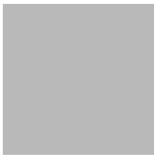




Zaher Salman :: Paul Scherrer Institute

MIDAS and Muon Spin Spectroscopy at PSI

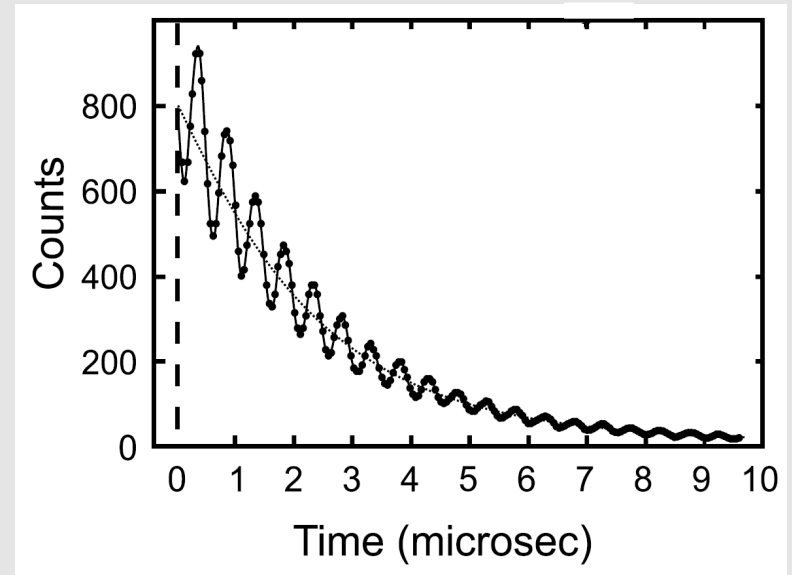
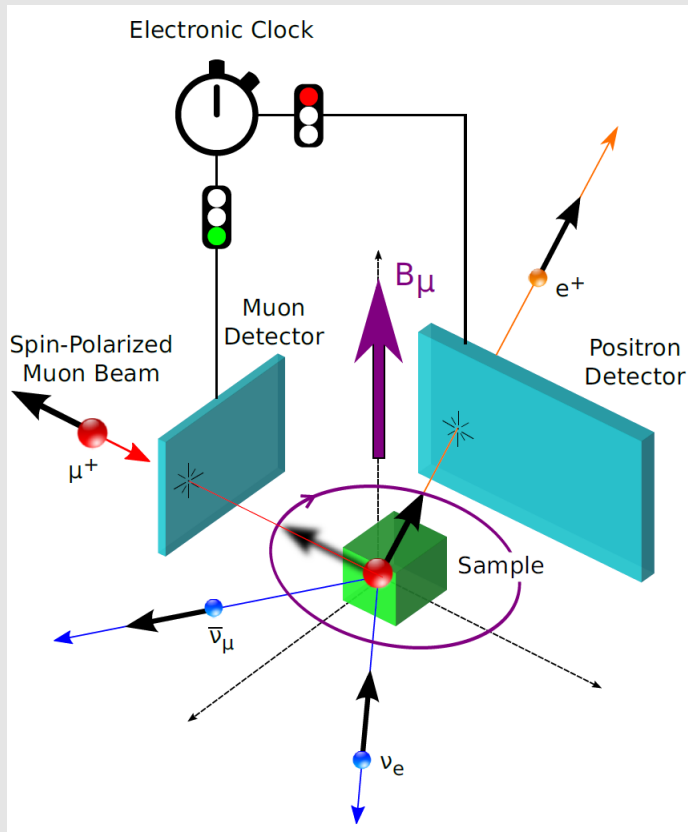
MIDAS Workshop – 13 September 2023



Outline

- Muon Spin Rotation / Relaxation (μ SR) technique
- Swiss Muons Source and instrumentation
- Use of MIDAS for μ SR
 - Current state
 - Future Plans
- Contribution to MIDAS
 - Read/write files to server
 - Other GUI elements

The μ SR Technique

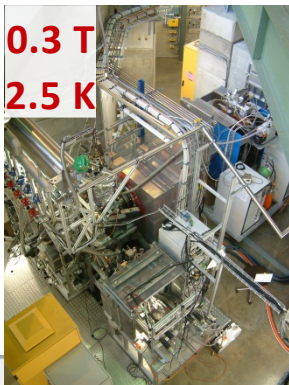


$$N(t) = Bkg + N_0 \exp(-t/\tau_\mu) [1 + a \hat{n} \cdot P(t)]$$

\hat{n} - direction of detector

Muon Spin Spectroscopy at PSI: S μ S (Swiss Muon Source)

0.3 T
2.5 K



LEM

Low Energy Muon Instrument

Muon Energy:
0.5-30 keV



DOLLY

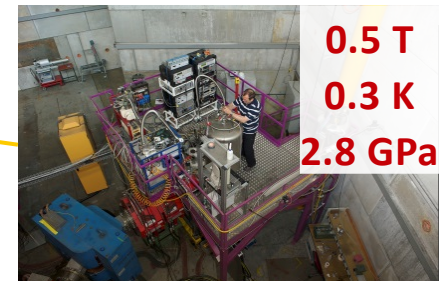
Muon Energy: **4.2 MeV** (μ^+)

0.5 T
0.25 K

GPD

General Purpose Decay Channel Instrument (for Pressure Studies)

Muon Energy: **5-60 MeV** (μ^+ / μ^-)



0.5 T
0.3 K
2.8 GPa

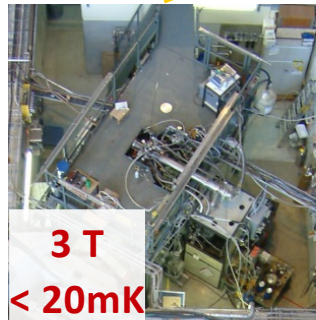
HAL

High Field and Low Temperature

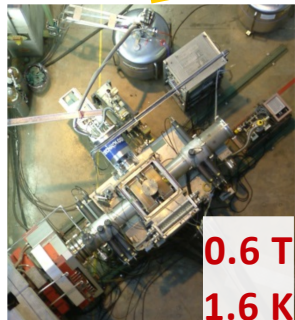


9.5 T
< 20mK

FLAME



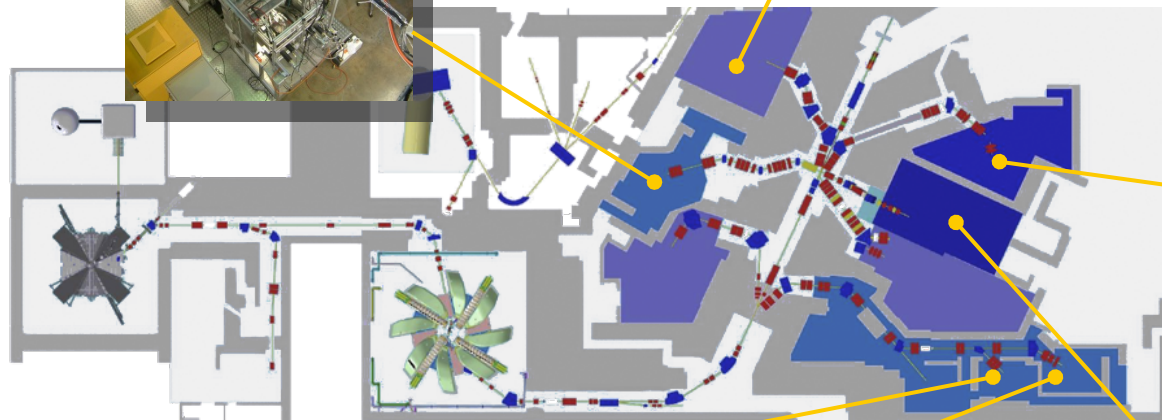
0.6 T
1.6 K
3 T
< 20mK



GPS

General Purpose Surface Muon Instrument

Shared Surface Muon Beam
Muon on Request (MORE)
Muon Energy: **4.2 MeV** (μ^+)



How do we use MIDAS?

Low Energy Muons

Andreas Suter, Thomas Prokscha and ZS

- Muons at 1-15 keV for thin films and heterostructures
- MIDAS from March 2023 with some backports.
- **All** used equipment has FE and device drivers written for MIDAS.
- Used only via MIDAS web interface with extensive JavaScript custom pages (MuDAS).
- Has its own Autorun FE to run (fully) automated measurements.

Bulk Muons

Andrea Raselli

- Muons at >4 MeV for bulk samples (crystals, powders, liquids)
- MIDAS from 2018 with some backports.
- **Most** used equipment has FE and device drivers written for MIDAS.
- Used mostly via a Qt3 based GUI (Deltatt).
- Has its own Autorun FE to run (partially) automated measurements.

Our users

- 100s of users every year.
- About 200 beam days per year.
- Non-MIDAS experts.
- Fields: condensed matter, material science and chemistry.

Deltatt GUI – Bulk μ SR

The screenshot displays the Deltatt GUI interface. At the top, there is a menu bar with 'File' and 'Help'. Below this is a section titled 'Instrument GPS' containing a table of instrument parameters. The parameters are as follows:

Run NOT ACTIVE **MANUAL**	Sample: CuxTiSe2
Last Run: 2306	Temperature: 10.000K
Autorun: STOPPED	Field: 50.000 G
TDC Mode: Veto - 1st Port	Orientation: powder
	Proposal ID: 20222847 p21043
	Proposal Info: Sugiyama
Start Time: Mon Sep 11 10:30:27 2023	Run Title: CuxTiSe2, wTF100G,
Stop Time: Mon Sep 11 12:22:01 2023	3p3K

Below the instrument status is a navigation bar with tabs: 'Run Control' (selected), 'TDC Status', 'TDC Settings', 'Modify Devices', and 'Exp. Magnets'. To the right of these tabs are left and right arrow buttons. The 'Run Control' tab contains several control buttons:

- Start Run
- Stop Run
- Zero Run
- Proposal ID
- Change Limit
- Modify Run Title
- Write Data to Disk

There is also an 'AutoRun Sequence' sub-panel containing:

- Start Sequence
- Stop Sequence
- Proceed Sequence
- Status
- Edit Sequence

Deltatt GUI – Control Equipment

File Help

Instrument GPS

Run NOT ACTIVE **MANUAL** Sample: CuxTiSe2
 Last Run: 2306 Temperature: 10.000K
 Autorun: STOPPED Field: 50.000 G
 TDC Mode: Veto - 1st Port Orientation: powder

Alias: Temperature Type: LTC21 Name: templtc0
 LTC Serial: 576 Directory: /userdisk0/musr/exp/td_musr2n/dat/ltc/

Last update device readout: 0 seconds
 Last update database demand: 1 days 3 hours 25 minutes 56 seconds

WRITE MODE : modified demand value will be sent to LTC21

	Device Readout	Database / Demand	Modified Demand
<input type="checkbox"/> Sample Holder	-	Quantumholder_09_Quant_95	
<input type="checkbox"/> Instrument Mode	CONTROL	CONTROL	
<input type="checkbox"/> Sensor #1 Temperature	48.301 K	-	
<input type="checkbox"/> Sensor #2 Temperature	48.410 K	-	
<input type="checkbox"/> Heater Setpoint [K]	10.000	10.000	
<input type="checkbox"/> Analog Setpoint [K]	10.000	10.000	

Update Title

Deltatt GUI – Edit and Run Scripts

The screenshot shows the Deltatt GUI interface. On the left, there is a sidebar with the following sections:

- Instrument GPS**
 - Run NOT ACTIVE*
 - Last Run: 21-Oct-2022 15:33:48
 - Autorun: S
 - TDC Mode: V
 - Start Time: Mon 21-Oct-2022 15:33:48
 - Stop Time: Mon 21-Oct-2022 15:33:48
- Run Control** (selected tab)
 - Start Run
 - Stop Run
 - Zero Run
 - Proposal ID
 - Modify Run Title
- TDC S** (partially visible tab)

The main window displays a script with the following content:

```
*** WARNING Proposal ID 20222847 is scheduled for this instrument (GPS) this year
MODIFIED 21-Oct-2022 15:33:48 Deltat l_musr_tst pc11318
MODIFIED 21-Oct-2022 15:30:36 Deltat l_musr_tst pc11318
MODIFIED 21-Oct-2022 15:28:48 Deltat l_musr_tst pc11318
MODIFIED 21-Oct-2022 11:10:29 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 20:27:37 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 20:25:27 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 17:57:08 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 17:53:27 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 17:42:39 Deltat l_musr_tst pc11318
#example high temp regime

#Stopping run after getting to No of events
#stop histogram back 10000000

#Switches off all magnets to ZF, waits 120 s
set magnet WED 0 120

start histogram back 8000000

#weak LF 50G Wait 120 second
set magnet WEDL 50 120
start histogram back 8000000

#LF 800G Wait 120 second
set magnet WED 800 120
start histogram back 8000000

#LF 2000G Wait 120 second
set magnet WED 2000 120
start histogram back 8000000

#Switches off all magnets to ZF, waits 120 s
set magnet WED 0 120

#switch to Transverse Field
set magnet WED 100 120
```

At the bottom of the window, there are several buttons: Save and Quit, Verify, Cancel, ShowHints, Print Text, Print Sequence..., and Help.

Deltatt GUI – Edit and Run Scripts

The screenshot shows the Deltatt GUI interface. On the left, there is a sidebar with the following sections:

- Instrument GPS**
 - Run NOT ACTIVE
 - Last Run:
 - Autorun:
 - TDC Mode:
 - Start Time: Mon S
 - Stop Time: Mon S
- Run Control** (selected)
 - Start Run
 - Stop Run
 - Zero Run
 - Proposal ID
 - Modify Run Title
- TDC S**

The main window displays a script with the following content:

```
*** WARNING Proposal ID 20222847 is scheduled for this instrument (GPS) this year
MODIFIED 21-Oct-2022 15:33:48 Deltat l_musr_tst pc11318
MODIFIED 21-Oct-2022 15:30:36 Deltat l_musr_tst pc11318
MODIFIED 21-Oct-2022 15:28:48 Deltat l_musr_tst pc11318
MODIFIED 21-Oct-2022 11:10:29 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 20:27:37 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 20:25:27 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 17:57:08 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 17:53:27 Deltat l_musr_tst pc11318
MODIFIED 20-Sep-2022 17:42:39 Deltat l_musr_tst pc11318
#example high temp regime

#Stopping run after getting to No of events
#stop histogram back 10000000

#Switches off all magnets to ZF, waits 120 s
set magnet WED 0 120

start histogram back 8000000

#weak LF 50G Wait 120 second
set magnet WEDL 50 120
start histogram back 8000000

#LF 800G Wait 120 second
set magnet WED 800 120
start histogram back 8000000

#LF 2000G Wait 120 second
set magnet WED 2000 120
start histogram back 8000000

#Switches off all magnets to ZF, w
set magnet WED 0 120

#switch to Transverse Field
set magnet WED 100 120
```

A yellow callout box contains the following text:

- Getting too old (QT3, cannot be compiled on modern systems).
- Works with MIDAS 2018
- Not needed with custom pages, JavaScript and JSON-RPC.

The bottom of the window has a toolbar with the following buttons: Save and Quit, Verify, Cancel, ShowHints, Print Text, Print Sequence..., and Help.

MIDAS – Low Energy μ SR

status x +

← → ↻ 🏠 🔒 lem03.psi.ch:8081/?cmd=Status 80% ☆ 🔍 Search 🔔 ABP 📄 🌐 🗄️ ☰

☰ nemu Alarms: None 13 Sept 2023, 11:50:34 UTC+2

Status

ODB

Messages

Elog

Alarms

Programs

Buffers

History

MSCB

Config

Help

AutoRun

LemVac

SampleCryo

ConfigSetup

RunLog

Mudas

▶ MudasTabs

Scaler

ControlRoomScaler

Sep61PS64_Vac

LEMDocu ↗

SafetyAtPSI ↗

SearchDB ↗

AccStatus ↗

EventSettings ↗

HIPA-Energy ↗

HIPA-ELOG ↗

Run Title

Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00

Run Status

Run 15123 Stopped	Start: Mon Sep 11 19:48:32 2023	Stop: Mon Sep 11 22:20:49 2023
<input type="button" value="Start"/>	Alarms: On	Restart: Off
Data dir: /data/nemu/dlog		

1694598488 11:48:08.476 2023/09/13 [lemPlug,INFO] lemplug_cmd_1: Cannot connect to host 129.129.140.44, port 80

Equipment

Equipment +	Status	Events	Events[/s]	Data[MB/s]
Trigger	VME_FE@lem03.psi.ch	782623	0.0	0.000
Scaler	VME_FE@lem03.psi.ch	47411	0.3	0.000
SlowControl	VME_FE@lem03.psi.ch	1829	0.0	0.000
Beamline	Ok	0	0.0	0.000
ModCryo	Ok	0	0.0	0.000
SampleCryo	Ok	0	0.0	0.000
HV	Ok	0	0.0	0.000
HV Detectors	Ok	0	0.0	0.000
WEW	Ok	0	0.0	0.000
Danfysik_Spin_Rot	Ok	0	0.0	0.000
LEMVAC	Ok	0	0.0	0.000
Sep61Ps64Vac	Ok	0	0.0	0.000
SCS2001M	Ok	0	0.0	0.000
lemplug	Ok	0	0.0	0.000
TPG262	Ok	0	0.0	0.000
TFL	Ok	0	0.0	0.000

Logging Channels

Channel	Events	MB written	Compr.	Disk Level
#0: lem23_15123.root				
Lazy Label				
TPG262_SC [lem03.psi.ch]				
TFL_SC [lem03.psi.ch]	Analyzer [lem03.psi.ch]		VME_FE [lem03.psi.ch]	
BeamLine SC [lem03.psi.ch]	SCS2001M_SC [lem03.psi.ch]		lemPlug [lem03.psi.ch]	
FUG [lem03.psi.ch]	ModCryo [lem03.psi.ch]		K2400 SC [lem03.psi.ch]	
QL564P-Ta [lem03.psi.ch]	Logger [lem03.psi.ch]		mhttpd [lem03.psi.ch]	
mserver [lem03.psi.ch]	HV Detectors [lem03.psi.ch]		LEMVAC_SC [lem03.psi.ch]	

The expert user can still use the standard MIDAS interface.

MuDAS – User Friendly Interface

The screenshot displays the MuDAS web interface in a browser window. The browser address bar shows the URL: `lem03.psi.ch:8081/?cmd=custom&page=Mudas&tab=1`. The interface includes a sidebar menu on the left with options like Status, ODB, Messages, Elog, Alarms, Programs, Buffers, History, MSCB, Config, Help, AutoRun, LemVac, SampleCryo, ConfigSetup, RunLog, Mudas, MudasTabs, Scaler, ControlRoomScaler, Sep61PS64_Vac, LEMDocu, SafetyAtPSI, SearchDB, AccStatus, EventSettings, HIPA-Energy, and HIPA-ELOG. The main content area shows the 'Mudas LEM' interface with the following details:

- Run status: **Stopped**
- Run title: **Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00**
- Run #: 15123
- Start time: Mon Sep 11 19:48:32 2023
- Stop time: Mon Sep 11 22:20:49 2023
- Event rate: 0 /s (Ip=0 μ A)
- Total stats: 0.783 M
- Autorun: **-Stopped-**
- [12.09.23, 07:15:59] Autorun finished.
- Sample: **Ca10Cr7O28 C**
- Temperature: 0.00 K
- Field: 0.0 G
- Imp. Energy: -0.9 keV
- Proposal ID: 2023.0006 (From DUO)
- P-Group: p2 (000)
- PI: Fabian Netz

Below the run details, there are several tabs: **Run Control**, Auto Run, Sample Cryo., LAR Editor, Counts, Vacuum, Moderator, HV Edit, and More... The 'Run Control' tab is active, showing a table of parameters:

	Demand	Readback
Sample Temp.	300.00 K	0.00 K
Ramp Rate	0.00 K/min	0.00 K/min
He Flow (BH)	0	0
Needle Valve	0.10% (Auto)	0.20%
Heater		0.0%
Magnetic Field	0.0 G (Degauss)	0.0 G
Sample HV	0.00 kV	0.00 kV

A red arrow points from a yellow callout box to the 'Vacuum' tab. The callout box contains the text: "Different tabs for different tasks. No browser reloads needed." Below this, another yellow callout box contains the text: " μ SR+MIDAS = MuDAS GUI with a simple and familiar look."

MuDAS – Ability to Monitor and Control

The screenshot displays the MuDAS web interface for monitoring and controlling a vacuum system. The browser address bar shows the URL `lem03.psi.ch:8081/?cmd=custom&page=Mudas&tab=6`. The interface includes a navigation menu on the left with options like Status, ODB, Messages, Elog, Alarms, Programs, Buffers, History, MSCB, Config, Help, AutoRun, LemVac, SampleCryo, ConfigSetup, RunLog, and Mudas. The main content area features several monitoring panels:

- History pressure UHV:** A line graph showing pressure over time for three sensors: MC_Gj (1.8927e-10), TC_Gj (2.41401e-9), and SC_Gj (1.29203e-8). The x-axis shows dates from 13 Sept 23, 06:00 to 12:00.
- History Temp_CF:** A line graph showing temperature for CF1 (13.6467) and Chimney (8.5241) sensors. The x-axis shows dates from 07:00 to 12:00.
- Run Control:** A schematic diagram of the vacuum system with three chambers: Moderator Chamber, Trigger Chamber, and Sample Chamber. Each chamber has associated gauges and valves. Gauges show values like 1.89e-10 mbar, 5.25e-8 mbar, 2.41e-9 mbar, 3.49e-10 mbar, 1.29e-8 mbar, 9.31e-3 mbar, 1.43e-2 mbar, 1.94e-2 mbar, and 9.10e-3 mbar. A red arrow points from the History pressure UHV graph to the Trigger Chamber gauge.
- Reset HV Interlock:** A control panel with three buttons: MC, TC, and SC.

At the bottom, a yellow callout box contains the text: "With floating histories to monitor".

MuDAS – Easy Visual Hints

LEM Mudas | lem03.psi.ch:8081/?cmd=custom&page=Mudas&tab=3 | 80% | Search | Alarms: None | 13 Sept 2023, 11:59:59 UTC+2

Mudas LEM | Run status: **Stopped** | ELOG

Run title: **Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00**

Run #: 15123 | Sample: **Ca10Cr7O28 C**

Start time: Mon Sep 11 19:48:32 2023 | Temperature: 0.00 K

Stop time: Mon Sep 11 22:20:49 2023 | Field: -0.0 G

Event rate: 0 /s (Ip=0 μ A) | Imp. Energy: -0.9 keV

Total stats: 0.783 M | Proposal ID: **2023-0000** (From DUO)

Autorun: **-Stopped-** | P-Group: **021000**

[12.09.23, 07:15:59] Autorun finished. | PI: **Fabian Netz**

Run Control | Auto Run | **Sample Cryo.** | LAR Editor | Counts | Vacuum | Moderator | HV Edit | More...

Sample Temperature: 300.00 (K) | Ramp Rate: 0.00 (K/min) | He Flow (BH): 0 | Needle Valve: 0.10

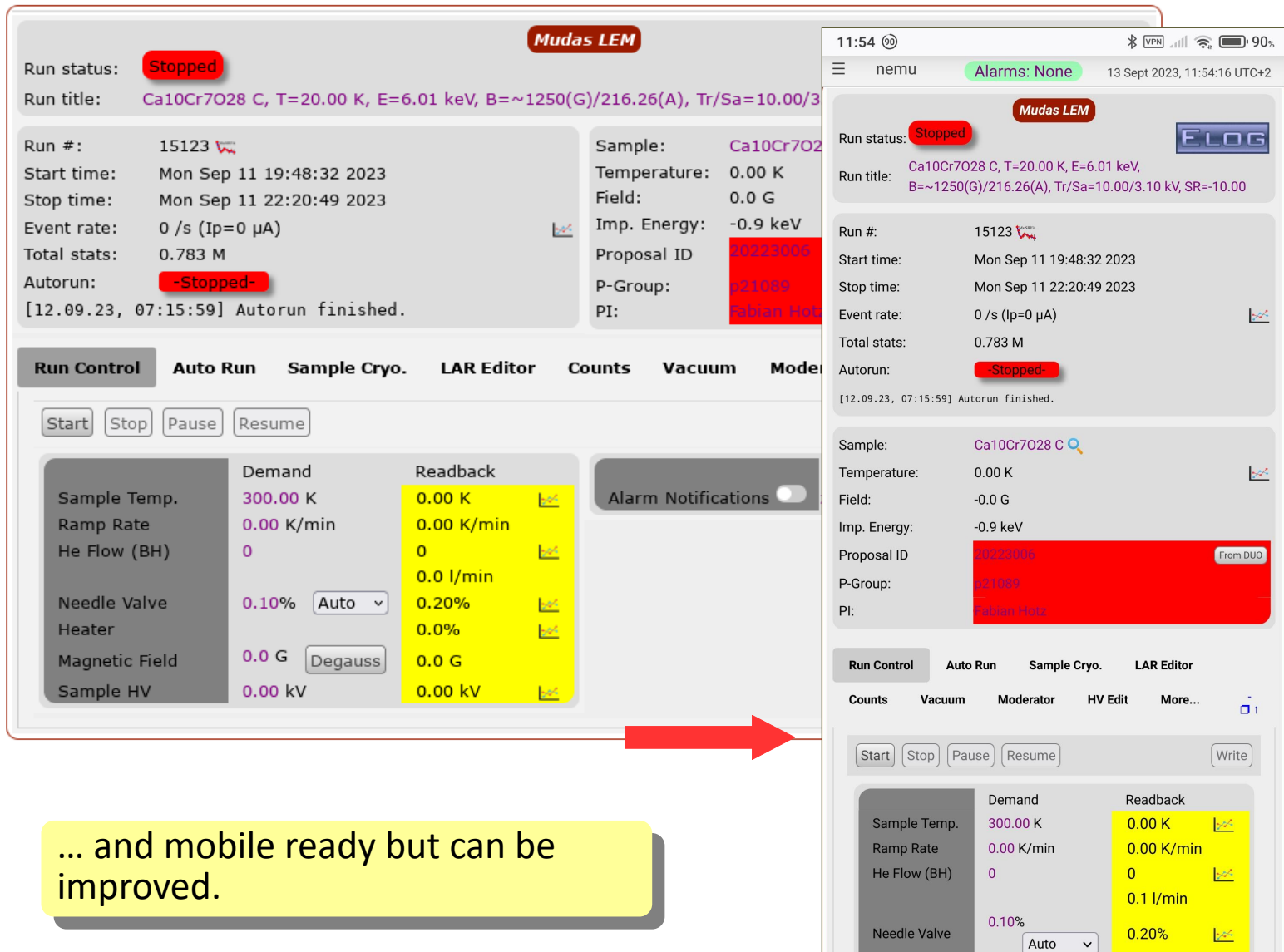
He recovery: 55.30% | NV=0.20% | Konti-2 | BH=0.00 | ACP28 0.05 l/min | 0.99 bar

T=0.00 K
Heater=0.0%
HV=0.0 kV
E=-0.9 keV
B=-0.02 G
p=1.29e-8 mbar

SampleCryo - HeFlow | SampleCryo - CryoPressure | SampleCryo - SampleTemp

Intuitive and modern looking

MuDAS – Mobile Ready (?)



Mudas LEM

Run status: **Stopped**

Run title: Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3

Run #: 15123

Start time: Mon Sep 11 19:48:32 2023

Stop time: Mon Sep 11 22:20:49 2023

Event rate: 0 /s (Ip=0 μA)

Total stats: 0.783 M

Autorun: **-Stopped-**

[12.09.23, 07:15:59] Autorun finished.

Sample: Ca10Cr7O28 C

Temperature: 0.00 K

Field: 0.0 G

Imp. Energy: -0.9 keV

Proposal ID: 20223006

P-Group: p21089

PI: Fabian Holtz

Run Control Auto Run Sample Cryo. LAR Editor Counts Vacuum Mode

Start Stop Pause Resume

	Demand	Readback	
Sample Temp.	300.00 K	0.00 K	
Ramp Rate	0.00 K/min	0.00 K/min	
He Flow (BH)	0	0	
		0.0 l/min	
Needle Valve	0.10% <input type="text" value="Auto"/>	0.20%	
Heater		0.0%	
Magnetic Field	0.0 G <input type="text" value="Degauss"/>	0.0 G	
Sample HV	0.00 kV	0.00 kV	

Alarm Notifications

11:54 90%

nemu Alarms: None 13 Sept 2023, 11:54:16 UTC+2

Mudas LEM

Run status: **Stopped**

Run title: Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00

Run #: 15123

Start time: Mon Sep 11 19:48:32 2023

Stop time: Mon Sep 11 22:20:49 2023

Event rate: 0 /s (Ip=0 μA)

Total stats: 0.783 M

Autorun: **-Stopped-**

[12.09.23, 07:15:59] Autorun finished.

Sample: Ca10Cr7O28 C

Temperature: 0.00 K

Field: -0.0 G

Imp. Energy: -0.9 keV

Proposal ID: 20223006

P-Group: p21089

PI: Fabian Holtz

Run Control Auto Run Sample Cryo. LAR Editor

Counts Vacuum Moderator HV Edit More...

Start Stop Pause Resume Write

	Demand	Readback	
Sample Temp.	300.00 K	0.00 K	
Ramp Rate	0.00 K/min	0.00 K/min	
He Flow (BH)	0	0	
		0.1 l/min	
Needle Valve	0.10% <input type="text" value="Auto"/>	0.20%	

... and mobile ready but can be improved.

MuDAS – Direct Link to Data Analysis/Logbook

Mudas LEM

Run status: **Stopped** **ELOG**

Run title: **Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00**

Run #: **15123** ↗ Sample: **Ca10Cr7O28 C** 🔍

Start time: **Mon Sep 11 19:48:32 2023** Temperature: **0.00 K** 📄

Stop time: **Mon Sep 11 20:49 2023** Field: **0.0 G**

Event rate: **0 /s (Ip=0 μA)** Imp. Energy: **-0.9 keV**

100nm PdCo2Al2O3 - He imp 1.5e15 - 700C, T=4.11 K, E=6.01 keV, B=~100(G)/17.30(A), Tr/Sa=15.00/8.29 kV, SR=-10.00

MIGRAD ▾
HESSE ▾
FIT
Theory Block
asymmetry Asy
simplExpo Lam
TFieldCos Phi Frq
Functions Block

FFT
x-axis range
Fi=
Ff=
Units=MHz ▾
Apodization=STRONG ▾
Log x
Log y
t cor.
X,Y range
Xi=
Xf=
Yi=
Yf=
View Bin
PLOT
Restart

χ²/NDF = 397.1, NDF = 404, chisq/NDF = 0.982993

RUN numbers separated with commas, hyphens (from-to) or colons (from:to:step)

14716

t_i= 0 t_f= 8 Bin= 100

Fit type | Asymmetry GLB ▾ | Histograms: 1 5,3 7

Plot pars.	Name	Value	Error	Min	Max
1	Alpha_14716	0.8590	0.0015		
2	Asy_14716	0.1763	0.0030		
3	Lam_14716	0.356	0.014		
4	Phi_14716	27.28	0.85		
5	Frq_14716	1.3786	0.0019		

ID: **20223006** From DUO

p21089
Fabian Hotz

vacuum Moderator HV Edit More... 📄 ↑

Write

Notifications zaher.salman@gmail.com

Since we are in the browser, we can link directly to online data analysis tools.

MuDAS – Direct Link to Data Analysis/Logbook

Mudas LEM

Run status: **Stopped** **ELOG**

Run title: **Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00**

Run #: 15123 Sample: **Ca10Cr7O28 C**

Start time: Mon Sep 11 19:48:32 2023 Temperature: 0.00 K

Stop time: Mon Sep 11 22:20:49 2023 Field: 0.0 G

Event rate: 0 /s (Ip=0 μ A) Imp. Energy: -0.9 keV

Total stats: 0.783 M Download selected as MusrRoot Bin by: histogram groups NPP&PPC Red

Autorun: **-Stopped** Plot Selected Go Back

[12.09.23, 07:15:59] Au

Run Control **Auto Run**

Start Stop Pause R

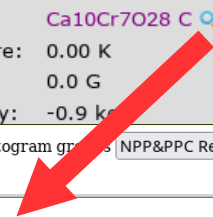
Sample Temp.
Ramp Rate
He Flow (BH)

Needle Valve
Heater

Magnetic Field

Sample HV

	Year	RUN	STATS	Title
<input type="checkbox"/>	2023	15073	4002.3k	Ca10Cr7O28 C, T=289.99 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15074	4008.6k	Ca10Cr7O28 C, T=249.95 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15075	4004.6k	Ca10Cr7O28 C, T=199.98 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15076	4010.7k	Ca10Cr7O28 C, T=199.99 K, E=20.01 keV, B=~50(G)/8.65(A), Tr/Sa=15.00/-5.70 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15077	4007.9k	Ca10Cr7O28 C, T=149.97 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15078	4003.5k	Ca10Cr7O28 C, T=99.98 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15079	4003.7k	Ca10Cr7O28 C, T=99.99 K, E=20.01 keV, B=~50(G)/8.65(A), Tr/Sa=15.00/-5.70 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15080	4006.8k	Ca10Cr7O28 C, T=75.00 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15081	4007.7k	Ca10Cr7O28 C, T=49.99 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15082	4001.8k	Ca10Cr7O28 C, T=50.00 K, E=20.01 keV, B=~50(G)/8.65(A), Tr/Sa=15.00/-5.70 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15083	4007.5k	Ca10Cr7O28 C, T=19.99 K, E=20.01 keV, B=~50(G)/8.65(A), Tr/Sa=15.00/-5.70 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15084	4010.4k	Ca10Cr7O28 C, T=19.99 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15085	4011.4k	Ca10Cr7O28 C, T=10.02 K, E=2.02 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/7.10 kV, SR=-10.00 --- PN: 20223006
<input type="checkbox"/>	2023	15086	2004.1k	Ca10Cr7O28 C, T=4.20 K, E=6.01 keV, B=~50(G)/8.65(A), Tr/Sa=10.00/3.10 kV, SR=-10.00 --- PN: 20223006



... or to have a look at the run log for the current experiment.

MuDAS – Read/Write Files to MIDAS Server

The screenshot displays the MuDAS control interface. At the top, the status is 'Stopped' and the run title is 'Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00'. The interface includes a 'Run Control' menu with options like 'Auto Run', 'Sample Cryo.', 'LAR Editor', 'Counts', 'Vacuum', 'Moderator', 'HV Edit', and 'More...'. A sidebar on the left contains various control buttons such as 'Temperature Loop', 'Sample HV Loop', 'Single Run', 'Set Commands', and 'Other'. A central text area is currently empty, with a 'File Name:' label above it. At the bottom right, there are 'Load', 'Save', and 'Clear' buttons, with the 'Load' button circled in red. A yellow callout box contains the text: 'One important aspect is reading/writing scripts or other configuration files to the server. Must be flexible but safe.'

Run status: **Stopped** ELOG

Run title: Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00

Run #: 15123 v

Start time: Mon Sep 11 19:48:32 2023

Stop time: Mon Sep 11 22:20:49 2023

Event rate: 0 /s (Ip=0 μ A)

Total stats: 0.783 M

Autorun: **-Stopped-**

[12.09.23, 07:15:59] Autorun finished.

Sample: Ca10Cr7O28 C q

Temperature: 0.00 K v

Field: -0.0 G

Imp. Energy: -0.9 keV

Proposal ID: 20223006 From DUO

P-Group: p21089

PI: Fabian Hotz

Run Control Auto Run Sample Cryo. **LAR Editor** Counts Vacuum Moderator HV Edit More... v

Run Blocks

Temperature Loop

Sample HV Loop

Single Run

Set Commands

Temperature

Magnetic Field

Sample HV

SR Angle

Ring Anode

General ODB

Other

Degauss Magnet

Transport HV

Warmup

Enable Pop-Up

File Name:

One important aspect is reading/writing scripts or other configuration files to the server. Must be flexible but safe.

Load Save Clear

MuDAS – Read/Write Files to MIDAS Server

Mudas LEM

Run status: **Stopped** ELOG

Run title: Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00

Run #: 15123

Start time: Mon Sep 11 19:48:32 2023

Stop time: Mon Sep 11 22:20:49 2023

Event rate: 0 /s (Ip=0 μ A)

Total stats: 0.783 M

Autorun: **-Stopped-**

[12.09.23, 07:15:59] Autorun finished.

Sample: Ca10Cr7O28 C

Temperature: 0.00 K

Field: -0.0 G

Imp. Energy: -0.9 keV

Proposal ID: 20223006 From DUO

P-Group: p21009

PI: Fabian Hotz

Run Control Au Generator HV Edit More...

Run Blocks

Temperature Loop

Sample HV Loop

Single Run

Set Commands

Temperature

Magnetic Field

Sample HV

SR Angle

Ring Anode

General ODB

Other

Degauss Magnet

Transport HV

Warmup

Enable Pop-Up

Select file dialog

Name	Modified	Size
CaCrO-C_TF_2_konti....	Mon Sep 11 2023 19:...	879
CaCrO-C_TF_1_konti....	Mon Sep 11 2023 15:...	721
CaCrO-C_LF_2_konti....	Mon Sep 11 2023 10:...	1136
CaCrO-C_LF_1_konti....	Mon Sep 11 2023 07:...	2042
CaCrO-C_3_konti.lar	Sun Sep 10 2023 20:...	1973
CaCrO-C_2_konti.lar	Sun Sep 10 2023 08:...	861
CaCrO-C_1_konti.lar	Sat Sep 09 2023 21:...	3631
CaCrO-5_konti.lar	Sat Sep 09 2023 15:...	4235

File picker, key strokes to “search” for file, sort according to name, date or size, etc...

Load **Cancel**

Load **Save** **Clear**

MuDAS – Read/Write Files to MIDAS Server

The screenshot displays the MuDAS LEM control interface. At the top, the run status is 'Stopped' and the title is 'Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00'. The 'Run Control' section includes buttons for 'Auto Run', 'Sample Cryo.', 'LAR Editor', 'Counts', 'Vacuum', and 'Moderator'. The 'LAR Editor' is active, showing a script with commands like '% Temperature scan from RT to base', 'LOOP_START', 'LOOP_LIST', 'LOOP_TEMP', 'TITLE', 'START', and 'LOOP_END'. A 'Mudas dialog' box is open, titled 'Save script as ... warmup_vent.lar', with options: 'Do nothing' (selected), 'Load as autorun', and 'Set as next autorun'. A yellow callout box states: 'After saving, we can continue directly to the next step.' At the bottom right, the 'Save' button is circled in red.

Run status: **Stopped**

Run title: Ca10Cr7O28 C, T=20.00 K, E=6.01 keV, B=~1250(G)/216.26(A), Tr/Sa=10.00/3.10 kV, SR=-10.00

Run #: 15123

Start time: Mon Sep 11 19:48:32 2023

Stop time: Mon Sep 11 22:20:49 2023

Event rate: 0 /s (Ip=0 μ A)

Total stats: 0.783 M

Autorun: **-Stopped-**

[12.09.23, 07:15:59] Autorun finished.

Sample: Ca10Cr7O28 C

Temperature: 0.00 K

Field: -0.0 G

Imp. Energy: -0.9 keV

Proposal ID: 20223006 From DUO

P-Group: p21

PI: F30

Run Control Auto Run Sample Cryo. **LAR Editor** Counts Vacuum Moderator

Run Blocks

Temperature Loop

Sample HV Loop

Single Run

Set Commands

Temperature

Magnetic Field

Sample HV

SR Angle

Ring Anode

General ODB

Other

Degauss Magnet

Transport HV

Warmup

Enable Pop-Up

File Name: warmup_vent.lar

Do nothing

Load as autorun

Set as next autorun

Save

Load Save Clear

After saving, we can continue directly to the next step.

File Read/Write – Technical Details

Development in collaboration with Stefan Ritt

- **/src/system.cxx**
- Use `ss_file_find(const char *path, const char *pattern, STRING_LIST *plist)` to get list of files matching a pattern, modified to return time/size.
- Use `ss_dirlink_find(const char *path, const char *pattern, STRING_LIST *plist)` to get list of directories and symbolic links (this replaces `ss_dir_find()`).

/src/mjsonrpc.cxx

- Get list of files: `static MJsonNode* js_ext_list_files(const MJsonNode* params)`
Can replace `js_seq_list_files`
- Read ASCII files: `static MJsonNode* js_ext_read_files(const MJsonNode* params)`
- Write ASCII files: `static MJsonNode* js_ext_save_files(const MJsonNode* params)`
Can replace `js_seq_save_script`

/resources/filesrw.js

- Open file_picker:
`file_picker(pathName, ext, funcCall, saveFlag = false, param = {}, crtFldr = false)`
- Save file:
`file_save_ascii(filename, text, alert)`
- Read file:
`file_load_ascii(filename, callback)`
- Filenames and path names are all relative to “`experiment_directory/userfiles/`” which will be created on first use.

File Read/Write – Snippets

- To open file_picker for loading files

```
<input class="mbutton" type="button" value="Load"
onclick="file_picker('autoRun', '*.msl', dblclick_load, false, {}, true);">
```

- To open file_picker for saving files

```
<input class="mbutton" type="button" value="Save"
onclick="file_picker('autoRun', '*.msl', dblclick_save, true);">
```

```
<script src="filesrw.js"></script>
<script>
  function dblclick_load(filename) {
    let editor = document.getElementById("editor");

    file_load_ascii(filename, function(text) {
      editor.innerText = text;
      spToJson2(text);
    });
    // Close dlg modal cleanly
    sessionStorage.removeItem("depthDir");
  }

  function dblclick_save(filename) {

    console.log("dblclick save as", filename);
    let editor = document.getElementById("editor");
    let text = editor.innerText;
    // Close dlg modal cleanly
    sessionStorage.removeItem("depthDir");
    // Send text to save
    file_save_ascii(filename, text)
  }
</script>
```

Summary and Conclusions

Where can we contribute to MIDAS?

- Contribute to the JavaScript GUI, JSON-RPC calls etc.
- Frontends and device drivers, we use many different devices.
- Improvements of the Sequencer, in particular validation of script before you start it.

What can be useful for us?

- An extensive collection/library of device drive and frontends.

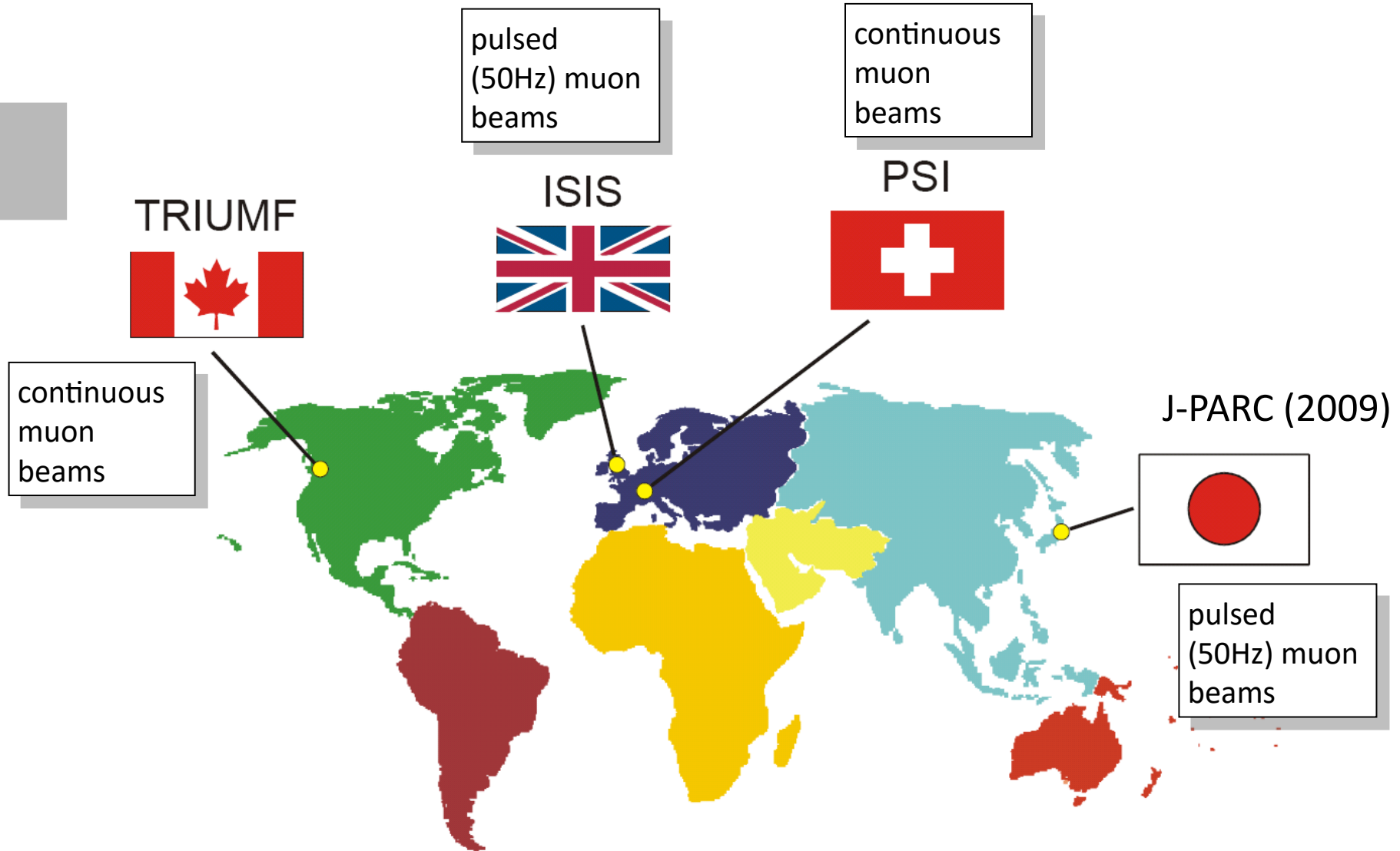
Thanks

**Thank you for your
attention**

Thanks also to all of my colleagues at LMU.

<http://www.psi.ch/lmu>

μ SR Facilities Around the World



From “ μ SR brochure” by J.E Sonier, Simon-Fraser-Univ., Canada, 2002.
<http://musr.org/intro/musr/muSRBrochure.pdf>

What do we use μ SR for?

- Muons are local magnetic probe. It allows determination of magnetic / superconducting / other volume fraction.
- μ SR can be performed at any temperature and/or magnetic field in any sample (solid, liquid or gas).
- Muons are highly sensitive, can detect magnetic fields from moments as small as 10^{-3} – $10^{-4} \mu_B$, and magnetic fluctuations in the range 10^5 – 10^9 Hz.
- The muon can also act as a hydrogen-like isotope, produce radical states, and interact with molecules (labeling).