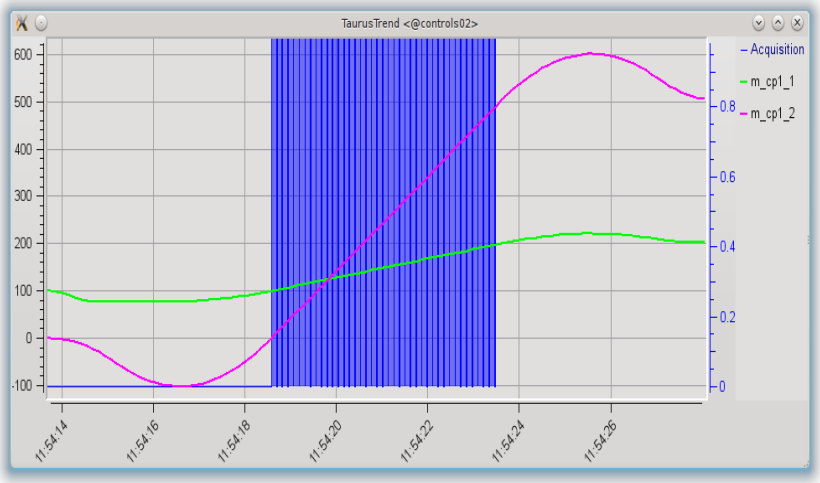
Iterative Development of the Generic Continuous Scans in Sardana



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Sardana – Scientific SCADA

- Sardana is an **open source**, **Python based**, **scientific SCADA** suite applicable in large spectrum of installations such as particle accelerators, experimental stations or small labs

www.sardana-controls.org

- Sardana was initially an internal Alba project

  ...but after its successful use in other synchrotrons it became a **community** driven project

www.albasynchrotron.es

- Its architecture is based on the **client-server** model with **Tango** as the middleware

www.tango-controls.org

Taurus Based User Interfaces

- Taurus is a framework for creating GUI and CLI to interact with control systems or other data sources

THHC3O03

www.taurus-scada.org

- **Spock** – **IPython** based Sardana CLI which syntax mimics **SPEC** commands, provides total control over the system: executes procedures, interacts with the elements, …

```
Door_1[2]: ascan mot01 0 10 3 0.1
Operation will be saved in /data/test.h5 (w5)
Scan #323 started at Sat Oct 11 21:27:02 2014.
Moving to start positions...
 #Pt No     mot01        ct01         dt
   0          0           0.1        0.6228
   1       3.33333        0.1        0.921683
   2       6.66667        0.1        1.16706
   3         10           0.1        1.41391
Operation saved in /data/test.h5 (w5)
Scan #323 ended at Sat Oct 11 21:27:04 2014
Door_1[2]:
```

Scan execution using Spock.

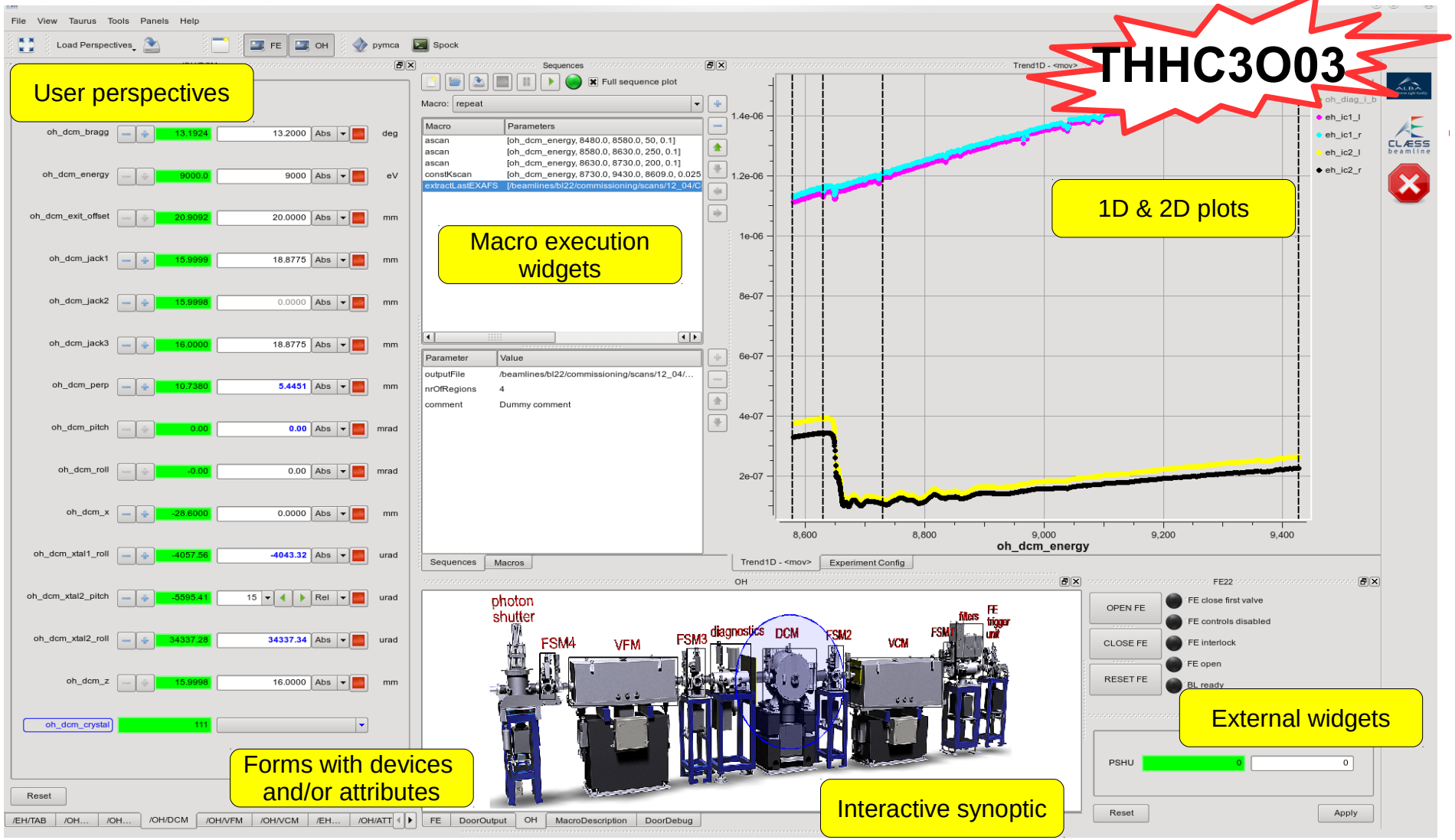
- **GUI**: Taurus based widgets e.g. macro executor, motor, experiment configuration, scan plots, …

  ...or a complete SardanaGUI without programming a single line of code!

Taurus based widgets interacting with Sardana

SardanaGUI w/o programming

THHC3O03



BL22 (ALBA) GUI created with the TaurusGUI framework

MacroServer & User Procedures

Hooks

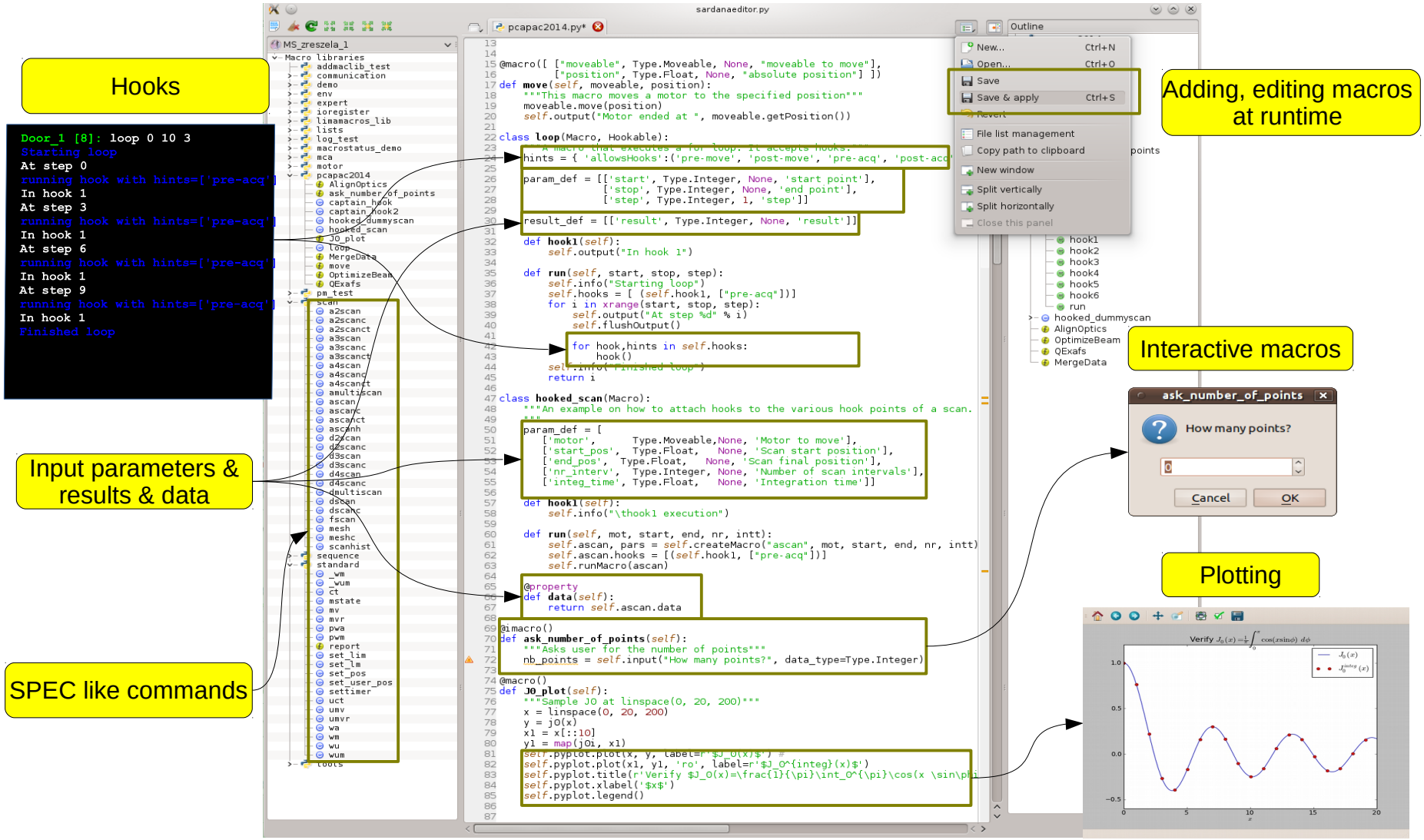
Input parameters & results & data

SPEC like commands

Adding, editing macros at runtime

Interactive macros

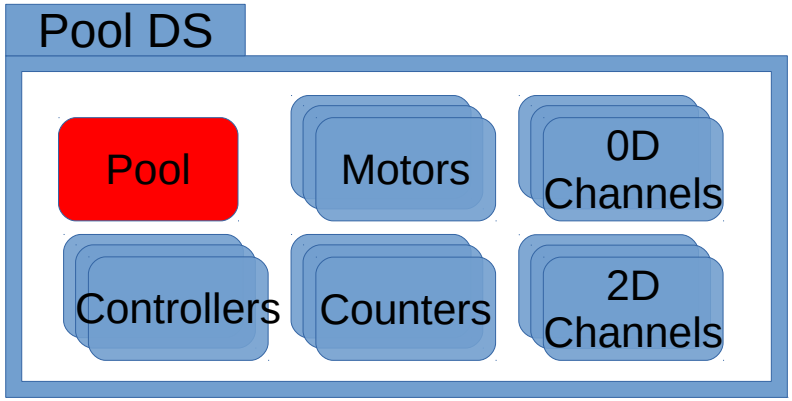
Plotting



Macro editor with exemplary macros demonstraing advanced macro programming features.

Pool - Unifies Hardware Access

- All the equipments are interfaced via Pool and its **plug-in** controller classes (**Python**)
- Generic elements' interfaces allow building high level layers on top of them e.g. MeasurementGroup, virtual/pseudo elements, generic GUIs, ...



Pool Device Server and its elements

Element Type	*Example of application*
Motor	stepper, servo or piezo actuator
PseudoMotor	energy, HKL of a diffractometer, slit's gap or offset
CounterTimer	event counter, position measurement
PseudoCounter	vertical beam position in the X-ray beam position monitor (XBPM)
0DExpChannel	analog to digital converter (ADC), low current electrometer
1DExpChannel	position sensitive detector (PSD), multichannel analyzer (MCA)
2DExpChannel	CCD camera, 2D X-ray detector

Sardana element types and its examples

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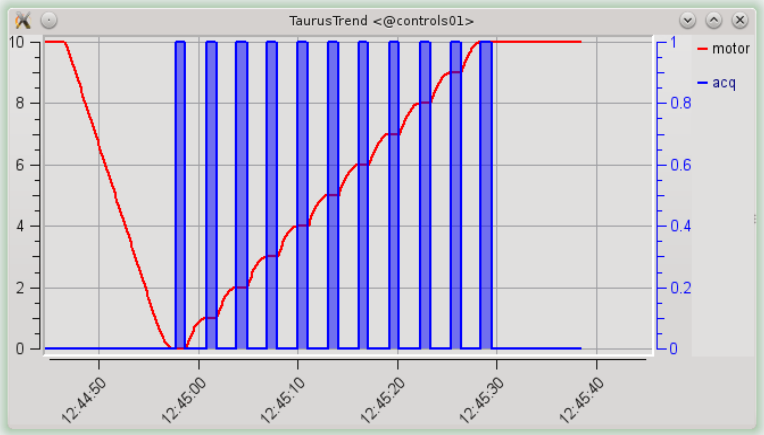
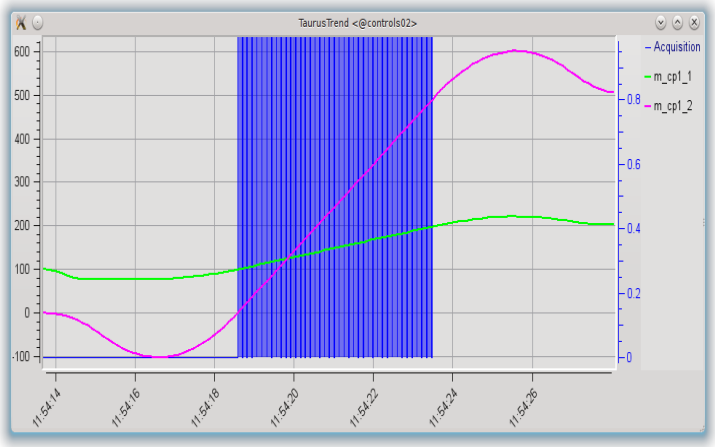
Continuous scans



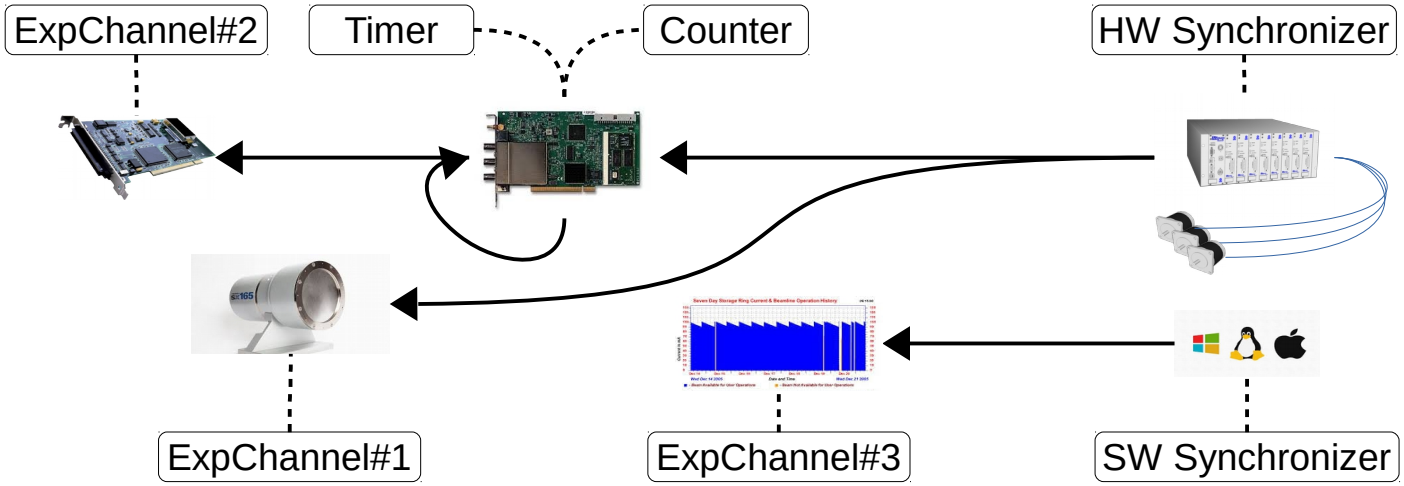
Motion & acquisition during the step scan.



Motion & acquisition during the continuous scan

- Give many benefits, but also many challenges...
- Numerous ad-hoc implementations, but hard to reuse...
- What do we focus on?
  - Abstract access to the hardware.
  - Generic hardware & software synchronization.
  - Common experiment configuration.
  - Transparent user experience with the scans: scan inputs and outputs.

Meas. Group Configuration



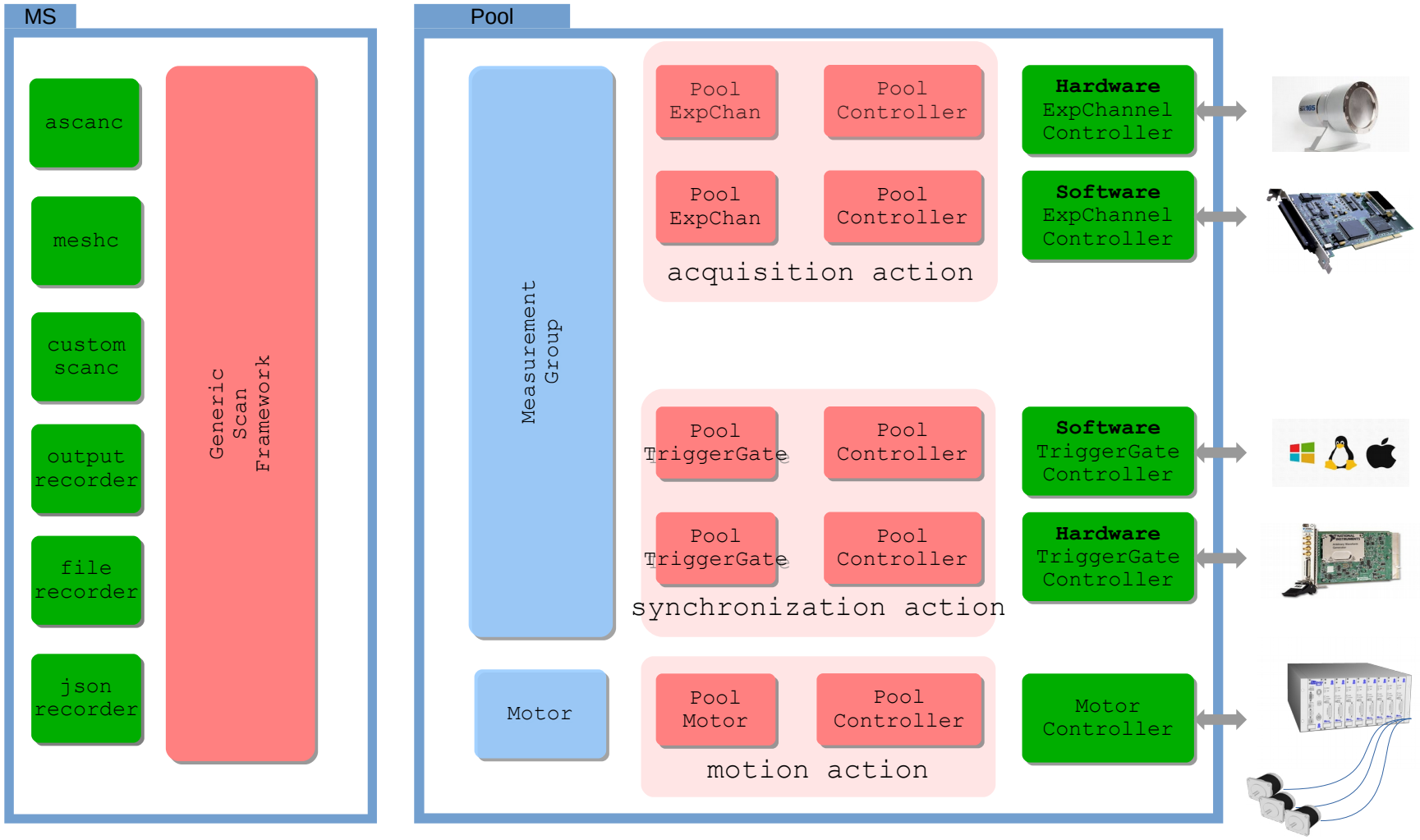
Exemplary setup involved in a continuous scan comprising mixture of hardware and software synchronization

Channel	Control	Synchronizer
Timer	Trigger	HW Synchronizer
ExpChannel#1	Trigger	HW Synchronizer
Counter	Gate	Timer
ExpChannel#2	Gate	Timer
ExpChannel#3	Trigger	SW Synchronizer

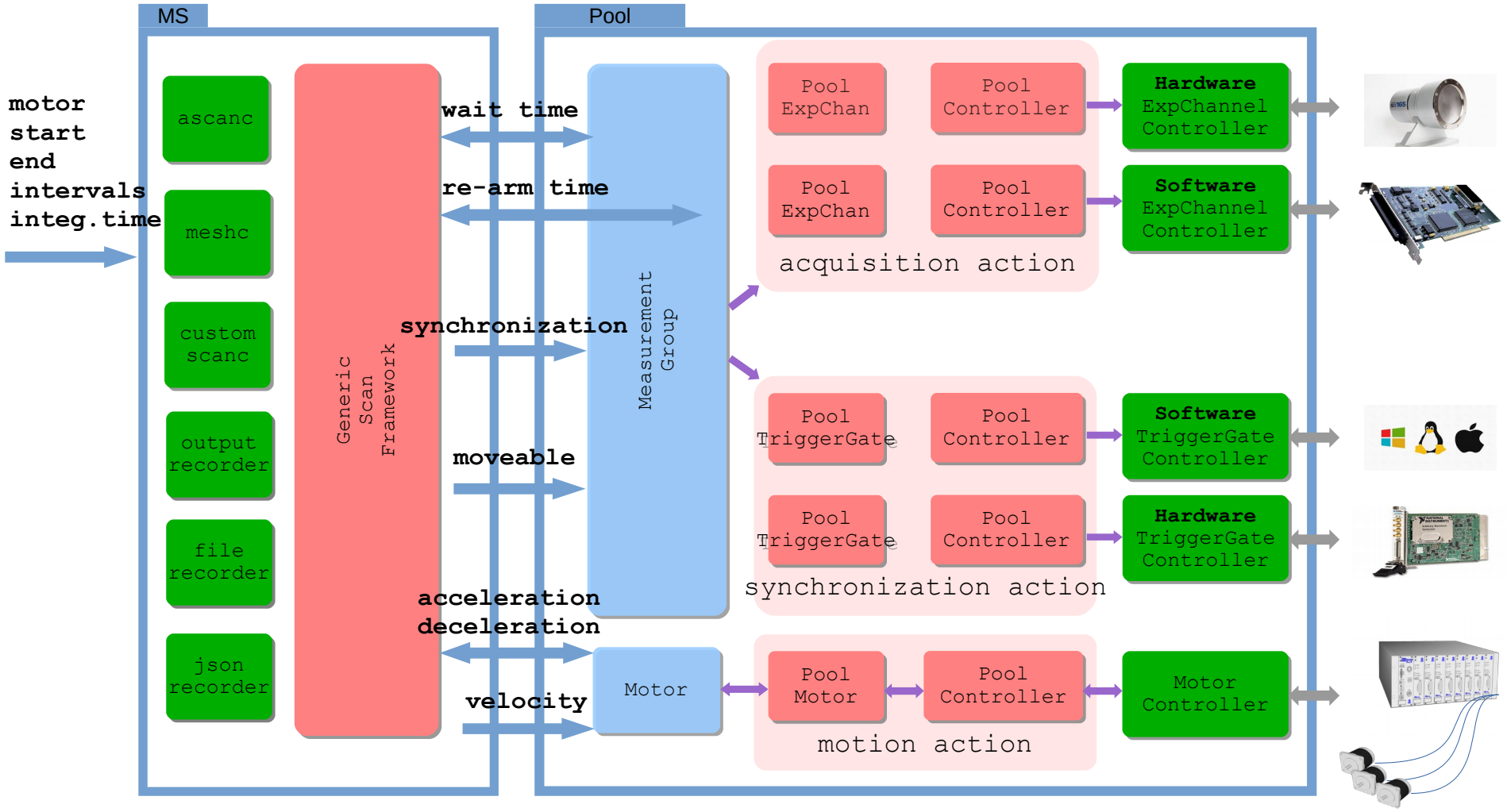
Direction of the synchronization control

Measurement Group configuration expressed by 1-to-1 relation between the Synchronizer and the Experimental Channel

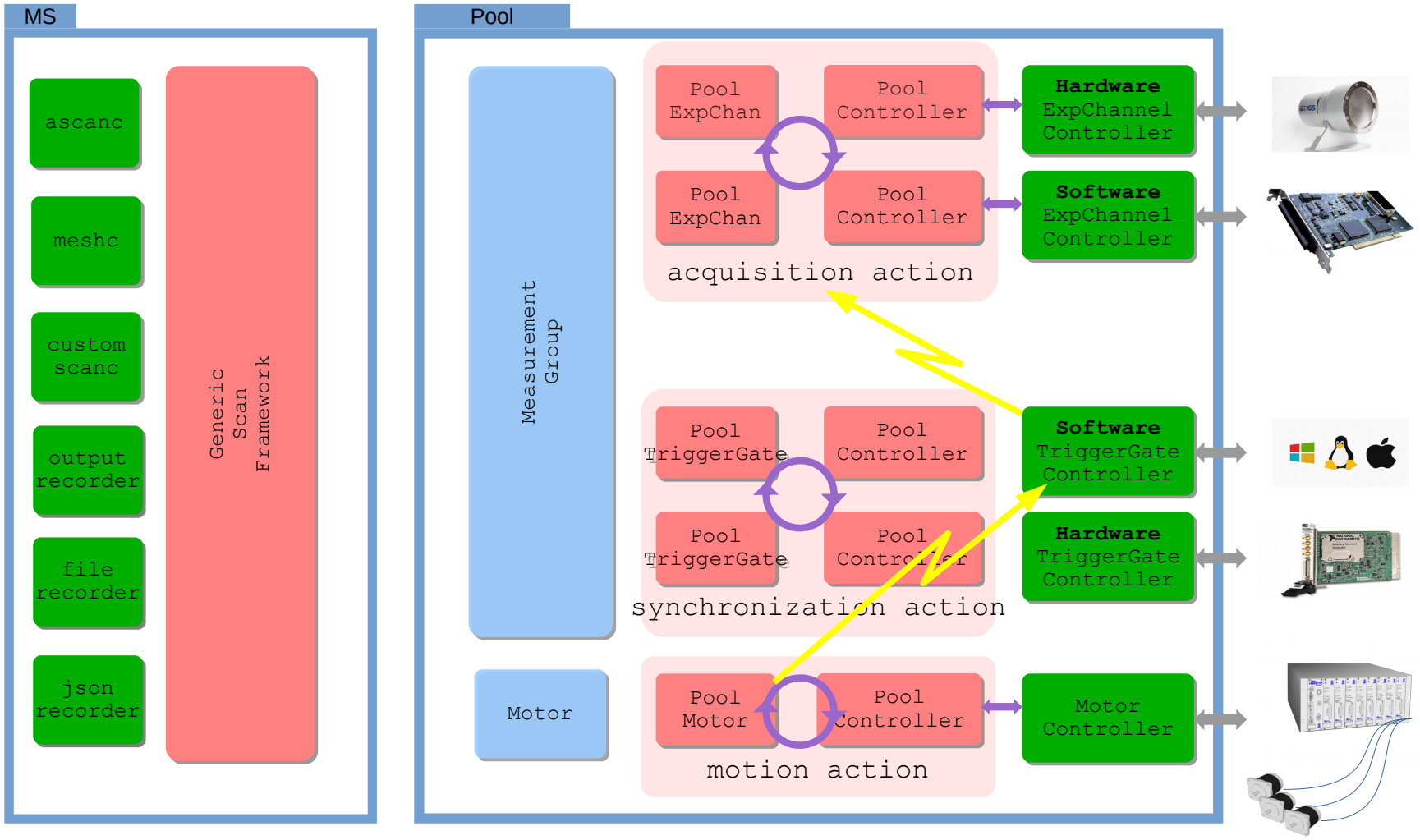
Involved elements



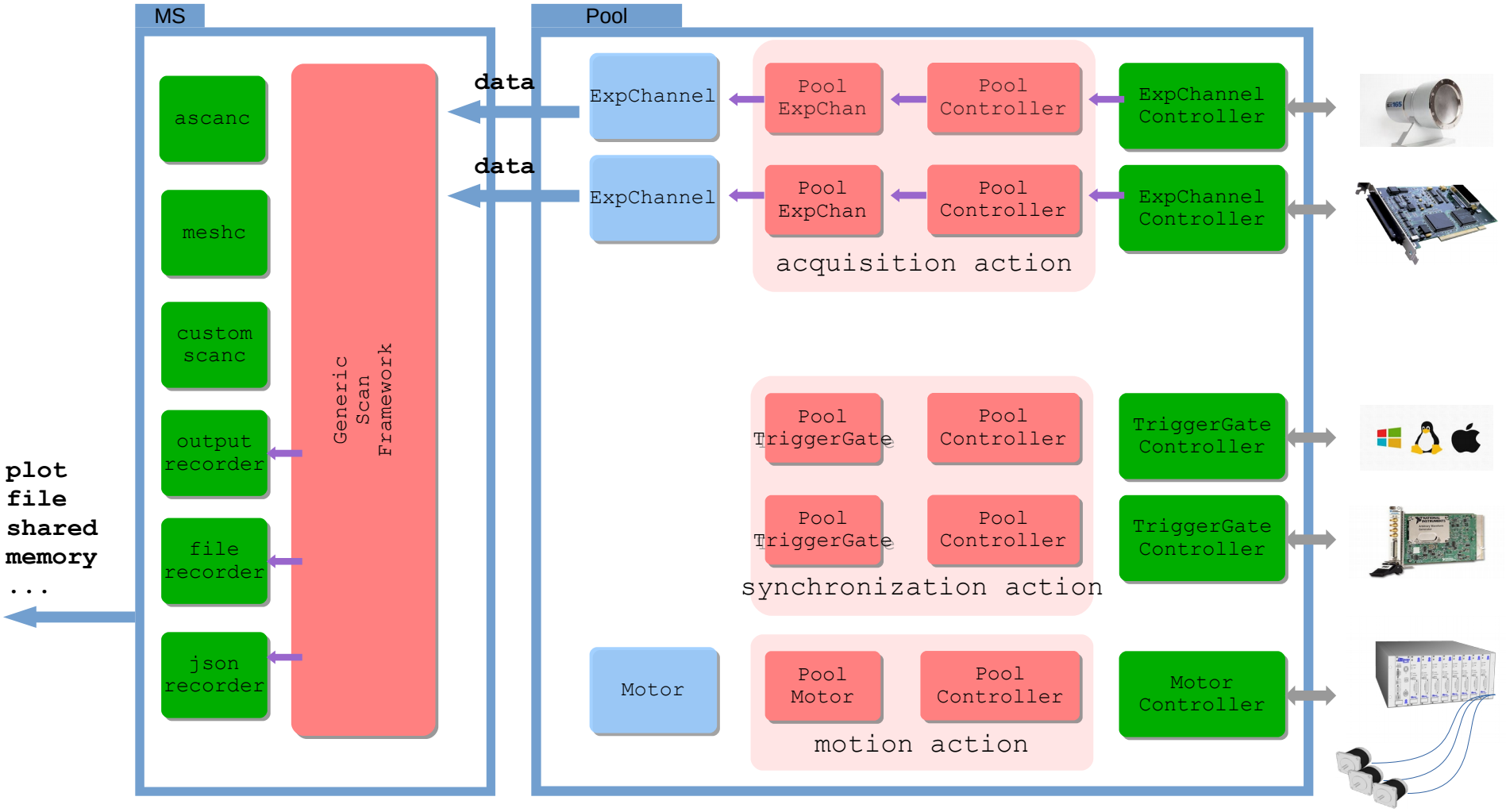
Scan configuration



Synchronization and acquisition



Data transfer, merging, storage



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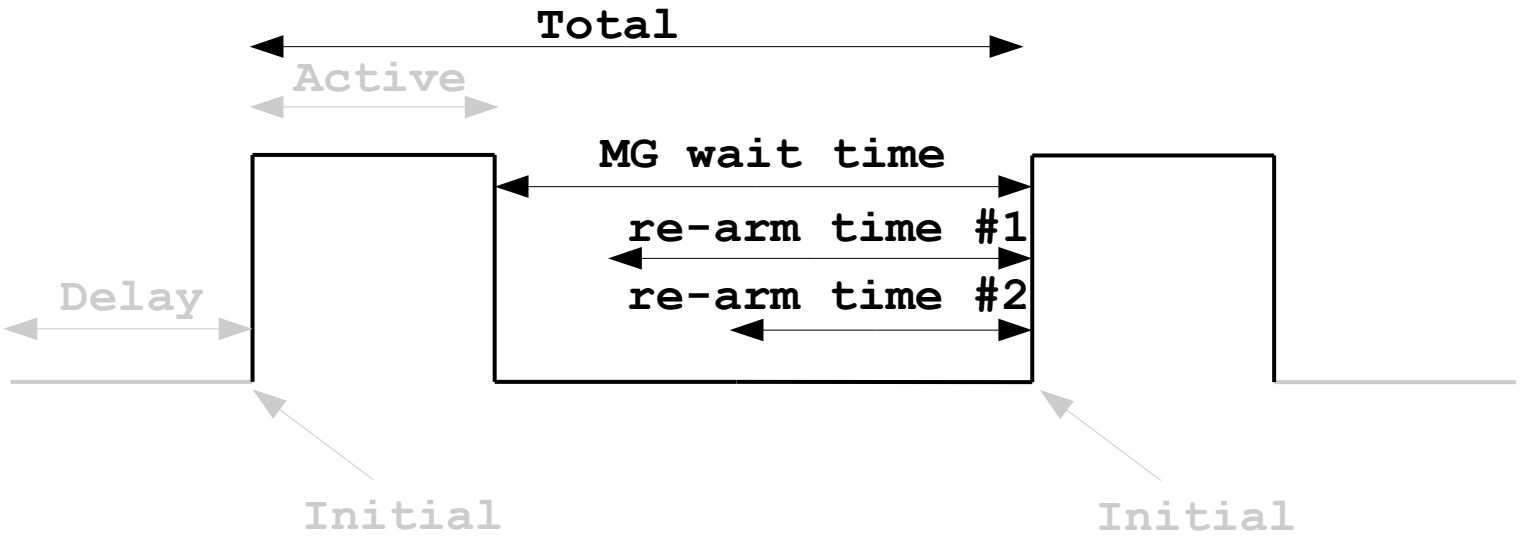
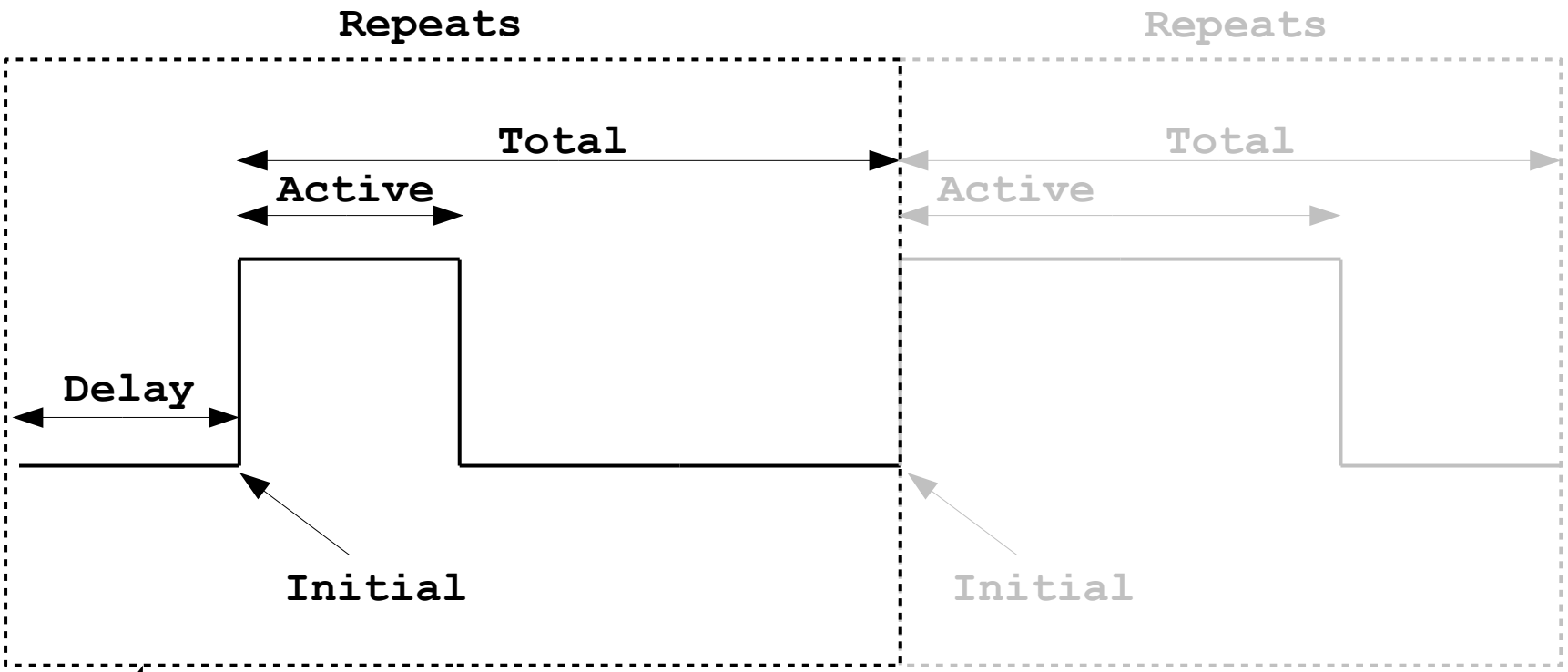
MG wait time & re-arm time



- **MG wait time** – configurable by user, useful when software synchronization is in use – helps to avoid skipped acquisitions.
- **re-arm time** – specification parameter defined by the experiment channel hardware controller
- **Passive time** = max(re-arm time #1, re-arm time #2, MG wait time)
- Affects directly total interval (time) and indirectly motors' velocities.

Synchronization description

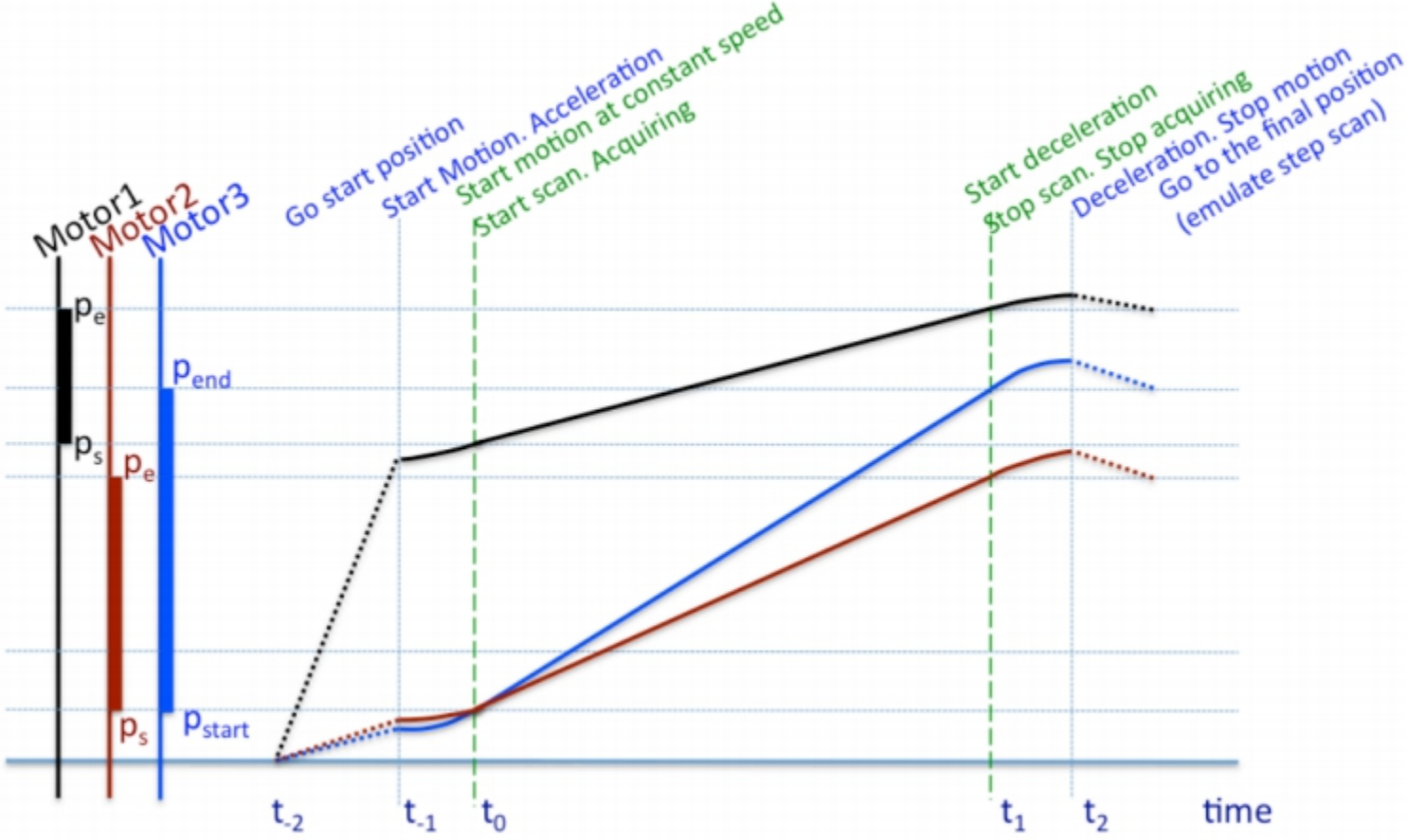


Group

```
[{Delay:    {Time: 0.3, Position: 400},
  Initial:  {Time: None, Position: 0},
  Active:   {Time: 0.1, Position: 10},
  Total:    {Time: 0.15, Position: 15},
  Repeats: 1000},
 ...]
```

Motion

- Physical motors maintain constant velocities while scanning – **no trajectory control** (for the moment...).



Data merging

- Every acquired value is stamped with the absolute time and the acquisition **index.**
- GSF **receives data in chunks** and fills the records based on the indexes.
- Software synchronized channels do not guarantee to provide data for each record.
- **Zero order hold** (constant interpolation) is applied in case of skipped acquisitions in order to fill the gaps.
- Interpolated data must be easily distinguishable from the raw data.

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Summary

- Design of the generic continuous scan model for Sardana is complete (for the equidistant scans).
- Implementation is still ongoing – its increments are gradually deployed in three Alba's beamlines.
- Non-equidistant scans will be possible by exchanging the scan configuration layer and use of multiple groups in the synchronization definition.
- Trajectory control is planned to be supported in the future.

Acknowledgement

- Alba beamline scientists – especially **François Fauth**, **Laura Simonelli** and **Manuel Valvidares** for their valuable feedback during the commissioning.
- We would also like to thank the Controls and Electronics Sections of Alba for their active work in this project: **Sergi Rubio**, **Fulvio Becheri**, **Roberto Homs**, **Daniel Roldan**, **Jordi Andreu** and **Xavier Serra**.
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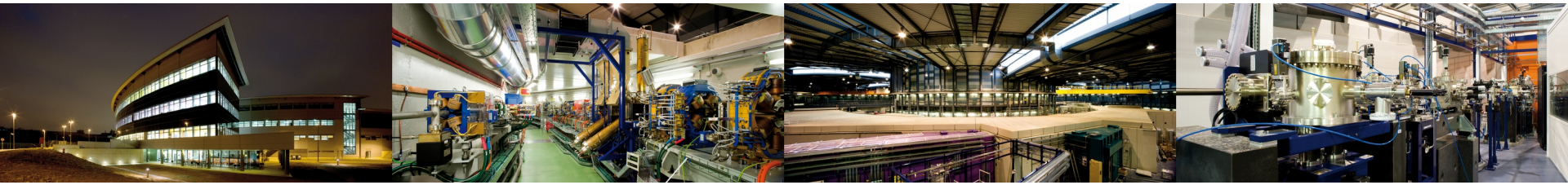

Thank you!


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