



High-level Applications
- Super-FRS Controls Workshop -

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11.11.2024

Agenda

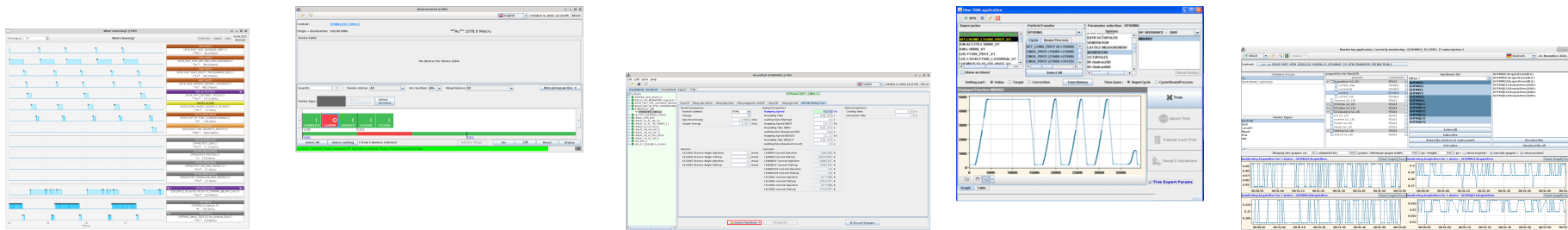
◆ Applications

- ❖ Overview: Applications by the APP group
- ❖ SchedulingApp
- ❖ BSS Control
- ❖ ParamModi
- ❖ DeviceControl
- ❖ SequencerApp (ACO/OPE)
- ❖ MASP GUI (APS)
- ❖ Further Applications

Applications by the APP group

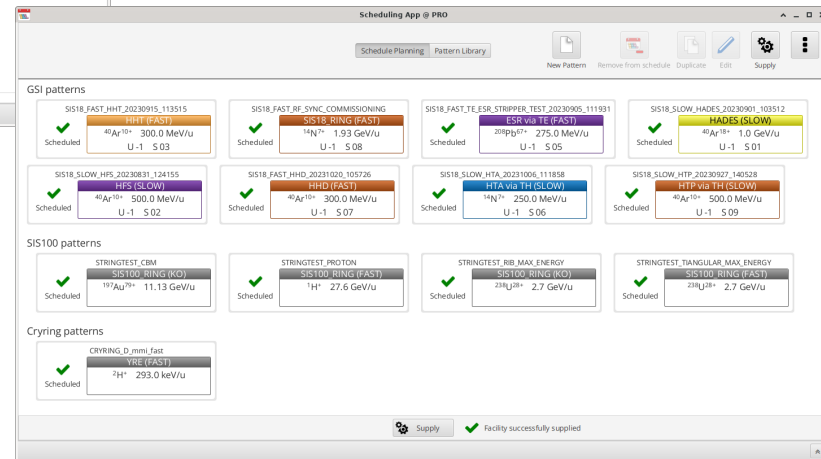
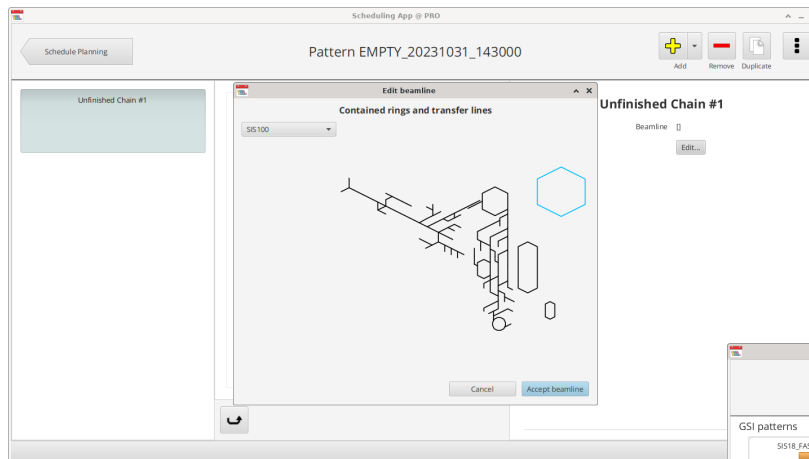
Applications provided by APP will cover all standard operation software for controlling the accelerators used in the central and local control rooms of FAIR

- modular and distributed SW architecture
- all processes are data driven
- separation of concerns, MVC, logic in central or distributed services
- usage of code templates, libraries, widgets, prefilled components
- Java with JavaFX as GUI technology



SchedulingApp

- ◆ Used to create and schedule Patterns and BeamProductionChains



BSS Control

- ◆ Overview of scheduled beams and their execution status
- ◆ Switch Beam execution on/off

The screenshot displays the BSS Control @ PRO interface, which is a web-based control system for particle beams. The interface is organized into several sections:

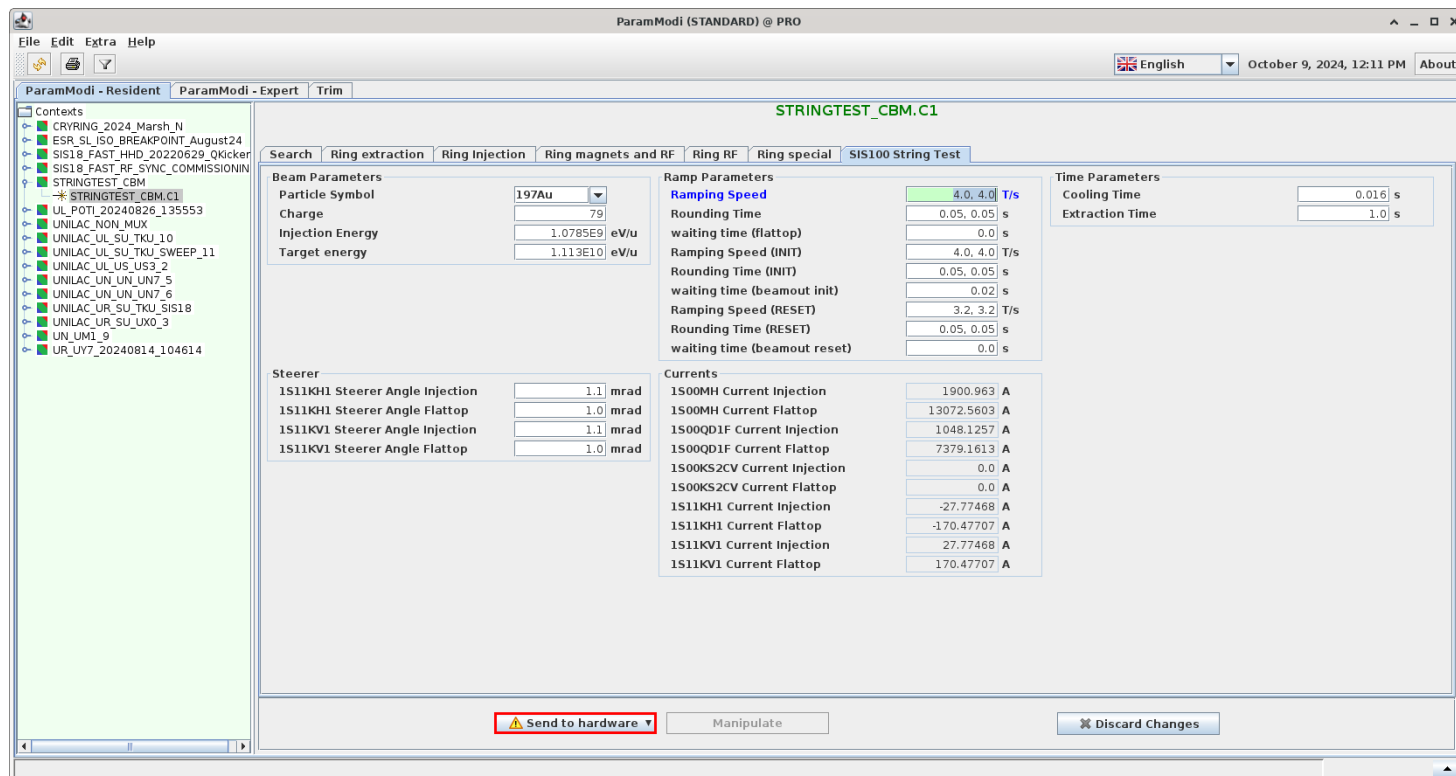
- Refresh PatternGroups:** A button to refresh the list of pattern groups.
- All PatternGroups:** A dropdown menu to filter the displayed patterns.
- Data Supply Results:** A button to view data supply results.
- Couple/Decouple Patterns:** A button to manage the coupling or decoupling of patterns.
- en:** A language dropdown menu.
- About:** A button to access information about the system.

The main content area is divided into three categories of patterns:

- GSI patterns:** This section contains 8 cards, each representing a different beam configuration. Each card includes a status indicator (a vertical bar), a timer, a refresh icon, and a '1x' multiplier. The cards are:
 - HHT (FAST):** $^{40}\text{Ar}^{10+}$ 300.0 MeV/u. Status: NO_BEAM. Controls: U-1, S03.
 - SIS18_RING (FAST):** $^{14}\text{N}^{7+}$ 1.93 GeV/u. Status: NO_BEAM. Controls: U-1, S08.
 - ESR via TE (FAST):** $^{208}\text{Pb}^{67+}$ 275.0 MeV/u. Status: NO_BEAM. Controls: U-1, S05.
 - HADES (SLOW):** $^{40}\text{Ar}^{18+}$ 1.0 GeV/u. Status: NO_BEAM. Controls: U-1, S01.
 - HFS (SLOW):** $^{40}\text{Ar}^{10+}$ 500.0 MeV/u. Status: NO_BEAM. Controls: U-1, S02.
 - HHD (FAST):** $^{40}\text{Ar}^{10+}$ 300.0 MeV/u. Status: NO_BEAM. Controls: U-1, S07.
 - HTA via TH (SLOW):** $^{14}\text{N}^{7+}$ 250.0 MeV/u. Status: NO_BEAM. Controls: U-1, S06.
 - HTP via TH (SLOW):** $^{40}\text{Ar}^{10+}$ 500.0 MeV/u. Status: NO_BEAM. Controls: U-1, S09.
- SIS100 patterns:** This section contains 4 cards, each representing a different beam configuration. Each card includes a status indicator, a timer, a refresh icon, and a '1x' multiplier. The cards are:
 - STRINGTEST_CBM:** SIS100_RING (KO). $^{197}\text{Au}^{79+}$ 11.13 GeV/u. Status: NO_BEAM. Controls: U-1, S02.
 - STRINGTEST_PROTON:** SIS100_RING (FAST). $^1\text{H}^+$ 27.6 GeV/u. Status: NO_BEAM. Controls: U-1, S07.
 - STRINGTEST_RIB_MAX_ENERGY:** SIS100_RING (KO). $^{238}\text{U}^{28+}$ 2.7 GeV/u. Status: NO_BEAM. Controls: U-1, S06.
 - STRINGTEST_TANGULAR_MAX_ENERGY:** SIS100_RING (FAST). $^{238}\text{U}^{28+}$ 2.7 GeV/u. Status: NO_BEAM. Controls: U-1, S07.
- Cryring patterns:** This section contains 1 card, representing a different beam configuration. It includes a status indicator, a timer, a refresh icon, and a '1x' multiplier. The card is:
 - CRYRING_D_mmi_fast:** YRE (FAST). $^2\text{H}^+$ 293.0 keV/u. Status: NO_BEAM. Controls: U-1, S02.

ParamModi 1/3

- ◆ Trim settings
- ◆ Data supply of devices, but also of central systems (BSS, MASP, ..)



Screenshots: ParamModi 2/3

Screenshot: Menu -> Extra -> Show Data Supply Results

ParamModi (STANDARD) @ PRO

File Edit Extra Help

ParamModi - Resident ParamModi - E

Contexts

- CRYRING_2024_Marsh_N
- ESR_SL_ISO_BREAKPOINT_August24
- SIS18_FAST_HHD_20220629_QKicker
- SIS18_FAST_RF_SYNC_COMMISSIONIN
- STRINGTEST_CBM
 - STRINGTEST_CBM.C1
 - STRINGTEST_CBM.C1.SIS100_RING_BEAMOUT_INIT.1
 - STRINGTEST_CBM.C1.SIS100_RING_RING_INJECTION.1
 - STRINGTEST_CBM.C1.SIS100_RING_RING_RAMP.1
 - 1500MH/Setting#coeffArrCurr
 - 1500MH/Setting#coeffArrVolt
 - STRINGTEST_CBM.C1.SIS100_RING_RING_PRE_EXTRACTION.1
 - STRINGTEST_CBM.C1.SIS100_RING_RING_EXTRACTION_KO.1
 - STRINGTEST_CBM.C1.SIS100_RING_BEAMOUT_RESET.1
 - 1500QD1
 - 1511KH1
 - 1511KV1

- UL_POT1_20240826_135553
- UNILAC_NON_MUX
- UNILAC_UL_SU_TKU_10
- UNILAC_UL_SU_TKU_SWEEP_11
- UNILAC_UL_US_US3_2
- UNILAC_UN_UN_UN7_5
- UNILAC_UN_UN_UN7_6
- UNILAC_UR_SU_TKU_SIS18
- UNILAC_UR_SU_UXO_3
- UN_UM1_9
- UR_UY7_20240814_104614

Show only errors Filter by text: Top-level grouping: Device

09.10.2024 12:15:09 - STRINGTEST_CBM - Trim: ParamModi Trim

- 1500K52Cv
- 1500MH
 - STRINGTEST_CBM.C1.SIS100_RING_BEAMOUT_INIT.1
 - STRINGTEST_CBM.C1.SIS100_RING_RING_INJECTION.1
 - STRINGTEST_CBM.C1.SIS100_RING_RING_RAMP.1
 - 1500MH/Setting#coeffArrCurr
 - 1500MH/Setting#coeffArrVolt
 - STRINGTEST_CBM.C1.SIS100_RING_RING_PRE_EXTRACTION.1
 - STRINGTEST_CBM.C1.SIS100_RING_RING_EXTRACTION_KO.1
 - STRINGTEST_CBM.C1.SIS100_RING_BEAMOUT_RESET.1
- 1500QD1
- 1511KH1
- 1511KV1

09.10.2024 12:14:13 - STRINGTEST_CBM - Trim: ParamModi Trim

09.10.2024 12:12:46 - STRINGTEST_CBM - Trim: ParamModi Trim

Close

1511KH1 Current Injection -27.77

1511KH1 Current Flattop -170.47

Data Supply Process Results

Show only errors Filter by text: Top-level grouping: Device

09.10.2024 12:20:17 - SIS18_FAST_HHD_20220629_QKicker - Trim: ParamModi Trim

- GHHDKX1
- GHHDKX2
- GHHDKY1
- GHHDKY2
- GS00BE_F
- GS00BE_Y
- GS00B51W
- GS00ZB_E
- GS00ZG1
- GS01B01EH
- GS01DT_ML
 - SIS18_FAST_HHD_20220629_QKicker.C1.SIS18_RING_BEAMOUT_INIT.1
 - GS01DT_ML/Setting#dipoleFieldRamp
 - GS01DT_ML/Setting#maxRevolutionFrequency

LSA parameter 'GS01DT_ML/Setting#dipoleFieldRamp' in context 'SIS18_FAST_HHD_20220629_QKicker.C1.SIS18_RING_BEAMOUT_INIT.1' (Selector 'FAIR.SELECTOR.C=2:T=300:S=2:P=9')

Value calculated by LSA:

```
(double[][]:5x6) -> [0.0, 0.014, 0.118173, 0.0, 0.0, 0.0], [0.014, 0.046, 0.11817300000000003, 7.848151850620155E-7, 32.08153797452546, 0.0], [0.046, 0.154, 0.15102452, 0.05322027777777777, 0.0, 0.0], [0.154, 0.186, 0.37277231000000033, 2.0532192151848125, -32.081537974525396, 0.0], [0.186, 0.226, 0.40562383, 0.0, 0.0, 0.0]
```

The setting was calculated successfully.

JAPC parameter 'GS01DT_ML/Setting' in context 'SIS18_FAST_HHD_20220629_QKicker.C1.SIS18_RING_BEAMOUT_INIT.1' (Selector 'FAIR.SELECTOR.C=2:T=300:S=2:P=9')

Setting sent:

```
maxRevolutionFrequency (double:1) -> 594174.2
```

```
dipoleFieldRamp (double[][]:5x6) -> [0.0, 0.014, 0.118173, 0.0, 0.0, 0.0], [0.014, 0.046, 0.11817300000000003, 7.848151850620155E-7, 32.08153797452546, 0.0], [0.046, 0.154, 0.15102452, 2.0532202777777777, 0.0, 0.0], [0.154, 0.186, 0.37277231000000033, 2.0532192151848125, -32.081537974525396, 0.0], [0.186, 0.226, 0.40562383, 0.0, 0.0, 0.0]
```

```
revolutionFrequencyRamp (double[][]:5x6) -> [0.0, 0.014, 150000.0, 0.0, 0.0, 0.0], [0.014, 0.046, 150000.0, -0.5832491594192106, 7083358.070286227, 0.0], [0.046, 0.154, 157253.34, 453333.5185185184, 0.0, 0.0], [0.154, 0.186, 206213.35999999996, 453334.33324915916, -7083358.070286199, 0.0], [0.186, 0.226, 213466.7, 0.0, 0.0, 0.0]
```

An exception occurred during data supply:

```
JapcParameterDriveResult [exception=cern.japc.core.ParameterException: Failed to connect to server 'DCCT_DU.sddsc055': failed to connect to 'tcp://sddsc055:13367', parameterName=GS01DT_ML/Setting, parameterValue=maxRevolutionFrequency (double:1) -> 594174.2
```

```
dipoleFieldRamp (double[][]:5x6) -> [0.0, 0.014, 0.118173, 0.0, 0.0, 0.0], [0.014, 0.046,
```

Close

Screenshots: ParamModi 3/3

Screenshot: Trim Tab – Show Settings on all levels of the hierarchy

The screenshot shows the ParamModi (STANDARD) @ PRO software interface. The main window is titled "ParamModi (STANDARD) @ PRO" and has a menu bar with "File", "Edit", "Extra", and "Help". The interface is divided into several panes:

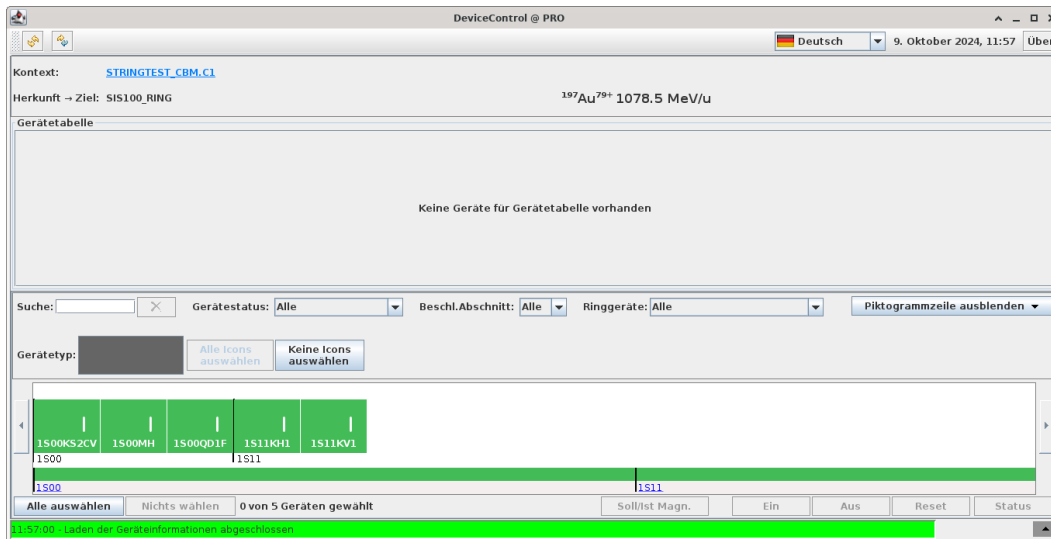
- Left Pane:** Shows a list of parameters under "StandAloneContext" and "Chains". The "Chains" section is expanded to show "STRINGTEST_CBM.C1".
- Middle Pane:** Shows "Particle Transfer" and "BeamProcess" sections. The "BeamProcess" section is expanded to show a list of parameters for "C1.SIS100_RING", including "BEAMOUT_INIT.1", "RING_INJECTION.1", "RING_RAMP.1", "RING_PRE_EXTRACTION_KO.1", and "BEAMOUT_RESET.1".
- Right Pane:** Shows "Parameter selection - SIS100_RING" with "Parameter Groups" and "Type Groups" lists. The "Parameters" section is expanded to show "LOGICAL.1S00MH/I".
- Bottom Pane:** Shows a graph of the "Displayed Function: LOGICAL.1S00MH/I" over time. The x-axis is labeled with "0E0", "5E5", "1E6", "1.5E6", and "2E6". The y-axis ranges from 0 to 12000. The graph shows a curve that rises from 0 to about 12000 at 5E5, stays flat until 1.5E6, and then falls back to 0. Below the graph are "Graph" and "Table" tabs.

At the bottom of the interface, there are several control buttons and options:

- Setting part: Value Target Correction
- Trim History
- Time base: Pattern BeamProcess
- Buttons: Trim, Trim point, Abort Trim, Cancel Last Trim, Apply
- Checkbox: Trim Expert Params

DeviceControl 1/3

- ◆ Control on device level
 - ❖ Reading status
 - ❖ Switching devices on / off
 - ❖ (Driving step motors, etc.)



Color code for all devices and their states in Device Control Application

Moving and measuring devices

All other devices



Device has its position inside beam trajectory. If it is a measuring device it should be able to measure.



Device is powered off and/or has a status error.



Device has its position outside beam trajectory.



Device is online, powered on and has no status error.



Device is offline.



Device is offline.



Device is a pneumatic actuator which is not in an outer nor in an inner position but in an undesired position in between.



Device is a stepping motor actuator which is not in an outer nor in an inner position but in a defined position in between.



DeviceControl 2/3

Screenshot: Show the Detailed Status Window of a device

The screenshot displays the DeviceControl software interface. On the left, a sidebar shows the context 'STRINGTEST_CBM.C1' and a list of devices. The main window is titled '1S00MH: Gerätestatus'. It features a green status bar indicating the device is online and in remote operation. Below this, key parameters are listed: Power (Ein), Steuerung (Remote), Server (PowerSupplyStrTest_DU.ksh5cus01), and FEC (ksh5cus01). The 'Detailed Status' section contains a list of 17 items, including ADC channels and SCMI modules, all marked as 'Unused'. The 'Module Status' section shows 'AdcDacChannel' as 'TrLocked' and 'TrAlive' as 'TrAlive'. The 'Exceptions' section is currently empty. At the bottom, there are control buttons for 'Drucken', 'Schließen', 'Soll/Ist Magn.', 'Ein', 'Aus', 'Reset', and 'Status'. An orange arrow points to the 'Status' button.

1S00MH: Gerätestatus

Gerät ist online, eingeschaltet, im Remotebetrieb und hat keinen Statusfehler

Power: Ein
Steuerung: Remote
Server: PowerSupplyStrTest_DU.ksh5cus01
FEC: ksh5cus01

Interlock: Nein
OP-Ready: bereit
Status: 09 Oct 2024 10:06:21
Modulstatus: 09 Oct 2024 10:06:21

Detailed Status

0	ADC 1100 Comp Neg 2	...	SCM4 7120 SignalsCoparator
1	ADC 1101 Comp Neg 1	...	SCM4 7121 MainContactor Failure
2	ADC 1102 Comp Pos 2	...	SCM4 7122 Unused Bit 34
3	ADC 1103 Comp Pos 1	...	SCM4 7123 Unused Bit 35
4	ADC 1104 DCCT Error	...	SCM4 7124 Unused Bit 36
5	SCM1 2100 Unused	...	SCM4 7125 Unused Bit 37
6	SCM1 2101 Unused	...	SCM4 7126 Unused Bit 38
7	SCM1 2102 SR1 1 Sek	...	SCM4 7127 Unused Bit 39
8	SCM1 2103 Unused	...	B11.1 8100 SR1 Sicherung
9	SCM1 2104 Unused	...	B11.1 8101 Unused
10	SCM1 2105 Unused	...	B11.1 8102 SR2 Sicherung
11	SCM1 2106 SR2 1 Sek	...	B11.1 8103 Unused
12	SCM1 2107 Unused	...	B11.1 8104 SR3 Sicherung
13	SCM1 2108 Freilauf Last	...	B11.1 8105 Unused
14	SCM1 2109 FL Last	...	B11.1 8106 SR4 Sicherung
15	SCM1 210A 1 Prim 20kV	...	B11.1 8107 Unused
16	SCM1 210B Unused	...	B11.1 8108 Erdungsschalter EIN = AH
17	SCM1 210C Unused	...	B11.1 8109 Unused

Module Status

0	AdcDacChannel	2	TrLocked
1	TrAlive		

Exceptions

Drucken | Schließen

1S00MH | 1S11

Alle auswählen | Nichts wählen | 1 von 5 Geräten gewählt

Soll/Ist Magn. | Ein | Aus | Reset | Status

DeviceControl 3/3

Screenshot: Switching Devices on/off, performing reset

The screenshot displays the DeviceControl @ PRO software interface. At the top, the window title is "DeviceControl @ PRO". The interface includes a language dropdown set to "English" and a timestamp of "October 9, 2024, 12:32 PM".

The main area shows the context: "Context: [STRINGTEST_CBM.C1](#)" and "Origin → destination: SIS100_RING" with a beam energy of $^{197}\text{Au}^{79+}$ 1078.5 MeV/u. Below this is a "Device table" section which is currently empty, displaying "No devices for device table".

A control panel below the device table includes a search field, "Device status: All", "Acc. Section: Alle", "Ring Devices: All", and a "Hide pictogram line" button. There are also "Reset Icon Selection" and "Select no icons" buttons.

The device list at the bottom shows five devices: 1S00KS2CV, 1S00MH, 1S00QD1F, 1S11KH1, and 1S11KV1. The 1S00MH device is highlighted in red. Below the list, there are buttons for "Select All", "Select nothing", "1 from 5 devices selected", "Set/Act. Magn.", "On", "Off", "Reset", and "Status".

A green status bar at the bottom of the window displays the message: "12:32:43 - 1S00MH: Power command OFF has been accepted. Please check the execution later." Two orange arrows point from the 1S00MH device in the list to the "Off" button and then to the status bar message.

MASP GUI (by APS)

◆ Display Interlocks and execution permission

MASP GUI @ PRO

Alarm Alarm stop

Available Chains and Status Selected Chain Overview Graphic Overview

#	Chain Name	Chain Status	Exec Perm	BeamMode	Last Update (Heartbeat)	LSACon	Alarm
32	ESR_SL_ISO_BREAKPOINT_August24.C1	OFFLINE	true	NO_BEAM	09.10.2024 10:30:33	true	false
1	SIS18_FAST_RF_SYNC_COMMISSIONING.C1	OFFLINE	true	NO_BEAM	09.10.2024 10:30:33	true	false
2	SIS18_FAST_HHD_20220629_QKicker.C1	OFFLINE	true	NO_BEAM	09.10.2024 10:30:33	true	false
3	STRINGTEST_CBM.C1	OFFLINE	true	NO_BEAM	09.10.2024 10:30:33	true	false
31	CRYRING_2024_Marsh_N.C1	OFFLINE	true	NO_BEAM	09.10.2024 10:30:33	true	false

MASP GUI @ PRO

Alarm Alarm stop Über de

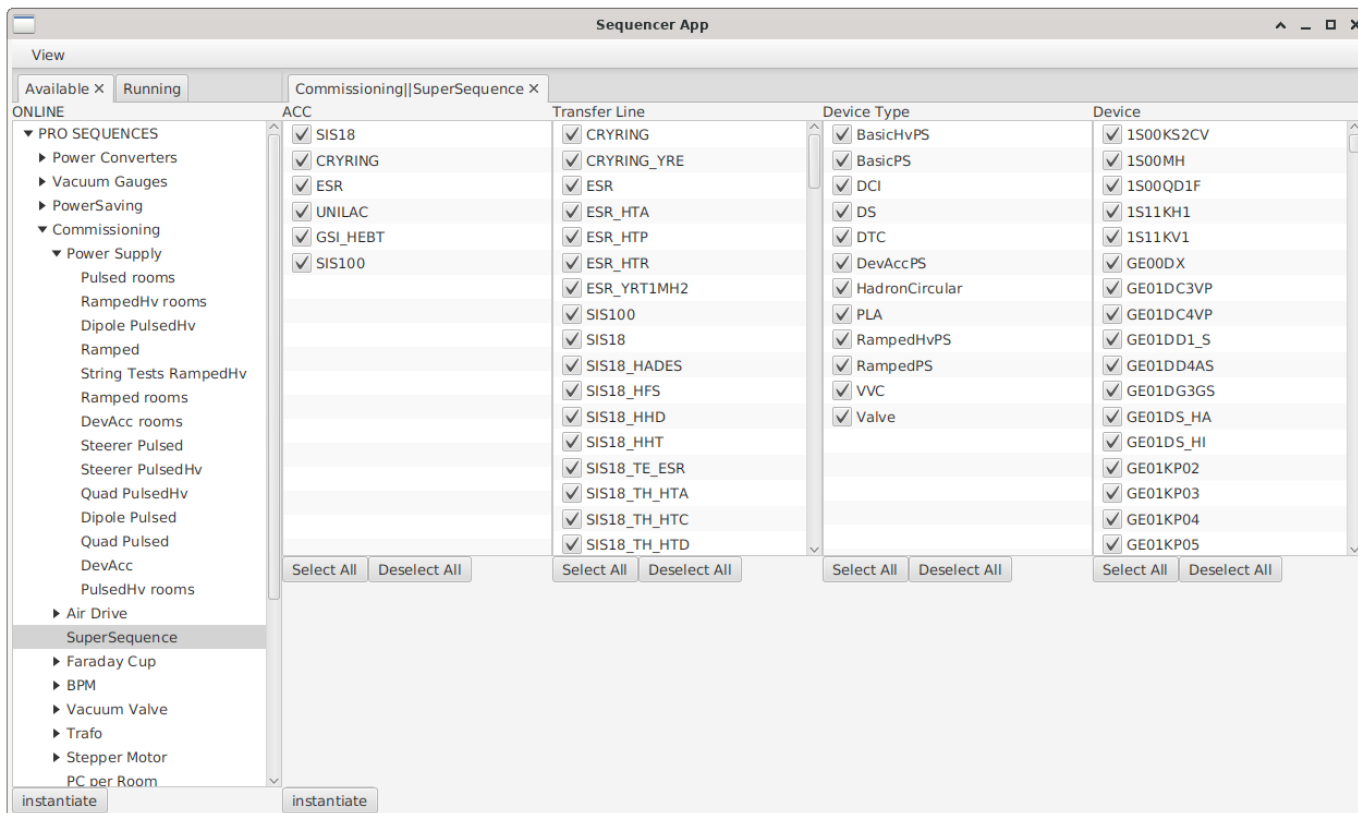
Available Chains and Status Selected Chain Overview Graphic Overview

3-STRINGTEST_CBM.C1

Name	Status	Maskable	N-Mask	F-Mask	S-Mask	Beam Mode
▼ STRINGTEST_CBM.C1	OFFLINE					
▼ TRANSFER/LINAC	OFFLINE					NO_BEAM
▼ GLOBAL	OFFLINE		NONE	NONE	NONE	
▶ U_CAPGATEWAY	ACTUAL_OK	false	false	NONE	NONE	
▶ U_HW_ILK	OFFLINE	false	false	NONE	NONE	
▼ SIS100_RING	SETUPBEAMFLAG_MASKABLE		NONE	NONE	NONE	
▶ 1S00KS2CV	ACTUAL_OK	true	false	NONE	NONE	
▶ 1S00MH	SETUPBEAMFLAG_MASKABLE	true	false	NONE	NONE	
▶ 1S00QD1F	ACTUAL_OK	true	false	NONE	NONE	
▶ 1S11KH1	ACTUAL_OK	true	false	NONE	NONE	
▼ 1S11KV1	ACTUAL_OK	true	false	NONE	NONE	
INTERLCK	true	true	false	false	false	
POWER_ON	true	true	false	false	false	
OP_READY	true	true	false	false	false	
ONLINE	true	true	false	false	false	
REMOTE	true	true	false	false	false	
MOD_RDY	true	true	false	false	false	
UNIQUE_EMITTER	true	true	false	false	false	

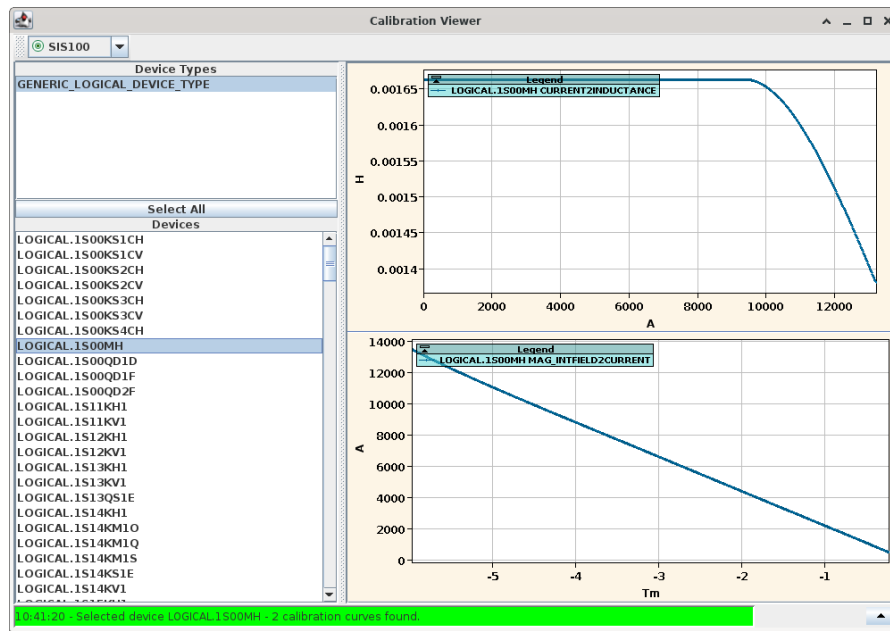
SequencerApp (by ACO-SER and OPE)

- ◆ Execute sequences of tasks on device level, used typically for commissioning, testing, but also for operational tasks



Other Applications

- ◆ Other Applications that might be of interest
e.g. Calibration Viewer, EquipState / FESA Explorer,
DAVE (Archiving), ...



CalibrationViewer



Thank you!

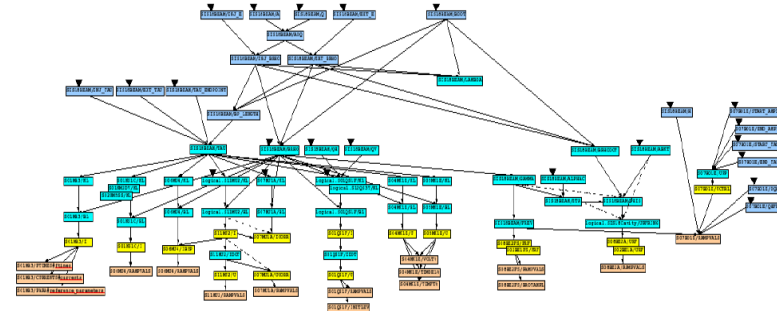
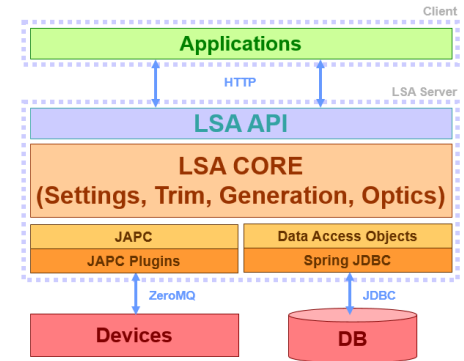
Agenda

- ◆ Backup Slides: LSA Framework

Settings Management System: LSA

LSA (LHC Software Architecture): Settings Management System

- well developed framework for CERN accelerators, now maintained and enhanced in collaboration
- highly data driven
- DB is the master, contains optics, devices, cycles, etc. for all accelerators
- parameters are organized in hierarchies (from physics to HW)
- consistent settings management on all levels
- devices are accessed using an abstraction layer that hides middleware
- => APP provides the framework
FAIR-DV and others the physics model



Terminology 1/2

- ◆ Beamline
 - ❖ Path along the facility, e.g. through HEBT
- ◆ Particle Transfer
 - ❖ pieces of a Beamline, between junctions
- ◆ Accelerator Zone
 - ❖ Sub-division of Particle Transfer where beam properties change, e.g. at choppers
- ◆ Device
 - ❖ Physical representation of Equipment in the Control System
- ◆ Parameters (“Hardware” Parameters)
 - ❖ Property-Field combination of a device, e.g. Setting/current

Terminology 2/2

- ◆ Beam Production Chain (BPC)
 - ❖ Organizational structure to manage parallel operation and beam transfer through FAIR accelerator facility
 - ❖ Defines the beam line and contains the settings for the parameters
- ◆ Pattern
 - ❖ Grouping of Beam Production Chains
- ◆ Parameter and Setting
 - ❖ A setting is a scalar/function for a parameter depending on a context (i.e. BeamProcess)

