

# Motion control status in ALBA

Exchange on Motion Control in  
Synchrotron Radiation Facilities

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Julio Lidón - Electronics Group  
Guifré Cuní - Controls Group

- Hardware numbers
- Alba approach
- Motor controller configuration management system
- Integration in the Sardana control system
- Conclusions

# Motion numbers at ALBA

The main actuator at ALBA is the 2 phase stepper:

- ~500 axis distributed in 7 beamlines
- ~50 axis in 8 front ends
- ~50 axis in the accelerators

Around 50% of them have an associated encoder (incremental or ssi) and work in position closed loop

All driven with IcePAP controller

Apart from steppers, a handful of brushless DC motors driven with PMAC or ETEL controllers in specific equipment and few piezo actuators (Jena or PI controllers)

## Single controller solution. IcePAP

Simplifies:

- Software interface
- Axis configuration and operation
- Hardware axis synchronization
- Hardware maintenance and spare management
- Cabling

Equipment manufacturers are provided with guidelines during design stages

We haven't found problems with equipment manufacturers failing to supply compatible hardware

# Integration in complex setups

Apart from all the features mentioned in the previous presentation and standard in most controllers, these other features were very practical when integrating the motor controller in different setups:

- Easy forward of position information by means of encoder-like signals:
  - To counter or other acquisition cards for continuous scans
  - To external amplifiers (for non-standard motors)
- Easy interaction with PSS or other safety systems with “per axis” or “per rack” input disable signals
- Accepts external encoder-like signals as position source (slave mode): external boards can generate trajectories if the application demands it (RF cavities plungers)
- Immediate control of brakes and other subsystems through front panel available digital outputs that can be assigned to internal states (moving, stopped, acceleration, constant speed,...)

# System configuration: IcepapCMS

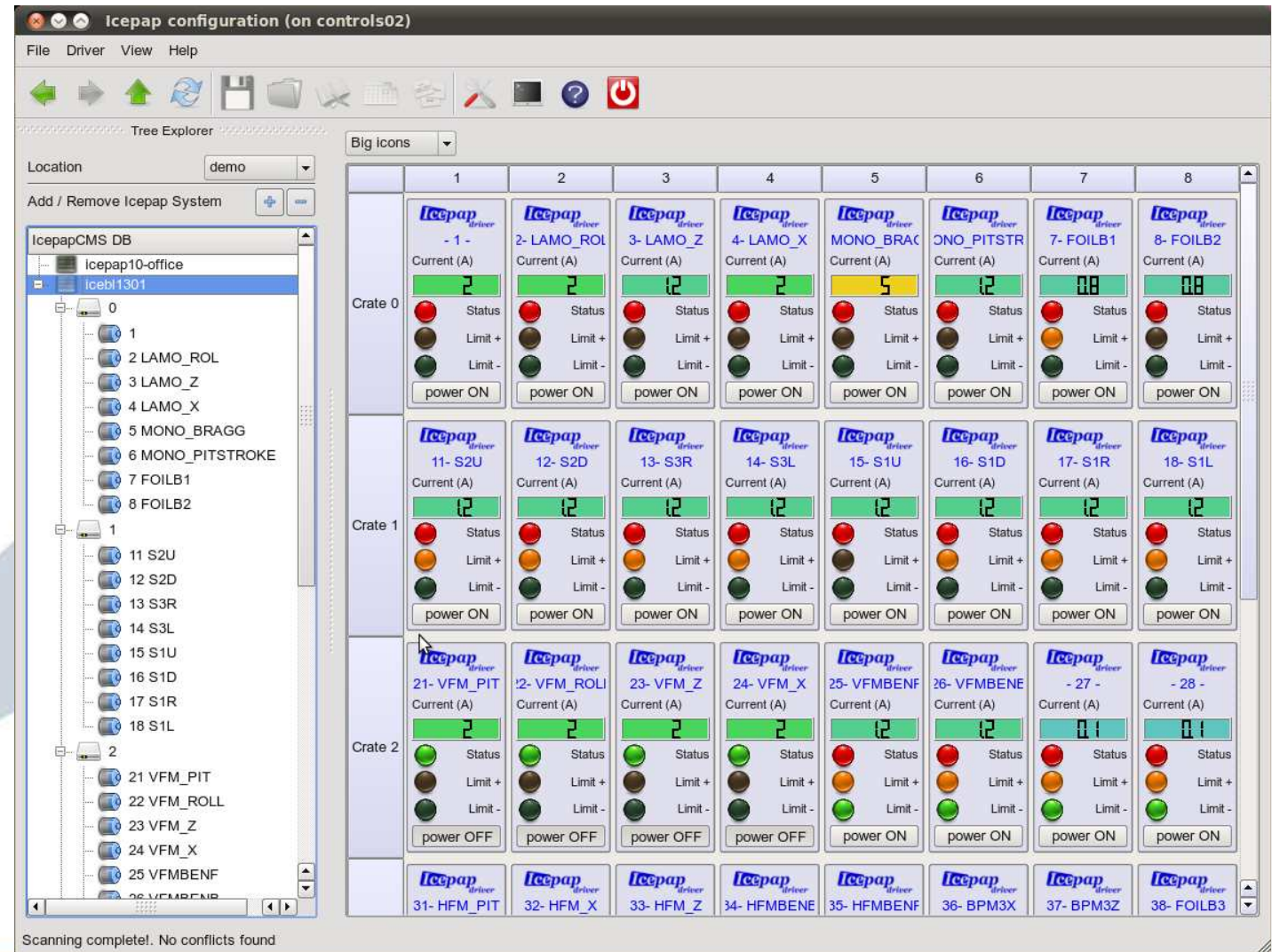
## A tool for managing axis configurations

Configurations stored in a DB

Whole system view

Browse by name

Current / Power / Limits at a glance





## DB Storage and user folders preferences

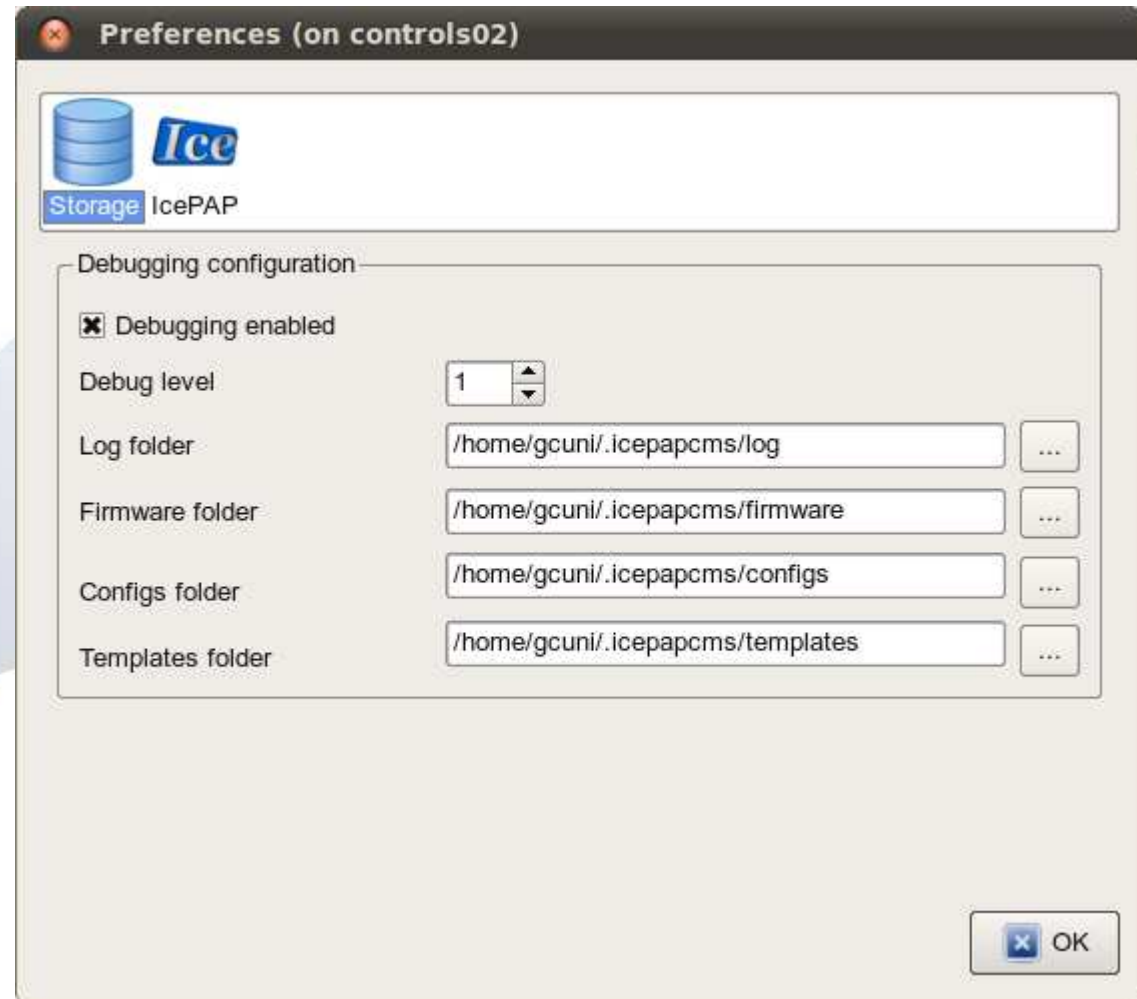
Storage:

- ) Sqlite
- ) MySql
- ) Postgres

IcePAP preferences:

- ) Log folder
- ) Firmware folder
- ) Configs folder
- ) Templates

folder



## IcepapCMS configuration tabs

Axis

Motor

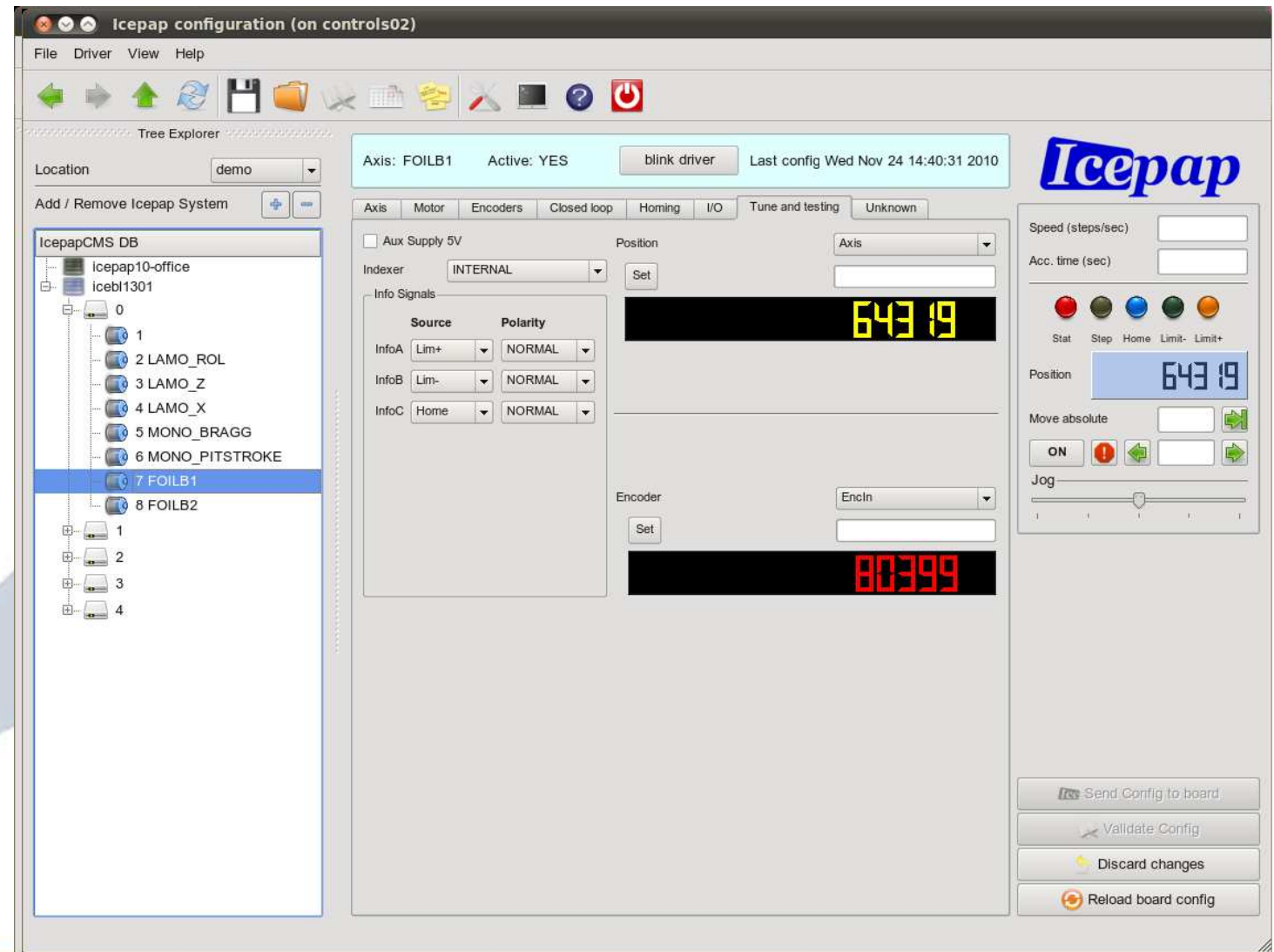
Encoders

Closed Loop

Homing

I/O

Tune&Testing



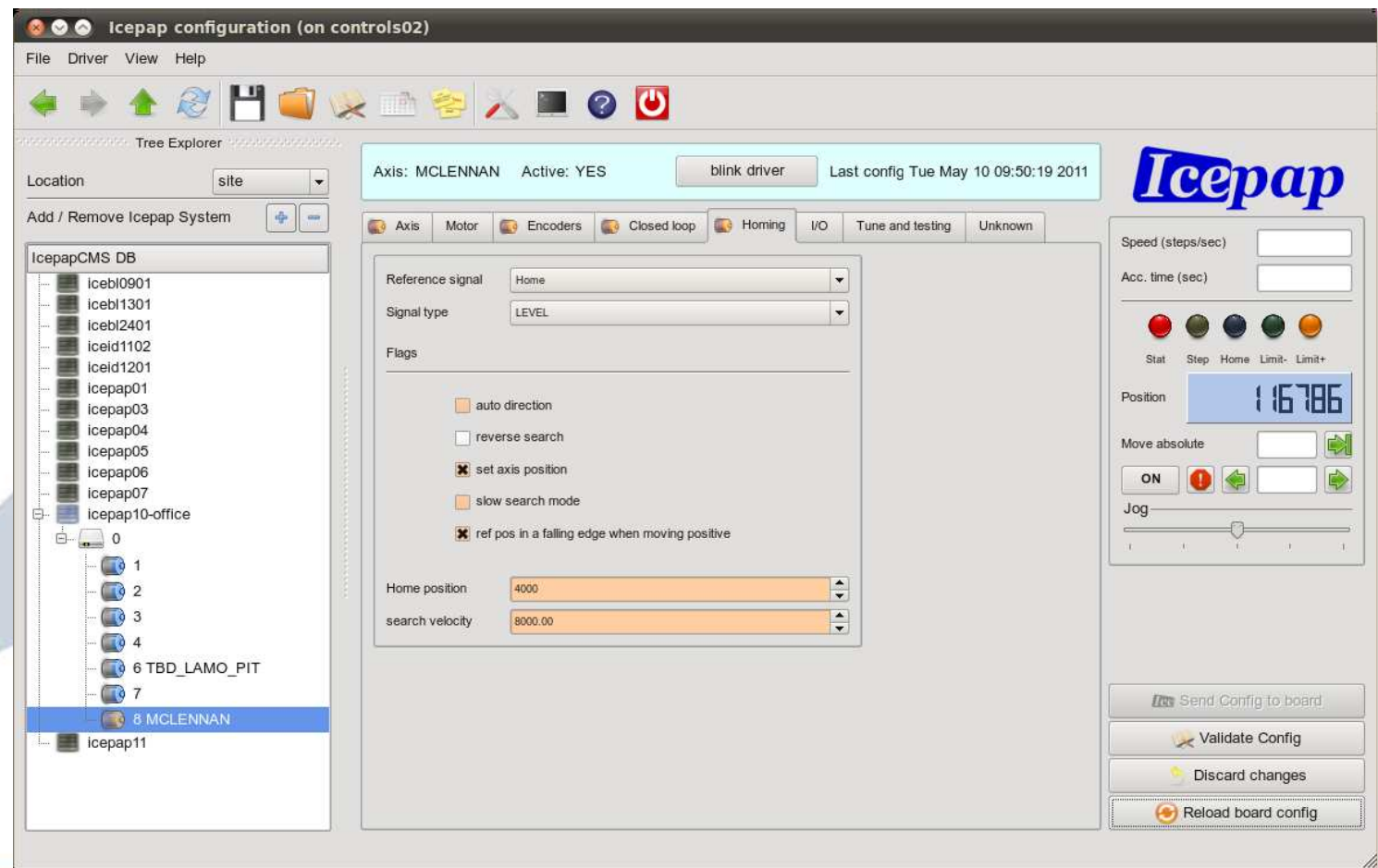


## Retrieve historical values

Calendar view

Highlighted changes

Database mismatch



## Template management (first draft)

Browse template

Filter by motor  
name or  
description

Apply all config  
values

IcepapCMS Templates Catalog (on controls02)

Filter column: Description Select ☒ Auto close

Template	Description
Oriental Motors PK264BE-SG10	ALBA FE MOVABLE MASK Oriental Motors PK264BE-SG10 Bipolar series 8 leads 1.4A, 3.9V, 2.8Ohm, 5.6mH 200steps x10 gear, 0.18stepangle B stands for double shaft. No info for E: SG stands for geared stage and affects ANSTEPS
Oriental Motors PK267JA	ALBA DI FSH, ALBA DI SCR, ALBA DI SCR Oriental Motors PK267JA Bipolar series 6 leads 1.4A, 6.7V, 4.8Ohm, 14.2mH, 200steps
Oriental Motors PK268M-E2.0B	ALBA FE XBPM, ALBA FE FLUORESCENCE SCREEN Oriental Motors PK268M-E2.0B Bipolar series 8 leads 1.4A, 6.3V, 4.5Ohm, 19.2mH, 400steps M stands for extended resolution
Phytron VSS 25.200.1.2	XAS D. Phytron VSS 25.200.1.2 1.2A/ph 0.95Ohm/ph 0.4mH/ph 200steps HT: 12 mNm, Rotor Inertia: 0.002 kg/cm2
Phytron VSS 32.200.1.2	XAS E, F, G. Phytron VSS 32.200.1.2 1.2A/ph 1.3 Ohm/ph 1.2mH/ph 200steps, HT: 45 mNm, Rotor Inertia: 0.01 kg/cm2
Phytron ZSH 87/2.200.6.5-12-H500	ALBA ID MPW80 TAPER Phytron ZSH 87/2.200.6.5-12-H500 Bipolar parallel 4 leads. H500 encoder 500 lines 6.5A, 0.5Ohm/win(0.25Ohm), 1.5mH/win (1.5mH), 200 steps The 12 seems to be the shaft diameter
Phytron ZSH 87/2.200.6.5-12-H500...	ALBA ID MPW80 GAP Phytron ZSH 87/2.200.6.5-12-H500-KEB Bipolar parallel 4 leads. H500 encoder 500 lines. KEB brake. 6.5A, 0.5Ohm/win (0.25Ohm), 1.5mH/win (1.5mH) 200 steps
Phytron ZSH 88/2.200.8	ALBA ID IVU21 Phytron ZSH 88/2.200.8 Bipolar parallel 4 leads 8A, 0.2Ohm/win (0.1Ohm), 1.15mH/win (1.15mH), 200steps
Phytron ZSH 88/3.200.8	ALBA ID EU62, ALBA ID EU71 Phytron ZSH 88/3.200.8 Bipolar parallel 4 leads 8A, 0.29Ohm/win (0.14Ohm) 2.6mH/win (2.6mH), 200steps
SLO-SYN KML061F02	Kaliber SCR SLO-SYN KML061-F02 Bipolar 4 leads 1.05A, 5.19V, 4.94Ohms 30.1mH, 200steps
UNKNOWN 1.2A	XAS C. Stepper Motor (1.2A)

# IcepapCMS (vi) - interaction

## Console within IcepapCMS

## ipython profile

```

Icepap Console (on controls02)
Icepap host: icpap10-office
[Connect] [Disconnect]

Connected to Icepap: icpap10-office
icpap10-office > ?sysstat
?SYSSTAT 0x0001
icpap10-office > ?sysstat 0
?SYSSTAT 0xEF 0xEF
icpap10-office > 0:ver info
0:VER $
SYSTEM : 1.101 : Mon Apr 11 11:29:10 2011
CONTROLLER: 1.101
  DSP : 2.86 : Wed Apr 6 19:31:48 2011
  FPGA : 0.03 : Tue Jun 19 16:54:00 2007
  PCB : 0.07
  MCPU0 : 0.20
  MCPU1 : 0.20
  MCPU2 : 1.125
  DRIVER : 1.101
$
icpap10-office > #1:power on
1:POWER OK
icpap10-office > #1:move 1000
1:MOVE OK
icpap10-office > 1:?pos
1:?POS 1000
icpap10-office > 1:?vstatus
1:?VSTATUS $
0x00B00203
.....3 - PRESENCE = 3: Board is alive
.....C - MODE = 0: Board mode is OPER
.....2... - READY = 1: Board is READY
.....8..... - POWERON = 1: Motor power is ON
.....7... - DISABLE = 0: Motor power is NOT DISABLED
.....18... - INDEXER = 0: Indexer source is INTERNAL
.....4... - MOVING = 0: Motor is not moving
.....3C... - STOPCODE = 0: No abnormal stop condition
.....8... - SETTLING = 0: Closed loop is idle
.....1... - OUTOFWIN = 0: Axis is in target window
.....4... - LIMITPOS = 0: Limit+ signal is not active
.....8... - LIMITNEG = 0: Limit- signal is not active
.....1..... - HSIGNAL = 1: Home signal is HIGH
.....2... - WARNING = 0: Warning flag is off
.....2..... - 5VPOWER = 1: Aux 5V power supply is ON
.....4..... - VERSERR = 0: Firmware versions are consistent
FF..... - INFO = 0: Info value is 0
$
icpap10-office >

```

```

gcuni@controls02:~/svn/IcepapCMS
gcuni@controls02:~/svn/IcepapCMS> ipython -p ipapconsole
Python 2.6 (r26:66714, Feb 3 2009, 20:49:49)
Type "copyright", "credits" or "license" for more information.

IPython 0.10 -- An enhanced Interactive Python.
?          -> Introduction and overview of IPython's features.
%quickref  -> Quick reference.
help       -> Python's own help system.
object?    -> Details about 'object'. ?object also works, ?? prints more.

IPython profile: ipapconsole

In [1]: %connect icpap10-office

In [2]: wr 1:?power
-> 1:?POWER
1:?POWER ON

In [3]: wr ?pos 1 2
-> ?POS 1 2
?POS 1000 0

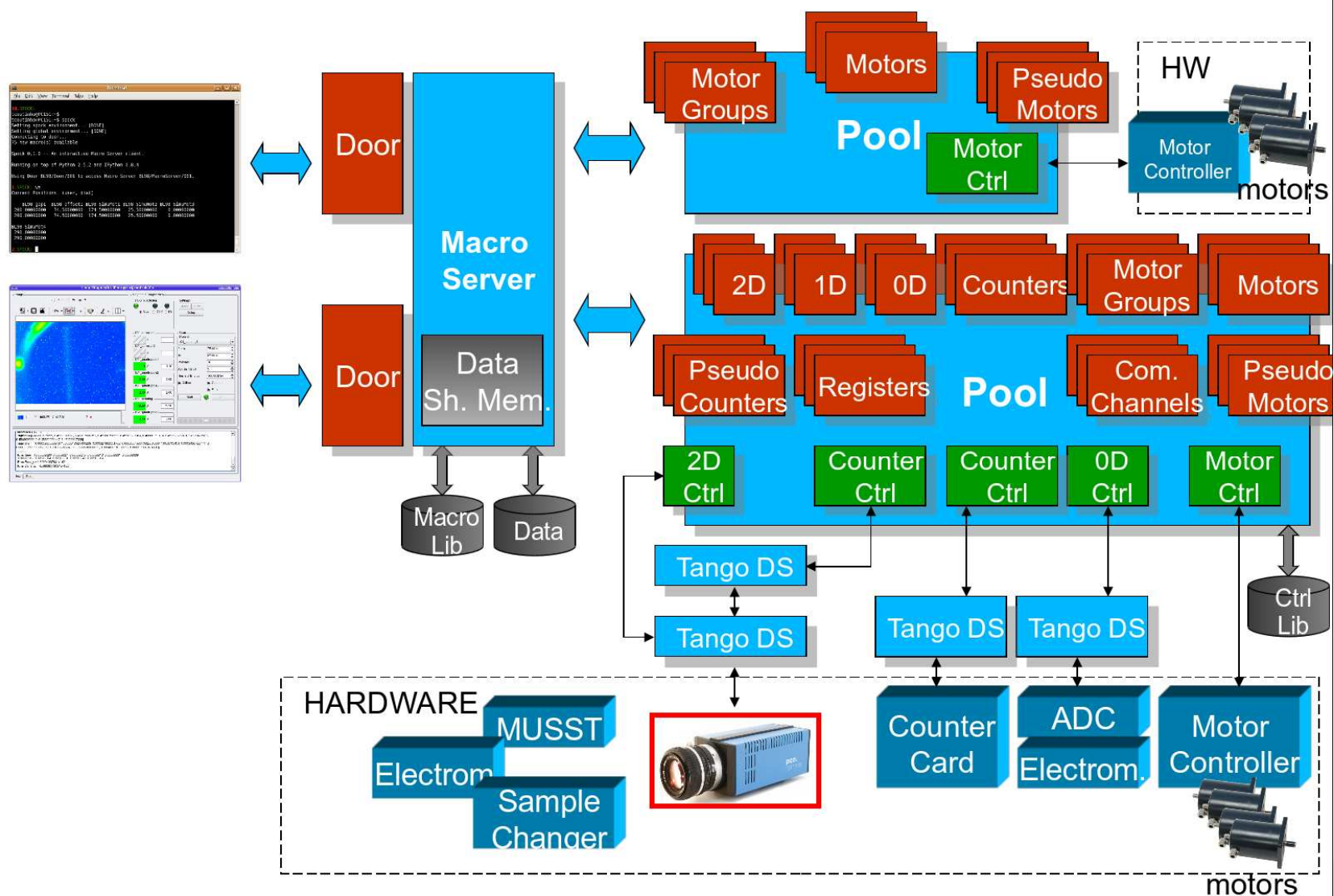
In [4]: [_ip.magic('wro %d:?status' % axis) for axis in [1,2,3,4,6,7,8]]
-> 1:?STATUS
-> 2:?STATUS
-> 3:?STATUS
-> 4:?STATUS
-> 6:?STATUS
-> 7:?STATUS
-> 8:?STATUS
Out[4]:
['1:?STATUS 0x00B00203',
'2:?STATUS 0x00B00203',
'3:?STATUS 0x00300003',
'4:?STATUS 0x00300003',
'6:?STATUS 0x003C0063',
'7:?STATUS 0x00300173',
'8:?STATUS 0x00B91203']

In [5]: %listversions
Out[5]:
{0: '0:?VER 1.101',
1: '1:?VER 1.101',
2: '2:?VER 1.101',
3: '3:?VER 1.101',
4: '4:?VER 1.101',
6: '6:?VER 1.101',
7: '7:?VER 1.101',
8: '8:?VER 1.101'}

In [6]:

```

# Sardana (i) - architecture



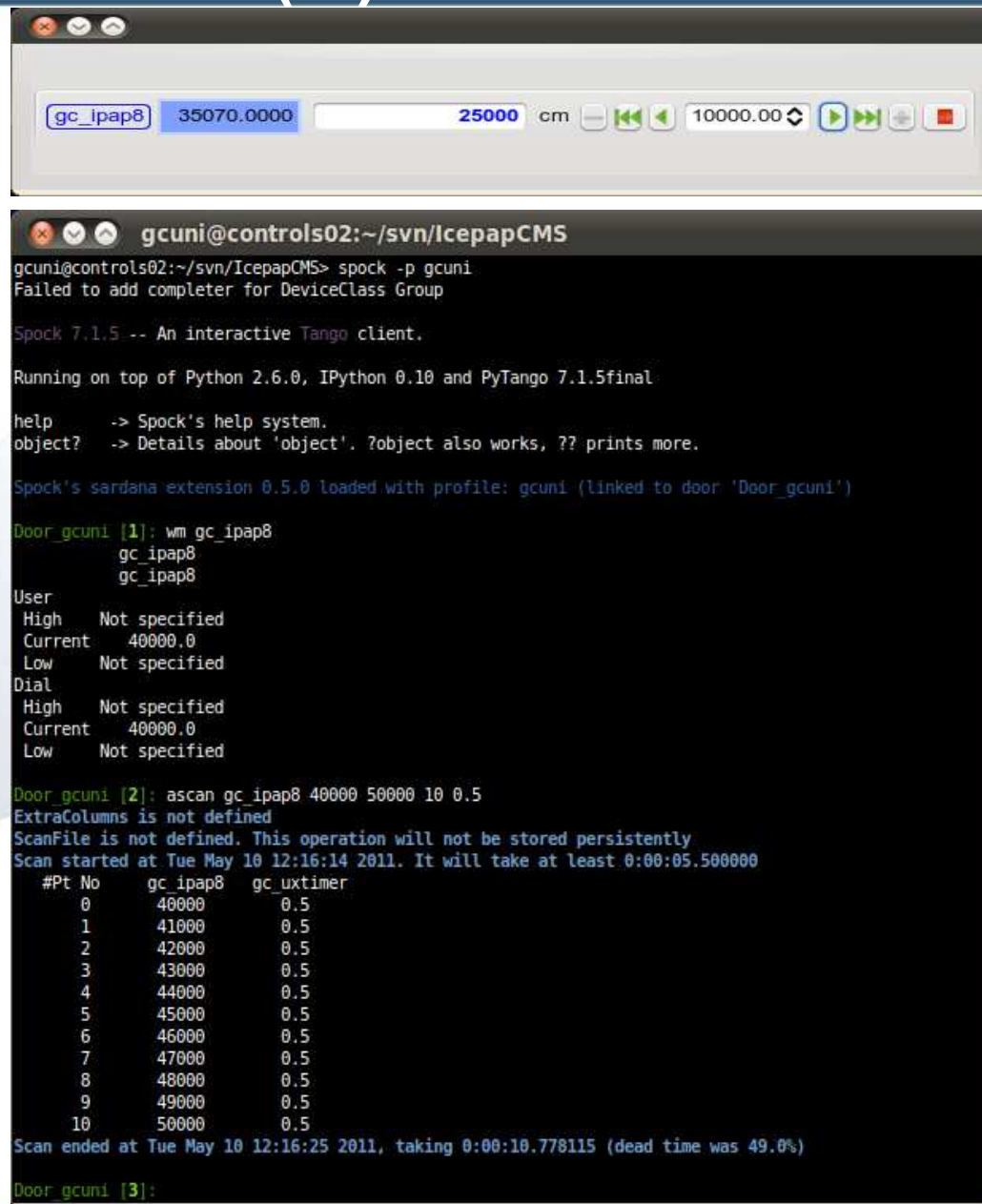


Using a common tango interface, we can provide standard tools to operate any kind of motor.

QtWidgets

Standard scans

Equipment-specific macros like homing



The image shows two windows. The top window is a Qt Widgets application with a motor control interface. It features a text input field containing 'gc\_ipap8', a numeric input field with '35070.0000', a unit dropdown set to 'cm', and a range slider with '25000' and '10000.00'. The bottom window is a terminal titled 'gcuni@controls02:~/svn/IcepapCMS'. It shows the execution of 'spock -p gcuni', which starts the Spock 7.1.5 interactive Tango client. The terminal displays the loaded profile 'gcuni' and the execution of the command 'wm gc\_ipap8', which shows motor parameters like High, Current, Low, and Dial. It then shows an 'ascan' command being executed, displaying a table of scan points and their times.

```
gcuni@controls02:~/svn/IcepapCMS> spock -p gcuni
Failed to add completer for DeviceClass Group

Spock 7.1.5 -- An interactive Tango client.

Running on top of Python 2.6.0, IPython 0.10 and PyTango 7.1.5final

help      -> Spock's help system.
object?   -> Details about 'object'. ?object also works, ?? prints more.

Spock's sardana extension 0.5.0 loaded with profile: gcuni (linked to door 'Door_gcuni')

Door_gcuni [1]: wm gc_ipap8
gc_ipap8
gc_ipap8

User
High    Not specified
Current 40000.0
Low     Not specified
Dial
High    Not specified
Current 40000.0
Low     Not specified

Door_gcuni [2]: ascan gc_ipap8 40000 50000 10 0.5
ExtraColumns is not defined
ScanFile is not defined. This operation will not be stored persistently
Scan started at Tue May 10 12:16:14 2011. It will take at least 0:00:05.500000
#Pt No   gc_ipap8  gc_uptime
0      40000    0.5
1      41000    0.5
2      42000    0.5
3      43000    0.5
4      44000    0.5
5      45000    0.5
6      46000    0.5
7      47000    0.5
8      48000    0.5
9      49000    0.5
10     50000    0.5

Scan ended at Tue May 10 12:16:25 2011, taking 0:00:10.778115 (dead time was 49.0%)

Door_gcuni [3]:
```

## Specific motor controllers (software)

- Icepap (eth)
- Pmac (eth)
- PI-E516 piezo (serial/gpib)
- Tango Attribute with threshold (e.g. DAC)

They provide same Tango interface:

Position, Limit\_switches, Abort()...

Plus any particular dynamic attribute:

**Icepap:** StopCode, EncoderPosition...

**Pmac:** PhasingSearchError, IntegrationMode...



- Though it might look restrictive, a single controller approach simplifies our daily logistics and operation
- Firmware modification to add extra features possibility is a plus
- A single hardware access point to all the axis simplifies the task of higher software layers
- Centralized configuration management helped us a lot during the installation phase

Thank you for your attention.

Questions?