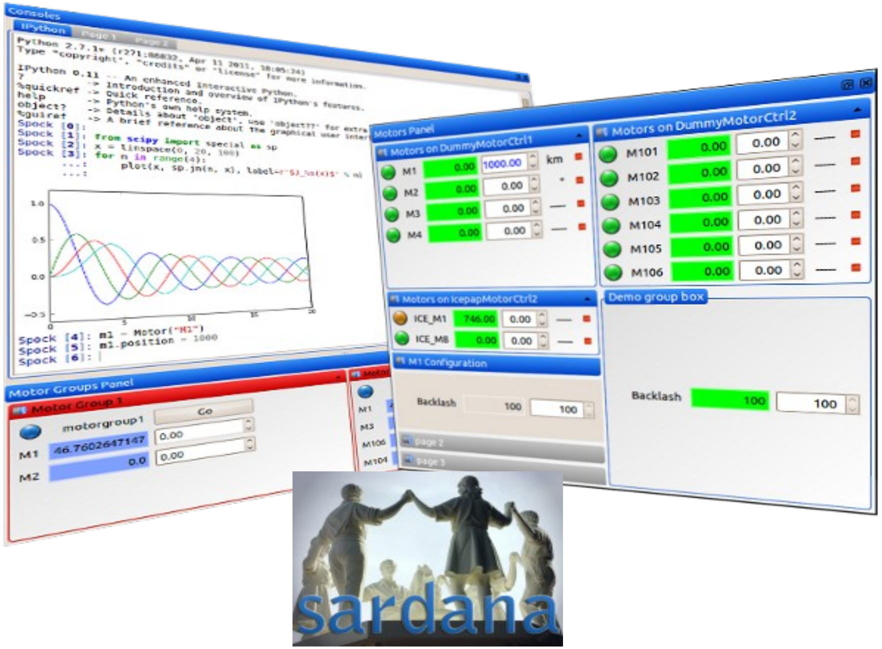


```
Python 2.7.1+ (r271:86832, Apr 11 2011, 18:05:24)
Type "copyright", "credits" or "license" for more information.

IPython 0.11 -- An enhanced Interactive Python.
?            -> Introduction and overview of IPython's features.
%quickref    -> Quick reference.
help         -> Python's own help system.
object?      -> Details about 'object', use 'object??' for extra
%guiref      -> A brief reference about the graphical user inter
Spock [0]:
Spock [1]: from scipy import special as sp
Spock [2]: x = linspace(0, 20, 100)
Spock [3]: for n in range(4):
     ...:     plot(x, sp.jn(n, x), label=r'$J_%s(x)$' % n)
     ...:
```

```
Spock [4]: m1 = Motor("M1")
Spock [5]: m1.position = 1000
Spock [6]:
```

Introduction to Sardana

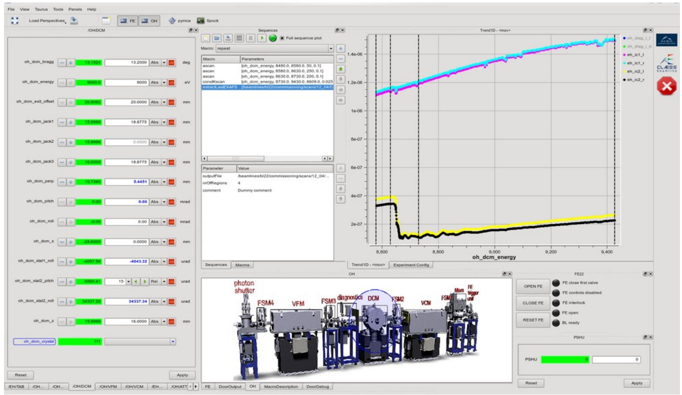
by **Zbigniew Reszela** (ALBA) on behalf of the **Sardana Community**

Tango Workshop @ ICALEPCS2021, 14.10.2021

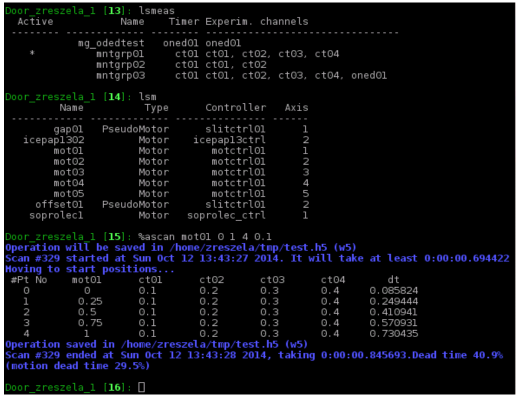
Prerequisites

- Tango DB
- TangoTest DS running
- https://github.com/sardana-org/sardana-training.git repository cloned

What is Sardana?



Taurus based GUIs



```
Door_zreszela_1 [13]: lsmeas
  Active            Name    Timer Experim. channels
 -------- ------------- -------- ---------------------------------
              mg_odedtest   oned01 oned01
    *            mntgrp01     ct01 ct01, ct02, ct03, ct04
                 mntgrp02     ct01 ct01, ct02
                 mntgrp03     ct01 ct01, ct02, ct03, ct04, oned01

Door_zreszela_1 [14]: lsm
          Name          Type       Controller   Axis
 ----------- ------------ --------------- ------
         gap01   PseudoMotor       slitctrl01      1
   icepap1302         Motor    icepap13ctrl      2
         mot01         Motor       motctrl01      1
         mot02         Motor       motctrl01      2
         mot03         Motor       motctrl01      3
         mot04         Motor       motctrl01      4
         mot05         Motor       motctrl01      5
      offset01   PseudoMotor       slitctrl01      2
     soprolec1         Motor   soprolec_ctrl      1

Door_zreszela_1 [15]: %ascan mot01 0 1 4 0.1
Operation will be saved in /home/zreszela/tmp/test.h5 (w5)
Scan #329 started at Sun Oct 12 13:43:27 2014. It will take at least 0:00:00.694422
Moving to start positions...
 #Pt No    mot01      ct01      ct02      ct03      ct04       dt
   0         0        0.1       0.2       0.3       0.4     0.085824
   1        0.25      0.1       0.2       0.3       0.4     0.249444
   2        0.5       0.1       0.2       0.3       0.4     0.410941
   3        0.75      0.1       0.2       0.3       0.4     0.570931
   4         1        0.1       0.2       0.3       0.4     0.730435
Operation saved in /home/zreszela/tmp/test.h5 (w5)
Scan #329 ended at Sun Oct 12 13:43:28 2014, taking 0:00:00.845693.Dead time 40.9%
(motion dead time 29.5%)

Door_zreszela_1 [16]: ▯
```

Spock – IPython based CLI

Scientific SCADA Suite

Suite = Sardana & Taurus projects

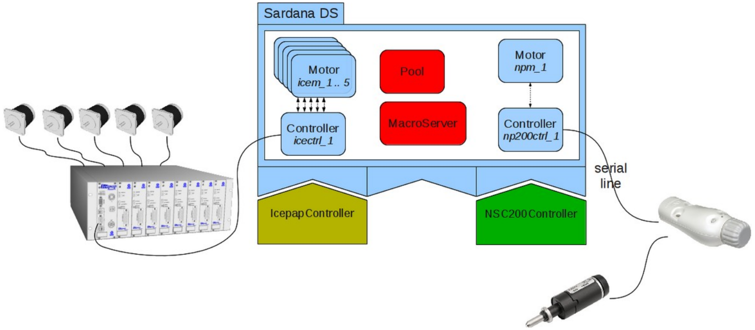
100 % Python

Built on top of Tango CS

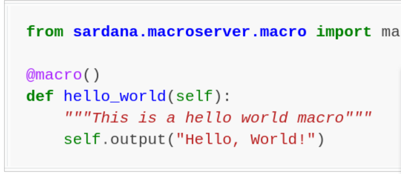
Extendable with plugins

Configure, don't program!

Device Pool – HW access + low level control

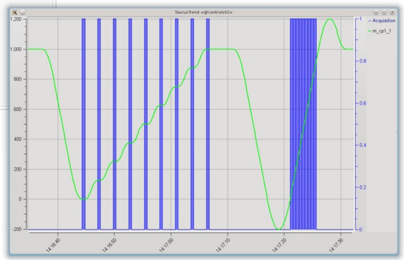


MacroServer – powerful sequencer



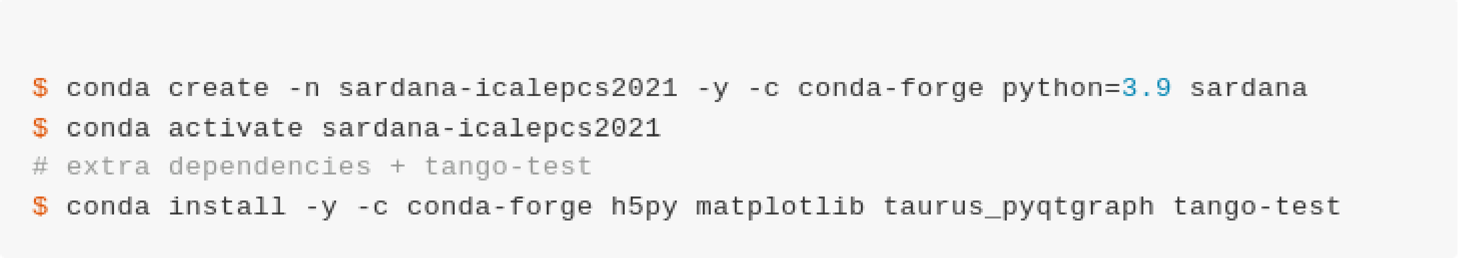
```
from sardana.macroserver.macro import macro

@macro()
def hello_world(self):
    """This is a hello world macro"""
    self.output("Hello, World!")
```



Installation

- Debian packages (apt install python3-sardana)
- PyPI (pip install sardana)
- Conda:

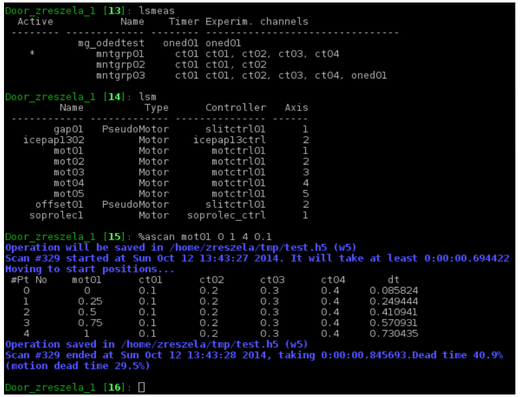


```
$ conda create -n sardana-icalepcs2021 -y -c conda-forge python=3.9 sardana
$ conda activate sardana-icalepcs2021
# extra dependencies + tango-test
$ conda install -y -c conda-forge h5py matplotlib taurus_pyqtgraph tango-test
```

Creating sar_demo environment

Creating sar_demo environment

- Start Sardana server
- Start Spock client
- List macros and elements
  - Built-in macros try to follow the SPEC syntax
- Run sar_demo macro



```
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               mntgrp03     ct01 ct01, ct02, ct03, ct04, oned01

Door_zreszela_1 [14]: lsm
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        mot02         Motor       motctrl01      2
        mot03         Motor       motctrl01      3
        mot04         Motor       motctrl01      4
        mot05         Motor       motctrl01      5
     offset01   PseudoMotor      slitctrl01      2
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Operation will be saved in /home/zreszela/tmp/test.h5 (w5)
Scan #329 started at Sun Oct 12 13:43:27 2014. It will take at least 0:00:00.694422
Moving to start positions...
 #Pt No    mot01      ct01      ct02      ct03      ct04       dt
   0         0        0.1       0.2       0.3       0.4     0.085824
   1        0.25      0.1       0.2       0.3       0.4     0.249444
   2        0.5       0.1       0.2       0.3       0.4     0.410941
   3        0.75      0.1       0.2       0.3       0.4     0.570931
   4         1        0.1       0.2       0.3       0.4     0.730435
Operation saved in /home/zreszela/tmp/test.h5 (w5)
Scan #329 ended at Sun Oct 12 13:43:28 2014, taking 0:00:00.845693.Dead time 40.9%
(motion dead time 29.5%)

Door_zreszela_1 [16]: 
```
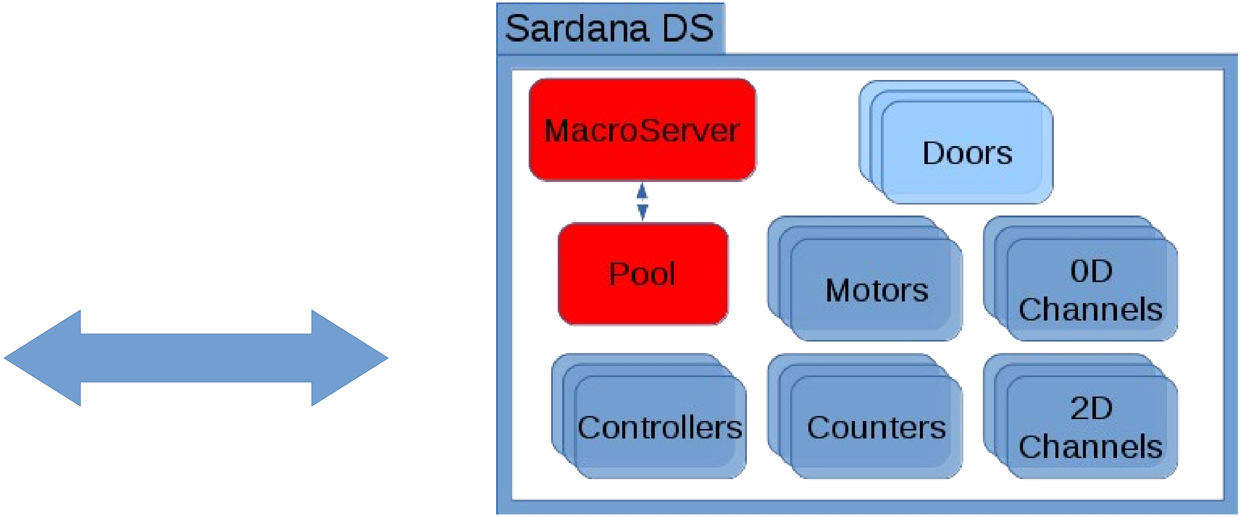
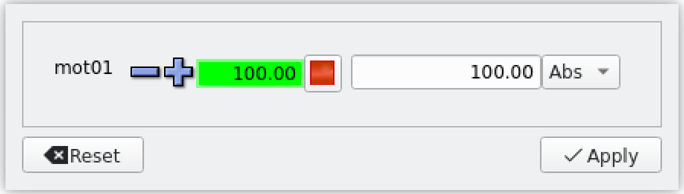
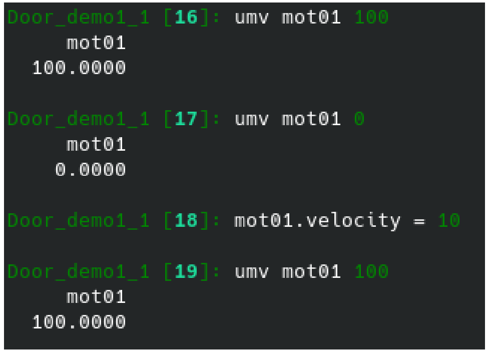



Motion control (simulators)

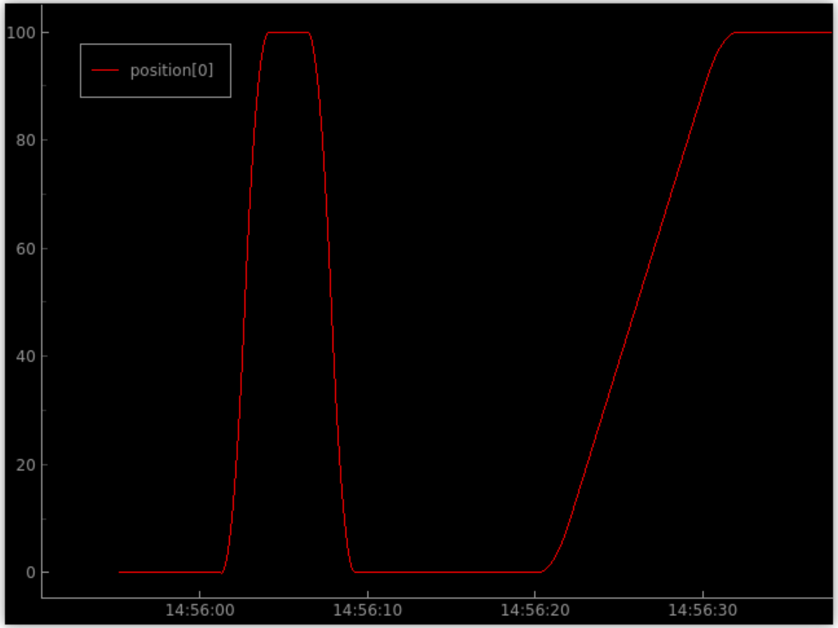
- Motor widget & motion macros
- Change motor’s velocity



mot01 100.00 100.00 Abs

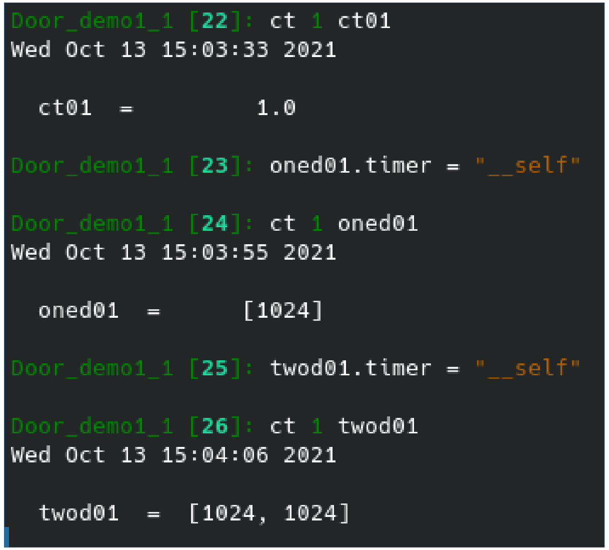


```
Door_demo1_1 [16]: umv mot01 100
      mot01
  100.0000

Door_demo1_1 [17]: umv mot01 0
      mot01
    0.0000

Door_demo1_1 [18]: mot01.velocity = 10

Door_demo1_1 [19]: umv mot01 100
      mot01
  100.0000
```

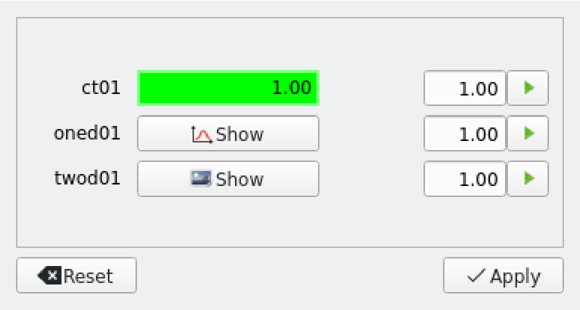


DAQ control (simulators)

- Channel widget and DAQ macros
- Change channel’s timer and integration time



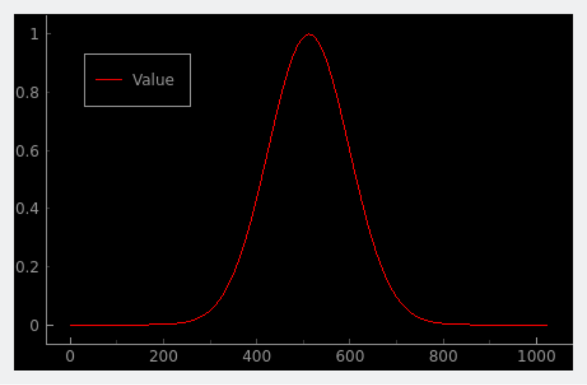
```
Door_demo1_1 [22]: ct 1 ct01
Wed Oct 13 15:03:33 2021

  ct01  =         1.0

Door_demo1_1 [23]: oned01.timer = "__self"

Door_demo1_1 [24]: ct 1 oned01
Wed Oct 13 15:03:55 2021

  oned01  =      [1024]

Door_demo1_1 [25]: twod01.timer = "__self"

Door_demo1_1 [26]: ct 1 twod01
Wed Oct 13 15:04:06 2021

  twod01  =  [1024, 1024]
```

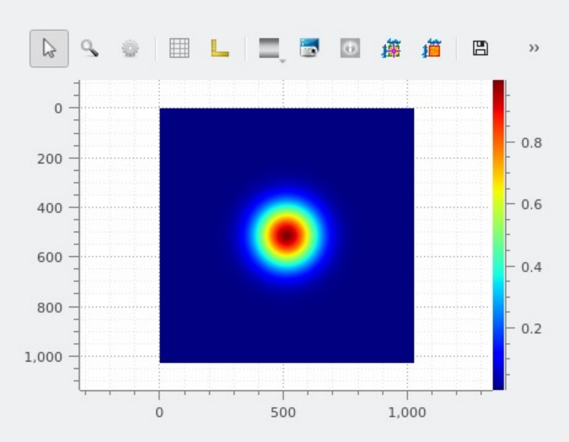


ct01 1.00 1.00

oned01 Show 1.00

twod01 Show 1.00





Taurus GUI

Taurus GUI without programming a single line of code

- Execute command: taurus newgui
- Follow the wizard:
  - Choose the project directory (e.g: <your home>/demogui)
  - Choose GUI name (e.g: demogui)
  - Add synoptic (optional): sardana-training/short/res/demoBL.jdw
  - Enable Sardana communication (optional) select: MacroServer - MacroServer/demo1/1 and Door - Door/demo1/1
  - Generate panels from Sardana Pool (optional): choose yes
- We will skip some steps: custom logo, extra panels, Monitor list

Taurus GUI - interaction with *instruments*

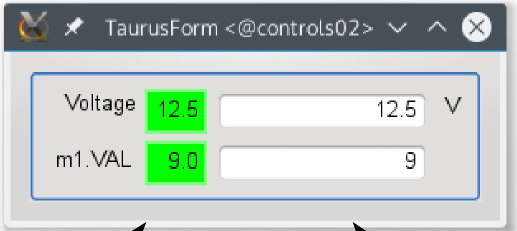
- Reorder the widgets for "interaction with instruments":
  - Go to Panels -> hide all panels
  - Click on the "demoBL" button in the toolbar to show the synoptic panel
  - Click on the "mirror" instrument in the synoptic (the area below "DCM"). This should show the "/mirror" panel
  - Move the "mirror" panel above the synoptic
  - Click on the slits in the synoptics (labeled "diagnostics" in the synoptic). This should show the "/slits" panel. Move it to a tab together with "/mirror"
  - Click on the monitor in the synoptics (labeled "FSM4" in the synoptic). This should show the "/monitor" panel. Move it to a tab together with "/mirror" and "/slits"
- Show the 2-ways communication between panels and synoptics
  - Click on the active areas of the synoptics and show that the corresponding panels are shown
  - Select the panels and see that the synoptic highlights the corresponding area
- Save as *Instruments* perspective

Taurus GUI - interaction with Tango CS

- Go to Panels -> hide all panels
- Create a Tango DB tree panel:
  - Use New Panel button
    - Select TaurusDBTreeWidget and use name db
    - Click on "Advanced Settings" and set tango://<your Tango DB host>:10000 as model and click on finish
- Create a Plot panel:
  - Use New Panel button
    - Select TaurusPlot and use name plot and click on finish
- Create a Form panel:
  - Use New Panel button
    - Select TaurusForm and use name form and click on finish
- Make sure that the "db" and "form" and "plot" panels are all simultaneously visible
- Add new elements to the "form" panel:
  - Navigate in the db panel to sys/tg_test/1/ampli, and drag and drop it into "form".
  - Navigate in the db panel to sys/tg_test/1/boolean_scalar, and drag and drop it into "form"
- Add a new element to the "plot" panel:
  - Navigate in the db panel to sys/tg_test/1/wave, and drag and drop it into "plot"
- Save as *Tango* perspective

Taurus models and schemes

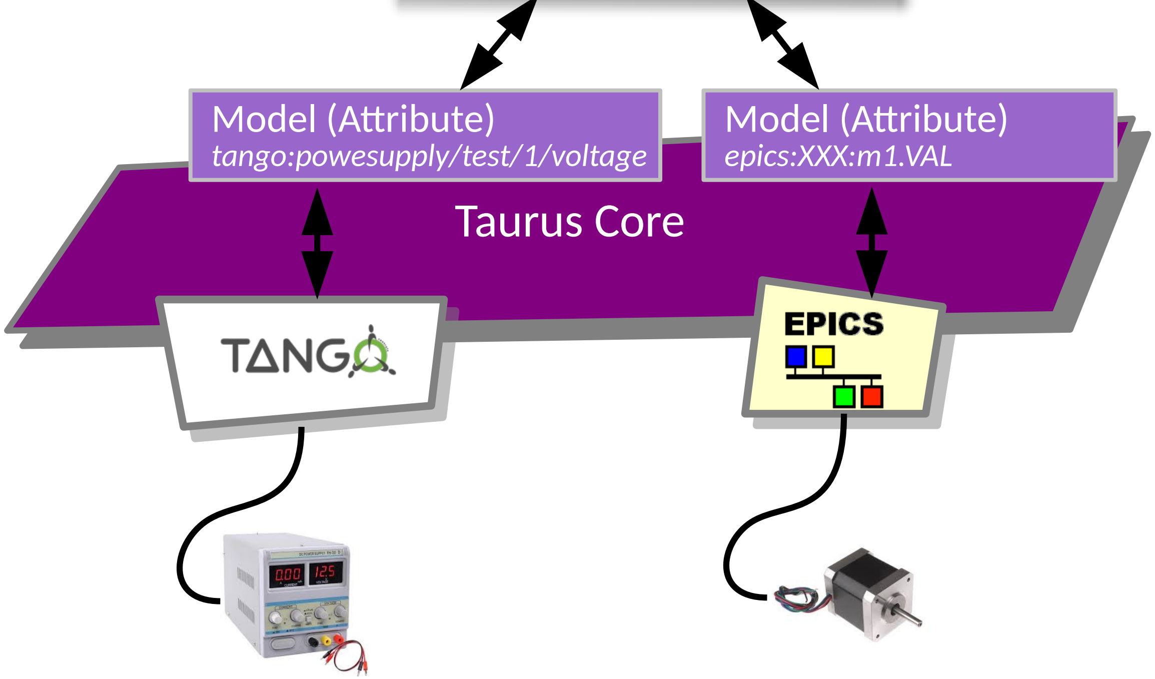
- Taurus is **data source agnostic**
- Taurus uses **Model ↔ View** pattern
- Models are provided by ***schemes* plugins**



TaurusForm <@controls02>

Voltage 12.5 12.5 V

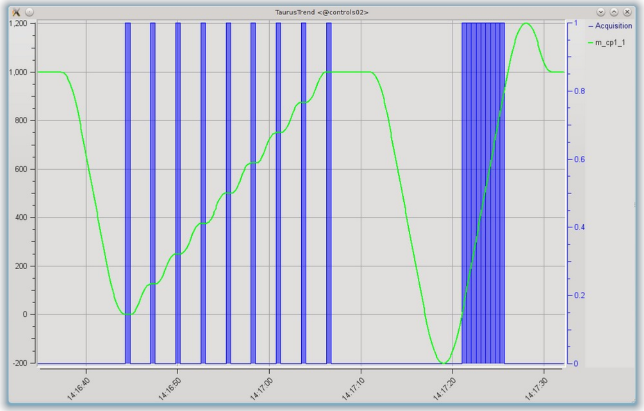
m1.VAL 9.0 9

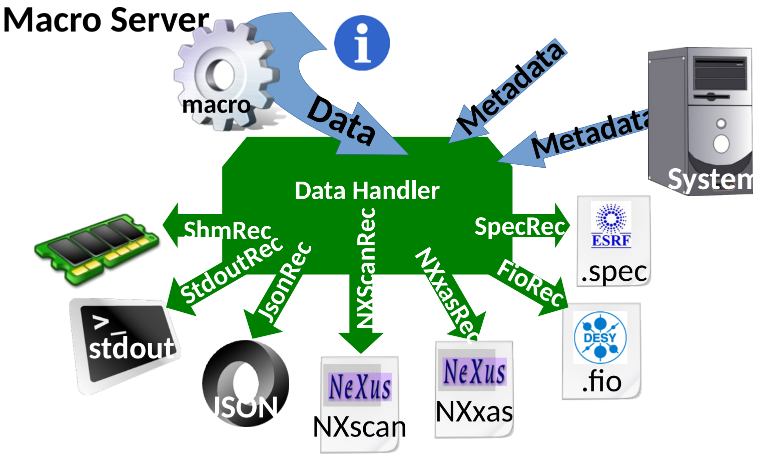


Scans

Generic Scan Framework

- Step and Continuous Scans
- Turn-key scan macros
- Framework for developing custom scans
- *Recorder* plugins for data storage





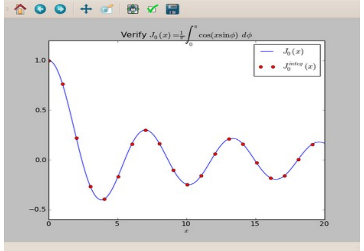
Developing macros and controllers

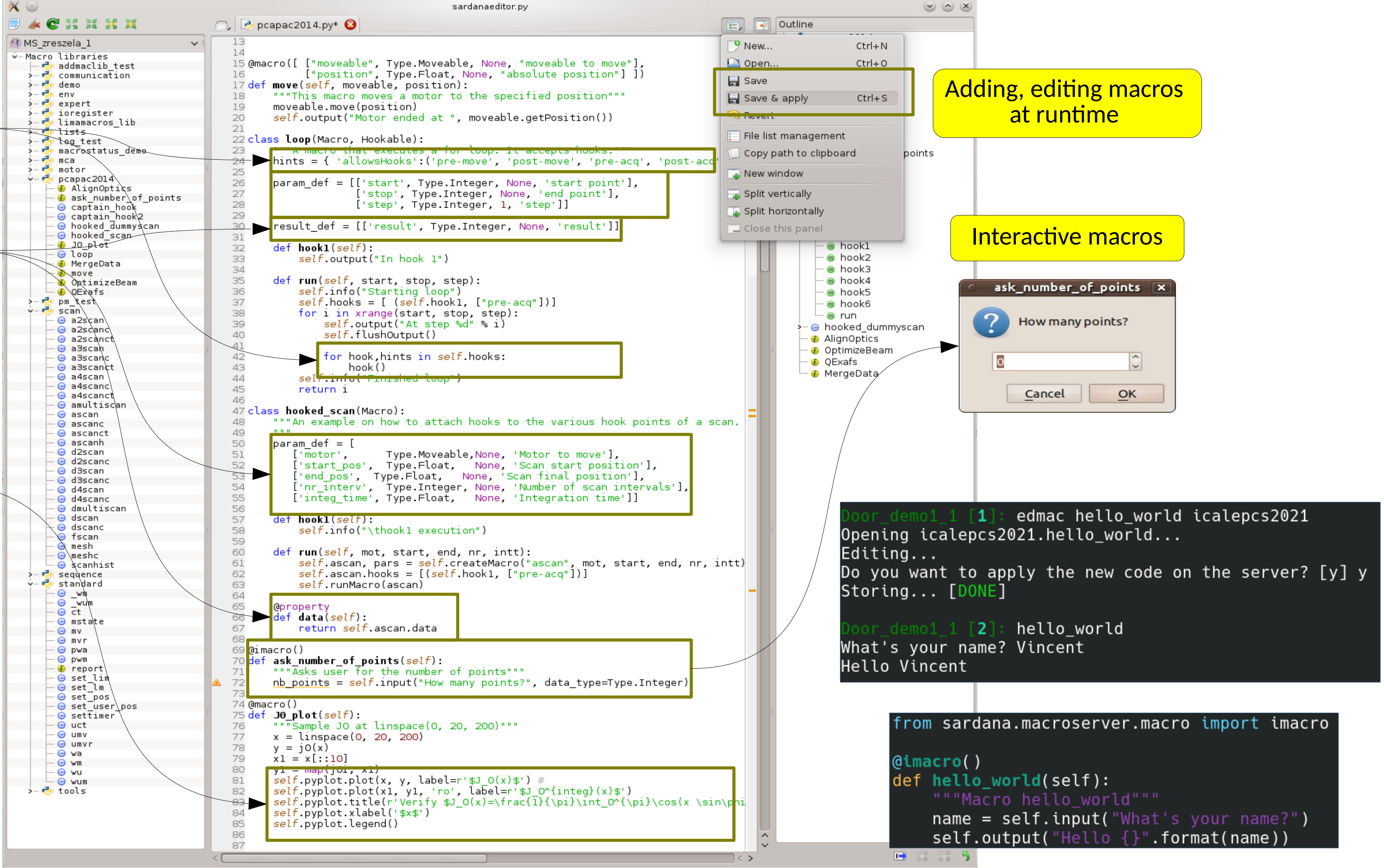
Developing custom macros

Hooks

Input parameters & results & data

Plotting





```python


@macro([ ["moveable", Type.Moveable, None, "moveable to move"],
         ["position", Type.Float, None, "absolute position"] ])
def move(self, moveable, position):
    """This macro moves a motor to the specified position"""
    moveable.move(position)
    self.output("Motor ended at ", moveable.getPosition())

class loop(Macro, Hookable):
    """A macro that executes a for loop. It accepts hooks."""
    hints = { 'allowsHooks':('pre-move', 'post-move', 'pre-acq', 'post-acq'

    param_def = [['start', Type.Integer, None, 'start point'],
                 ['stop', Type.Integer, None, 'end point'],
                 ['step', Type.Integer, 1, 'step']]

    result_def = [['result', Type.Integer, None, 'result']]

    def hook1(self):
        self.output("In hook 1")

    def run(self, start, stop, step):
        self.info("Starting loop")
        self.hooks = [ (self.hook1, ["pre-acq"])]
        for i in xrange(start, stop, step):
            self.output("At step %d" % i)
            self.flushOutput()

            for hook,hints in self.hooks:
                hook()
        self.info("Finished loop")
        return i

class hooked_scan(Macro):
    """An example on how to attach hooks to the various hook points of a scan.
    """
    param_def = [
       ['motor',      Type.Moveable,None, 'Motor to move'],
       ['start_pos',  Type.Float,   None, 'Scan start position'],
       ['end_pos',  Type.Float,   None, 'Scan final position'],
       ['nr_interv',  Type.Integer, None, 'Number of scan intervals'],
       ['integ_time', Type.Float,   None, 'Integration time']]

    def hook1(self):
        self.info("\thook1 execution")

    def run(self, mot, start, end, nr, intt):
        self.ascan, pars = self.createMacro("ascan", mot, start, end, nr, intt)
        self.ascan.hooks = [(self.hook1, ["pre-acq"])]
        self.runMacro(ascan)

    @property
    def data(self):
        return self.ascan.data

@imacro()
def ask_number_of_points(self):
    """Asks user for the number of points"""
    nb_points = self.input("How many points?", data_type=Type.Integer)

@macro()
def J0_plot(self):
    """Sample J0 at linspace(0, 20, 200)"""
    x = linspace(0, 20, 200)
    y = j0(x)
    x1 = x[::10]
    y1 = map(j0l, x1)
    self.pyplot.plot(x, y, label=r'$J_0(x)$') #
    self.pyplot.plot(x1, y1, 'ro', label=r'$J_0^{integ}(x)$')
    self.pyplot.title(r'Verify $J_0(x)=\frac{1}{\pi}\int_0^{\pi}\cos(x \sin\phi
    self.pyplot.xlabel('$x$')
    self.pyplot.legend()
```

Adding, editing macros at runtime

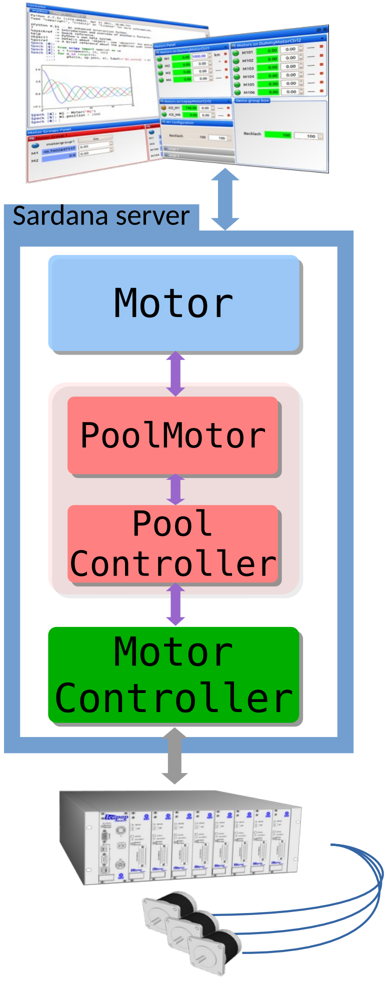
Interactive macros

```
Door_demo1_1 [1]: edmac hello_world icalepcs2021
Opening icalepcs2021.hello_world...
Editing...
Do you want to apply the new code on the server? [y] y
Storing... [DONE]

Door_demo1_1 [2]: hello_world
What's your name? Vincent
Hello Vincent
```

```python
from sardana.macroserver.macro import imacro

@imacro()
def hello_world(self):
    """Macro hello_world"""
    name = self.input("What's your name?")
    self.output("Hello {}".format(name))
```

Developing custom controllers

- Motor standard interface
- MotorController API
- *Blender Slits* as custom hardware
- Plugin discovery mechanism
- Define Sardana controllers and elements
- Scan *Blender Slits* offset



Motor

position: float
state: enum
offset: float
sign: int
steps_per_unit
…

Stop()
Abort()
…

```
class MyMotorCtrl(MotorController):

    def StateOne(self, axis):
        [...]

    def ReadOne(self, axis):
        [...]

    def StartOne(self, axis, pos):
        [...]

    def AbortOne(self, axis):
        [...]
```

Sardana Community collaboration

Sardana applications

ALBA	8 Beamlines (BLs) in prod. (+5 BLs in constr.); Accelerator (ACC); 3 Labs
DESY	14 BLs in prod.
ESRF The European Synchrotron	ACC operation (MacroServer only)
IPANEMA	1 Lab
LPS ORSAY	1 Lab (diffractometer)
MAX IV LABORATORY	14 BLs
MBI Max Born Institute	7 Lab setups
SOLARIS NATIONAL SYNCHROTRON RADIATION CENTRE	4 BLs in prod.

~50 Sardana applications

Community Tools & Events

Docs: ***http://www.sardana-controls.org***
http://www.taurus-scada.org

Projects: *https://gitlab.com/taurus-org/taurus*
https://github.com/sardana-org/sardana *(soon on GitLab)*

SEP Sardana Enhancement Proposal **TEP** Taurus Enhancement Proposal

SEP index: *https://sardana-controls.org/sep/index.html*
TEP index: *https://taurus-scada.org/tep/index.html*

Follow-up: *https://meet.jit.si/sardana*
https://github.com/sardana-org/sardana-followup *(soon on GitLab)*

Sardana plugins catalog: *https://github.com/sardana-org/sardana-plugins*
(soon on GitLab)

Training and workshops:
https://github.com/sardana-org/sardana-training *(soon on GitLab)*
(satellite to Tango meetings or ICALEPCS conference)

Announcements: *sardana-users@lists.sourceforge.net*
tauruslib-users@lists.sourceforge.net

Coordination: *sardana-devel@lists.sourceforge.net*
tauruslib-devel@lists.sourceforge.net

Thank you for your attention!