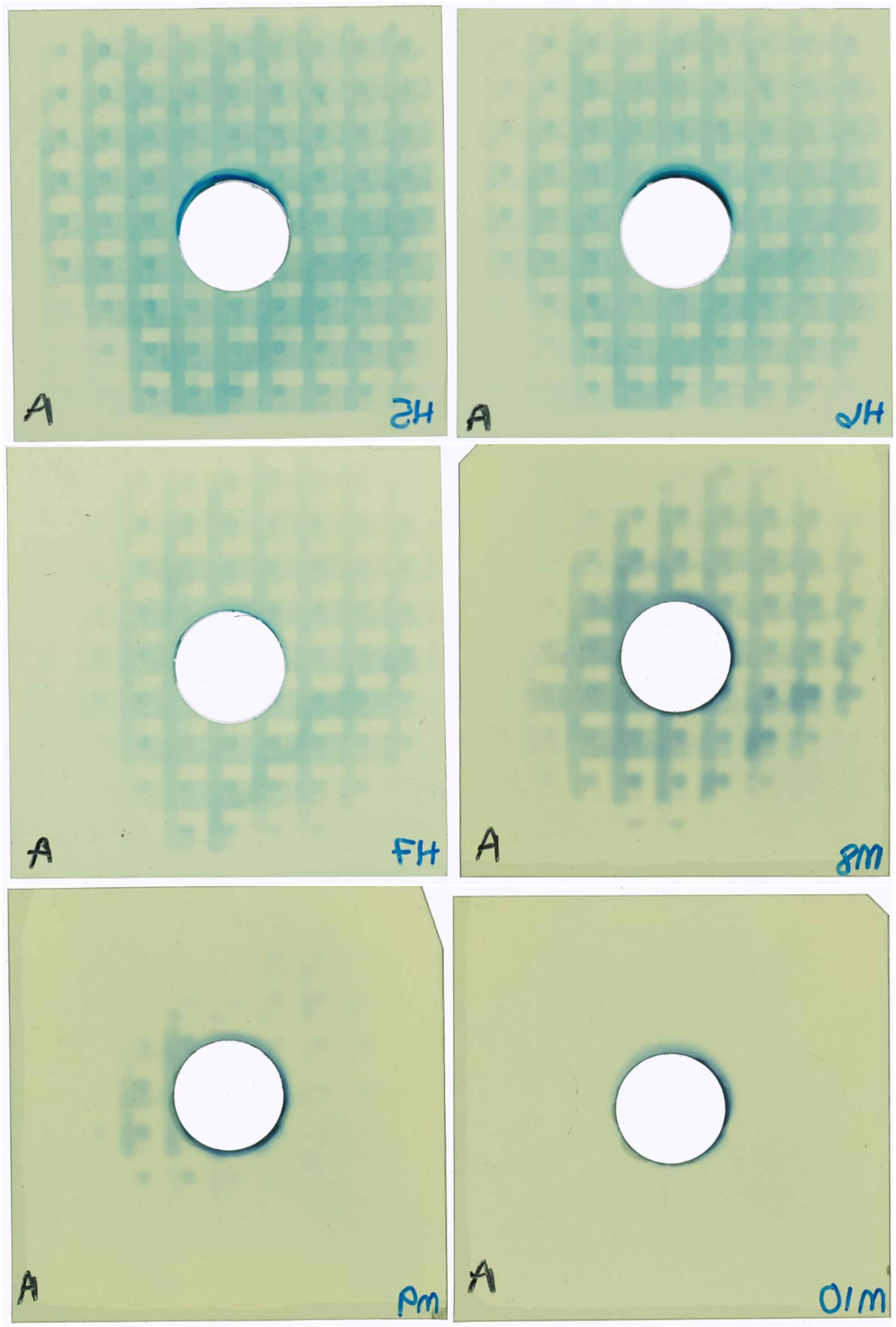




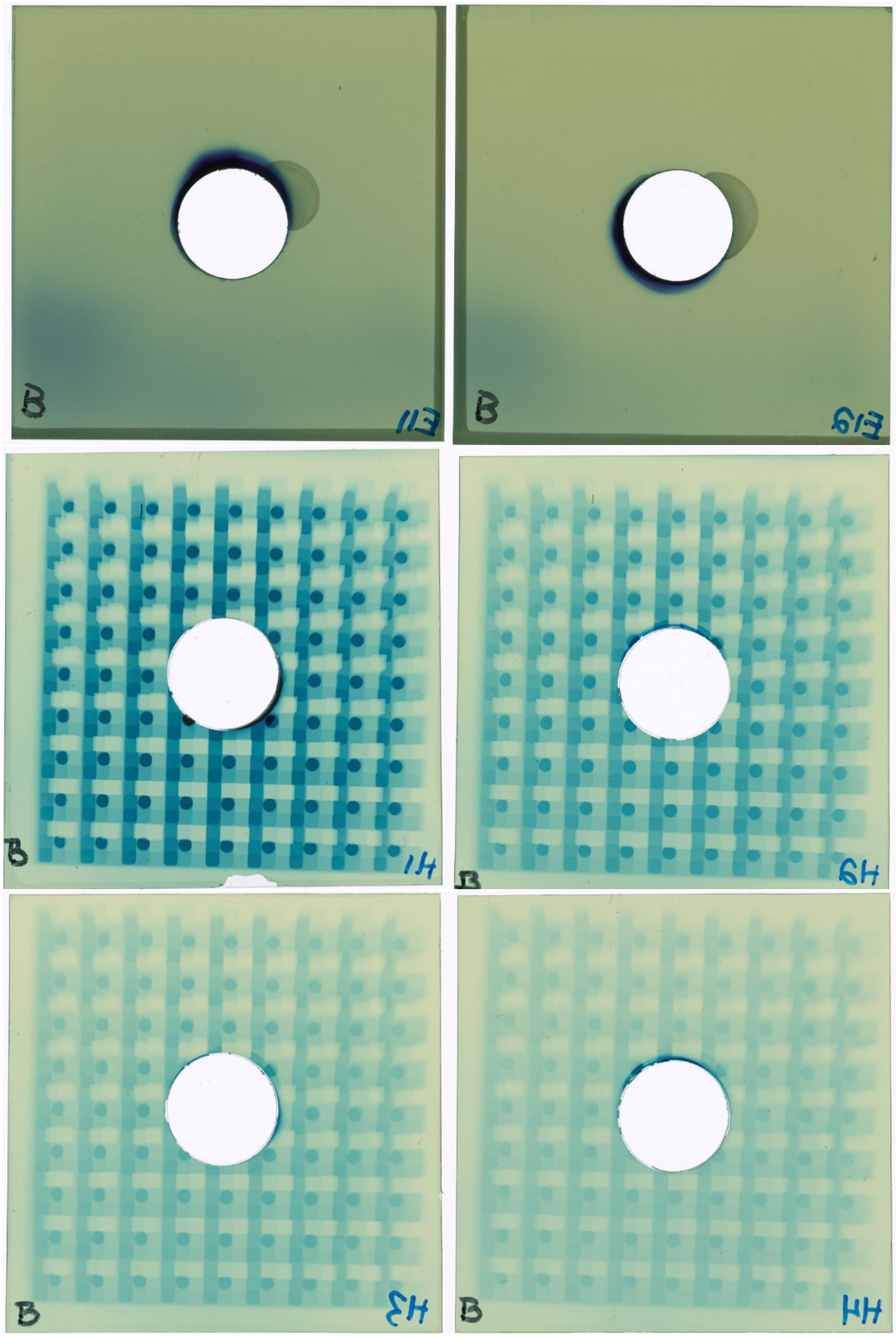
PROBIES data

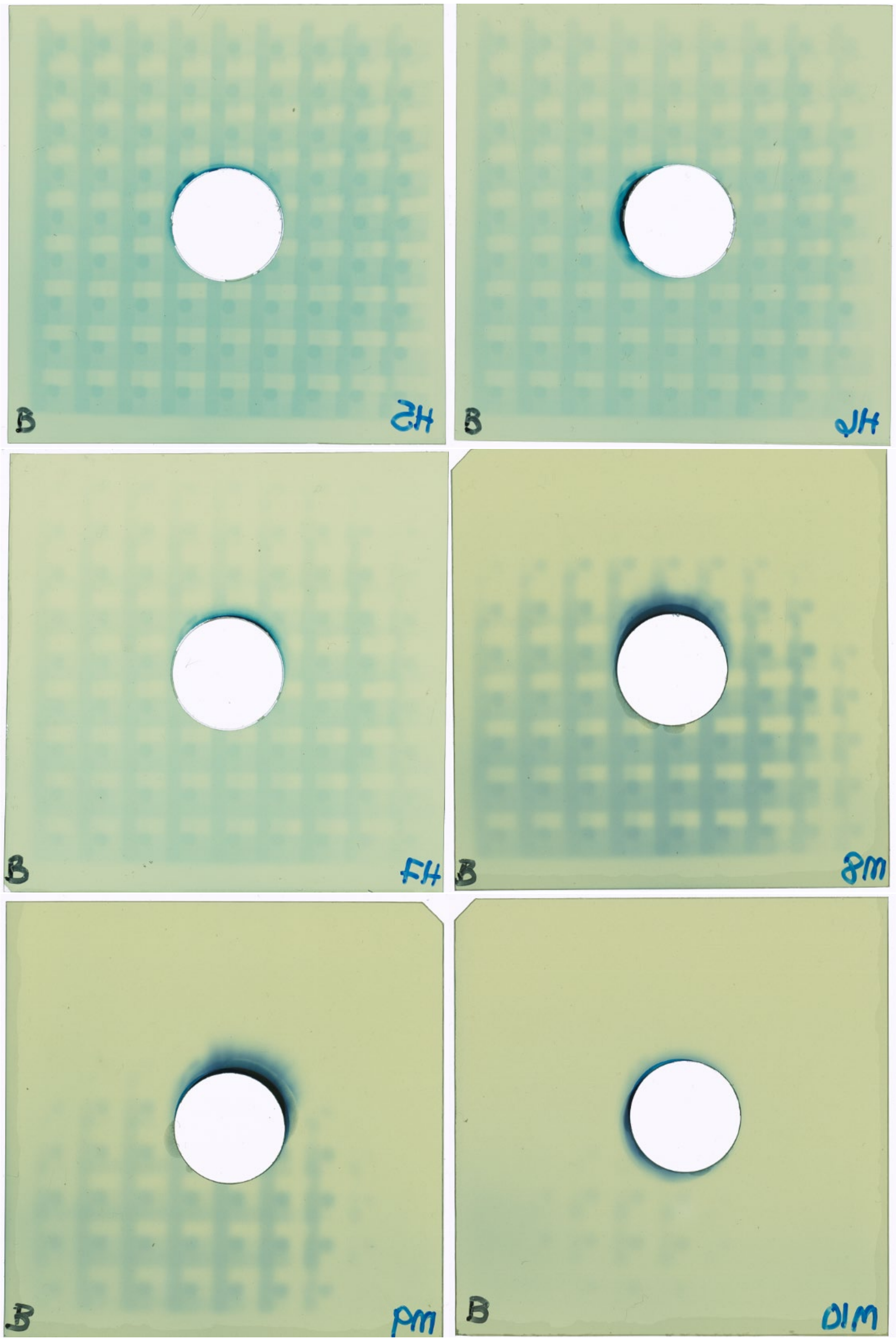
Shot 38058 (note E films are in back)



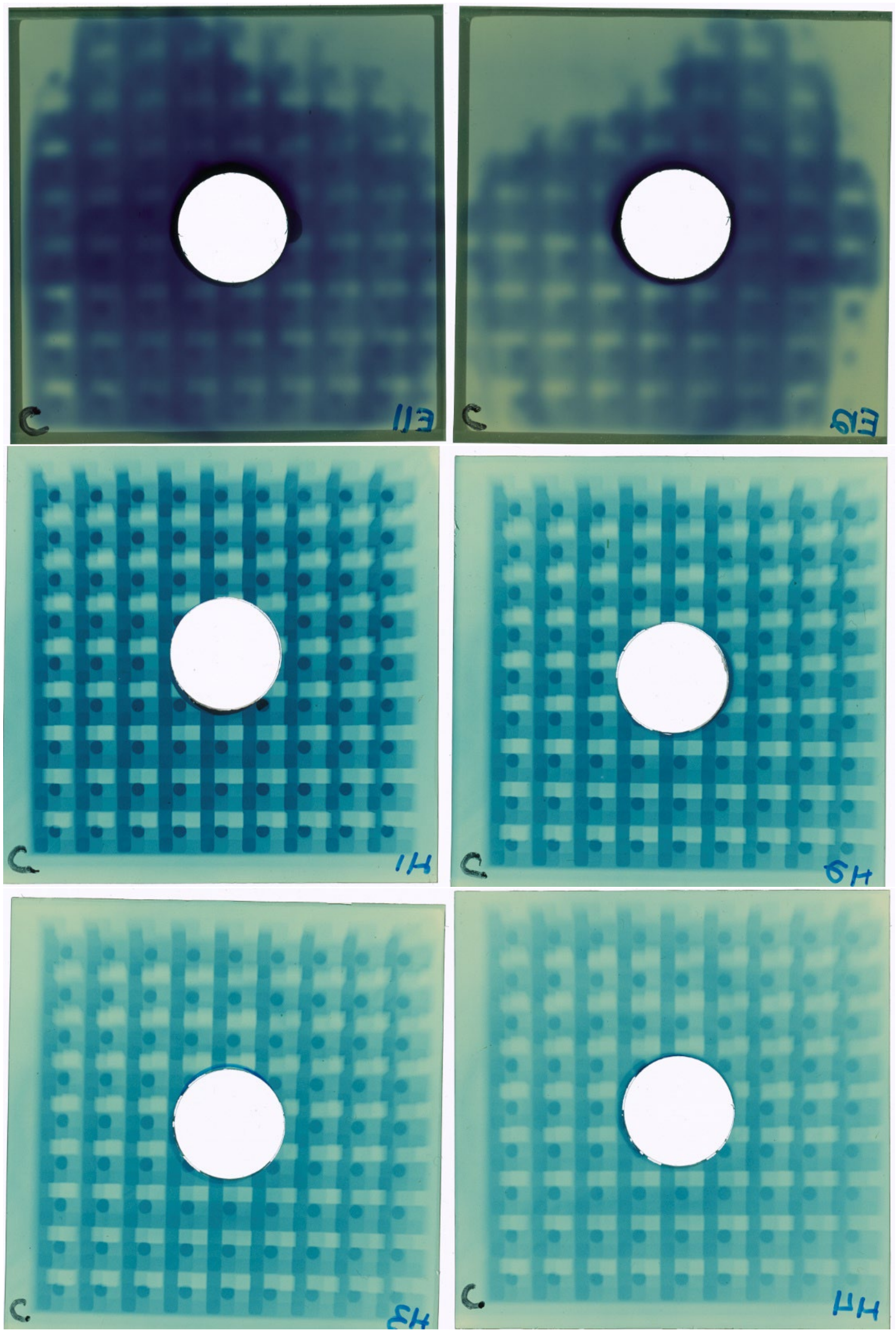


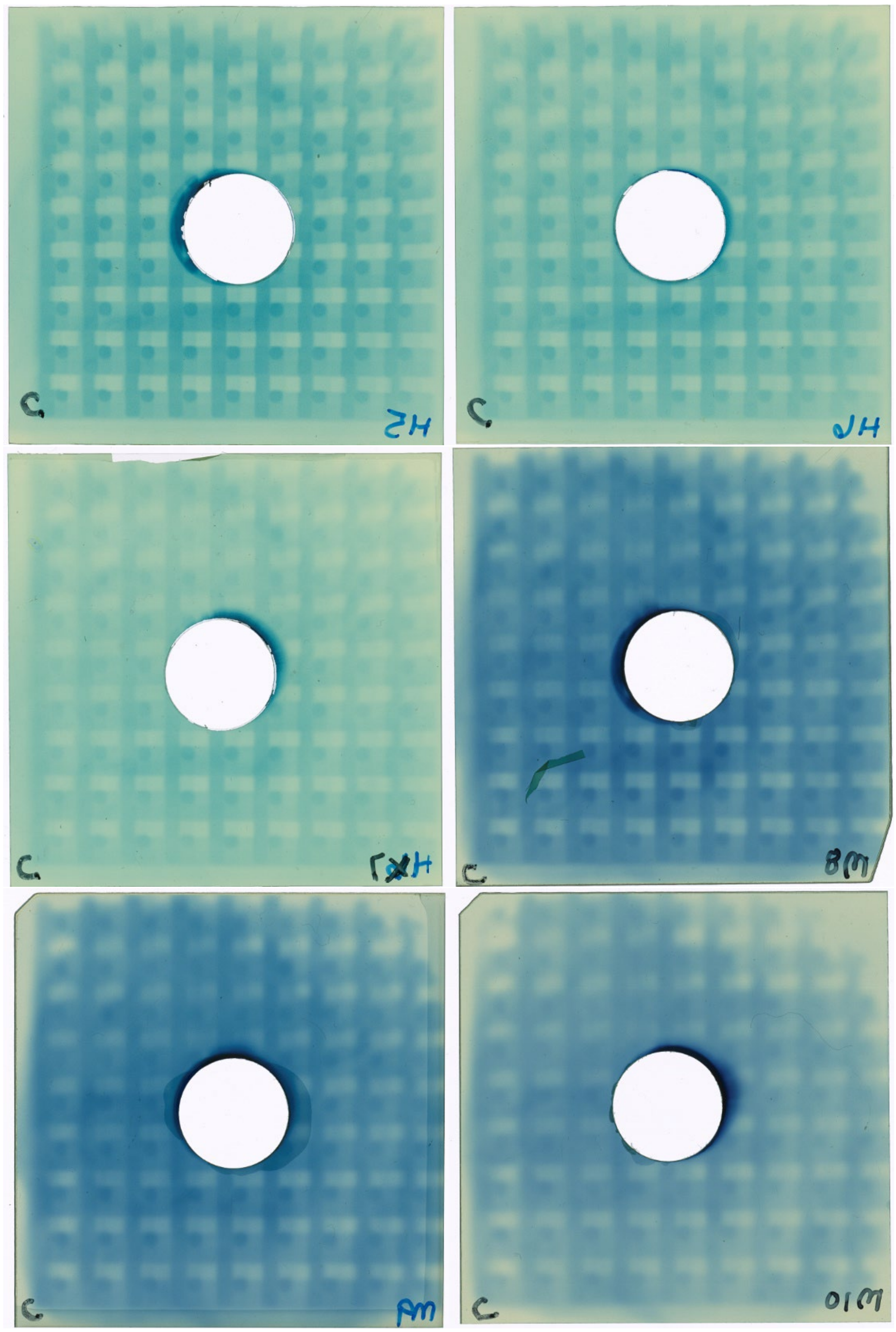
Shot 38060



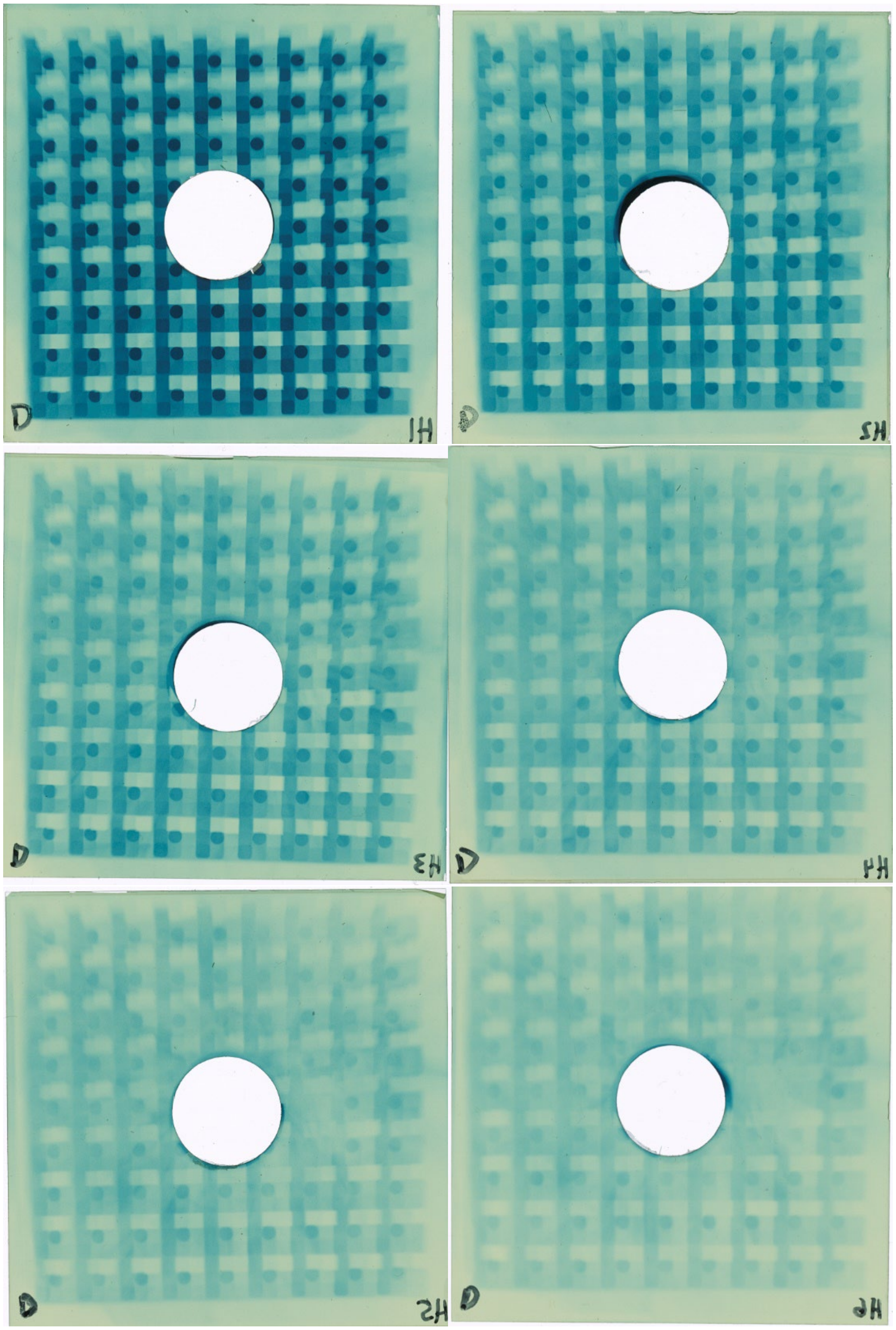


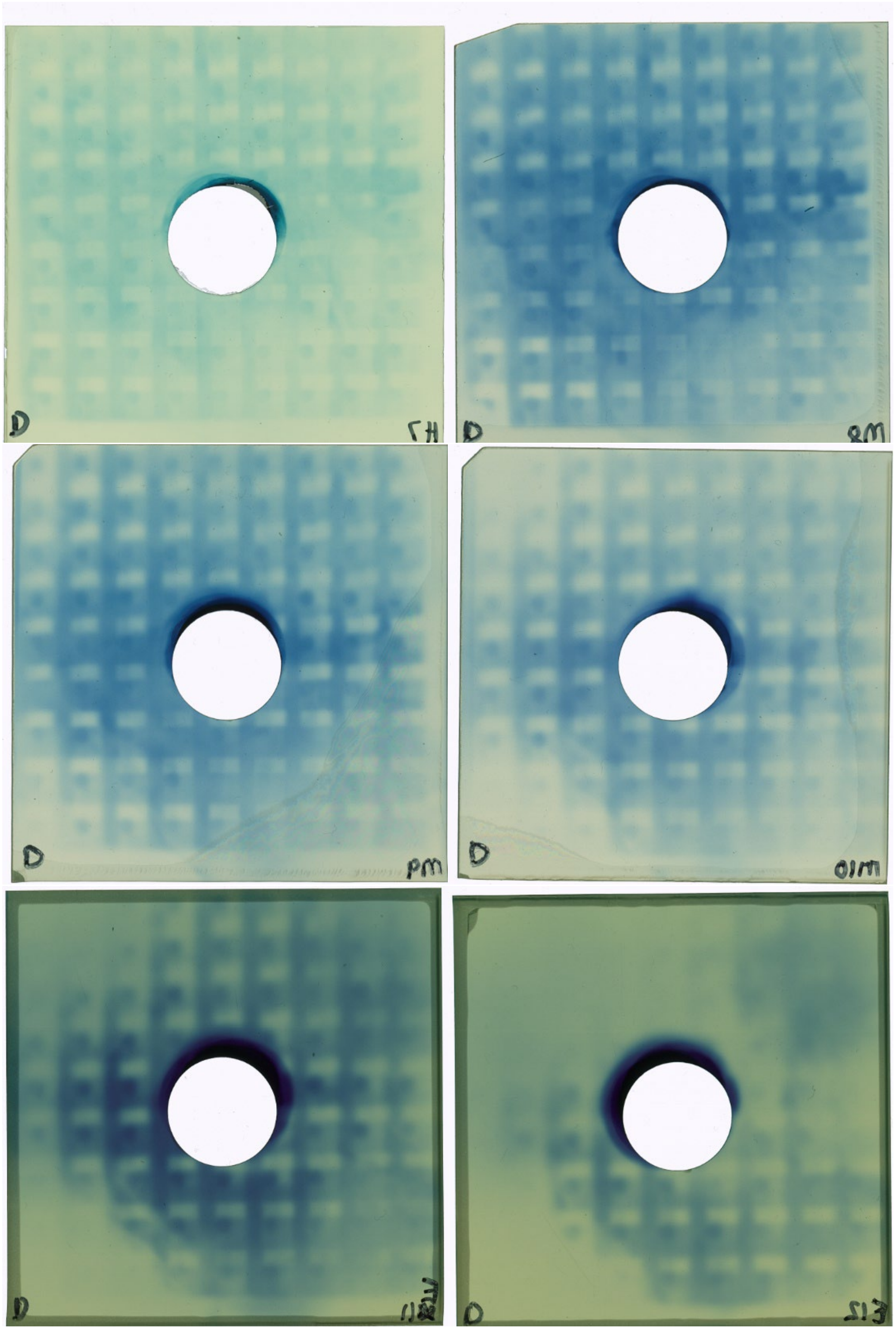
Shot 38062



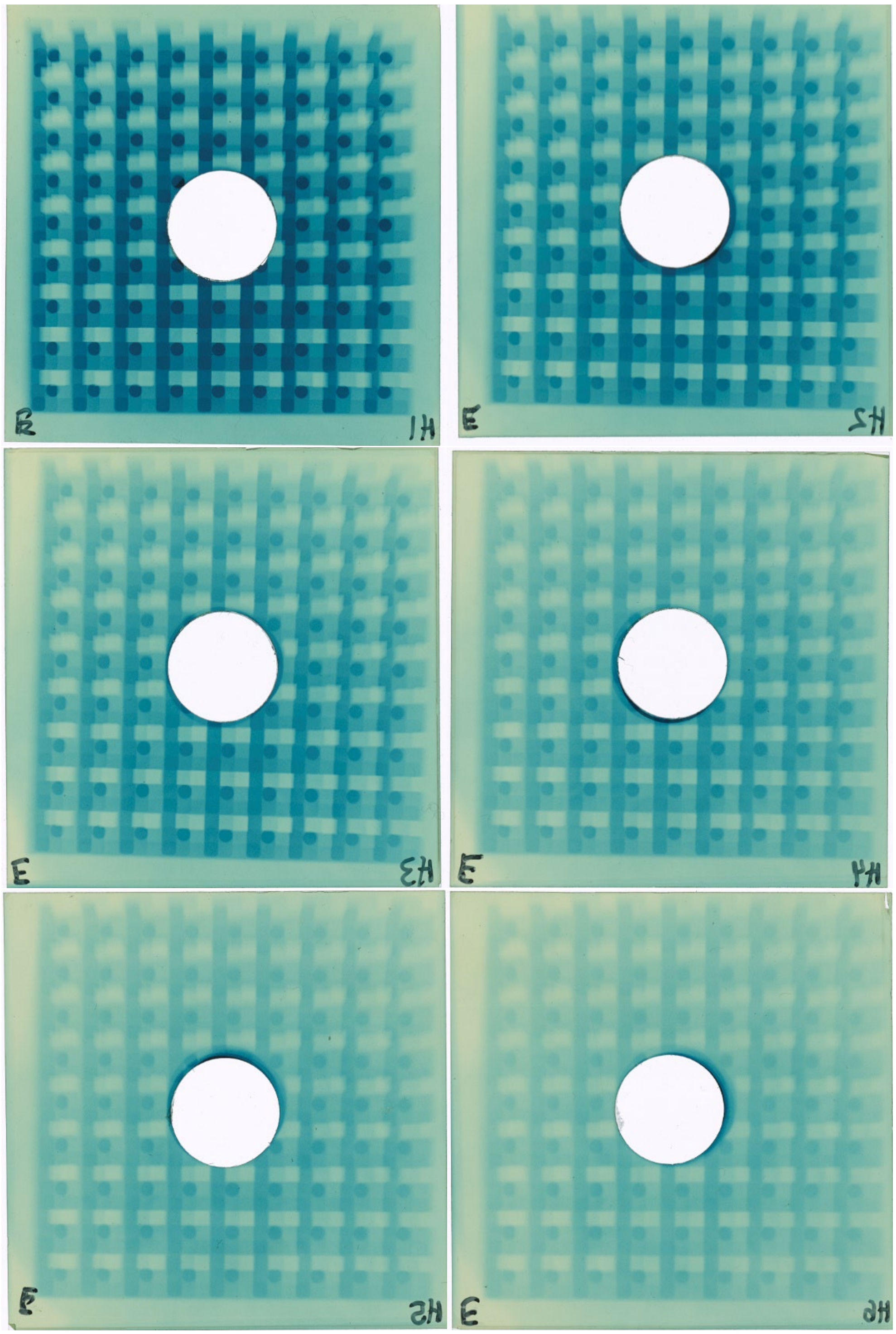


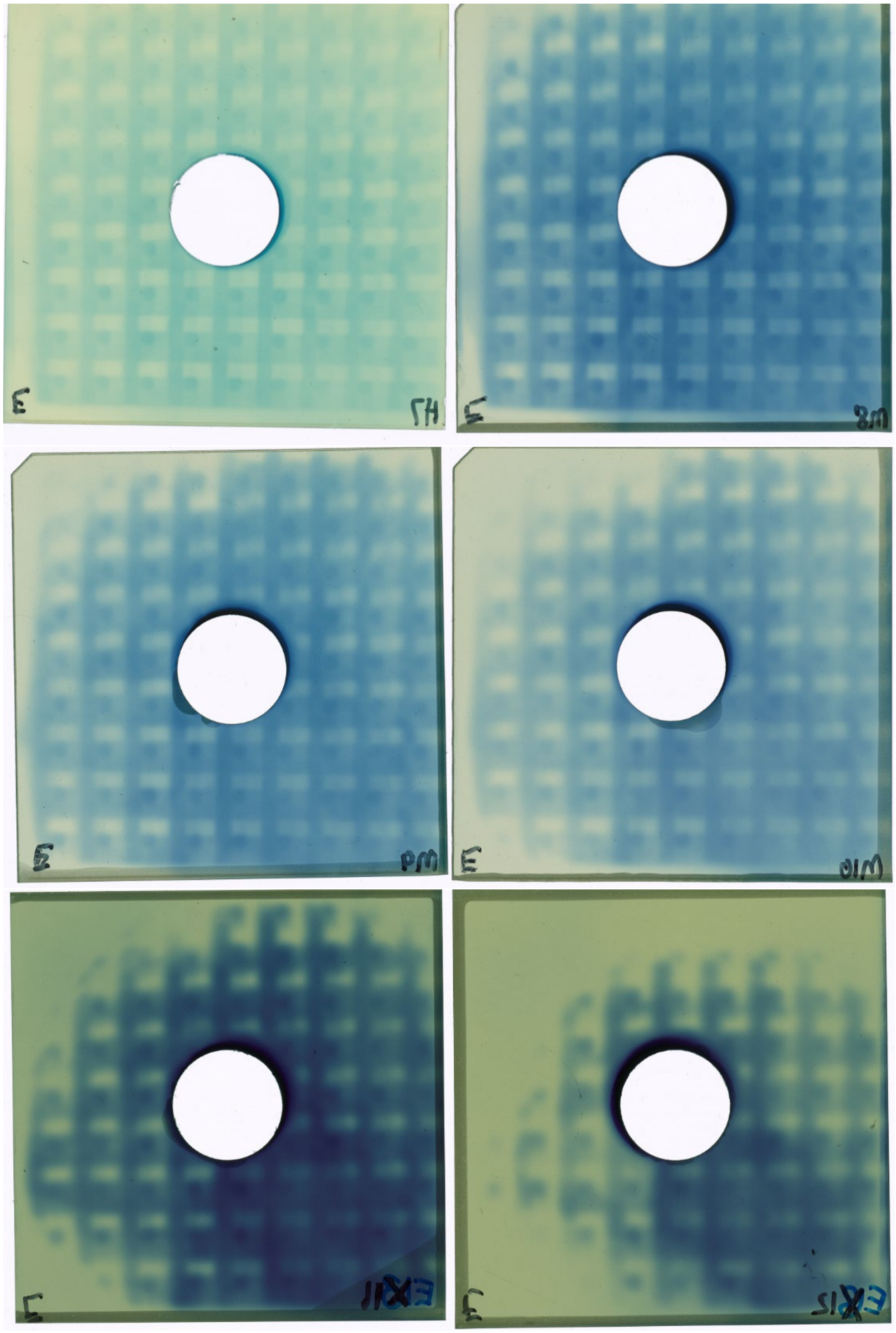
Shot 38064



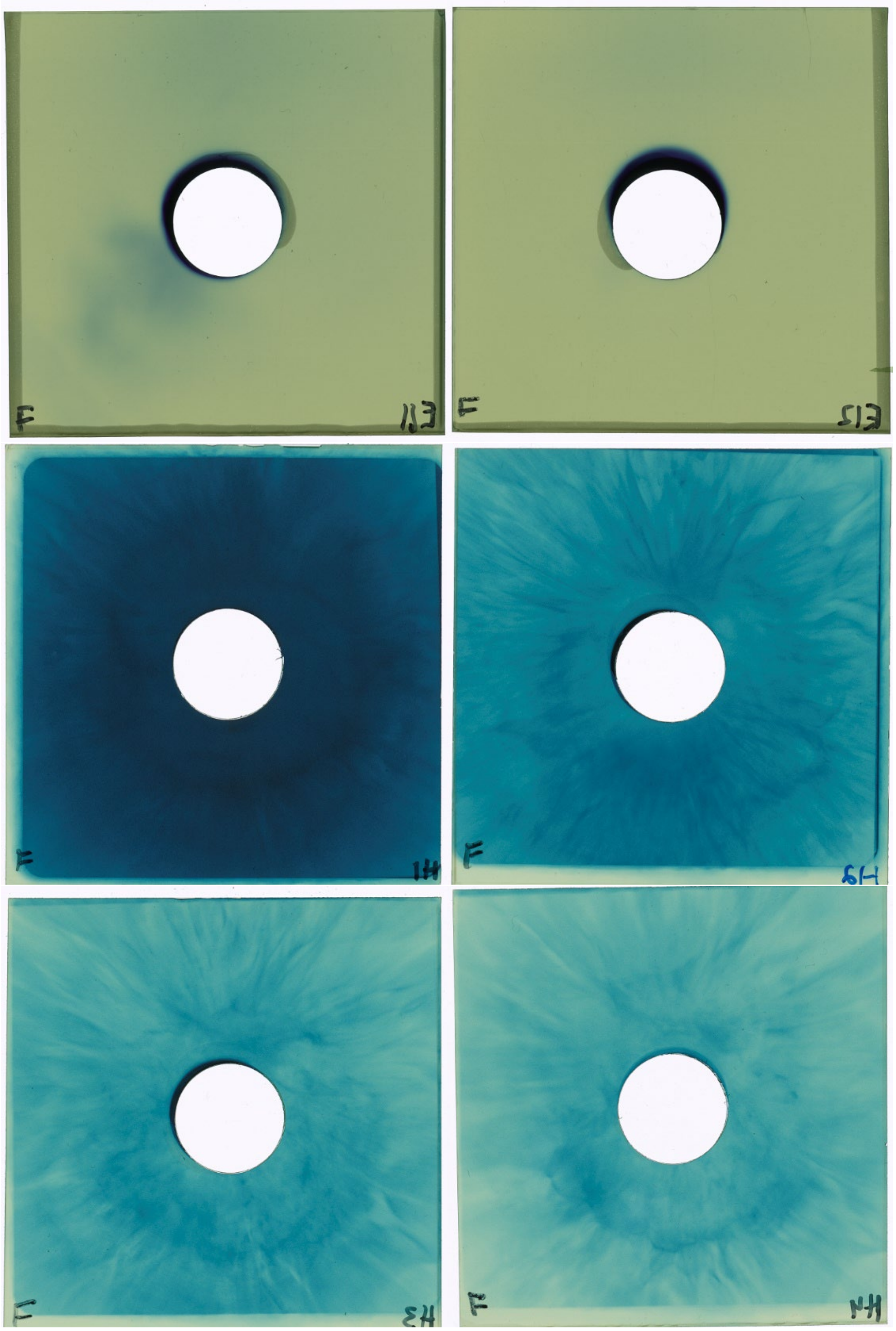


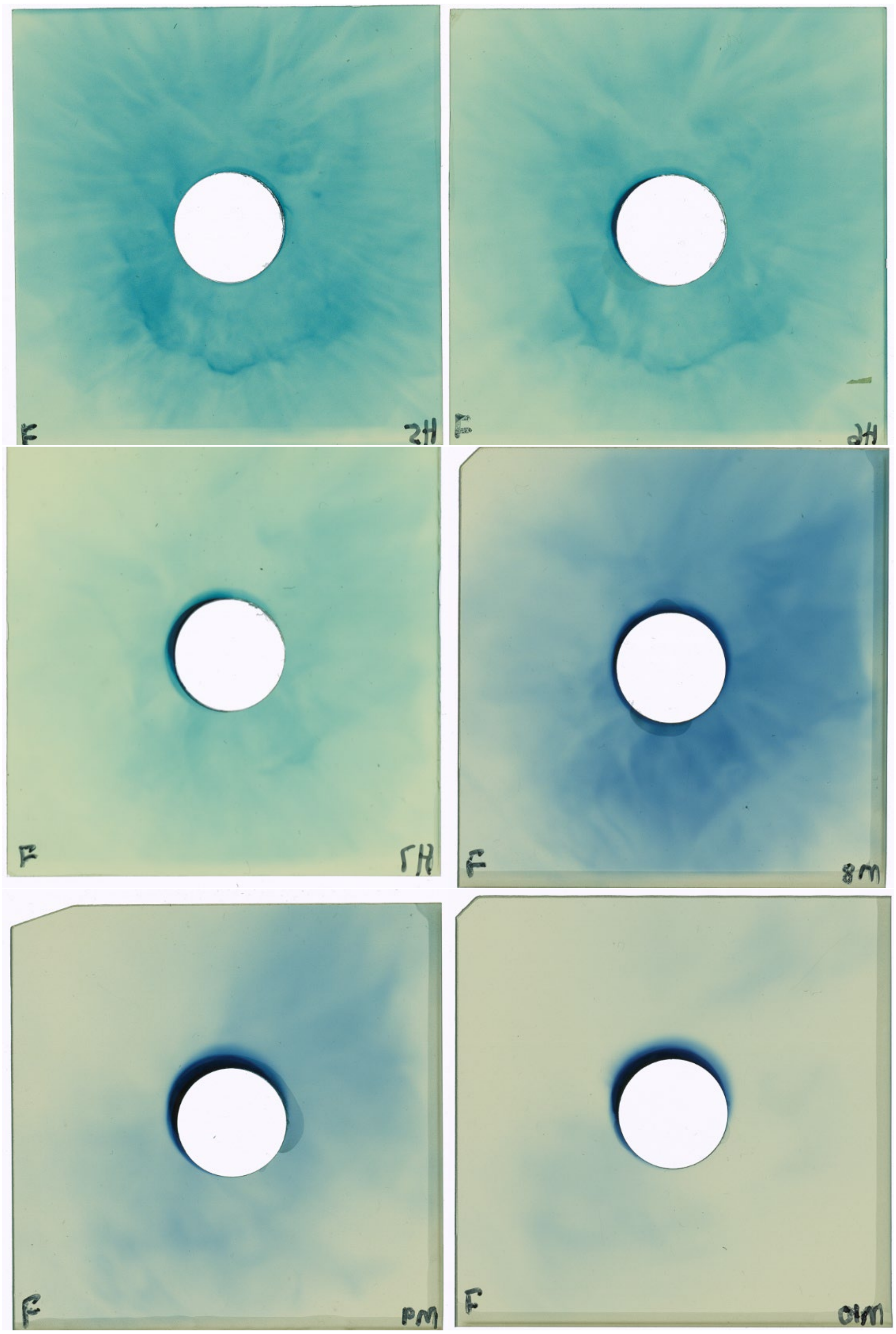
Shot 38066





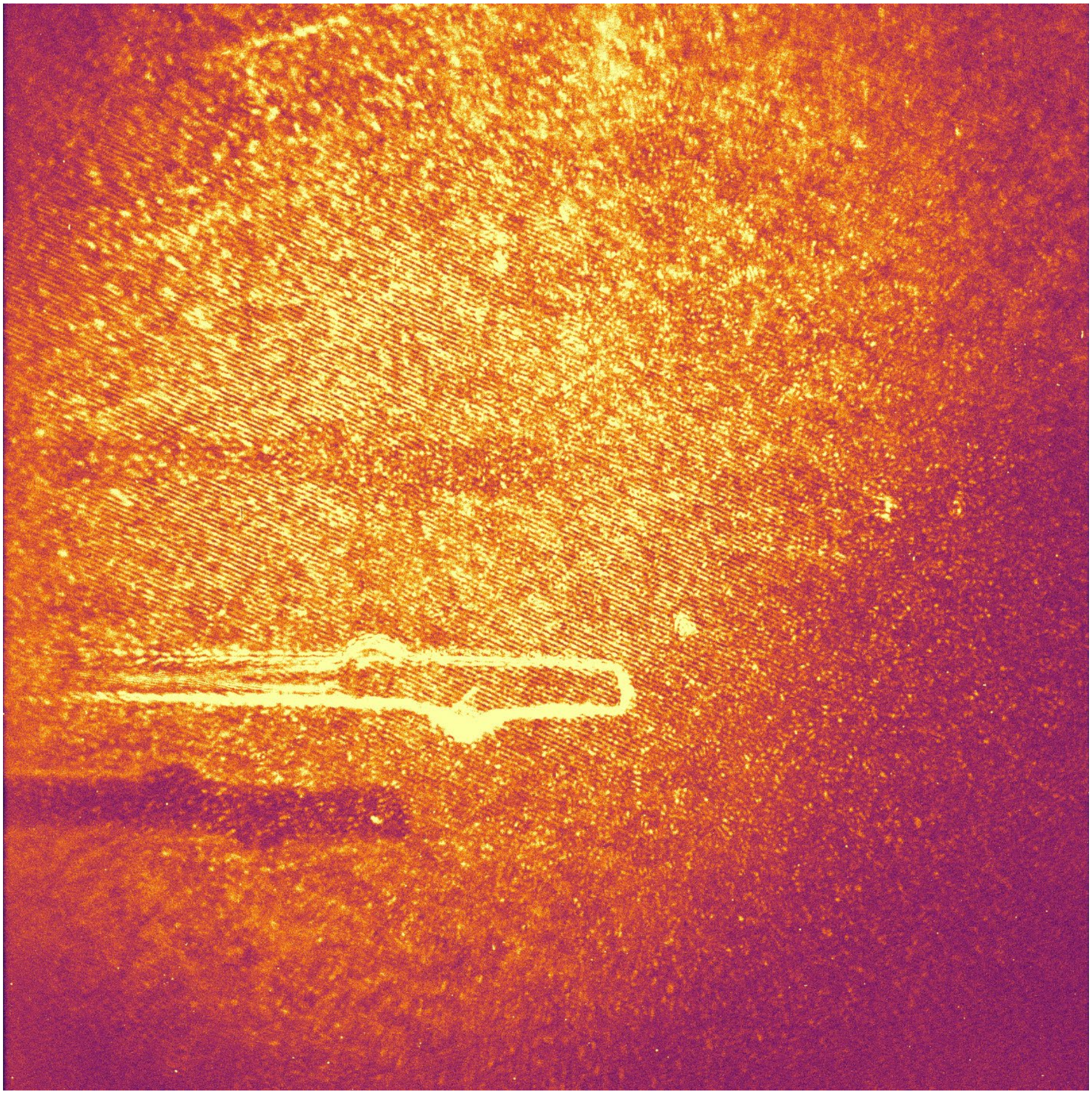
Shot 38068 (PROBIES filter not included)

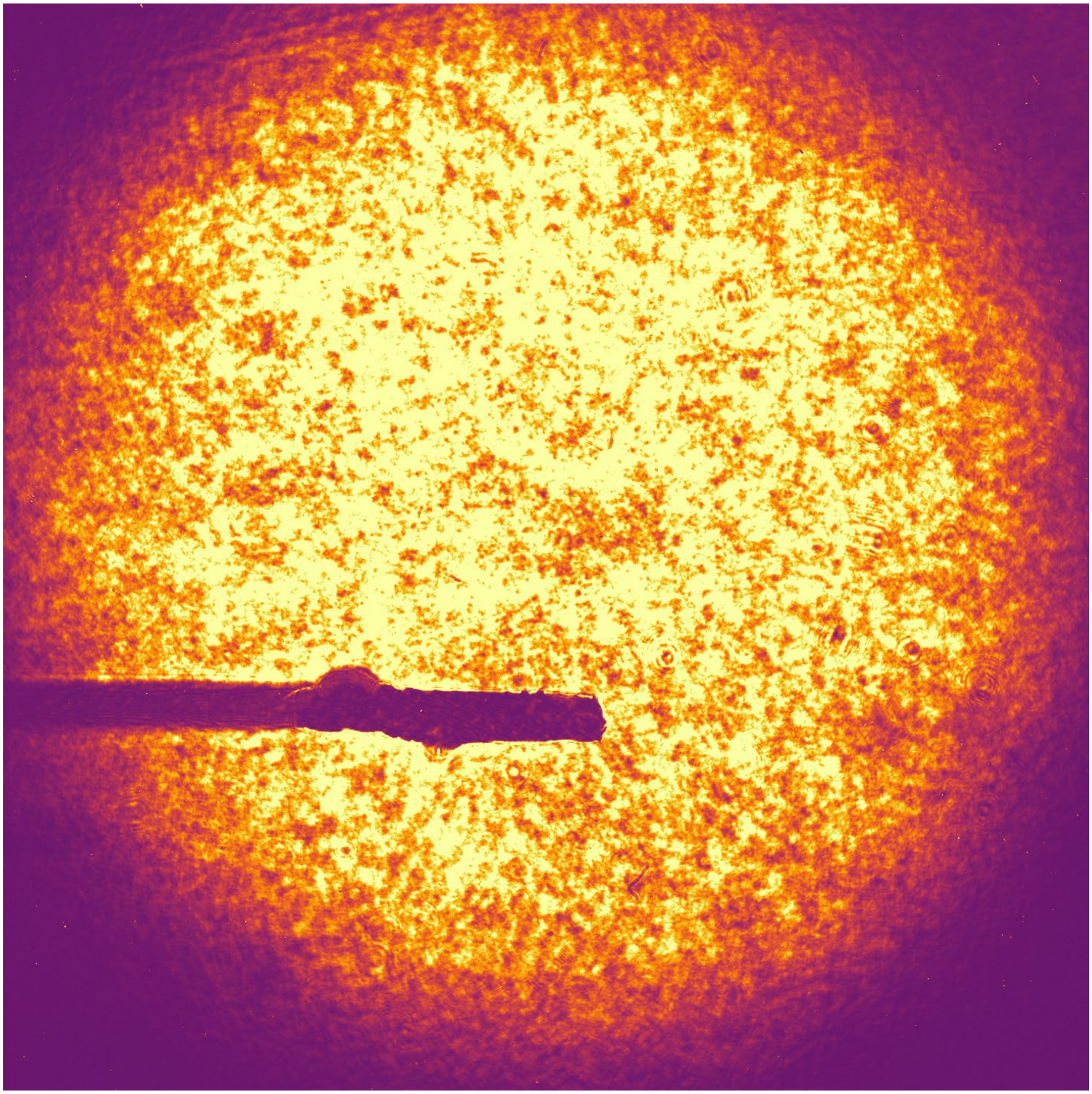


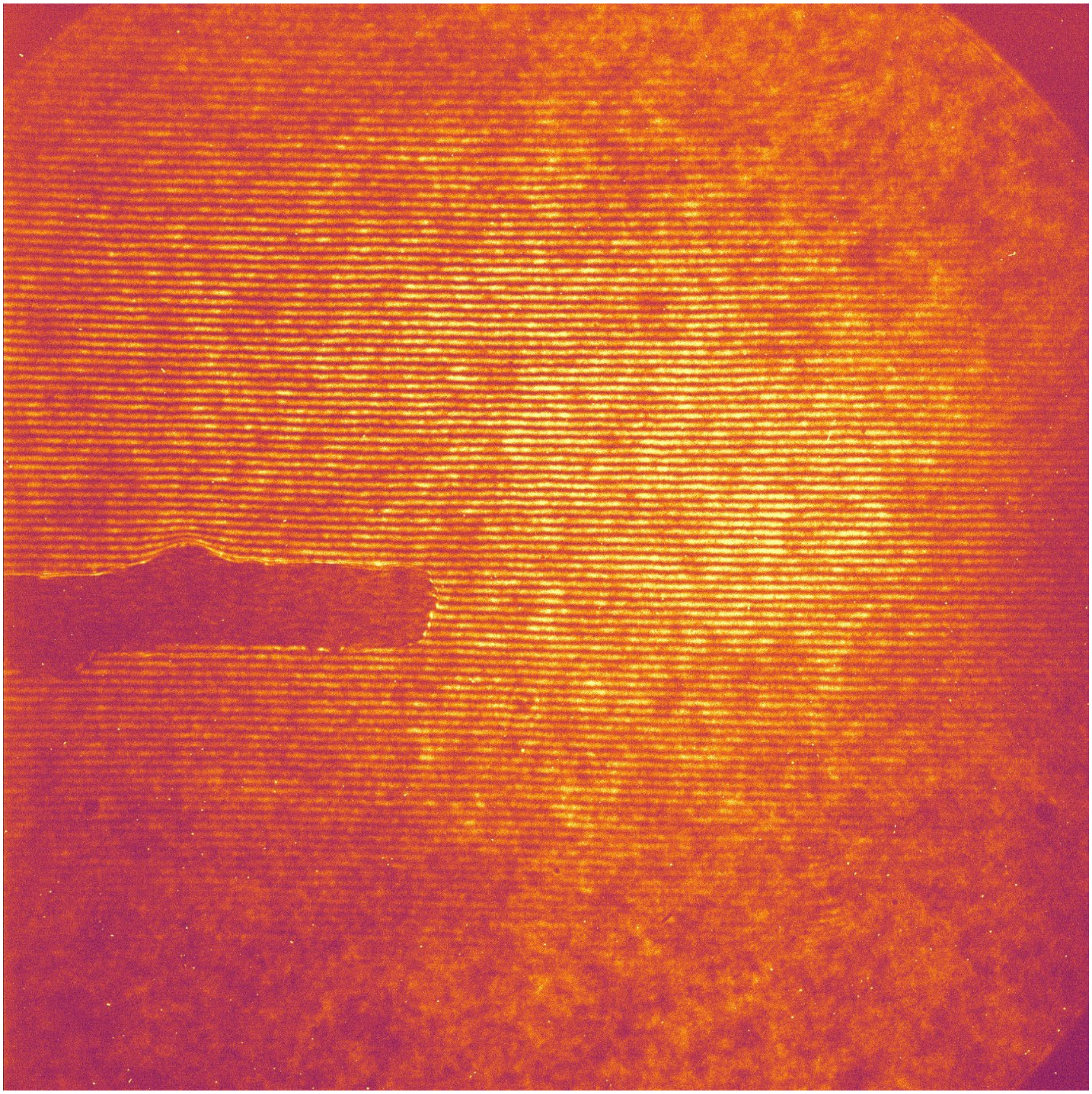


4w probe data

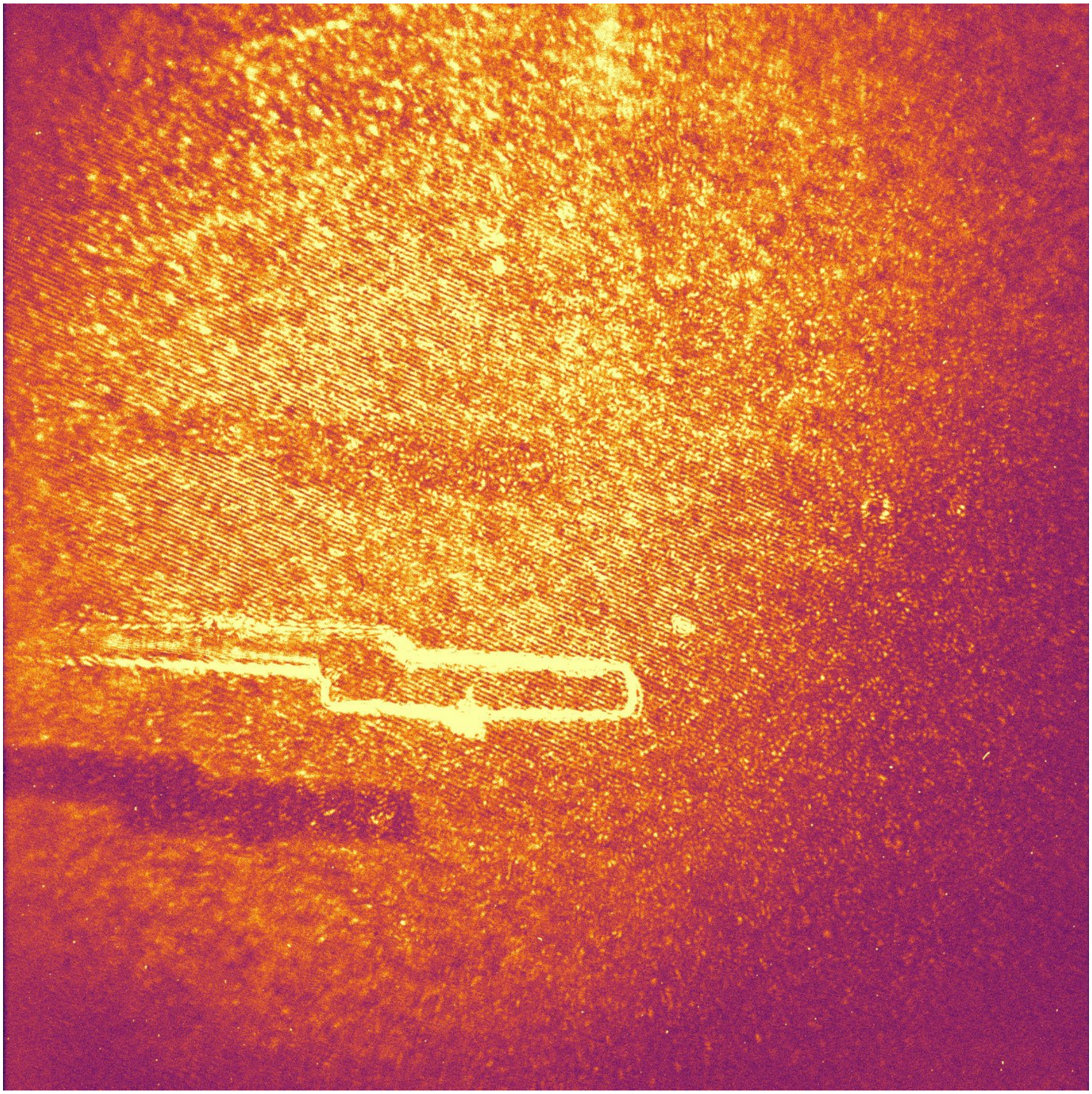
Shot 38058

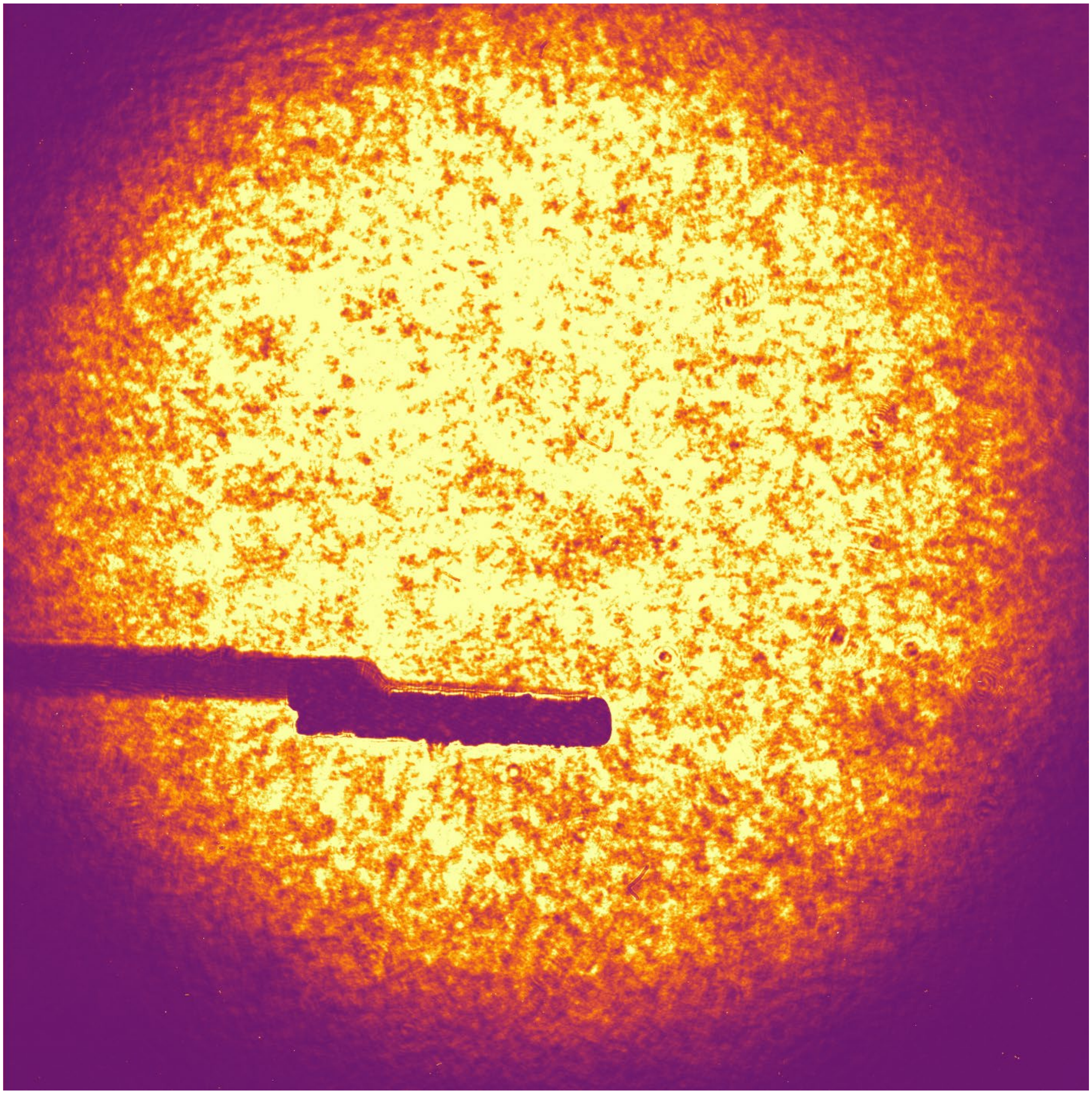


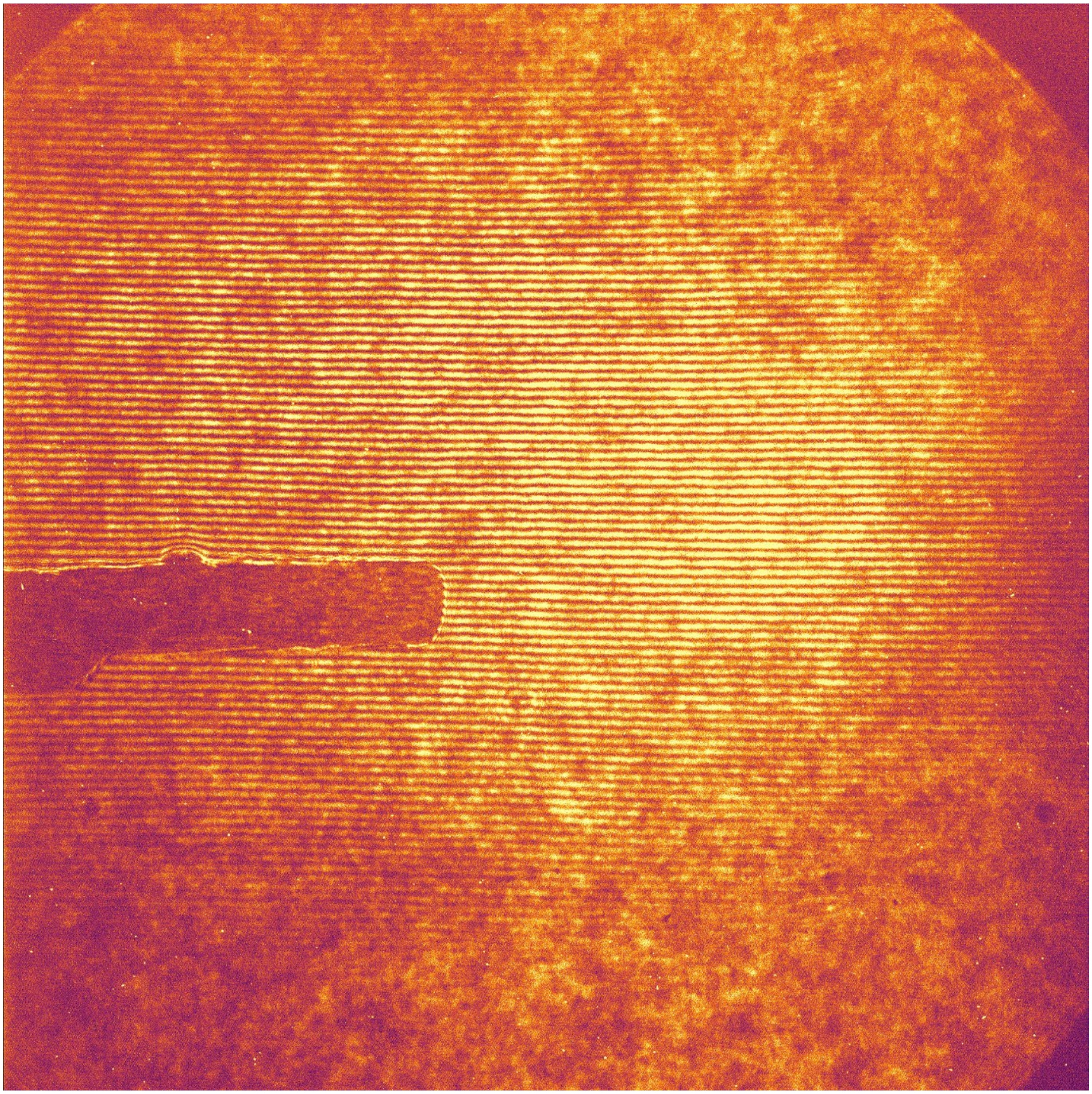




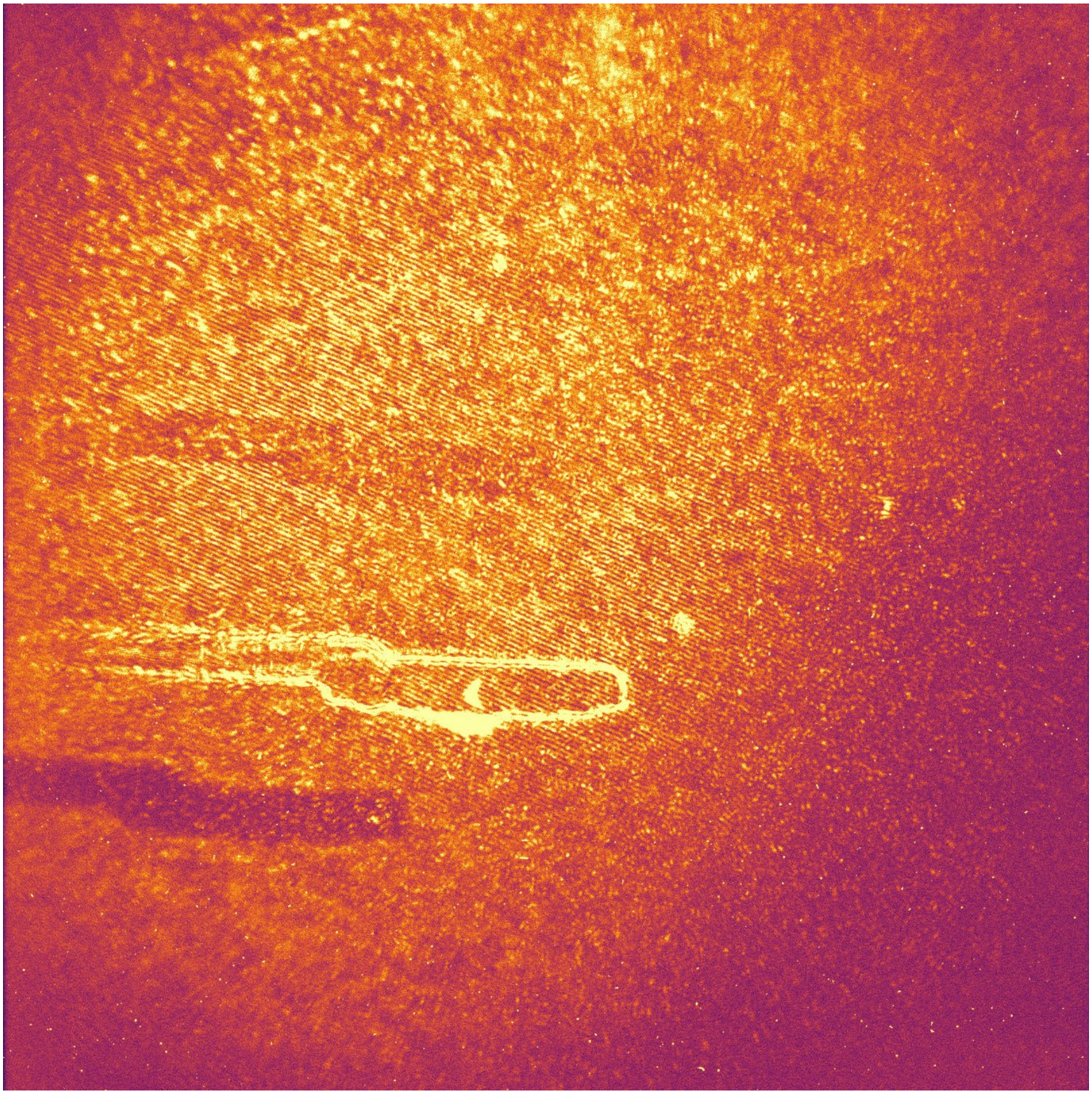
Shot 38060

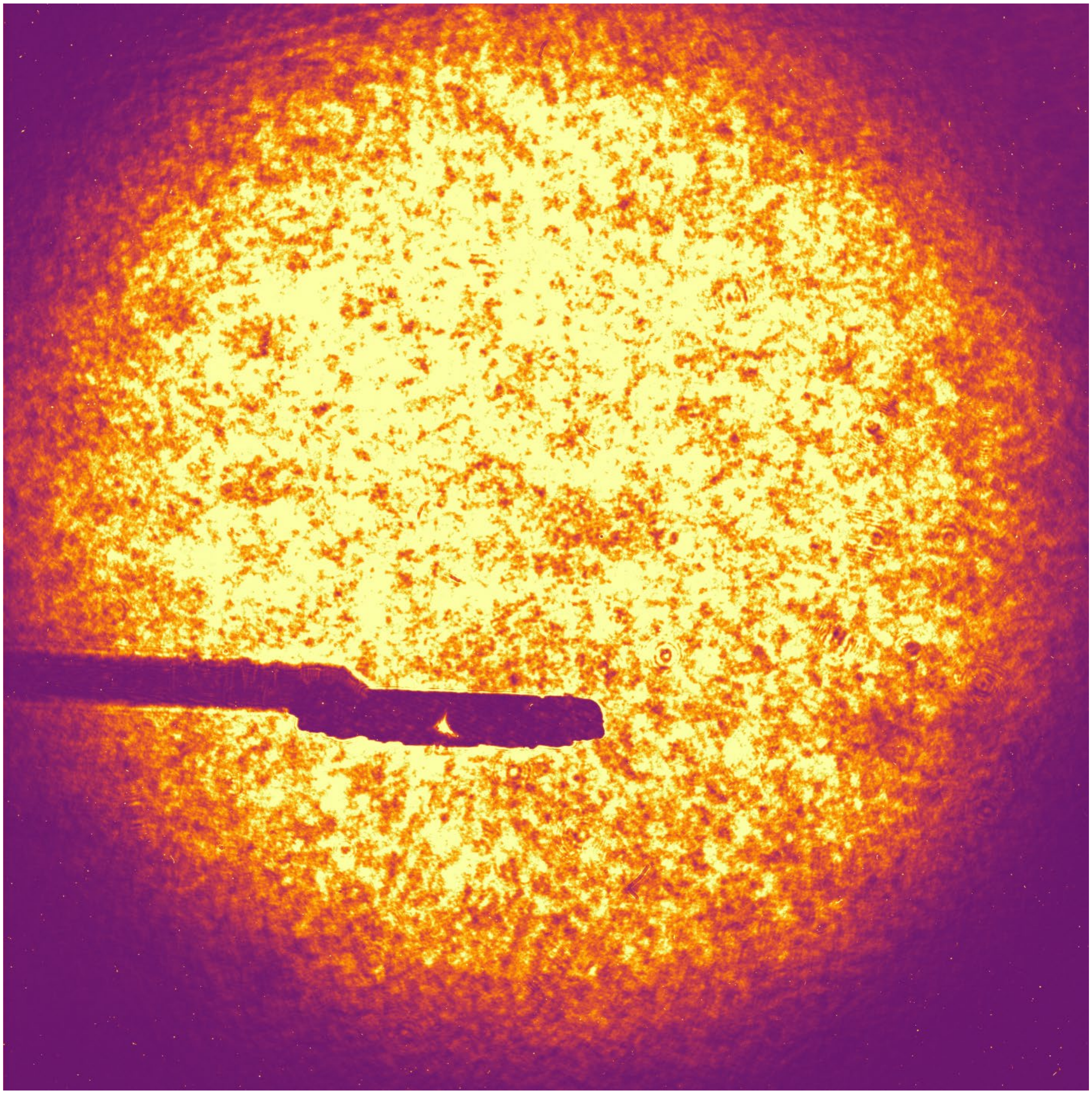


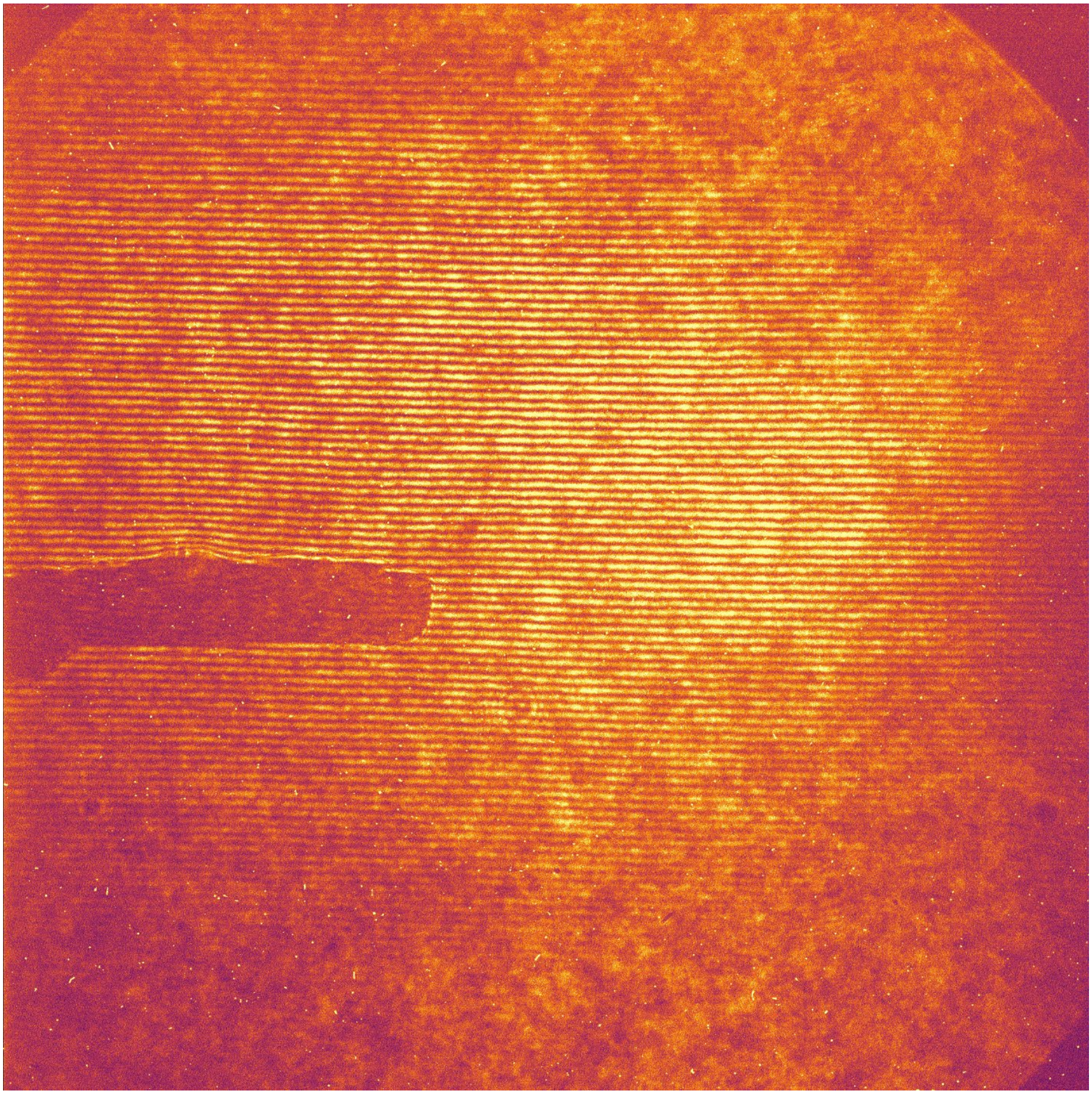




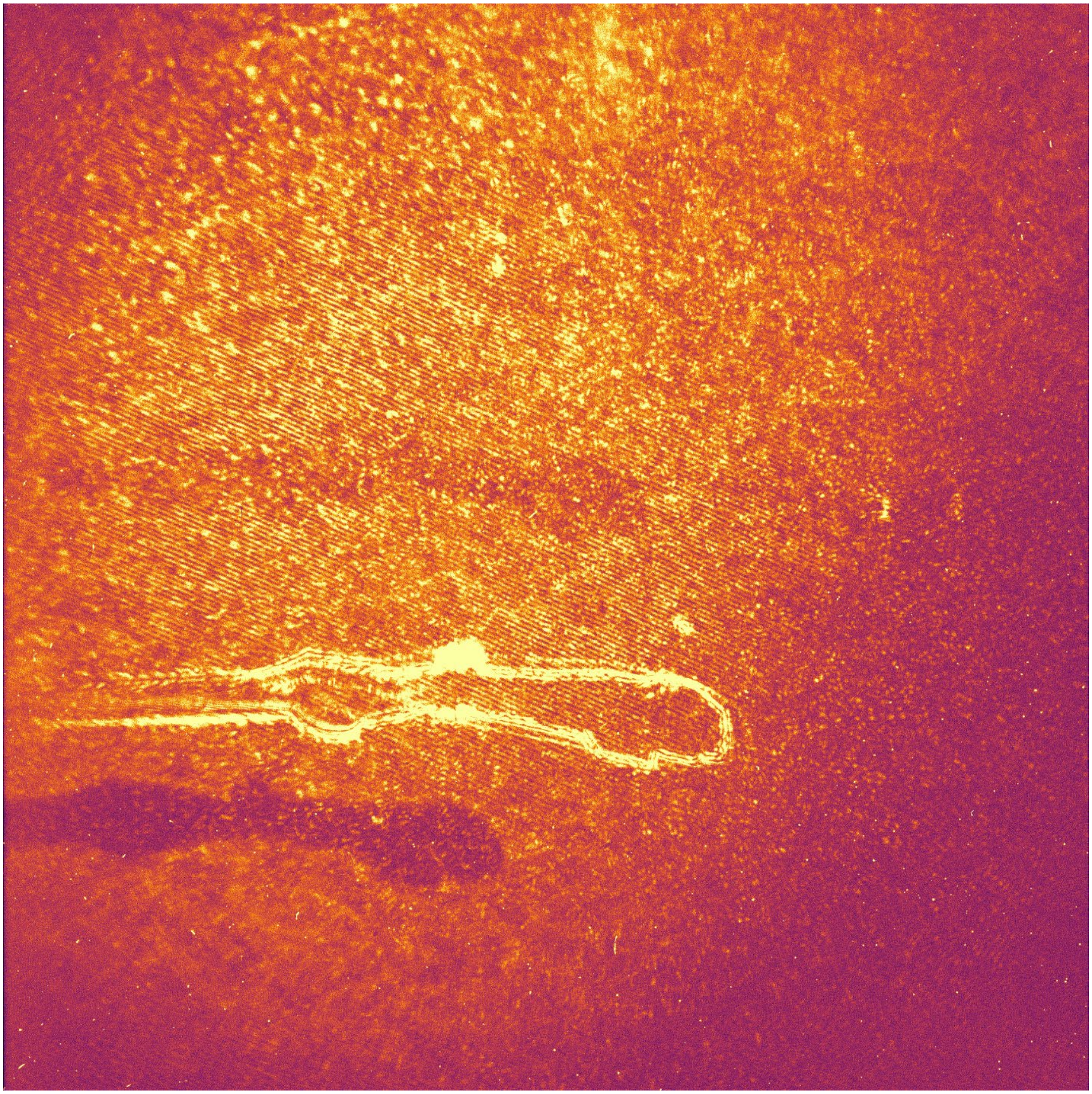
Shot 38062

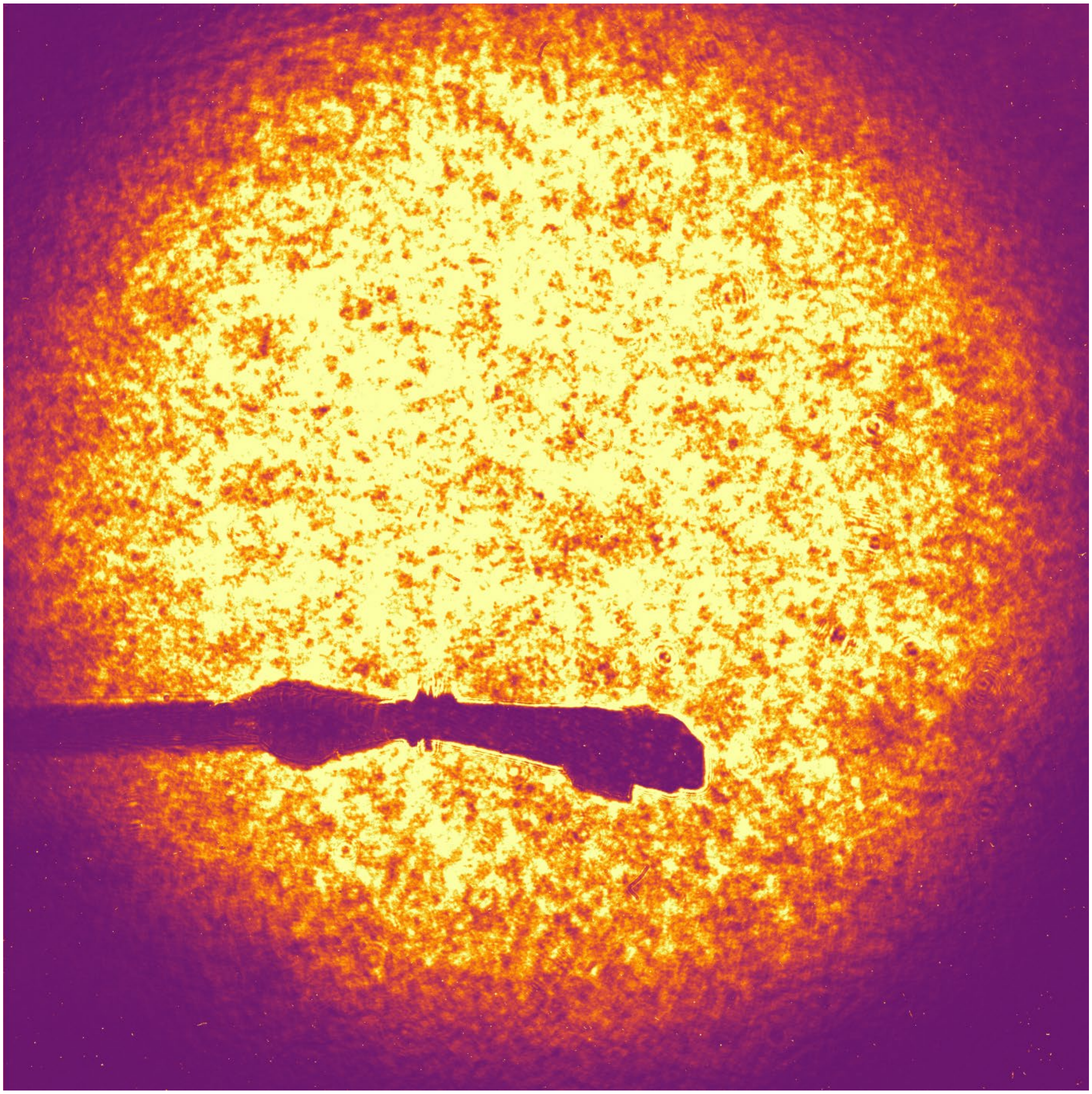


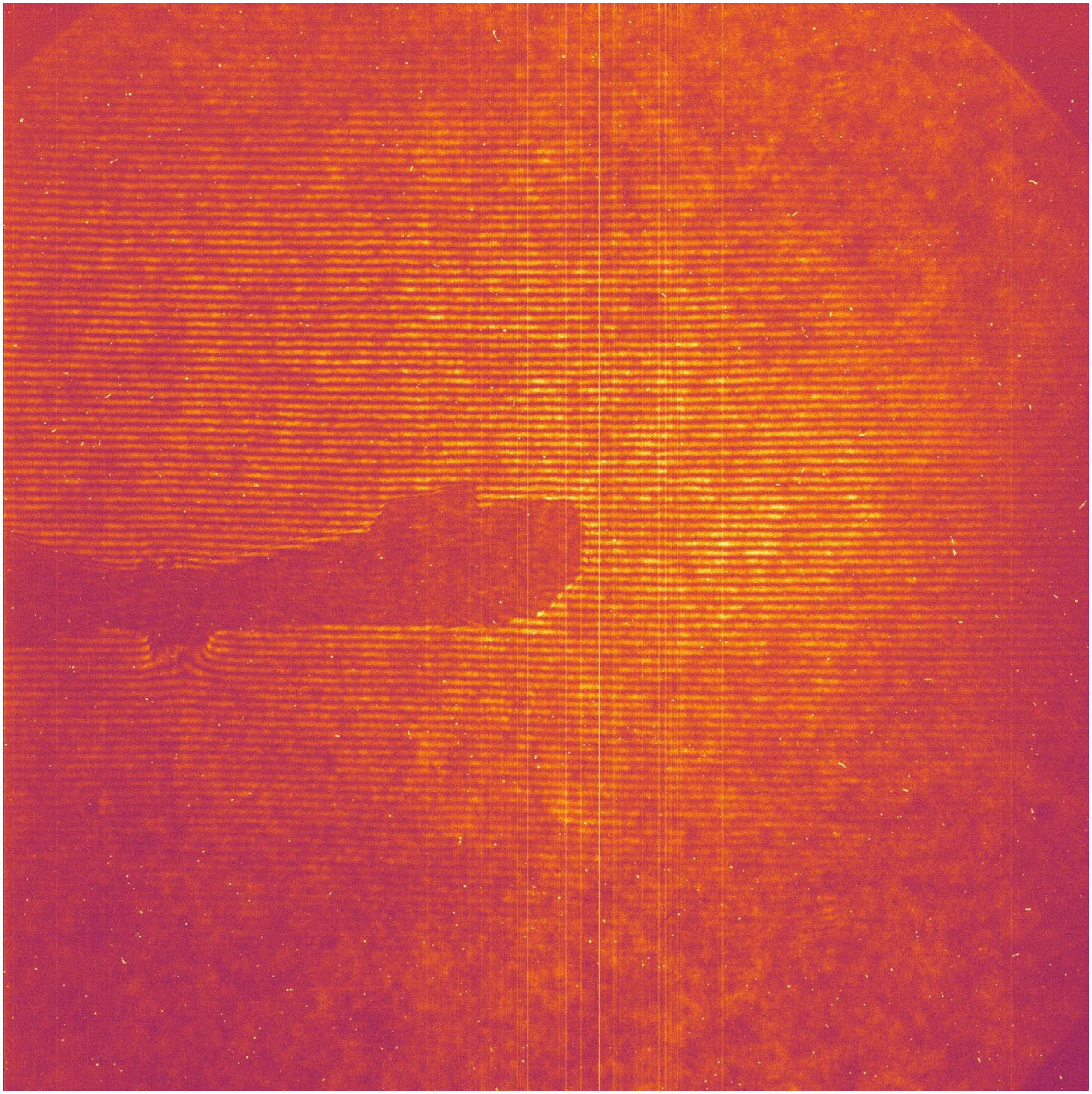


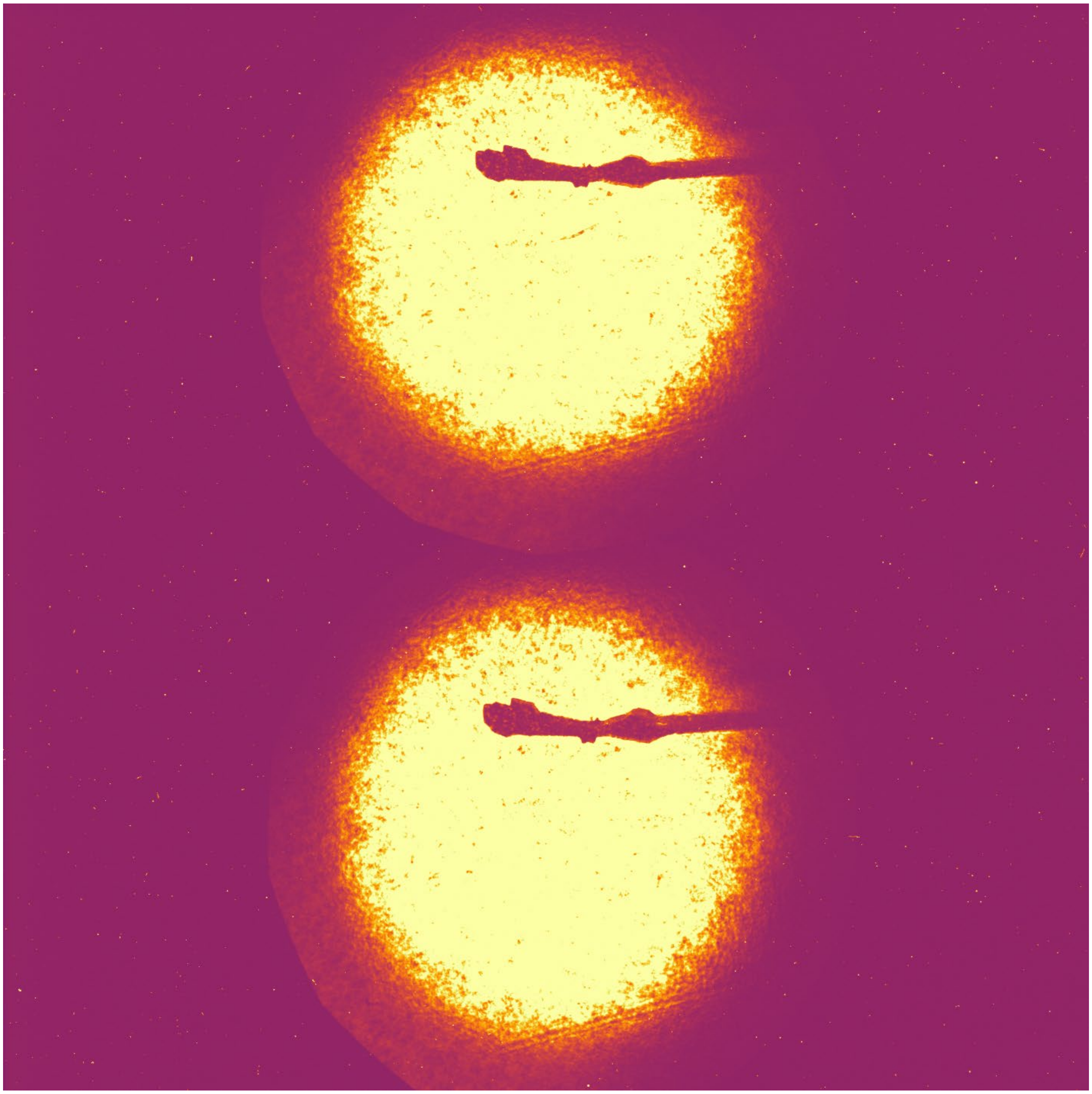


Shot 38064

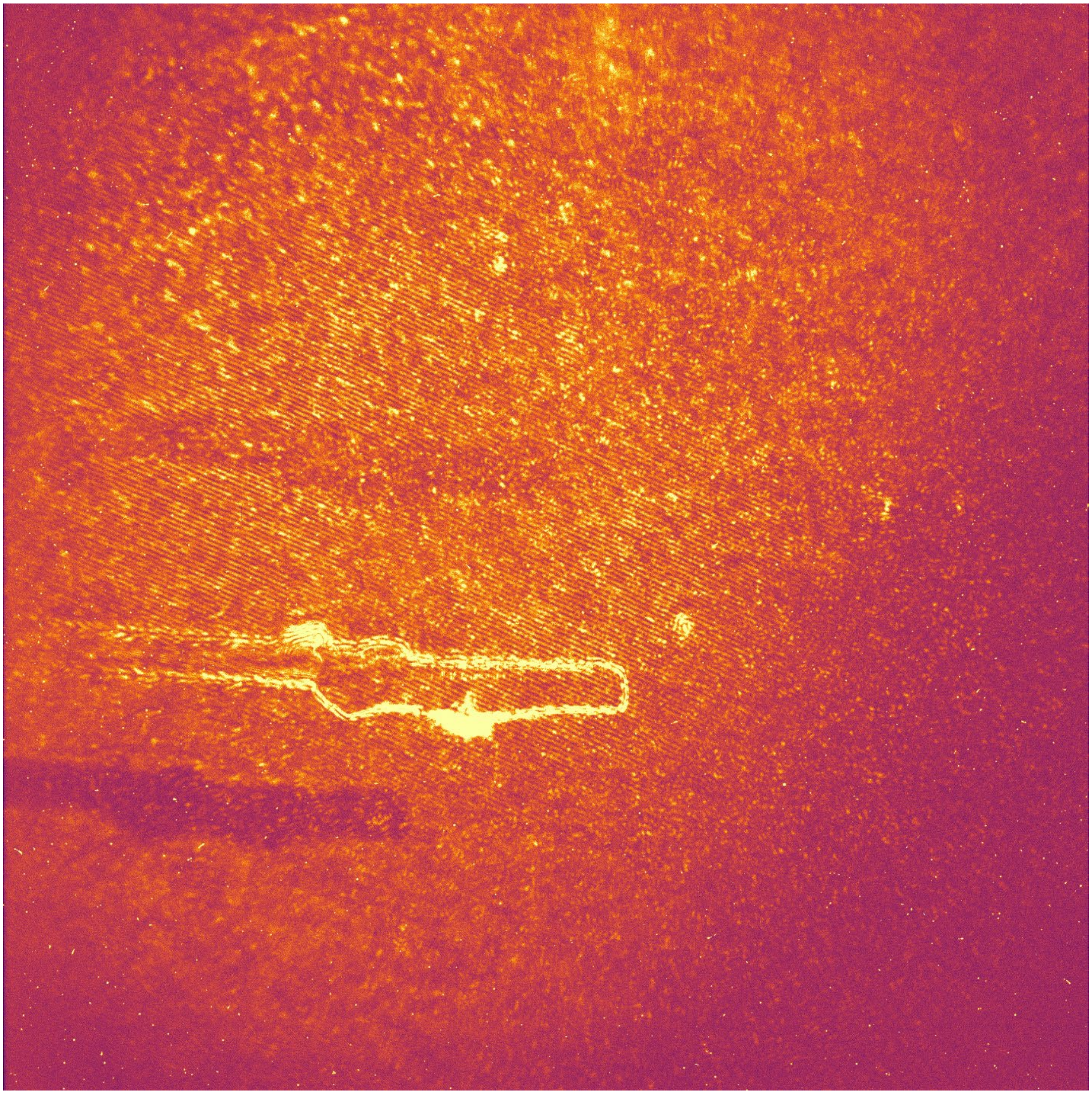


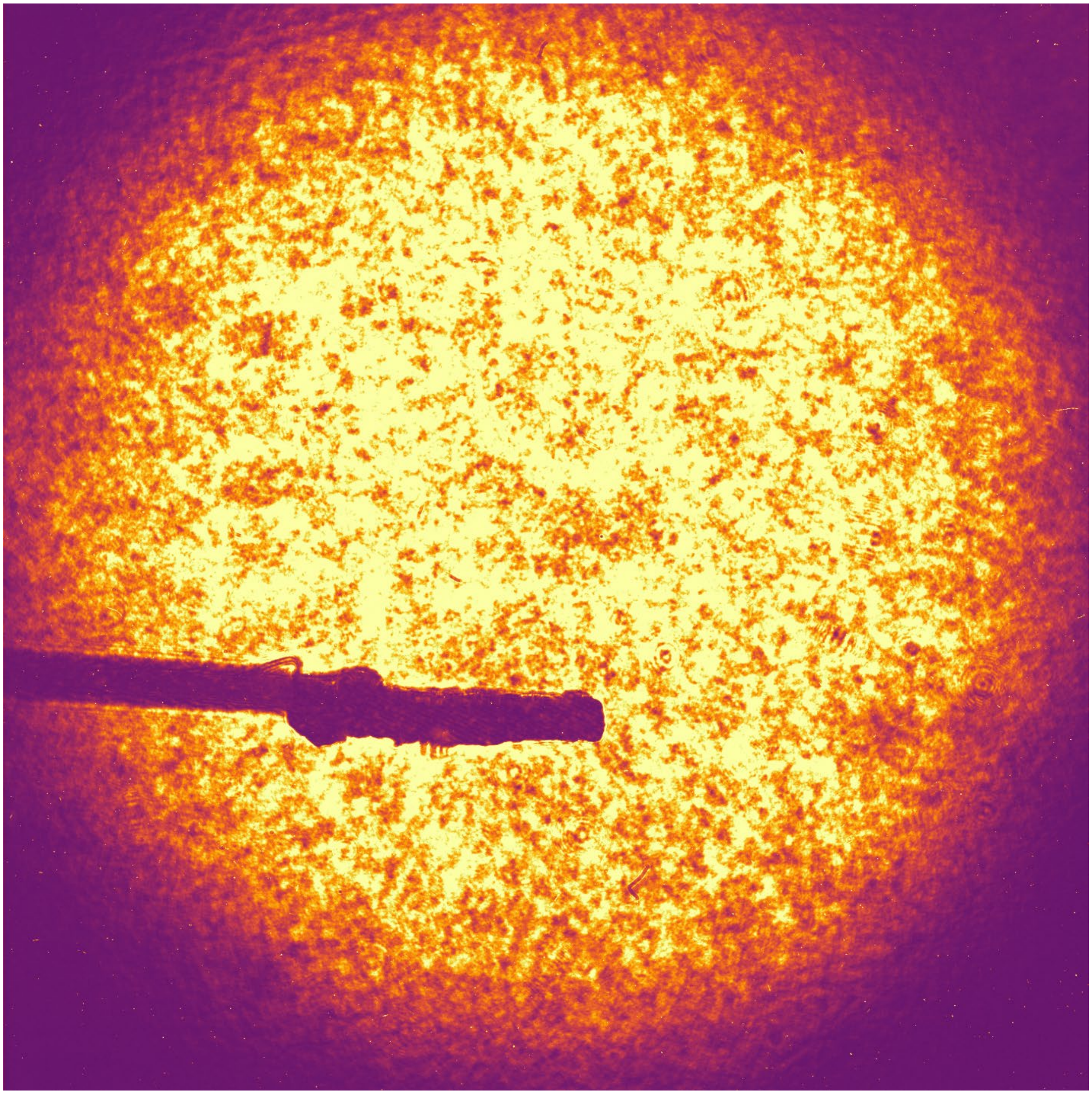


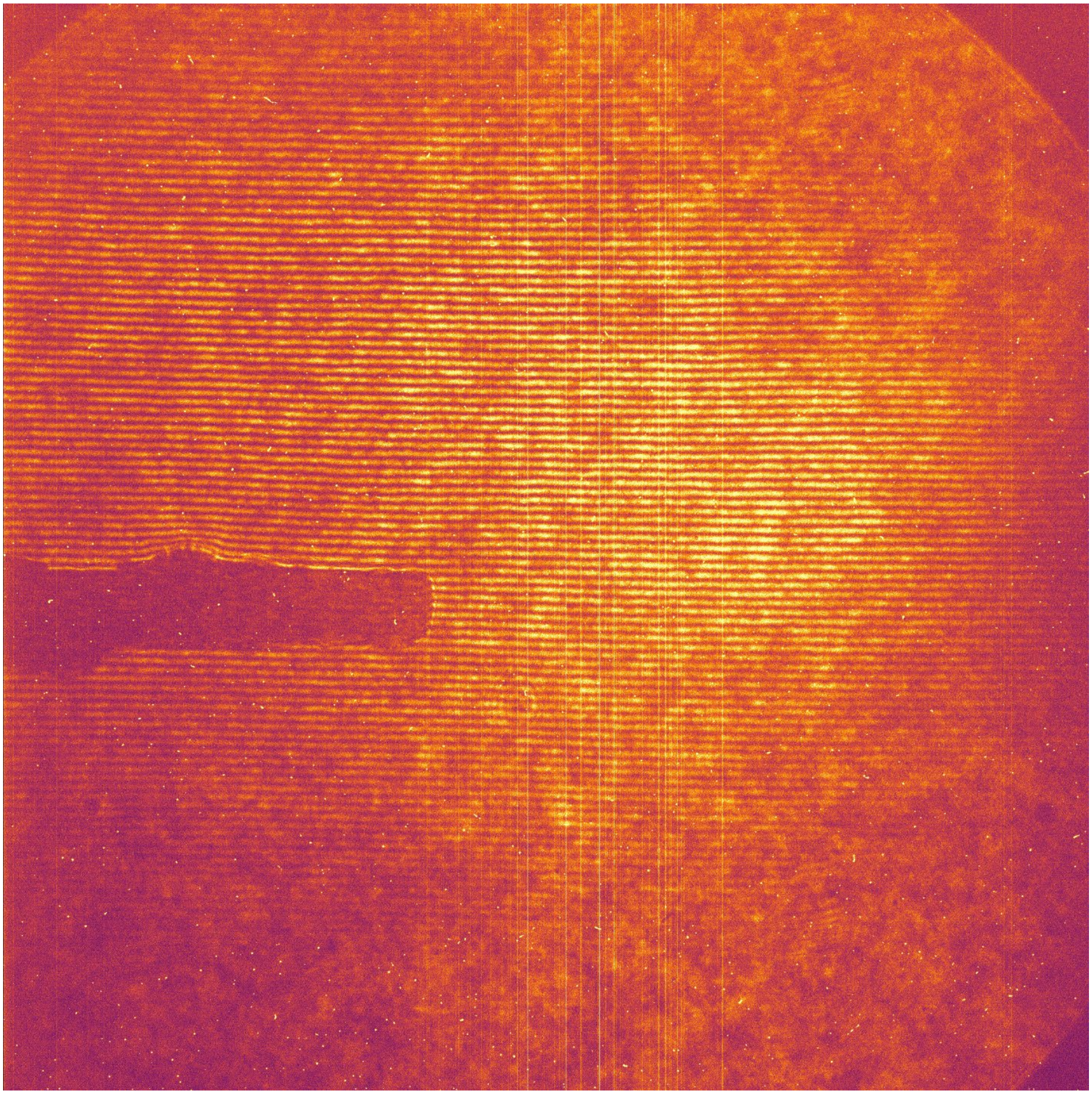


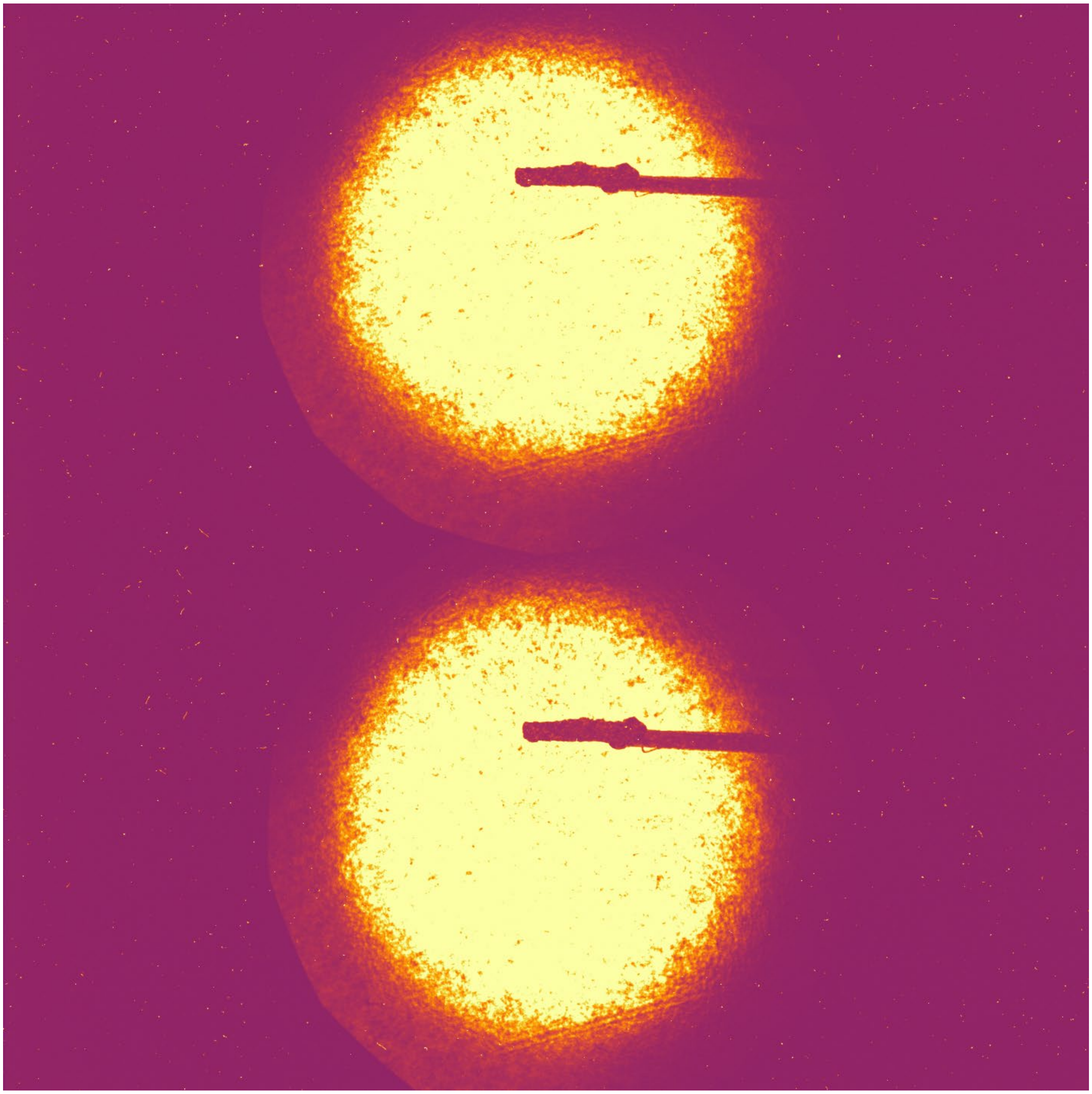


Shot 38066









Shot 38068