

Cameras and Data Acquisition at FACET-II

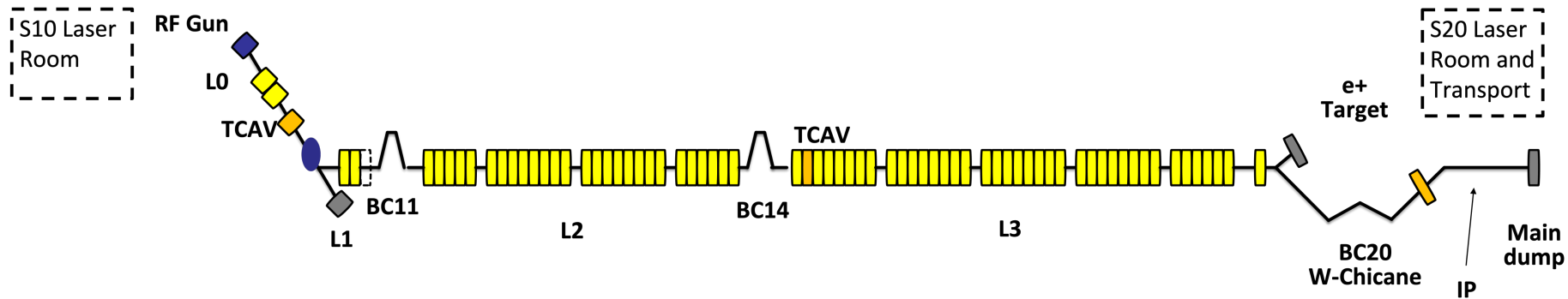
Spencer Gessner
E300 Collaboration Meeting
May 3, 2022

Digital Cameras at SLAC

- At FACET, we deployed 28 GigE cameras and 6 Scientific CMOS cameras, for a total of 34 digital cameras in 2016.
- At FACET-II, we currently have 75 GigE cameras and 3 sCMOS cameras deployed.
 - LCLS has 68 digital cameras
 - LCLS-II has 25 digital cameras
- Soon, we will have 101 digital cameras in operation.

**FACET will deploy more cameras than
LCLS and LCLS-II combined!**

Digital Cameras at FACET



Region	S10 Laser Room	Injector Vault	L1 and BC11	L2 and BC14	BC20	S20 Laser Room + Transport	IP Area	Spectrometer Line	Total
Cameras Deployed	7	3	6	2	2	21	25	12	76
Cameras Planned	10	5	10	6	2	21	31	16	101

Camera Flavors

SLAC

Make	Model	Interface	Chip Type	Size (MP)
AVT Manta	G-033B	GigE	CCD	0.33
AVT Manta	G-095B	GigE	CCD	0.95
AVT Manta	G-125B	GigE	CCD	1.2
AVT Manta	G-146B	GigE	CCD	1.4
AVT Manta	G-895B	GigE	CMOS	8.9
AVT Mako	G-032B	GigE	CCD	0.32
AVT Mako	G-125B	GigE	CCD	1.2
AVT Mako	G-507B	GigE	CMOS	5.1
Hamamatsu	Flash 4.0v3	USB3	sCMOS	4
Hamamatsu (development)	Fusion	USB3	BT-sCMOS	4



AVT Manta



AVT Mako



*Hamamatsu
ORCA Flash 4.0v3*

On-going Camera Work

- Expansion from 9 to 12 cameras per GigE server (Cosylab).
- Stability of Hamamatsu servers (Cosylab).
- “Event2” module for improved PulseID reliability (TID).
- Camera watchdogs and performance tracking (Spencer).



Challenges: Radiation

- Radiation is the enemy!
 - 9 cameras died due to radiation since start of 2022.
 - The PMON camera has been replaced 3 times since start of FACET operations.
- We purchased an active dosimetry system to help diagnose local, high radiation areas.
- We expect performance to improve as Ops gets a better handle on the beam.



Elettra DOSFET Active
Dosimetry System

Access to FACET-II depends on LCLS-II. What happens if we lose a “critical” camera?

Challenges: Organization



- SLAC EPICS development team is focused on LCLS-II.
 - FACET camera operations have been negatively affected by LCLS-II “upgrades.”
- There is a lot of bookkeeping. . .
 - https://docs.google.com/spreadsheets/d/1rTnVijkaE2pYRpQYQCJFv1CYQAsr9d2I2Q_FhbWH_Yv0/edit?usp=sharing
- Not to mention EDM, PyDM, Matlab updates when we add cameras.

	A	B	C	D	E	F	G
1	Name	Tunnel Port	Gallery Port	POE Port	Server Port	PV	Model
2	TOP_VIEW_US	IPDS to 20-44 1	FKG20-20-44 1	poe-i20-pm02 18	facet-i20-pm01 6	CAMRLT20:0206	Mako G-125B
3	TOP_VIEW_DS	IPDS to 20-44 2	FKG20-20-44 2	poe-i20-pm02 17	facet-i20-pm01 5	CAMRLT20:0205	
4	Rail	IPDS to 20-44 3	FKG20-20-44 3	poe-i20-pm02 19	facet-i20-pm01 7	CAMRLT20:0207	Mako G-125B
5	Probeline1	IPDS to 20-44 4	FKG20-20-44 4	poe-i20-pm01 16	cpu-i20-pm03 4	CAMRLI20:2003	Mako G-032B
6	Probeline2	IPDS to 20-44 5	FKG20-20-44 5	poe-i20-pm01 17	cpu-i20-pm03 5	CAMRLI20:2004	Mako G-125B
7		IPDS to 20-44 6	FKG20-20-44 6				
8	Probeline3	IPDS to 20-44 7	FKG20-20-44 7	poe-i20-pm01 18	cpu-i20-pm03 6	CAMRLI20:2005	Mako G-125B
9	EOS1	IPDS to 20-44 8	FKG20-20-44 8	poe-i20-pm01 19	cpu-i20-pm03 7	CAMRLI20:2006	Mako G-125B
10		IPDS to 20-44 9	FKG20-20-44 9				
11	EOS2	IPDS to 20-44 10	FKG20-20-44 10	poe-i20-pm01 20	cpu-i20-pm03 8	CAMRLI20:2007	Mako G-125B
12	Frontview	IPDS to 20-44 11	FKG20-20-44 11	poe-i20-pm01 21	cpu-i20-pm03 9	CAMRLI20:2008	Mako G-125B
13	DSHM_FAR	IPDS to 20-44 12	FKG20-20-44 12	poe-i20-pm02 1	cpu-i20-pm04 1	CAMRLI20:300	Mako G-032B
14	USOTR	IPUS to 20-46 1	FKG20-20-46 1	poe-i20-pm01 2	cpu-i20-pm02 2	CAMRLI20:101	Mako G-125B
15	IPOTR1	IPUS to 20-46 2	FKG20-20-46 2	poe-i20-pm01 3	cpu-i20-pm02 3	CAMRLI20:102	Manta_G-125B
16	DSOTR	IPUS to 20-46 3	FKG20-20-46 3	poe-i20-pm01 6	cpu-i20-pm02 6	CAMRLI20:105	Manta_G-146B
17	WDSOTR	IPUS to 20-46 4	FKG20-20-46 4	poe-i20-pm01 7	cpu-i20-pm02 7	CAMRLI20:106	Manta_G-095B
18	IPOTR1P	IPUS to 20-46 5	FKG20-20-46 5	poe-i20-pm01 4	cpu-i20-pm02 4	CAMRLI20:103	Mako G-125B
19	IPOTR2	IPUS to 20-46 6	FKG20-20-46 6	poe-i20-pm01 5	cpu-i20-pm02 5	CAMRLI20:104	Mako G-125B
20	CompNear	IPUS to 20-46 7	FKG20-20-46 7	poe-i20-pm01 14	cpu-i20-pm03 2	CAMRLI20:201	Mako G-125B
21	CompFar	IPUS to 20-46 8	FKG20-20-46 8	poe-i20-pm01 15	cpu-i20-pm03 3	CAMRLI20:202	Mako G-125B
22	DSHM_NEAR	IPUS to 20-46 9	FKG20-20-46 9	poe-i20-pm02 5	cpu-i20-pm04 5	CAMRLI20:304	Mako G-032B
23	DM Mirror	IPUS to 20-46 10	FKG20-20-46 10				
24	MO_FOV	IPUS to 20-46 11	FKG20-20-46 11	poe-i20-pm02 15	facet-i20-pm01 3	CAMRLT20:0203	
25	MO_MAG	IPUS to 20-46 12	FKG20-20-46 12	poe-i20-pm02 16	facet-i20-pm01 4	CAMRLT20:0204	Mako G-125B
26	B4	IPUS to 21-43 13	FKG20-21-43 37	poe-i20-ex01	facet-i20-pm02 5	CAMRLT20:0105	Mako G-125B
27	B5	IPUS to 21-43 14	FKG20-21-43 38	poe-i20-ex01	facet-i20-pm02 6	CAMRLT20:0106	Mako G-125B
28	B6	IPUS to 21-43 15	FKG20-21-43 39	poe-i20-ex01	facet-i20-pm02 7	CAMRLT20:0107	Mako G-125B
29	Low Data Rate	IPUS to 21-43 16	FKG20-21-43 40				
30	PB Near	IPUS to 21-43 17	FKG20-21-43 41	poe-i20-pm02 13	facet-i20-pm01 1	CAMRLT20:0201	Mako G-125B
31	PB Far	IPUS to 21-43 18	FKG20-21-43 42	poe-i20-pm02 14	facet-i20-pm01 2	CAMRLT20:0202	Mako G-125B
32	Probeline 4	IPUS to 21-43 19	FKG20-21-43 43				
33	Ionizer	IPUS to 21-43 20	FKG20-21-43 44	poe-i20-pm02 6	cpu-i20-pm04 6	CAMRLI20:305	Mako G-125B
34	Shadowgraphy	IPUS to 21-43 21	FKG20-21-43 45	poe-i20-pm02 7	cpu-i20-pm04 7	CAMRLI20:306	Mako G-125B
35	TopView	IPUS to 21-43 22	FKG20-21-43 46				
36	Probeline0	IPUS to 21-43 23	FKG20-21-43 47	poe-i20-pm01 13	cpu-i20-pm03 1	CAMRLI20:200	Mako G-125B

Overview of DAQ

10th Int. Beam Instrum. Conf.
ISBN: 978-3-95450-230-1

IBIC2021, Pohang, Rep. of Korea
ISSN: 2673-5350

JACoW Publishing
doi:10.18429/JACoW-IBIC2021-WEPP33

THE FACET-II DATA ACQUISITION SYSTEM*

S. J. Gessner[†], SLAC National Accelerator Laboratory, Menlo Park, CA, USA

Abstract

The Data Acquisition System (DAQ) at FACET-II is designed to address the challenge of collecting synchronized, time-stamped data from a variety of diagnostics spread throughout the kilometer-long linac and experimental area. The EPICS control system is used to read out data from devices at FACET-II via Channel Access (CA) over the network. This poses a problem for collecting image data at the 30 Hz beam rate. With image sizes ranging from 0.3-10 Megapixels, the data rate from a single camera can be as high as 0.6 Gbps and there are nearly 100 cameras deployed at FACET-II. Simultaneous image acquisition from just a few of these cameras would overwhelm the network. The FACET-II DAQ solves this problem by coordinating the camera IOCs to write their image data to network-attached storage (NAS) and then validating time-stamps to confirm synchronization.

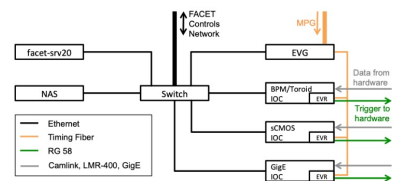


Figure 1: Network topology in FACET Sector 20. Note that the EVG has been relocated to the FACET injector in Sector 10.

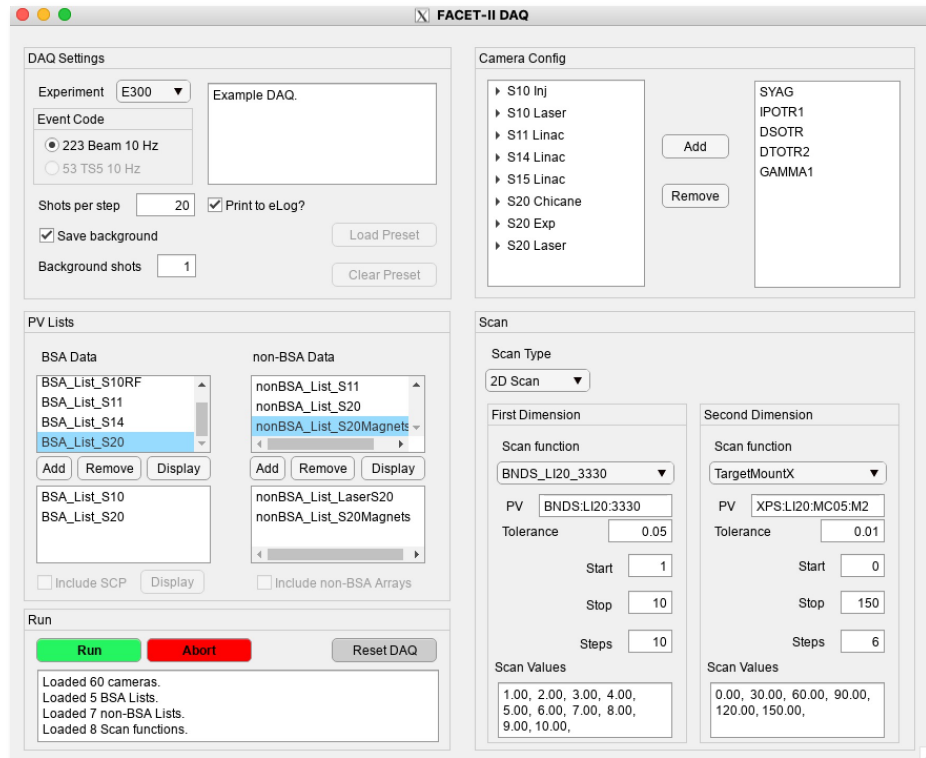
also uses scientific-CMOS cameras in the experimental area. All servers run areaDetector [3] IOCs. There are 7 camera servers along the linac and 9 camera servers located in Sector 20 (S20), the experimental area. The camera servers in S20

There is an IBIC paper summarizing the FACET-II DAQ here:

<https://accelconf.web.cern.ch/ibic2021/papers/wepp33.pdf>

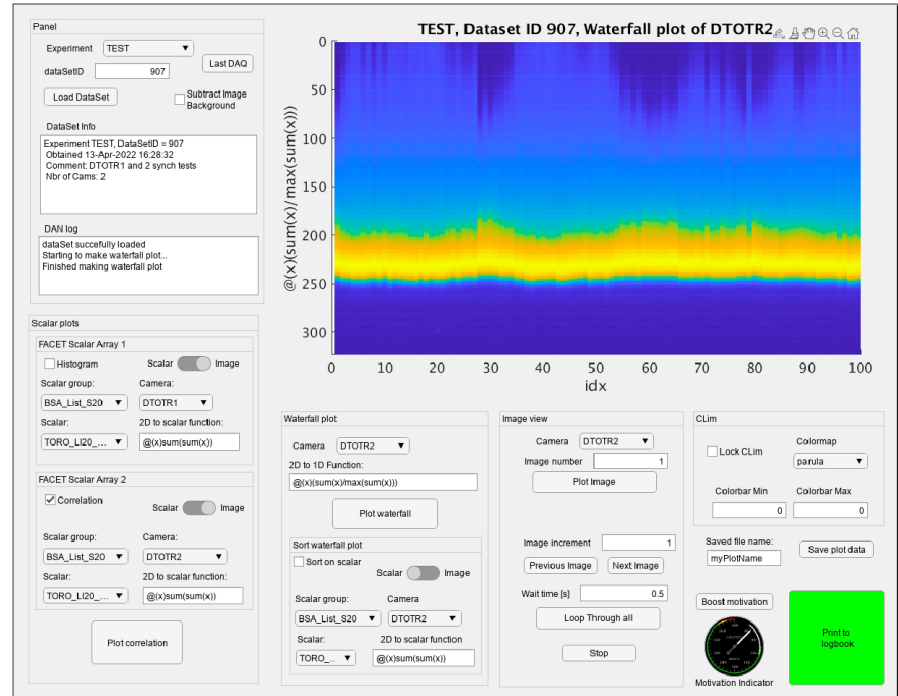
DAQ Functionality

- DAQ tested with 12 cameras taking 800 shots each.
- Henrik found way to improve speed of quality control portion by 10X.
- DAQ scan functions are flexible and can include complicated tasks.



DAN Functionality

- DAN written by Henrik.
- Provides “Chris Clayton Level” correlation functionality.
- Very user-friendly.
- Long-term: include common analysis functions that can be shared by FACET users.
- Helps boost motivation.



DAQ and DAN Improvements

1. Add low beamrate data acquisition.
2. Add support for on-the-fly scan function definitions.
3. Add dedicated DAQ Event Code.
4. Add AIDA/SCP acquisition.
5. Fix HDF5 functionality.
6. Fix Scan PV functionality.
7. Fix Load Config functionality.
8. Create DAQ-DAN link to analyze datasets as the data is acquired.