

# ADTimePix3 areaDetector driver

<https://github.com/areaDetector/ADTimePix3>

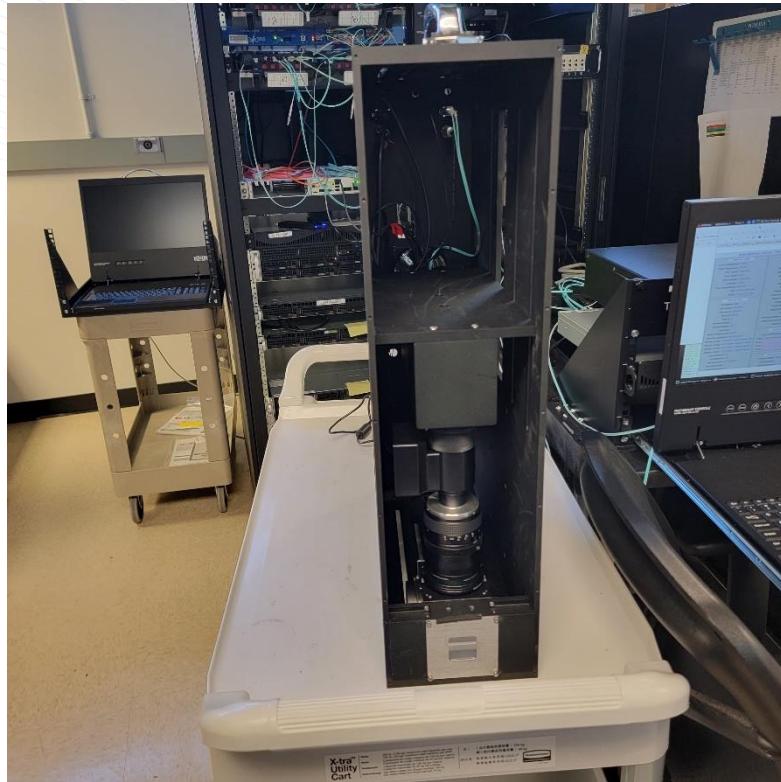
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ORNL

EPICS Collaboration Meeting FNAL, IL, USA  
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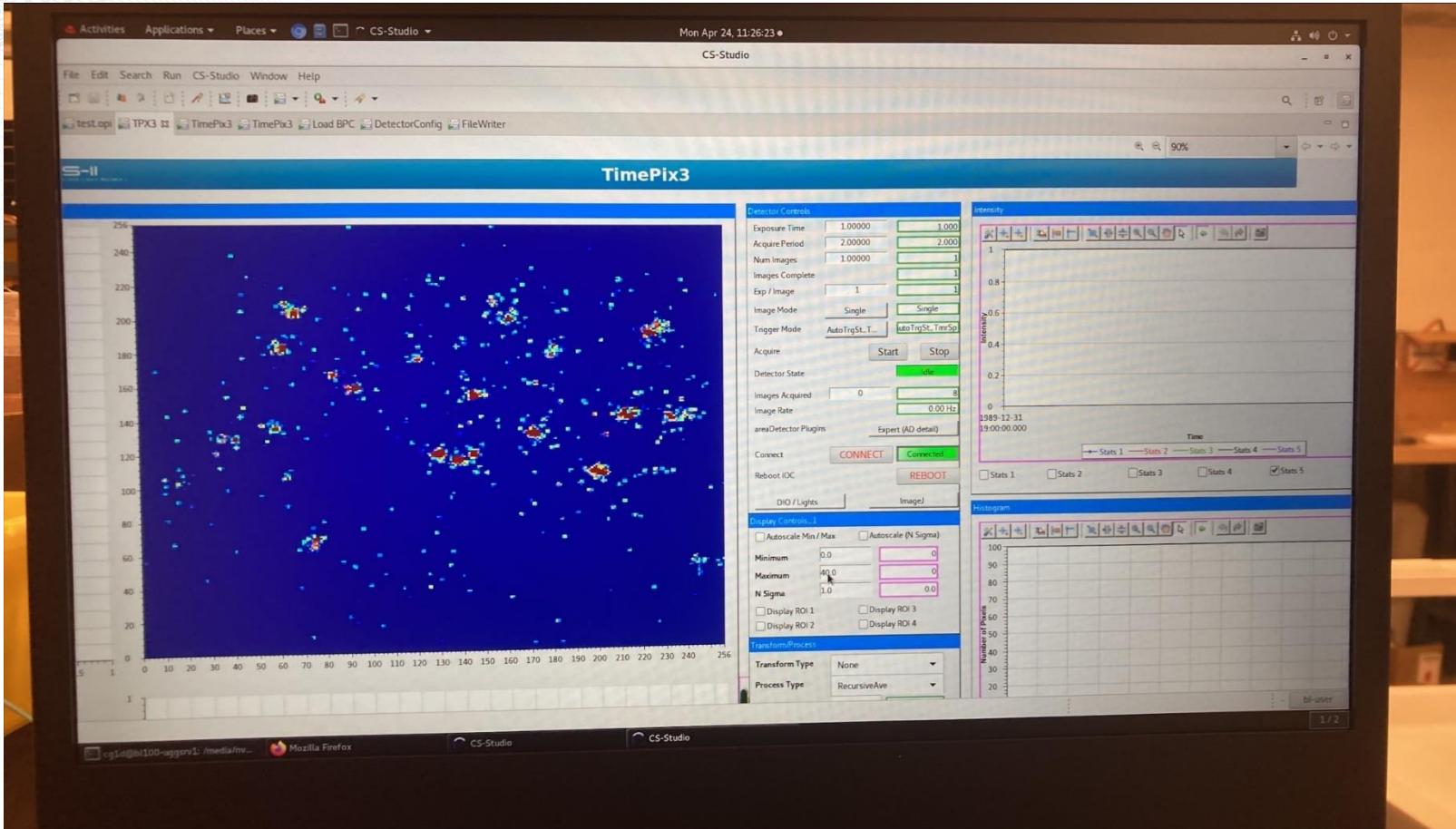
# ASI tpx3Cam for SNS, and HFIR reactor beamlines



- Thermal neutron detection process
  - ${}^6\text{Li} (\text{n}+\text{alpha}) {}^3\text{H} + 4.78 \text{ [MeV]} (5\text{-}9 \mu\text{m})$
  - Scintillator containing  ${}^6\text{Li}$  generates light converted in photocathode and amplified by dual MCP stack.
  - Electron cluster detected by TimePix3
- Alternative
  - ${}^{10}\text{B} (\text{n}+\text{alpha}) {}^7\text{Li} + 2.31 \text{ [MeV]}$

- Funama Fumiaki (single chip tpx3Cam optical)
- Greg Guyotte (four chip, custom), CG1a/HFIR), BL3

# ASI tpx3Cam thermal neutron ‘clusters’ – preview



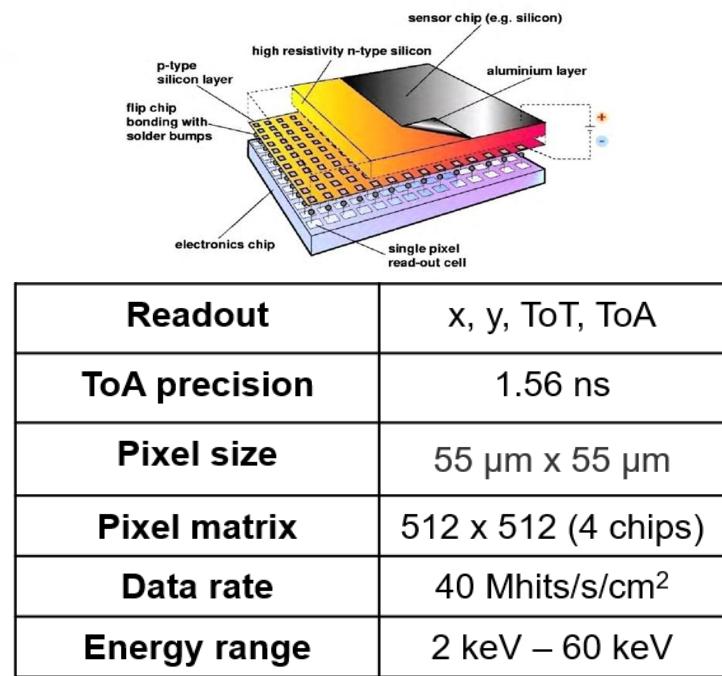
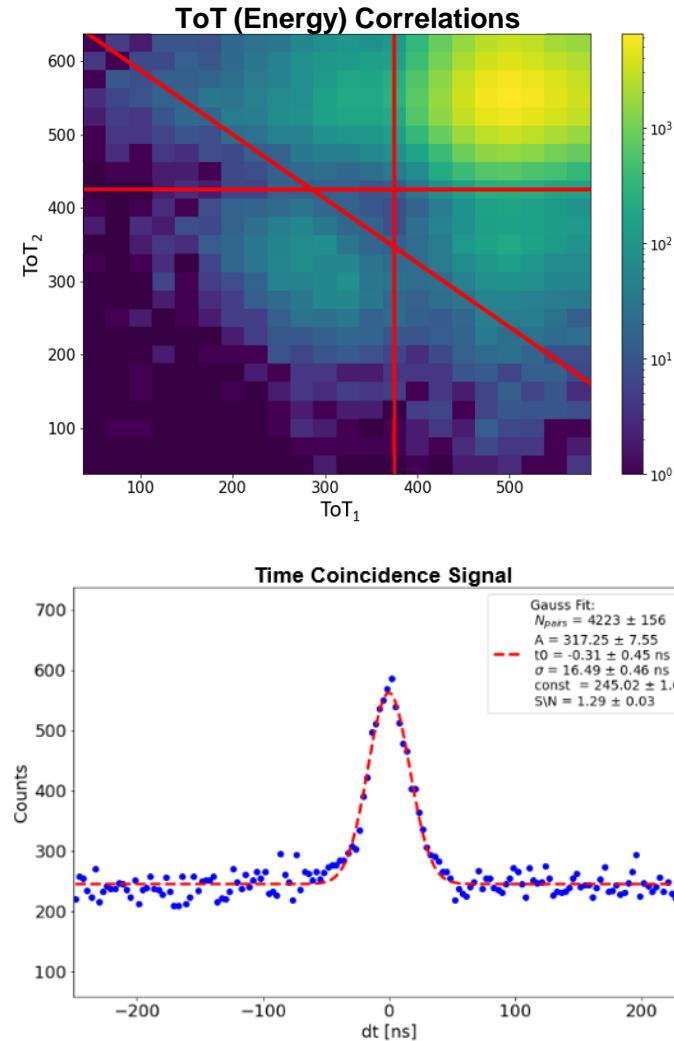
- Funama Fumiaki (tpx3Cam optical)
- Real time data pipeline
- Clustering
- nED
- ADnED
- ADARA

# ASI TimePix3 four chip: direct detection of X-ray

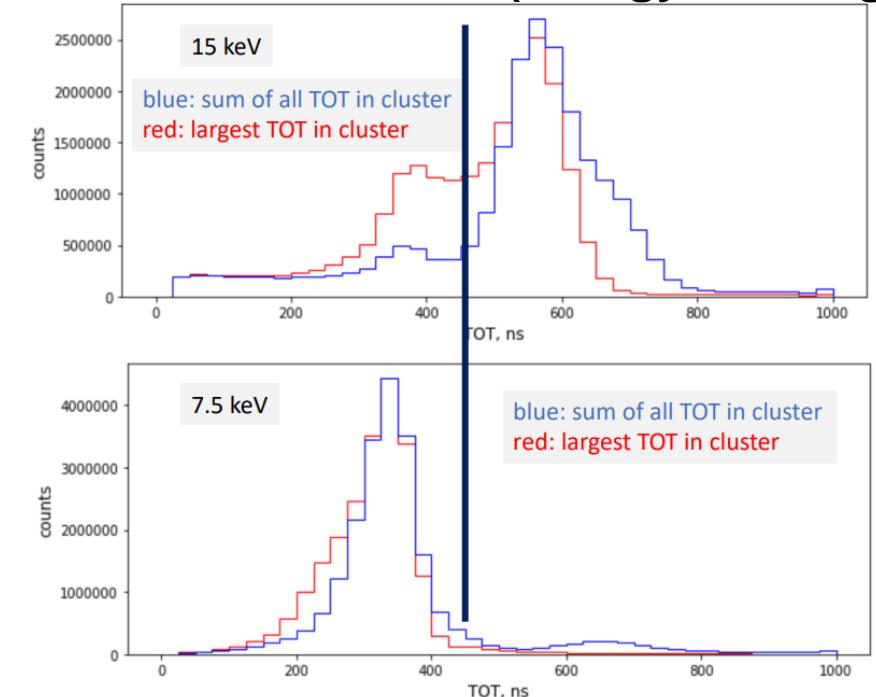
- An EPICS areaDetector driver for TimePix3 quad 512 x 512 detector from ASC.
- ASC <https://www.amsclns.com/>
- NSLS2/CHX – Coherent Hard X-ray Scattering beamline.
- TDC – Timing from accelerator (260 ps); DIO: 2 x 3 (timing signals)



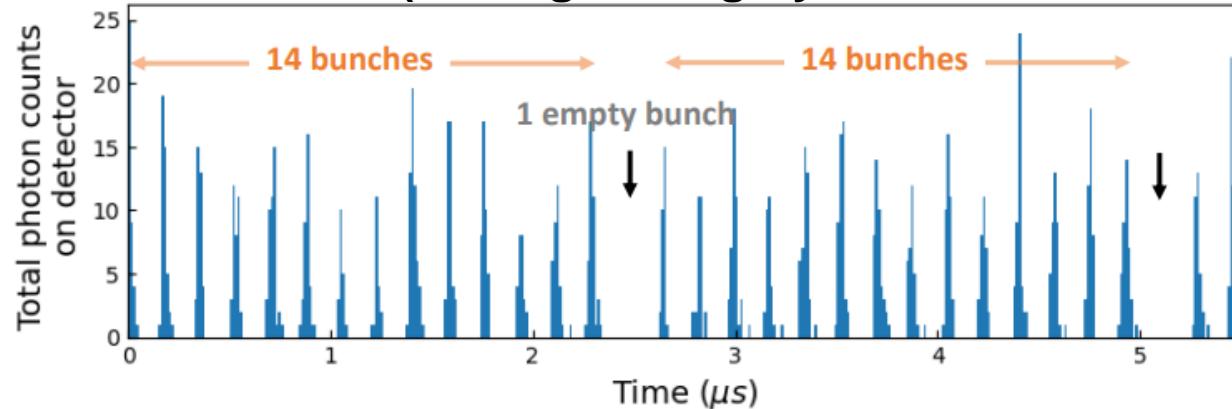
# ASI TimePix3 four chip – direct detection



## ToT Distributions (Energy Filtering)



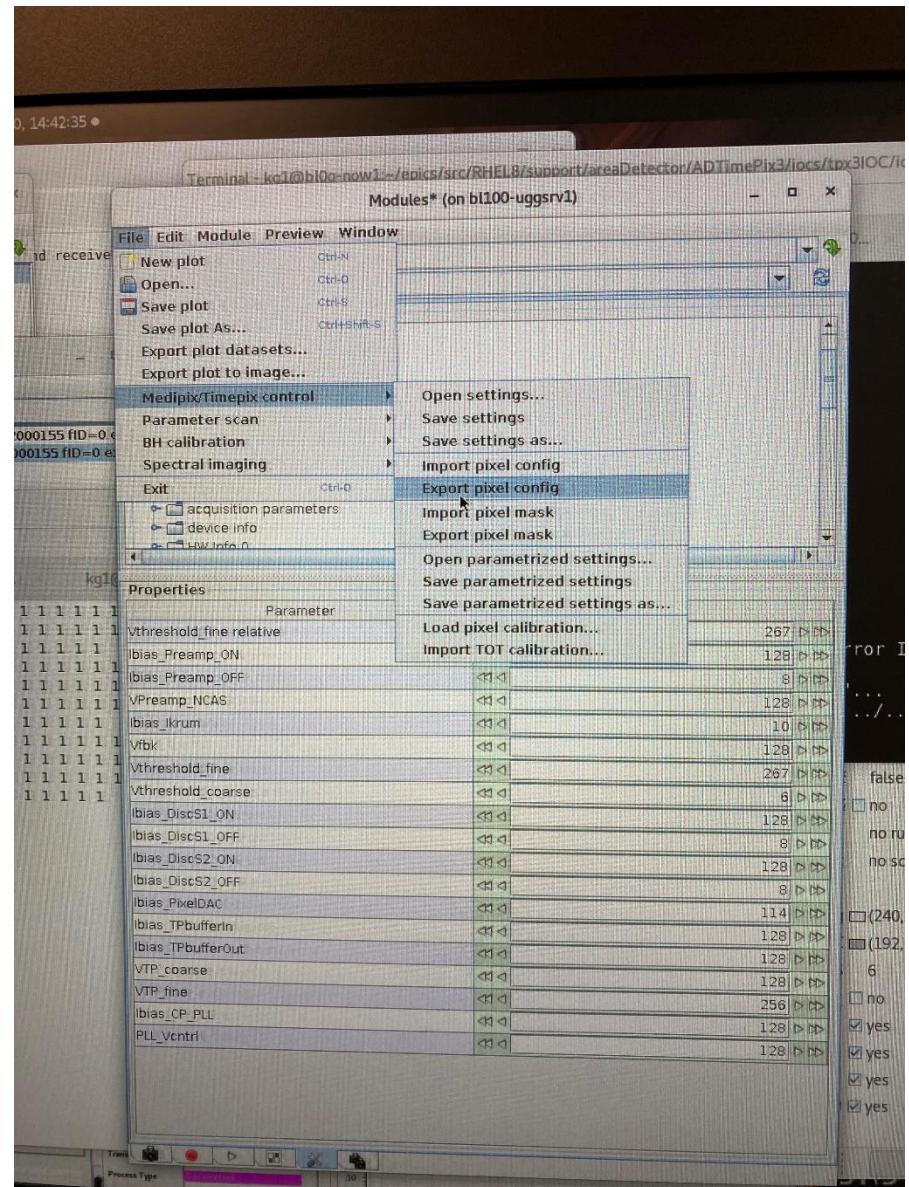
## Ultrafast ToA (Distinguishing Synchrotron Bunches)



Courtesy of Justin Goodrich, Andrei Fluerasu, et. al. NSLS2

# ASI TimePix3 Calibration

- SoPhy vendor software
  - DACS calibration file
  - Binary Pixel Configuration file
- ASI provides calibrations with detector



# ADTimePix3 dependencies

- Dependencies
  - Depends on the CPR version 1.9.1.
  - Depends on the json version v3.11.2.
  - Developed with ADCore R3-11 and ADSupport R1-10 or newer.
  - This has only been tested on ubuntu 18.04, 20.04, 22.04 Linux 64-bit machines.
  - Tested with RHEL 7.9
  - This has only been tested with Serval version 3.0.0, and 3.1.1
    - Driver is specific to Serval version, since features differ (2.3.6->3.0.0 major changes)
- Dependencies (ADTimePix3/tpx3Support/)
  - Compile cpr (<https://github.com/libcpr/cpr>)
  - Clone json (<https://github.com/nlohmann/json>)

# ADTimePix3 dependencies

- Json C++ cpr, and json library use

```
std::string config;
config = this->serverURL + std::string("/detector/config");

// Detector configuration file
r = cpr::Get(cpr::Url{config},
              cpr::Authentication{"user", "pass", cpr::AuthMode::BASIC},
              cpr::Parameters{{"anon", "true"}, {"key", "value"}});

json config_j = json::parse(r.text.c_str());
config_j["BiasVoltage"] = 103;
config_j["BiasEnabled"] = true;

//config_j["Destination"]["Raw"][0]["Base"] = "file:///home/kgofron/Downloads";
//printf("Text JSON server: %s\n", config_j.dump(3, ',').c_str());

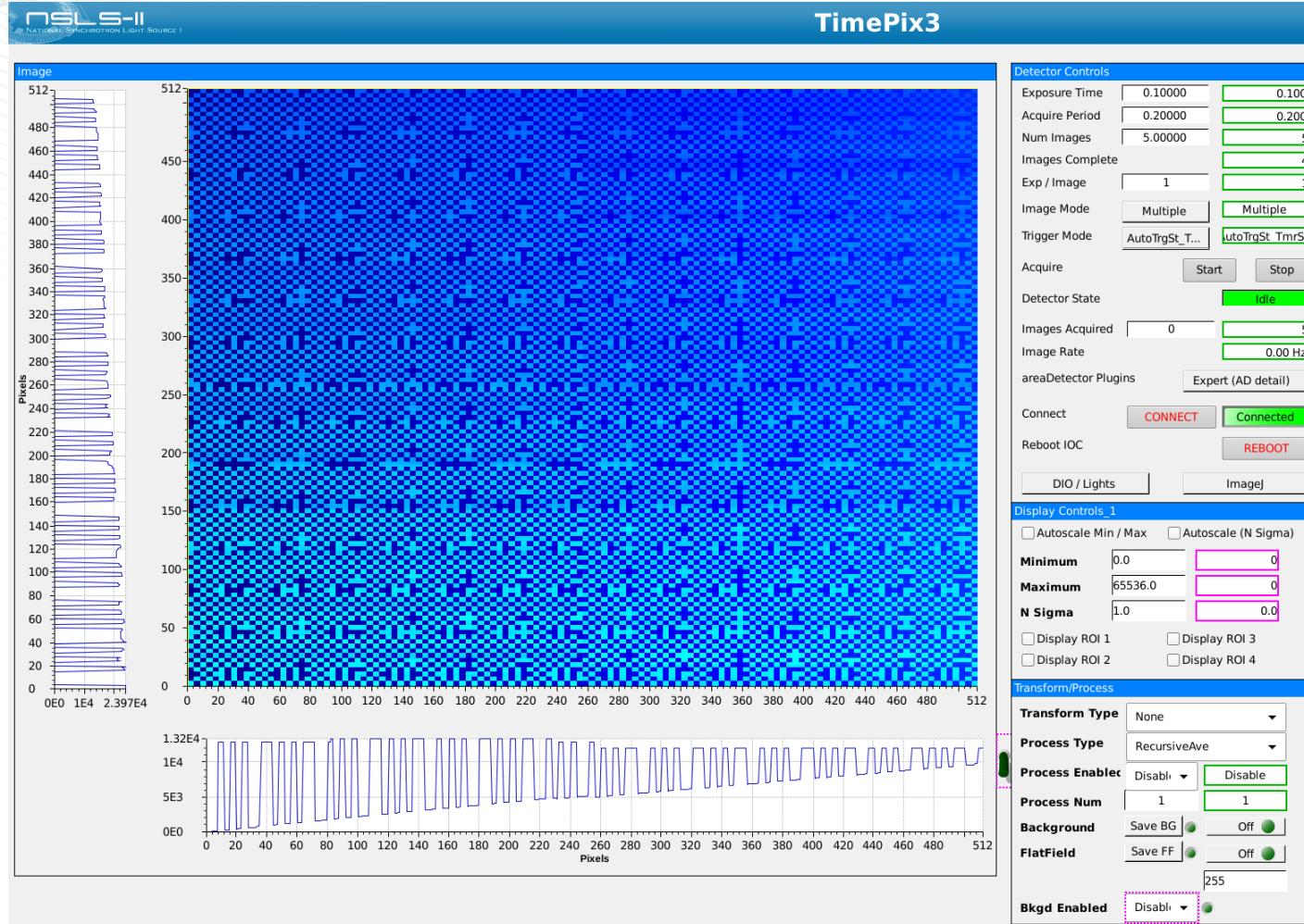
r = cpr::Put(cpr::Url{config},
              cpr::Body{config_j.dump().c_str()},
              cpr::Header{{"Content-Type", "text/plain"}});

printf("Status code: %li\n", r.status_code);
printf("Text: %s\n", r.text.c_str());
```

# ADTimePix3 control

- ADTimePix3 configures serval to perform data collection
  - One of 8 triggering modes in serval
  - Where serval will send data
  - Where to send data
- Only preview images are send through areaDetector

# ADTimePix3 opi – load .bpc and .dacs configurations



TPX3-TEST:cam1:

Exists: No

BPC File path

BPC File name

Exists: No

DACS File path

DACS File name

Upload BPC file

Upload DACS file

Write status code

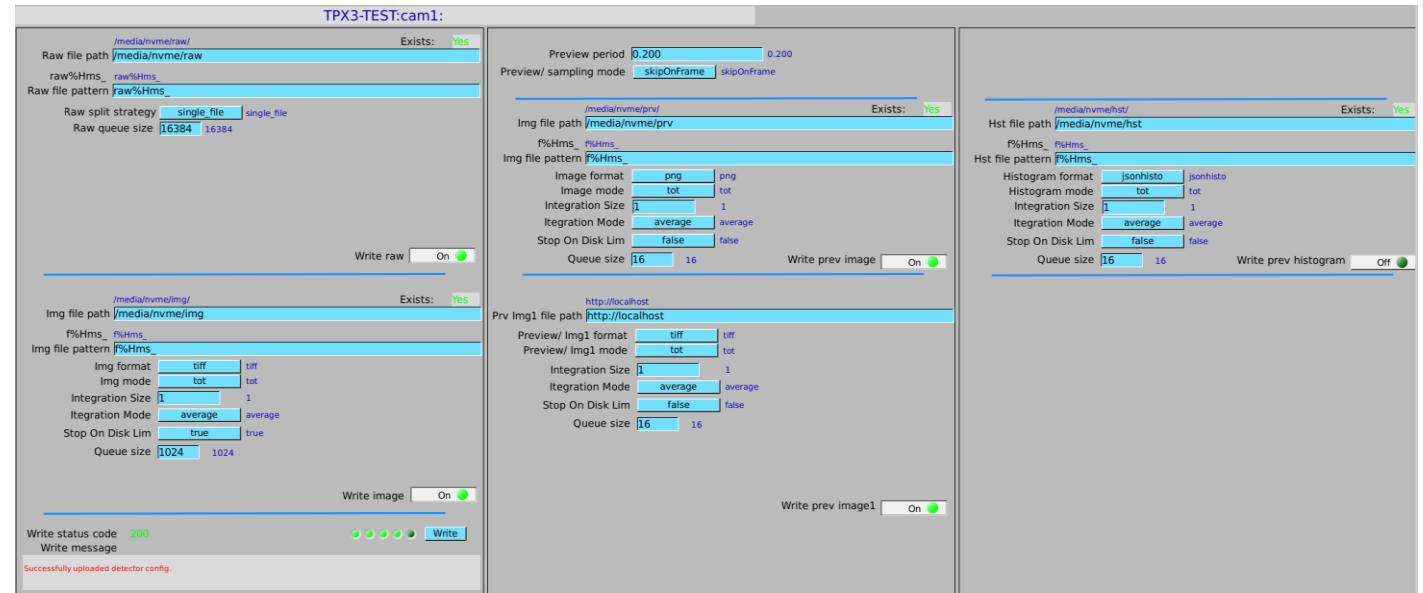
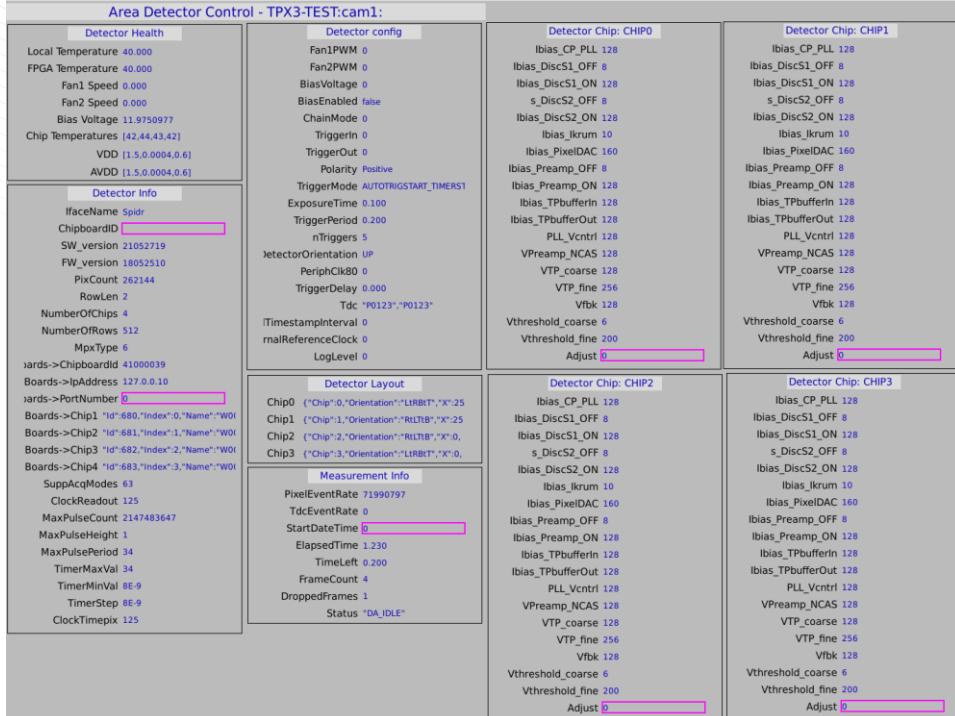
Write message

Successfully uploaded detector config.

Detector requires hardware configuration:  
1. Binary Pixel Configuration file loading from CSS  
2. DACS configuration files loading from CSS

# ADTimePix3 opi – Status, and FileWriter

- An EPICS ADTimePix3 detector status, and FileWriter.



## FileWriter configuration for channels

- Raw
- Image
- Preview
  - Image
  - Histogram

# ADTimePix3 opi – disk data structure

- Detector configuration, and controls.
- Currently data written to NVME internal disk for performance
- NVME
  - Raw
  - Img
  - Prv
    - Img
    - Hst {Serval experimental version support}
- Real time data using socket – SNS/HFIR primary
- Data write rates (>> 1GB/s)
- EPICS channel used for viewing
- .tpx3 data format
-

# Summary

- An EPICS ADTimePix3 areaDetector driver for ASI TimePix3 was developed.
  - Uses Curl for human's library
  - Uses json library
- X-ray, and charged particles use direct detection
- Thermal neutrons use indirect detection through fission of  $^6\text{Li}$  scintillator, or similar reaction
  - Thermal neutron are processed in real time
- Primary method of storing data is through .tpx3 file, and/or live stream.

# Acknowledgements

- Jakub Wlodek, NSLS2, Brookhaven National Lab
- CHX/NSLS2 team
  - Andrei Fluerasu, Xiaoqian Chen, Justin C. Goodrich, NSLS2, Brookhaven National Lab
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- ORNL
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  - Starra Lyons, Seth Giles
  - Funama Fumiaki, Chong Su-Ann, Zhang, Chen