



# Acquaman

## Scientific Software as the Beamline Interface

```
100
101 ▼ UserInterface::collectData(){
102
103     previousData_ = acquaman_->lastRun();
104
105 ▼ if(userScience_->isEnabled()){
106     acquaman_->doScience();
107 }
108
109 }
110
```

David Chevrier - CAP - June 15, 2015  
Interim Systems Technology Manager  
Canadian Light Source



# Road Map

- The five W's
  - (I'm hoping not to talk too much about "how")
- Explore the pillars of Acquaman development
  - Database, Visualization, Workflow
- Switch the perspective
  - Managing a modular, scalable, and flexible framework
  - Case Studies: IDEAS & SXRMB



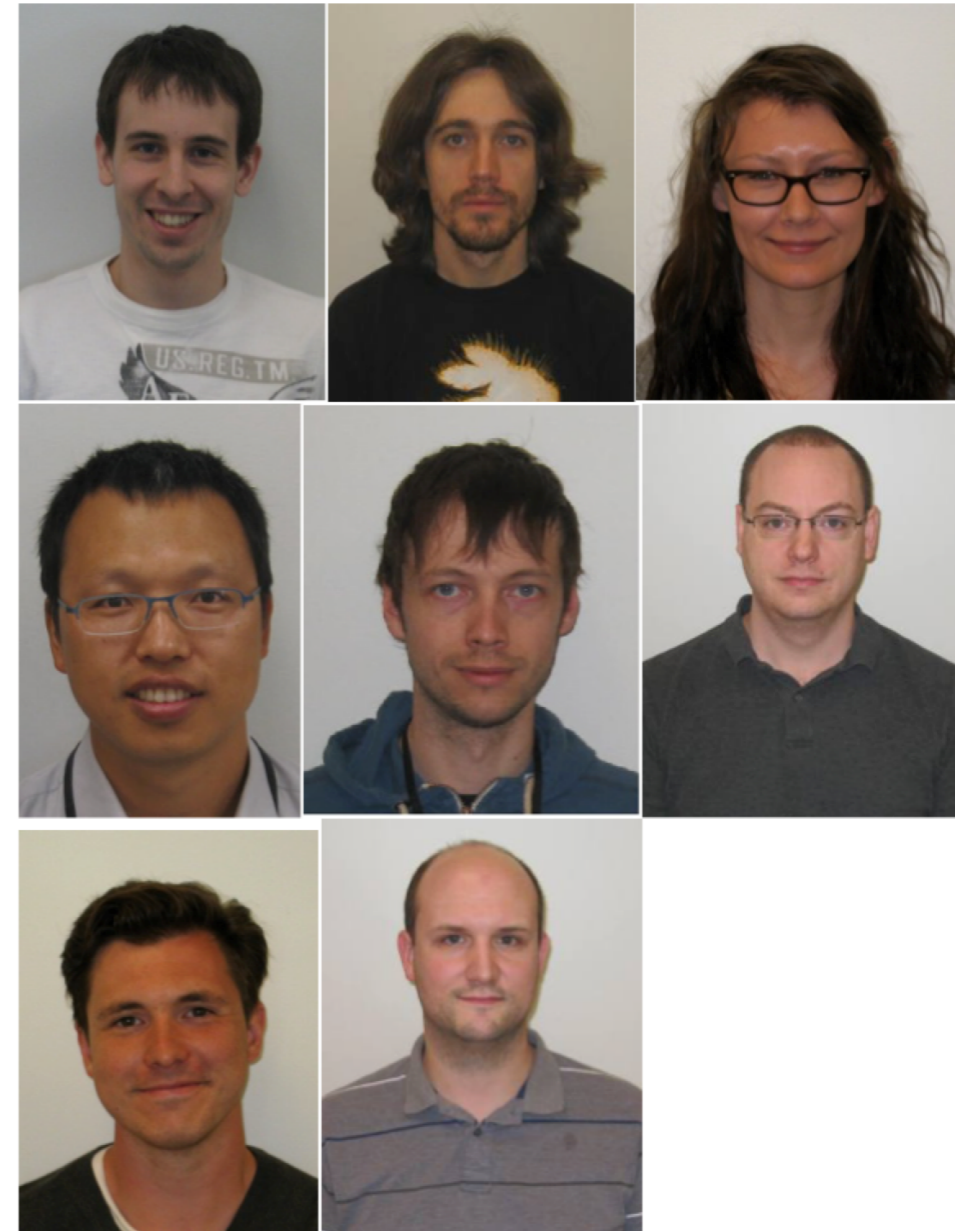
# who/what/when/where

- What is an Acquaman?
  - Acquisition and Data Management
  - Framework & Program



# who/what/when/where

- What is an Acquaman?
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  - Framework & Program
- Who is involved?
  - David Chevrier
  - Darren Hunter, Jessie Helfrich, Sheldon Liu, Iain Workman, David Muir, David Leacock, David Beauregard





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- When did it happen?
  - Founded in February 2010
  - 1st Deployment Spring 2011



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- When did it happen?
  - Founded in February 2010
  - 1st Deployment Spring 2011
- Where is Acquaman?
  - SGM, VESPERS, REIXS (original)
  - REIXS, IDEAS (~2014)
  - SXRMB, BioXAS Side (2015)
  - BioXAS Main & Imaging (~2016)
  - PGM & HXMA (?)



# *Why* Develop Acquaman?

- Letting users focus on Science
  - Experiment tool *not* a beamline interface
  - One-stop Shop
  - Pleasant and efficient



# Why Develop Acquaman?

The screenshot displays the Acquaman software interface, which is used for beamline control and data acquisition. The interface is divided into several main sections:

- SGM Beamline Control (Left Panel):** Includes status indicators for "BEAM ON", "Close Vacuum", and "Visible Light On/OFF". It also shows HV Group status, Beamline Energy (Set Point: 1138.000 eV, Feedback: 1137.841 eV), and Scanning parameters (Acquire, Stop, Run buttons, 17 minutes 8 seconds remaining, Scan 1 of 1, 47% progress).
- Energy Tracking and Grating Selection (Left Panel):** Shows Undulator (ON), Grating (ON), and Exit Slit (ON) status. It also includes Grating Selection (Low, Medium, High) and Entrance/Exit Slit settings (Set Point: 250.0 um, Feedback: 244.0 um).
- Scanning Region Table (Middle-Left):** A table with columns for Region, Start, Delta, and End. It lists Region 1: BL1611-ID-1:Energy, Start: 1100, Delta: 0.25, End: 1180.
- Recorded PV (Middle-Left):** A list of recorded parameters including BL1611-ID-1:Energy, PCT1402-01:mA:fbk, and various detector and monitor readings.
- Main Data Plots (Center and Right):** Several plots are visible, including a large plot of TEY/EA2 Io [THM037\_9.dat] and TEY/EA2 Io [THM031\_8.dat], a plot of EA1 Io [THM010\_5.dat], and a plot of CLS (Wed Sep 15 10:52:54 2010). There are also smaller plots at the bottom showing various detector responses.
- Acquisition and Spectrum Control (Right Panel):** Includes buttons for Start, Stop, and State. It also shows Spectrum control (GetSpectrum, Clear) and Old/New Energy data (Old Energy: 77, 265; New Energy: 539, 1835).
- Preset Settings (Bottom-Right):** A detailed configuration panel for BIAS, Amp, ADC1, ADC2, Preset, Elapsed, Roi, and Roi Conf. It includes fields for Real, Live, Peak, Count, Type, Preset, Data, DwellTime, Sample Interval, and MCS Input Mode.





# Why Develop Acquaman?

The screenshot displays the Acquaman software interface, which is used for controlling the SGM Beamline. The interface is divided into several sections:

- Workflow:** Shows a list of completed actions and a table of upcoming actions. The current action is a "Scan Action" that is running.
- Completed Actions:** A table listing actions that have been successfully executed.
- Current Action:** A progress bar and control buttons for the active scan.
- Upcoming Actions:** A list of actions that are queued to run next.
- SGM Beamline:** A control panel for the beamline, including buttons for "Beam On", "Beam Off", "Emergency Motor Stop", "Close Vacuum", "Visible Light", and various detector settings.
- DATA:** A section for viewing data, including a plot of the current scan results.

Action	Status	Finished	Duration
Fast Scan from 270 to 320	✓	Dec 15 (2012) at 9:22am	39 seconds
LEG_Flux_ XAS Scan from 250 eV to 700 eV	✓	Dec 15 (2012) at 9:52am	26 minutes and 4 sec
MEG_Flux_ XAS Scan from 500 eV to 1200 eV	✓	Dec 15 (2012) at 10:36am	38 minutes and 11 sec
Fast Scan from 920 to 970	✓	Dec 15 (2012) at 10:56am	21 seconds
Fast Scan from 920 to 970	✓	Dec 15 (2012) at 10:58am	17 seconds
Fast Scan from 690 to 750	✓	Dec 15 (2012) at 11:01am	32 seconds

**Current Action: Scan Action**  
Running | 0:17 | 0% | N/A | Pause | Skip | Cancel

**Upcoming Actions**  
7 actions in the workflow queue | Duplicate | Delete | Queue Running (Click to stop at next action)

**SGM Beamline**  
SAFETY SHUTTER  
Beam On | Beam Off | Emergency Motor Stop  
Close Vacuum | Visible Light  
Energy: 280.20 eV  
STOPPED  
Undulator | Grating | Exit Slit  
Grating: Low  
Exit Slit: 50.3 um | Not Scanning | Reset  
IO [checked] | TEY [unchecked] | TFY [unchecked] | PD [unchecked] | Auto [unchecked]  
FPD1 [unchecked] | FPD2 [unchecked] | FPD3 [unchecked] | FPD4 [unchecked] | Log [unchecked]  
Min: 0.00 | Max: 1000000.00

**DATA**  
Runs: Beamline Recovery, FastScanTesting, David Crash Testing, SGM\_TRXEOL, SGM\_VanVeggel, SGM, May 17 (2012), SGM, May 14 (2012), SGM\_EC\_CELL, Mar ...

**Alert:** in [AMProcessVariableSupport]: AMProcessVariable: channel c...



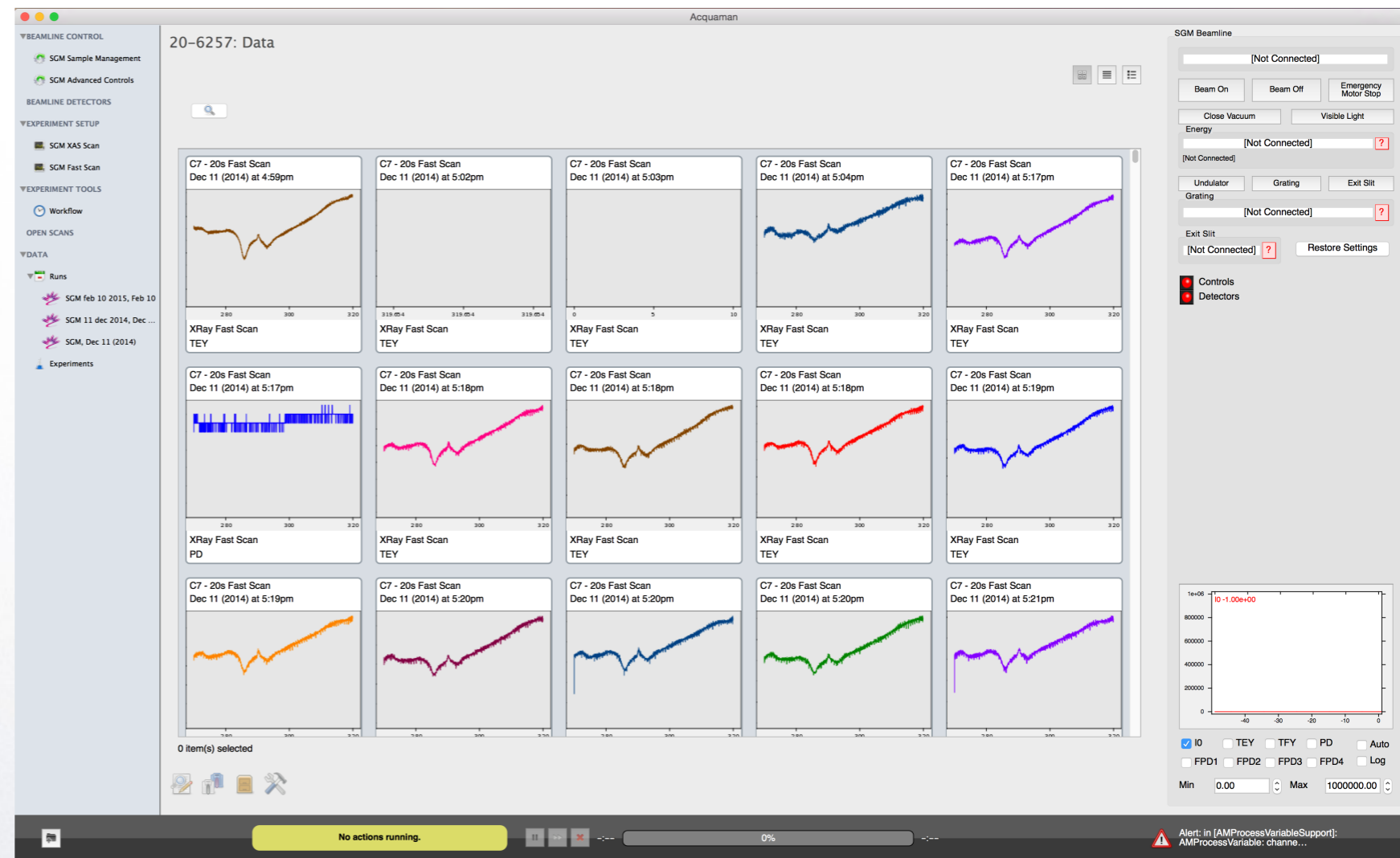
# Why Develop Acquaman?

- Letting users focus on Science
  - Experiment tool *not* a beamline interface
  - One-stop Shop
  - Pleasant and efficient
- Leveraging a framework
  - Started with Qt, SQL, git, github, OpenGL
  - Now AM is a framework



# Database

- What does it do?
- Long term storage
- Sorting
- Persistence





# Database

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- Persistence

The screenshot displays the Acquaman database interface. The main window shows a table of scan data with columns for Serial #, Name, #, When, Technique, Run, Sample Name, and Notes. The table contains 26 rows of data, all labeled as 'C7 - 20s Fast Scan'.

Serial #	Name	#	When	Technique	Run	Sample Name	Notes
1	C7 - 20s Fast Scan	1	2014-12-11 4:59 PM	XRay Fast Scan	SGM 11 dec 2014	C7	Scaler: TEY: 200 pA/VIO: 1 nA/V
2	C7 - 20s Fast Scan	2	2014-12-11 5:02 PM	XRay Fast Scan	SGM 11 dec 2014	C7	Scaler: TEY: 200 pA/VIO: 1 nA/V
3	C7 - 20s Fast Scan	3	2014-12-11 5:03 PM	XRay Fast Scan	SGM 11 dec 2014	C7	Scaler: TEY: 200 pA/VIO: 1 nA/V
4	C7 - 20s Fast Scan	4	2014-12-11 5:04 PM	XRay Fast Scan	SGM 11 dec 2014	C7	Scaler: TEY: 200 pA/VIO: 1 nA/V
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7	C7 - 20s Fast Scan	7	2014-12-11 5:18 PM	XRay Fast Scan	SGM 11 dec 2014	C7	Scaler: TEY: 200 pA/VIO: 1 nA/V
8	C7 - 20s Fast Scan	8	2014-12-11 5:18 PM	XRay Fast Scan	SGM 11 dec 2014	C7	Scaler: TEY: 200 pA/VIO: 1 nA/V
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The interface also includes a sidebar with navigation options like 'BEAMLINE CONTROL', 'EXPERIMENT SETUP', and 'OPEN SCANS'. A status bar at the bottom indicates 'No actions running' and '0%'. A small plot in the bottom right shows a data point at 10^-1.00e+00.



# Database

- What does it do?
  - Long term storage
  - Sorting
  - Persistence
- What do you get?
  - Convenience
  - Confidence

The screenshot displays the Acquaman database interface. The main window shows a table of scan data with columns for Serial #, Name, #, When, Technique, Run, Sample Name, and Notes. The table contains 26 rows of data, all labeled as 'C7 - 20s Fast Scan' with a 'Scalor: TEY' and '200 pA/Vi: 1 nA/V'.

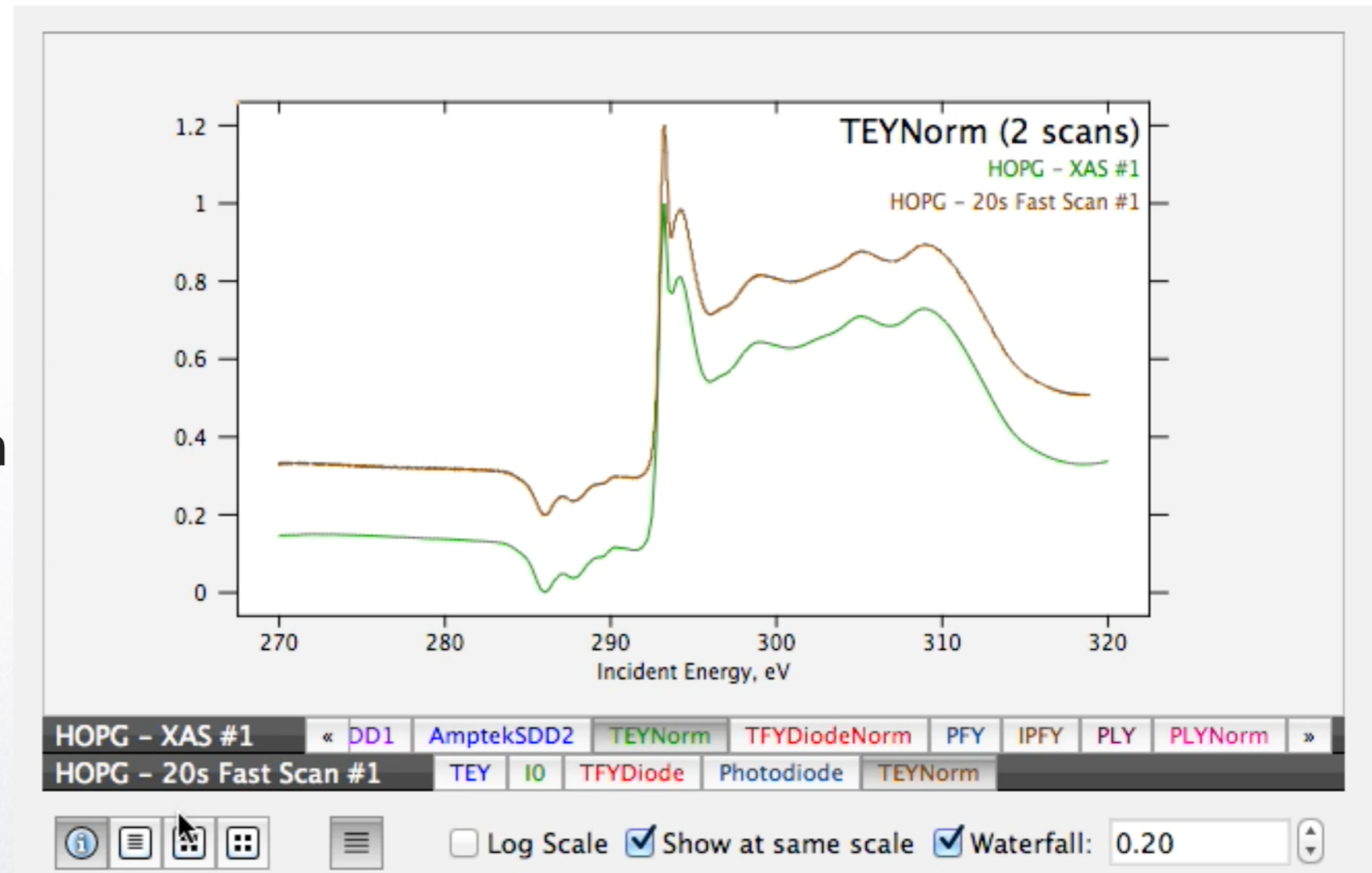
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# Visualization

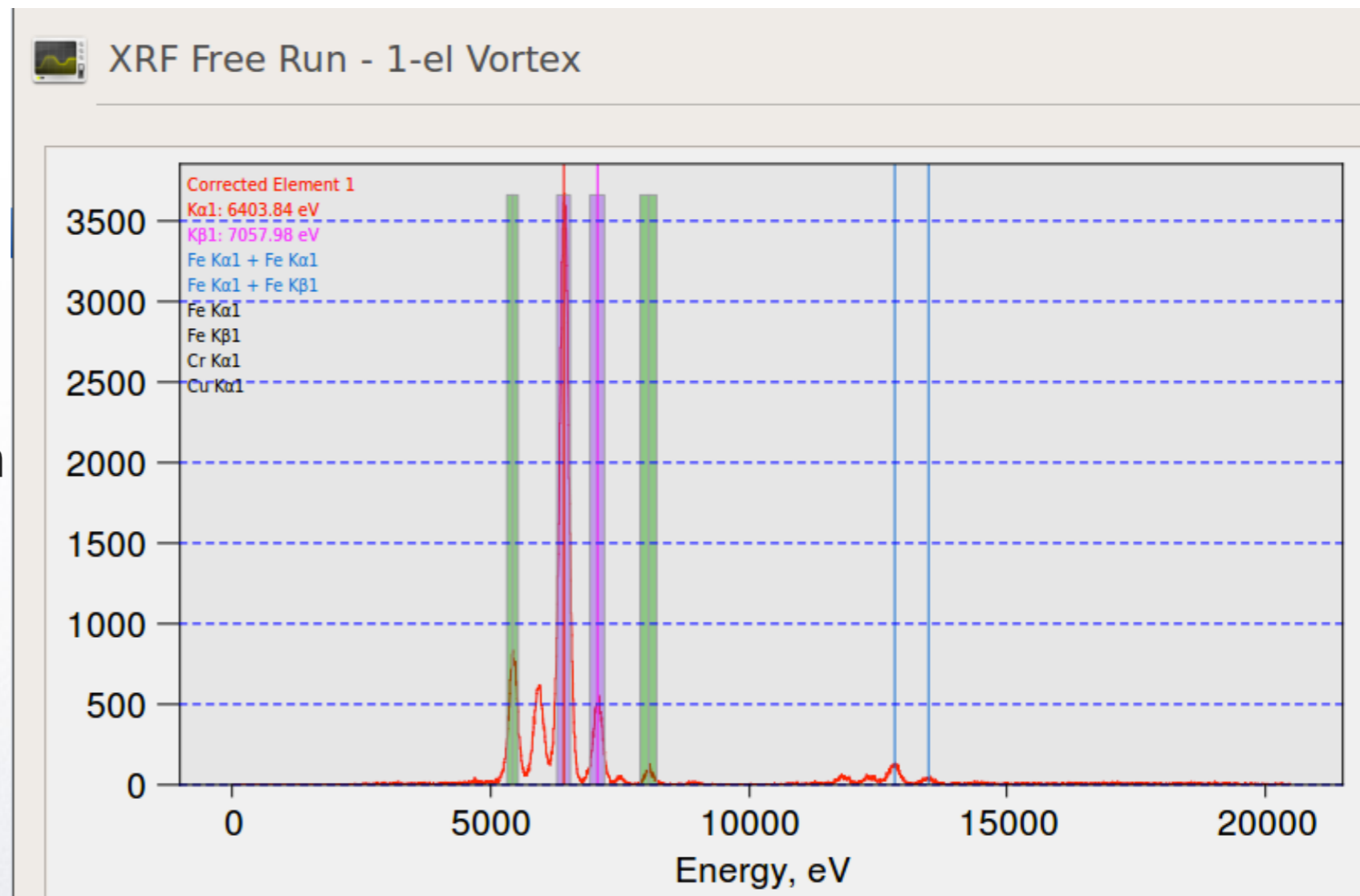
- What does it do?
- View live or reloaded data
- Line scans or maps (or both)
- Compare within a scan or between scans





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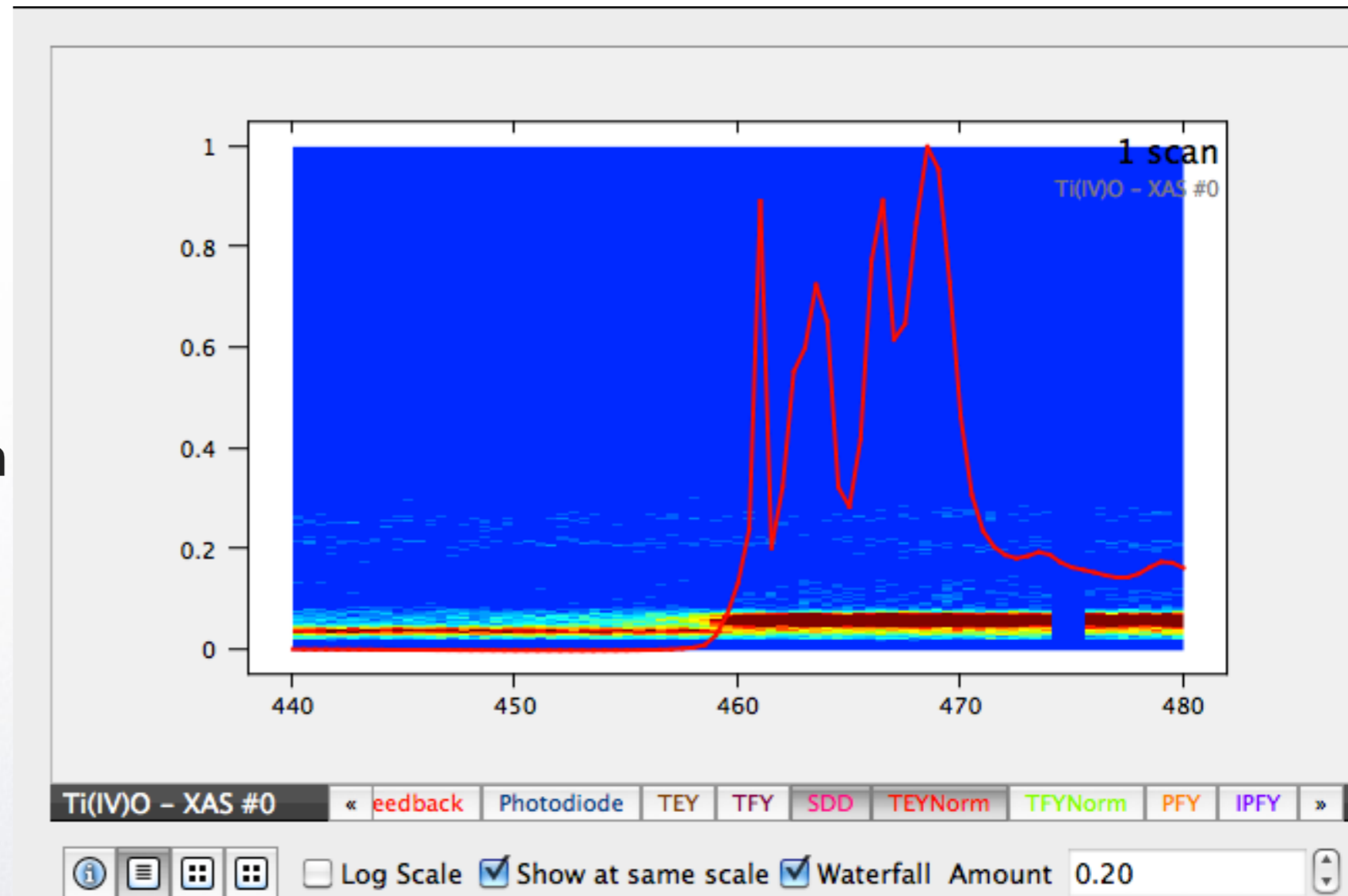
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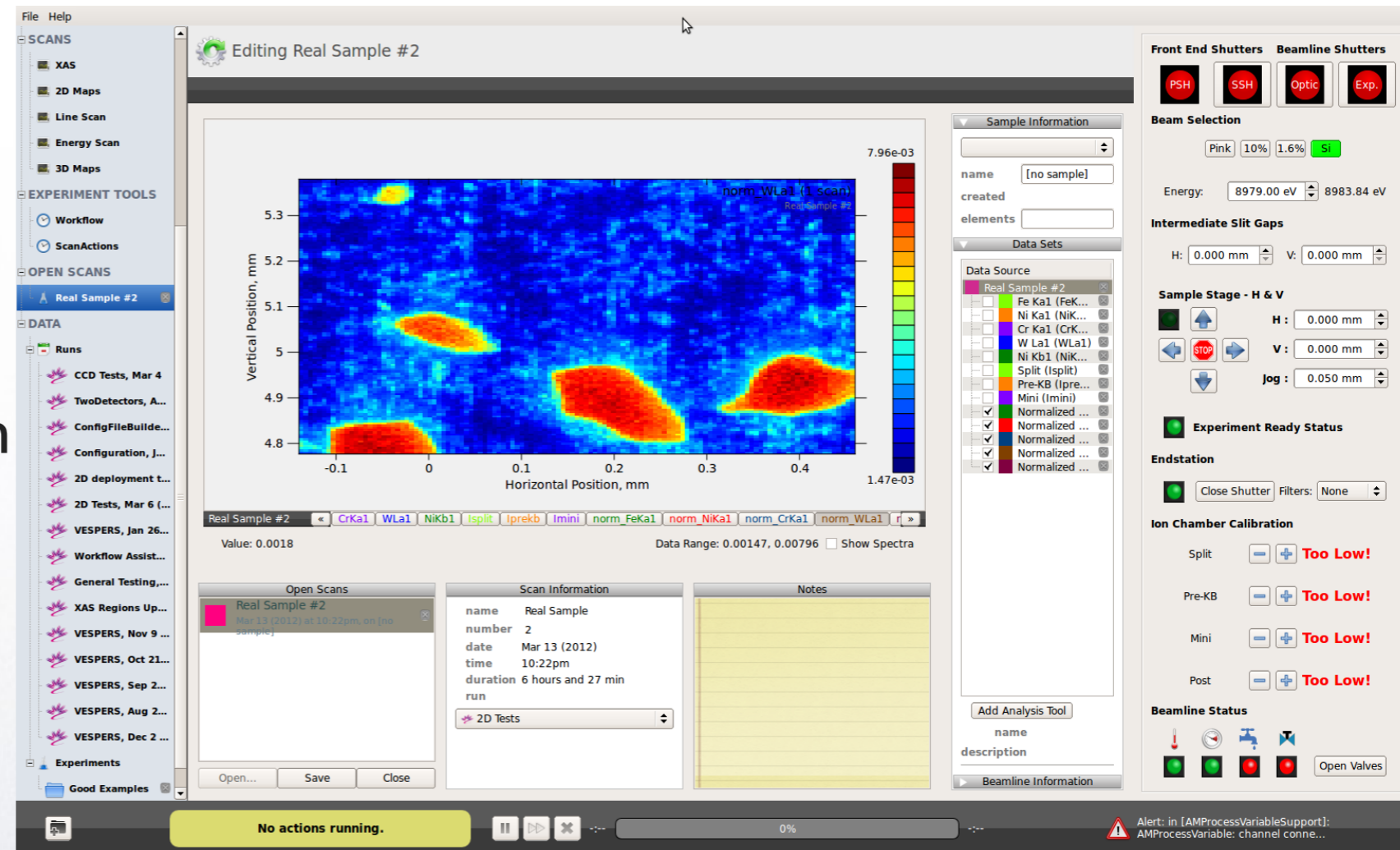






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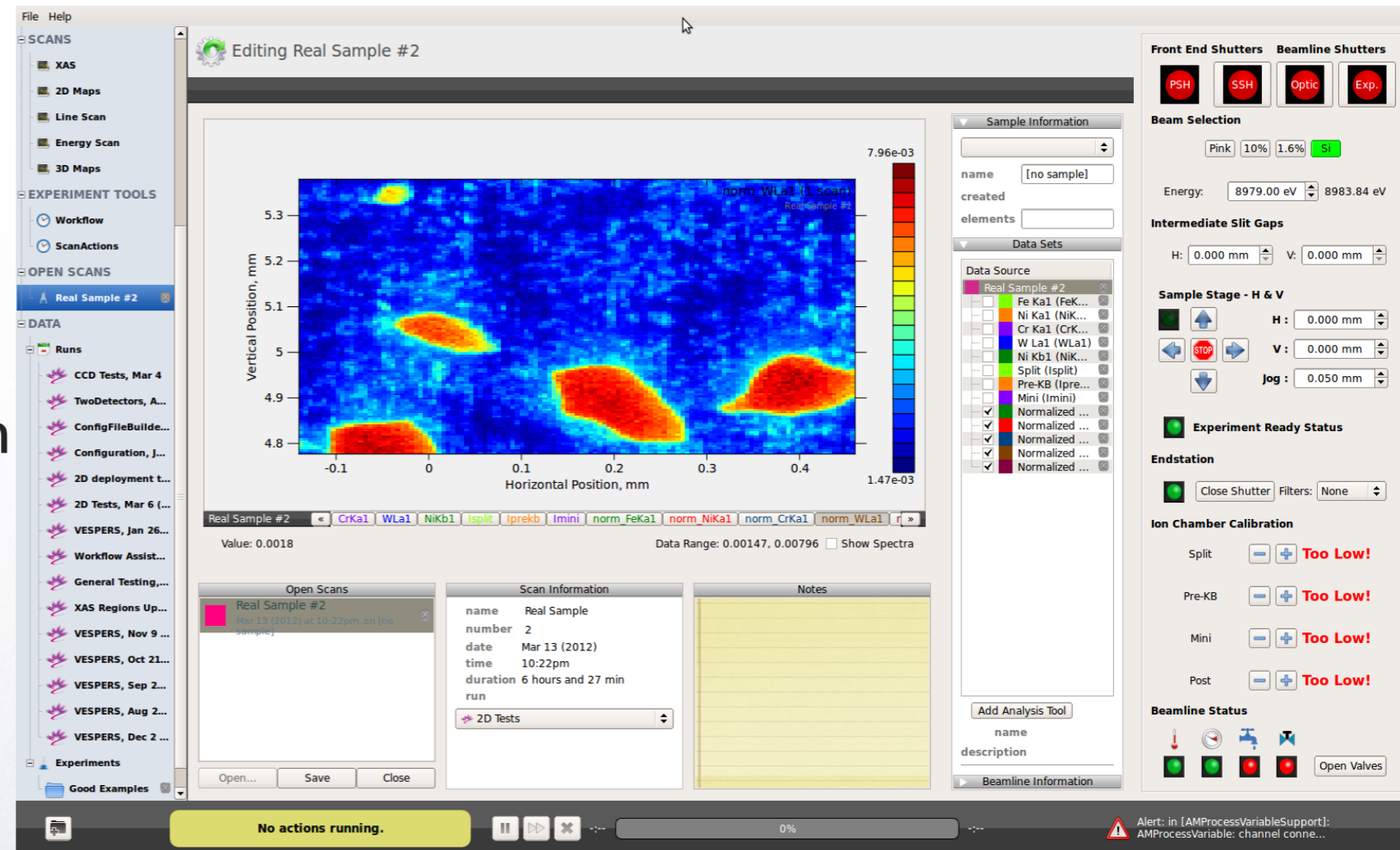
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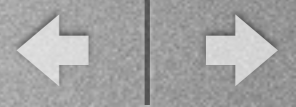




# Visualization

- What does it do?
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- What do you get?
- Convenience
- Adaptability





*If you have Visualization ...*

# Analysis

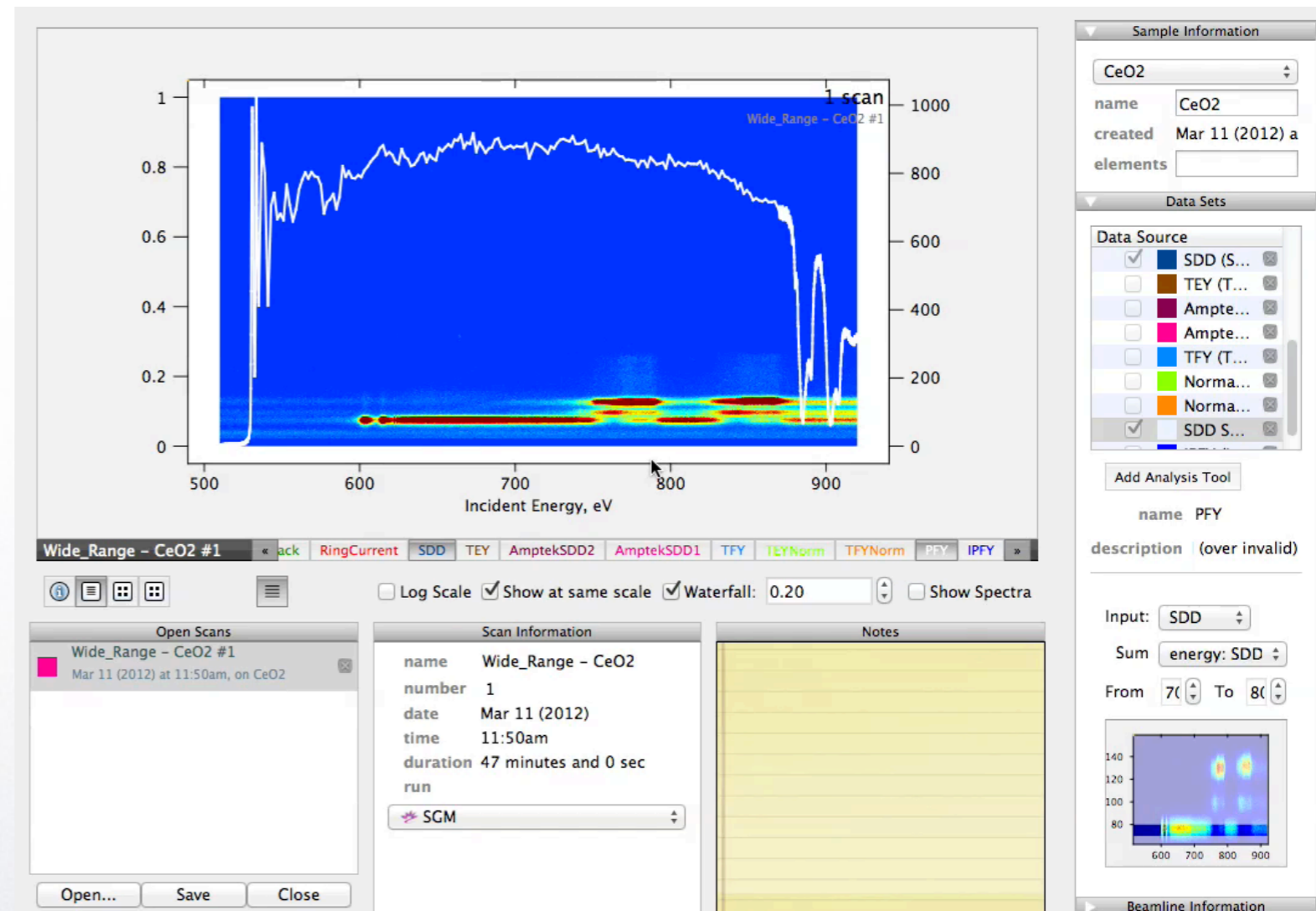
- What does it do?
  - Analysis while running or once finished
  - Simple arithmetic
  - Simple image processing
  - Extensibility
  - *(Doesn't) "Out-Igor" Igor*



If you have Visualization ...

# Analysis

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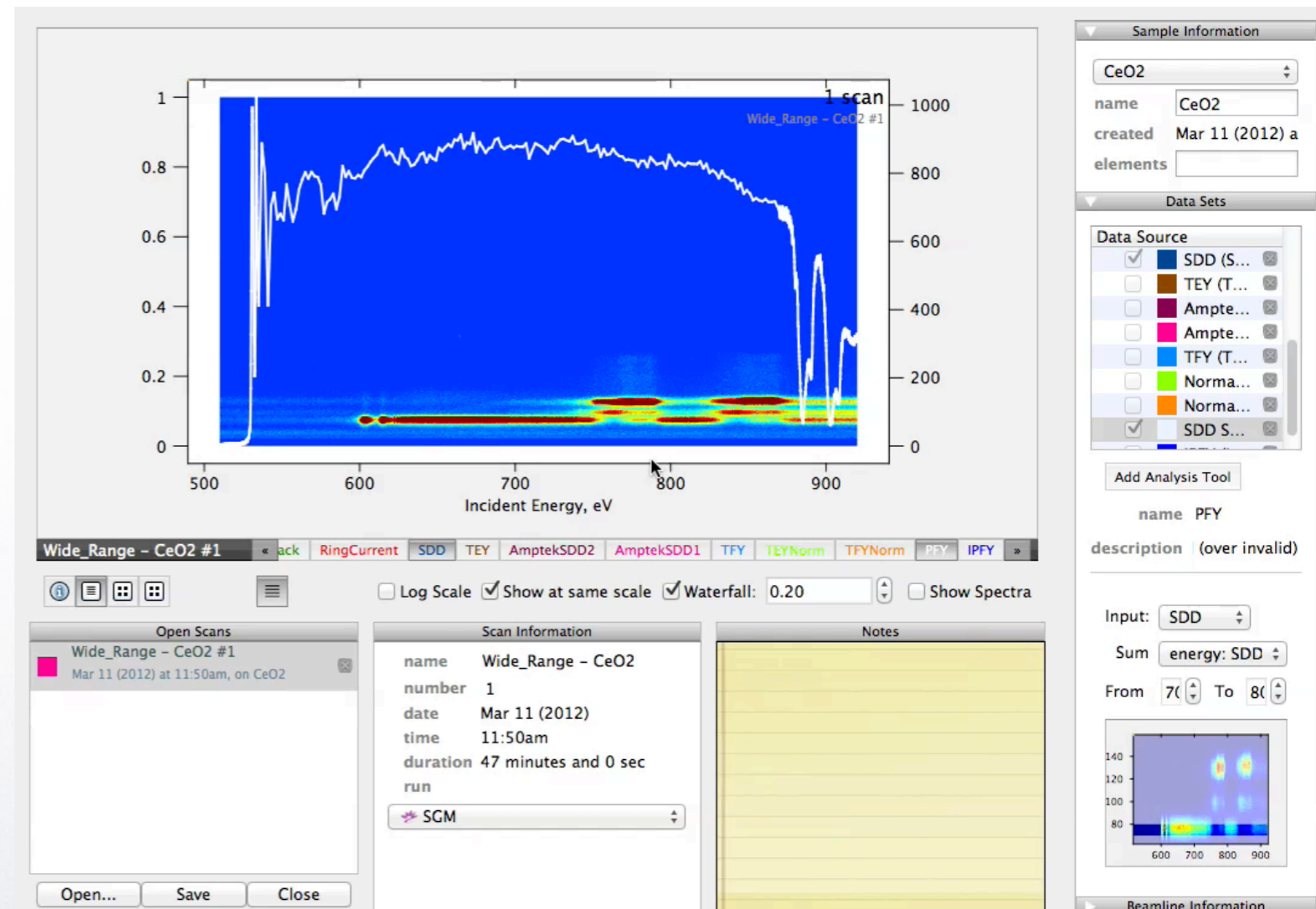




If you have Visualization ...

# Analysis

- What does it do?
  - Analysis while running or once finished
  - Simple arithmetic
  - Simple image processing
  - Extensibility
  - (Doesn't) "Out-Igor" Igor
- What do you get?
  - Timeliness
  - Configurability





# Workflow

The screenshot displays the Aquaman software interface, which is used for managing beamline workflows. The interface is divided into several sections:

- Workflow Management:** A central panel titled "Workflow" showing a list of "Completed Actions" and "Upcoming Actions". The "Completed Actions" table includes columns for Action, Status, Finished, and Duration. The "Upcoming Actions" section shows a queue of 7 actions, including XAS scans and sample movements.
- Current Action:** A section for the "Current Action: Scan Action", showing a progress bar at 0% and a duration of 0:17. It includes buttons for Pause, Skip, and Cancel.
- SGM Beamline Control:** A panel on the right for controlling the SGM beamline, featuring buttons for Beam On/Off, Emergency Motor Stop, Close Vacuum, and Visible Light. It also displays energy settings (280.20 eV) and a plot of the beamline's position.
- Navigation and Status:** A sidebar on the left contains navigation menus for Beamline Control, Detectors, Experiment Setup, and Data. A status bar at the bottom indicates the system is "[Running]" with a progress bar and an alert message.

- What does it do?
- Automates beamline actions
- Scans, sample moves, beamline movements
- Runs requested items, indicates progress, reports problems



# Workflow

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- Workflow Management:** A central panel showing a list of completed actions and upcoming actions. The completed actions table includes columns for Action, Status, Finished, and Duration. The upcoming actions section shows a queue of tasks to be performed.
- Current Action:** A section for the active task, showing its progress (0:17 / 0%) and controls for Pause, Skip, and Cancel.
- SGM Beamline Control:** A panel on the right for controlling the beamline, including buttons for Beam On/Off, Emergency Motor Stop, Close Vacuum, and Visible Light. It also displays energy levels (280.20 eV) and various detector settings.
- Alerts:** A status bar at the bottom right shows an alert: "Alert: in [AMProcessVariableSupport]: AMProcessVariable: channel c...".

- What does it do?
- Automates beamline actions
- Scans, sample moves, beamline movements
- Runs requested items, indicates progress, reports problems
- What do you get?
- “Brew Mode”
- Reduce “4 am” errors



# Managing Acquaman





# Managing Acquaman

- Keeping Acquaman modular, scalable, and flexible



# Managing Acquaman

- Keeping Acquaman modular, scalable, and flexible
- As a code framework
  - Use good design patterns
  - Always aim for the best of both worlds



# Managing Acquaman

- Keeping Acquaman modular, scalable, and flexible
- As a code framework
  - Use good design patterns
  - Always aim for the best of both worlds
- As a development community
  - Foster a group environment
  - Invest in mentorship
  - Develop good practices
  - Encourage new ideas



# Case Study - IDEAS



# Case Study - IDEAS

- The Background



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- The Background
  - IDEAS is a hard X-ray beamline focusing on absorption spectroscopy



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  - He asks “how hard would it be to get Aquaman on IDEAS?”





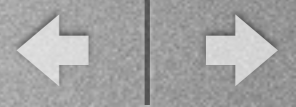
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  - David Muir had just been assigned as part time Science Associate
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- The Task



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- The Background
  - IDEAS is a hard X-ray beamline focusing on absorption spectroscopy
  - David Muir had just been assigned as part time Science Associate
  - He asks “how hard would it be to get Aquaman on IDEAS?”
- The Task
  - Implement application, beamline with mono & shutters, ion chamber detectors, XAS scan, and custom views



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- The Background
  - IDEAS is a hard X-ray beamline focusing on absorption spectroscopy
  - David Muir had just been assigned as part time Science Associate
  - He asks “how hard would it be to get Acquaman on IDEAS?”
- The Task
  - Implement application, beamline with mono & shutters, ion chamber detectors, XAS scan, and custom views
  - And all of the Acquaman core features - data management, workflow, analysis, etc.



# Case Study - IDEAS

- The Background
  - IDEAS is a hard X-ray beamline focusing on absorption spectroscopy
  - David Muir had just been assigned as part time Science Associate
  - He asks “how hard would it be to get Acquaman on IDEAS?”
- The Task
  - Implement application, beamline with mono & shutters, ion chamber detectors, XAS scan, and custom views
  - And all of the Acquaman core features - data management, workflow, analysis, etc.
- The Project



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- The Background
  - IDEAS is a hard X-ray beamline focusing on absorption spectroscopy
  - David Muir had just been assigned as part time Science Associate
  - He asks “how hard would it be to get Acquaman on IDEAS?”
- The Task
  - Implement application, beamline with mono & shutters, ion chamber detectors, XAS scan, and custom views
  - And all of the Acquaman core features - data management, workflow, analysis, etc.
- The Project
  - Planning: developing task list with David M, Darren, and David C ~1 day



# Case Study - IDEAS

- The Background
  - IDEAS is a hard X-ray beamline focusing on absorption spectroscopy
  - David Muir had just been assigned as part time Science Associate
  - He asks “how hard would it be to get Acquaman on IDEAS?”
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  - Implement application, beamline with mono & shutters, ion chamber detectors, XAS scan, and custom views
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  - Execution: implementing and testing by Darren and David C ~2 days



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  - Planning: developing task list with David M, Darren, and David C ~1 day
  - Execution: implementing and testing by Darren and David C ~2 days
  - Outcome: functioning XAS scans & interface & Ketek ~1600 lines



# Case Study - SXRMB





# Case Study - SXRMB

- The Background



# Case Study - SXRMB

- The Background
  - SXRMB was an existing “medium” X-ray beamline



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  - Implement application, full beamline, point & spectral detectors, XAS scans, 2D mapping, and custom views



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  - Three distinct endstations: 2D microprobe, vacuum XAS, and ambient



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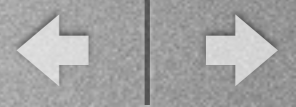
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  - Planning: developing task list with beamline, Darren, and David C ~3 days



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  - P I: beamline & 2D mapping by Darren & David C ~4 days 5500 lines



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  - Implement application, full beamline, point & spectral detectors, XAS scans, 2D mapping, and custom views
  - Three distinct endstations: 2D microprobe, vacuum XAS, and ambient
- The Project
  - Planning: developing task list with beamline, Darren, and David C ~3 days
  - P 1: beamline & 2D mapping by Darren & David C ~4 days 5500 lines
  - P 2: vacuum & ambient upgrade by Darren & Sheldon ~7 days 5000 lines



# Conclusion

- Acquaman is purpose-built to help users
  - Focus on making the user's life easy, comfortable, and maybe even fun
- Acquaman is focused on user requirements
  - Data, visualization, scans
  - Optimized to support required techniques (XAS, mapping)
  - Specific customizations can grow into new general tools
- Acquaman keeps growing
  - Support more user needs
  - Support more beamline staff needs
  - Make it as easy as possible for programmers



# Questions