

Software for device controlling and data reduction in TAKUMI

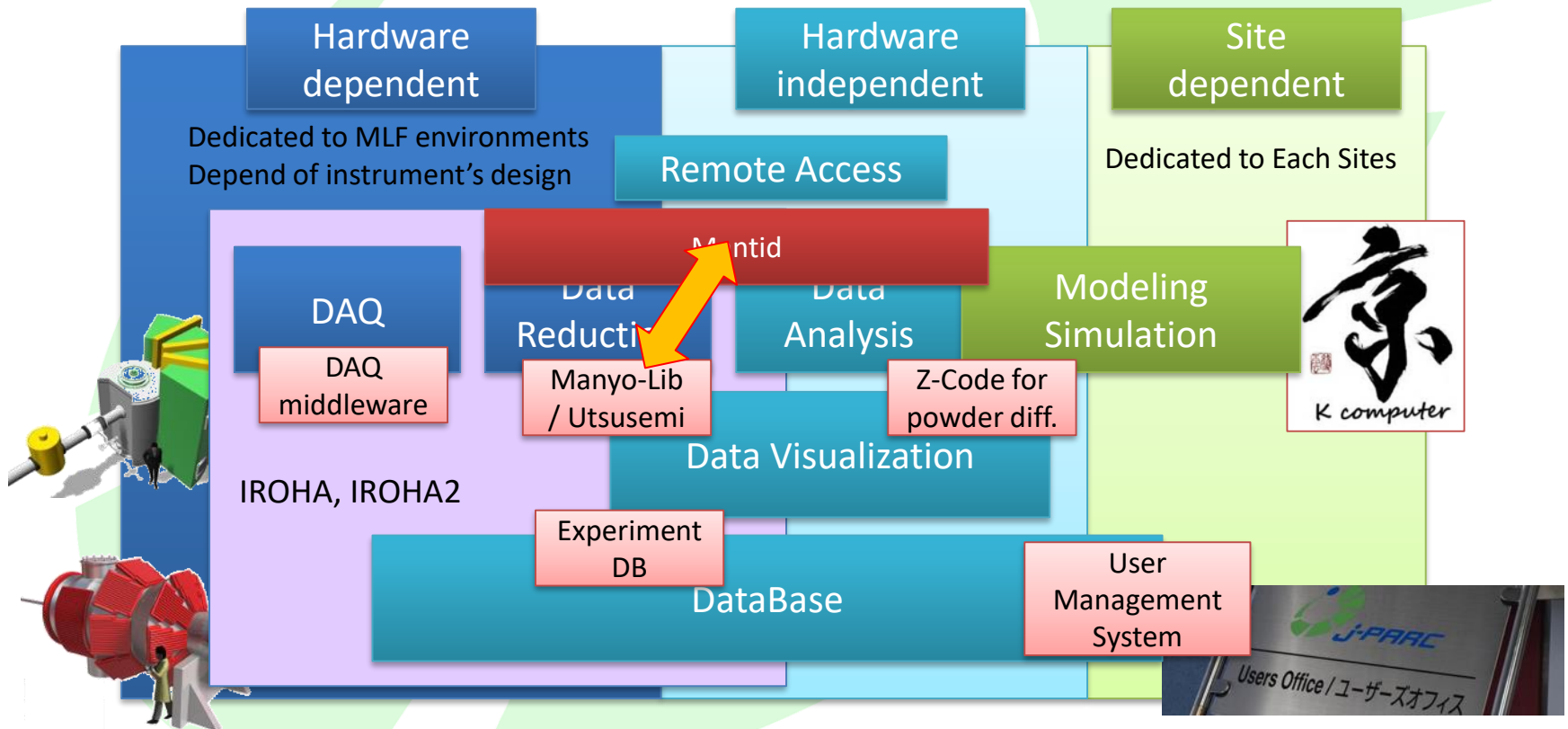
Takuro KAWASAKI, Stefanus HARJO

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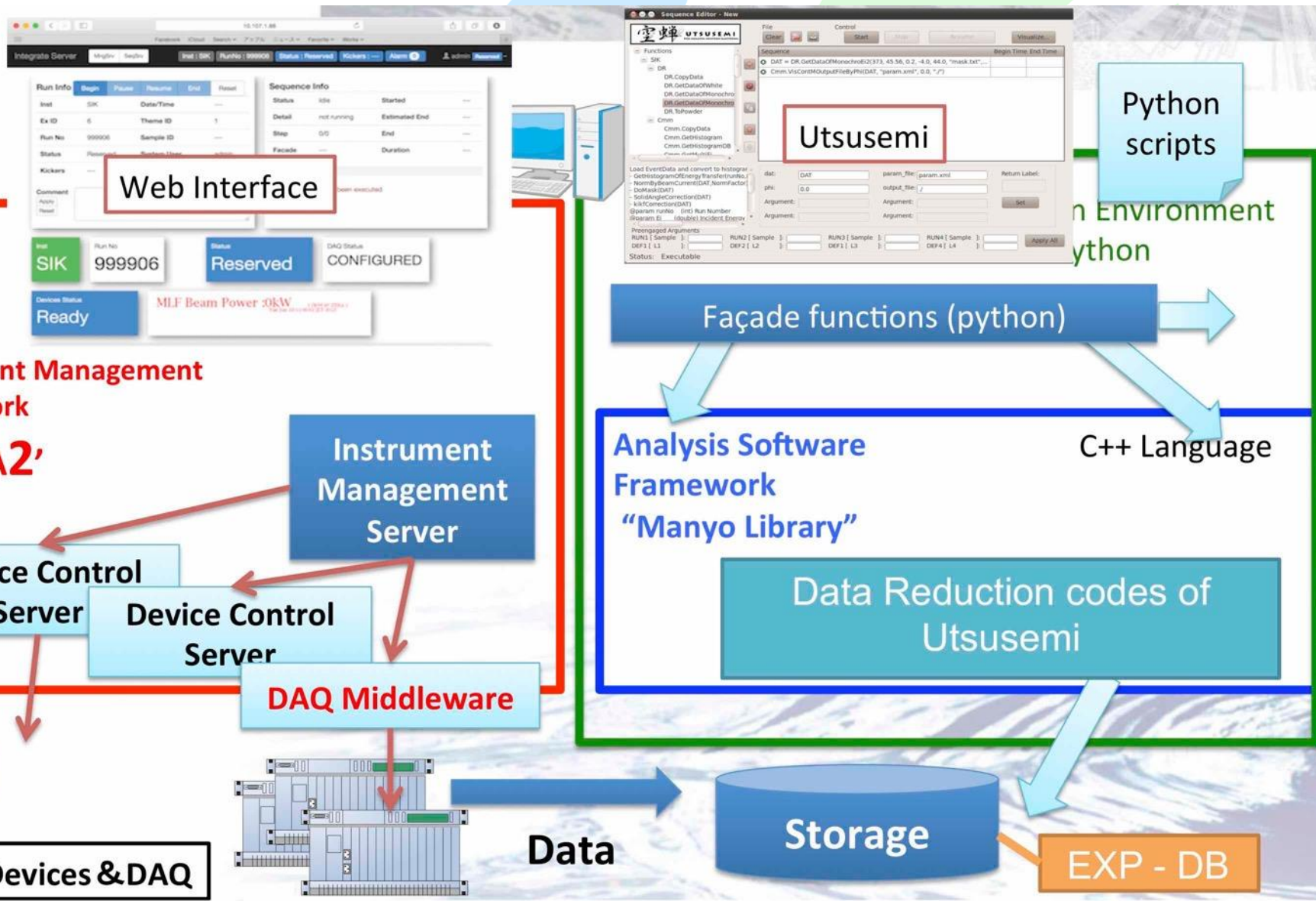
J-PARC Center, JAEA

Components of MLF software

- Hardware dependent software have been developed by MLF



Structure of 'Instrument Software'



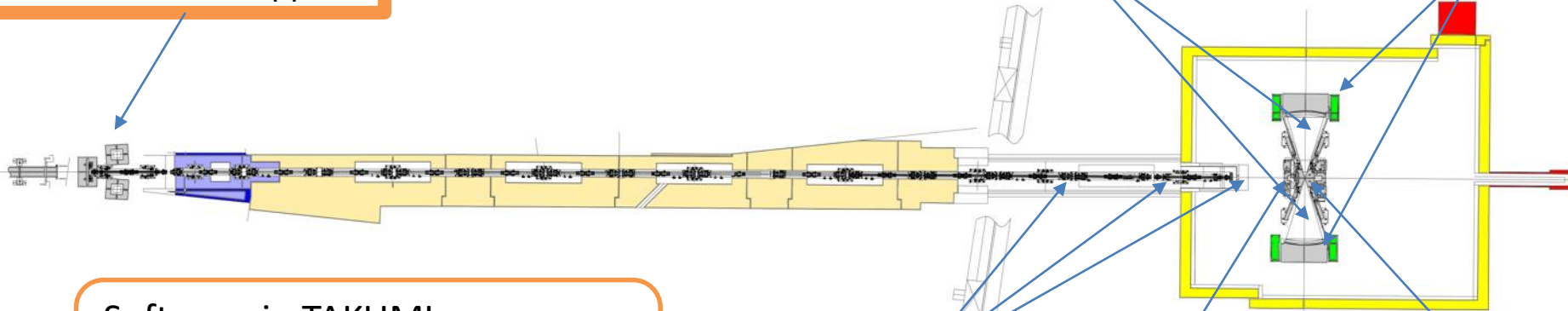
Components & devices in TAKUMI



Band Width Chopper

Radial Collimators

Detectors



Beam Slits

Sample Stage

Sample Env. Devices

Software in TAKUMI

Control

- Meas. Controlling GUI
- IROHA2 Framework
- DAQ middleware
- HiTTs -> loading

Data reduction

- Emaki-GUI
- Utsusemi
- Manyo-Lib

Loading machine

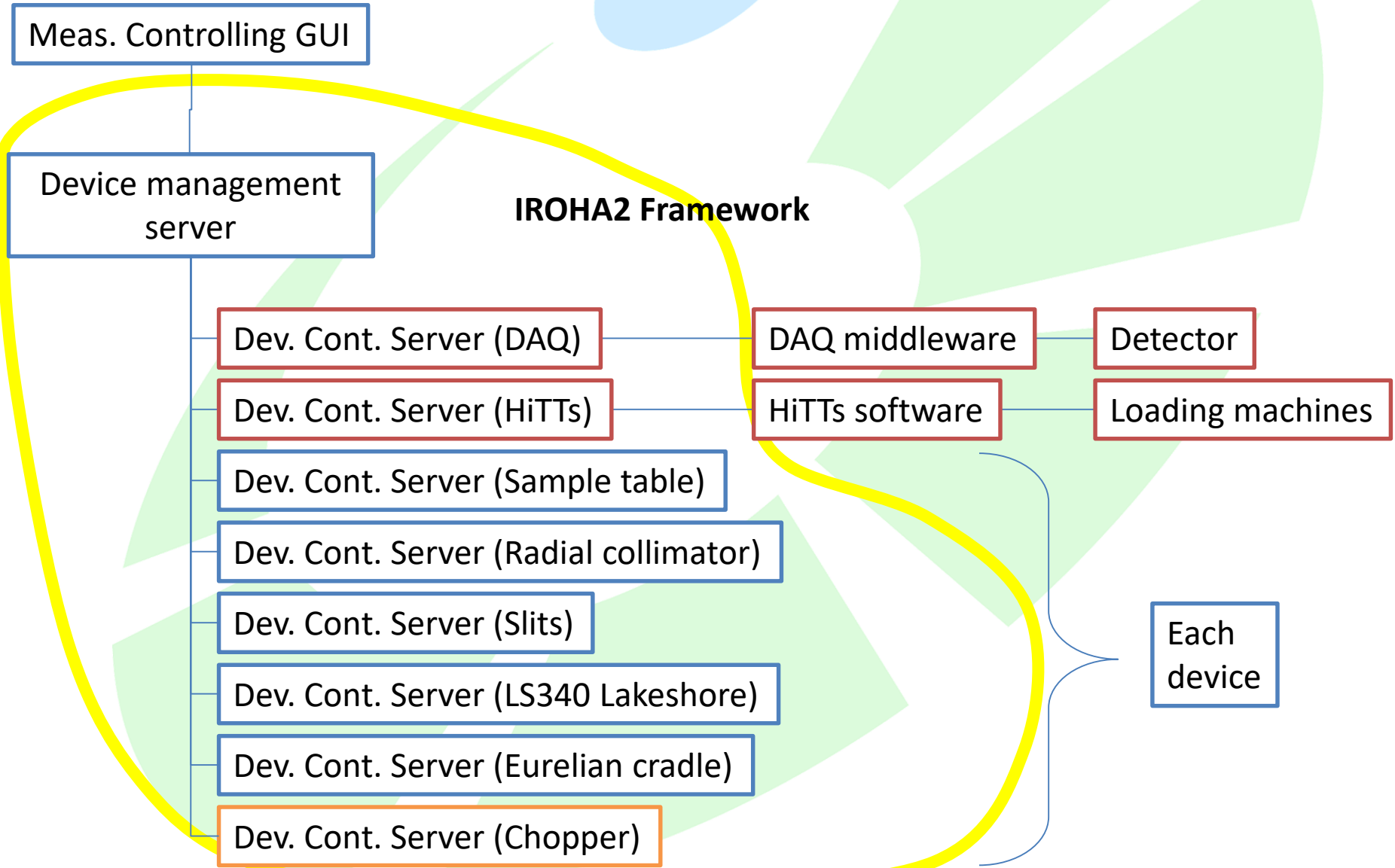


Furnace



Etc.

Structure of software in TAKUMI



Software for loading machine in TAKUMI

- HiTTS -

HiTTS

File Edit View Run

Register Delete Save Condition Input Step Start Stop Manage Exit Info.

Machine type: TAKUMI Low Temperature High Temperature

Condition: TRIP Highgamma RT cyclictensi Comment: TRIP cyclic tensile RT

Step cnt.: 56 Repeat cnt.: 5 Load range: 10000 Input Ch.: Ch1

Repeat start: 51 Time unit: Minute

		Step											
		1	2	3	4	5	6	7	8	9	10	11	
Output	Gas substitution												
	Temp. control	Target temp.(C)											
	Load axis	Load slope(N/sec)		30			30			30			30
		Speed(mm/min)			0.01			0.01			0.01		
EL slope(ppm/sec)													
Watch	Time(sec)	900		0.1	300		0.1	300		0.1	300		
	Temp.(C)												
	Load(N)		600			1200			1800			2400	
	Disp.(mm)												
Alarm	Time(sec)												
	Temp.(C)												
	Load(N)												
	Disp.(mm)	>2	>2	>2	>8	>8	>8	>8	>8	>8	>12	>12	
Input	Wave												
	Sampling trigger	Time(sec)	Time(sec)	Time(sec)	Time(sec)	Time(sec)	Time(sec)	Time(sec)	Time(sec)	Time(sec)	Time(sec)	Time(sec)	
	Interval	1	1	1	1	1	1	1	1	1	1	1	

Realtime monitor

Standard parameter

Load: 42.8 N

Disp.: 0.019 mm

Elongation: -0.003 mm

CV-5700: Unconnect mm

EL.1: -3.30 ppm

EL.2: -0.02 ppm

EL.Ave: -1.66 ppm

Temperature: Unconnect C

Step: 1 Step

Repeat count: 1 Count

Step elapsed: 0.00 sec

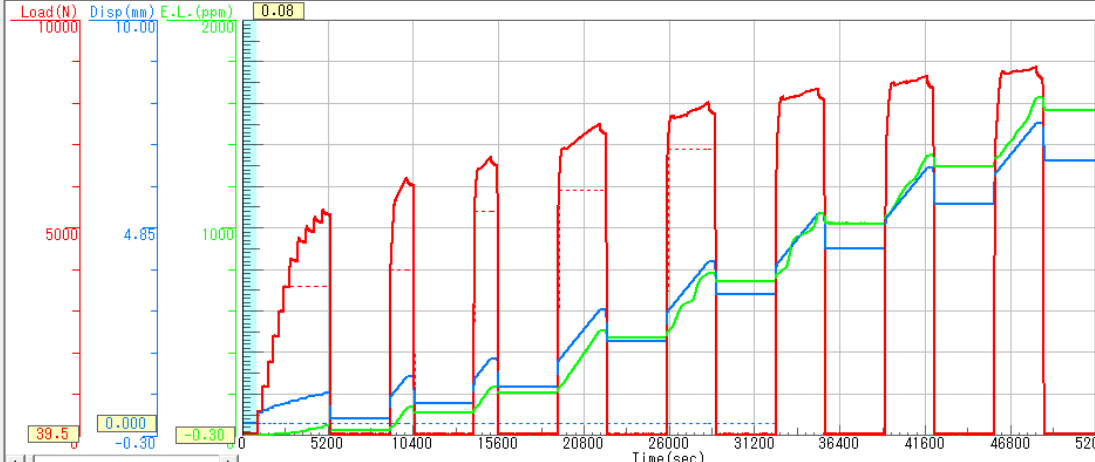
Pattern elapsed: 0.00 sec

Total elapsed: 0.00 sec

Sampling count: 49438 Count

PID settings

Max	P(°C)	I(sec)	D(sec)
900	Area4: 800	10	1
600	Area3: 600	10	1
300	Area2: 400	10	1
Min	Area1: 200	10	1



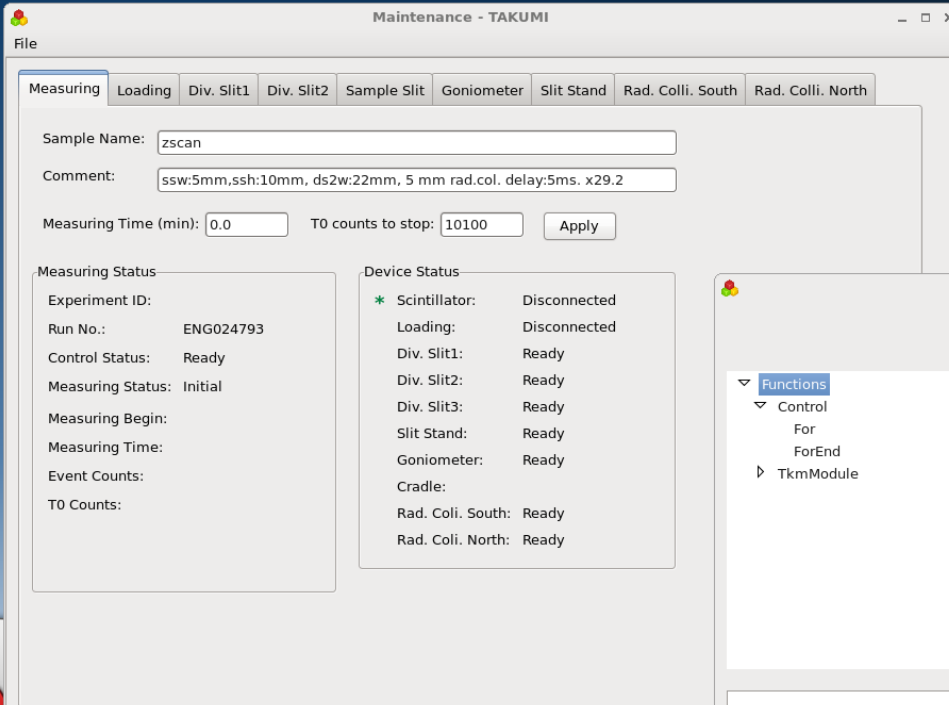
Message: The examination ended.

CAPS NUM INS SCRL 10:02 6/11/2018 1A

- ✓ Load control
- ✓ Displacement control
- ✓ Strain control (extensometer, strain gauge)
- ✓ Heating control
- ✓ Cyclic

GUI for Device Controlling

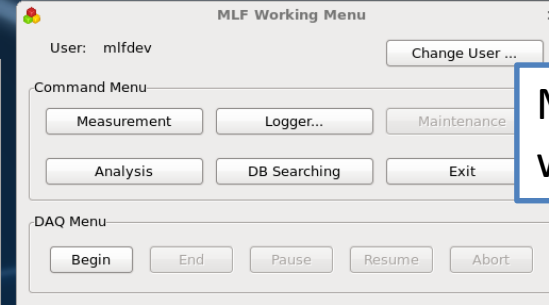
Main window



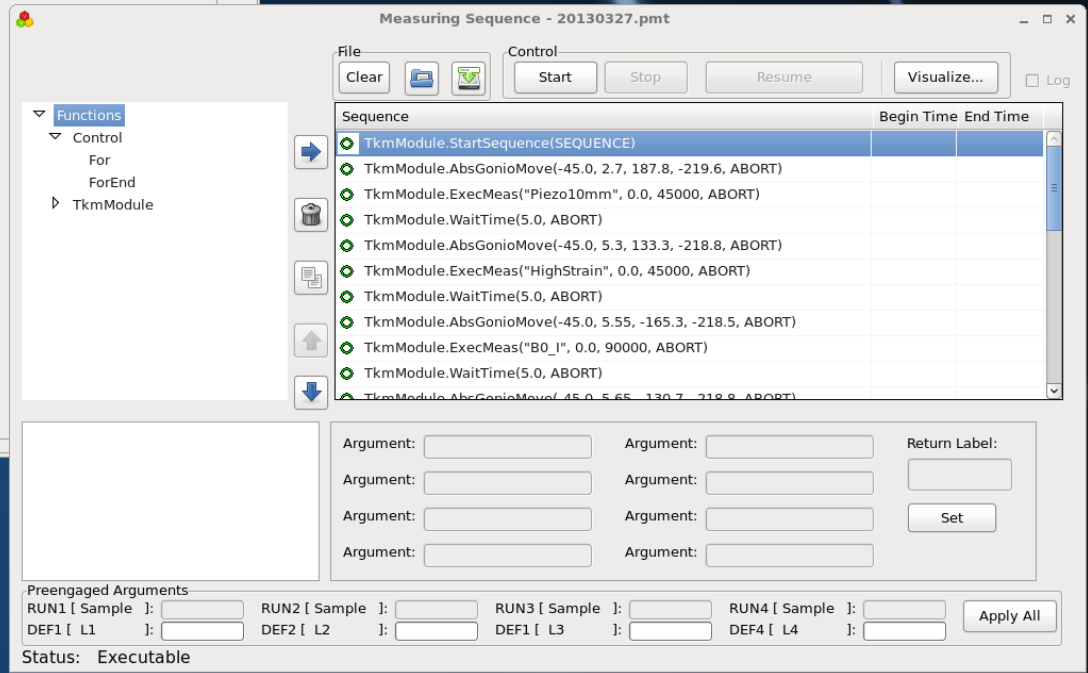
The main window displays various control parameters and device status. It includes a menu bar with options like Measuring, Loading, Div. Slit1, Div. Slit2, Sample Slit, Goniometer, Slit Stand, Rad. Colli. South, and Rad. Colli. North. Below the menu, there are input fields for Sample Name (zscan), Comment (ssw:5mm,ssh:10mm, ds2w:22mm, 5 mm rad.col. delay:5ms. x29.2), Measuring Time (0.0), and T0 counts to stop (10100). A table shows the status of various components:

Measuring Status	Device Status
Experiment ID: ENG024793	* Scintillator: Disconnected
Run No.: ENG024793	Loading: Disconnected
Control Status: Ready	Div. Slit1: Ready
Measuring Status: Initial	Div. Slit2: Ready
Measuring Begin:	Div. Slit3: Ready
Measuring Time:	Slit Stand: Ready
Event Counts:	Goniometer: Ready
T0 Counts:	Cradle:
	Rad. Colli. South: Ready
	Rad. Colli. North: Ready

Management window



The management window shows the user (mlfdev) and provides a Command Menu with buttons for Measurement, Logger..., Maintenance, Analysis, DB Searching, and Exit. It also includes a DAQ Menu with buttons for Begin, End, Pause, Resume, and Abort.



The sequence window displays a list of functions to be executed in a predetermined order. The functions include:

- TkmModule.StartSequence(SEQUENCE)
- TkmModule.AbsGonioMove(-45.0, 2.7, 187.8, -219.6, ABORT)
- TkmModule.ExecMeas("Piezo10mm", 0.0, 45000, ABORT)
- TkmModule.WaitTime(5.0, ABORT)
- TkmModule.AbsGonioMove(-45.0, 5.3, 133.3, -218.8, ABORT)
- TkmModule.ExecMeas("HighStrain", 0.0, 45000, ABORT)
- TkmModule.WaitTime(5.0, ABORT)
- TkmModule.AbsGonioMove(-45.0, 5.55, -165.3, -218.5, ABORT)
- TkmModule.ExecMeas("B0_I", 0.0, 90000, ABORT)
- TkmModule.WaitTime(5.0, ABORT)
- TkmModule.AbsGonioMove(-45.0, 5.65, 130.7, -218.8, ABORT)

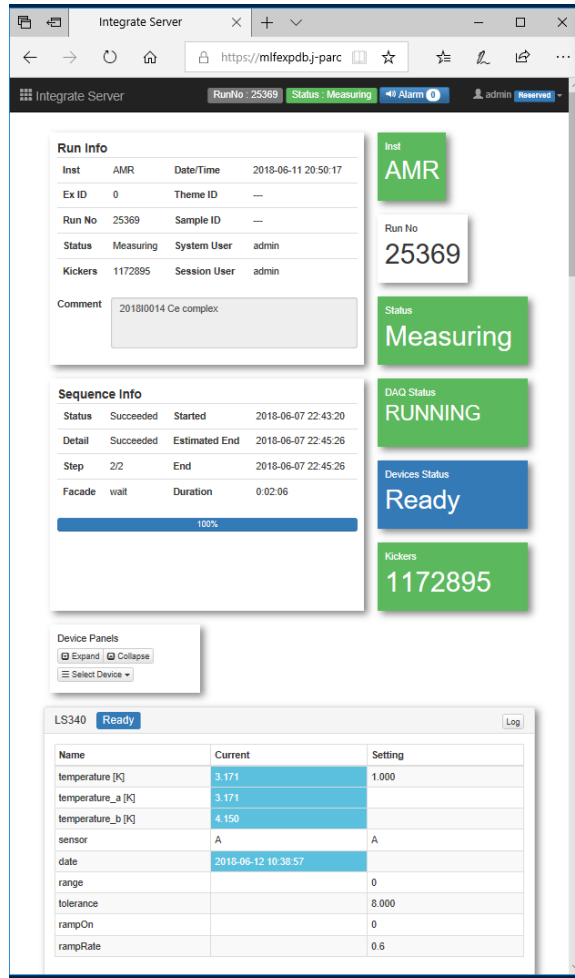
Below the list, there are input fields for arguments and a Return Label, along with a Set button. At the bottom, there are preengaged arguments for RUN1 through RUN4 and DEF1 through DEF4, and an Apply All button. The status is shown as Executable.

Sequence window

→ Automatic control in a predetermined order

Instrument control from the web browser (IROHA2)

BL01, BL14



Run Info

Inst	AMR	Date/Time	2018-06-11 20:50:17
Ex ID	0	Theme ID	---
Run No	25369	Sample ID	---
Status	Measuring	System User	admin
Kickers	1172895	Session User	admin

Inst
AMR

Run No
25369

Status
Measuring

Sequence Info

Status	Succeeded	Started	2018-06-07 22:43:20
Detail	Succeeded	Estimated End	2018-06-07 22:45:26
Step	2/2	End	2018-06-07 22:45:26
Facade	wait	Duration	0:02:06

DAQ Status
RUNNING

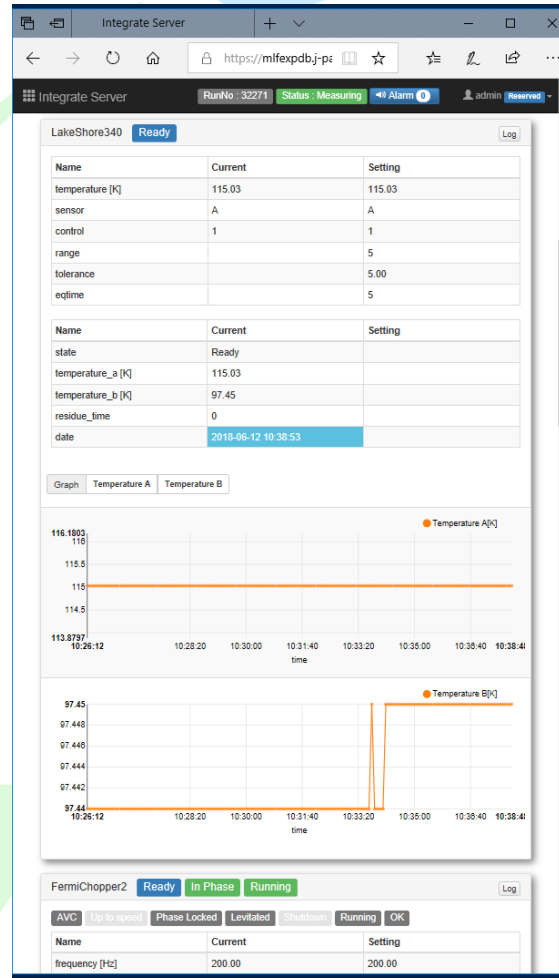
Devices Status
Ready

Kickers
1172895

Device Panels
Expand Collapse
Select Device

LS340 Ready

Name	Current	Setting
temperature [K]	3.171	1.000
temperature_a [K]	3.171	
temperature_b [K]	4.150	
sensor	A	A
date	2018-06-12 10:38:57	
range	0	
tolerance		8.000
rampOn	0	
rampRate		0.6



LakeShore340 Ready

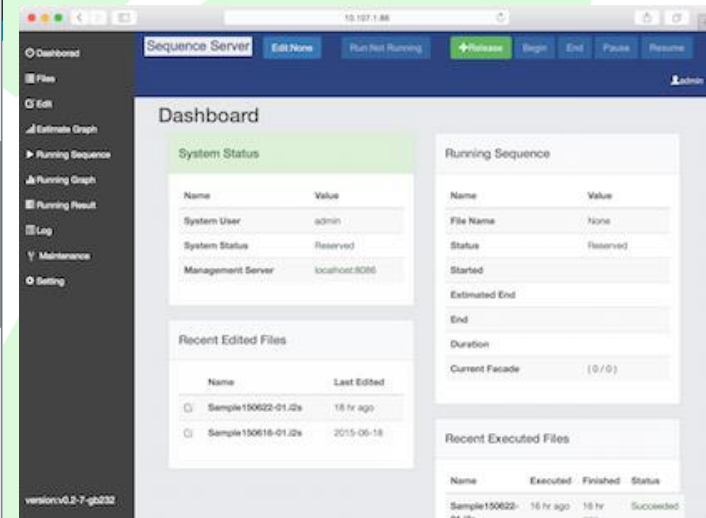
Name	Current	Setting
temperature [K]	115.03	115.03
sensor	A	A
control	1	1
range		5
tolerance		5.00
eqtime		5

Name	Current	Setting
state	Ready	
temperature_a [K]	115.03	
temperature_b [K]	97.45	
residue_time	0	
date	2018-06-12 10:38:53	

Graph Temperature A Temperature B

FermiChopper2 Ready In Phase Running

Name	Current	Setting
frequency [Hz]	200.00	200.00



Sequence Server

Dashboard

System Status

Name	Value
System User	admin
System Status	Reserved
Management Server	localhost:8080

Running Sequence

Name	Value
File Name	None
Status	Reserved
Started	
Estimated End	
End	
Duration	
Current Facade	(0/0)

Recent Edited Files

Name	Last Edited
Sample150622-01.i2s	18 hr ago
Sample150618-01.i2s	2015-06-18

Recent Executed Files

Name	Executed	Finished	Status
Sample150622-	16 hr ago	16 hr	Succeeded

IROHA2 Sequence Server



IROHA2 Integrated Control Server

Enable to see the user experimental situations from out site of J-PARC, MLF

Run Info

Inst	SCD	Date/Time	2018-06-12 10:24:31
Ex ID	0000	Theme ID	---
Run No	10113	Sample ID	---
Status	Measuring	System User	admin
Kickers	11175	Session User	admin

Comment: Kaneko

Sequence Info

Status	Succeeded	Started	2018-06-12 09:57:44
Detail	Succeeded	Estimated End	2018-06-12 09:59:54
Step	0/4	End	---
Facade	daq_run	Duration	0:00:00

Inst
SCD

Run No
10113

Status
Measuring

DAQ Status
RUNNING

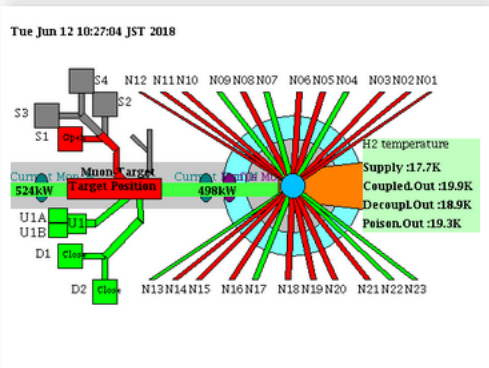
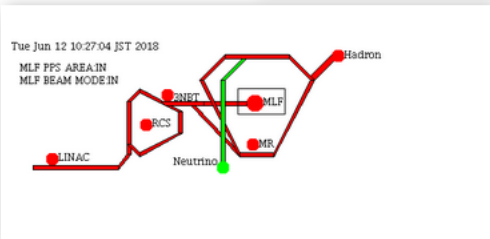
Devices Status
Ready

Kickers
11175

Configuration
PiezoGonio



MLF Beam Power : 524kW
Tue Jun 12 10:27:04 JST 2018

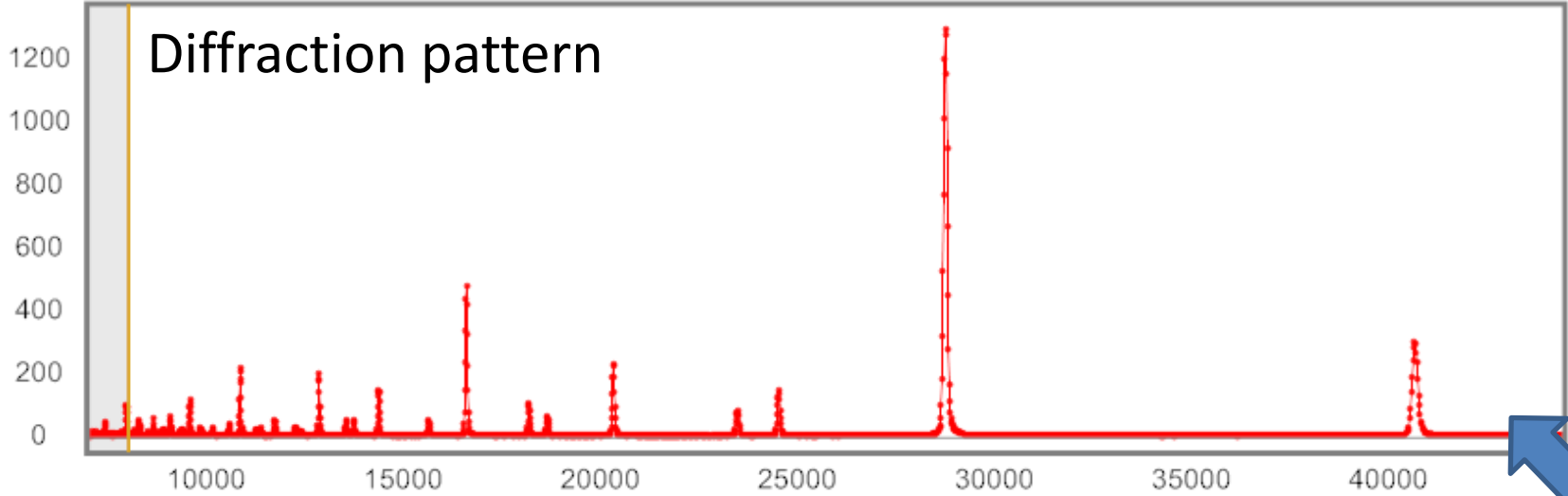


T0 Ready
Log Edit

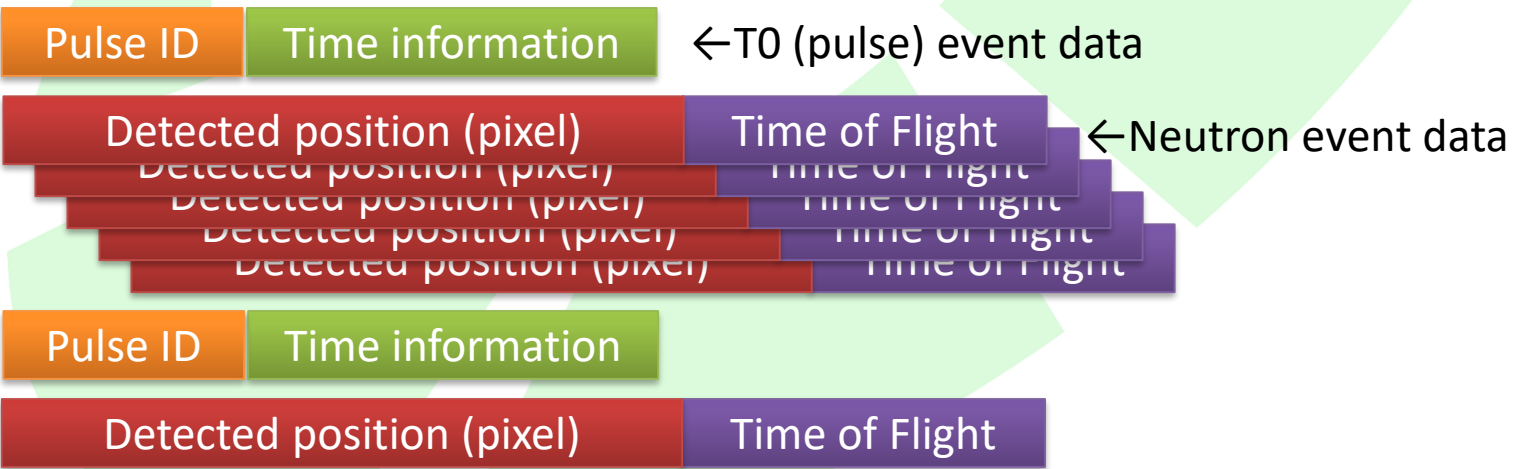
Current	
type	T0
status	Ready
state	Ready
operation	Running

Setting		Apply	Cancel	Reset Fields
frequency [Hz]	50.00	<input type="text" value="50.00"/>		
phase_delay [us]	0.0	<input type="text" value="0.0"/>		
phase_error_tolerance [us]	11.1	<input type="text" value="11.1"/>		

Event data format for data acquisition

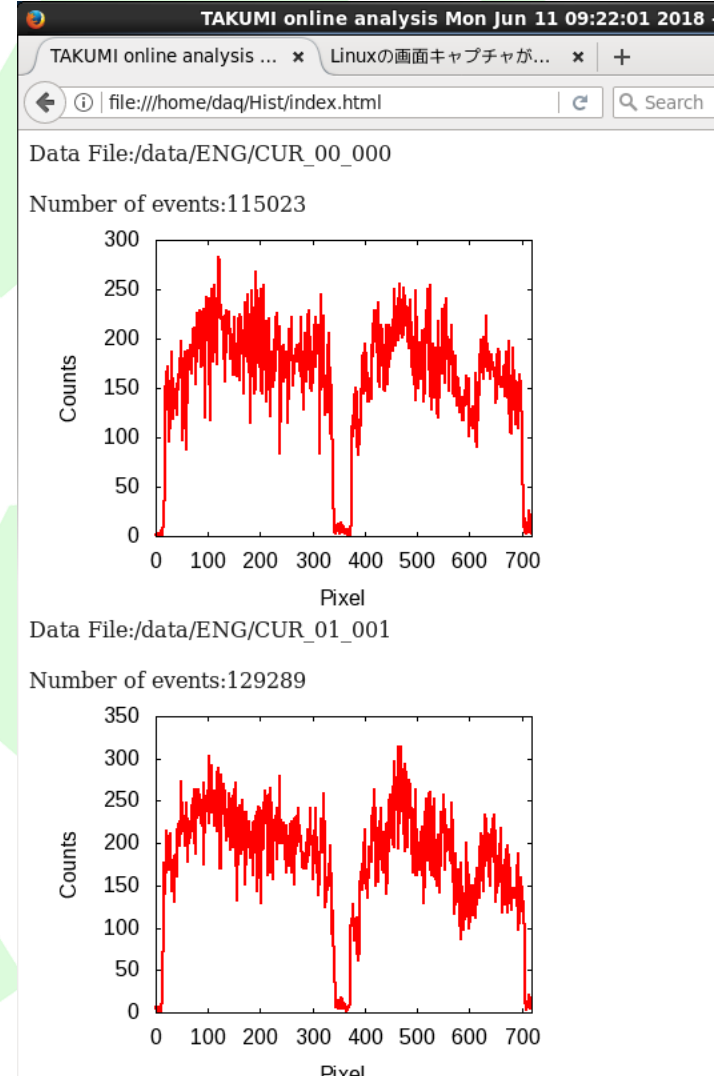
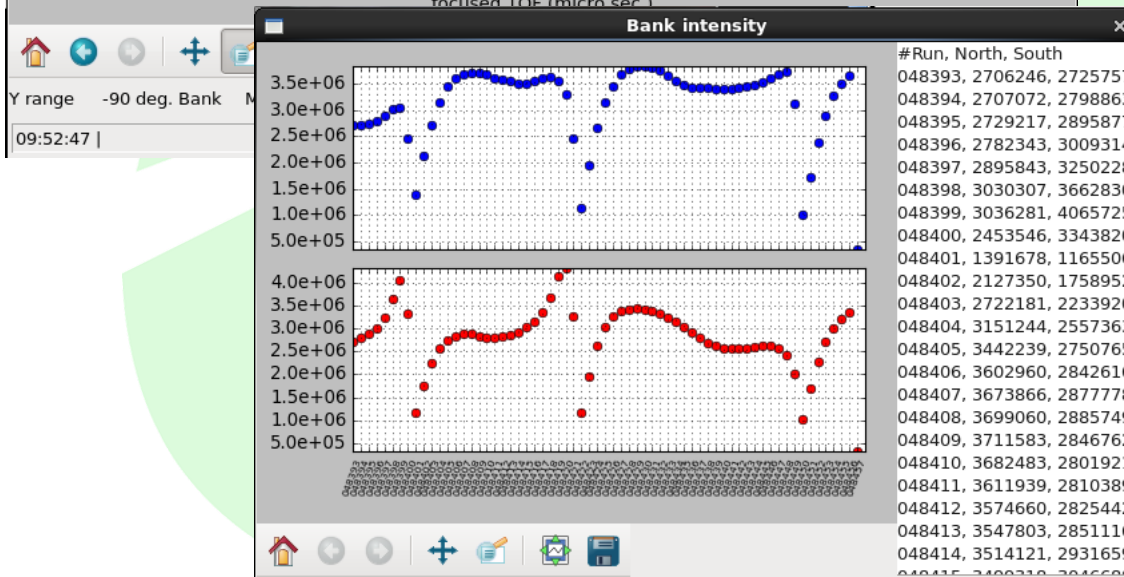
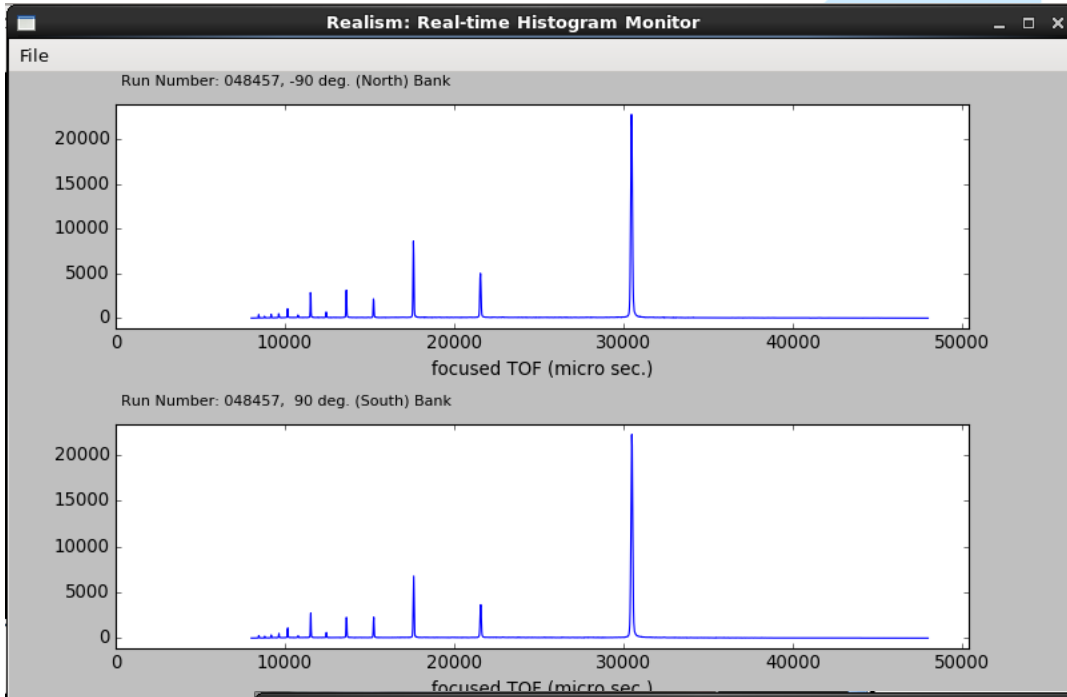


Using dedicated software

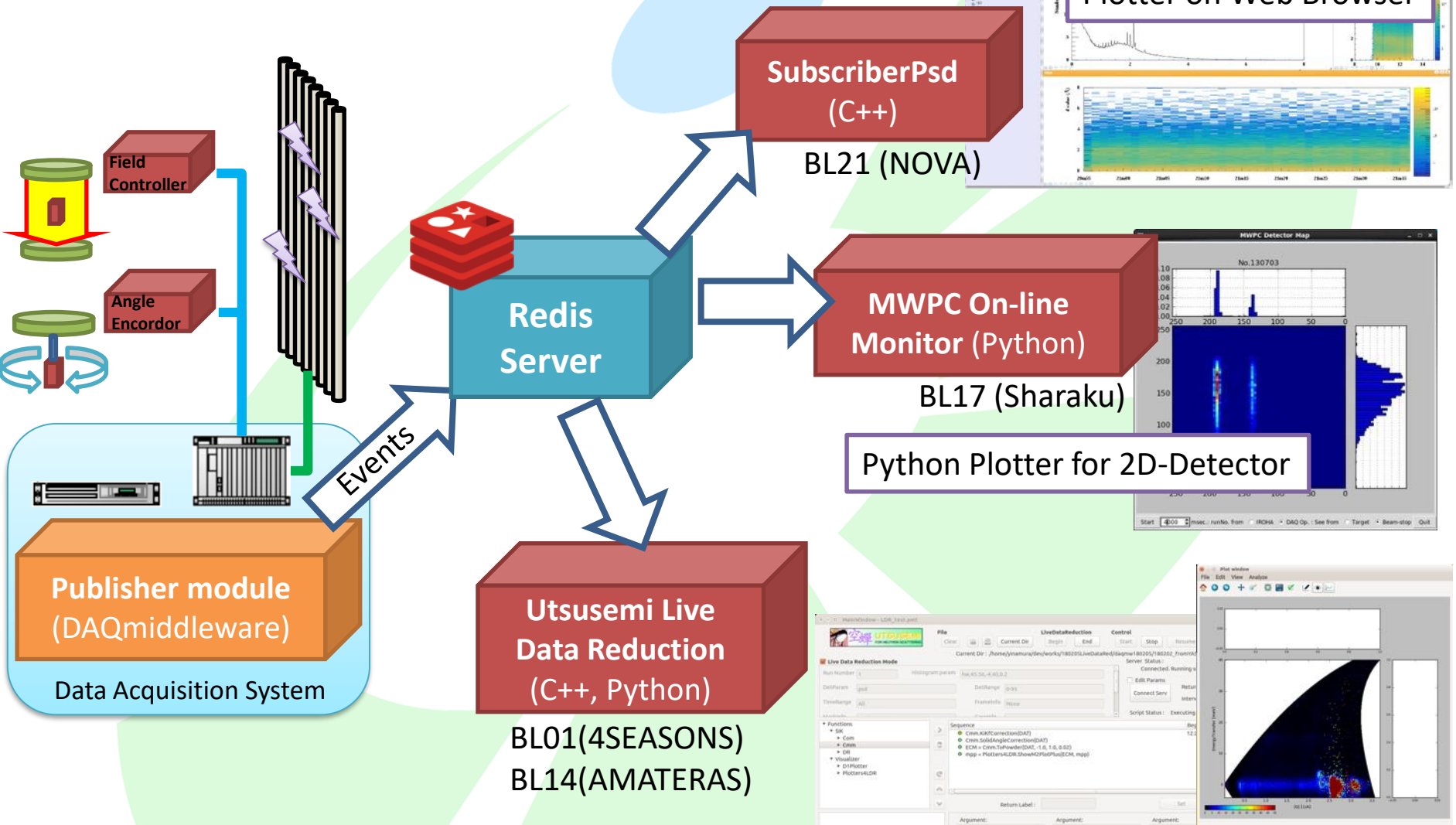


Data file recorded in PC

Real time histogram monitor / online monitor

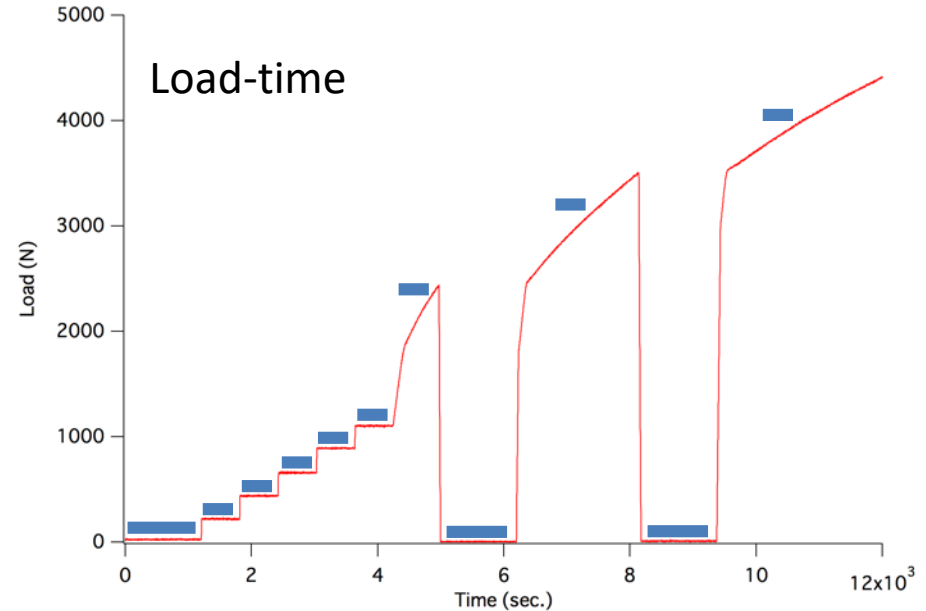
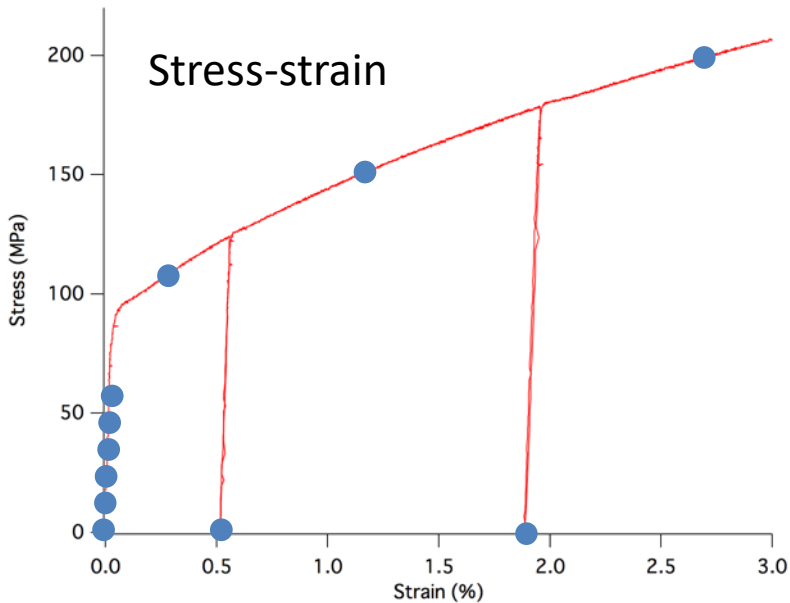


Active LDR systems in MLF



Enable to control a sequence of data reduction commands and to change their parameters during an inelastic measurement

Time division data processing based on sample environment information

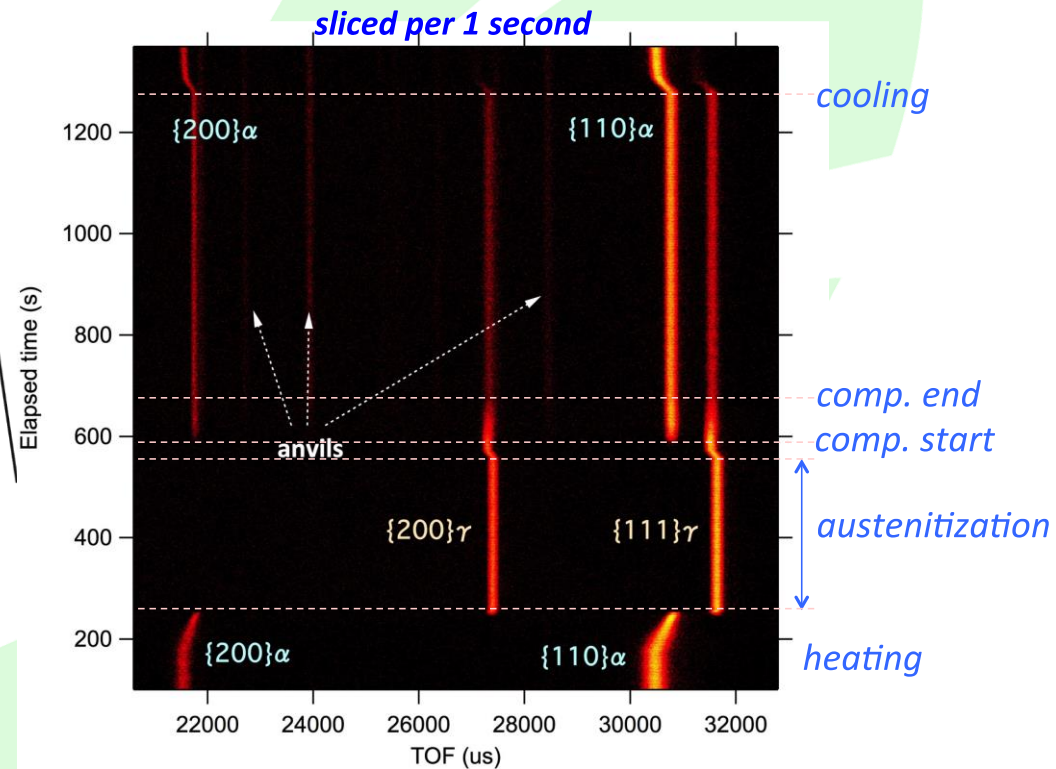
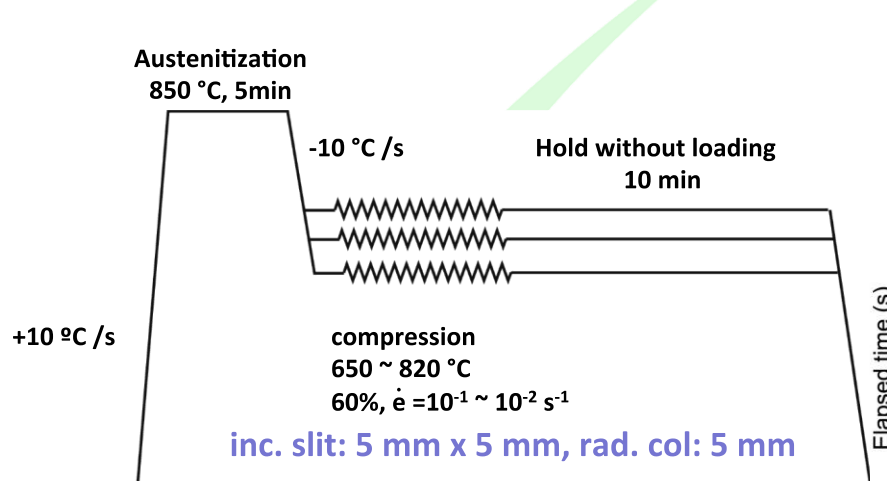


- ✓ Referring to the sample environment information recorded together with the neutron diffraction intensity data and the start time
- ✓ Extract neutron event of time corresponding to desired environmental condition
- ✓ Reduction to diffraction pattern

After completion of the measurement, neutron diffraction patterns divided at arbitrary time width can be created any times.

An example of time division data reduction

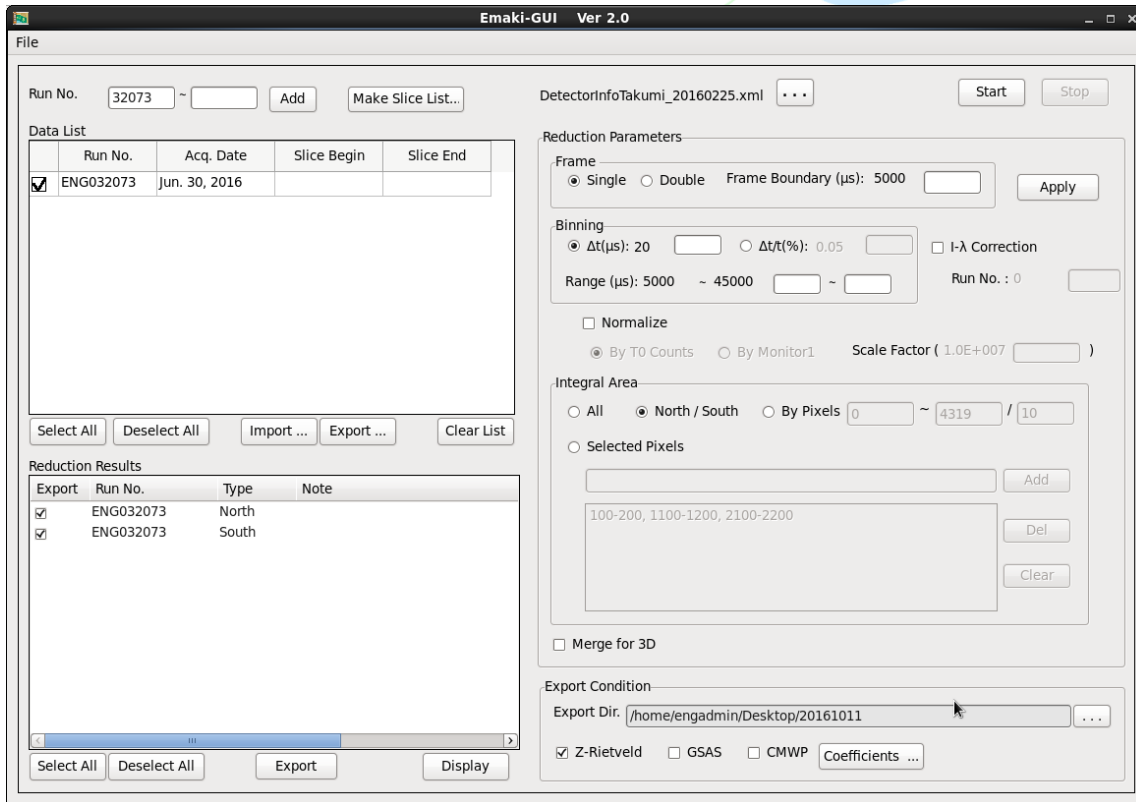
In situ measurement during thermo-mechanical treatment



- ✓ Complex pattern of test
- ✓ Setting time division pattern is bit complicated

- Time division for reduction $> \sim 1\text{ sec.}$
- $5 \times 5 \times 5\text{ mm}^3$ of steel sample
- Beam power: 500 kW

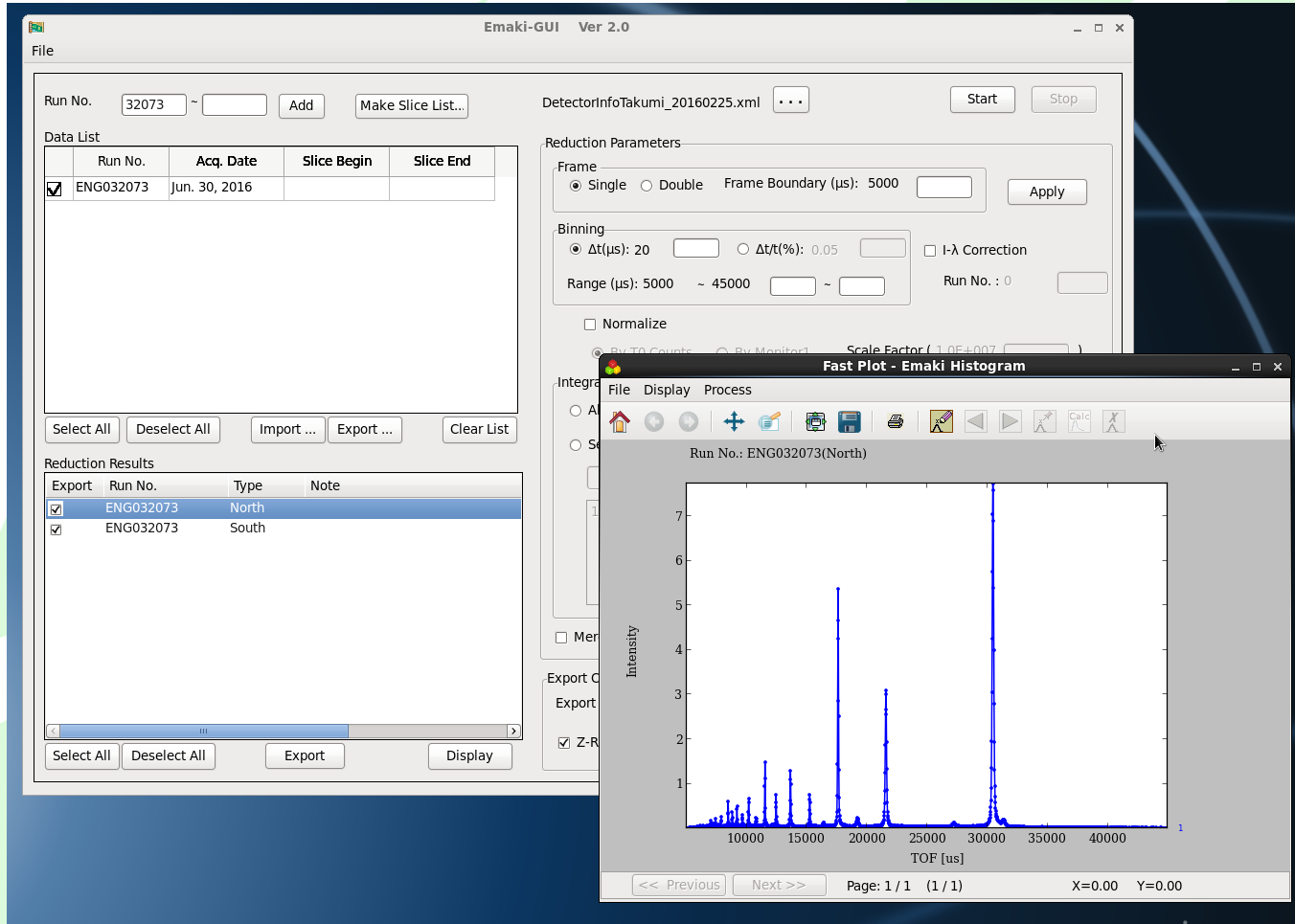
Data reduction software in TAKUMI Emaki-GUI



- ✓ Time binning, frame width, phase boundary
- ✓ Normalization: time, spectrum
Detector range
- ✓ No need for command entry, script rewriting, etc.
- ✓ Various data format: Rietveld, CMWP

We have developed the windows version and distributed to users with the installer

Data reduction software in TAKUMI Emaki-GUI



The screenshot displays the Emaki-GUI Ver 2.0 interface. The main window is titled "Emaki-GUI Ver 2.0" and contains several panels:

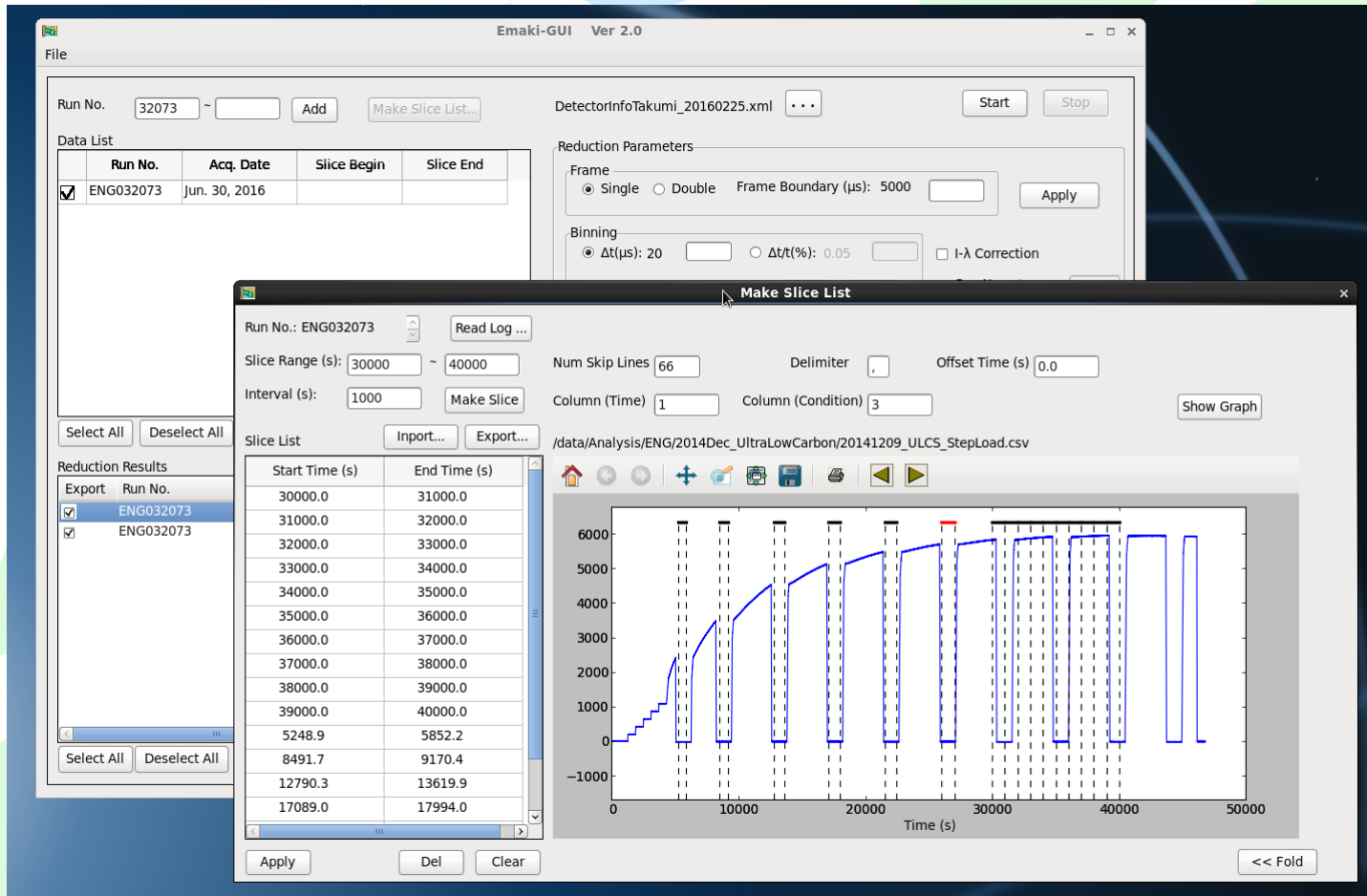
- Run No.:** 32073 ~ [] Add Make Slice List...
- DetectorInfoTakumi_20160225.xml** [] Start Stop
- Data List:**

	Run No.	Acq. Date	Slice Begin	Slice End
<input checked="" type="checkbox"/>	ENG032073	Jun. 30, 2016		
- Reduction Parameters:**
 - Frame: Single Double Frame Boundary (μ s): 5000 [] Apply
 - Binning: Δt (μ s): 20 [] $\Delta t/t$ (%): 0.05 [] I- λ Correction
 - Range (μ s): 5000 ~ 45000 [] ~ [] Run No. : 0 []
 - Normalize
- Reduction Results:**

Export	Run No.	Type	Note
<input checked="" type="checkbox"/>	ENG032073	North	
<input checked="" type="checkbox"/>	ENG032073	South	

An inset window titled "Fast Plot - Emaki Histogram" shows a plot of Intensity versus TOF [μ s]. The plot title is "Run No.: ENG032073(North)". The x-axis ranges from 10000 to 40000 μ s, and the y-axis ranges from 0 to 7. The plot shows a series of peaks, with the most prominent peak at approximately 30000 μ s. The plot includes a toolbar with various navigation and analysis tools.

Data reduction software in TAKUMI Emaki-GUI



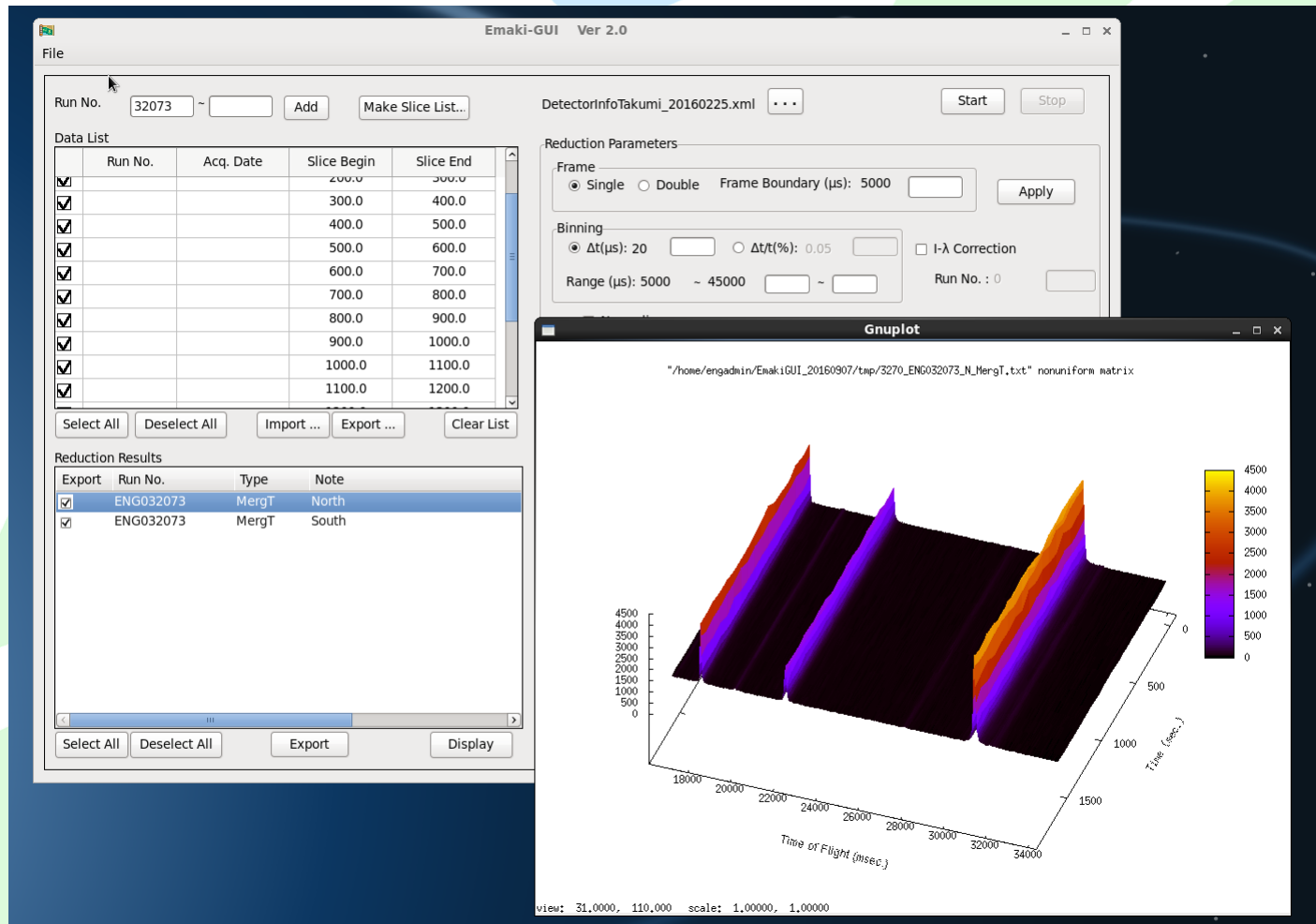
The screenshot displays the Emaki-GUI software interface, version 2.0. The main window shows the 'Data List' and 'Reduction Parameters' sections. The 'Data List' contains one entry for Run No. ENG032073, Acq. Date Jun. 30, 2016. The 'Reduction Parameters' section includes options for Frame (Single, Double) and Binning ($\Delta t(\mu\text{s})$, $\Delta t(\%)$, I- λ Correction).

A 'Make Slice List' dialog box is open, showing the 'Slice Range (s)' from 30000 to 40000, 'Interval (s)' of 1000, and 'Num Skip Lines' of 66. The 'Slice List' table below shows the resulting time intervals:

Start Time (s)	End Time (s)
30000.0	31000.0
31000.0	32000.0
32000.0	33000.0
33000.0	34000.0
34000.0	35000.0
35000.0	36000.0
36000.0	37000.0
37000.0	38000.0
38000.0	39000.0
39000.0	40000.0
5248.9	5852.2
8491.7	9170.4
12790.3	13619.9
17089.0	17994.0

The 'Reduction Results' section shows a list of Run Nos. with checkboxes for selection. A graph titled 'Show Graph' displays the detector data for the selected run, showing a step-like signal with a blue curve overlaid. The x-axis is 'Time (s)' from 0 to 50000, and the y-axis ranges from -1000 to 6000. The graph shows a signal that increases in steps and then exhibits a series of sharp, periodic pulses.

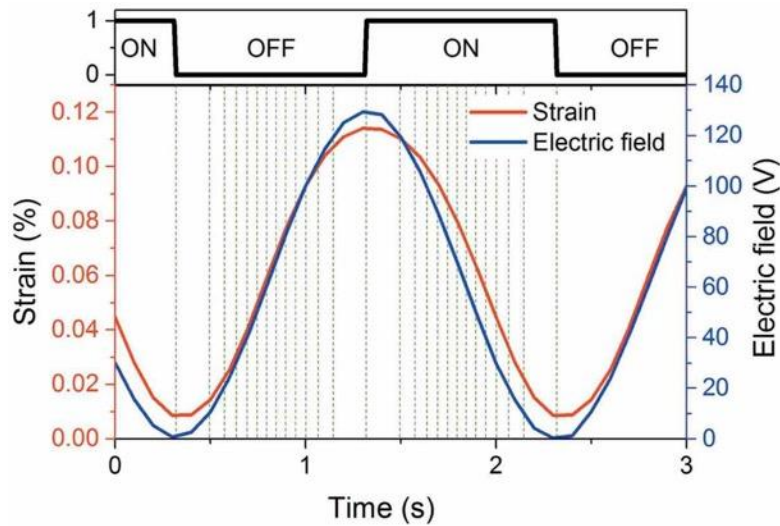
Data reduction software in TAKUMI Emaki-GUI



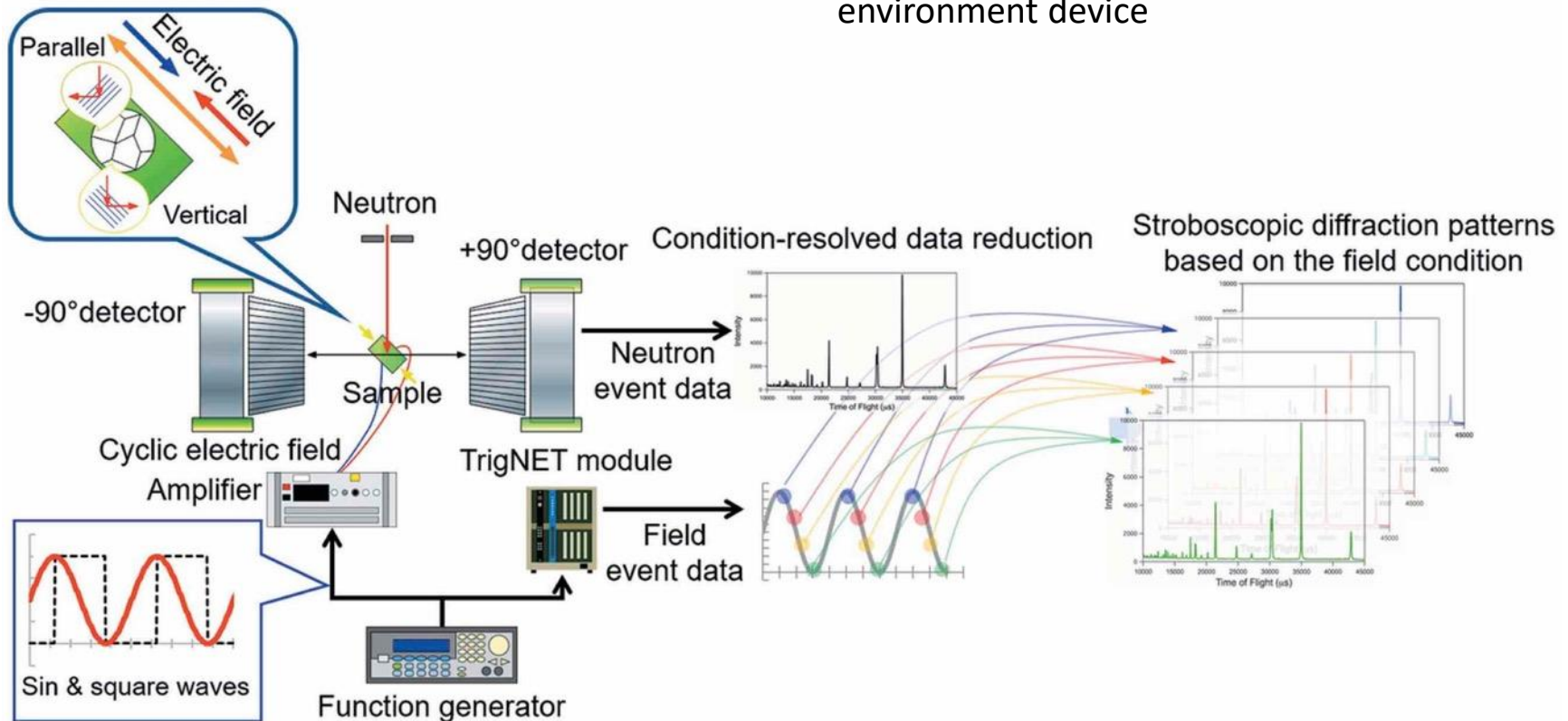
The screenshot displays the Emaki-GUI Ver 2.0 interface. The main window is divided into several sections:

- File:** Includes a menu bar and a Run No. field set to 32073, with buttons for 'Add' and 'Make Slice List...'. The detector info is 'DetectorInfoTakumi_20160225.xml'.
- Data List:** A table with columns for Run No., Acq. Date, Slice Begin, and Slice End. All entries are checked. Below the table are buttons for 'Select All', 'Deselect All', 'Import ...', 'Export ...', and 'Clear List'.
- Reduction Parameters:**
 - Frame:** Radio buttons for 'Single' (selected) and 'Double'. Frame Boundary (μs): 5000. Button: 'Apply'.
 - Binning:** Radio buttons for $\Delta t(\mu\text{s})$: 20 (selected) and $\Delta t(\%)$: 0.05. A checkbox for 'I- λ Correction' is present. Range (μs): 5000 ~ 45000. Run No.: 0.
- Reduction Results:** A table with columns for Export, Run No., Type, and Note. Two entries are listed: 'ENG032073 MergT North' and 'ENG032073 MergT South', both checked. Buttons for 'Select All', 'Deselect All', 'Export', and 'Display' are at the bottom.
- Gnuplot:** A 3D surface plot titled 'nonuniform matrix'. The axes are 'Time of Flight (nsec.)' (0 to 34000), 'Time (sec.)' (0 to 1500), and a vertical axis (0 to 4500). A color scale on the right ranges from 0 to 4500. The plot shows a series of peaks. At the bottom, it says 'view: 31.0000, 110.0000 scale: 1.00000, 1.00000'.

Stroboscopic measurement in TAKUMI



- ✓ Analogue data of sample environmental device is also recorded as the event data ... using TrigNET module
- ✓ Neutron diffraction data reduction is performed based on the physical properties of sample environment device



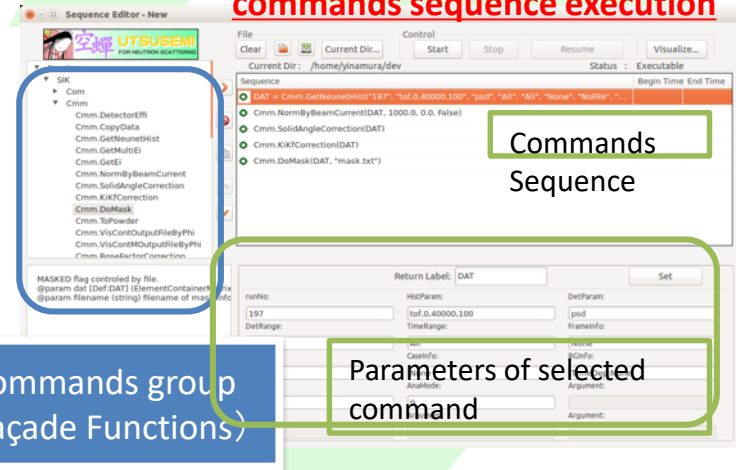
A large, stylized graphic of the letters 'M', 'L', and 'F' in light green, with a white circle in the center of the 'L'. A light blue oval is positioned above the 'L'. The text 'THANK YOU' is centered in the white circle.

THANK YOU

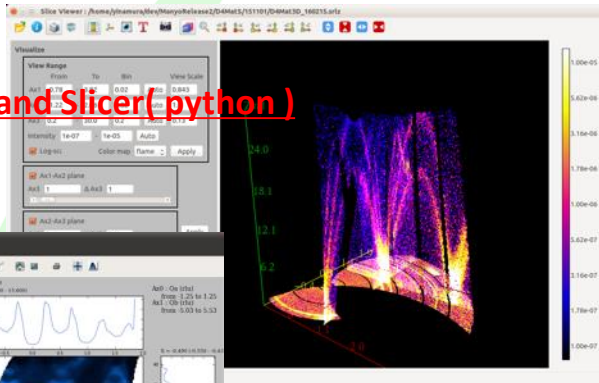
Utsusemi

- Histogram data creation and visualization from event-recorded data produced by DAQ system in MLF
- Data Reduction functions
- GUI (Commands execution, visualizations)

**“SequenceEditor”,
commands sequence execution**

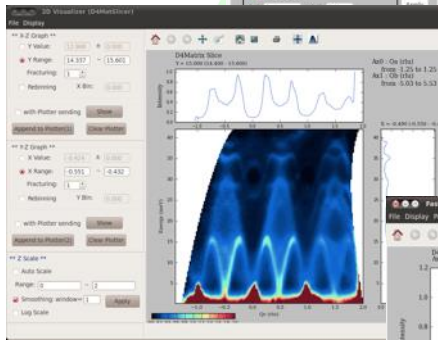


3D Plotter and Slicer (python)

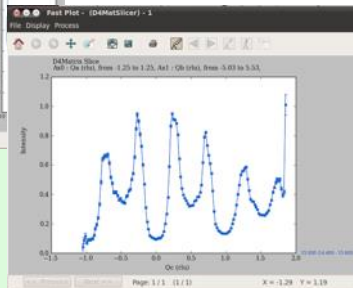


For Inelastic measurement

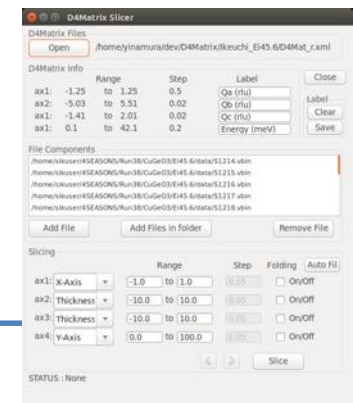
2D plotter (python)



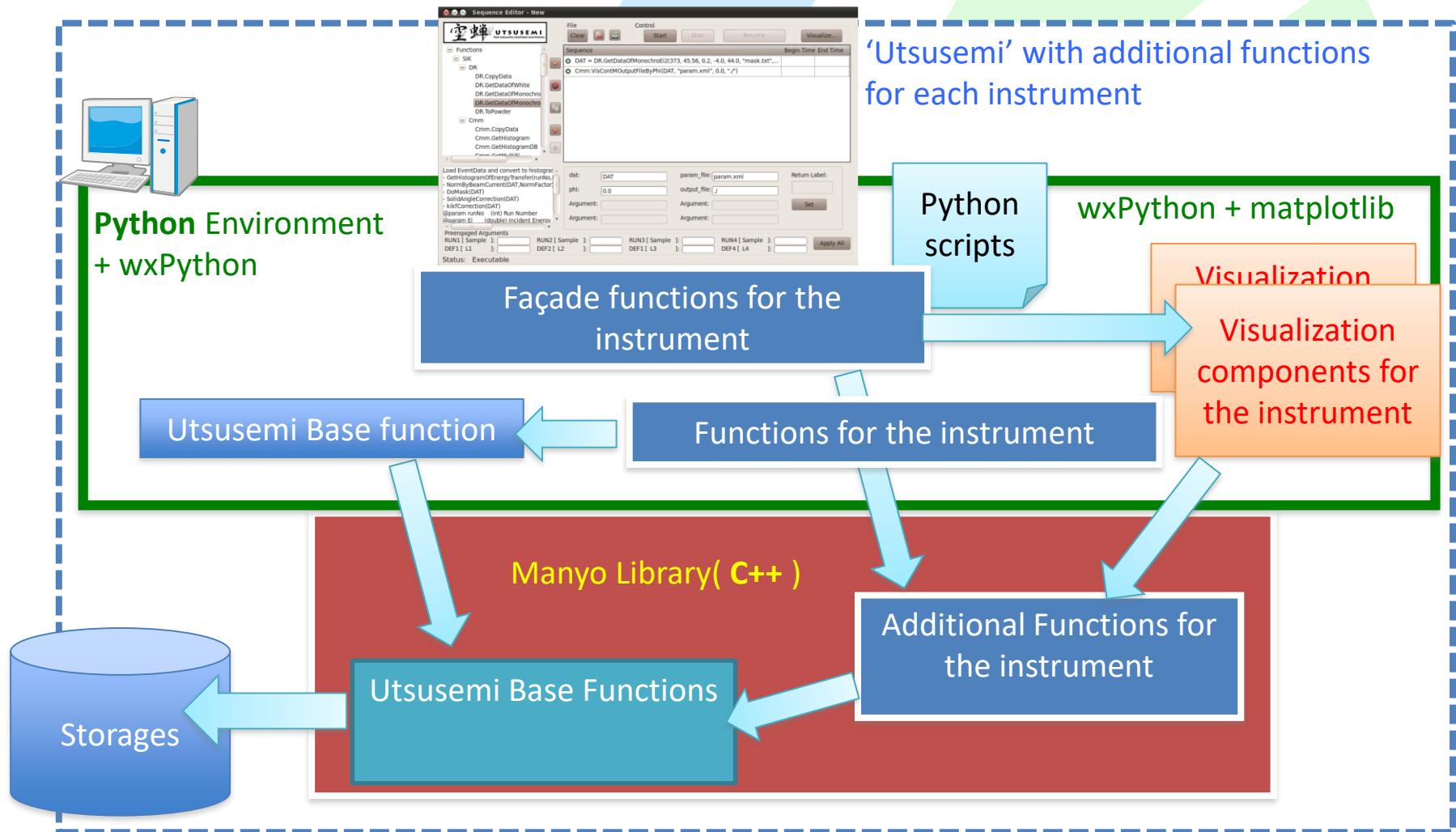
1D plotter (python)



**VisualContM & D4MatSlicer
For single crystal measurements**



Structure of Utsusemi



Manyo Library : Software framework provides fundamental and generic functionalities for developing application software for neutron scattering experiments.

Covering Detectors and unit conv.

Detector type covered by Utsusemi

Position Sensitive Detector	1-D detector, U-type detector
Scintillation Detector	1D, 2D

Unit type of axis in Histogram from event data

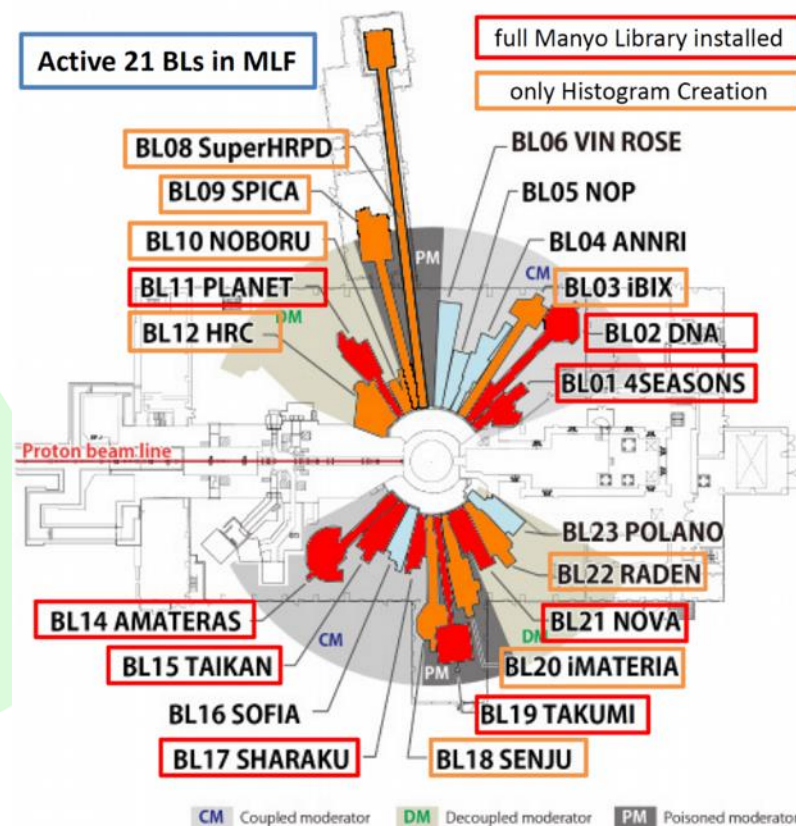
TOF [micro-sec]	$\Delta\text{TOF} = \text{const.}$
TOF [micro-sec]	$\Delta\text{TOF}/\text{TOF} = \text{const.}$
TOF [micro-sec]	$\Delta\text{TOF} = \text{const. with time focusing}$
TOF [micro-sec]	$\Delta\text{TOF}/\text{TOF} = \text{const. with time focusing}$
Energy Transfer [meV]	$\Delta\text{hw} = \text{const.}$
Energy [meV]	$\Delta E = \text{const.}$
Momentum transfer [1/Angstrom]	$\Delta Q = \text{const.}$
Wave length [Angstrom]	$\Delta\lambda = \text{const.}$
Wave length [Angstrom]	$\Delta\lambda/\lambda = \text{const.}$
d value [Angstrom]	$\Delta d = \text{const.}$

Beam Line using Utsusemi functions

BL01 (4SEASONS)	Inelastic Scattering Spectrometer (direct geometry)
BL02 (DNA)	Inelastic Scattering Spectrometer (indirect geometry)
BL03 (iBIX)	Biological Crystal Diffractometer
BL08 (supserHRPD)	High Reso. Powder Diffractometer
BL09 (SPICA)	Powder Diffractometer
BL11 (PLANET)	High Pressure Diffractometer
BL14 (AMATERAS)	Inelastic Scattering Spectrometer (direct geometry)
BL15 (TAIKAN)	Small and Wide Angle Diffractometer
BL17 (SHARAKU)	Polarized Neutron Reflectometer
BL18 (SENJU)	Single Crystal Neutron Diffractometer
BL19 (TAKUMI)	Engineering Materials Diffractometer
BL20 (iMATERIA)	Materials Design Diffractometer
BL21 (NOVA)	Total Diffractometer

Used in MLF

Status



More Information

Utsusemi Binary Package

OS	Version
Windows	64bit 7, 8.2, 10
MacOS X, macOS	10.11 (El Capitan), 10.12(Sierra), 10.13(High Sierra)

Portal Site

meet@MLF Utsusemi

Search!

- Download binary package
- Manual (Only Japanese, sorry)
- Update information




The screenshot shows the 'Utsusemi Portal Site' for neutron scattering. It features a top navigation bar with 'Instruments', 'User Programs', 'Operation', 'Access', and 'Local Information'. A sidebar on the left lists categories: 'Instruments', 'Become a User', 'Let's visit MLFI', and 'Local Information'. The main content area includes a 'What's New' section with a list of updates from 2018.02.05 to 2018.05.21, and a 'Downloads' section with a table of installers for Ubuntu Linux, Windows, and MacOS.

Operating System	Download Links	BL Available
UbuntuLinux (14.04LTE, 16.04LTE 64bit Only) [*1]	0.3.6.180521#	BL01, BL02, BL14, BL15
Windows (7, 8.2, 10 64bit Only)	0.3.6.180521#	BL01, BL14, BL15, BL17, BL19
MacOS (10.11 El Capitan to 10.13 High Sierra)	0.3.6.180521#	BL01, BL14, BL15

<http://mlfuser.cross-tokai.jp/ja/compenv/utsusemi.html>