LCLS-II Requirements

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Linac Coherent Light Source (Sector 20) ... the world's first "hard x-ray" laser

LCLS Linac (Sectors 21-30)

> LCLS Beam Transport

> > LCLS Undulator Hall

> > > LCLS Near Experimental Hall

LCLS Office Building (901)

> Endstation Systems

LCLS X-ray Transport/ Optics/Diagnostics

> Endstation Systems

LCLS Far Experimental Hall (underground)

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LCLS-II, a major (~ B\$) upgrade to LCLS is currently underway. Online in 2020.



Role of LCLS facility in data acquisition, storage, analysis

- The role of the LCLS facility has evolved since the beginnings of LCLS, driven by
 - **Throughput** increases and improvements in experimental efficiency
 - Larger datasets
 - Complex, computationally demanding analyses
 - Variability: rapid turnaround of experiments, many new user groups
 - Every shot is unique: all data associated with a fiducial is analyzed within the same context
- Today, the LCLS facility has taken on the role of
 - data acquisition
 - online monitoring, fast feedback
 - data storage and management
 - data archiving
 - providing an analysis framework and analysis farm

LCLS-II New Instruments



XPP will be modified for high rep rate tender X-ray operations

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NEH 1.1

- 250 2000 eV
- 1 µm / 0.3 µm
- **Minimal Optics**

- 1 µm
- 2x XFELs

NEH 2.2

- **RIXS**
- -250 1600 eV
- 2 x 2 µm
- Up to 30,000 resolving power

LCLS–II and –HE X-ray instruments, detectors, and data systems

LCLS-II instrument development (underway)



LCLS–II and –HE require a new suite of X-ray instruments, detectors, and data systems, consistent with the leap from 120 Hz to 1 MHz

LCLS-II will increase data throughput by three orders of magnitude by 2025

LCLS-II Requirements: High Rate Detectors

- Coherent Scattering, Imaging & Diffraction at the Nanoscale
 - Soft x-ray imaging VeryFastCCD, FLORA, epixM (4 MP @ 10kHz)
 - Tender x-ray imaging ePix-HighRate (4 MP @ 40kHz)
- Fundamental Dynamics of Energy & Charge
 - Molecular reaction microscope MCP + delay-line anode
 - Strong-field AMO Tixel/Particle detector
 - ~20 digitizer channels, 1-5 GHz sampling
- Catalysis, Photo-catalysis and Bio-spectroscopy
 - Moderate resolution, high quantum (and collection) efficiency soft X-ray
 - TES spectrometer (1000 pixels, 1 2 MHz sampling)
- High-resolution Spectroscopy: Quantum Materials & Physical Chemistry
 - 2D, high quantum efficiency soft X-rays
- Very high spatial resolution (5 μm) area detector (RIXS-CCD, 4 kP @ 1 kHz)
 Hard X-ray Scattering & Spectroscopy
 - 2D, high quantum efficiency up to 25 keV, 120 Hz ePix (120Hz)











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Instrument	Photon Energy (eV)	Detector Needs	First Light	Fully Comm.
NEH 1.1	250-2500	2D ToF Charged Particle (1 MHz) 2D ToF Multi-Particle	11/2020	5/2021
NEH 2.x - LJE	250-1600	2D High Spatial Resolution (5 μm) TES - 1000 pixel (≤1 eV, ≥10 kHz)	11/2020	5/2021
NEH 2.x - RIXS	250-1600	2D High Spatial Resolution (5 μm) 2D Imaging (≥ 2 kHz)	1/2022	6/2022
NEH 1.2	400-6000	2D High Spatial Resolution (5 µm) 2D Imaging (≥ 2 kHz)	1/2023	6/2023

Plan was revised to consolidate capabilities and create a less aggressive time phasing of detectors: Merged the NEH 2.2 and 2.1 endstations onto a single beamline Imaging capabilities consolidated into TXI instrument

LCLS-II requirements: experiment duration

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Experiments typically last 1 to 5 days, with teams of 10 to 80 people per experiment

Science Area

LCLS User schedule snapshot



A detailed analysis has been undertaken of the anticipated data flow to quantify the scale of the challenge

We have predicted the following as a function of a time:

- Expected experiments and their anticipated beam allocation at each endstation (based on our 5-year "First Experiments" plan)
- Detectors, acquisition rates, and experimental techniques; drives the throughput requirements
- **Peak throughput** expected from these experiments; drives the data acquisition and network <u>bandwidth</u> requirements
- Average throughput written to disk; drives storage requirements
- Beam utilization, the fraction of the beam time used to record data; drives throughput and storage requirements

A time-phased assessment of data output has been derived

LCLS-II Requirements: Throughput and Storage

LCLS Data Throughput

Data Storage Requirements

Throughput/storage requirements are extremely challenging: data reduction needed

Computing Requirements for Data Analysis: a Day in the Life of a User Perspective

- During data taking:
 - Must be able to get real time (~1 s) feedback about the quality of data taking, e.g.
 - Are we getting all the required detector contributions for each event?
 - Is the hit rate for the pulse-sample interaction high enough?
 - Must be able to get feedback about the quality of the acquired data with a latency lower (~1 min) than the typical lifetime of a measurement (~10 min) in order to optimize the experimental setup for the next measurement, e.g.
 - Are we collecting enough statistics? Is the S/N ratio as expected?
 - Is the resolution of the reconstructed electron density what we expected?
 - New: Validating data reduction pipeline parameters
- During off shifts: must be able to run multiple passes (> 10) of the full analysis on the data acquired during the previous shift to optimize analysis parameters and code in preparation for the next shift
- During 4 months after the experiment: must be able analyze the raw and intermediate data on fast access storage in preparation for publication
- After 4 months: if needed, must be able to restore the archived data to test new ideas, new code or new parameters

LCLS-II computing requirements

- 1. Fast feedback is essential (seconds / minute timescale) to reduce the time to complete the experiment, improve data quality, and increase the success rate
- 2. 24/7 availability
- **3. Short burst** jobs, needing very short startup time Very disruptive for computers that typically host simulations that run for days
- 4. Storage represents significant fraction of the overall system, both in cost and complexity
- 5. Throughput between storage and processing is critical *Currently most LCLS jobs are I/O limited*
- Speed and flexibility of the development cycle is critical Wide variety of experiments, with rapid turnaround, and the need to tune data analysis during experiments

LCLS is uniquely challenging due to the data throughput, the variety of experiments and the need for fast feedback

Summary of key requirements

LCLS-II, LCLS-II HE, and detector upgrades create demanding data throughput and processing rates, demanding a coordinated effort to upgrade the LCLS Data Systems and SLAC computing infrastructure

Phase I Phase II Phase III Parameter LCLS-I LCLS-II comm. LCLS-II ops LCLS-II HE Present 2020 2024 2028 1-2.5 GB/s 2.5-25 GB/s 1296 Ave throughput 5-200 GB/s GB/s 5 GB/s 200 GB/s 200 GB/s 1.3 TB/s Peak throughput Data cache storage 50 TB/hall 1 PB 3 PB 10 PB 1 PFlops 5 PFlops Peak Processing 50 TFlops >130 PFlops (offline) 6 PB 16 PB 36 PB >100 PB Disk storage

Backup Slides

Portfolio, development paths and phases

Application	Specification	Project Description	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
Spectroscopy	Energy range: 250 - 1600 eV ≤ 0.5 eV, ≥ 10 kHz	TES Spectrometer		R&D	R&D Production	R&D Production	R&D Production	R&D Production	R&D LJE/Inst.	LJE/Depl.	
	2D High Spatial Resolution (5 μm)	RIXS CCD		First article	First article	First article	Production	LJE/Inst.	LJE/Depl.	RIXS/Inst.Dep	I
Scattering/Imaging tender/hard		epix 10k	Demo	Demo	Demo	First article					
	Energy range: 1500 - 7000 eV	epix HR	R&D	R&D	R&D	R&D					
	≥ 5 kHz, 100 µm, 2 x 2.4M & 0.5 M					First article	First article	First article			
	1 - 10,000 ph/pix/frame							Production	Production	Production	TXI/Inst Depl
		Jungfrau		Pr/Int	Pr/Int	Depl	Depl	rioddollori	Troduction	Troduction	Training Dopi.
	High QE @ 25 keV	Hard X-ray detectors		,	,	R&D	R&D				
							First article	First article			
								Production	Production		
	≥ 10 kHz	Very High Frame detector						R&D	R&D	R&D	First Article
Scattering/Imaging soft	Energy range: 250 - 1500 eV									RIXS/Inst.Dep	TXI/Inst Depl
	> 5 kHz 50 um 1M	opixM		P&D	PPD					·	i varinoa Bopii
		ерхм		Rab	RaD	First article	First article				
						i list article	Thotarticle	Production	Production		
		Very East CCD		R&D	R&D	First article		Troduction	Troduction		
		FLORA		Kab	R&D	R&D	Production R&D	Production			
							First article	First article	First article		
									Production	Production	Production
		Very High Frame detector						R&D	R&D	R&D	First Article
Particle detector	1 MHz, TOF < 500 ps, < 250 μm	MCP/Delay Line						TMO/Inst.Depl			
		Tixel Detector			R&D	R&D					
		Particle Detector					R&D	R&D	_	_	
									First article	First article	
										Production	TMO/Inst.Depl

-SLAC

- 1. **Detector rates** for each instrument
- 2. Distribution of experiments across instruments (as function of time, ie as more instruments are commissioned)
- 3. Typical uptimes (by instruments)
- 4. Data reduction capabilities based on the experimental techniques
- 5. Algorithm **processing times** for each experimental technique for each layer: Data Reduction, Fast Feedback, and Offline

Undulator	Instrument	Endstation	Technique	Detector	Detector Size	Detector Rate (Hz)	Data Rate (aggregate) (GB/s)	Ultilization Factor (0-1)	Data Reduction Type	DR Factor	Data Rate after DRP (GB/s)	FFB algorithm type	FFB Computing [msec / event]	FFB Computing [TFLOPs]	Computing w/ Indexing [TFLOPs]	Offline algorithm type	Offline Computing [msec / event]	Offline Computing [TFLOPs]	FY20 Q1	FY20 Q2	FY20 Q3	FY20 Q4	Q1 0	Y21 FY Q2 C	21 FY21 23 Q4	Q1	FY22 F Q2	Q3	FY22 F Q4	Y23 FY2 Q1 Q2	3 FY23 F Q3	FY23 F1 Q4 (Y24 F
SXU	NEH 1.1	DREAM	COLTRIMS	Digitizer	800000	100000	160.0	0.75	Zero suppression	0.020	3	ROENTDEK Coincidence Sorting	0.04	0.1	0.1445	detailed reconstruction of ToF, x, y	5.0000	16.8		1.00	1.00	0.50	0.25 0	25 0	25 0.25	0.25	0.19	0.19	0.19 (2.19 0.1	0.19	0.19 0	.19 0
SXU	NEH 1.1	DREAM	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	4	peak finding			0.0001	statistics		0.0				0.13	0.13 0	.13 0.	06 0.06	0.06	0.03	0.03 /	0.03 (1.03 0.0	1 0.03 F	0.03 0	.03 0
SXU	NEH 1.1	LAMP	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	4	peak finding		-	0.0001	statistics		0.0				0.13	0.13 0	.13 0.	06 0.06	0.06	0.03	0.03	0.03 (0.03 0.0	3 0.03 F	0.03 0	.03 0
SXU	NEH 1.1	LAMP	Imaging	SXR Imag. + Digi.	4000000	10000	82.0	0.45	Veto	0.100	8	Fourier Transform	44.50	1.5	1.4952	MTIP								0.	13 0.13	0.13	0.06	0.06	0.06 0	0.0 0.0	0.06	0.06 0	.06 0
SXU	NEH 2.2	LJE	XAS / XES	TES	1000	100000	20.0	0.60	Zero suppression	0.100	2	Binning	0.01	0.0	0.0336	na	÷+								0.06	0.13	0.13	0.13 f	0.13 1	113 0.1	0.13	0.13	
SXU	NEH 2.2	LJE	XAS / XES	TES	10000	100000	200.0	0.60	Zero suppression	0.100	20	Binning	0.10	0.3	0.3360	na	-															0	.13 0
SXU	NEH 2.2	LJE	XAS / XES	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0	Binning	0.01	0.00034	0.0003	na						0.25	0.50 0	.25 0,	25 0.19	0.13	0.06	0.06	0.06 1	1.06 0.0	0.06	0.06 0	.06 0
SXU	NEH 2.2	RIXS	IXS / RIXS	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0	Binning	0.01	0.00034	0.0003	na	+						0	1.13 0.	13 0.19	0.19	0.19	0.19	0.19 (1.19 0.1	0.19	0.19 0	.19 0
SXU	NEH 2.2	RIXS	XRD / RXRD	SXR Imaging	1000000	10000	20.0	0.60	ROI	0.100	2												0	.06 0.	06 0.03	0.03	0.03	0.03 (0.03 (1.03 0.0	0.03	0.03 0	03 0
SXU	NEH 2.2	RIXS	XPCS	SXR Imaging	1000000	10000	20.0	0.60	Compression	0.500	10	Photonize	50.00	16.8	16.8000	Stats Analysis	0.0100	0.0					0	.06 0.	06 0.03	0.03	0.03	0.03 /	0.03 1	1.03 0.0	3 0.03	0.03 0	.03 0
SXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	2	FXS Correlations (subset)	3.30	0.1	0.1109	FXS Correlations + MTIP	300.0000	10.1									0.13	0.13	0.13 0	13 0.1	0.13	0.13 0	1.13 0
SXU	NEH 1.2	-	Imaging	epix100-HR + Digi.	4000000	5000	42.0	0.45	Veto	0.100	4	Fourier Transform	44.50	0.7	0.7476	MTIP											0.06	0.06	0.06 0	0.06 0.0	0.06	0.06 0	.06 0
SXU	NEH 1.2		XAS / XES	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0	Peak Finding	2.00	0.1	0.0672	statistics											0.06	0.06	0.06 (0.0 0.0	0.06	0.06 0	.06 0
		Soft X-ray So	ource Total										50.00	16.80					0.00	1.00	1.00	1.00	1.00 1	.00 1.	.00 1.00	J 1.00	1.00	1.00	1.00 1	1.00 1.0	1.00	1.00 1	.00 1
HXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	2	Peak Finding	200.00	67.2	5107.2000	Indexing	15000.00	5040.0									0.06	0.06	0.06	1.05 0.0	0.19	0.19 0	.19 0
HAVE .	NEW 1.2	1000	Impoint	ania 100 MD + Diai	4000000	6000	42.0	0.45	Mate	0.100		Fourier		1999													0.02	0.02	0.00		0.00	0.00 0	00 0

Instruments & Endstations

Predicted beamtime allocation: Soft x-ray undulator (1.0) Hard x-ray undulator (~1.4) Endstation Commissioning Endstation Early Science Endstation Normal Operations

Utilization: Based on historical data and expected improvements in operations, what fraction of the time are users recording data? Applying the utilization factor produces average data throughput.

Estimated User Hours

										User Hours	563	563	563 5	563 112	25 112	5 1125	1125	1125	125 1	125 11:	25 112	5 1125	1125	1125	1125 1	125 112	5 112	5 1125	1125	1125 1	125 11:	25 11	25 112	1125
Undulator	Instrument	Endstation	Technique	Detector	Detector Size	Detector Rate (Hz)	Data Rate (aggregate) (GB/s)	Ultilization Factor (0-1)	Data Reduction Type	Dis Pactor	FY20 Q1	Q2	Y20 F	Y20 FY	21 FY2 1 Q2	1 FY21 Q3	FY21 Q4	FY22 F	922 F	722 FY	22 FY2 4 Q1	3 FY23 Q2	FY23 Q3	FY23 Q4	Q1	724 FY	4 FY2	4 FY25 Q1	FY25 Q2	FY25 F	725 FY	26 FY	26 FY2 22 Q	6 FY26 3 Q4
SXU	NEH 1.1	DREAM	COLTRIMS	Digitizer	800000	100000	160.0	0.75	Zero suppression	0.020	0	422	422 2	211 21	1 211	1 211	211	211	158 1	58 15	8 158	158	158	158	158	158 15	8 15	158	158	158 1	58 15	58 15	58 15	8 158
SXU	NEH 1.1	DREAM	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	0	0	0 1	53 10	5 105	5 53	53	53	26	26 21	3 26	26	26	26	26	26 26	26	26	26	26	26 21	6 2	6 26	26
SXU	NEH 1.1	LAMP	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	0	0	0 :	53 10	5 10	5 53	53	53	26 :	26 21	5 26	26	26	26	26	26 26	26	26	26	26	26 20	6 2	6 26	26
SXU	NEH 1.1	LAMP	Imaging	SXR Imag. + Digi.	4000000	10000	82.0	0.45	Veto	0.100	0	0	0	0 0	K	0 63	63	63	32 :	32 3:	2 32	32	32	32	32	32 32	32	32	32	32	32 3	12 3	2 37	32
SXU	NEH 2.2	LJE	XAS / XES	TES	1000	100000	20.0	0.60	Zero suppression	0.100	0	0	0	0 0	0	0	42	84	84 1	84 84	84	84	84	84	0	0 0	0	0	0	0	0 0	0 0	0 0	0
SXU	NEH 2.2	LJE	XAS / XES	TES	10000	100000	200.0	0.60	Zero suppression	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	84	84 84	84	84	84	84	84 8	14 8	4 84	84
SXU	NEH 2.2	LJE	XAS / XES	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0	0	0 1	84 33	8 165	9 169	127	84	42 4	42 43	2 42	42	42	42	42	42 43	42	42	42	42	42 4	2 4	2 47	42
SXU	NEH 2.2	RIXS	IXS / RIXS	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0	0	0	0 0	84	84	127	127	127 1	27 12	7 127	127	127	127	127	127 12	7 12	127	127	127	27 12	27 12	27 12	7 127
SXU	NEH 2.2	RIXS	XRD / RXRD	SXR Imaging	1000000	10000	20.0	0.60	ROI	0,100	0	0	0	0 0	42	42	21	21	21 :	21 2	1 21	21	21	21	21	21 21	21	21	21	21	21 2	1 2	1 21	21
SXU	NEH 2.2	RIXS	XPCS	SXR Imaging	1000000	10000	20.0	0.60	Compression	0.500	0	0	0	0 0	42	42	21	21	21 :	21 2	1 21	21	21	21	21	21 21	21	21	21	21	21 2	1 2	1 21	21
SXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	0	0	0	0 0	0	0	0	0	42	42 43	2 42	42	42	42	42	42 43	42	42	42	42	42 4	12 4	2 47	42
SXU	NEH 1.2		Imaging	epix100-HR + Digi.	4000000	5000	42.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	32	32 3	2 32	32	32	32	32	32 32	32	32	32	32	32 3	12 3	2 37	32
SXU	NEH 1.2		XAS / XES	RIXS-cod	4096	1000	0.0	0.60	N.A.	1.000	0	0	0	0 0	0	0	0	0	42	42 43	2 42	42	42	42	42	42 43	42	42	42	42	42 4	2 4	2 47	42
		Soft X-ray So	ource Total								0	422	422 4	101 75	9 75	9 717	717	717	654 6	54 65	4 654	654	654	654	654	654 65	4 65	654	654	654 (454 6!	54 65	54 65	4 654
HXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	0	0	0	0 0	0	0	0	0	21	21 2	21	21	63	63	63	63 63	21	21	21	21	21 2	1 2	1 21	21
HXU	NEH 1.2		Imaging	epix100-HR + Dioi.	4000000	5000	42.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	16	16 1	16	16	32	32	32	32 32	16	16	0	0	0 0	0 0	0 0	0
HXU	NEH 12		XAS / XES	RIXS.cod	4096	1000	0.0	0.60	NA	1.000	0	0	0	0 0	0	0	0	0	21	21 2	21	21	42	42	42	42 43	21	21	21	21	21 2	1 2	1 21	21
HXU	NEH 1.2		Imaging	ePixUHB	4000000	40000	336.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	16	16	16 1/	6 1	6 16	16
HXU	NEH 1.2		Imaging	ePixUHR	16000000	40000	1296.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0 0	0 0	0 0	0
HXU	XPP	1000	Scattering	CSPAD	2000000	120	0.5	0.75	NA	1.000	79	53	53 3	79 15	8 15	R 158	158	158	158 1	58 15	8 158	158	158	158	158	0 0	0	0	0	0	0 0	0 0	0 0	0
HXU	XPP		XAS / XES	ePix100	500000	120	0.1	0.75	NA	1.000	26	53	53	26 5	53	53	53	53	53	53 5	53	53	53	53	53	0 0	53	53	53	53	53 5	3 5	3 52	53
HXU	XPP		IXS / RIXS	ePix100	500000	120	0.1	0.75	NA	1.000	26	53	53	26 5	53	53	53	53	53	53 5	53	53	53	53	53	0 0	53	53	53	53	53 5	3 5	3 52	53
HXU	XPP	A1970	XRD / RXRD	ePix100	500000	120	0.1	0.75	NA	1 000	26	13	13	26 5	53	53	53	53	53	53 5	53	53	53	53	53	0 0	53	53	53	53	53 5	3 5	3 57	53
HYLL	YPP		Scattering	aPix10k-HP	4000000	5000	40.0	0.75	Bioplog	0.001	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	1.63	150	150	150	150 11	50 0	0 0	0
HYU	YPP		Scattering	ePixt IHR	4000000	40000	320.0	0.75	Biopiog	0.000	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0 0	0 1	58 15	8 158
HYU	YPP		Coattoring	aPixLHdP	16000000	40000	1280.0	0.75	Bioping	0.000	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0 1	0	~	0 1
HYU	VCR/IVE		vece	ePix100	500000	120	1200.0	0.75	NA	1.000	62	63	53 1	62 10	6 10	5 105	105	105	105 1	05 10	5 105	105	105	105	105	0 0	0	0	0	0	0 0	0 0	0 0	0
HXU	YCS/IYS		IVS / RIVS	ePix100	500000	120	0.1	0.75	NA	1.000	53	53	53 4	53 10	5 10	5 105	105	105	105 1	05 10	5 105	105	105	105	105	0	0 15	150	150	150	150 11	50 14	50 15	0 150
HYU	VCENVE		VPD (PVPD	ePix100	500000	120	0.1	0.75	NA	1.000	53	53	53 4	E2 10	5 10	5 105	105	105	105 1	05 10	5 105	105	105	105	105	0	0 26	20	20	26	26 2			20
HAU	XCENXE		VROCE		500000	6000	5.0	0.75	Companying	0.500	00	00	00 0	0 10	0 10	0	100	0.	0	0. 0	0 100	100	100	100	0	0	0 20	20	20	20		2	0 0	20
HAU	XCONXO		XPCS	epix roo-rik	500000	40000	5.0	0.45	Compression	0.500	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0 03	03	0.5	00	0 1		2 01	0
HAU	MEY		Viollegeophy	ericonic	4000000	40000	40.0	0.45	Compression	1.000	22	22	22 1	22 61	0 62	62	62	62	62	0 0	0 62	62	0	0	0	0 0	0	0	0	0	0 0		3 03	03
HAU	MEA	1,1000	Xtallography	Junghau	4000000	120	1.0	0.45	No.	0.400	3z	3z	02 .	0 0	00	03	03	00	00 1	0 0	03	03	0	0	0	107 40			0	0				-
HAU	OXI		Xtallography	Jungirau	4000000	8000	64.0	0.45	Veto	0.100	62	62	82 4	62 12	7 10	7 107	107	107	107 1	0 0	7 107	107	0	0	0	2/ 12	03	0.5	0.5	00	0 1	0 0	3 03	03
HAU	CXI		Ataiography	Junghau	4000000	120	1.0	0.45	N.A.	1.000	03	03	22	22 6		62	60	60	10	10 11	1 121	121	0	0	0	0 0	0	0	0	0	0 0		0 0	0
HAU	OXI		imaging	Junghau	4000000	120	1.0	0.45	N.A.	1.000	32	3z	02 .	0 0	000	03	03	03	10	0 0	0 10	10	0	0	0	107 10		107	107	107	0 0		, 0	0
HAU	CXI		Ataliography	Jungtrau	4000000	0006	64.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	12/ 12	12	121	127	12/	21 12	21 0	, ,	0
HXU	CXI		Imaging	Jungtrau	4000000	8000	64.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	10 10	18	16	10	16	10 10	0 0	, 0	0
HXU	CXI		Xtallography	ePixUHR	4000000	40000	320.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0 0	0 12	12	1 127
HXU	CXI		Atallography	ePixOHR	16000000	40000	1280.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0 0		, 0	0
HXU	CXI		Imaging	ePixUHR	4000000	40000	320.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0 0	0 1	8 16	16
HXU	CXI		Imaging	ePixUHR	16000000	40000	1280.0	0.45	Veto	0.100	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0 0	0	0	0 0
HXU	MEC			ePix100	500000	10	0.0	0.38	N.A.	1.000	26	26	26 3	26 5	3 53	53	53	53	53	53 53	3 53	53	0	0	0	66 66	53	53	53	53	13 5	3 5	3 53	53
		Hard X-ray Se	ource Total								469	483 4	483 4	169 93	9 931	9 939	939	939	949 9	49 94	9 949	949	770	770	770 .	472 47	2 88	881	881	881 8	181 88	81 88	31 88	1 881

Utilization Hours = BT allocation x User Hours x Utilization factor Utilization factor (fraction of beamtime in data collection mode)

Raw data rate: Calculate the maximum instantaneous data throughput for each experiment type. No corrections for utilization or data reduction at this point.

										Quarterly LCLS Raw Data (PB)	1	244	244	198 2	275 2	81 22	24 224	227	160 1	60 160	160	160	165 1	65 220	281	281	285	285 30	02 30	2 302	302	601	601 601
Undulator	Instrument	Endstation	Technique	Detector	Detector Size	Detector Rate (Hz)	Data Rate (aggregate) (GB/s)	Itilization Factor (0-1)	Data Reduction Type	DR Factor	FY20 Q1	FY20 Q2	FY20 Q3	FY20 F	Y21 F1	Y21 FY 22 Q	21 FY2	1 FY22 F Q1	Y22 FY	22 FY2 23 Q4	2 FY23 Q1	FY23 F Q2	Y23 F	723 FY2	FY24 Q2	FY24 Q3	FY24 Q4	Q1 Q	25 FY2	25 FY25 3 Q4	FY26 Q1	FY26 F Q2	FY26 FY26 Q3 Q4
SXU	NEH 1.1	DREAM	COLTRIMS	Digitizer	800008	100000	160.0	0.75	Zero suppression	0.020	0.0	245.0	245.0	1211.0110						-													
SXU	NEH 1.1	DREAM	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	0.0	0.0	0.0	38.0 7	5.9 75	5.9 38	3.0 38.0	38.0	19.0 19	9.0 19.0	19.0	19.0	19.0 1	9.0 19.0	19.0	19.0	19.0	19.0 19	.0 19.	.0 19.0	19.0	19.0	19.0 19.0
SXU	NEH 1.1	LAMP	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	0.0	0.0	0.0	38.0 7	5.9 7	5.9 38	3.0 38.0	38.0	19.0 19	9.0 19.0	19.0	19.0	19.0 1	9.0 19.0	19.0	19.0	19.0	19.0 19	.0 19	0 19.0	19.0	19.0	19.0 19.0
SXU	NEH 1.1	LAMP	Imaging	SXR Imag. + Digi.	4000000	10000	82.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 18	3.7 18.7	18.7	9.3 9	.3 9.3	9.3	9.3	9.3 9	.3 9.3	9.3	9.3	9.3	9.3 9.	3 9.3	3 9.3	9.3	9.3	9.3 9.3
SXU	NEH 2.2	LJE	XAS / XES	TES	1000	100000	20.0	0.60	Zero suppression	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 3.0	6.1	6.1 6	.1 6.1	6.1	6.1	6.1 6	.1 0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0 د	0.0	0.0	0.0 0.0
SXU	NEH 2.2	LJE	XAS / XES	TES	10000	100000	200.0	0.60	Zero suppression	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 60.8	60.8	60.8	60.8	60.8 60	.8 60.	8 60.8	60.8	60.8 f	60.8 60.8
SXU	NEH 2.2	LJE	XAS / XES	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	0.0	0.0	0.0	0.0	0.0 0.	0 0.0	0.0	0.0	0.0	0.0 0.0
SXU	NEH 2.2	RIXS	IXS / RIXS	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0 0.0	0.0	0.0	0.0	0.0 0.0
SXU	NEH 2.2	RIXS	XRD / RXRD	SXR Imaging	1000000	10000	20.0	0.60	ROI	0.100	0.0	0.0	0.0	0.0	0.0 3	3.0 3.	.0 1.5	1.5	1.5 1	.5 1.5	1.5	1.5	1.5 1	.5 1.5	1.5	1.5	1.5	1.5 1.	5 1.5	5 1.5	1.5	1.5	1.5 1.5
SXU	NEH 2.2	RIXS	XPCS	SXR Imaging	1000000	10000	20.0	0.60	Compression	0.500	0.0	0.0	0.0	0.0	0.0 3	3.0 3.	.0 1.5	1.5	1.5 1	.5 1.5	1.5	1.5	1.5 1	.5 1.5	1.5	1.5	1.5	1.5 1.	5 1.5	5 1.5	1.5	1.5	1.5 1.5
SXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	3.0 3	.0 3.0	3.0	3.0	3.0 3	.0 3.0	3.0	3.0	3.0	3.0 3.	0 3.0	0 3.0	3.0	3.0	3.0 3.0
SXU	NEH 1.2	3-44 C	Imaging	epix100-HR + Digi.	4000000	5000	42.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	4.8 4	.8 4.8	4.8	4.8	4.8 4	.8 4.8	4.8	4.8	4.8	4.8 4.	8 4.8	3 4.8	4.8	4.8	4.8 4.8
SXU	NEH 1.2		XAS / XES	RIXS-cod	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0 0.0	0.0	0.0	0.0	0.0 0.0
		Soft X-ray So	ource Total								0.0	243.0	243.0 1	197.4 21	73.4 27	9.5 223	2.2 222.	2 225.2 1	55.4 15	5.4 155.	4 155.4	155.4 1	55.4 15	5.4 210.	210.0	210.0	210.0 2	210.0 210	0.0 210	1.0 210.0	210.0	210.0 2	10.0 210.0
HXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	1.5 1	.5 1.5	1.5	1.5	4.6 4	.6 4.6	4.6	4.6	1.5	1.5 1.	5 1.5	5 1.5	1.5	1.5	1.5 1.5
HXU	NEH 1.2		Imaging	epix100-HR + Digi.	4000000	5000	42.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	2.4 2	.4 2.4	2.4	2.4	4.8 4	.8 4.8	4.8	4.8	2.4	2,4 0.	0.0	0.0 C	0.0	0.0	0.0 0.0
HXU	NEH 1.2		XAS / XES	RIXS-cod	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	0.0	0.0	0.0	0.0	0.0 0.	0 0.0	0.0	0.0	0.0	0.0 0.0
HXU	NEH 1.2		Imaging	ePixUHR	4000000	40000	336.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 19	.1 19.	.1 19.1	19.1	19.1	19.1 19.1
HXU	NEH 1.2		Imaging	ePixUHR	16000000	40000	1296.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0 0.0
HXU	XPP		Scattering	CSPAD	2000000	120	0.5	0.75	N.A.	1.000	0.1	0.1	0.1	0.1 0	0.3 0	0.3 0.	3 0.3	0.3	0.3 0	3 0.3	0.3	0.3	0.3 0	.3 0.3	0.0	0.0	0.0	0.0 0.	0.0	0.0 C	0.0	0.0	0.0 0.0
HXU	XPP		XAS / XES	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0 0.0	0.0	0.0	0.0	0.0 0.0
HXU	XPP		IXS / RIXS	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0	0 0.0	0.0	0.0	0.0	0.0 0.0
HXU	XPP		XRD / RXRD	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0 0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0	0 0.0	0.0	0.0	0.0	0.0 0.0
HXU	XPP		Scattering	ePix10k-HR	4000000	5000	40.0	0.75	Binning	0.001	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	0.0	0.0	0.0	22.8	22.8 22	8 22	8 22.8	22.8	0.0	0.0 0.0
HXU	XPP		Scattering	ePixUHR	4000000	40000	320.0	0.75	Binning	0.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0 C	0.0	182.3 1	82.3 182.3
HXU	XPP		Scattering	ePixUHR	16000000	40000	1280.0	0.75	Binning	0.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0	.0 0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0 0	0.0	0.0	0.0 0.0
HXU	XCS/IXS		XPCS	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0	0.0	0.0 0.0
HXU	XCS/IXS		IXS / RIXS	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.1	0.1 0.	1 0.1	1 0.1	0.1	0.1	0.1 0.1
HXU	XCS/IXS		XRD / RXRD	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	0.0 0.0	0.0	0.0	0.0	0.0 0.	0 0.0	0.0	0.0	0.0	0.0 0.0
HXU	XCS/IXS		XPCS	epix100-HR	500000	5000	5.0	0.45	Compression	0.500	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	0.0	0.0	0.0	1.1	1.1 1.	1 1.7	1 1.1	1.1	0.0	0.0 0.0
HXU	XCS/IXS		XPCS	ePixUHR	500000	40000	40.0	0.45	Compression	0.500	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0 C	0.0	9.1	9.1 9.1
HXU	MFX		Xtallography	Jungfrau	4000000	120	1.0	0.45	N.A.	1.000	0.1	0.1	0.1	0.1 0	0.2 0	0.2 0.	2 0.2	0.2	0.2 0	2 0.2	0.2	0.2	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0 0.0
HXU	MFX		Xtallography	Jungfrau	4000000	8000	64.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	29.2	29.2	14.6	14.6 14	.6 14/	6 14.6	14.6	14.6	14.6 14.6
HXU	CXI		Xtallography	Jungfrau	4000000	120	1.0	0.45	N.A.	1.000	0.2	0.2	0.2	0.2 (0.4 0	0.4 0.	.4 0.4	0.4	0.4 0	.4 0.4	0.4	0.4	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0 C	0.0	0.0	0.0 0.0
HXU	CXI		Imaging	Jungfrau	4000000	120	1.0	0.45	N.A.	1.000	0.1	0.1	0.1	0.1 0	0.2 0	0.2 0.	2 0.2	0.2	0.1 0	.1 0.1	0.1	0.1	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0 0	0.0	0.0	0.0 0.0
HXU	CXI		Xtallography	Jungfrau	4000000	8000	64.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	29.2	29.2	29.2	29.2 29	2 29.	2 29.2	29.2	0.0	0.0 0.0
HXU	CXI		Imaging	Jungfrau	4000000	8000	64.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	3.6	3.6	3.6	3.6 3.	6 3.6	\$ 3.6	3.6	0.0	0.0 0.0
HXU	CXI		Xtallography	ePixUHR	4000000	40000	320.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	145.8 1	45.8 145.8
HXU	CXI		Xtallography	ePixUHR	16000000	40000	1280.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0 C	0.0	0.0	0.0 0.0
HXU	CXI		Imaging	ePixUHR	4000000	40000	320.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0 0	0.0	18.2	18.2 18.2
HXU	CXI		Imaging	ePixUHR	16000000	40000	1280.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0 0.	.0 0.0	0.0	0.0 0.0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0 0	0.0	0.0	0.0 0.0
HXU	MEC			ePix100	500000	10	0.0	0.38	N.A.	1.000	0.0	0.0	0.0	0.0	0.0 0.0	0.0 0.	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0 0.	0 0.0	0.0	0.0	0.0	0.0 0.0
		Hard X-ray Se	ource Total								0.7	0.6	0.6	0.7	1.4 1	.4 1.	4 1.4	1.4	5.1 5	.1 5.1	5.1	5.1	9.8 9	.8 9.8	71.3	71.3	75.4	75.4 92	1.1 92.	.1 92.1	92.1	390.8 3	190.8 390.8
																						_							_	_	_	_	

Data Rate = Det. size x Det. rate

SLAC

Reduced data: The data pass through a data reduction pipeline prior to being written to disk. This pipeline applies a veto, feature extraction, and/or compression to obtain a reduction in data throughput. The data reduction factor depends on the science and experimental technique employed.

										Quarterly LCLS Reduced Data (PB)	1	6	6	5	7	9	9	8	9 7	7	7	7	7	7	7	13	18	18 1	1	19	19	19	19	36	36	36
Undulator	Instrument	Endstation	Technique	Detector	Detector Size	Detector Rate (Hz)	Data Rate (aggregate) (GB/s)	Ultilization Factor (0-1)	Data Reduction Type	DR Factor	FY20 Q1	FY20 Q2	FY20 Q3	FY20 Q4	FY21 Q1	G2	G3	FY21 F	Y22 FY2 Q1 Q2	2 FY22 Q3	2 FY22 Q4	FY23 Q1	FY23 I Q2	FY23 F Q3	Y23 P	Q1	Q2	G3 G	24 FY	25 FY2 1 Q2	5 FY2	5 FY25 Q4	FY26 Q1	FY26 Q2	FY26 1 Q3	FY26 Q4
SXU	NEH 1.1	DREAM	COLTRIMS	Digitizer	800000	100000	160.0	0.75	Zero suppression	0.020	0.0	4.9	4.9	2.4	2.4	2.4	2.4	2.4 2	2.4 1.4	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8 1.	3. 1.	3 1.8	1.8	1.8	1.8	1.8	1.8	1.8
SXU	NEH 1.1	DREAM	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	0.0	0.0	0.0	0.8	1.5	1.5	0.8	0.8 0	0.8 0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4 0.	ŧ 0.	4 0.4	0.4	0.4	0.4	0.4	0.4	0.4
SXU	NEH 1.1	LAMP	Time of Flight	Digitizer	1000000	100000	200.0	0.75	Zero suppression	0.020	0.0	0.0	0.0	0.8	1.5	1.5	0.8	0.8 0	0.8 0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4 0.	t 0.	\$ 0.4	0.4	0.4	0.4	0.4	0.4	0.4
sxu	NEH 1.1	LAMP	Imaging	SXR Imag. + Digi.	4000000	10000	82.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	1.9 0.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9 0.	.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9
SXU	NEH 2.2	LJE	XAS / XES	TES	1000	100000	20.0	0.60	Zero suppression	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3 0	0.6 0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SXU	NEH 2.2	LJE	XAS / XES	TES	10000	100000	200.0	0.60	Zero suppression	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	6.1	6.1 6	1 6.	6.1	6.1	6.1	6.1	6.1	6.1	6.1
SXU	NEH 2.2	LJE	XAS / XES	RIXS-cod	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SXU	NEH 2.2	RIXS	IXS / RIXS	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SXU	NEH 2.2	RIXS	XRD / RXRD	SXR Imaging	1000000	10000	20.0	0.60	ROI	0.100	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.2 0	0.2 0.3	2 0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2 0	2 0.3	2 0.2	0.2	0.2	0.2	0.2	0.2	0.2
SXU	NEH 2.2	RIXS	XPCS	SXR Imaging	1000000	10000	20.0	0.60	Compression	0.500	0.0	0.0	0.0	0.0	0.0	1.5	1.5	0.8 0	0.8 0.4	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8 0.	3 0.	8 0.8	0.8	0.8	0.8	0.8	0.8	0.8
SXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3 0	3 0.	3 0.3	0.3	0.3	0.3	0.3	0.3	0.3
sxu	NEH 1.2	: 	Imaging	epix100-HR + Digi.	4000000	5000	42.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5 0	5 0.	5 0.5	0.5	0.5	0.5	0.5	0.5	0.5
SXU	NEH 1.2		XAS / XES	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Soft X-ray Sour	rce Total								0.0	4.9	4.9	4.0	5.5	7.3	7.6	7.0 7	7.3 5.1	5.8	5.8	5.8	5.8	5.8	5.8	11.3	11.3	11.3 11	3 11	3 11.	3 11.3	3 11.3	11.3	11.3	11.3	11.3
HXU	NEH 1.2		X-ray/X-ray	SXR Imaging	1000000	10000	20.0	0.30	ROI	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.3	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5 0.	2 0.	2 0.2	0.2	0.2	0.2	0.2	0.2	0.2
нхи	NEH 1.2		Imaging	epix100-HR + Digi.	4000000	5000	42.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.3	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5 0	2 0.	2 0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	NEH 1.2		XAS / XES	RIXS-ccd	4096	1000	0.0	0.60	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	NEH 1.2		Imaging	ePixUHR	4000000	40000	336.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9
HXU	NEH 1.2		Imaging	ePixUHR	16000000	40000	1296.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XPP		Scattering	CSPAD	2000000	120	0.5	0.75	N.A.	1.000	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3 (0.3 0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XPP		XAS / XES	ePix100	500000	120	0,1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XPP		IXS / RIXS	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XPP		XRD / RXRD	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XPP	5 mm	Scattering	ePix10k-HR	4000000	5000	40.0	0.75	Binning	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XPP		Scattering	ePixUHR	4000000	40000	320.0	0.75	Binning	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XPP		Scattering	ePixUHR	16000000	40000	1280.0	0.75	Binning	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XCS/IXS		XPCS	ePix100	500000	120	0.1	0.75	NA	1,000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XCS/IXS		IXS / RIXS	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	00 0	1 0.	0.1	0.1	0.1	0.1	0.1	0.1	0.1
HXU	XCS/IXS		XRD / RXRD	ePix100	500000	120	0.1	0.75	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	XCS/IXS		XPCS	epix100-HR	500000	5000	5.0	0.45	Compression	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	3 0.	0.6	0.6	0.6	0.6	0.0	0.0	0.0
HXU	XCS/IXS		XPCS	ePixUHR	500000	40000	40.0	0.45	Compression	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	00 0	0.0	0.0	0.0	0.0	0.0	4.6	4.6	4.6
HXU	MEX	200	Xtallography	Jungfrau	4000000	120	1.0	0.45	N.A.	1.000	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2 (2 03	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0 0	0 0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	MEX		Xtallography	Jungfrau	4000000	8000	64.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	29 1	5 1	5 1.5	1.5	1.5	1.5	1.5	15	15
HXU	CXI		Xtallography	Jungfrau	4000000	120	1.0	0.45	N.A.	1.000	0.2	0.2	0.2	0.2	0.4	0.4	0.4	0.4 (0.4 0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HXU	CXI		Imaging	Jungfrau	4000000	120	1.0	0.45	NA	1,000	0.1	0.1	0.1	0.1	0.2	0.2	0.2	02 0	12 0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0 0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HYU	CYI		Ytallography	lungfrau	4000000	8000	64.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0 01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20	20 2	2 21	2 2 0	2.9	2.9	2.9	0.0	0.0	0.0
HYU	CXI		Imaging	lungfrau	4000000	8000	64.0	0.45	Voto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0 04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	04 0			0.4	0.4	0.4	0.0	0.0	0.0
HXU	CXI		Ytallography	a Divi IND	4000000	40000	320.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0 04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0 0		0.0	0.0	0.0	0.0	14.6	14.6	14.6
HAU	CXI		Xtallography	PIXUNK	4000000	40000	520.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.		0.0	0.0	0.0	0.0	14.0	14.0	0.0
HAU	CXI		Atanography	ePixUHR	4000000	40000	1280.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
HAU	CXI		imaging	OPIXUAR	4000000	40000	320.0	0.45	Veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.0	0.0	0.0	0.0	0.0	1.8		
HAU	UKI NEC	0	gnigkimi	ePixUHR	1000000	40000	1280.0	0.45	veto	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HAU	MEG			er-1x100	500000	10	0.0	0.38	N.A.	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.	0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Hard X-ray Sou	rce i otal								0.7	0.6	0.6	0.7	1.4	1.4	1.4	1.4 1	1.4 1.1	1.6	1.6	1.6	1.6	1.4	1.4	1.4	7.1	7.1 5.	5.	a 7.5	7.5	7.5	7.5	24.6	24.6	24.6

Reduced Data = Raw Data X Data Reduction Factor Data Reduction Factor Det. rate

SLAC

Computation: Run analyses (DRP, FFB, and Offline) used in today's experiments to evaluate time per event. Use processing time per event and anticipated data rates to calculate FLOPs

Undulator	Instrument	Endstation	Technique	Detector	Detector Size	Detector Rate (Hz)	Data Rate (aggregate) (GB/s)	Data Reduction Type	DR Factor	Event Rate (after DRP) [Hz]	DR Computing Time [ms]	DR Computing [TFLOPs]	FFB algorithm type	FFB Computing [msec / event]	FFB Computing [TFLOPs]	Offline algorithm type	Offline Computing [msec / event]	Offline Computing [TFLOPs]	FY20 Q1	20 FY20 FY20 FY20 FY21 FY21 FY21 FY21 FY22 FY22 FY22 FY22
SXU	NEH 1.1	DREAM	COLTRIMS	Digitzer	800000	100000	160.0	Zero suppression	0.020	100000			ROENTDEK Coincidence			detailed reconstruction	5 0000	16.6		1.00 1.00 0.50 0.25 0.25 0.25 0.25 0.25 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19
SXU	NEH 1.1	DREAM	Time of Flight	Dioitizer	1000000	100000	200.0	Zero suppression	0.020	100000			ceak foding			statistics.	0.0000	0.0		
SXU	NEH 1.1	LAMP	Time of Flight	Digitizer	1000000	100000	200.0	Zero suppression	0.020	100000	1	-	peak finding		-	statistics		0.0		
SXU	NEH 1.1	LAMP	Imaging	SXR Imag. + Digi.	4000000	10000	82.0	Veto	0.100	1000	6.0	2.0	Fourier	44.50	15	MTIP				0.13 0.13 0.13 0.16 0.06 0.06 0.06 0.06 0.06 0.06 0.06
SXU	NEH 2.2	LJE	XAS / XES	TES	1000	100000	20.0	Zero suppression	0.100	100000	1.3	4.4	Binning	0.01	0.0	0.0	141	1.0440		0.06 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
SXU	NEH 2.2	LJE	XAS / XES	TES	10000	100000	200.0	Zero suppression	0.100	100000	13.0	43.7	Binning	0.10	0.3	na	-			0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
SXU	NEH 2.2	LJE	XAS / XES	RIXS-cod	4096	1000	0.0	NA	1.000	1000			Binning	0.01	0.00034		-			025 0.50 0.25 0.25 0.19 0.13 0.06 0.06 0.06 0.06 0.06 0.08 0.06 0.06
SXU	NEH 2.2	RIXS	DCS / RDCS	RIXS-cod	4096	1000	0.0	N.A.	1.000	1000			Binning	0.01	0.00034	na	-			0.13 0.13 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19
SXU	NEH 2.2	RIXS	XRD / RXRD	SXR Imaging	1000000	10000	20.0	ROI	0.100	10000	0.2	0.1	1000							0.05 0.05 0.03 0.03 0.03 0.03 0.03 0.03
SXU	NEH 2.2	RIXS	XPCS	SXR Imaging	1000000	10000	20.0	Compression	0.500	10000	50.0	16.8	Photonize	50.00	16.8	Stats Analysis	0.0100	0.0		0.05 0.05 0.03 0.03 0.03 0.03 0.03 0.03
SXU	NEH 1.2	-	X-ray/X-ray	SXR Imaging	1000000	10000	20.0	ROI	0.100	1000			FXS Correlation			FXS Correlations +				0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
SXU	NEH 1.2		Imaging	epix100-HR + Dioi	4000000	5000	42.0	Veto	0.100	500	50.0	16.8	(subset) Fourier	3.30	0.1	MTP	300.0000	10.1		
0.01	NEW CO.		VICINES	Divis and		1000			1 000	1000	6.0	1.0	Transform	44.50	0.7	MTIP				
anu	NER 1.2	Roll V and Ro	ANS/ AES	MIA3-000	401/0	1000	0.0	n.A.	1.000	1000			Peak Finding	2.00	0.1	N1409DCN			0.00	
1001	NEU 12	aun Arny au	V-res/V-res	SVR Imaging	1000000	10000	20.0	POI -	0.100	10000			Deale Finding	50.00	10.00	Inductors.	16000.00	6040.0	0.00	
HXU	NEH 1.2		Imaging	epix100-HR + Digi.	4000000	5000	42.0	Veto	0.100	500	02	0.1	Fourier	200.00	072	indexing	15000.00	5040.0		
HOLL	NEH 12		XAS/XES	RIXS-cont	4000	1000	0.0	NA	1 000	1000	0.0	1.0	Transcorm	41.50	0.0	MIL				
HXU	NEH 1.2		Imaging	ePixUHR	4000000	40000	336.0	Veto	0.100	4000	60	8.1	Fourier	44.50	6.0	MTIP	1000000 0000	134400.0		
HXU	NEH 1.2		Imaging	ePixUHR	16000000	40000	1296.0	Veto	0.100	4000	6.0	8.1	Fourier	44.50	6.0	MTP	1000000.0000	134400.0		
HXU	XPP		Scattering	CSPAD	2000000	120	0.5	NA.	1.000	120			Cube / Angular	20.10	0.1	Visualization	1 0000	0.0	0.19	9 0.13 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19
HXU	XPP		XAS / XES	ePix100	500000	120	0.1	NA	1.000	120		-	Photoniza	50.00	0.2	Stats Analysis	0.0100	0.0	0.06	
HOCU	XPP	-	DCS / RDCS	ePix100	500000	120	0.1	NA	1.000	120		-	Photonize	50.00	0.2	Stats Analysis	0.0100	0.0	0.06	
HXU	XPP		XRD / RXRD	ePix100	500000	120	0.1	NA	1.000	120			Photonize	50.00	0.2	Stats Analysis	0.0100	0.0	0.06	
HXU	XPP	-	Scattering	ePix10k-HR	4000000	5000	40.0	Binning	0.001	5000	12.0	2.0	Cube / Angular integration	20.10	3.4	Visualization	1.0000	0.2		0.19 0.19 0.19 0.19 0.19 0.19
HXU	хрр		Scattering	ePixUHR	4000000	40000	320.0	Binning	0.000	40000	12	16.1	Cube / Angular integration	20.10	27.0	Visualization	1.0000	1.3		0.19 0.19
HXU	хрр	-	Scattering	ePixUHR	16000000	40000	1280.0	Binning	0.000	40000	12	16.1	Cube / Angular integration	20.10	27.0	Visualization	1.0000	1.3		
HXU	XCS/IXS	-	XPCS	ePix100	500000	120	0.1	N.A.	1.000	120			Photonize	50.00	0.2	Stats Analysis	0.0100	0.0	0.13	3 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.1
HXU	XCS/IXS	-	DOS / RDOS	ePix100	500000	120	0.1	N.A.	1.000	120		and .	Photonize	50.00	0.2	Stats Analysis	0.0100	0.0	0.13	3 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.1
HXU	XCS/IXS	-	XRD / RXRD	ePix100	500000	120	0.1	NA	1.000	120			Photonize	50.00	0.2	Stats Analysis	0.0100	0.0	0.13	3 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.1
HXU	XCS/IXS		XPCS	epix100-HR	500000	5000	5.0	Compression	0.500	5000	25.0	4.2	Photonize	50.00	8.4	Stats Analysis	0.0100	0.0		0.13 0.13 0.13 0.13 0.13 0.13
HXU	XCS/IXS		XPCS	ePixUHR	500000	40000	40.0	Compression	0.500	40000	25.0	33.6	Photonize	50.00	67.2	Stats Analysis	0.0100	0.0	-	0.13 0.13
HXU	MEX	-	Xtallography	Jungfrau	4000000	120	1.0	NA	1.000	120		-	Peak Finding	200.00	0.8	Indexing	15000.00	60.5	0.13	3 013 0.13 0.13 0.13 0.13 0.13 0.13 0.13
HXU	Mex	-	Xtallography	Jungtrau	4000000	8000	64.0	Veto	0.100	800	12.0	3.2	Peak Finding	200.00	5.4	Indexing	15000.00	403.2	110.00	025 0.73 0.13 0.13 0.13 0.13 0.13 0.13 0.13
HXU	CXI		Xtallography	Jungfrau	4000000	120	1.0	NA.	1,000	120	-	-	Peak Finding Fourier	200.00	0.8	Indexing	15000.00	60.5	0.25	5 025 025 025 025 025 025 025 025 025 02
												-	Transform	44.50	0.2	MTIP	1000000.0000	4032.0		
HXU	CXU	444	Xtallography	Jungtrau	4000000	8000	64.0	Veto	0,100	800	12.0	3.2	Peak Finding	200.00	5.4	Indexing	15000.00	403.2		0.25 0.25 0.25 0.25 0.25 0.25 0.25
HXU	CXI		Imaging	Jungfrau	4000000	8000	64.0	Veto	0.100	800	12.0	3.2	Transform	44.50	1.2	MTIP	1000000.0000	26880.0	_	0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03
HXU	CXU	-	Xtallography	ePixUHR	4000000	40000	320.0	Veto	0.100	4000	12.0	16.1	Peak Finding	200.00	26.9	Indexing	15000.00	2016.0	-	025 025
nxu	u.ki		Asanography	(PIXUER	16000000	40000	1280.0	veto	0.100	4000	12.0	16.1	Peak Finding	200.00	26.9	incexing	15000.00	2016.0		
HXU	C30		Imaging	ePixUHR	4000000	40000	320.0	Velo	0.100	4000	12.0	16.1	Transform	44.50	6.0	MTIP	1000000.0000	134400.0		0.03 0.03
HXU	CXU		Imaging	ePixUHR	16000000	40000	1280.0	Veto	0.100	4000	12.0	16.1	Transform	44.50	6.0	MTIP	1000000.0000	134400.0	0.12	3 013 013 013 013 013 013 013 013 013 01
HAU	MEG			ePatiou	500000	10	0.0	NA.	1.000	10			TIFF	100.00	0.0	Animated GIF			0.13	
		Hard X-ray Se	ource rotal											200.00	67.20				1.38	1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08

How processing needs are calculated

Example: indexing time per e vent for nanocrystallography

Soft x-ray: Data Reduction, FFB, and Offline algorithms

Undulator	Instrument	Endstation	Technique	Detector	Data Reduction	FFB algorithm	Offline algorithm
SXU	NEH 1.1	DREAM	COLTRIMS	Digitizer	Zero suppression	ROENTDEK Coincidence Sorting	detailed reconstruction of ToF. x. v
SXU	NEH 1.1	DREAM	Time of Flight	Digitizer	Zero suppression	peak finding	statistics
SXU	NEH 1.1	LAMP	Time of Flight	Digitizer	Zero suppression	peak finding	statistics
SXU	NEH 1.1	LAMP	Imaging	SXR Imag. + Digi.	Veto	Fourier Transform	MTIP
SXU	NEH 2.2	LJE	XAS / XES	TES	Zero suppression	Binning	na
SXU	NEH 2.2	LJE	XAS / XES	RIXS-ccd	N.A.	Binning	na
SXU	NEH 2.2	RIXS	IXS / RIXS	RIXS-ccd	N.A.	Binning	na
SXU	NEH 2.2	RIXS	XRD / RXRD	SXR Imaging	ROI		
SXU	NEH 2.2	RIXS	XPCS	SXR Imaging	Compression	Photonize	Stats Analysis
SXU	NEH 1.2		X-ray/X-ray	SXR Imaging	ROI	FXS Correlations (subset)	FXS Correlations + MTIP
SXU	NEH 1.2		Imaging	epix100-HR + Digi.	Veto	Fourier Transform	MTIP
SXU	NEH 1.2		XAS / XES	RIXS-ccd	N.A.	Peak Finding	statistics

SLAC

Hard x-ray: Data Reduction, FFB, and Offline algorithms (1)

Undulator	Instrument	Technique	Detector	Data Reduction	FFB algorithm	Offline algorithm
HXU	NEH 1.2	X-ray/X-ray	SXR Imaging	ROI	Peak Finding	Indexing
HXU	NEH 1.2	Imaging	epix100-HR + Digi.	Veto	Fourier Transform	MTIP
HXU	NEH 1.2	XAS / XES	RIXS-ccd	N.A.		
HXU	NEH 1.2	Imaging	ePixUHR	Veto	Fourier Transform	MTIP
HXU	XPP	Scattering	CSPAD	N.A.	Cube / Angular integration	Visualization
HXU	XPP	XAS / XES	ePix100	N.A.	Photonize	Stats Analysis
HXU	XPP	IXS / RIXS	ePix100	N.A.	Photonize	Stats Analysis
HXU	XPP	XRD / RXRD	ePix100	N.A.	Photonize	Stats Analysis
HXU	XPP	Scattering	ePix10k-HR	Binning	Cube / Angular integration	Visualization
HXU	XPP	Scattering	ePixUHR	Binning	Cube / Angular integration	Visualization

Hard x-ray: Data Reduction, FFB, and Offline algorithms (2)

Undulator	Instrument	Technique	Detector	Data Reduction	FFB algorithm	Offline algorithm
HXU	XCS/IXS	XPCS	ePix100	N.A.	Photonize	Stats Analysis
HXU	XCS/IXS	IXS / RIXS	ePix100	N.A.	Photonize	Stats Analysis
HXU	XCS/IXS	XRD / RXRD	ePix100	N.A.	Photonize	Stats Analysis
HXU	XCS/IXS	XPCS	epix100-HR	Compression	Photonize	Stats Analysis
HXU	XCS/IXS	XPCS	ePixUHR	Compression	Photonize	Stats Analysis
HXU	MFX	Xtallography	Jungfrau	N.A.	Peak Finding	Indexing
HXU	MFX	Xtallography	Jungfrau	Veto	Peak Finding	Indexing
HXU	CXI	Xtallography	Jungfrau	N.A.	Peak Finding	Indexing
HXU	CXI	Imaging	Jungfrau	N.A.	Fourier Transform	MTIP
HXU	CXI	Xtallography	Jungfrau	Veto	Peak Finding	Indexing
HXU	CXI	Imaging	Jungfrau	Veto	Fourier Transform	MTIP
HXU	CXI	Xtallography	ePixUHR	Veto	Peak Finding	Indexing
HXU	CXI	Imaging	ePixUHR	Veto	Fourier Transform	MTIP
HXU	MEC		ePix100	N.A.	TIFF	Animated GIF