pgepics and pgpmac: LS-CAT postgresql based channel access server and MD2 interface
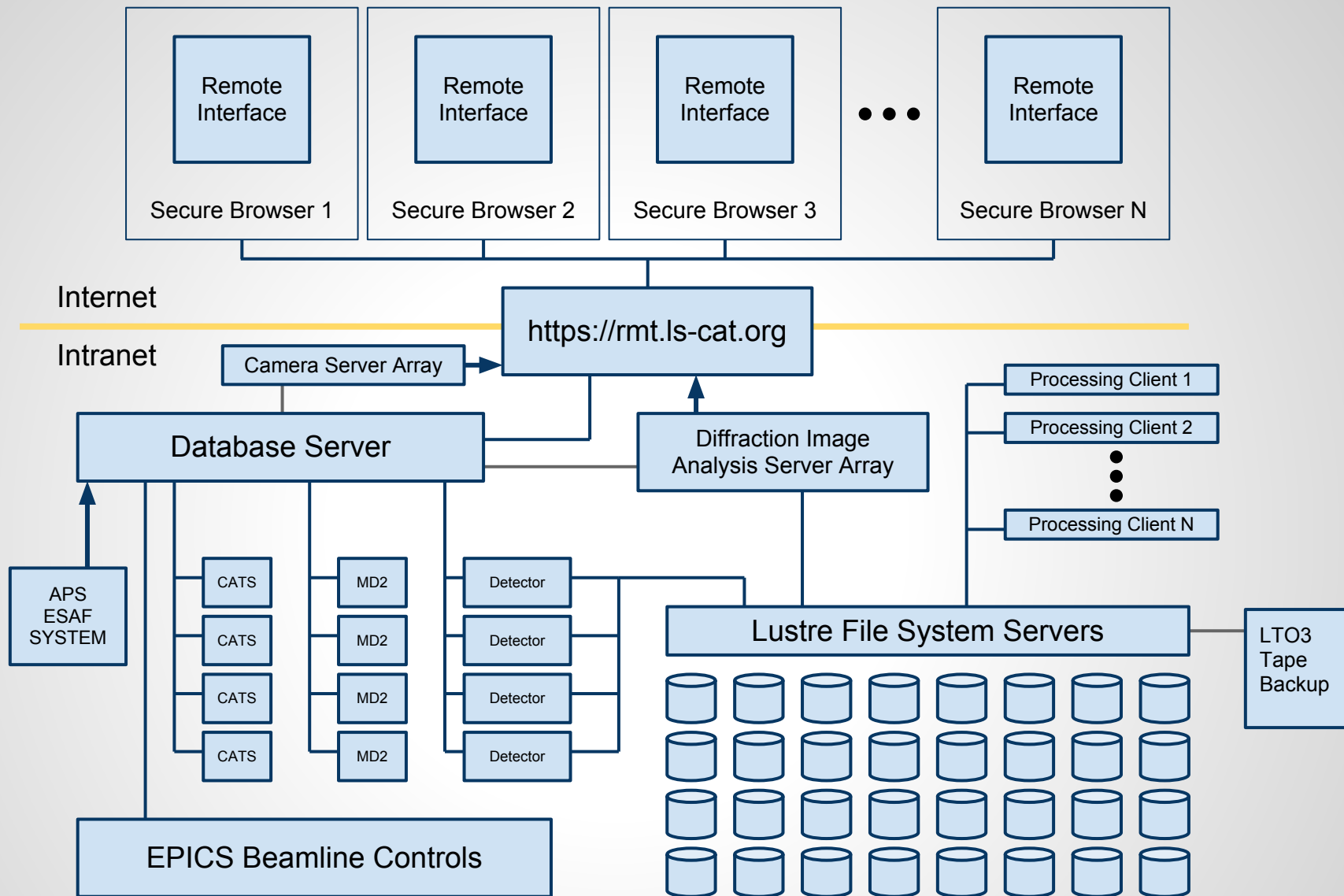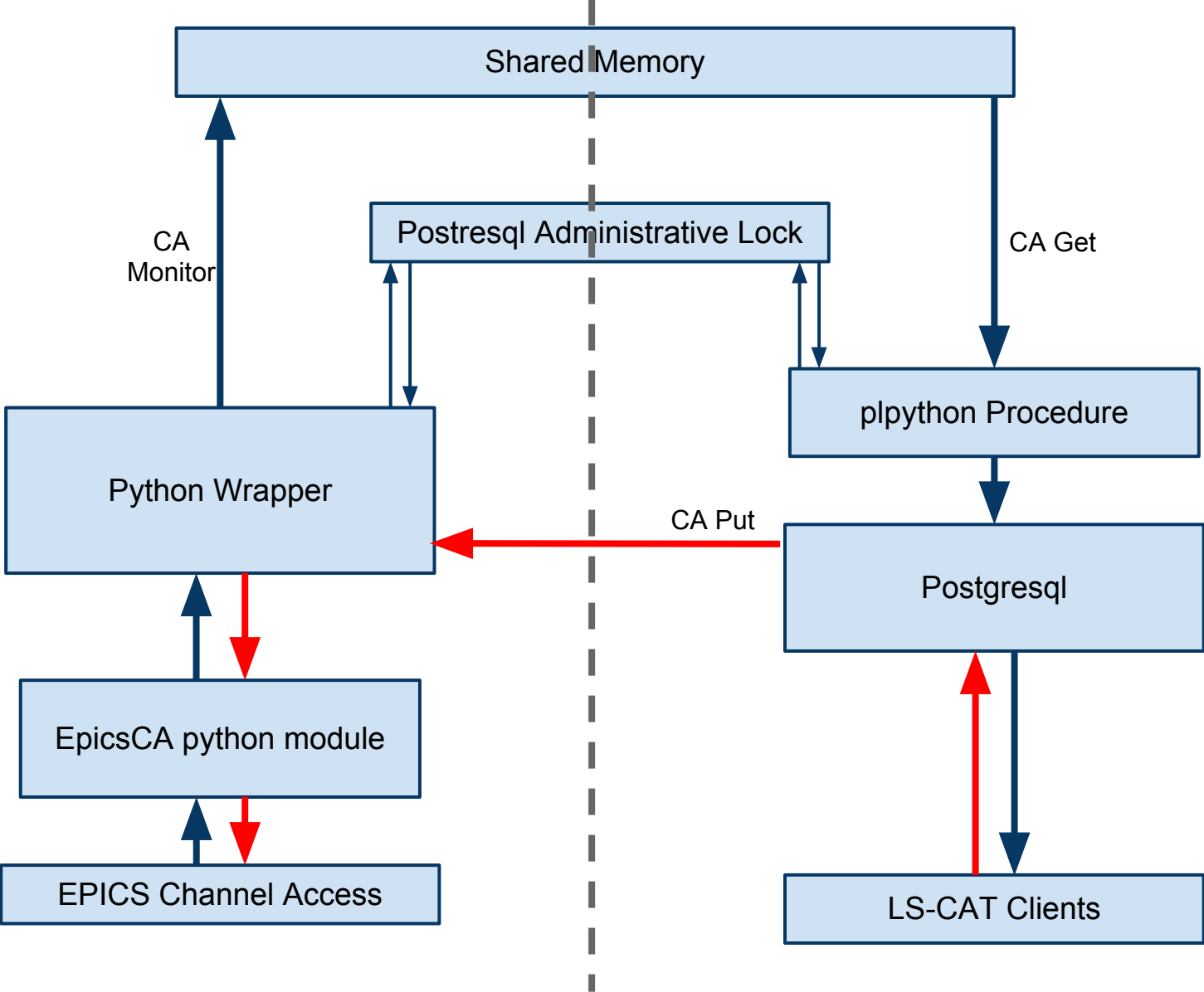
Keith Brister
LS-CAT

LS-CAT Computing Architecture

Keith Brister, TWG June 21, 2012

Postgresql CA Client

Remote Access Support

First Version:

- Current status of the beamline controls is polled periodically by client using "AJAX"
- Response from database is XML document describing the current state of page being displayed
- Each page would parse its own status and update itself
- Stateless: generated xml would not depend on the current state of the interface

Problems:

- As pages became more numerous the number of connections being made, the amount of data being transferred, and the number of variables being parsed was becoming unwieldy
- Maintaining the code was becoming problematic on both the client and the server.
- Much redundancy as many pages need similar or the same information as other pages.
- Each time a variable was added to the client page the web server and database applications would have to be modified as well.

"AJAX" example

Client Request: `https://rmt.ls-cat.org/stnstatus`

Server Response (partial)

```
...
<file skey="289421456" label="c.100" path="e/kb/120608/c/c.100" bupath="
/pf/esafs-bu/edu/northwestern/k-brister/94828/e/kb/120608/c/c.100"/>

<edit dspid="09fb0256823f4c3e88b97388e557d6e4" dsdir="e/kb/120608/c"
dsdirs="Valid" dsfp="c" dsstart="0" dsdelta="1" dsowidth="1" dsnwedge="0"
dsend="100" dsexp="1" dsexpunit="Seconds" dsdist="400"nframes="100"
dseditnum="2835"/>

<runqueue paused="false"/>

...
```

Remote Access Support

Second Version:

- Status is updated using a server push technique.

- Response from database is XML stream updating variables in pseudo real time

- Page request change events for the variables they are interested in

- Stateful: The database server tracks which variables need to be updated.

What does this have to do with EPICS?

To support the status stream mechanism our database stores status information as a set of key-value pairs with the sequence number indicating when a given client will need to be updated.

In our case all values are stored as strings and the keys look some like

Key	Value
stns.1.centering.x.inPosition	true

For our FLEX/Flash client this means that the station 21-ID-D centering stage X motor has a property "inPosition" that is true.

So if we just had a little program that would translate this key-value pair into an EPICS PV and knew how to encode the various EPICS types then we could extend our existing infrastructure to support EPICS clients

```
caget 21:mung:centering:x.inPosition
21:mung2:centering:x.inPosition true
```

LS-CAT Computing Architecture

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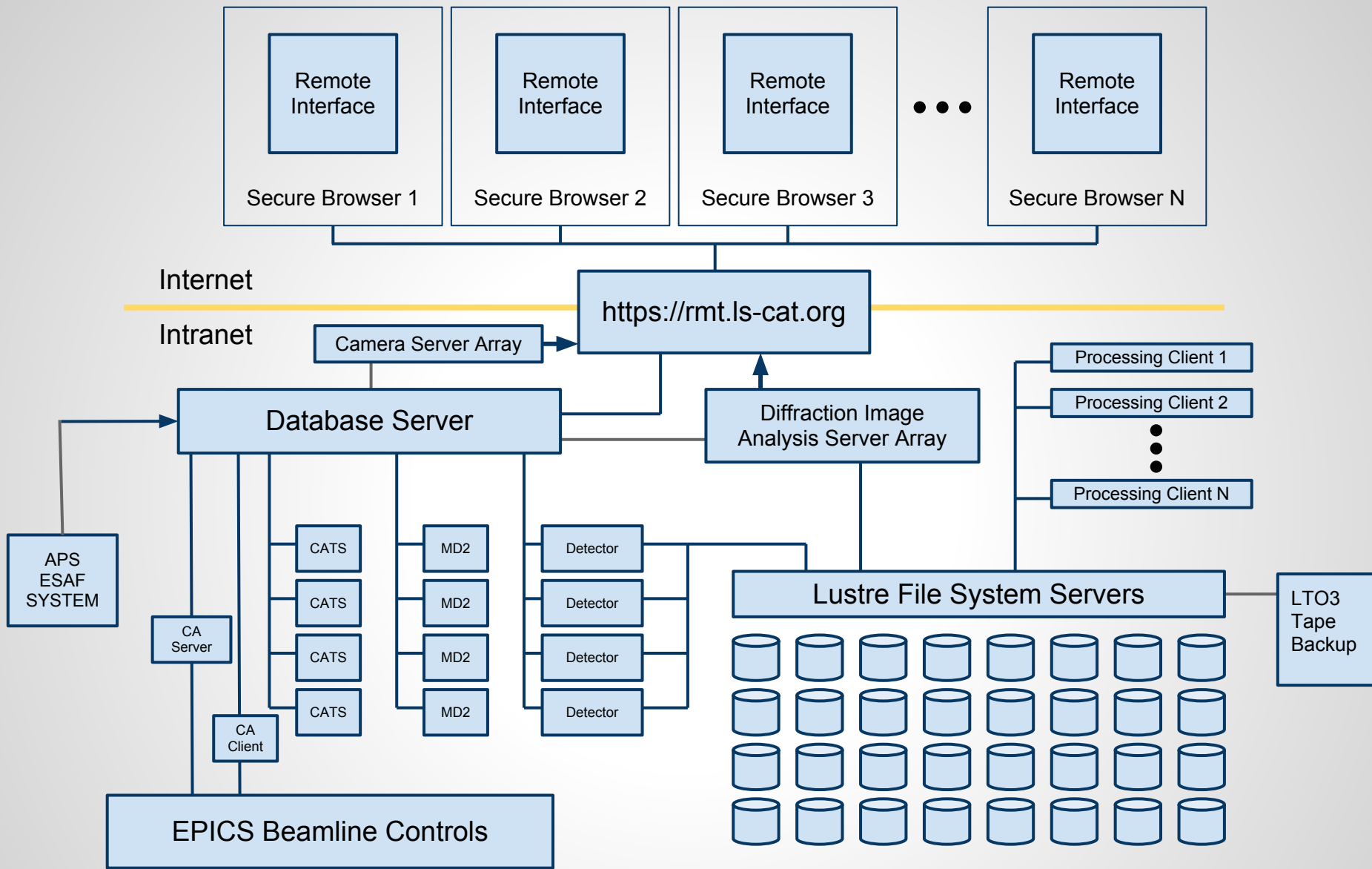
Advantages

EPICS applications can put, get, and monitor any of the LS-CAT key-value pairs.

New key-value pairs can be created and types modified with a trivial query: no reboots required.

When PV's are needed only to support user interface activities, it is much easier to use this "pgepic" scheme than a real IOC.

Changes to a PV can trigger the system to perform some action mimicking record processing.

Limitations

Currently the EPICS enum type is not supported although there is a simple mechanism that can be used to do so.

Arrays are not implemented except that strings can be returned as character arrays.

There are no limits on string length imposed or enforced. This could give rise to "interesting" behavior in EPICS clients.

Possibly this is not a great idea for high speed data processing chains.

Example: SAXS from µFluidic Plates

Daria Khvostichenko, Paul Kenis UIUC

Elena Kondrashkina, Keith Brister LS-CAT

Collect data from several wells at a number of different places in each well.
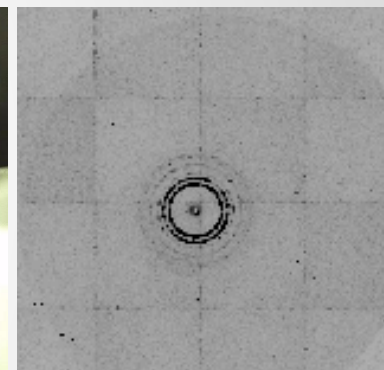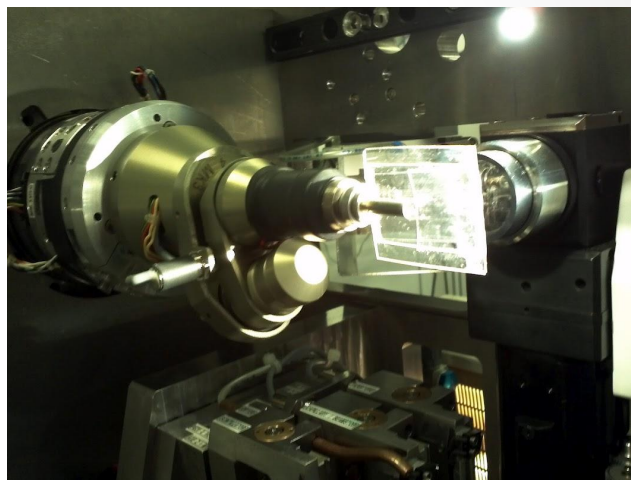
LS-CAT MD2-PMAC Interface

Current data collection interface is embedded in EMBL's .NET 2003 visual basic interface

Although mostly fine for local users there are some problems:

Random crashes (~once a day)

Random overhead limits data collection to ~18 frames/minute (max should be 24 frames/minute)

Soon to be unsupported as it runs on XP

LS-CAT MD2-PMAC Interface

Since the VB interface does not have any advantage to our remote users (an increasing fraction of our population) why not ditch it and talk directly to the PMAC from the LS-CAT database?

Features:

Text interface (curses) to ease maintenance over an ssh connection (most staff and all users won't be using this interface anyway)

Direct PMAC commands to simplify diagnosing hardware problems

Move all motors during detector readout so that the next frame can be start exposing quickly (measured 23 frames/minute)

High level controls though a database connection and existing remote access clients

Code added to PMAC without destroying ability to go back to the VB interface.

```
Omega    #1 &1 X            Align X #2 &3 X            Align Y #3 &3 Y            Align Z #4 &3 Z
             1 cts                    75313 cts                  467950 cts                  326689 cts
         0.0001°                     1.242 mm                    7.719 mm                    5.389 mm
          8921088                     8921088                     8921088                     8921088
           492545                     2589697                     2589697                     2589697
      In Position                 In Position                 In Position                 In Position


Anal     #5                   Zoom     #6 &4 Z            Aper Y   #7 &5 Y            Aper Z   #8 &5 Z
             0 cts                    34600 cts                  232418 cts                  145548 cts
             0°                       34600 cts                   1.917 mm                    2.401 mm
          8921088                     8921088                     8921088                     8921088
                1                     3638273                     4686849                     4686849
       Not Homed                  In Position                 In Position                 In Position


Cap Y    #9 &5 U             Cap Z  #10 &5 V             Scin Z #11 &5 W             Cen X  #17 &2 X
           216051 cts                 21851 cts                   45691 cts                    -932 cts
          1.782 mm                    1.100 mm                    2.300 mm                   -0.005 mm
          8921088                     8921088                     8921088                     8921088
          4490241                     4490241                     4490241                     1541121
      In Position                 In Position                 In Position                 In Position


Cen Y  #18 &2 Y              Kappa  #19 &7 X             Phi    #20 &7 Y             Shutter Closed
            -1570 cts                 20004 cts                       2 cts          Cap Detected
         -0.009 mm                    7.03°                       0.00°             Cryo In  Fluor Out
          8921088                     8921088                     8921088           Front:            0
          1541121                     6784001                     6784001           Back:             0
      In Position                 In Position                 In Position           Piezo:            0
```

```
ENABLE PLCC 0
DISABLE PLCC 1
ENABLE PLCC 2
M2000=1
^E
#1j=0
M401=1 M1115=1 #1$ &1B1R
^E
M401=1 M1115=1 #1$ &1B1R
```

```
PMAC>
```

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