

Overview of NIF Framing Cameras

2026 NIF and JLF User Group Meeting

Feb 12th, 2026

Clément Trosseille

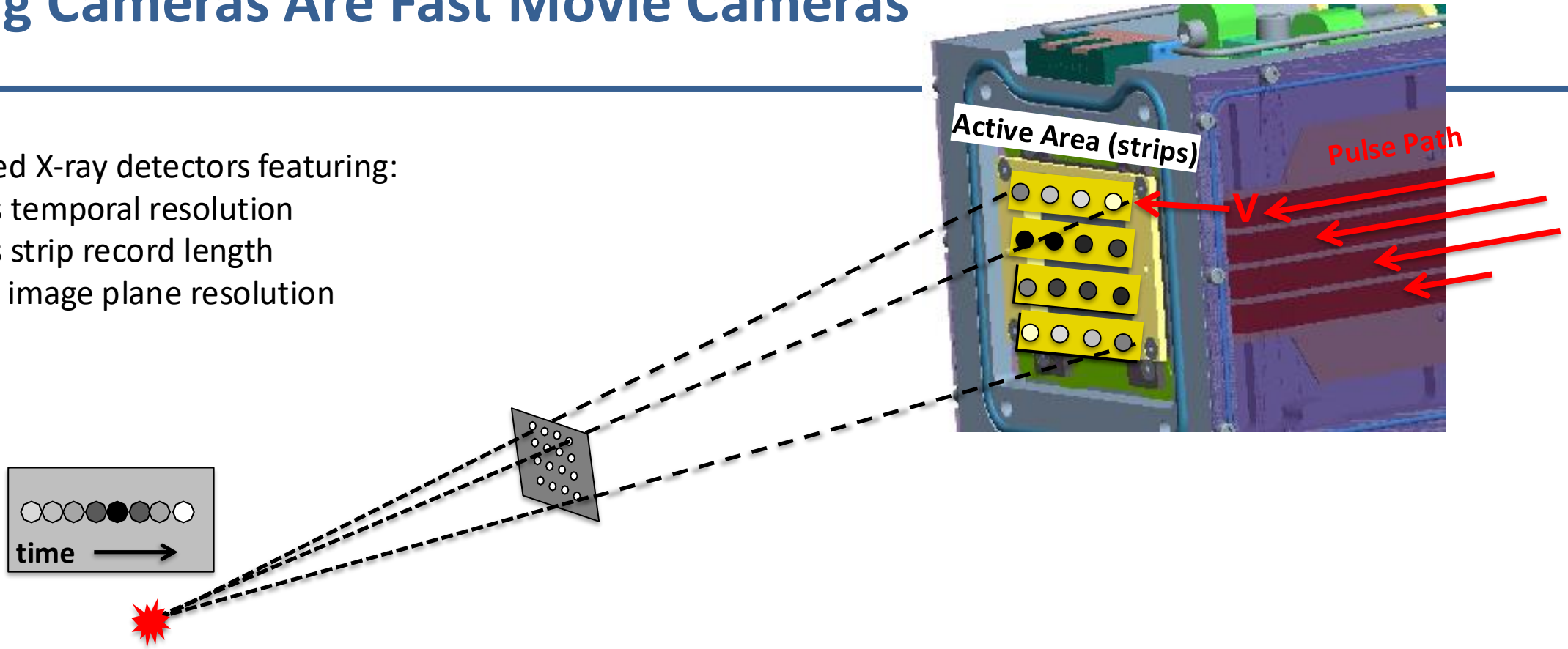
trosseille1@llnl.gov



Framing Cameras Are Fast Movie Cameras

Time-gated X-ray detectors featuring:

- 100 ps temporal resolution
- 250 ps strip record length
- 50 μm image plane resolution

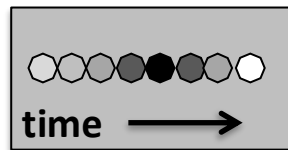
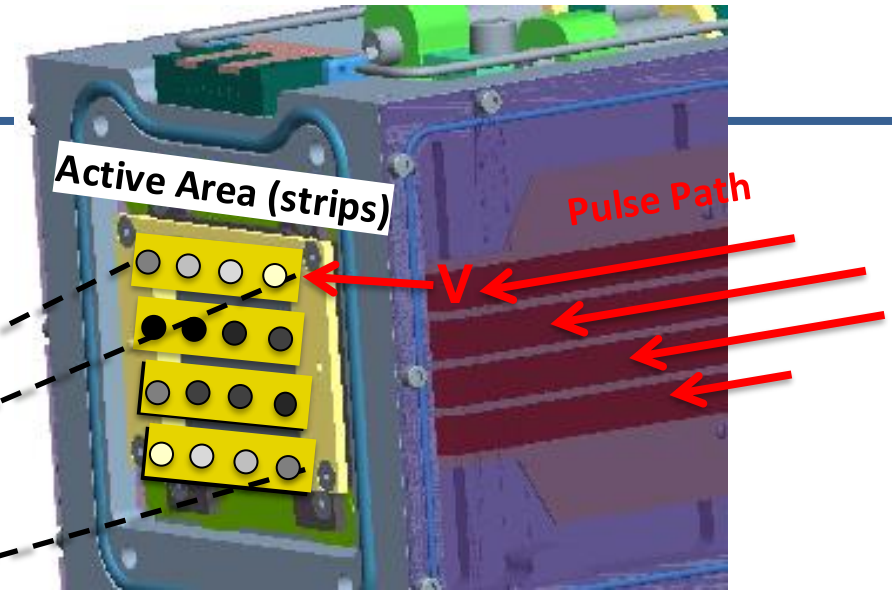


Paired with imaging snouts (pinhole arrays, Crystal Backlighter Imager, ...), spectrometers (Super Snout, ISS), etc...

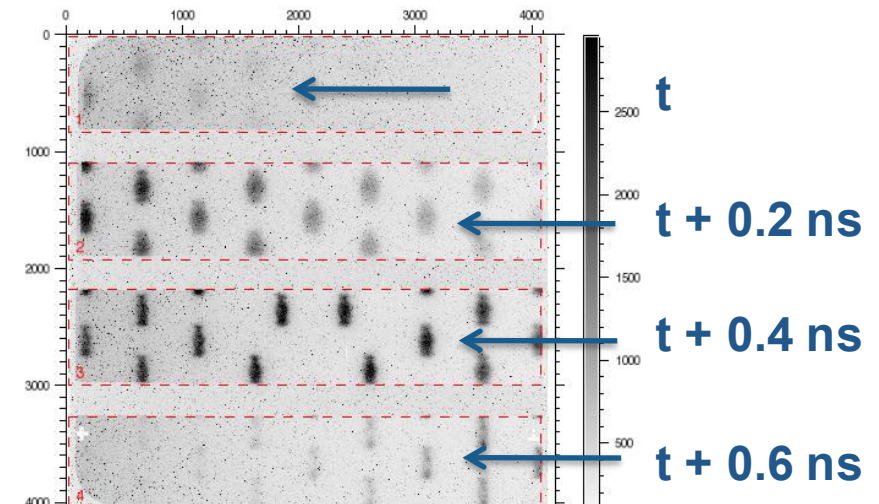
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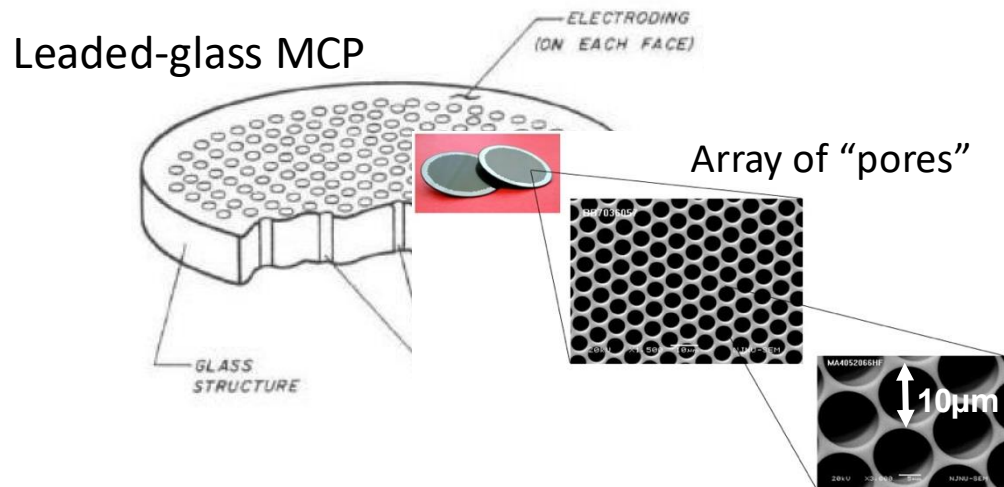


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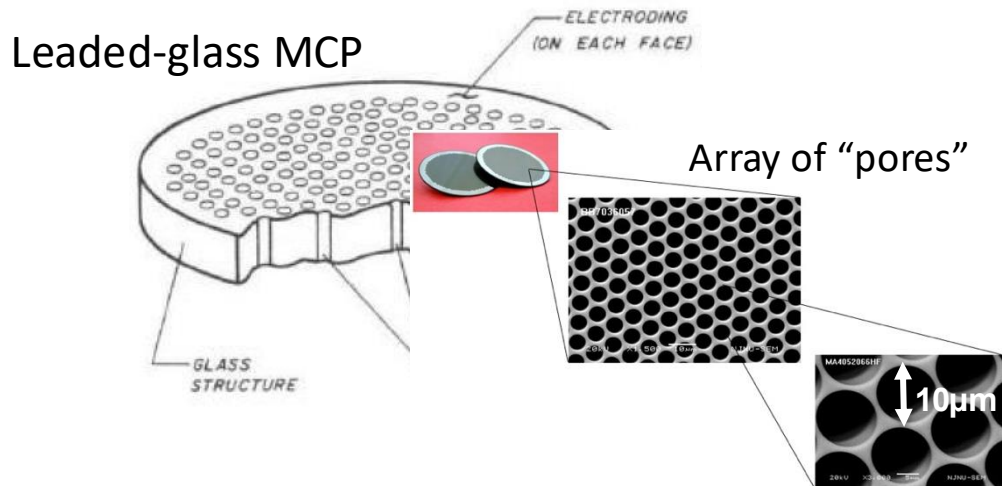


Imploding capsule recorded on framing camera

Framing Cameras Use MicroChannel Plates as Their Primary Active Detection Element



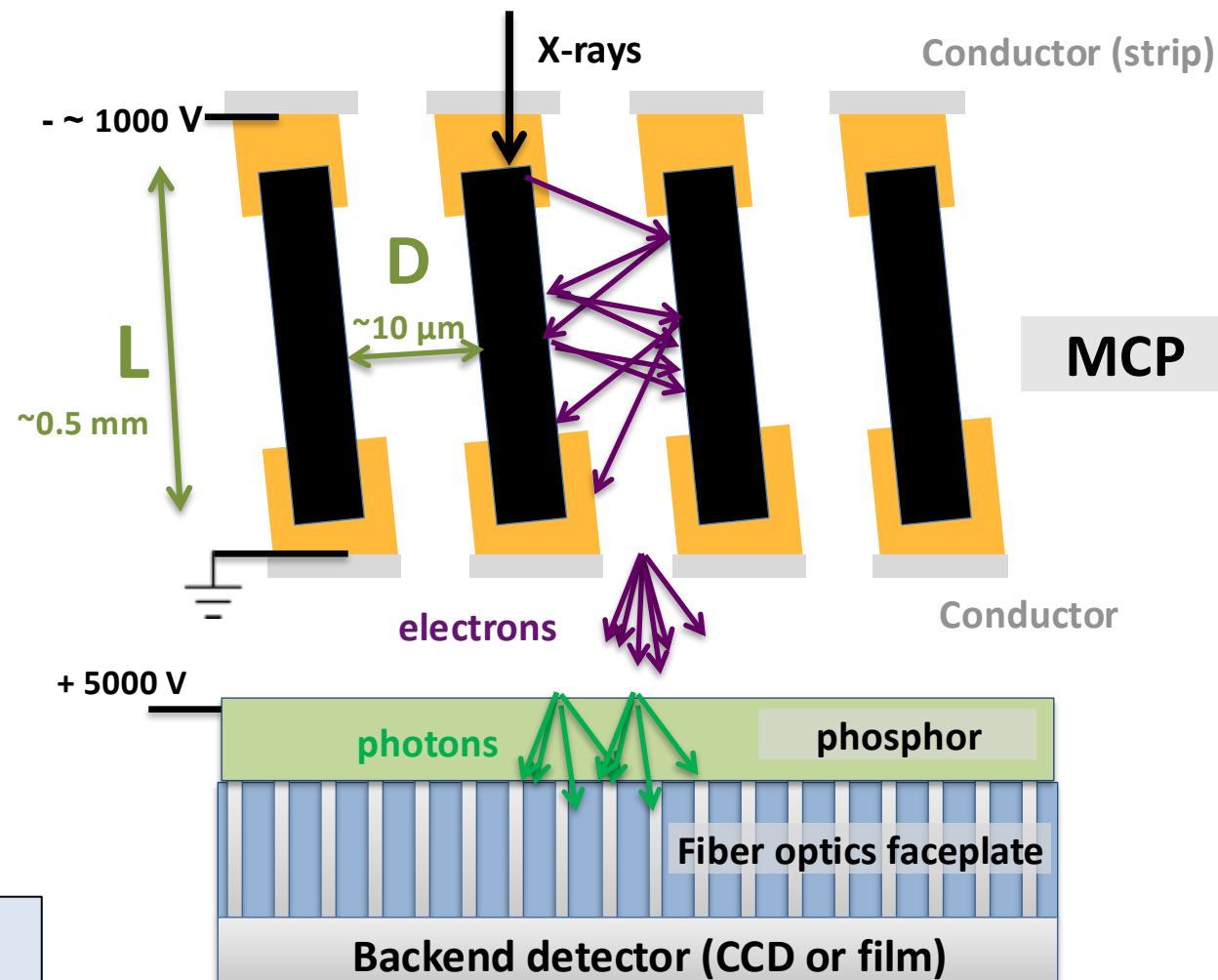
Framing Cameras Use MicroChannel Plates as Their Primary Active Detection Element



Conductors coated on top and bottom support a voltage difference:

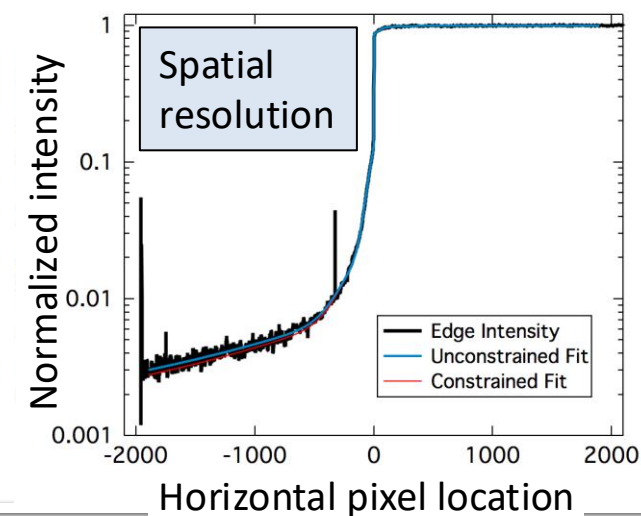
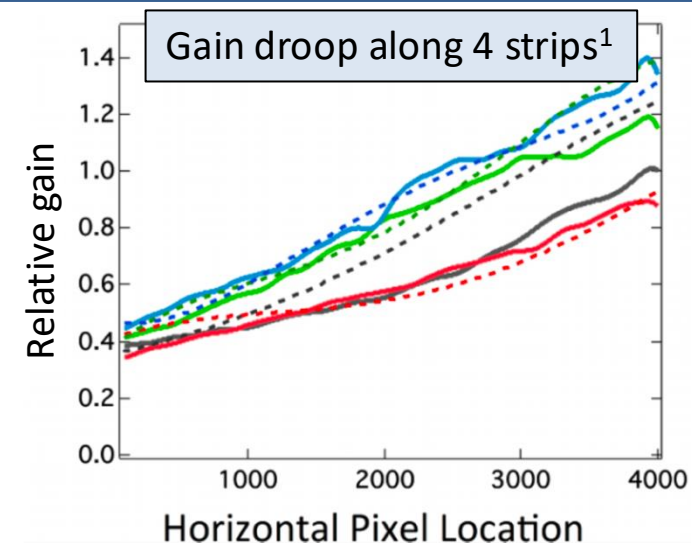
- Creating electric field in each pore
- Accelerates electrons down the pore
- Secondary electrons are produced at each impact (dynode)

$$\text{Electron cascade} \rightarrow \text{Gain} \propto V_{\text{MCP}}^\gamma \quad \gamma = \frac{L}{4D}$$



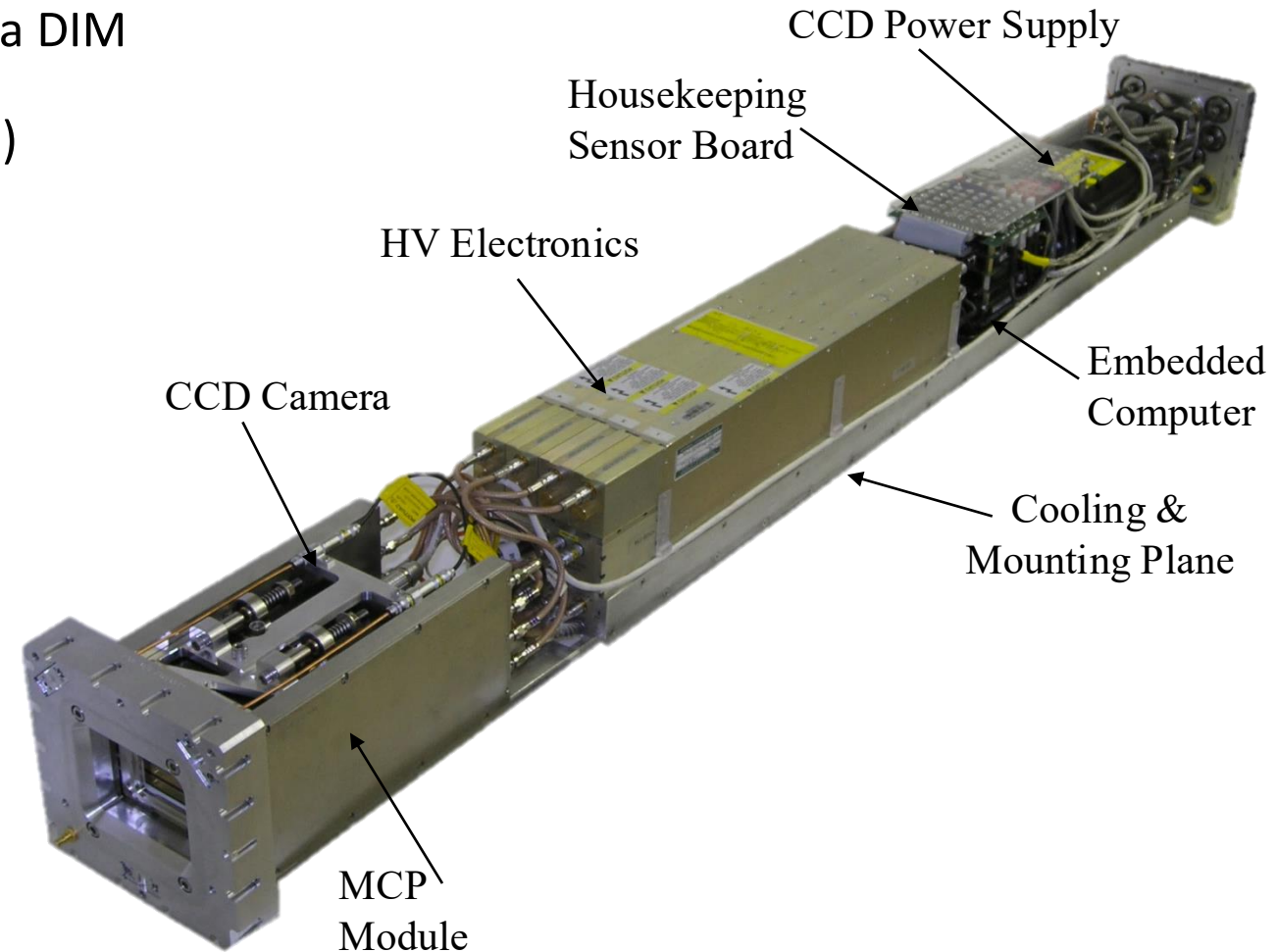
Individual Framing Camera Properties Are Hard to Predict or to Characterize

- Photon detection and signal amplification occur throughout the MCP
- Variability in the MCP and its coating, HV pulses and their coupling onto strips
- Actual use conditions are hard to reproduce during calibration
- We calibrate:
 - Pulse velocity across microstrip
 - Gate (gain) width
 - Gain variation with voltage on MCP
 - Strip-to-strip gain
 - Relative Droop
 - DC Sensitivity
 - ...







We Have Several Types of Framing Cameras on NIF

- Packaged inside an airbox, inserted and aligned *via* a DIM
- Hardened (HGXD) and non-hardened versions (GXD)
 - Film backend vs CCD backend
 - Recently, CMOS backend (HGXD-3)
- 4-strip and 2-strip (HGXD only) versions
- “-200” vs “-600” on some cameras
 - Controls integration time by shaping of HV pulse
 - Actual integration time is ~ 100 ps vs ~ 250 ps resp.



Framing Cameras Are Configured Through Shot Setup Tool (SST)

<https://nifit.llnl.gov/sst/>

TC090-078			
+ DIM Configuration (090,078)	TC090-078	● Approved 	✓
+ ARIANE (090,089)	TC090-089	● Approved (Secondary) 	⚠
DISC DIM (090,078)	TC090-078	● Not Used	
+ DIXI (090,100)	TC090-100	● Approved (Secondary) 	⚠
GXD DIM (090,078)	TC090-078	● Not Used	
+ HGXD DIM (090,078)	TC090-078	● Approved (Secondary) 	✓

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TC090-100		
GXD DIM (090,078)		
TC090-078		
- HGXD DIM (090,078)		
TC090-078		

TC090-078		
- DIM Configuration (090,078)	● Approved	✓
TC090-078		
Description		
Comment		
Template Applied	NONE	
Priority	Primary	
- Aimpoint Coordinates	Cartesian	
x (mm)	0	
y (mm)	0	
z (mm)	0	
+ DLP Nickname	HGXD6F	
Active	YES	
+ DIM Configuration	AAA10-115328 : HGXD2-H-640-25.4-1X	

← where the camera should be pointed to

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- HGXD DIM (090,078)	

TC090-078	
- DIM Configuration (090,078)	● Approved ✓
TC090-078	
Description	
Comment	
Template Applied	NONE
Priority	Primary
- Aimpoint Coordinates	Cartesian
x (mm)	0
y (mm)	0
z (mm)	0
+ DLP Nickname	HGXD6F IMPORT
Active	YES
+ DIM Configuration	AAA10-115328 : HGXD2

- DIM Configuration	AAA10-115328 : HGXD2-H-640-25.4-1X
Snout Selection	H-640-25.4
Snout Part Number	AAA10-115328
Cart Part Number	AAA12-105969
Airbox Part Number	AAA12-105140
Magnification	1X
Aimpoint-to-pinhole-plane Distance (mm)	640
Pinhole-plane-to-detector Distance (mm)	640
Aimpoint-to-detector Distance (mm)	1280
Snout-tip-to-pinhole-plane Distance (mm)	4.32
Aimpoint-to-snout-tip Distance (mm)	635.68
Roll Angle (deg)	0
Rotation (deg)	90
+ Nose Cap Assembly (Position 1 - Closest to TCC)	AAA12-113584 : 62 hole, 25um PH, 300um Coll Array No Polyimide
+ Nose Cone Assembly (Position 1 - Closest to TCC)	AAA10-102783 : Empty InLine Basket Filter
+ Kinematic Base Assembly (Position 1 - Closest to TCC)	1004015228 : FILTER ASSY, 25um Al/POLY, NO IP

← “snout” - imaging configuration

← pinhole array, filters, etc..

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TC090-078	
+ DIM Configuration (090,078)	● Approved ✓
TC090-078	
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TC090-089	
DISC DIM (090,078)	● Not Used
TC090-078	
+ DIXI (090,100)	● Approved (Secondary) ⚠
TC090-100	
GXD DIM (090,078)	● Not Used
TC090-078	
→ - HGXD DIM (090,078)	● Approved (Secondary) ✓
TC090-078	
Priority	Secondary
Description	
Comment	
Template Applied	NONE
+ Nickname	HGXD6F IMPORT
→ - Timing	

- Timing	
Trigger Delay rel Tzero (ns)	16.38
- Configuration	
Flange Filter	24um Al Polyimide
- Detector	
Pulse Forming Width (ps)	200
- Strip #1	
Timing Delay (ps) (in 25 ps increments)	0
Backbias (volts) (in 50V increments)	100
+ Strip #2	
+ Strip #3	
+ Strip #4	
Film	TMAX 400 with P11 phosphor 35mm FILM



← select trigger delay

← select ≥ 0 delay relative to global delay

← select MCP bias
+50 V → $\sim 1/3$ gain

Framing Camera Data is Recorded in NIF's Archive Viewer

<https://nifit.llnl.gov/viewer/main.action>

 <u>GXD</u>	
<u>TC090-124</u>	
<input type="checkbox"/> <u>FRAMING CAMERA TIMING</u>	1
<input type="checkbox"/> <u>DIAGNOSTIC IMAGE</u>	1
<input type="checkbox"/> <u>FRAMING CAMERA PULSER</u>	1
 <u>HGXD</u>	
<u>TC000-000</u>	
<input type="checkbox"/> <u>DROOP CORR IMAGE</u>	1
<input type="checkbox"/> <u>FRAMING CAMERA TIMING</u>	1
<input type="checkbox"/> <u>EXPOSURE IMAGE</u>	1
<input type="checkbox"/> <u>FRAMING CAMERA PULSER</u>	1
<input type="checkbox"/> <u>PDS IMAGE</u>	6
<u>TC090-078</u>	
<input type="checkbox"/> <u>DROOP CORR IMAGE</u>	1
<input type="checkbox"/> <u>FRAMING CAMERA TIMING</u>	1
<input type="checkbox"/> <u>PINHOLE EXTRACTED IMG</u>	1
<input type="checkbox"/> <u>EXPOSURE IMAGE</u>	1
<input type="checkbox"/> <u>FRAMING CAMERA PULSER</u>	1
<input type="checkbox"/> <u>PDS IMAGE</u>	6

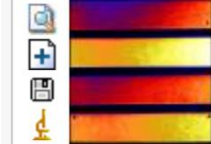

MONITOR_T1	Time for center of first strip relative to TCC T0	13.9
MONITOR_T2	Time for center of second strip relative to TCC T0	14.16
MONITOR_T3	Time for center of third strip relative to TCC T0	0
MONITOR_T4	Time for center of fourth strip relative to TCC T0	0

Framing Camera Data is Recorded in NIF's Archive Viewer

<https://nifit.llnl.gov/viewer/main.action>

<p>GXD</p> <p>TC090-124</p> <ul style="list-style-type: none"> <input type="checkbox"/> FRAMING_CAMERA_TIMING 1 <input type="checkbox"/> DIAGNOSTIC_IMAGE 1 <input type="checkbox"/> FRAMING_CAMERA_PULSER 1 	
<p>HGXD</p> <p>TC000-000</p> <ul style="list-style-type: none"> <input type="checkbox"/> DROOP_CORR_IMAGE 1 <input type="checkbox"/> FRAMING_CAMERA_TIMING 1 <input type="checkbox"/> EXPOSURE_IMAGE 1 <input type="checkbox"/> FRAMING_CAMERA_PULSER 1 <input type="checkbox"/> PDS_IMAGE 6 	
<p>TC090-078</p> <ul style="list-style-type: none"> <input type="checkbox"/> DROOP_CORR_IMAGE 1 <input type="checkbox"/> FRAMING_CAMERA_TIMING 1 <input type="checkbox"/> PINHOLE_EXTRACTED_IMG 1 <input type="checkbox"/> EXPOSURE_IMAGE 1 <input type="checkbox"/> FRAMING_CAMERA_PULSER 1 <input type="checkbox"/> PDS_IMAGE 6 	

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MONITOR_T3	Time for center of third strip relative to TCC T0	0
MONITOR_T4	Time for center of fourth strip relative to TCC T0	0

SHOT_IMAGE	Shot image	
PRESHOT_IMAGES	Preshot images	

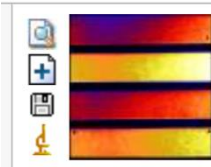
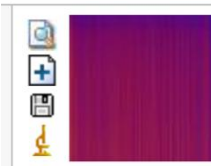
← subtract this from shot_image!

Framing Camera Data is Recorded in NIF's Archive Viewer

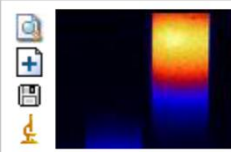
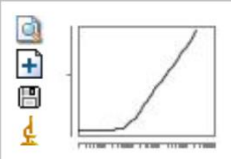
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<p>TC090-078</p> <ul style="list-style-type: none"> <input type="checkbox"/> DROOP_CORR_IMAGE 1 <input type="checkbox"/> FRAMING_CAMERA_TIMING 1 <input type="checkbox"/> PINHOLE_EXTRACTED_IMG 1 <input type="checkbox"/> EXPOSURE_IMAGE 1 <input type="checkbox"/> FRAMING_CAMERA_PULSER 1 <input type="checkbox"/> PDS_IMAGE 6 	

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MONITOR_T4	Time for center of fourth strip relative to TCC T0	0



SHOT_IMAGE	Shot image	
PRESHOT_IMAGES	Preshot images	

← subtract this from shot_image!

EXPOSURE_CORR_IMG	Corrected raw PDS image	
OPT_DENSITY_VS_EXP_WF	Optical density vs. Exposure plot	

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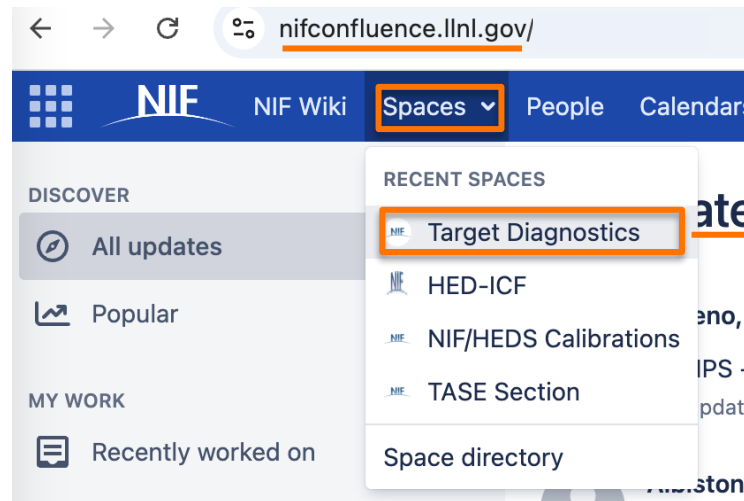
 <u>GXD</u>		
	<u>TC090-124</u>	
	<input type="checkbox"/> <u>FRAMING_CAMERA_TIMING</u>	1
	<input type="checkbox"/> <u>DIAGNOSTIC_IMAGE</u>	1
	<input type="checkbox"/> <u>FRAMING_CAMERA_PULSER</u>	1
 <u>HGXD</u>		
	<u>TC000-000</u>	
	<input type="checkbox"/> <u>DROOP_CORR_IMAGE</u>	1
	<input type="checkbox"/> <u>FRAMING_CAMERA_TIMING</u>	1
	<input type="checkbox"/> <u>EXPOSURE_IMAGE</u>	1
	<input type="checkbox"/> <u>FRAMING_CAMERA_PULSER</u>	1
	<input type="checkbox"/> <u>PDS_IMAGE</u>	6
	<u>TC090-078</u>	
	<input type="checkbox"/> <u>DROOP_CORR_IMAGE</u>	1
	<input type="checkbox"/> <u>FRAMING_CAMERA_TIMING</u>	1
	<input type="checkbox"/> <u>PINHOLE_EXTRACTED_IMG</u>	1
	<input type="checkbox"/> <u>EXPOSURE_IMAGE</u>	1
	<input type="checkbox"/> <u>FRAMING_CAMERA_PULSER</u>	1
	<input type="checkbox"/> <u>PDS_IMAGE</u>	6

Flat-fielded data only when calibration file is available!
Ask ahead of your shot if this is important for your experiment.

Useful User Resources

- Framing camera wiki page¹
 - Answers 95 % of your questions (setup + data processing)

- Gain
- Orientation
- Dimensions
- ...



- Calibration reports²
- Responsible scientists
 - Joe Holder (holder4@llnl.gov)
 - Clement Trosseille (trosseille1@llnl.gov)





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Framing camera cheat sheet (NIF wiki)

Available GXD Framing Cameras at NIF							
C C D	Camera	# strips	Add'l INFO	Gain Rel	Pulse Vel (mm/ns)	UV-measured gate width (ps)@(bias V)	Actual Interstrip Timing (vs req.)
	RGXD1F-200	4	No ERASER	8*	140	109 (50V) 107 (150V)	0/5/15/8 (co-timed)
	RGXD1F-600	4	No ERASER	256 (32x of -200 config)	140	240 (150V)	
	GXD3F &RGXD3F	4	No ERASER	1.2	142	115 (50V) 90 (300V)	
	RGXD4F-200	4	No ERASER	1.4	137	100 (100V)	
	RGXD4F-600 extended integration	4	No ERASER	22 (16x of -200 config)	139	228 (100V)	