Stage-I: YARR for LLS testing with FELIX

FELIX latest news: Mar 2024
Stage-I mandates from ITk Online SW: Nov 2023

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On behalf of YARR developers

ITk Week, March 2024
Pixels 6: Pixels local supports and system test

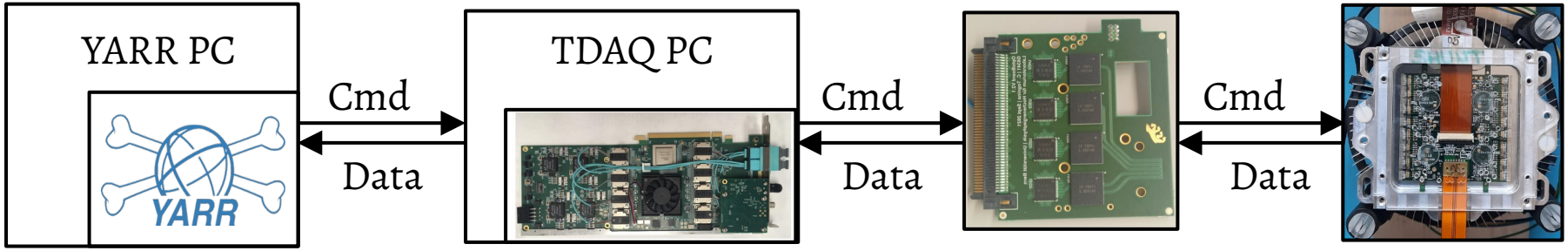
BERKELEY LAB

March 20th, 2024

ATLAS ITk

Introduction

"ITk DAQ recommendations: *FELIX-based scalable readout for loaded staves (barrel) and rings (endcap). Supports pre-production and production, systems tests and test beams. Baseline software:* ***YARR"***

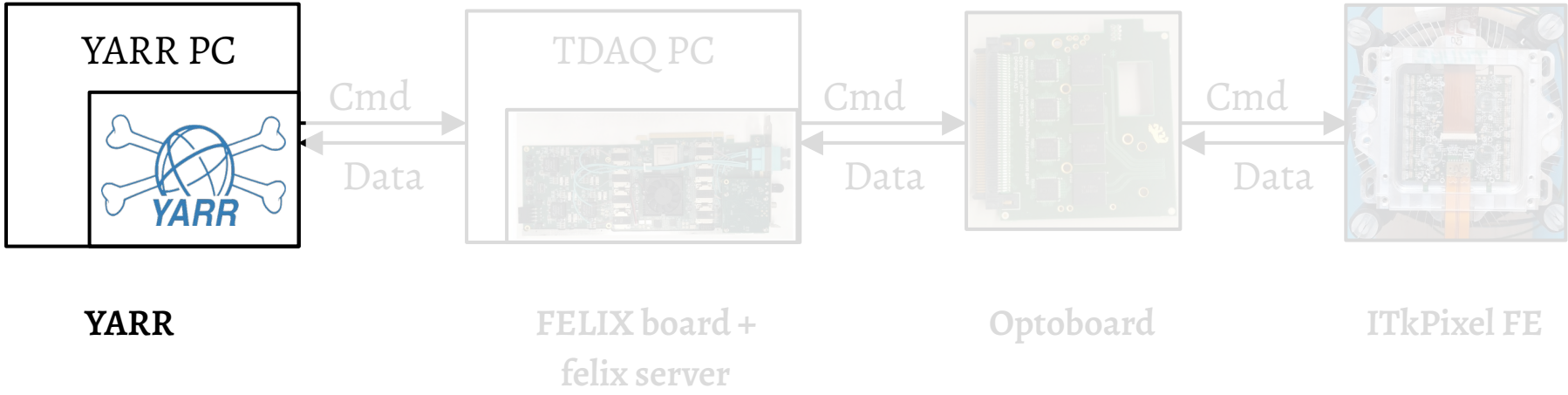


YARR | **FELIX board + felix server** | **Optoboard** | **ITkPixel FE**

*Exact connections will vary depending upon the use cases.

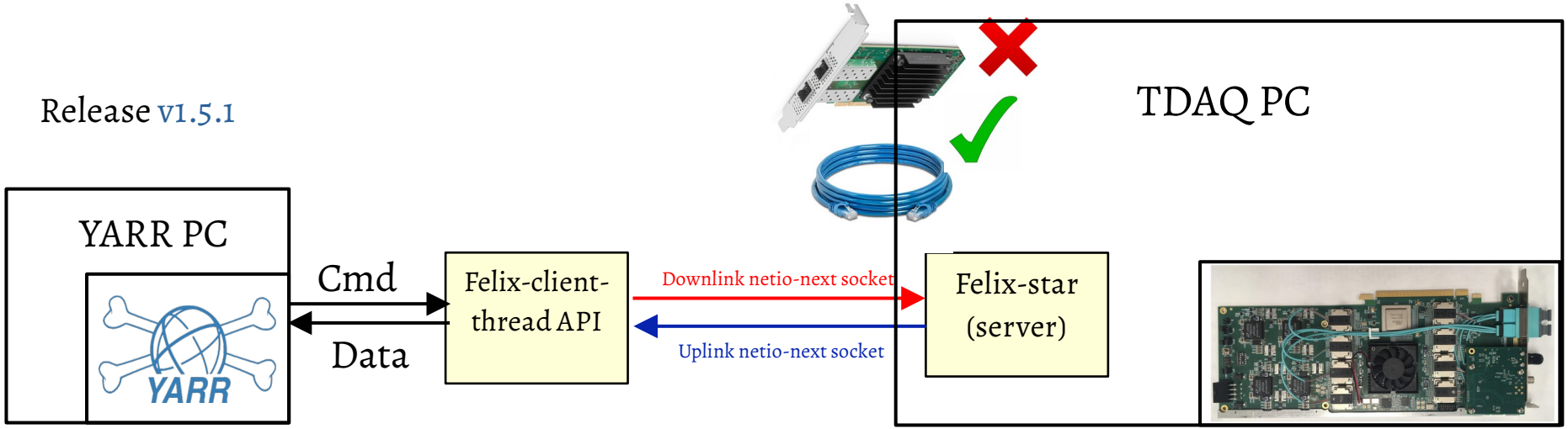
Latest from YARR

- **Official release with felix-star support out now: v1.5.1 (also supports ITk Strips)!!**
- **Full documentation with detailed instructions: wiki**



- **Supports both CentOS7 and ALMA9 OS host machine (YARR PC) for running scans.**
- **Supports running over multiple modules at the same time.**

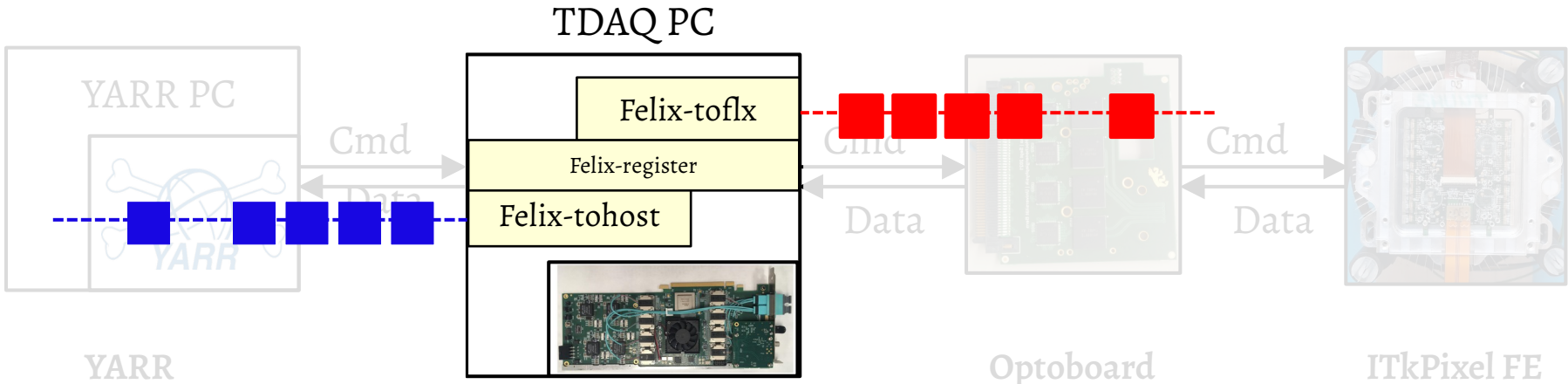
Key design features



- One felix-client thread per YARR 'scanConsole' i.e. for all tx and rx in the given connectivity file.
- Ongoing efforts for integrating YARR in TDAQ partition (link) and ultimately in the microservices (link) framework. Would nicely work for module QC at the LLS sites based on configDB.
- YARR and FELIX can be run from either same or from different host PC via ethernet connection (no Mellanox network card needed for now).

TDAQ requirements

- **FELIX software version >= 5.0.2, firmware version >= FLX712 Pixel (Nov 2023) and driver version >= 4.14, cc7 or 4.15, el9 (depending on the OS, check official FELIX release page).**
- **Current firmware release only supports one lane readout per FE: SCC ✓, Quad module ✓, Triplet module (enable one lane/chip) ✓.**

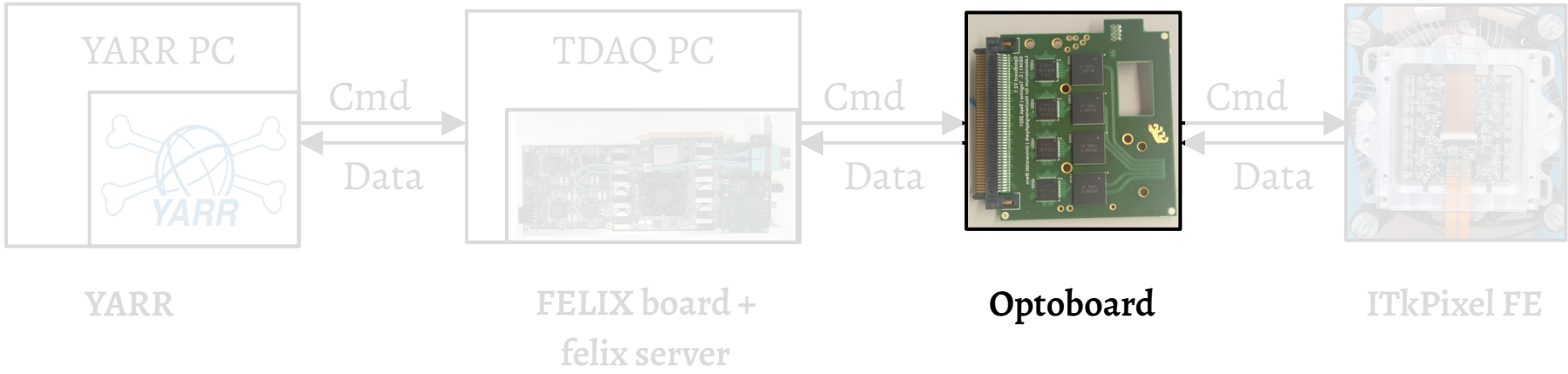


Buffered send connection: with command aggregation from YARR for the global and pixel chip configuration. Calibration injection & trigger commands are not buffered.

Buffered DAQ connection: to support high-throughput from the chips. Also, additional "message queue" helps in decoupling the event loop thread from user thread while parsing data.

Optoboard configuration

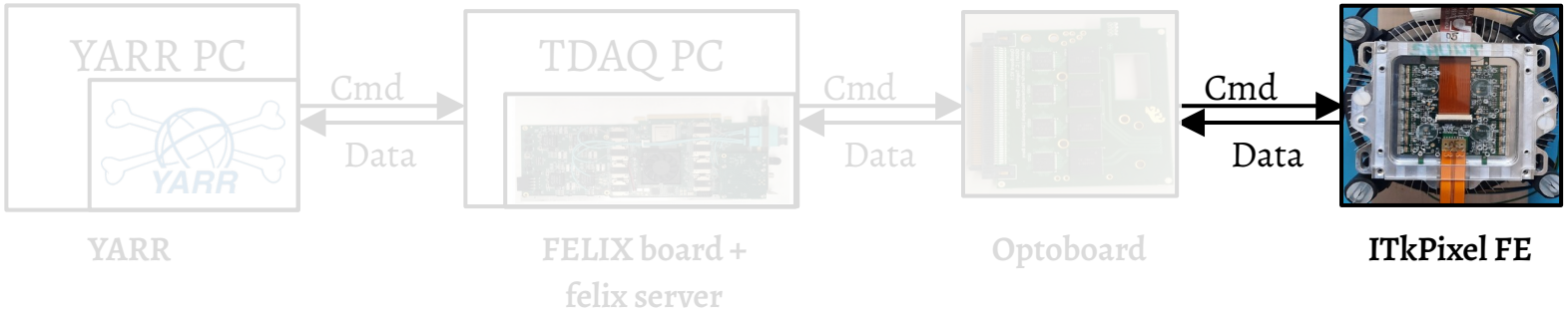
- **Complete documentation provided by Bern here - https://optoboard-system.docs.cern.ch/**
  Very nice summary presented at ITk week - Mar2024
- **For any help or questions, please use the mattermost channel - town-square**

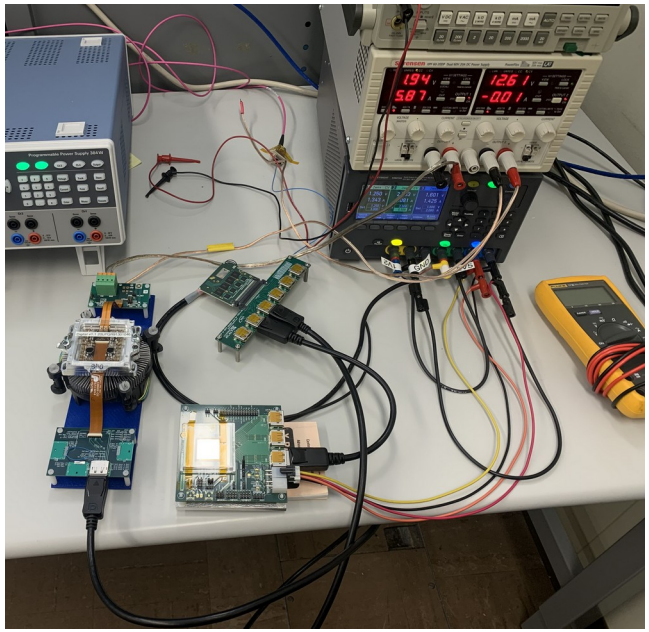


- Main LPGBT should have link alignment with FELIX (once configured) upon powering on, otherwise reset the clock (flx-init).
- Beware of the command (EPTX) and data (EPRX) polarity registers!
- Should have link alignment with the FE module, once the optoboard is fully configured and FE is switched on. If not, try power-cycling the FE, changing DP cable to different length.
- Use the above check to verify the uplink from the FE, to be used in YARR connectivity.
- Finally, adjust the chip configuration as instructed on the wiki.

Note for users

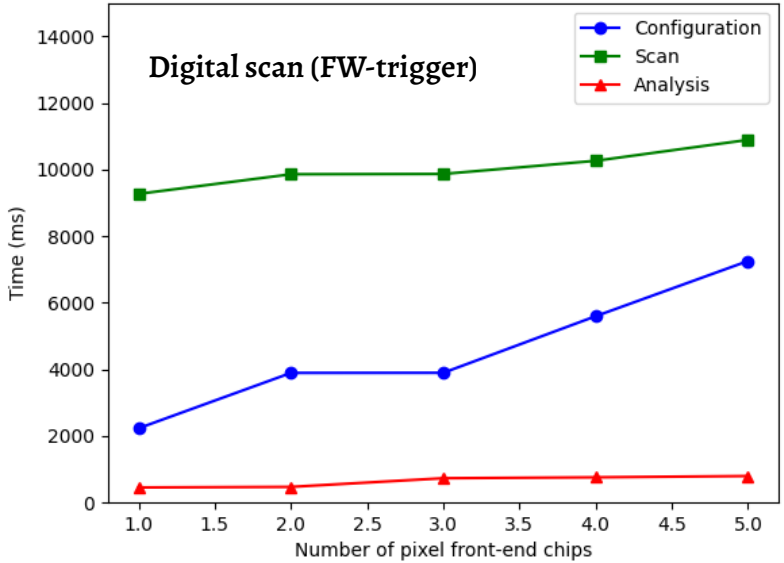
Front-end performance





LBL test stand

One SCC v1.1 and one quad module v1.1 connected on the Zaza adapter board.



*Will be extended for up to 32 FEs soon.

Scan performance

Good* | Better | Best

*old/deprecated

Calibration	Felixcore (FW-trigger)		Felix-star (SW-trigger)		Felix-star (FW-trigger)	
	SCC v1.1	Quad v1.1	SCC v1.1	Quad v1.1	SCC v1.1	Quad v1.1
Digital scan (5KHz, trigger multiplier = 16, injections = 100)	Scan time: 27.636 s Analysis: 556 ms Configuration: 209 ms Processing: 0 ms	Scan time: 39.198 s Analysis: 740 ms Configuration: 620 ms Processing: 0 ms	Scan time: 8.223 s Analysis: 490 ms Configuration: 2211 ms Processing: 0 ms	Scan time: 9.343 s Analysis: 788 ms Configuration: 7.157 ms Processing: 0 ms	Scan time: 5.4 s Analysis: 701 ms Configuration: 2181 ms Processing: 0 ms	Scan time: 6.041 s Analysis: 718 ms Configuration: 7163 ms Processing: 0 ms
Analog scan (5KHz, trigger multiplier = 16, injections = 100)	Scan time: 27.672 s Analysis: 550 ms Configuration: 183 ms Processing: 0 ms	Scan time: 43.065 s Analysis: 729 ms Configuration: 703 ms Processing: 0 ms	Scan time: 8.257 s Analysis: 644 ms Configuration: 2200 ms Processing: 0 ms	Scan time: 9.511 s Analysis: 716 ms Configuration: 7167 ms Processing: 0 ms	Scan time: 5.394 s Analysis: 565 ms Configuration: 2184 ms Processing: 0 ms	Scan time: 6.163 s Analysis: 754 ms Configuration: 7147 ms Processing: 0 ms
Threshold scan (8KHz, injections = 50, InjVcalDiff: [0, 300, step = 5])	Scan time: 1226.445 s Analysis: 428 ms Configuration: 177 ms Processing: 0 ms	Scan time: 1733.258 s Analysis: 787 ms Configuration: 696 ms Processing: 0 ms	Scan time: 247.047 s Analysis: 622 ms Configuration: 2194 ms Processing: 0 ms	Scan time: 310.361 s Analysis: 764 ms Configuration: 7172 ms Processing: 0 ms	Scan time: 201.598 s Analysis: 820 ms Configuration: 2195 ms Processing: 0 ms	Scan time: 256.783 s Analysis: 823 ms Configuration: 7200 ms Processing: 0 ms

- Timing performance of YARR scans with SCC v2 is exactly similar to SCC v1.1.
- ITkPix quad module v2 results soon…

What else are we providing?

"(Almost) 24x7 support for debugging LLS setups as well as individual test stands!!"

How to reach us?

- Mattermost channels:
  - ITkSW Pixel LLS: Link (recommended)
  - Status updates at YARR fortnightly meetings – https://indico.cern.ch/category/17603/
- General information from YARR:
  - YARR-users egroup (subscribe here) and YARR-developers egroup (subscribe here).
  - Town square mattermost: Link
  - Felix-star support: Link, open Felix-related issues: Link

How can we reach you? - URGENT!!!

- Need a point of contact from each LLS site and other individual test stands. Sign up here - spreadsheet
- This will help us provide support even more efficiently and rapidly! Moreover, eliminating setup-dependencies and understanding the needs to reach LLS QC sooner!

Data collected so far…

	A	B	C	D	E	F	G
1	**Site**	**Is an LLS site? (Yes/No)**	**Users**	**Point of contact**	**Goals with YARR**	**Status with YARR**	**Link to latest presentation**
2	CERN-SR1	Yes	Leyre Flores Sanz De Acedo, Benedikt Vormwald	Leyre			
3	Göttingen	Yes	Wael Alkakhi, Ali Skaf, Arnaulf Quadt	Wael			
4	Bern	?	Daniele Dal Santa, Marianna Glazewska, Aaron Paul O'Niell	Marianna			
5	ANL	?	Ricardo Luz, Alexander Paramanov	?			
6	CERN, B161	?	Andreas Korn	?			
7	SLAC	Yes	Brendon Bullard, Andrew Young, Su Dong	Brendon			
8	INFN Frascati	Yes	Antonio Sidoti, Paolo Morettini, Stefania Spagnolo, Gabriele Chiodini, Zaza Chubinidze, Marianna Testa	?			
9	INFN Genova	Yes	Paolo Morettini, Simone Ravera, Ettore Ruscino, Nanni Darbo				
10	INFN Lecce	Yes					
11	INFN Bologna						
12	RAL	Yes	Juliette Martin, Andreas Korn, Ben Smart	?			
13	Oxford	?	Simon Koch, Daniel Hynds	?			
14	Liverpool	?	David Vázquez Furelos, Jon Taylor	?			
15	Wuppertal	?	?	?			
16	Bonn	?	Konstantin	?			
17	U. Oslo	?	Ole Dorholt, Ole Rohne	?			

~5 YARR + Felix users (CERN-SR1, ANL, Frascati, Genova, Lecce, Bern) with successful calibrations and ~2 (Göttingen, SLAC) in pipeline to reach their goals soon.

Note for users: *Please help us populate this table together!*

Note for users: *Other setups that we've missed, please create entry in the table yourself or simply contact us!*

YARR next goals for pixels…

Spring 2024

1) Extensively test data-merging for ITkPix quad module v2.
2) Running data-transmission with triplets using new 4-lane/FE firmware from FELIX.
3) Useful utilities for debugging connectivity issues of YARR with FELIX.
4) …

Summer 2024

1) Reading chip registers for module QA/QC with FELIX.
2) Automatic FELIX registers configuration for running various calibration scans with FW-trigger generation.
3) Running eye diagram scans for FELIX-based readout.
4) …

Fall 2024

1) Running multiple modules in a serial-powered chain.
2) Support for RDMA (with new features from TDAQ) via Mellanox network card.
3) …

Tests

Utilities/features