Beam Line Controls at the APS

Support for spec at the APS

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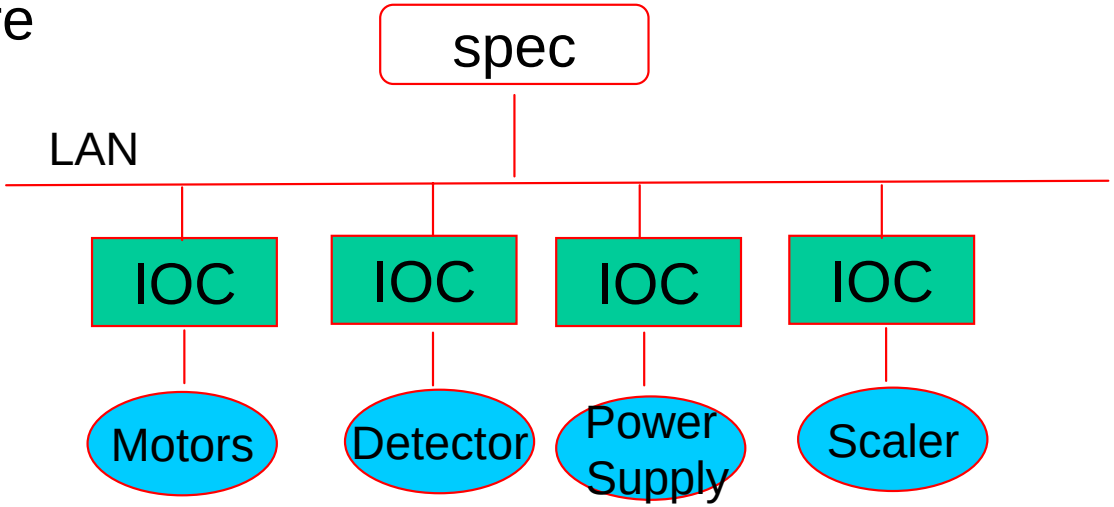
Xuesong Jiao
APS Engineering Support Division
Advanced Photon Source

Overview of spec

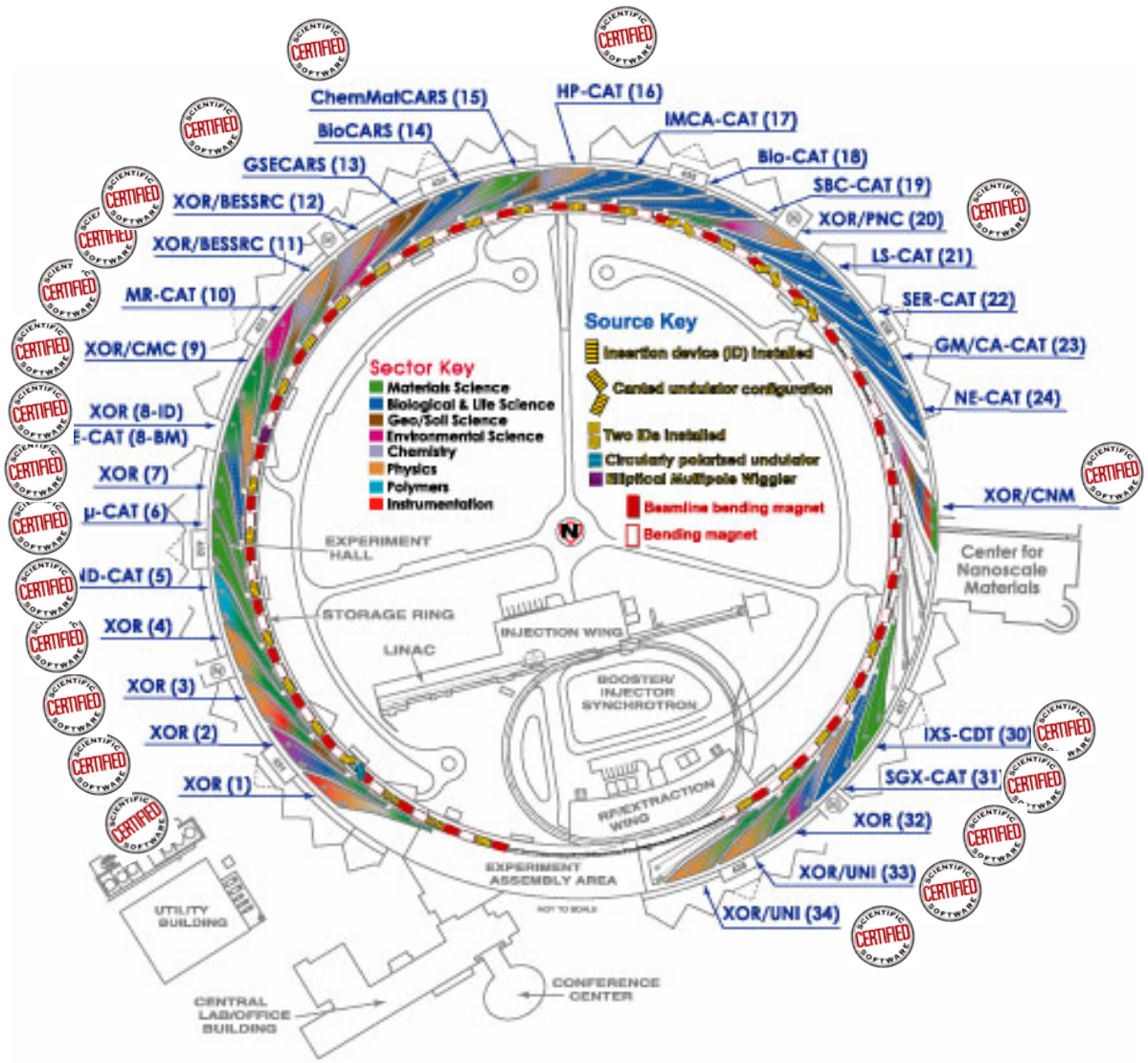
- Commercial software (Certified Scientific Software) X-ray diffraction control and data acquisition
- Works on Unix and Linux platforms
- Supports numerous diffraction geometries with built-in commands and predefined macros
- Easy to add user macros for specific controls
- EPICS friendly: built-in channel access interface to control EPICS-based hardware



- Used at many synchrotron sources around the world; sizable user community

spec Installations at the APS

- APS has a site license for 75 “seats”
- **spec** is in use at 22 APS sectors/CATs
- BCDA helps to install/upgrade **spec** at the APS

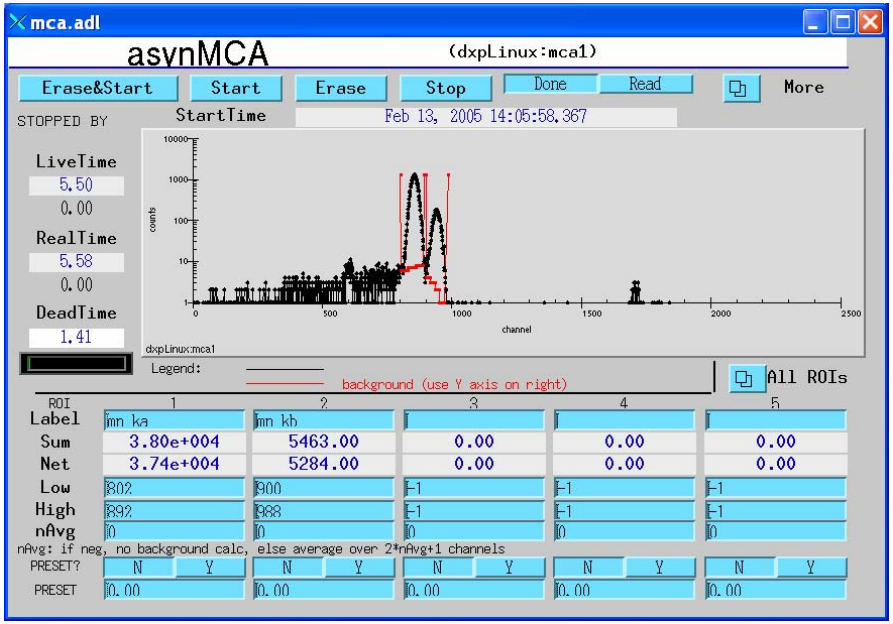


BCDA spec Support Program

- Initiated in 2005 in response to requests from beam line staff and users
- To support the beam line scientist in **spec** configuration and macros writing etc.
- To create the APS **spec** repository for generic purpose macros
- To develop **spec** related toolkits
- Has provided technical supports to many sectors(XOR-1,XOR-4, XOR-8, UNICAT, PNCCAT, Nano-Probe, IXS)

spec Macros for EPICS-based Multi Channel Analyzers

- A client package for the MCA and DXP EPICS Module
  - MCA/DXP module runs the hardware
  - MCA calibration and region of interest setup are done from the MEDM screen



  - spec macros mainly used for triggering the MCA and data collection
- Capable to control multiple MCAs at the same time
- Site-independent; ready to use at any APS beam lines

MCA Macros: Configuration

- setup_mca: connects the EPICS MCA by given PV prefix

```
SPEC> setup_mca
Current MCA Setup:
No MCA defined. Please define MCA first.
Configure a new MCA? (NO)? Y
MCA mnemonic: ()? vortex
MCA name: ()? mca1
EPICS MCA PV: ()? 4id:mca1
```

- show_mca: displays the connected MCAs' information

```
>show_mca
Mne     Name     EPICS_PV    Total_Chs    Use_Chs   Data_array
mca2    TST      4id:mca2     4000         4000     mcadat_mca2
mca1    vortex   4id:mca1     4000         4000     mcadat_mca1
```

MCA Macros: Data Collection

- mca_rois: reads in all ROIs configured in the MEDM screen

```
>mca_rois

Current configured ROI for mca2:
mne: mca2R0 |pv: 4id:mca2.R0  |name:Roi1  |low: 100  |high: 200

Current configured ROI for mca1:
mne: mca1R0 |pv: 4id:mca1.R0  |name:Mn Ka  |low: 1446  |high: 1600
mne: mca1R1 |pv: 4id:mca1.R1  |name:cr  |low: 1629  |high: 1712
```

- getandsave_mca *ct_time :* starts counting the MCA and saves the spectra to the spec data file
- MCAscanend *spec_scan_cmd*: saves the MCA spectra at the end of a spec scan
- MCAscanpt *spec_scan_command*: saves the MCA spectra at each scan point during a scan. The spectra are saved to an auxiliary spec data file

Example of Auxiliary Files

- Main spec file name : test
- Scan number: 2
- MCA mnemonic: mca1
- Auxiliary file Name test.scan2.mca1

```
#C Saving MCA data for Scan:2 in Datafile:./test
#S 1 mca_save_point Point:0 Scan:2 Datafile:./test
#D Tue Aug  2 17:38:44 2005
#T 2 (Seconds)
#Q 0 0 0
#U EPICS mca: mca1(4id:mca1)
#@MCA %25C
#@CHANN 4000 0 3999 1
#@CTIME 0 10 9.98
#@CALIB -0.395356 0.00770526 0
#N 1
#L Epics MCA mca1
@A 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\
…
```

MCA Macros: Data Collection (cont.)

- save_rois on/off**:** saves ROI counts at each scan points to spec file

```
>save_rois on
   Columns defined as pieces of identifier:mcaroi
   Ltmca1 :  epics_get("4id:mca1.ELTM")  :  %.8g
   Rtmca1 :  epics_get("4id:mca1.ERTM")  :  %.8g
   Ltmca2 :  epics_get("4id:mca2.ELTM")  :  %.8g
   Rtmca2 :  epics_get("4id:mca2.ERTM")  :  %.8g
   Roi1(mca2R0) :  epics_get("4id:mca2.R0")  :  %s
   MnKa(mca1R0) :  epics_get("4id:mca1.R0")  :  %s
   cr(mca1R1) :  epics_get("4id:mca1.R1")  :  %s
```

- To save the ROI data in the main spec file only, no spectra saved in auxiliary files

```
>save_rois on
>ascan m1 -1 1 100 1
```

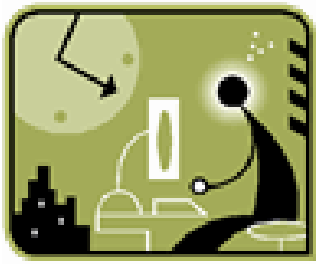
- Macros and help file available at BCDA webpage:

http://www.aps.anl.gov/aod/bcda/spec/APSMacros.php

Macros for the CCD Image Server

- A package suitable for numerous area detectors controlled by Brian Tieman's CCD Image Server Program
- Site and camera independent, ready to use
- Major user interface allows users to trigger the camera at each scan point during spec scan; to save many ROIs to spec file; to set up pseudo counter to monitor/plot the ROI during the spec etc.
- Many internal macros provide building blocks for specific camera control.
- Supports different shutter control mechanisms
- Has been tested at Sector 8-ID
- Available at the BCDA spec web page

After I start this mesh scan that takes an image at each position, I can get some sleep...



CCD Macros Setup

- Startup: *qdo ccdscan_new.mac*
  - When freshly loaded, it asks shutter type, whether to use a pseudo counter ccdc for plotting ROI

```
This BCDA package allows spec to control the CCD Image Server!

You need to answer some questions first.
Do you use the external trigger from a delay generator to control
the CCD? (NO)?

Setup a pseudo counter (ccdc) to monitor some ROIS (its average
value) from spec? (YES)?
Found a counter named ccdc.
Seems that you have already configured a pseudo counter (None
type).

Please use ccdsetup to configure the image server settings.
You need define ccd_blockbeam ccd_showbeam macro if you need to
take dark images.
For more help on this package, please use ccdhelp.
```

CCD setup

- ccd_setup: gets the PV prefix of the Image Server and other information from user input

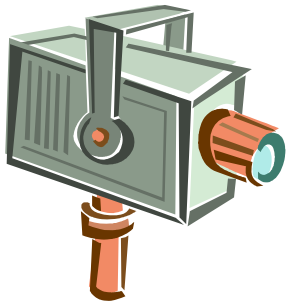
```
2.SPEC> ccdsetup
The EPICS prefix of the CCD device: (TST:CCD)? jiao:ccd
The windows directory where the Image Server saves the data:
(C:\data\)?
Use IMM file format (NO)?
Saved ROI#(1-50) i.e. R01 (R01)?
ROI# for the counter ("none" to not use) (R02)?

jiao:ccd is configured
==================================================
CCDManufacturer: Brian Tieman
CCDModel: Software Emulator
CCDChip Temperature: 0C
ADCSpeed: Slow ADC
BinX: 1
BinY: 1
CameraMode: Normal
Data home: C:\data\
Saved ROI: jiao:ccd.R01
CCD pseudo counter: jiao:ccd.R02
==================================================
```

CCD Macros

- ccdinfo: displays the current configurations of CCD Image Server
- ccdhelp: shows the user macros provided in this package
- ccdset_saved_roi *R02*: changes the ROI to be saved in image files
- ccd_addcolumn *R02*: adds one ROI (its average value) to be saved as a data column in the spec file
- setccdc *R01*

  plotselect *ccdc*

  sets one ROI as the pseudo counter *ccdc* which can be plotted during scanning

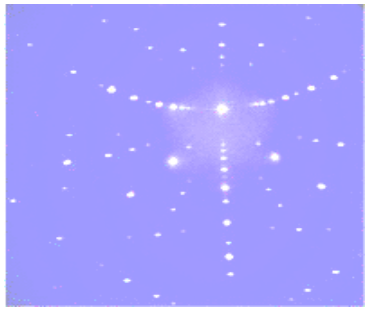


CCD Macros: scan

- ccdscan_setup: sets the parameters of ccdscan macro
  - can take darks before the scan starts. (users need implement blank macro ccd_blockbeam and ccd_showbeam)
  - can take multiple images at each scan point
  - can turn on/off saving image files

```
SPEC> ccdscan_setup
 Save images during scan? (YES)?
 Number of images to throw at the beginning: (0)? 2
 Number of darks to take at the beginning: (0)? 5
 Number of imgages per scan point: (1)?
```

- ccdscan *ascan th 0 1 100 1.0 :* starts a spec scan that triggers the camera at each position



CCD Macros: Data Output

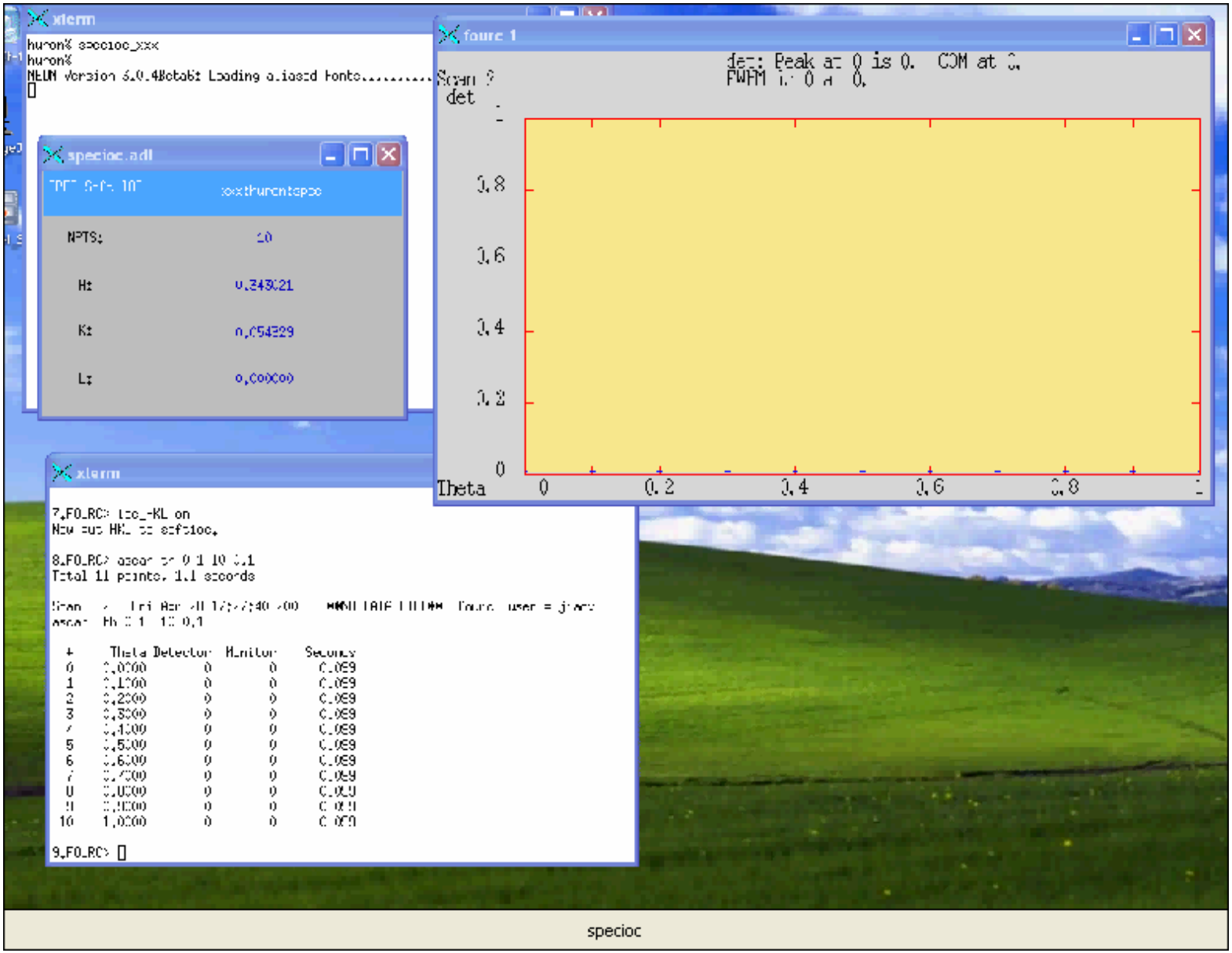
- Image file names are based on the spec file name, scan number and scan point number, i.e. *Myspecfile_SCANN_NPNTS_NIMG*
- *spec file output:*

```
#C Mon Jan 30 14:02:17 2006 ccdscan is turned on

#CCD ccdscan 2
#CCD save_flag 1
#CCD image_dir C:\data\test_2
#CCD repeats_per_point 1
#CCD dark 5
#CCD saved_roi jiao:ccd.R02 50 50 2 3
#CCD counter_roi jiao:ccd.R01 1 1 1024 1024
#S 2 ascan th 0 1 10 1
#D Mon Jan 30 14:02:29 2006
#T 1 (Seconds)
#G0 0
#G1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0
#G3 0 0 0 0 0 0 0 0 0
#G4 0
#Q
#P0 1
#N 6
#L th R03 Epoch Seconds Monitor ccdc
0 26624 434 1 0 1411.9824
0.1 27648 437 1 0 2845.5703
0.2 28672 440 1 0 3460.9883
```

specIOC

- A soft IOC based tool, allows spec to write the Miller Indices as PVs and displays the values in MEDM screen
- Enables to monitor these values in real time during spec scan
- Possible to add the Orientation Matrix
- Easy to use

specIOC Demonstration



APS Repository for spec Macros

- A collection for general purpose macros and other tools
- A resource for the **spec** community at the APS
- Only limited resources now; will keep growing
- Need collaboration with beam line scientists. You can contribute!
- Need better method for maintenance and distribution

Thank you!