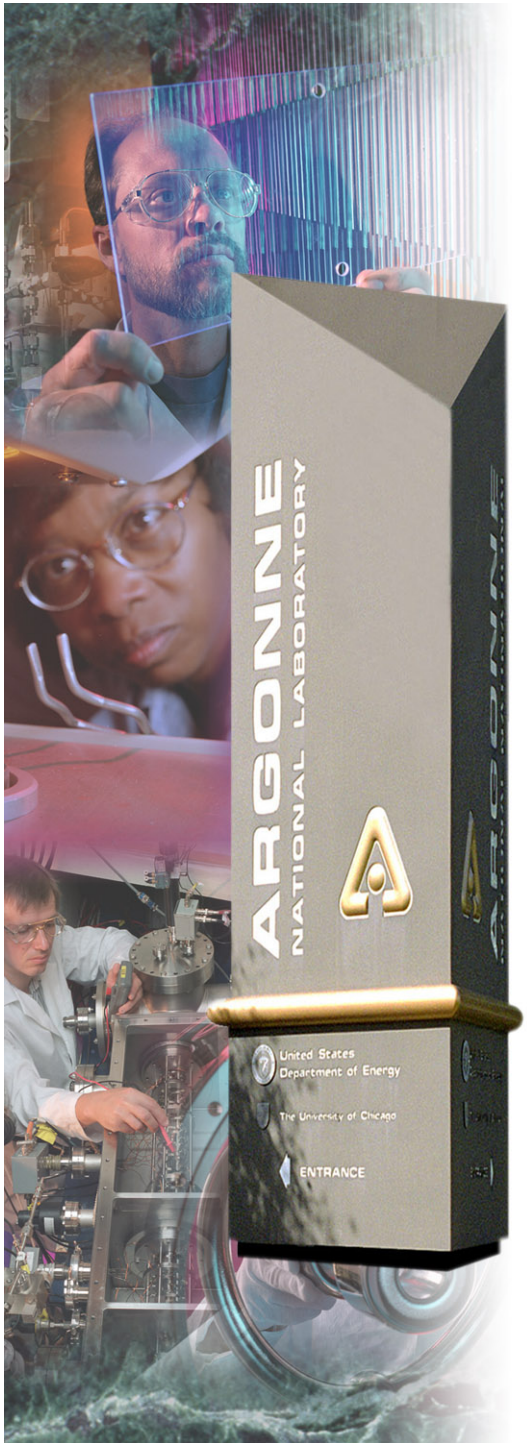


Data Visualization

EPICS Extensions IDL Tools

Ben-chin K. Cha

Beamline Control & Data Acquisition

Argonne National Laboratory

Office of Science
U.S. Department of Energy

A U.S. Department of Energy
Office of Science Laboratory
Operated by The University of Chicago

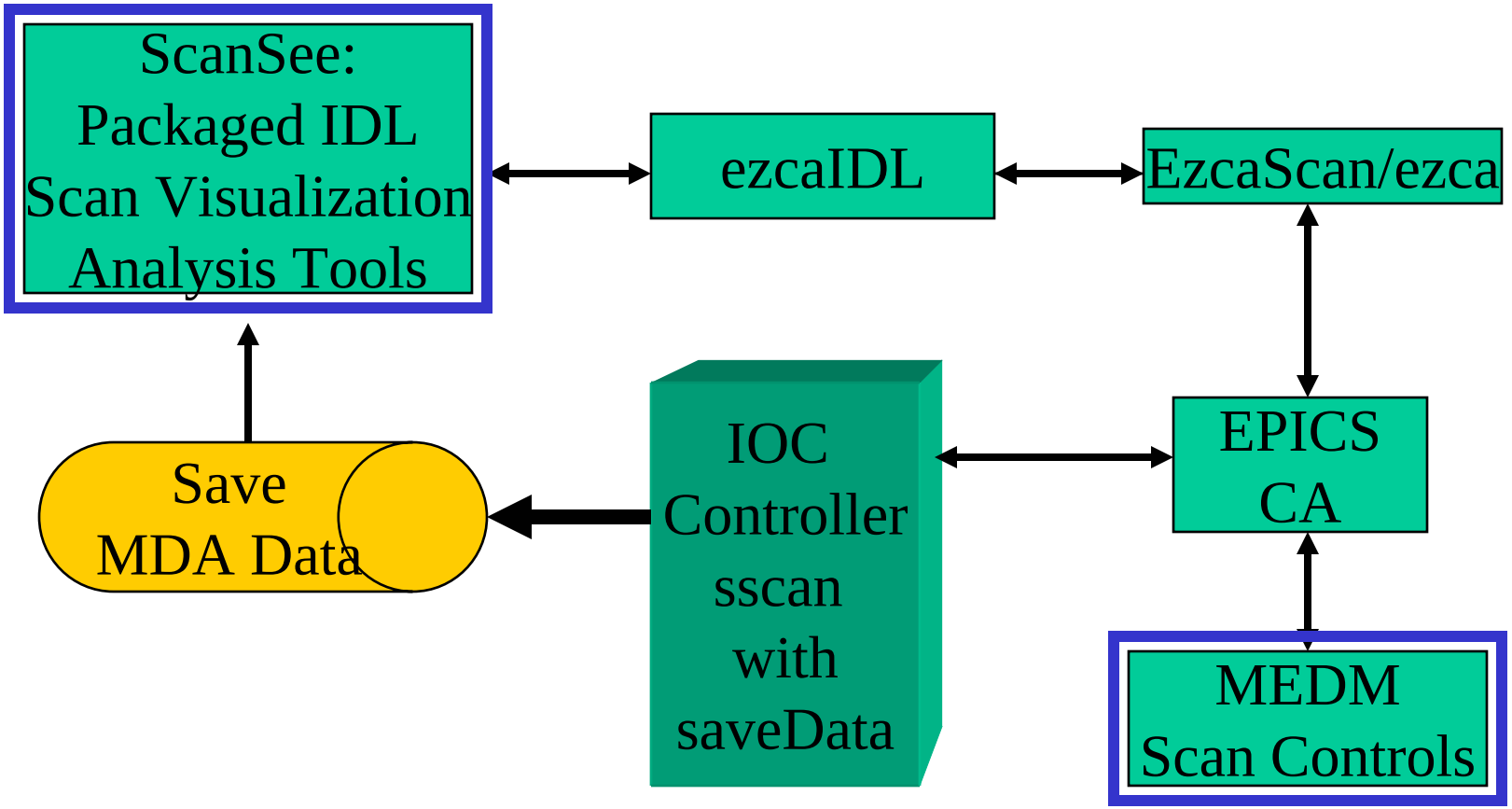
Introduction

- **Written in IDL/ezcaIDL to view real-time / post scan data**
- **Packaged data browsers with complete mouse driven user interface**
- **IDL interactive graphics and analysis tools**
- **High quality interactive graphic Itools (IDL 6.X)**
- **Packaged tools support license free IDLVM 6.0**
- **Platforms: Unix , Win2000/XP, Linux**
- **Object methods for easy post scan data array extraction and manipulation**

Outline

- **Overview**
- **System and setup requirement**
- **ScanSee program user interface**
- **Sharable visualization subprograms**
- **Scan object methods and examples**
- **EzcalDL setup and examples**

Scan Visualization Architecture



Overview

- **Scan Visualization Tools**
  - *scanSee – 85 detectors,1D/2D/3D scan (read MDA)*
  - *catcher – 15 detectors,1D/2D scan (save/read 1D/2D files)*
- **HDF Visualization Tools**
  - *hdfb – HDF4 1D/2D/3D browser*
  - *h5b - HDF5 1D/2D/3D browser*
- **Common/sharable Visual/Analysis Tools** http://www.aps.anl.gov/~cha/idl_html/list.html
  - *plot1d, ez _fit, overlay_1d*
  - *plot2d_image, plot2d, image2d, view3D_2D*
  - *calibration_factor, scan2d_roi, multiroi_pick*
  - *panimage, scan2d_overlay, wd_readascii*

Input Forms

- **XDR catcher 1D/2D file**
- **MDA 1D/2D/3D scan data**
- **Nexus/HDF release 4 1D/2D/3D data**
- **Nexus/HDF release 5 1D/2D/3D data**
- **Arrays data**
- **Fix format ASCII data**

Output Forms

- **1D/2D graphic output**
- **1D/2D ASCII report data**
- **Graphic output: TIFF / PNG / PICT / PS**
- **1D/2D ROI statistics reports**
- **Flexible 3D to 2D, 2D to 1D sliced output**

System Requirement

- **EPICS extensions built: ezca, EzcaScan, ezcalDL, idl**
  - *Scripts and executables installed under*
    /usr/local/epics/extensions/bin/solaris-sparc for 3.14.X
  - *IDL programs installed under*

    /usr/local/epics/extensions/idllib for 3.14.X
- **IDL 6.0 and IDLVM 6.0 installed**
- **IOC sscan record properly configured by medm**

Unix Setup Requirement

- Set EPICS_EXTENSIONS

  setenv EPICS_EXTENSION /usr/local/epics/extensions
- Access EPICS 3.14.X

  setenv EPICS_HOST_ARCH solaris-sparc

  set path=(/usr/local/epics/extensions/bin/solaris-sparc $path)

Packaged Unix Scripts for IDL Visualization Tools

- **scanSee – MDA viewer with real-time scanning**
- **sscan – post scan viewer for MDA files**
- **catcher – real-time scanning with data saving**
- **viewer – post scan viewer for data catcher**
- **hdfb – data browser for HDF4/Nexus files**
- **h5b – data browser for HDF5/Nexus files**
- **img – Tiff/Jpeg/Png/Ascii/Xdr image processor**
- **idlvm – run IDLVM 6.0 with any IDL 6.0 saved programs**

IDLVM 6.0

- **No license required for IDL 6.0 saved program**
- **Document:** http://www.aps.anl.gov/~cha/idlvm60.html
- **IDL 6.0 *.sav files:**
  - *catcher.sav – for catcher*
  - *viewer.sav – for viewer without CA*
  - *sscan.sav – for scanSee*
  - *SB2.sav – for MDA reader without CA*
  - *hdfb.sav – for HDF version 4*
  - *h5b.sav – for HDF version 5*
  - *Img.sav – image processor*
- **Unix script methods:**

  idlvm <pname>

  where <pname> can be any of the above name without '.sav'
- **Itools & data calibration not available in IDLVM 6.0**

Unix Access Methods

- **IDLVM version** **(recommend unless calibration is desired)**

  idlvm sscan *(scanSee.R3.4 and later)*

  idlvm catcher
- **Runtime version**

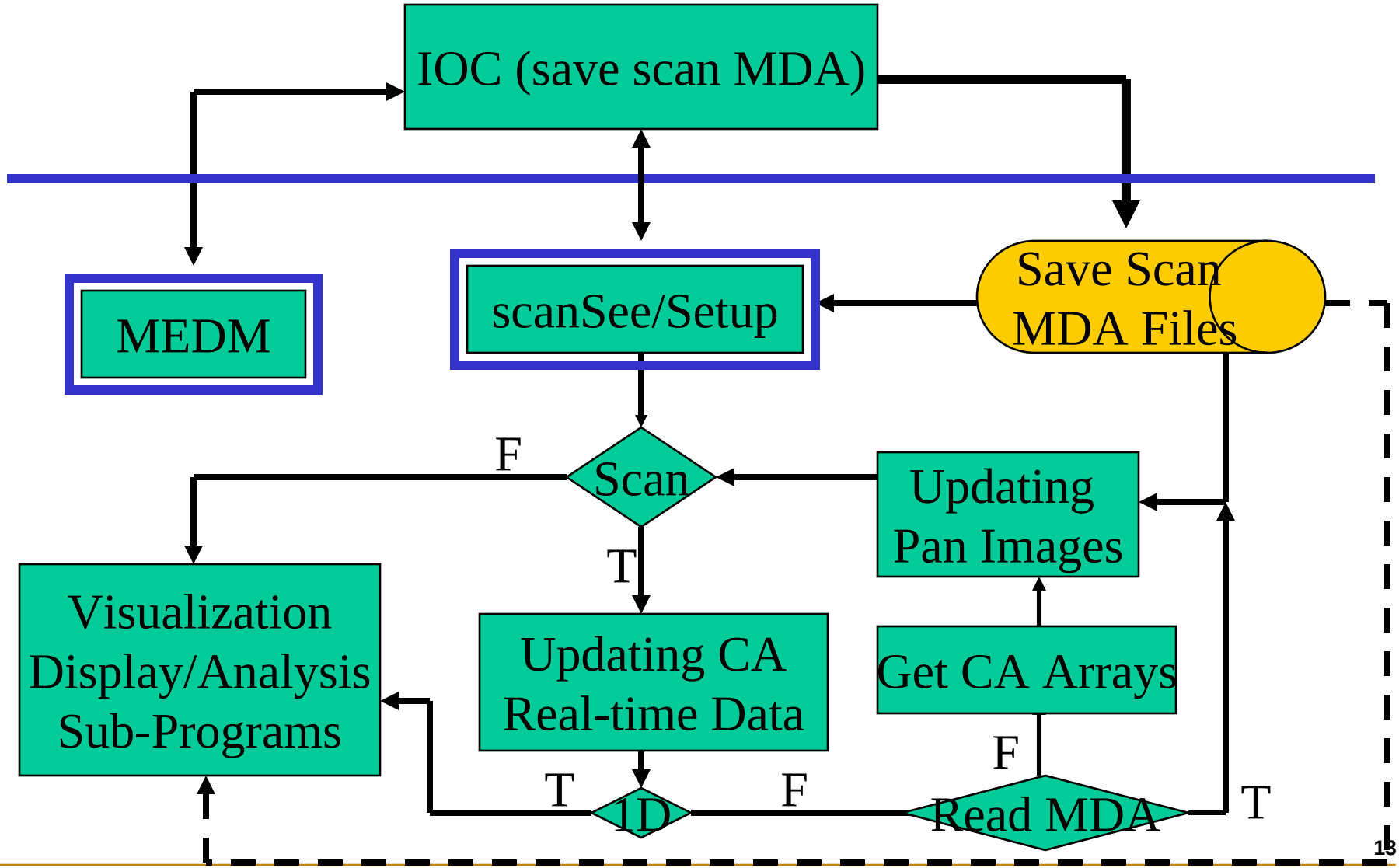
  scanSee

  catcher
- **Developer Version** **(ITOOLS available)**

  scanSee –D

  catcher –D

scanSee Flow Diagram



Files Used by scanSee

- **MDA scan files automatically saved by IOC**
- **Restart Configuration file: DC.config**
- **Saved output files:**
  - ASCII/*.txt - 1D/2D data files
  - TIFF/*.tiff - TIFF image files
  - PNG/*.png - PNG image files
  - PICT/*.pict - MAC image files
  - ROI/*.roi, *.rpt - various ROI files
  - idl.ps,plot2d.ps … - saved various PS plot, report files

Features Access Restriction

- **ITOOLS**
  - Developer version only
  - License free ITOOLS
    - *'readascii.sav' (IDLVM 6.1)*

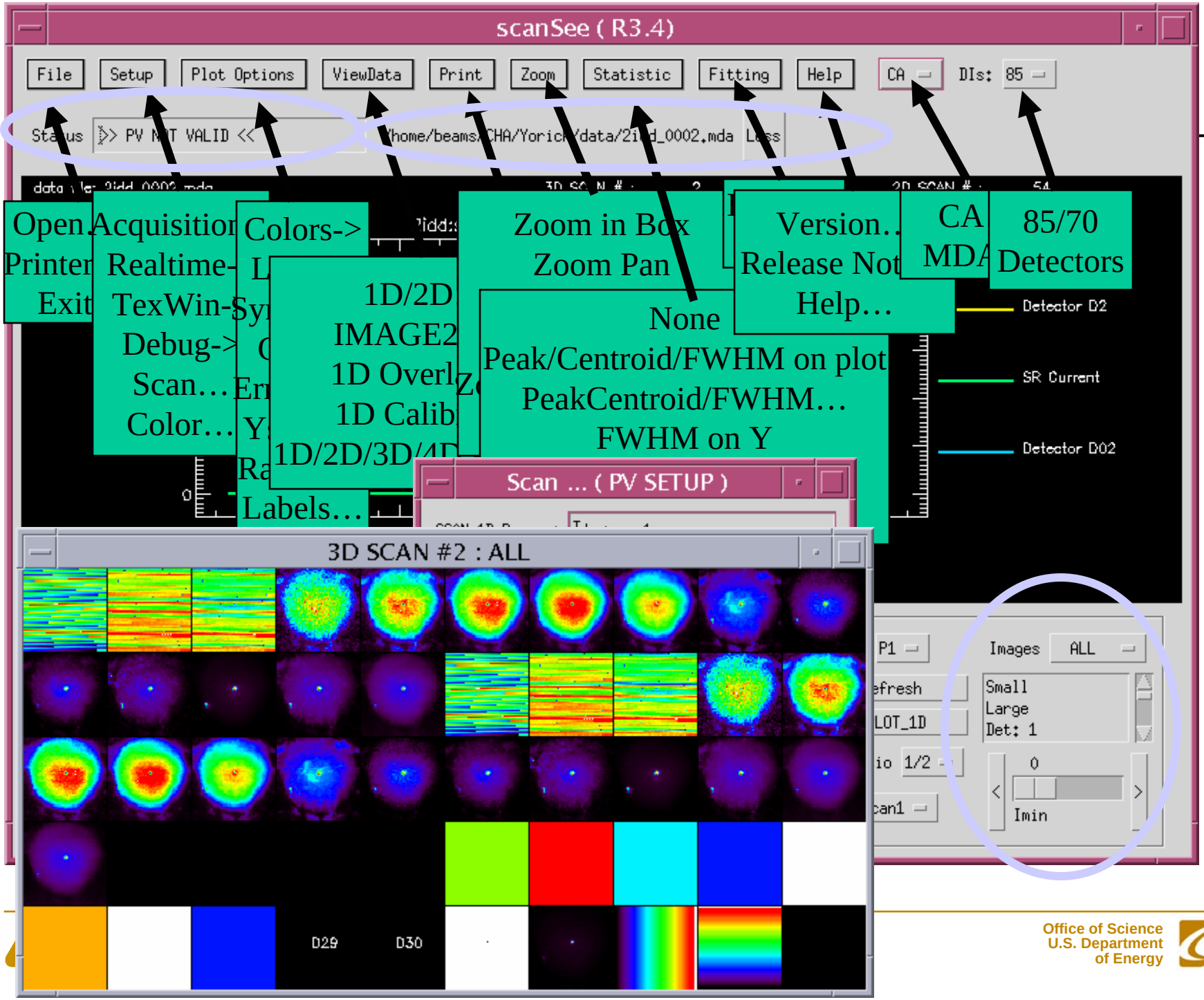
      Idlvm readascii
- **1D/2D Calibration features**
  - Developer and Runtime versions

Invocation Problem

- **Problem of startup scanSee**
  - *Due to MDA file not found in configuration file*
  - *Wrong type or bad file picked*
- **Resolve Invocation Problem**
  - *Method 1*
    - Use File->Open to pick a new file
  - *Method 2*
    - Remove the ‘DC.config’ before run **scanSee**

General Widget Interfaces

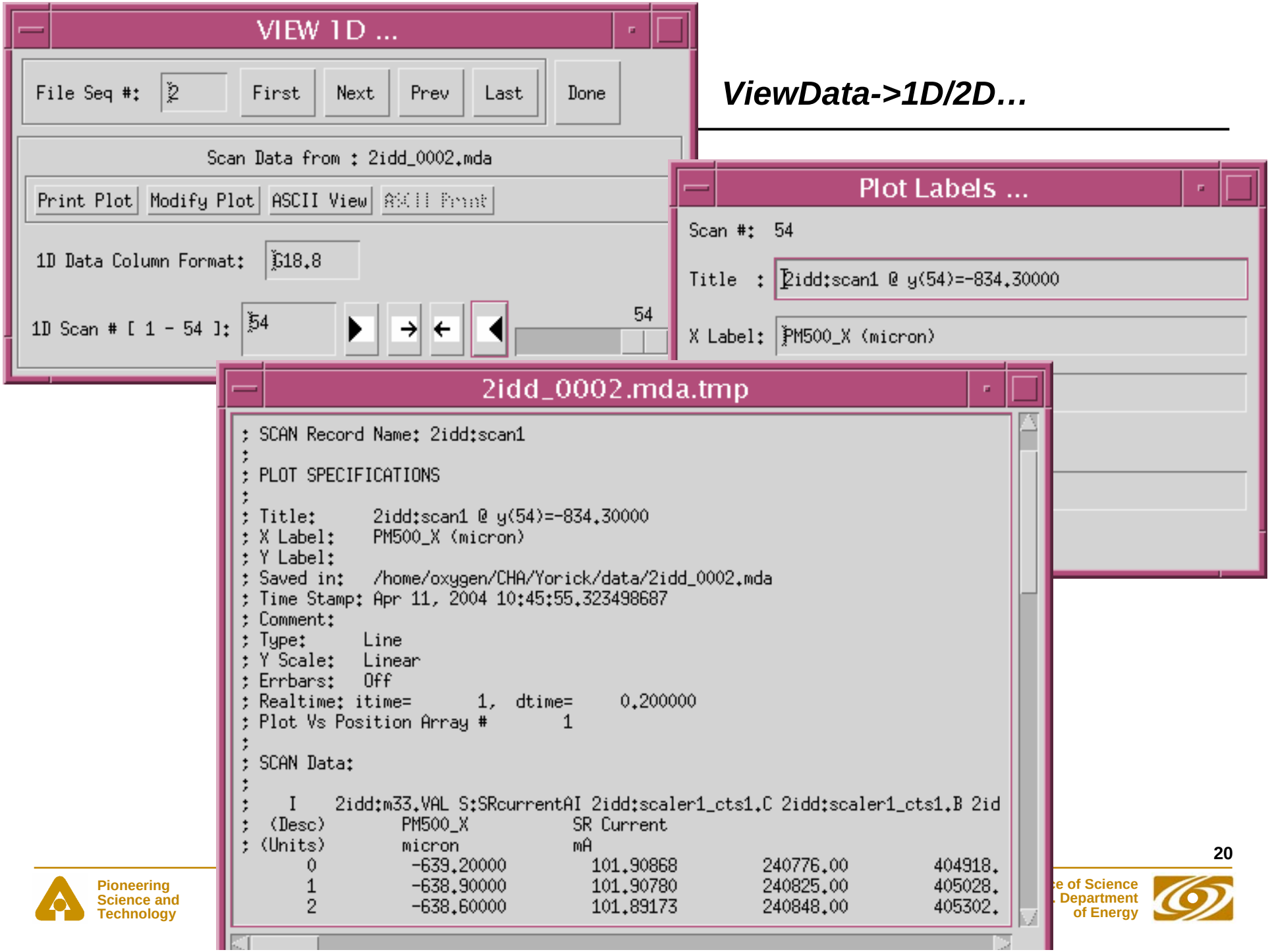
- **Click LMB - selection of menu/button/cursor/slider/list**
- **Text field - text entry must be ended with CR**
- **Button… - a pop up window/subprogram associated with it**
- **Multiple list selection**
  - *Cntl+LMB – add/delete item to selection list*
  - *Shift+LMB – select all items between current and last click*
- **ROI Mouse buttons**
  - *LMB – pick/drag ROI*
  - *MMB – resize ROI*
  - *RMB – accept ROI*


scanSee (R3.4)
File
Setup
Plot Options
ViewData
Print
Zoom
Statistic
Fitting
Help
CA
DIs: 85
Open
Printer
Exit
Acquisition
Realtime-
TexWin-Sy
Debug->
Scan…
Color…
Colors->
Er
Y
Ra
Labels…
1D/2D
IMAGE2
1D Overl
1D Calib
1D/2D/3D/4D
Zoom in Box
Zoom Pan
None
Peak/Centroid/FWHM on plot
PeakCentroid/FWHM…
FWHM on Y
Version…
Release Not
Help…
CA
MDA
85/70
Detectors
Detector D2
SR Current
Detector D02
Scan … (PV SETUP)
3D SCAN #2 : ALL
D29
D30
P1
Images
ALL
Small
Large
Det: 1
LOT_1D
io 1/2
Imin

ScanSee Features

- Use file DC.config for easy restart
- Flexible MDA file selection dialog
- User settable monitor of 1D/2D scan record
- Display near real-time 1D and 2D scanning data
- Flexible 1D display in detectors, line texture, plot ranges and labels, zoom, FWHM, easy fitting, etc
- Image data analysis, ROI statistics, calibrations
- Easy access 1D/2D/3D post scan data and pass to appropriate subprograms
- Easy ASCII/TIFF/PNG/PICT/ROI/PS output

ViewData->1D/2D…



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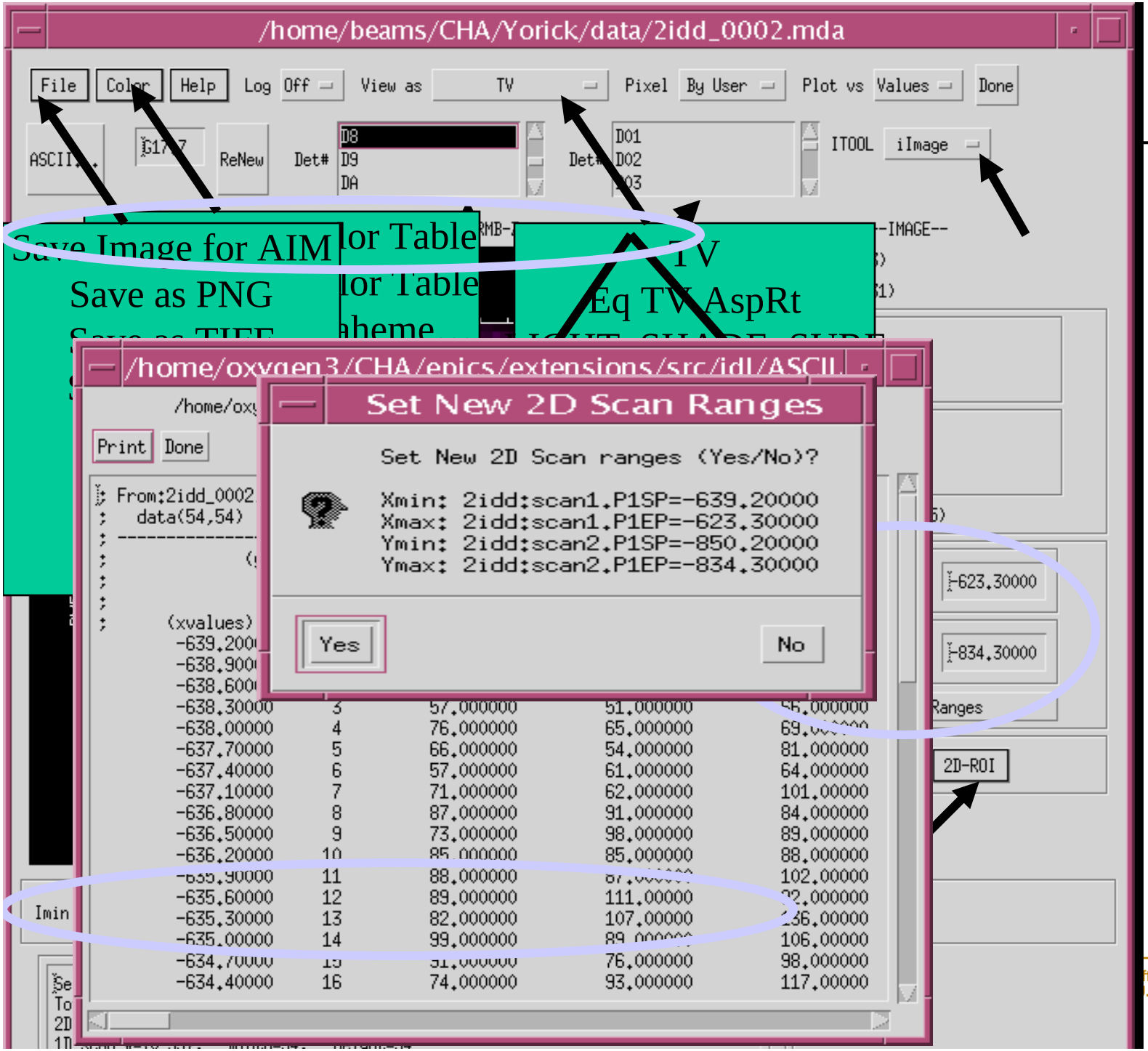
ViewData-> IMAGE2D..



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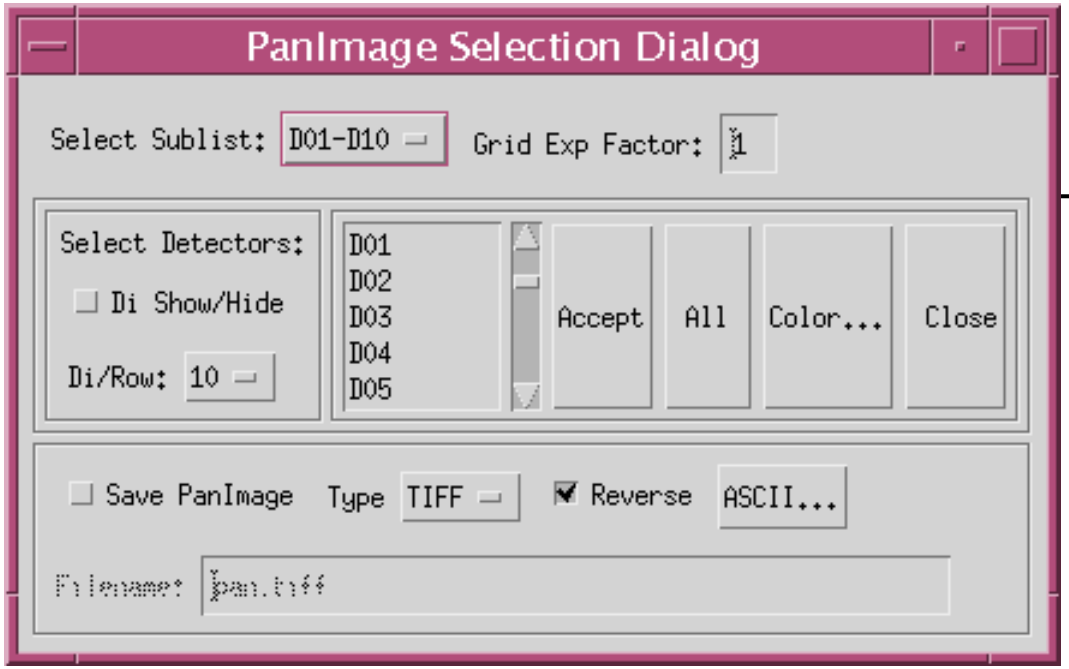
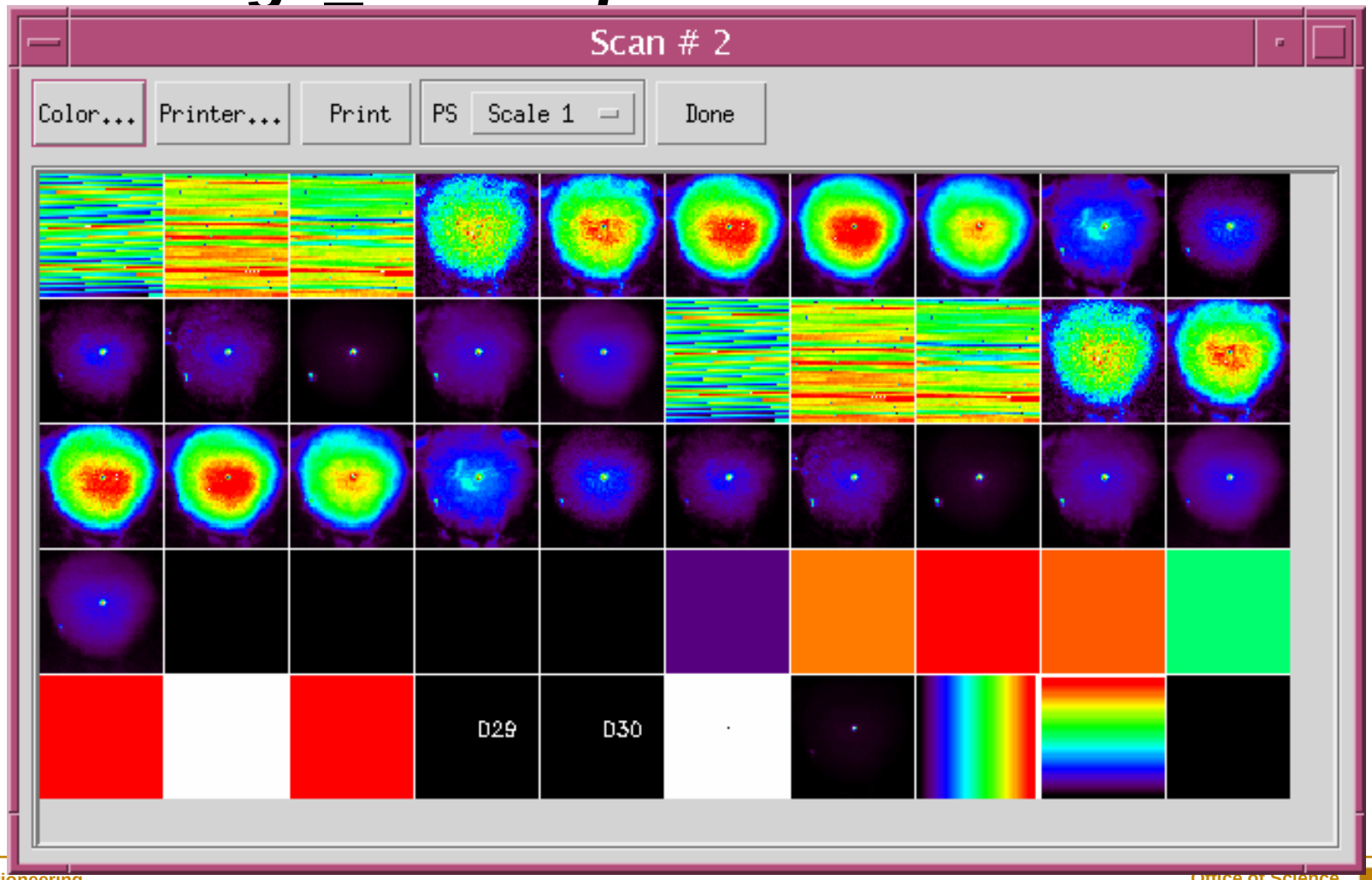


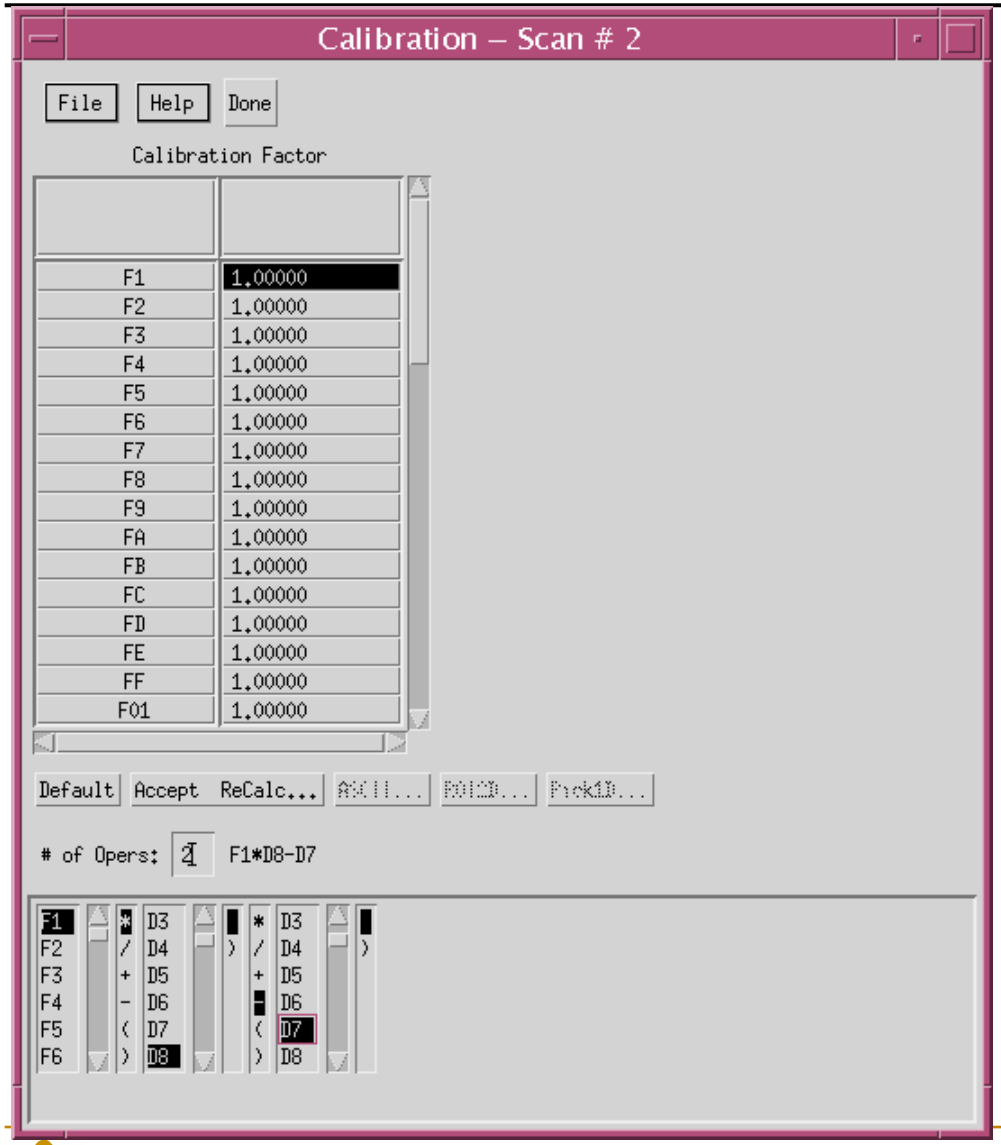
PanImage_sel Features

- **Panimage Select sub-list: D01-D10,D11-D20,…**
- **Multiple detectors selection list, default All**
- **Grid factor, default 1 (60x60)**
- **Show/Hide detector names**
- **Detectors per row, default 10**
- **Accept, All, Color table dialog**
- **Easy TIFF, PNG, PICT, ASCII panimage generation**

PanImage_sel Output

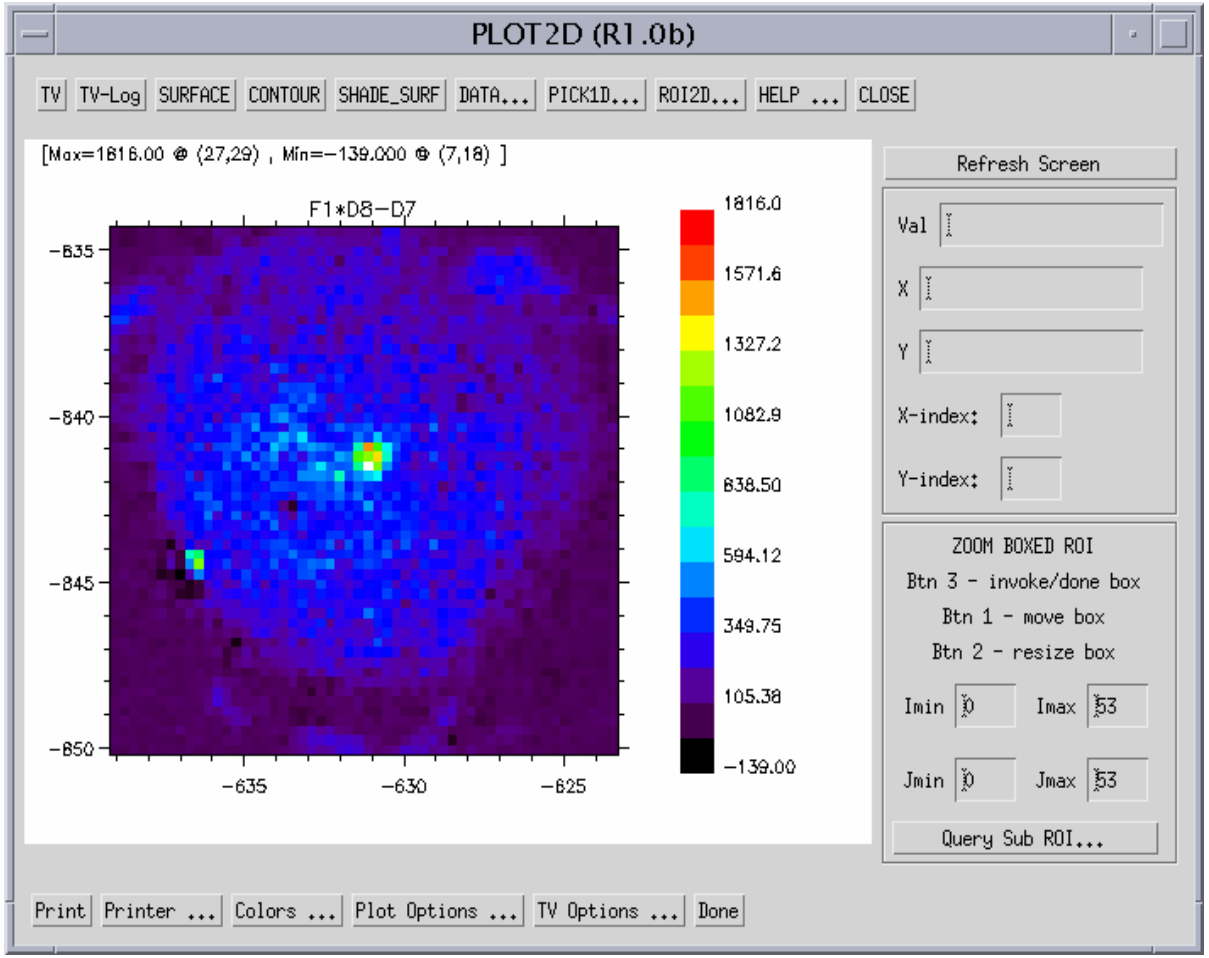


2D Calibration_factor Features



- Calibration_factor table freely modifiable
- File menu allows save/load factor file
- User settable # of terms, math operations, detectors, resultant calibration function displayed
- Accept & ReCalc, ASCII, ROI2D, Pick1D sub-programs

2D Calibra Result

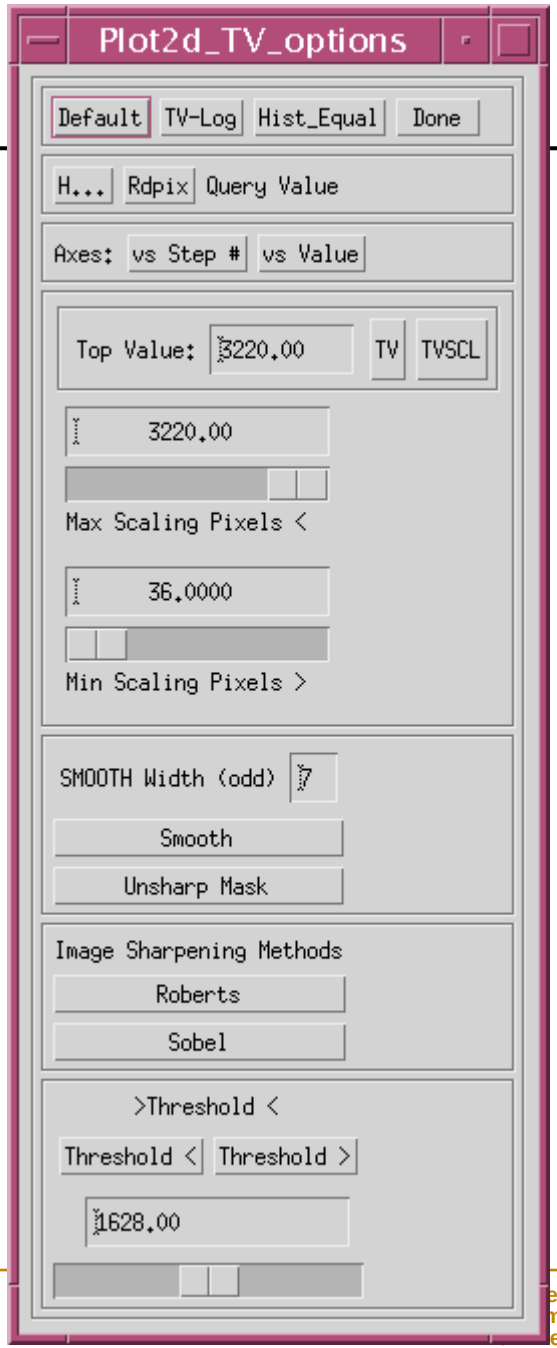


Plot2d Features

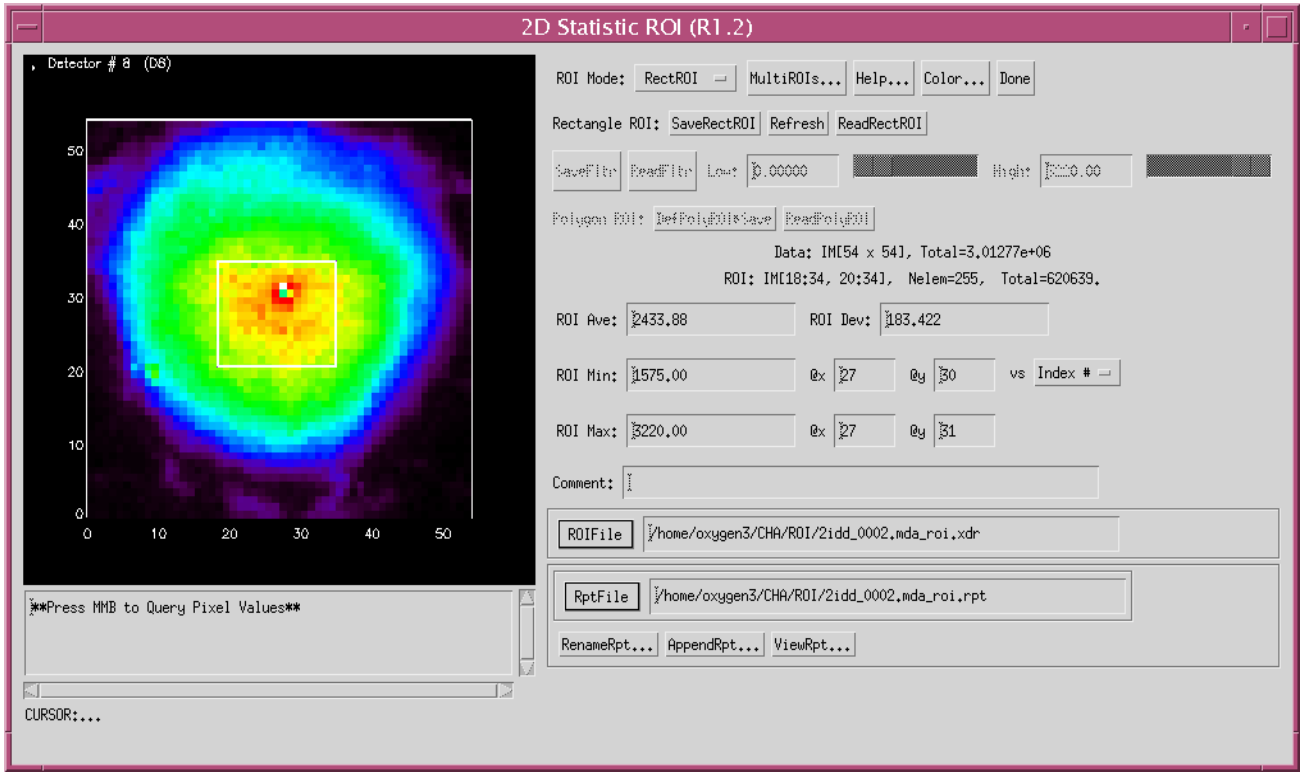
- **Support TV, Surface, Contour, Shade_Surface**
- **Access of ROI, Pick1D, ASCII data sub-programs**
- **TV image mouse query and sub-region query**
- **Dialog for various plot area configurations**
- **Dialog for various TV manipulation features: sharp, smooth, hist_equal,**

Plot2d_TV Options

- TV-log, TV, TVSCL
- Image query mode
- Hist_Equl
- Max/min filter value
- Smooth/Unsharp Mask
- Roberts/Sobel Sharpping
- Threshold



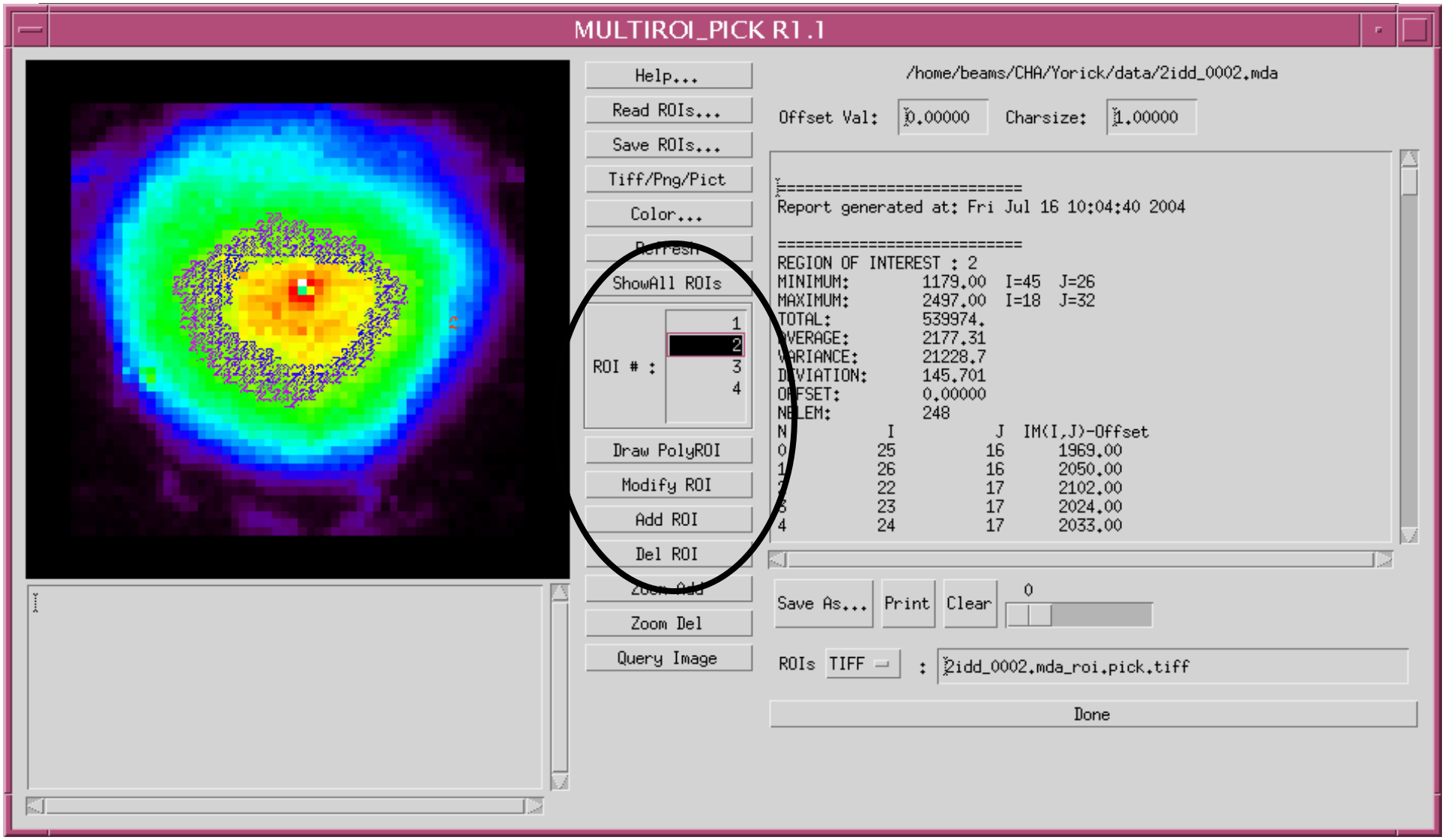
Scan2d_roi



ROI Features

- **Rect/Filter/Polygon/Multi mode of ROI**
- **Various controls of different ROI mode**
- **Mouse query / modify ROI**
- **Display statistic summary results**
- **User Settable ROI define and report filename**
- **Dialogs save, display, manage ROI reports**

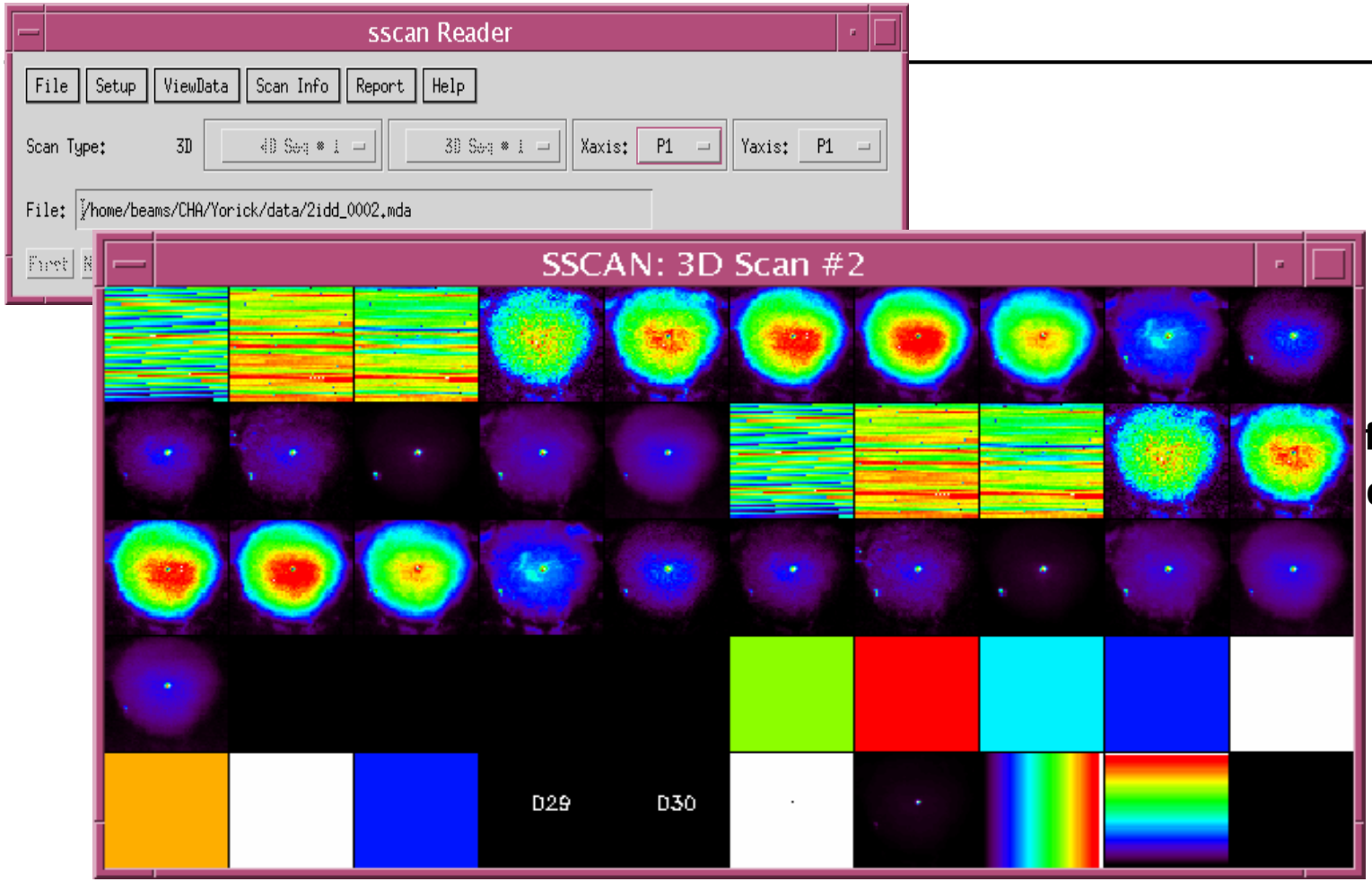
MultiROI_pick subprogram



Multi_ROI Features

- **Flexible Add/delete/modify ROIs**
- **Free hand drawing of polygon ROIs**
- **Display one/all statistic of ROIs**
- **Save/load multi ROIs to/from a file**
- **Manipulate/generate multi ROIs statistic report**
- **Save ROIs as a TIFF/PNG/PICT file**
- **Image query**

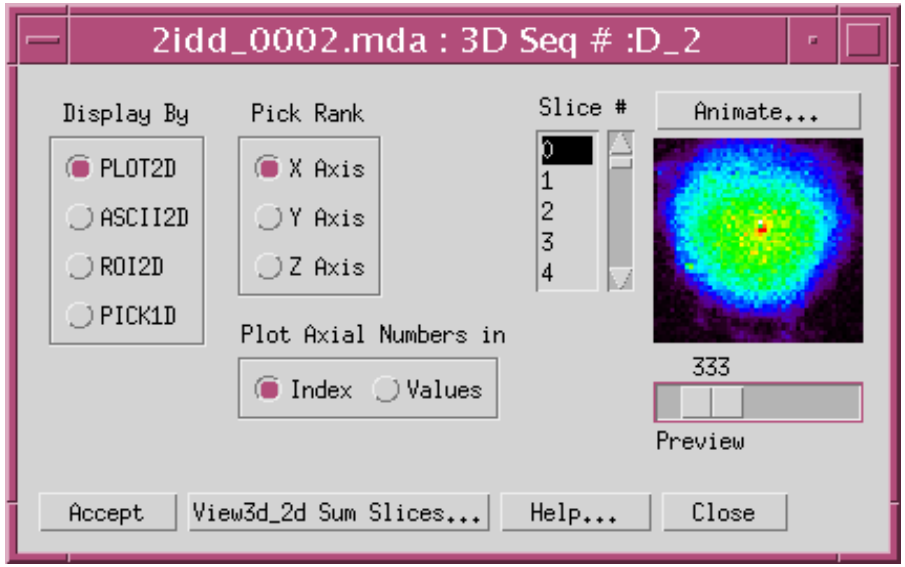
ViewData->SSCAN (1D/2D/3D/4D)…



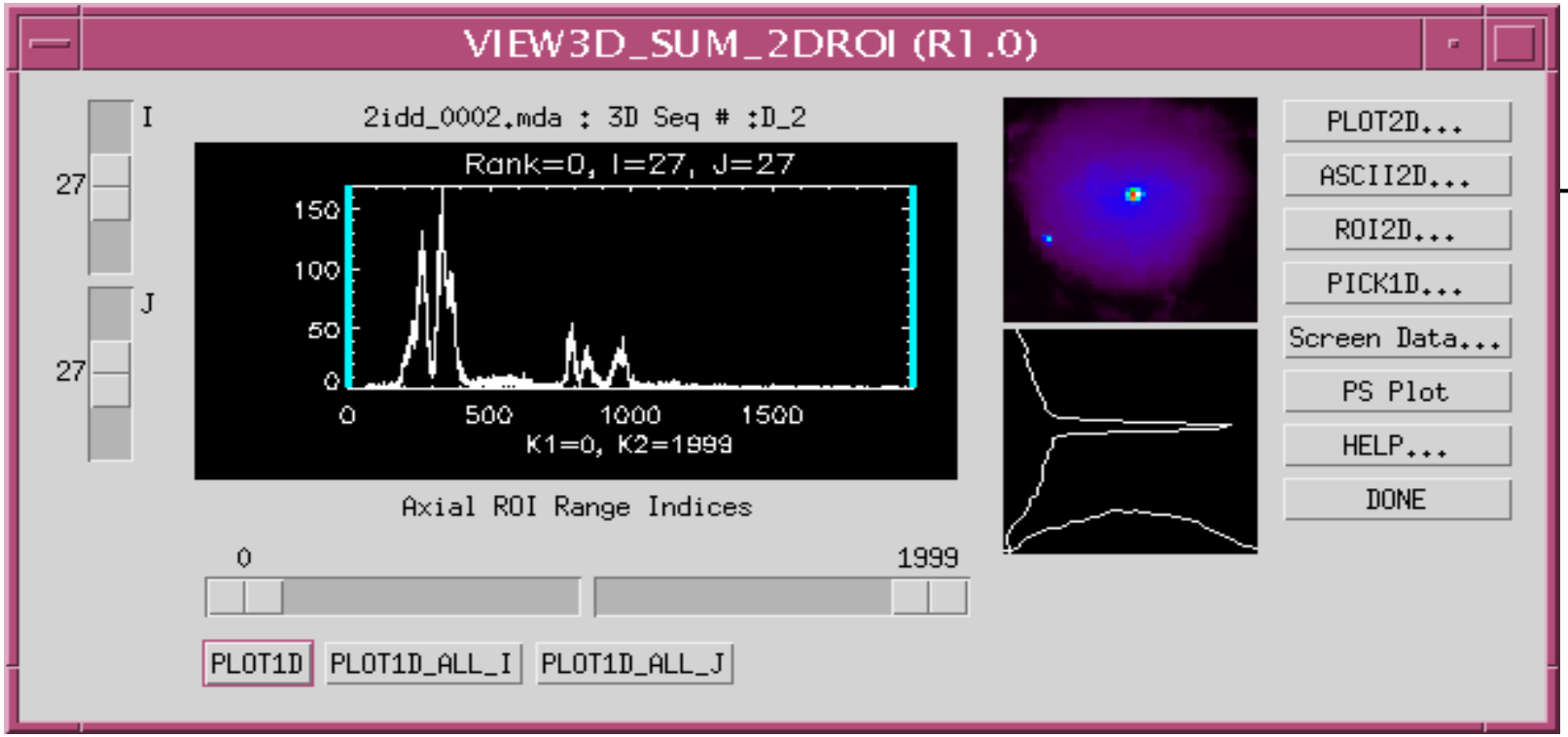
field

d_2d,

View3d_2d Slicer Features



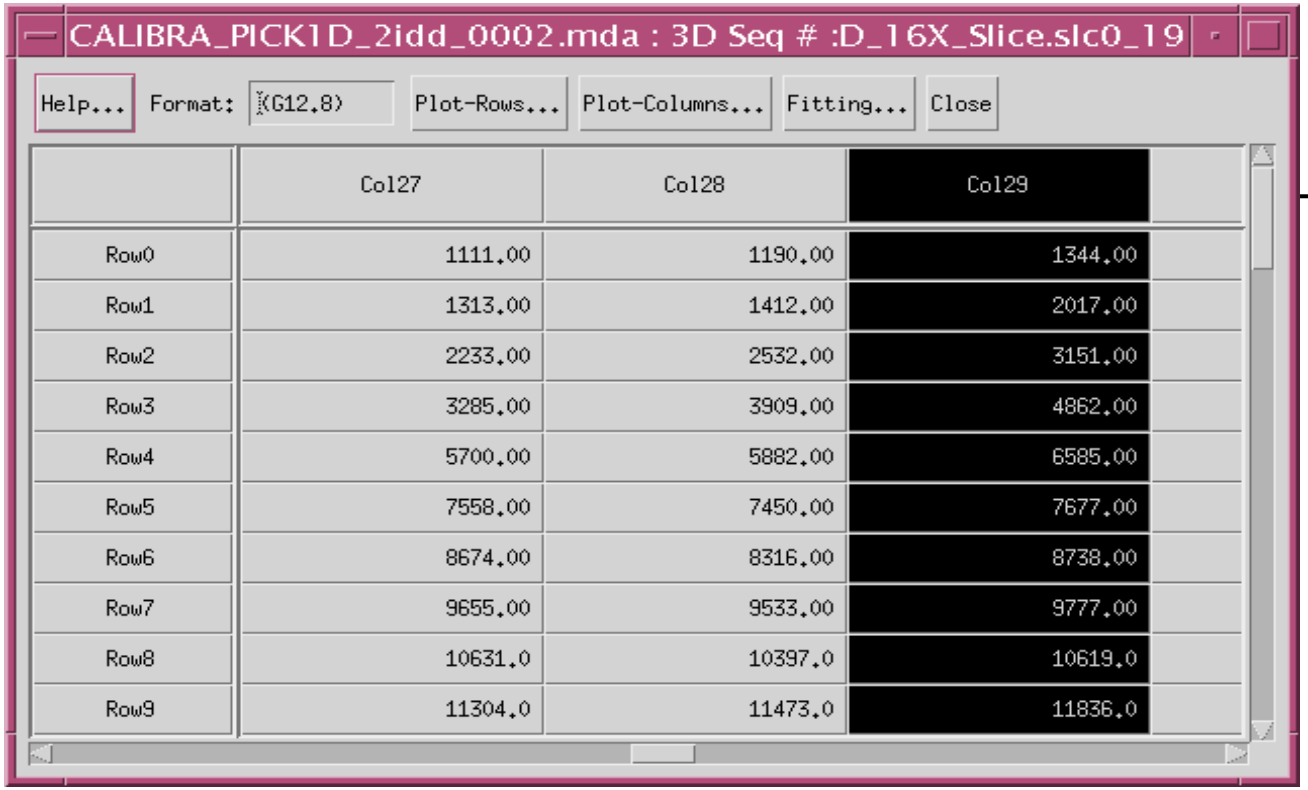
- **Plot2d/Ascii2d/ROI2d/Pick1d subprogram selection**
- **Flexible axial rank selection for 2D slicer**
- **Flexible 2D image animator or preview slider**
- **2D image slice # selection**
- **View3d_2d Sum ROI subprogram**



View3d_Sum_2DROI Features

- **Slider controls for I,J, axial range K1,K2**
- **Spectrum plot at I,J with K1,K2 marked as blue lines**
- **Option of PLOT1D, PLOT1D_ALL_I, PLOT1D_ALL_J specturm**
- **Image of sum of 2D values bound by K1,K2**
- **Plot of cross image line values at I,J**
- **Option of Plot2d/Ascii2d/Roi2d/Pick1d/Data/PS plot**

Calibra_pick1d Dialog

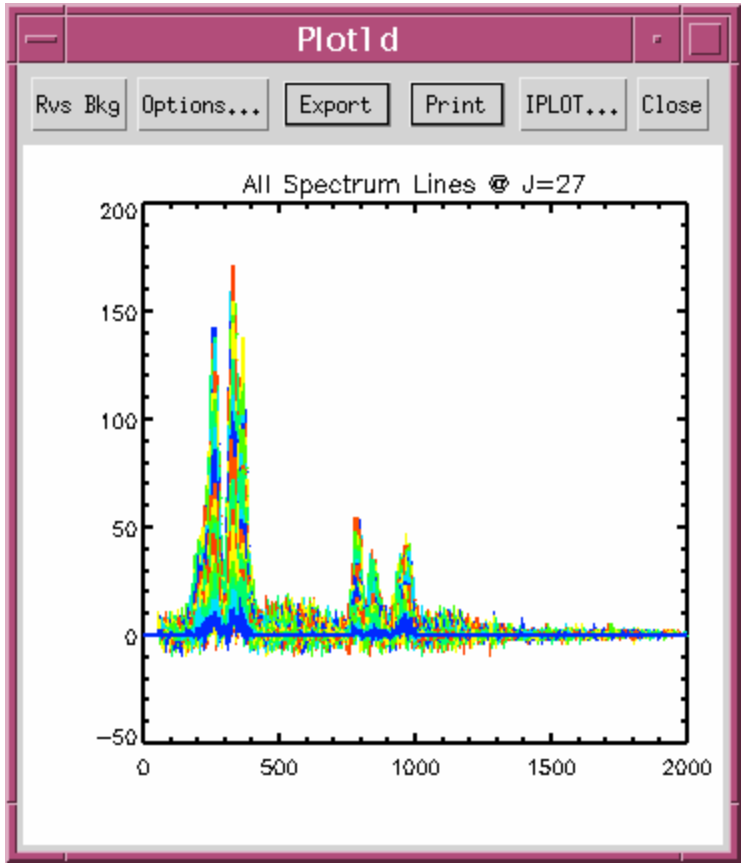


	Col27	Col28	Col29
Row0	1111.00	1190.00	1344.00
Row1	1313.00	1412.00	2017.00
Row2	2233.00	2532.00	3151.00
Row3	3285.00	3909.00	4862.00
Row4	5700.00	5882.00	6585.00
Row5	7558.00	7450.00	7677.00
Row6	8674.00	8316.00	8738.00
Row7	9655.00	9533.00	9777.00
Row8	10631.0	10397.0	10619.0
Row9	11304.0	11473.0	11836.0

Pick1D Features

- **Table display of 2D image value with format control**
- **Column/Row selection pops up plot1d grogram**
- **Plot all columns/rows with plot1d subprogram**
- **Access ez_fit subprogram with image array**

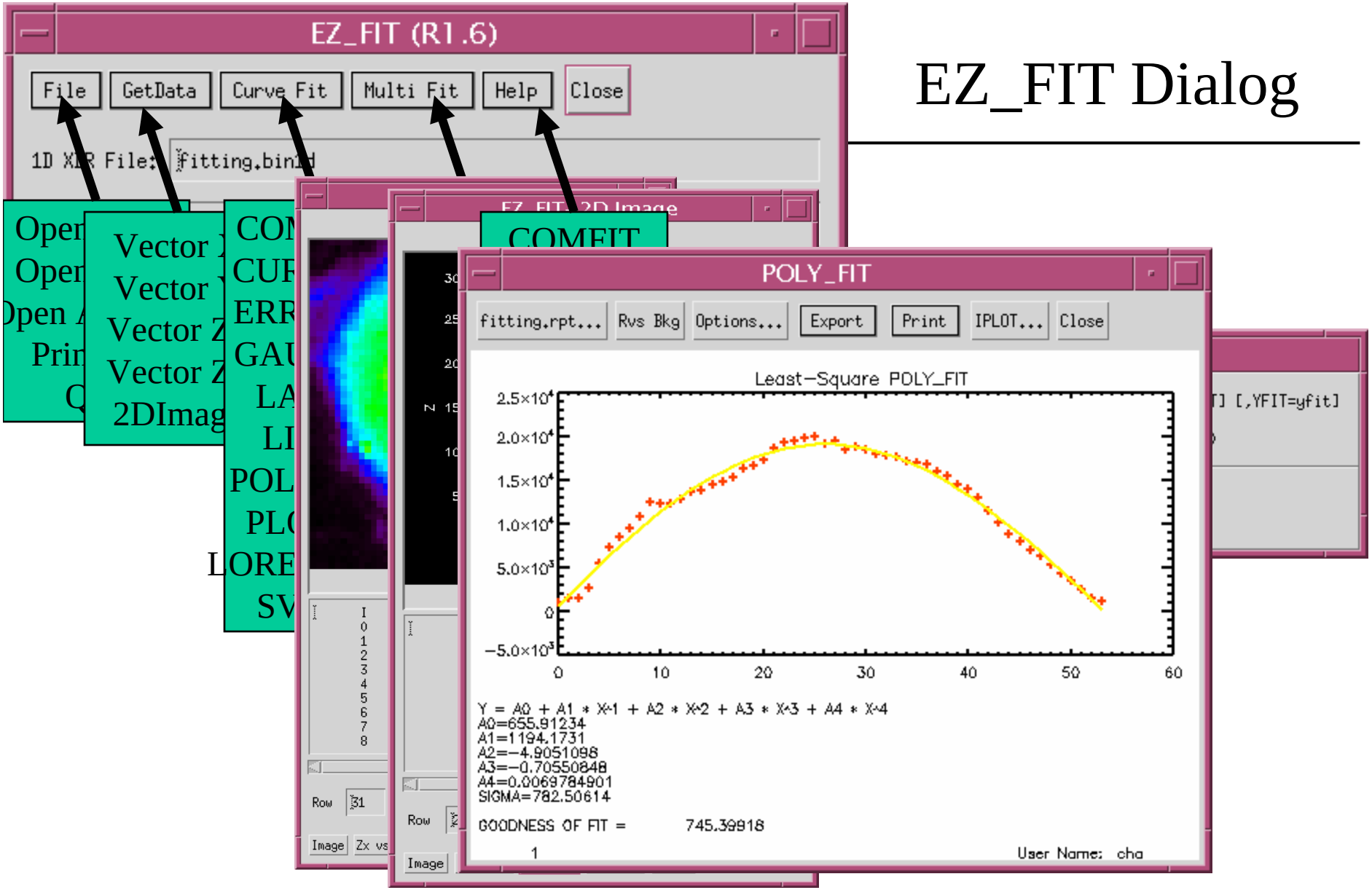
Plot All I-spectrum

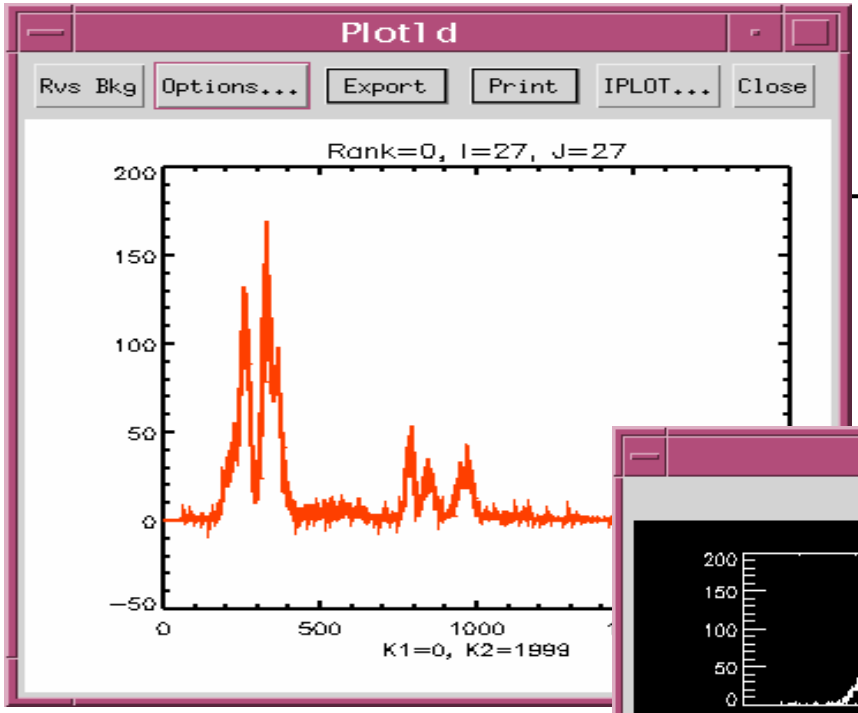


Plot1d Features

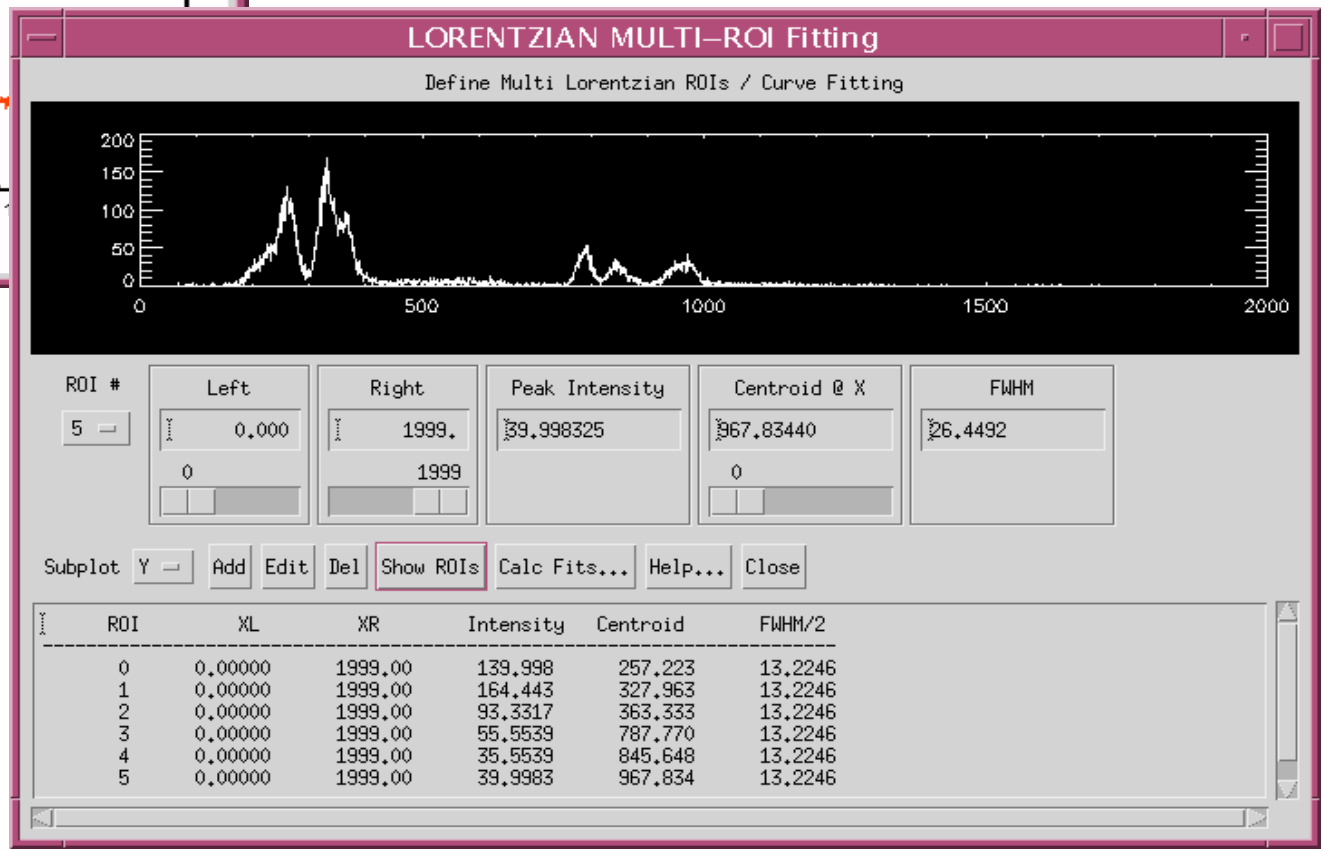
- **Plot region resize with window size**
- **Export ASCII, TIFF, PNG, PICT, PS file generation**
- **Access of IPLOT of IDL 6.0 Itools (developer version)**
- **Multiple lines plot program support scattering data**
- **Options… Dialog for various line plot configurations, legend, statistic, fitting, FWHM,etc**

EZ_FIT Dialog



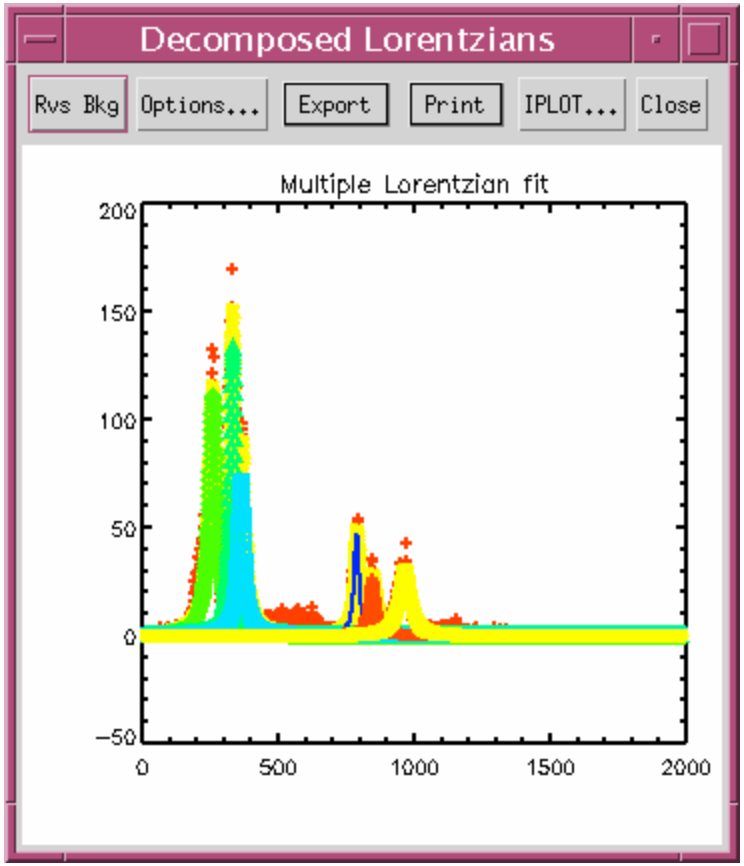


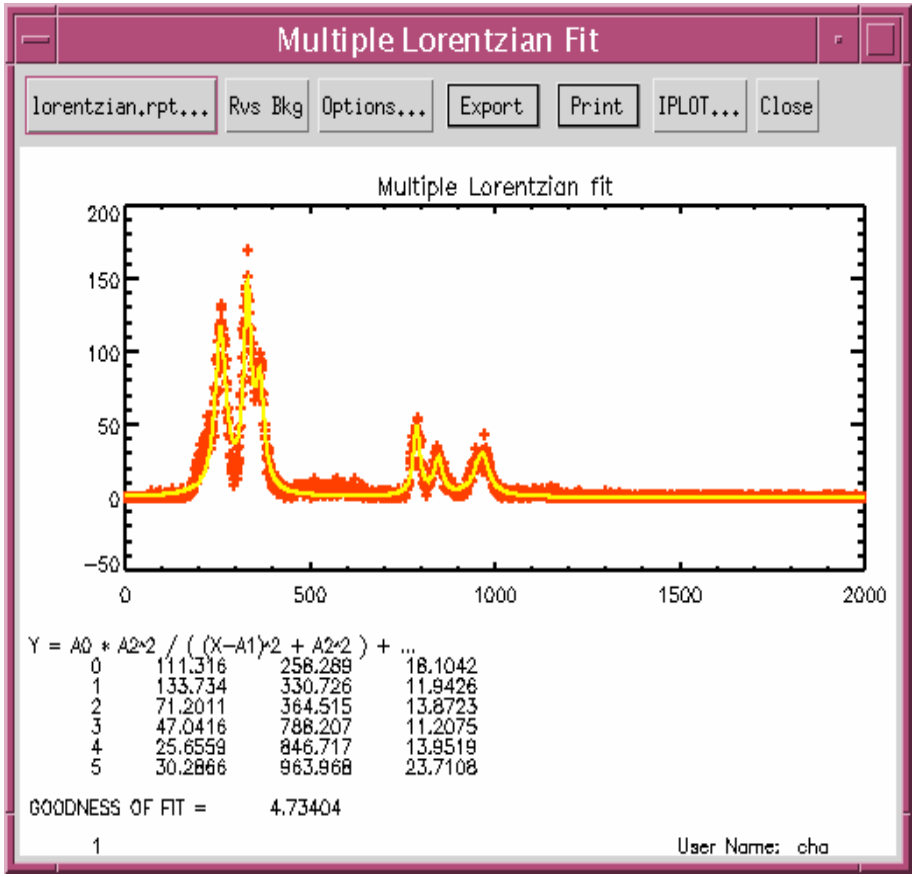
Options…->FITTING…
Muti Fit->LORENTZIAN



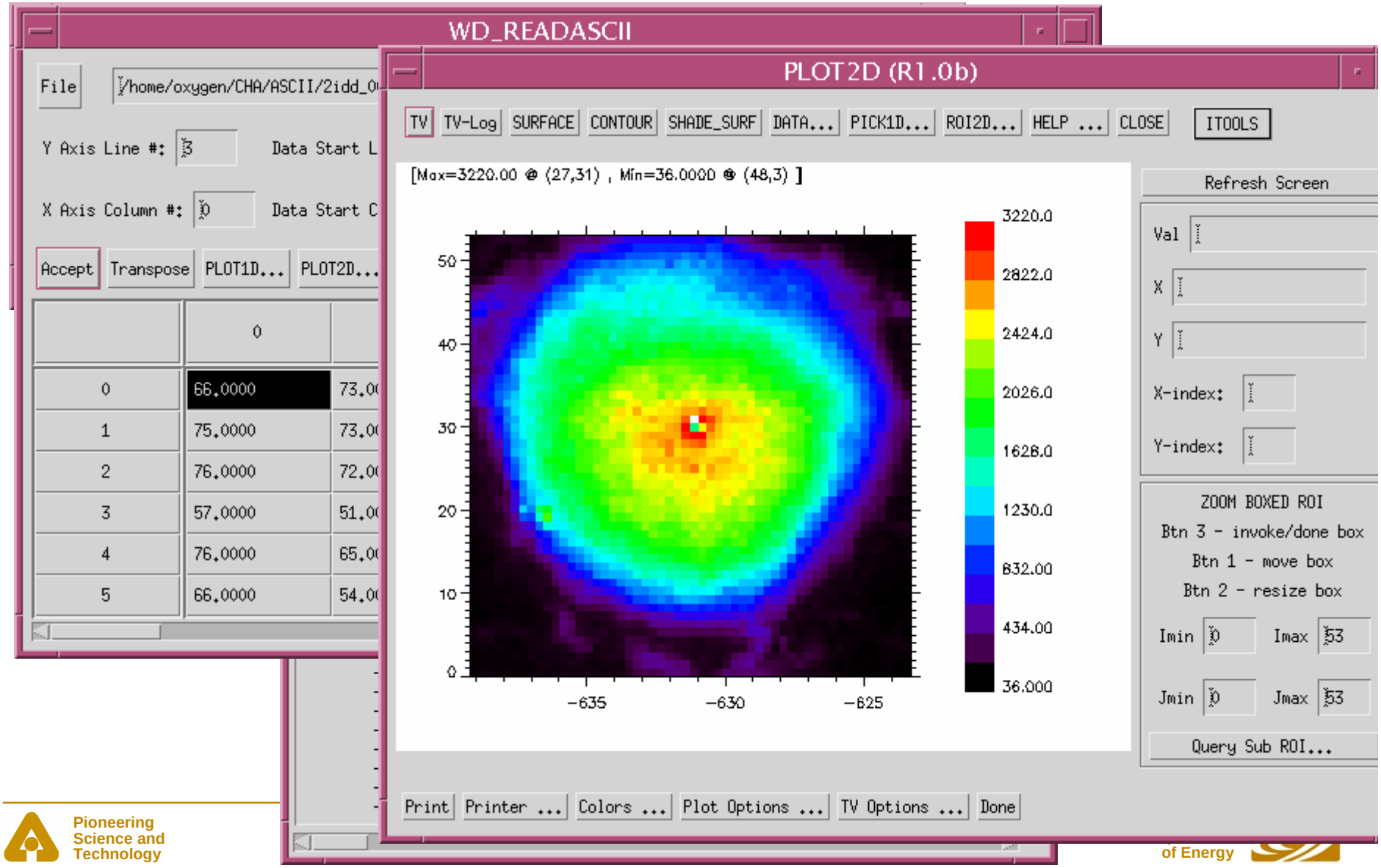
- Click First Peak
- Click Add Btn
- Click Next Peak
- Click Show ROIs
- Click Calc Fits…

Calc Fits…


Decomposed Lorentzians
Rvs Bkg
Options...
Export
Print
IPLOT...
Close
Multiple Lorentzian fit
200
150
100
50
0
−50
0
500
1000
1500
2000


Multiple Lorentzian Fit
lorentzian.rpt...
Rvs Bkg
Options...
Export
Print
IPLOT...
Close
Multiple Lorentzian fit
200
150
100
50
0
−50
0
500
1000
1500
2000
Y = A0 * A2^2 / ((X−A1)^2 + A2^2) + ...
0 111.316 258.289 18.1042
1 133.734 330.726 11.9426
2 71.2011 364.515 13.8723
3 47.0416 788.207 11.2075
4 25.6559 846.717 13.9519
5 30.2866 963.968 23.7108
GOODNESS OF FIT = 4.73404
1
User Name: cha

idlvm readascii



Use Sharable Programs

- **IDL Developer License Required**
- **Common Visualization Tools Sharable by Any Other IDL Program**
  - *Plot1d, plot2d, image2d,view3d_2d, panimage,…*
- **IDL Startup Setup**

  setenv IDL_STARTUP /usr/local/epics/extensions/idllib/viewer_startup.pro

- **Example**

idl

```
IDL> loadct, 39
IDL> da = dist(100)
IDL> plot2d,da
IDL> plot1d,da
```

Scan Object Files

- **Scan Object files with methods:**
  - sscan__define.pro (access MDA data)
  - scan2d__define.pro (access catcher 2D image file)
  - scan1d__define.pro (access catcher 1D file)

- **Object Access Setup :**

  setenv IDL_STARTUP /usr/local/epics/extensions/idllib/viewer_startup.pro

Sscan Object Examples

- **Referring**
  http://www.aps.anl.gov/~cha/idl_html/sscan_ObjectRef.html

- **Examples:**

```
idl
IDL> file='/home/beams/CHA/Yorick/data/2ixm_0020.mda'
IDL> V = obj_new('sscan',file=file)
IDL> V->image2d                    ; use object method
IDL> V->view3d_2d                  ; use object method
IDL> V->read,da1d=da1d,da2d=da2d,da3d=da3d,…
IDL> view3d_2d,da3d     ; call sharable program
IDL> image2d,da2d                  ; call sharable program
```

Catcher: Scan1d Object Examples

- **Referring:**
  http://www.aps.anl.gov/~cha/idl_html/scan1d_ObjectRef.html
- **Examples:**

```
idl
IDL> file='/home/beams/CHA/Yorick/data/junk2')
IDL> .run scan1d__define
IDL> V = obj_new('scan1d',file=file)
IDL> V->read,10,pa=pa,da=da,/plot; read scan #10 in pa and
                                ;   da  array also plot da
IDL> V->plot,10,iy='4,5'                ; read  scan # 10 and plot
                                ;   detector 4 & 5 only
IDL> plot1d,da                          ; call sharable program
```

Catcher: Scan2d Object Examples

- **Referring:**
  http://www.aps.anl.gov/~cha/idl_html/scan2d_ObjectRef.html

- **Examples:**

```
idl
IDL> file='/home/beams/CHA/Yorick/data/junk2.image')
IDL> V = obj_new('scan2d',file=file)
IDL> V->print                ; summary of image file
IDL> v->panimage,2           ; access the 2nd scan
IDL> v->images,2,im,def      ; extract all images in 2nd scan
IDL> image2d,im,id_def=def          ; use image2d to view 2nd scan
                                    ;  images
```

HDF4: NX Object Examples

- **Referring:**
  http://www.aps.anl.gov/~cha/idl_html/NX_ObjectRef.html

- **Examples:**

```
idl
IDL> file='/home/beams/CHA/Yorick/data/2xfm_0020.nexus')
IDL> .run NX__define
IDL> v = obj_new('NX',file=file)
IDL> v->print                          ;  dialog show file info, find num SDS
IDL> for i=0,309 do begin v->sds,i,da,name=na & help,da,out=t & print,na,i,t & end
        ;  get all SDS data name and array info
IDL> retall
IDL> v->sds,131,da,name=na      ; read the 131th  set of SDS
IDL> view3d_2d,da               ; pass 3D array to view3d_2d program
IDL> v->sds,96,da,name=na       ; read the 96th  set of SDS
IDL> plot2d,da                                  ; pass 2D array to plot2d program
IDL> hdfb                                       ; call hdfb  program
```

Access ezcaIDL functions

- **Reference Documents:**
  http://www.aps.anl.gov/~cha/catcher/ezcaIDLRef.html

- **Unix Setup Requirement:**
  source /usr/local/epics/extensions/bin/solsris-sparc/ezcaidl_setup
  (LD_LIBRARY_PATH, EZCA_IDL_SHARE, IDL_STARTUP)

- **Examples:**

```
Idl -32
IDL> r = caGetArray('cha:scan1.D1DA',data,max=11)
                                                    ; get 11 data points
IDL> plot1D,data                                    ; plot data array
IDL> x = ['chademoai1','chademoai2']                ; set x to two PVs
IDL> r = caGetArray(x, y)  & print,y                ; get &print values
IDL> newy = y+1. & r = caPutArray(x, newy)          ; add & put values
```

Where to Get More Information

- http://www.aps.anl.gov/aod/bcda/dataVis/index.php