

Python 'IOC' (pcaspy)

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<https://github.com/paulscherrerinstitute/pcaspy>

CA Server library for python

```
cd /ics/examples/22_python
```

```
python cas1.py
```

The image shows a terminal window and a PV Tree window. The terminal window is titled "training@training:~/epics-train/examples/python" and contains the following text:

```
File Edit View Search Terminal Help
[training@training python]$ python cas1.py
Try camonitor Python:RND
Try caget -d CTRL_DOUBLE Python:RND
Try caget Python:RND.EGU
Try phoebus 'PV Tree' for Python:RND
Change range via caput Python:RANGE 10
```

The PV Tree window is titled "PV Tree" and shows the following information:

PV: Python:RND

● PV 'Python:RND' (unknown) = 24.036 Ticks

More Examples

- PV supporting put-callback

```
python cas2.py
```

- CA Client as well as CA server

```
python cas3.py
```

For more, see `pcaspy` documentation: Access security, data types, ..

Caveats

- CA server, no records
 - No xxx.RTYP, .EGU, .SCAN, ...
- No Autosave
 - DIY
- No shell with 'dbl', 'dbpr', 'casr'
 - DIY

Use Cases

- Number Crunching
 - Numpy instead of CALC record
- Outside Data Source
 - Access web services, relational databases, .. and serve results
- Existing Python code
 - Turn script into IOC

Example: Proposal Database

ipts_items X

Beamline: **bl-14b** Run State: **Run** Only change when run state is IDLE! Proposal ID: **21188**

ID	Title	Start	Members
21376	Commissioning HYSPEC with new IRP & moderator	2018-05-17	2XY
21188	Study of intrinsic resonance mode found in ab-initio simulations of NaBr	2018-10-24	B_FULT...
20806	Magnetic Field Dependence of the Spin Dynamics at the Quantum Critical P...	2018-11-14	CLANC...
20536	Evolution of spinon excitations under external magnetic fields in TbIn0.95Mn...	2018-10-31	MGKIM;...
18299	BlueSky Ophyd testing with EPICS PV's, live	2016-12-19	19G;2X...
14871	Isolating magnetic excitations from phonons in isotopic Gadolinium	2016-02-12	19G;2X...
14664	Commissioning with EPICS, NED	2015-08-14	2L1;2X...
13589	Measuring the Magnetic Form Factor in the Topological Kondo Insulator Sm...	2015-05-20	2L1;2X...
12265	Magnetic excitations of the sawtooth Fe chains in Rb2Fe2O(AsO4)2	2014-08-15	2XY;2X...

ID	Name	Description	Mass	Container	Nature
-1	No sample	N/A	N/A	N/A	N/A
60430	La2CuO4	Solid polycrystalline di...	25 g	Aluminum Mount	Polycrystal
60431	LSCO	Solid polycrystalline di...	25 g	Aluminum Mount	Polycrystal

Proposal ID: **21188** Start: **2018-10-24**

Title: Study of intrinsic resonance mode found in ab-initio simulations of NaBr

Members: B_FULTZ;MEM;RH3;YSHEN

Contacts: (

Sample Environment Devices: Micas furnace GEN II

SMS Update: ● OK

Sample ID: **-1** Name: No sample

Mass: 0.0000 g Container: N/A

Formula: N/A Nature: N/A

Lattice: a,b,c: 0.0000 0.0000 0.0000 α, β, γ : 0.00 deg 0.00 deg 0.00 deg

Description: N/A

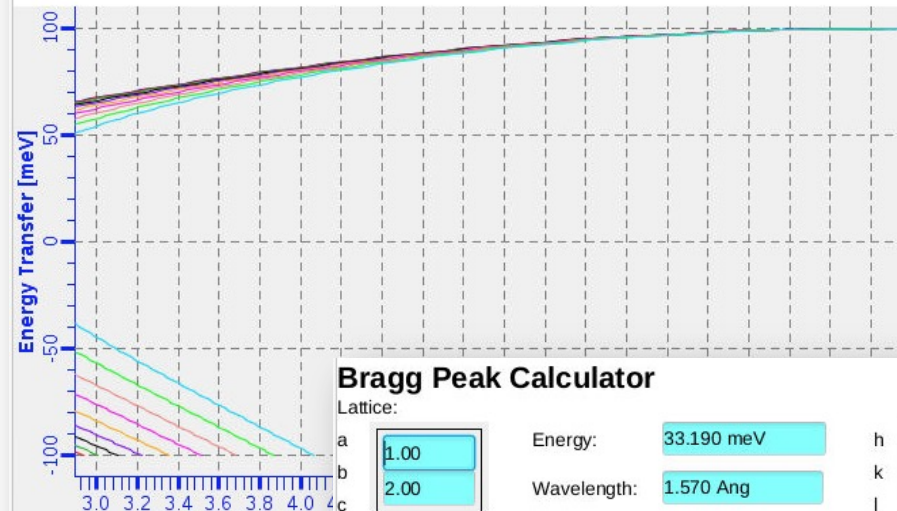
Comments: N/A

Example: Computations

Powder Planning Tool

Energy: Scattering Angle min: Calculate

Wavelength: Scattering Angle max: Calculate



Bragg Peak Calculator

Lattice: a: b: c: Maximum Values: h: k: l: Calculate

Energy: Wavelength:

2.0 [meV] 4.0 [meV] 6.0 [meV]
16.0 [meV] 18.0 [meV] 20.0 [meV]

h	k	l	q	d	2 theta [deg]
0.0	0.0	0.0	0.000	inf	0.000
0.0	0.0	1.0	0.000	inf	0.000
0.0	0.0	2.0	0.000	inf	0.000
0.0	1.0	0.0	0.000	inf	0.000
0.0	1.0	1.0	0.000	inf	0.000
0.0	1.0	2.0	0.000	inf	0.000
0.0	2.0	0.0	6.283	1.000	103.441
0.0	2.0	1.0	6.283	1.000	103.441
0.0	2.0	2.0	6.283	1.000	103.441
1.0	0.0	0.0	6.283	1.000	103.441
1.0	0.0	1.0	6.283	1.000	103.441
1.0	0.0	2.0	6.283	1.000	103.441
1.0	1.0	0.0	6.283	1.000	103.441
1.0	1.0	1.0	6.283	1.000	103.441
1.0	1.0	2.0	6.283	1.000	103.441

Single Crystal Planner

Energy: Sample Rotation Angle min: Calculate

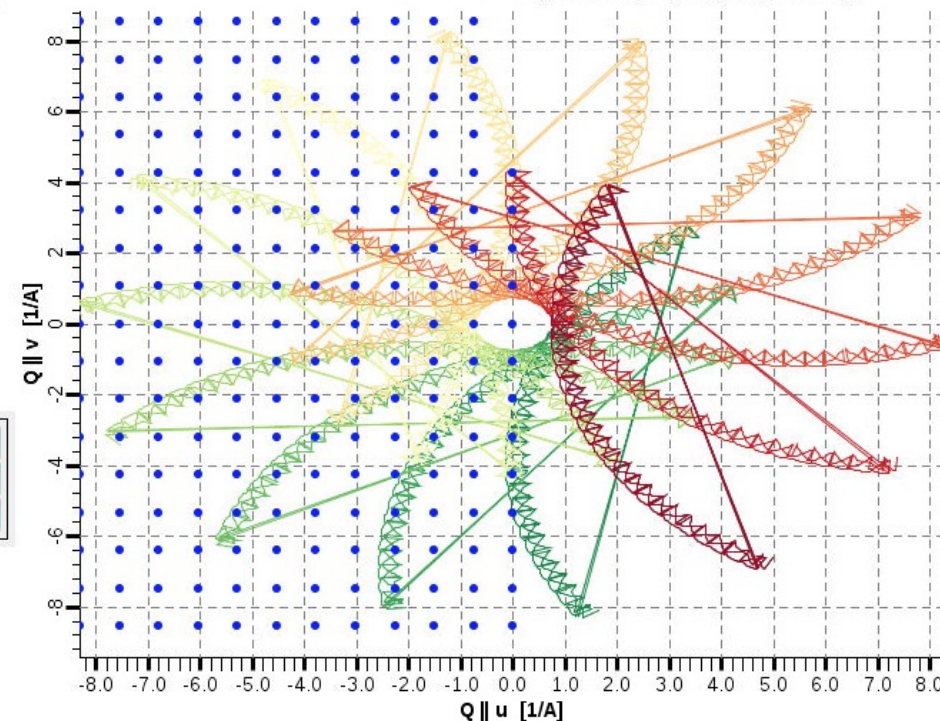
Energy transfer: Sample Rotation Angle max: Create Scan Tab.Scan

Sample Rotation Step: (updates tmp/crystal_plan_scan.csv)

Lattice Parameters [A]:

Lattice Angles [deg]:

Vectors u, v:



Min. sample angle ---

Max sample angle Grid

Energy Adjustment

IncidentEnergy ×

Desired Incident Energy: 17.000 meV <-- "Enter" on desired energy starts update of motors & choppers!

Last successfully set: 17.000 meV ● Kill Air And Stop

Fermi Chopper Speed: 300 Flat Focusing Test Mode

*Fermi speed, flat focusing become active the next time a desired energy is entered.
Consider using Test Mode before actual energy update.*

2018-10-24 16:00:53 INFO Would set BL14B:Chop:Skf4:EnergyReq = 17

2018-10-24 16:00:53 INFO Adjust positions for PG focus element

2018-10-24 16:00:53 INFO Current values m1pg 20.3678 deg, vm2 40.736 deg, mfgp 0.897044 1/m

2018-10-24 16:00:53 INFO Moving to m1pg 19.0826 deg, mfgp 0.983556 1/m

2018-10-24 16:00:53 INFO Would set BL14B:Mot:mfgp = 0.983556

2018-10-24 16:00:53 INFO Would set BL14B:Mot:m1pg = 19.0826

2018-10-24 16:00:53 INFO Evaluating safety of moving drum shield to 38.1653 deg

2018-10-24 16:00:53 INFO Moving to vm2 38.1653 deg

2018-10-24 16:00:53 INFO Would set BL14B:Mot:vm2 = 38.1653

2018-10-24 16:00:53 INFO PG Focus element angle at 20.368 deg

2018-10-24 16:00:53 INFO PG Focus element focus at 0.897 1/m

2018-10-24 16:00:53 INFO Drum shield angle at 40.736 deg

2018-10-24 16:00:53 INFO Successfully tested Ei=17 meV

2018-10-24 16:01:45 INFO ----- Setting Ei to 17 meV -----

2018-10-24 16:01:45 INFO Setting T0=30 Hz and Fermi=300 Hz

2018-10-24 16:01:45 INFO T0 is already at requested frequency.

2018-10-24 16:01:45 INFO Fermi frequency is already at requested frequency

2018-10-24 16:01:45 INFO Changing incident energy from 15 meV to 17 meV

2018-10-24 16:01:45 INFO Changing incident energy from 15 meV to 17 meV

2018-10-24 16:01:45 INFO Changing incident energy from 15 meV to 17 meV

2018-10-24 16:01:45 INFO Changing incident energy from 15 meV to 17 meV

2018-10-24 16:02:23 INFO Adjust positions for PG focus element

2018-10-24 16:02:23 INFO Current values m1pg 20.3678 deg, vm2 40.736 deg, mfgp 0.897044 1/m

2018-10-24 16:02:23 INFO Moving to m1pg 19.0826 deg, mfgp 0.983556 1/m

2018-10-24 16:02:40 INFO Evaluating safety of moving drum shield to 38.1653 deg

2018-10-24 16:02:40 INFO Moving to vm2 38.1653 deg

2018-10-24 16:04:10 INFO PG Focus element angle at 19.082 deg

2018-10-24 16:04:10 INFO PG Focus element focus at 0.98 1/m

2018-10-24 16:04:10 INFO Drum shield angle at 38.1653 deg

2018-10-24 16:04:10 INFO Successfully set Ei=17 meV

	Speed Req.	Energy Req.	Lock, OK	
T0:	30 Hz	17.0 meV	● ●	Details
T1A:		17.0 meV	● ●	
T1B:		17.0 meV	● ●	
Fermi:	300 Hz	17.0 meV	● ●	
Monochromator:	PG			Details
Heusler Rotation:	42.42300 deg		●	Details
Heusler Focus:	0.413333 mm		●	
P.G. Rotation:	19.08200 deg		●	Details
P.G. Focus:	0.98000 mm		●	
Detector Vessel:	-71.9913 deg			Details
Drum Shield:	1803.87111 mm			
Drum Shield:	38.1657 deg		●	

- Could use sequencer, but had existing python code

What if data is “Table” or Structure?

Channel Access can only handle scalar or arrays of number & string

h	k	l	q	d	2 theta [deg]
0.0	0.0	0.0	0.000	inf	0.000
0.0	0.0	1.0	0.000	inf	0.000
0.0	0.0	2.0	0.000	inf	0.000
0.0	1.0	0.0	0.000	inf	0.000
0.0	1.0	1.0	0.000	inf	0.000
0.0	1.0	2.0	0.000	inf	0.000
0.0	2.0	0.0	6.283	1.000	103.441
0.0	2.0	1.0	6.283	1.000	103.441
0.0	2.0	2.0	6.283	1.000	103.441

1. On server side (pcaspy), ‘pickle’ python data into CA byte waveform
2. On client side (CS-Studio), read byte waveform PV in display script, ‘unpickle’, then display in table or ...

Handling Table, Structure

h	k	l	q	d	2 theta [deg]
0.0	0.0	0.0	0.000	inf	0.000
0.0	0.0	1.0	0.000	inf	0.000
0.0	0.0	2.0	0.000	inf	0.000
0.0	1.0	0.0	0.000	inf	0.000
0.0	1.0	1.0	0.000	inf	0.000
0.0	1.0	2.0	0.000	inf	0.000
0.0	2.0	0.0	6.283	1.000	103.441
0.0	2.0	1.0	6.283	1.000	103.441
0.0	2.0	2.0	6.283	1.000	103.441

Yes, pickled byte waveform is a hack

- Requires scripts
- Only works with python as server & client

pvAccess can handle custom structures

- Better for server side
- Client likely needs more than dump of structure; Will still require script for user-friendly display.

Summary

Python with CA server & client libs can act as IOC

- Great tool to have
- Doesn't replace all IOCs