Data Visualization

EPICS Extensions IDL Tools

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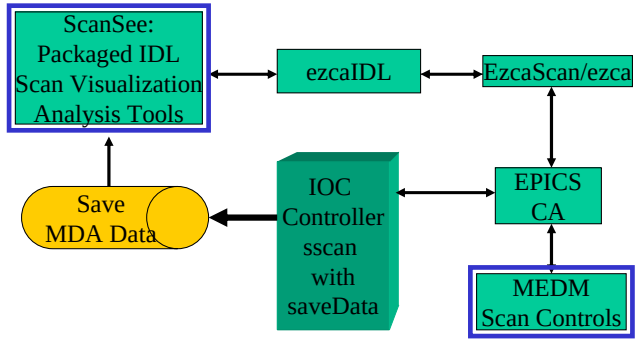
Introduction

- **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**
- **EzcaIDL 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, ezcaIDL, 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**

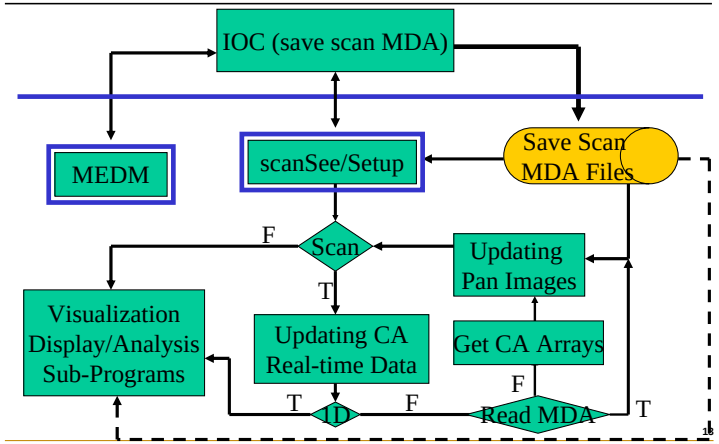
IDLVM 6.0

- **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 R3.4 and later*
  - *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)*

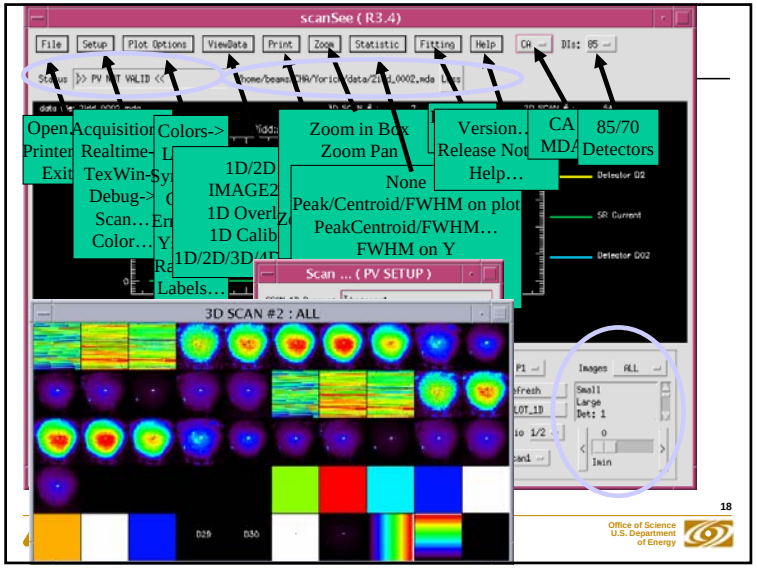
      Idlvm readascii
- **1D/2D Calibration features**
  - Developer and Runtime versions

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**

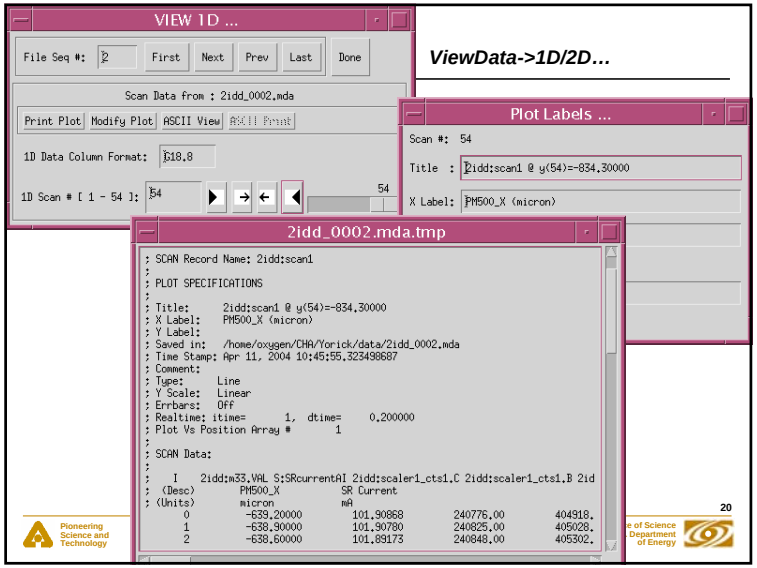
General Widget Interfaces

- **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*

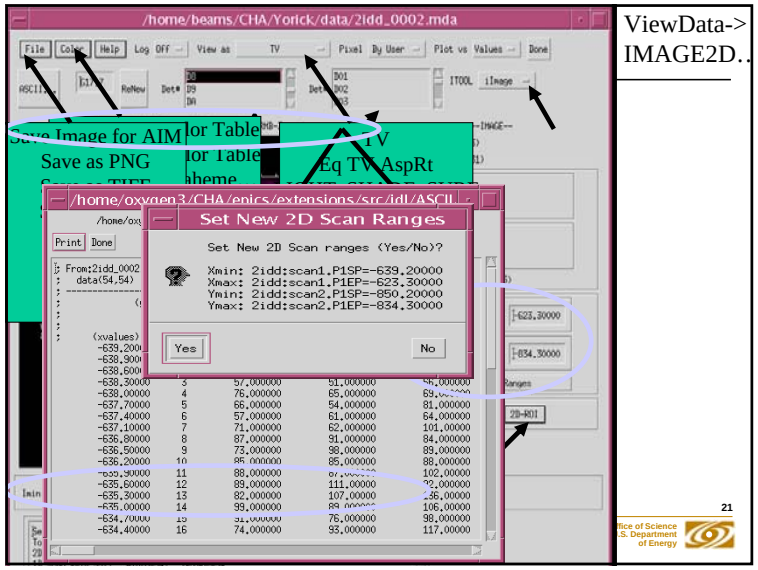


ScanSee Features

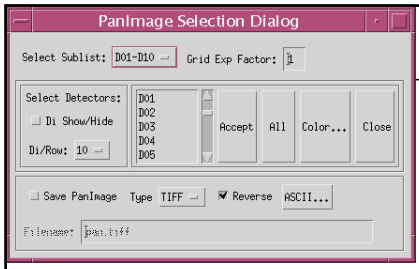
- **Use file DC.config for easy restart**
- **Flexible MDA file selection dialog**
- **User settable monitor of 1D/2D scan record**
- **Display near real-time 1D and 2D scanning data**
- **Flexible 1D display in detectors, line texture, plot ranges and labels, zoom, FWHM, easy fitting, etc**
- **Image 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…



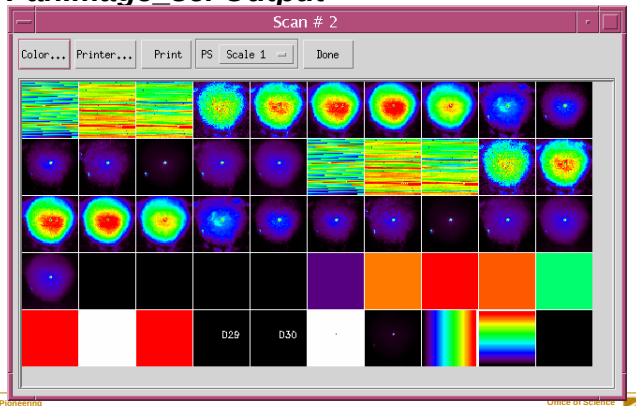
ViewData->
IMAGE2D..



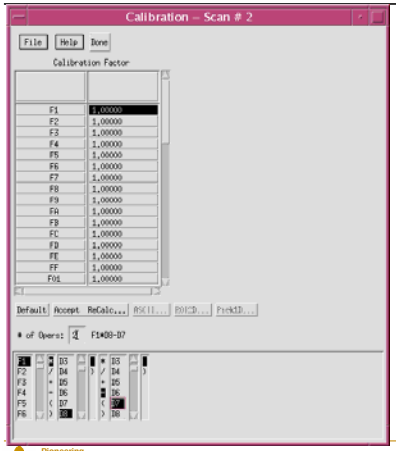
PanImage_sel Features

- **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

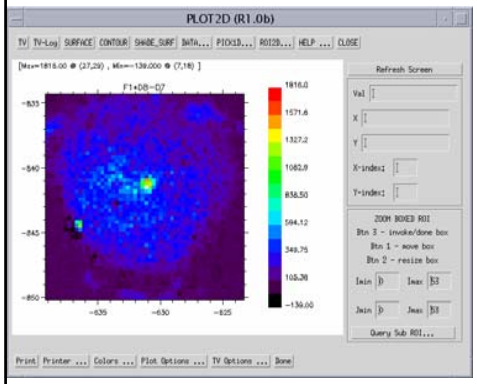


2D Calibration_factor Features



- **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**

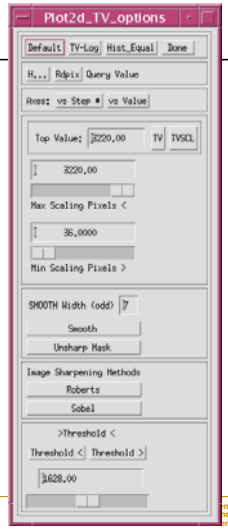
2D Calibra Result



Plot2d Features

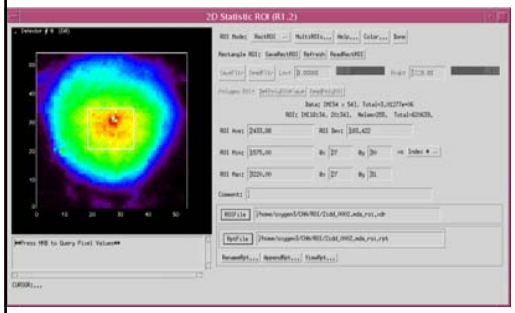
- Support TV, Surface, Contour, Shade_Surface
- Access of ROI, Pick1D, ASCII data sub-programs
- TV image mouse query and sub-region query
- Dialog for various plot area configurations
- Dialog for various TV manipulation features: sharp, smooth, hist_equal,

Plot2d_TV Options



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

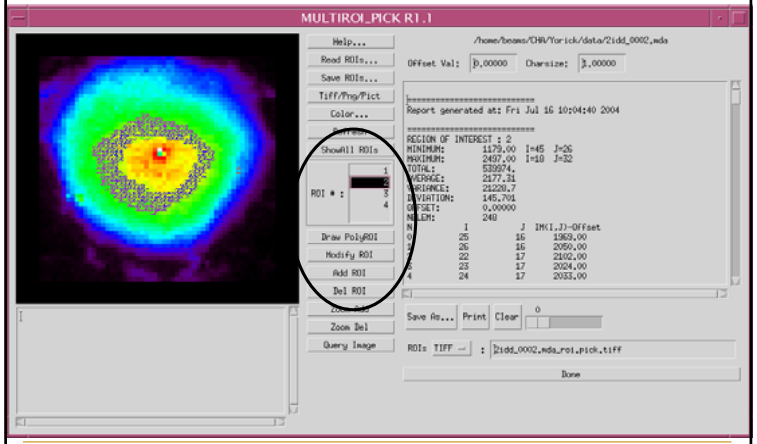
Scan2d_roi



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

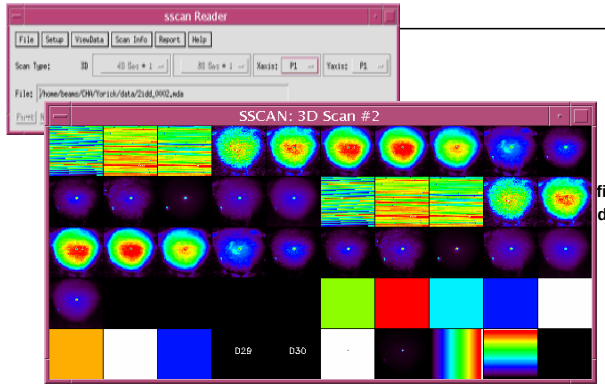
MultiROI_pick subprogram



Multi_ROI Features

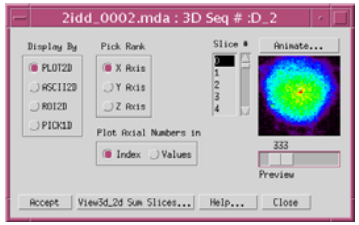
- Flexible Add/delete/modify ROIs
- Free hand drawing of polygon ROIs
- Display one/all statistic of ROIs
- Save/load multi ROIs to/from a file
- Manipulate/generate multi ROIs statistic report
- Save ROIs as a TIFF/PNG/PICT file
- Image query

ViewData->SSCAN (1D/2D/3D/4D)…

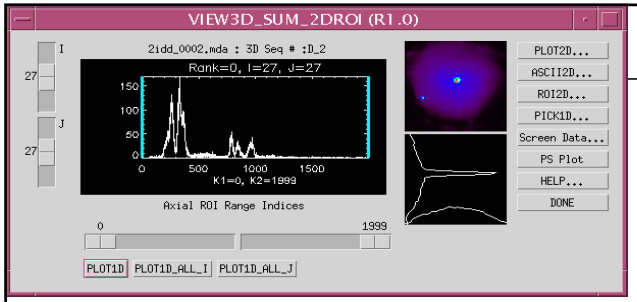


field
d_2d,

View3d_2d Slicer Features

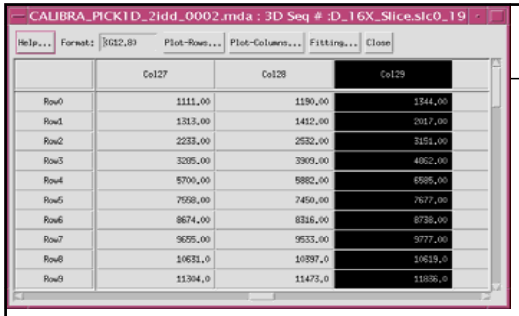


- Plot2d/Ascii2d/ROI2d/Pick1d subprogram selection
- Flexible axial rank selection for 2D slicer
- Flexible 2D image animator or preview slider
- 2D image slice # selection
- View3d_2d Sum ROI subprogram



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

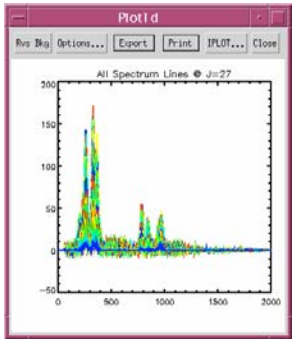


Calibra_pick1d Dialog

Pick1D Features

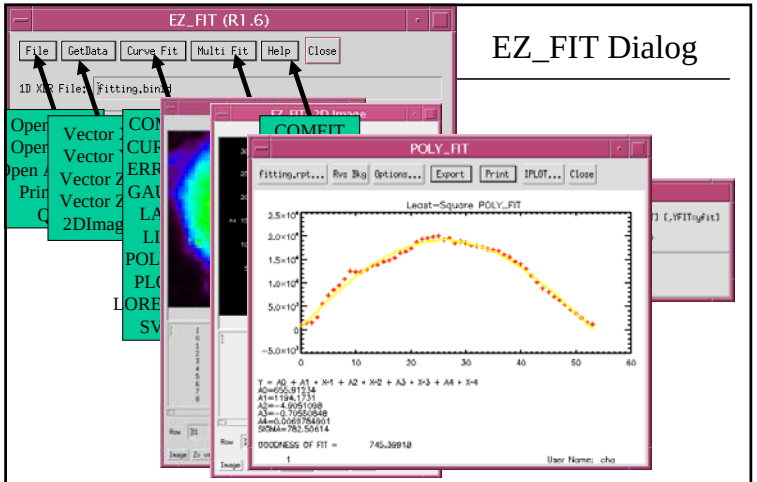
- Table display of 2D image value with format control
- Column/Row selection pops up plot1d grogram
- Plot all columns/rows with plot1d subprogram
- Access ez_fit subprogram with image array

Plot All I-spectrum

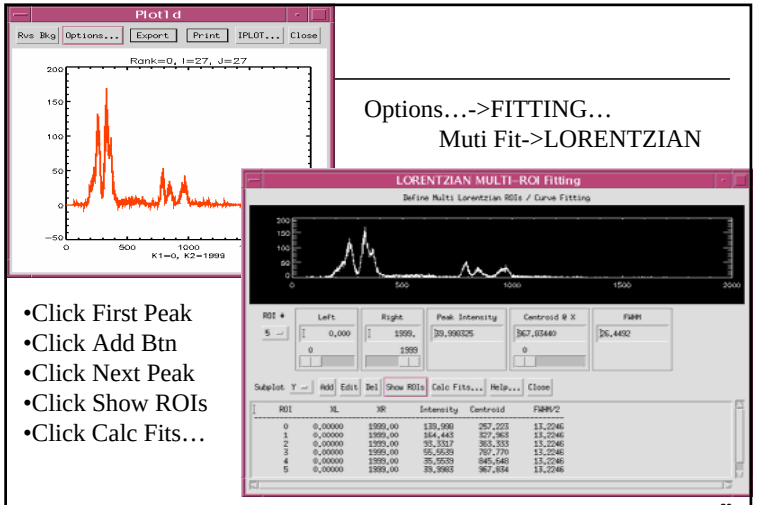


Plot1d Features

- 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



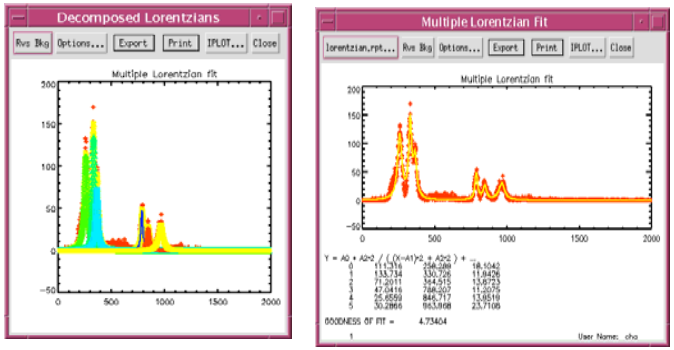
EZ_FIT Dialog



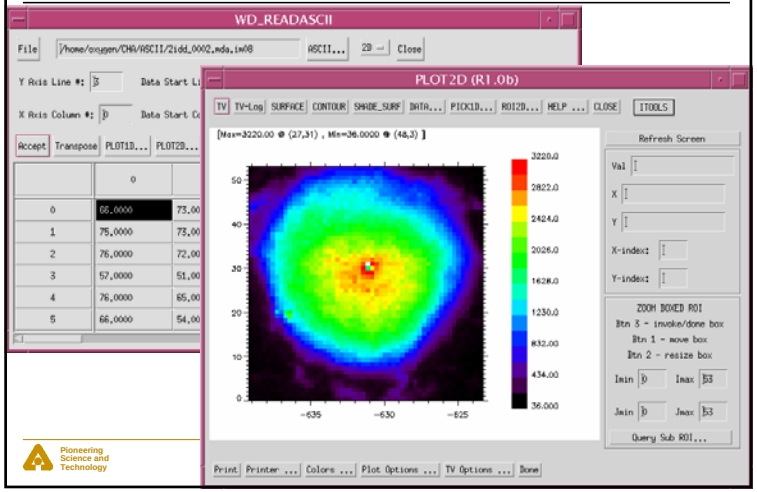
Options…->FITTING…
Muti Fit->LORENTZIAN

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

Calc Fits…



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