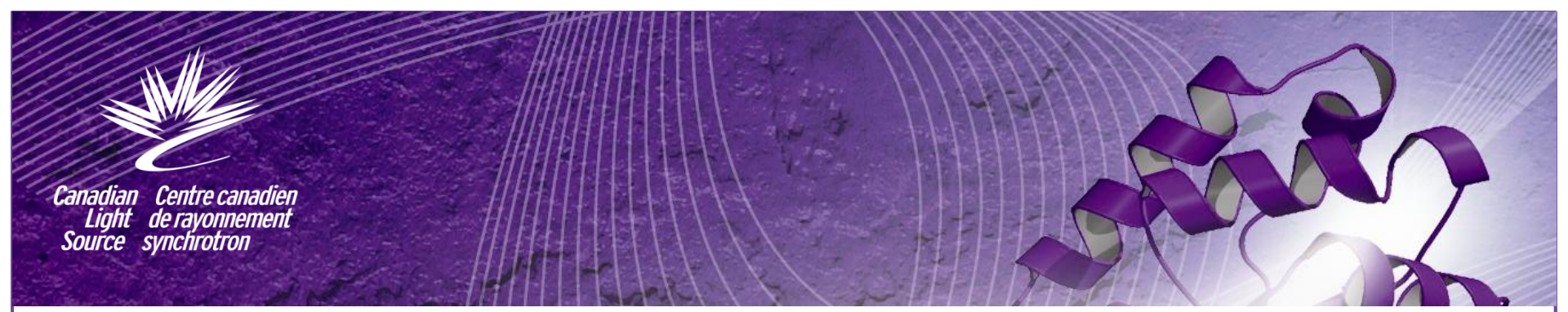


Using ezcalDL to connect to EPICS Channel Access from SHADOWVUI for Dynamic X-ray Tracing

Alan Duffy

Canadian Light Source

Outline

- Software requirements (what you need)
- Software overview (what it does)
- Simulation model of real-life beamline
  - (caveat ~~emptor~~ simulator)
- EPICS and ezcaIDL (connections)
- ezcaSHADOWVUI (dynamic ray tracing)

Software Requirements

- SHADOW (Fortran and C library of subroutines)
  - Ray tracing engine developed at Nanotech Wisconsin (University of Wisconsin)
  - Used to study flashlights to x-ray telescopes and microscopes
- XOP + SHADOWVUI (written in IDL)
  - Visual User Interface for SHADOW
- EPICS with extensions: ezca, ezcaIDL
  - Provides Channel Access (CA) to process variables

SHADOW

- Main program and utilities
- I/O session driven to define system
- SHADOW Structure
  - Data files (usually binary)
  - Parameter files (e.g. START.XX in NAMELIST format)

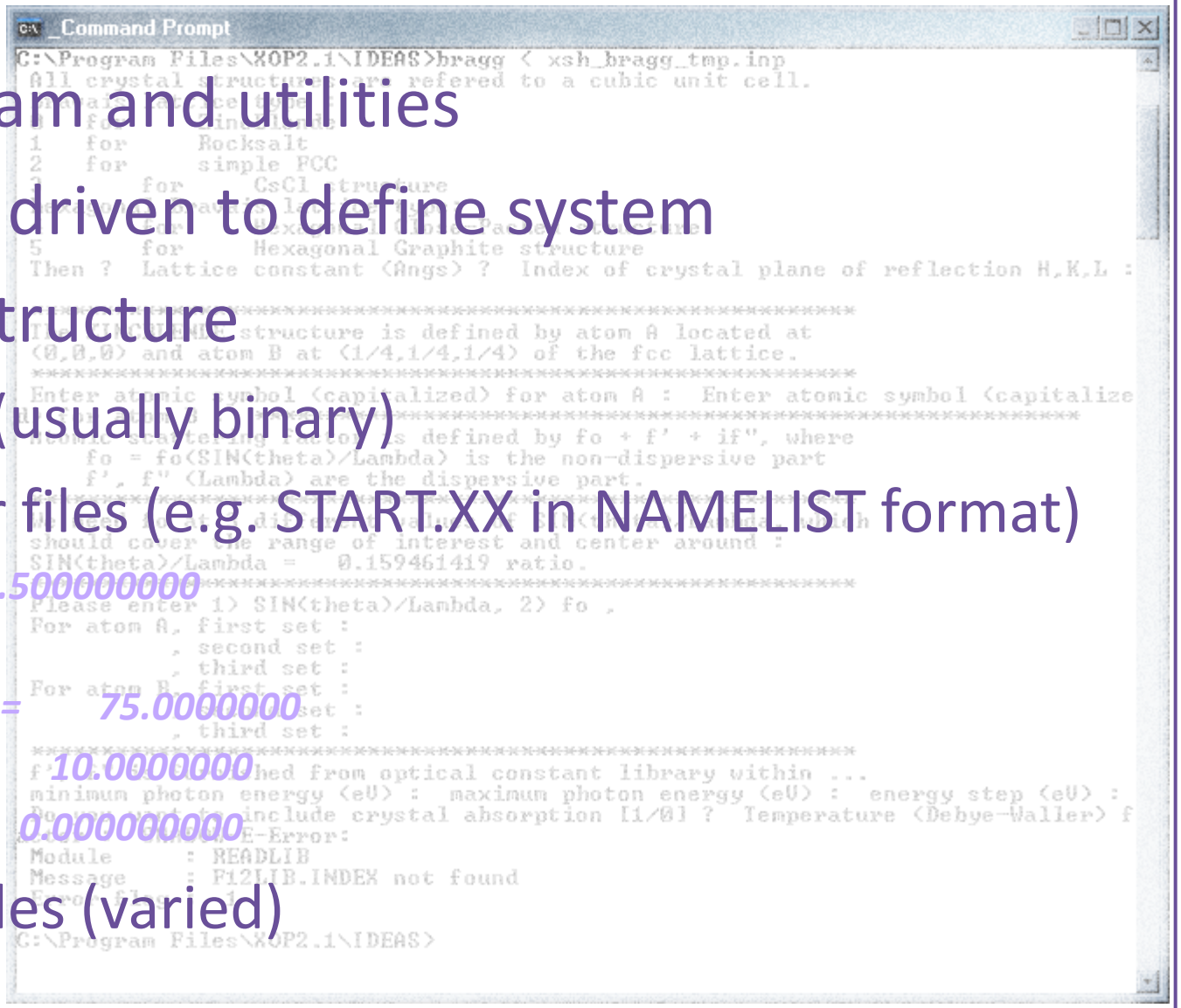
    X_ROT = -0.500000000

    ...

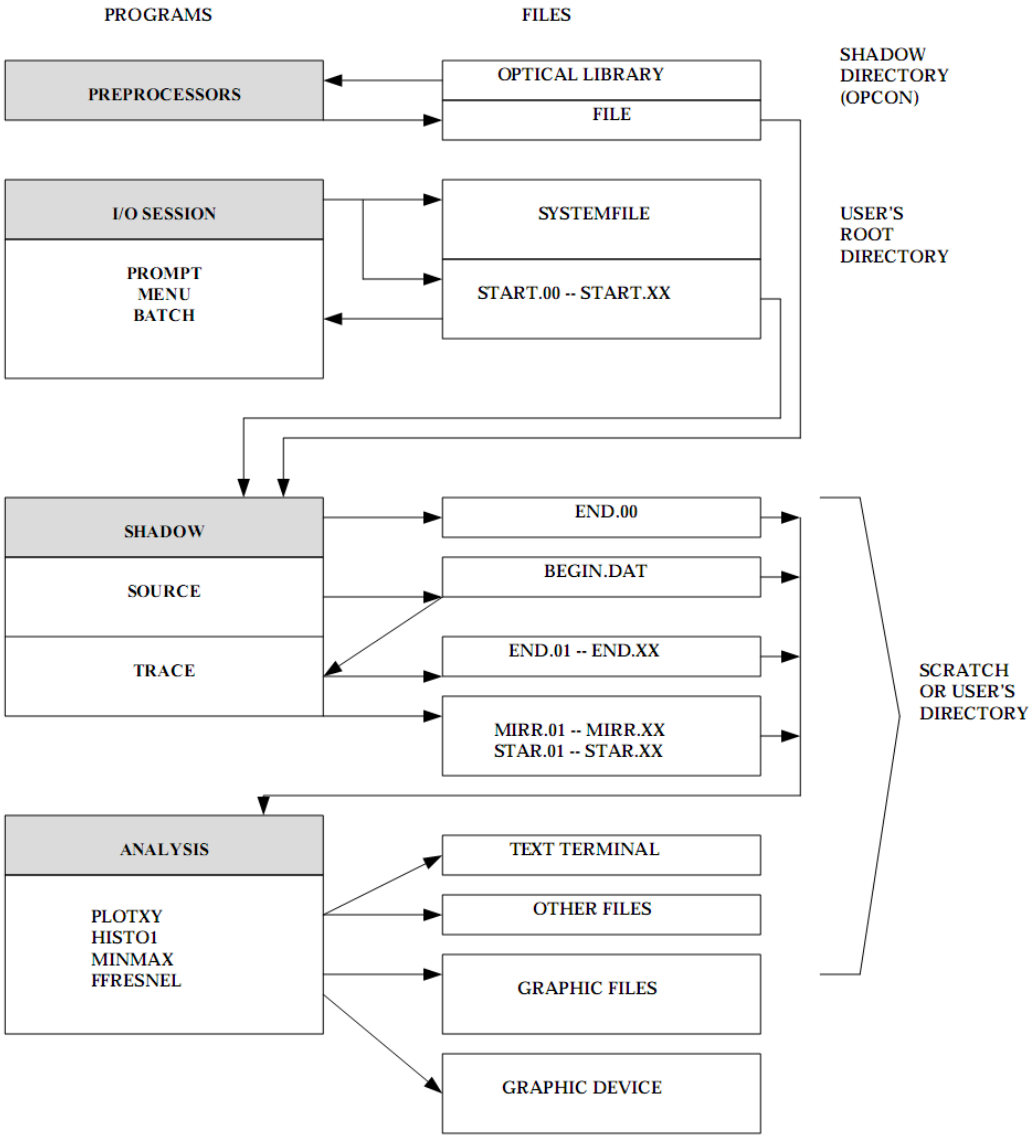
    T_INCIDENCE = 75.0000000

    T_SOURCE = 10.0000000

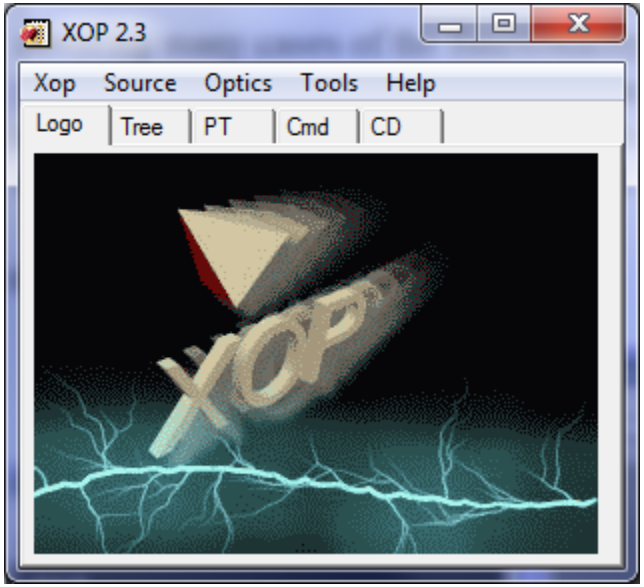
    T_IMAGE = 0.000000000
  - Analysis files (varied)

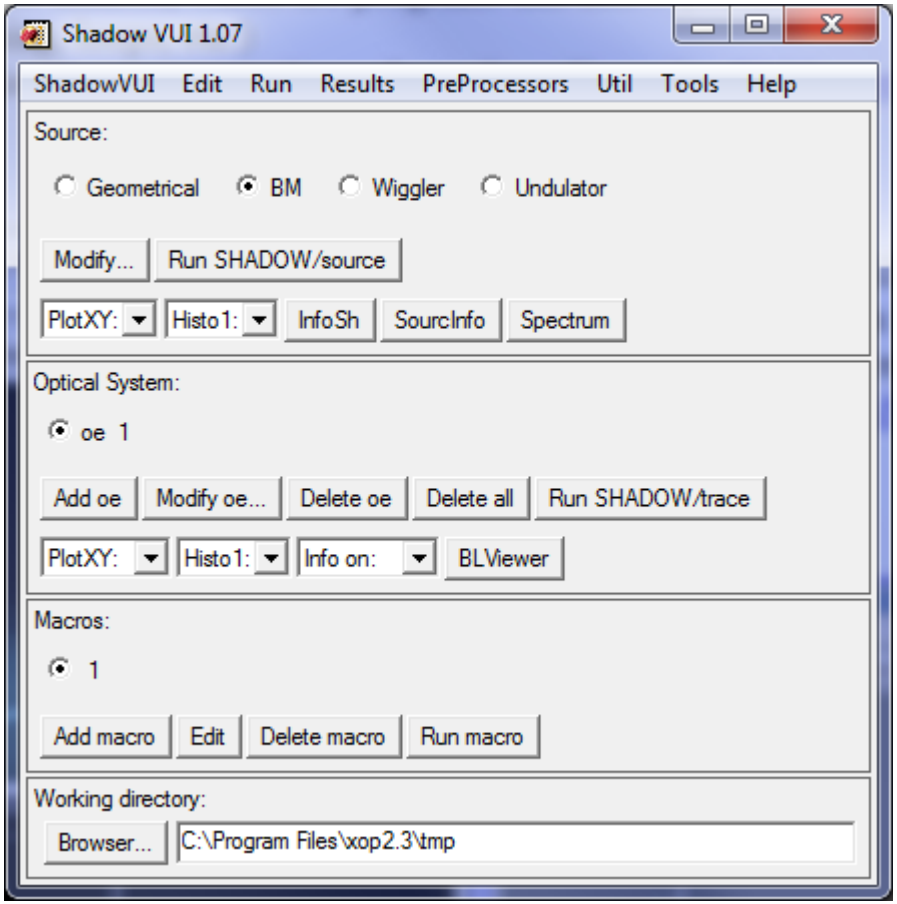


SHADOW Structure

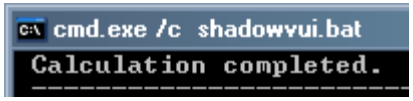


XOP + SHADOWVUI

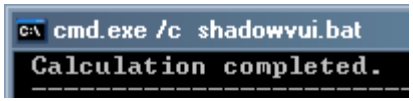




Run SHADOW/source

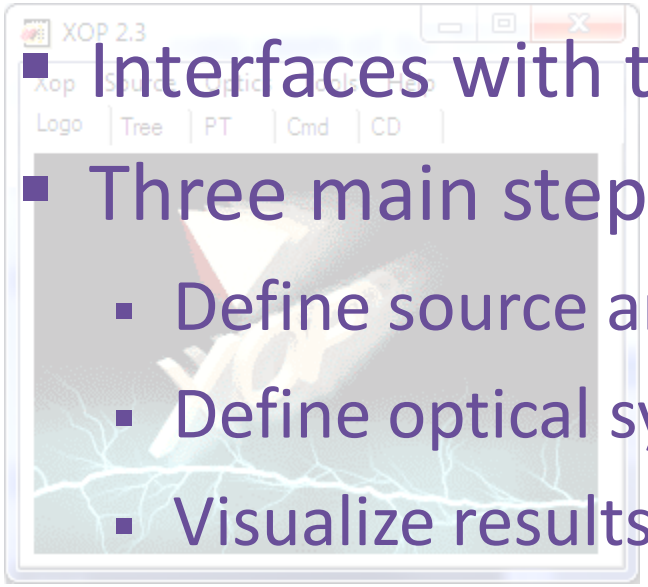


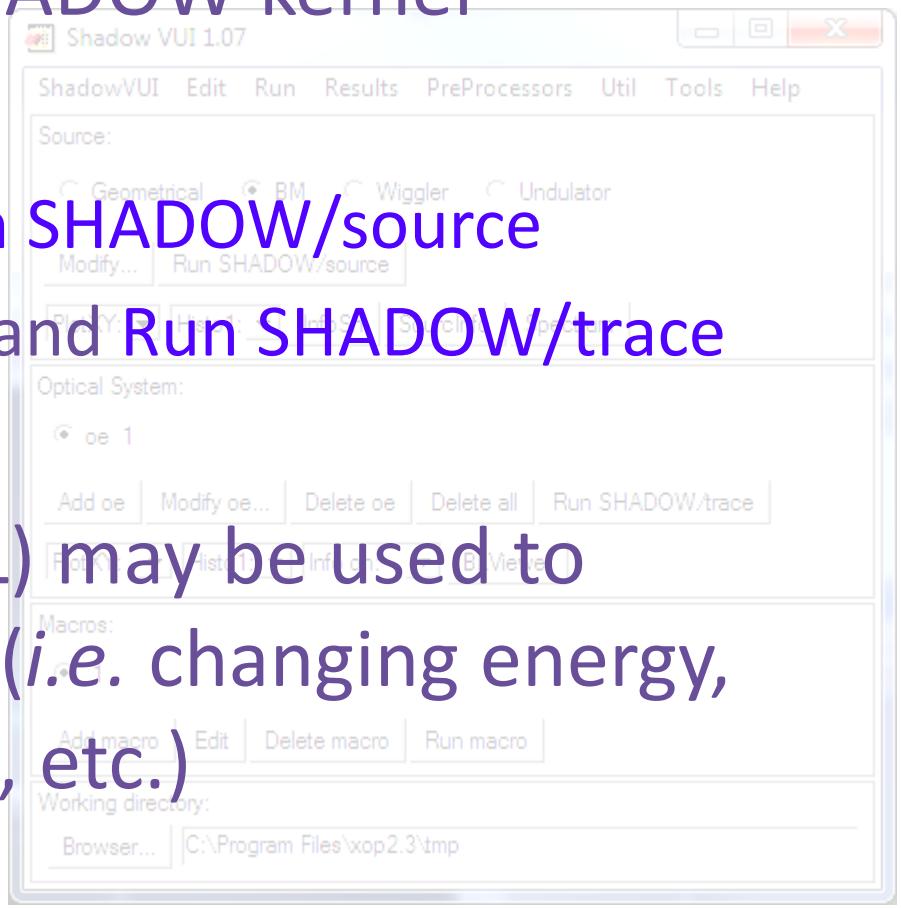
Run SHADOW/trace



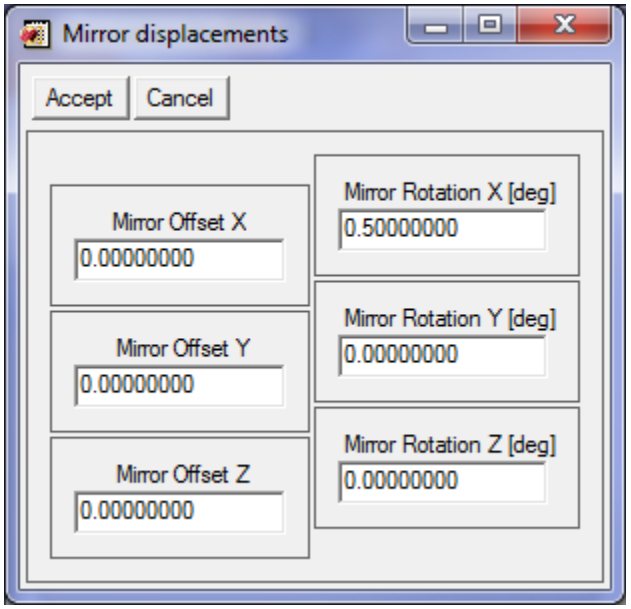
SHADOWVUI

- Interfaces with the SHADOW kernel
- Three main steps:
  - Define source and Run SHADOW/source
  - Define optical system and Run SHADOW/trace
  - Visualize results
- Macros (written in IDL) may be used to automate some tasks (*i.e.* changing energy, moving mirrors, loops, etc.)



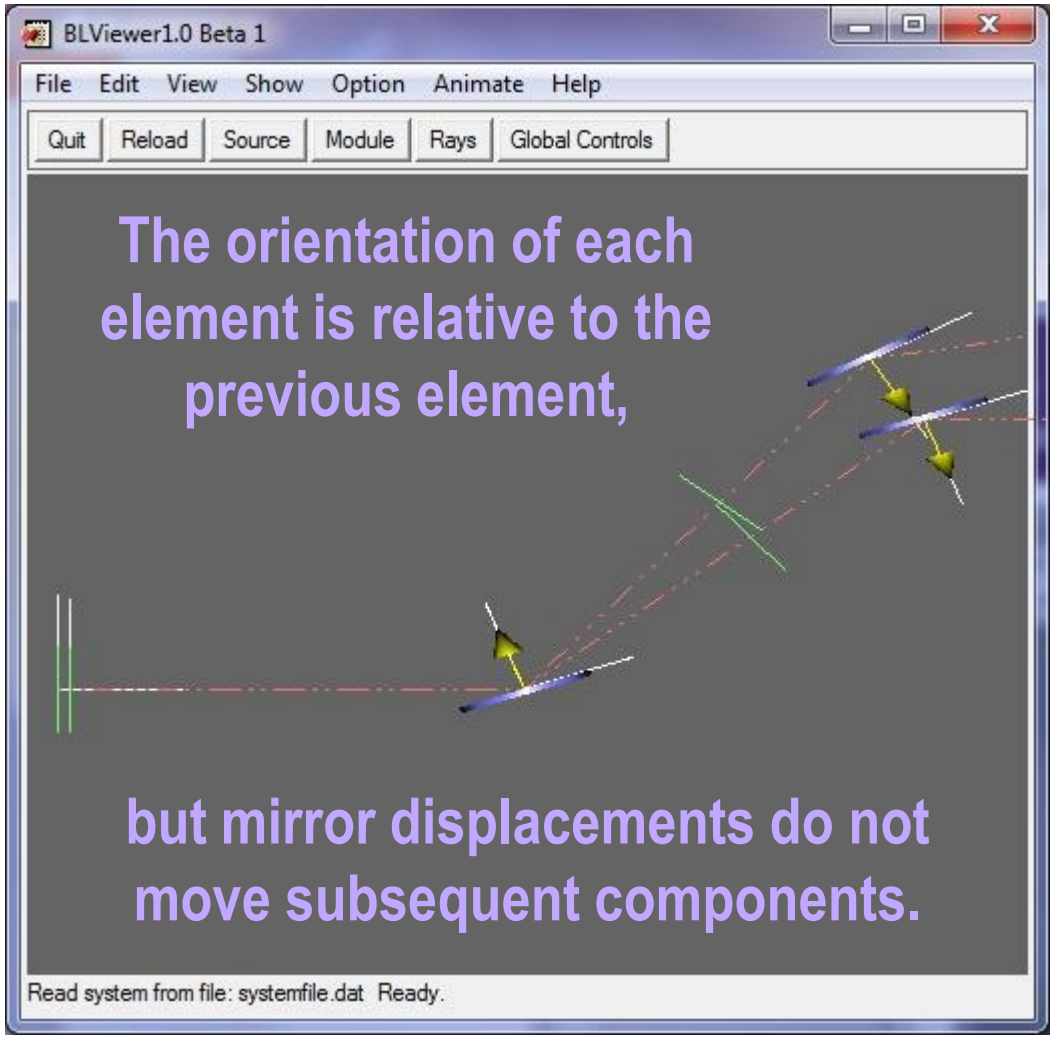


SHADOWVUI Simulation Model



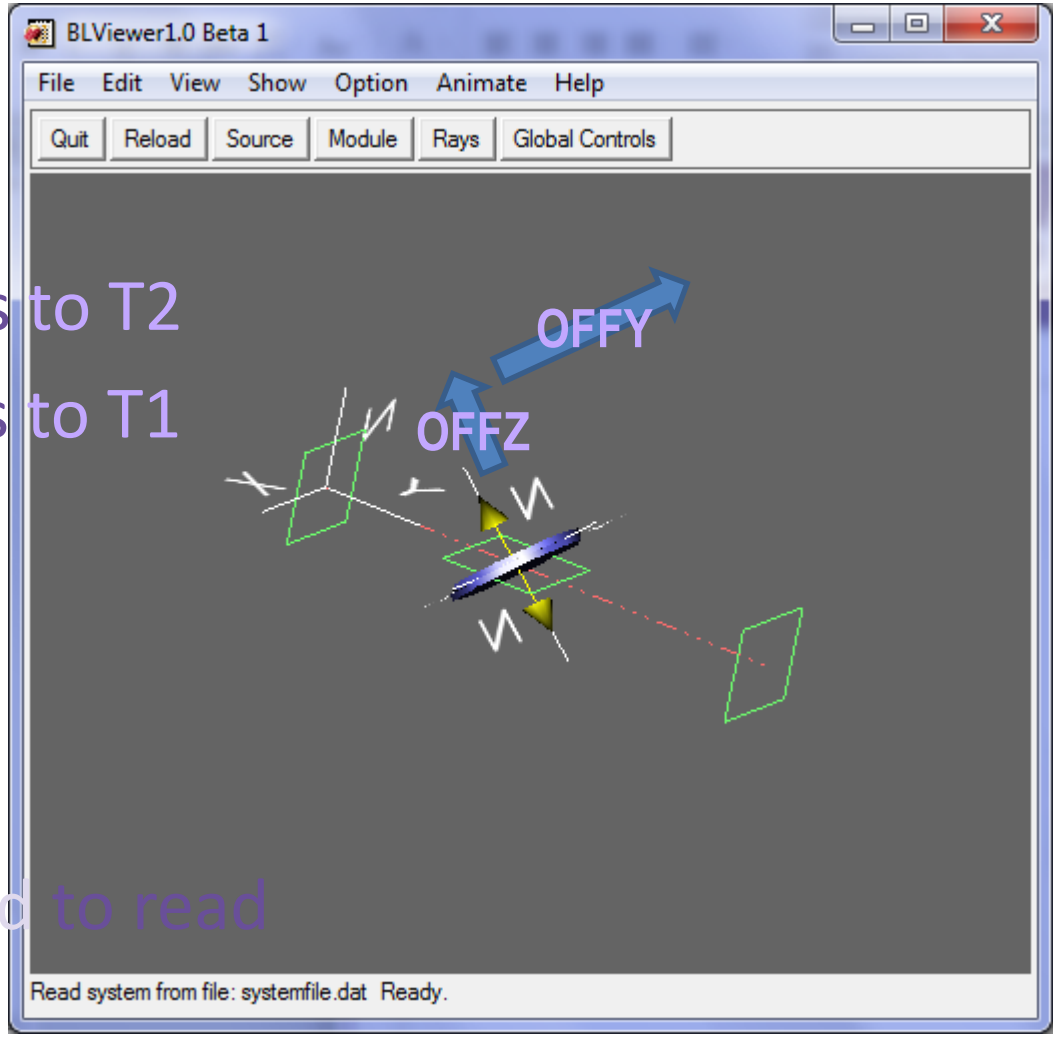
- SHADOW variables

OFFX	X_ROT
OFFY	Y_ROT
OFFZ	Z_ROT



SHADOWVUI Simulation Model

- In this model
  - OFFY corresponds to T2
  - OFFZ corresponds to T1
- Time to plug and play with EPICS



This is hard to read

EPICS and ezcaIDL

- EPICS
  - real-time control system for beamlines etc.
  - process variables indicate positions of optics
- ezcaIDL
  - allows access to a set of simplified IDL interface commands to connect to Channel Access

```
Status = caGet(pvname, value, /string, max=max)
Status = caSetMonitor(pvname)
Status = caWidgetSetMonitor(name,widget_id,time=time)
```

ezcaSHADOWVUI

- Initializes ezcaIDL

```
caInit
caSetTimeout,0.001
caPendIO,time=0.01,list_time=3.
caPendEvent,time=0.000001
add_caPendEvent,timer=5.0
```

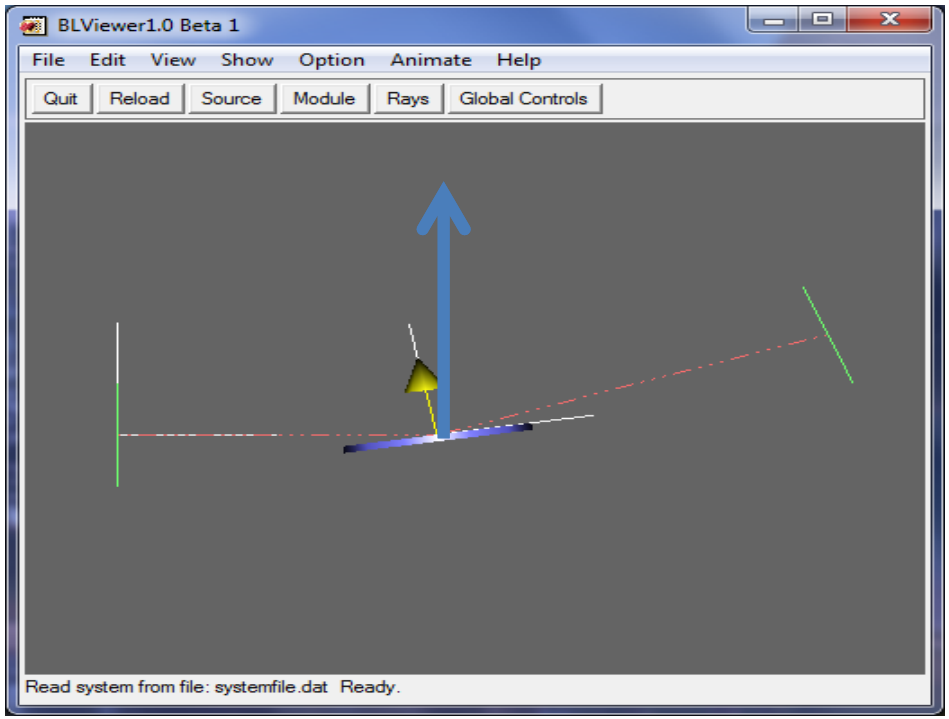
- Accesses SHADOW variables via SHADOWVUI
- Requires user input that defines relationship between model variables and beamline PVs in an IDL structure

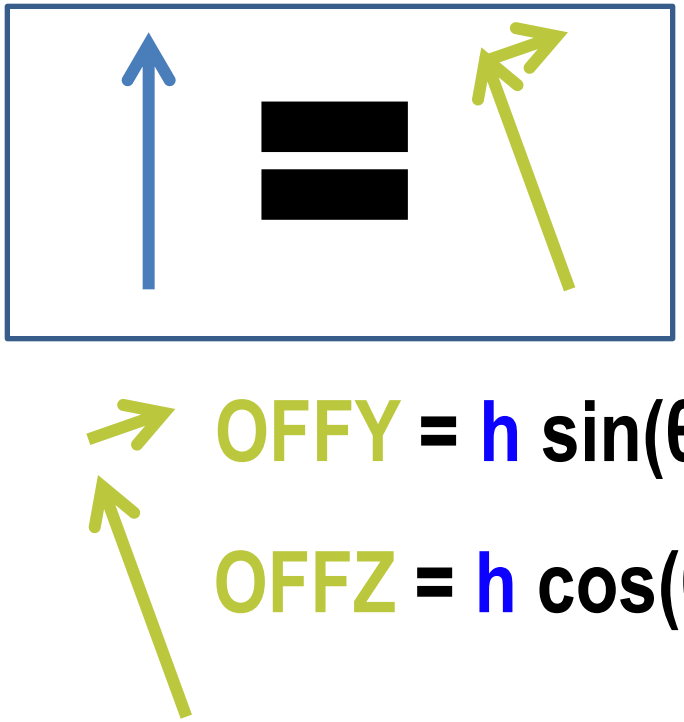
PV_INFO Structure

Field	Type	Description
pv	string	EPICS process variable string
desc	string	Text to describe process variable
pv_min	float	Lower limit
pv_max	float	Upper limit
oe_num	int	Optical element number (zero otherwise)
src_num	int	Screen number (zero otherwise)
pv_2vui	string	Equation(s) to convert value of PV(s) to SHADOWVUI variable
vui_2pv	string	To convert value of SHADOWVUI variables(s) to PV value
vui_val	float	Stores SHADOWVUI variable value

- **vui_2pv string is executed on widget start-up**
- **pv_2vui string is executed on PV events**

SHADOWVUI variables and PVs



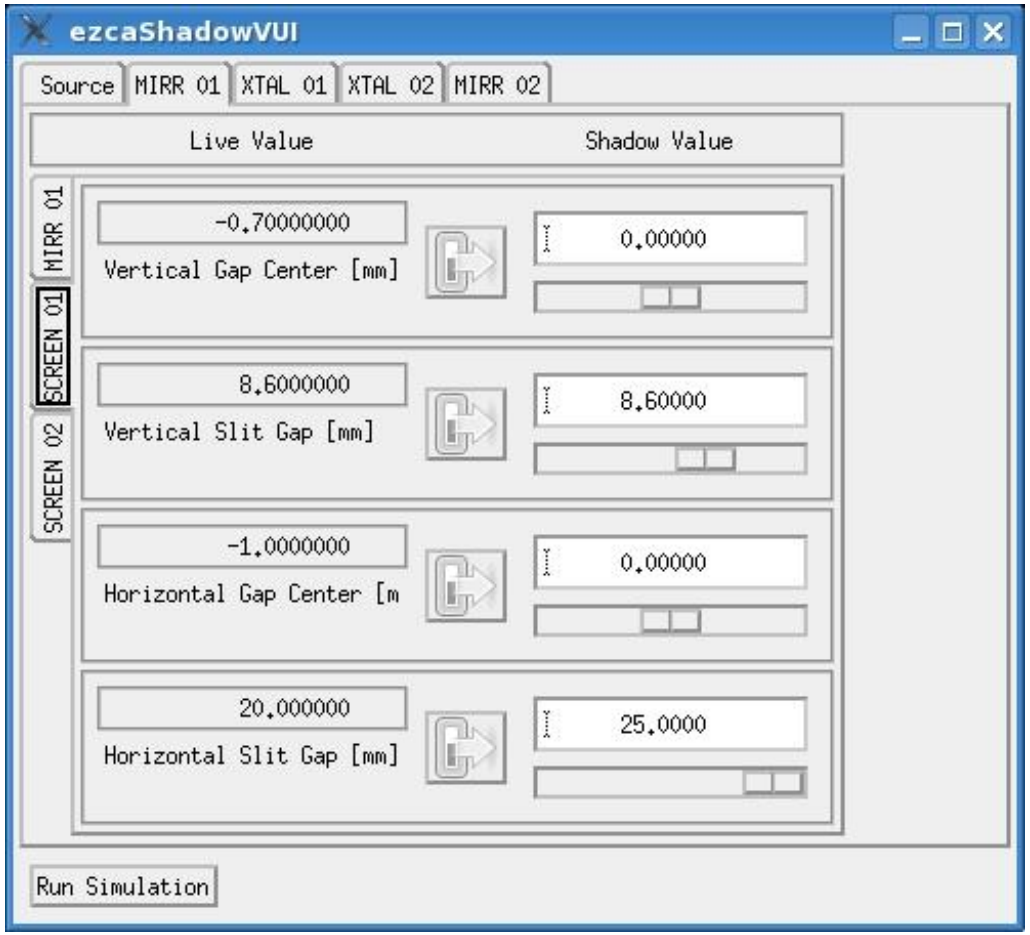


pv_2vui = '(*ptrOE1).OFFY = beamline.h.val * sin(beamline.theta.val)
& (*ptrOE1).OFFZ = beamline.h.val * cos(beamline.theta.val)'

vui_2pv = 'sqrt(((*ptrOE1).OFFY)^2 +((*ptrOE1).OFFZ)^2)'

ezcaSHADOWVUI Widget

```
IDL> reshadowvui, beamline
```



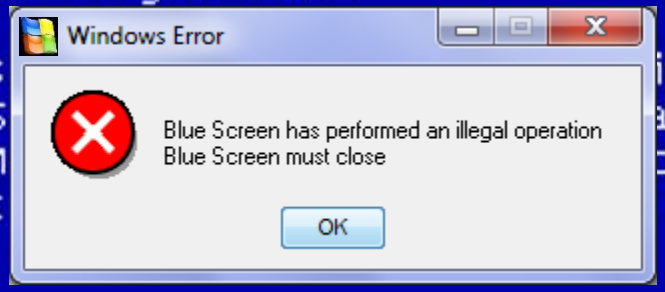
A problem has been detected and Windows has been shut down to prevent damage
to your computer.

DRIVER_IRQL_NOT_LESS_OR_EQUAL

If this is the first time you've seen this Stop error screen,
restart your computer, If this screen appears again, follow
these steps:

Check to make sure any new hardware or software is properly installed.
If this is a new installation, ask your hardware or software manufacturer
for any Windows updates you might need.

If problems continue, dis nstalled hardware
or software. Disable BIOS aching or shadowing.
If you need to use Safe M omponents, restart
your computer, press F8 t Options, and then
select Safe Mode.



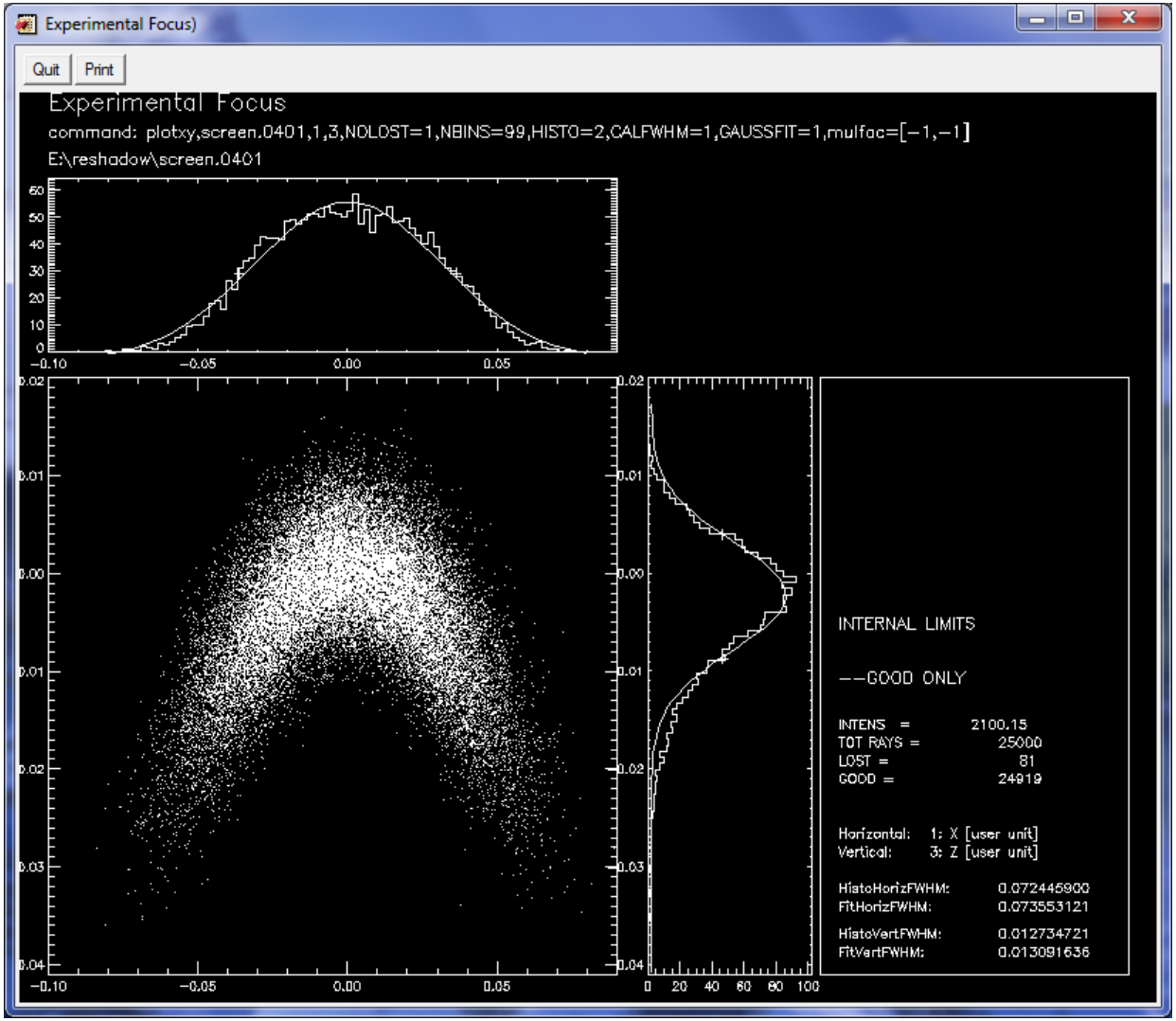
Technical information:

*** STOP: 0x000000D1 (0x0000000C,0x00000002,0x00000000,0xF86B5A89)

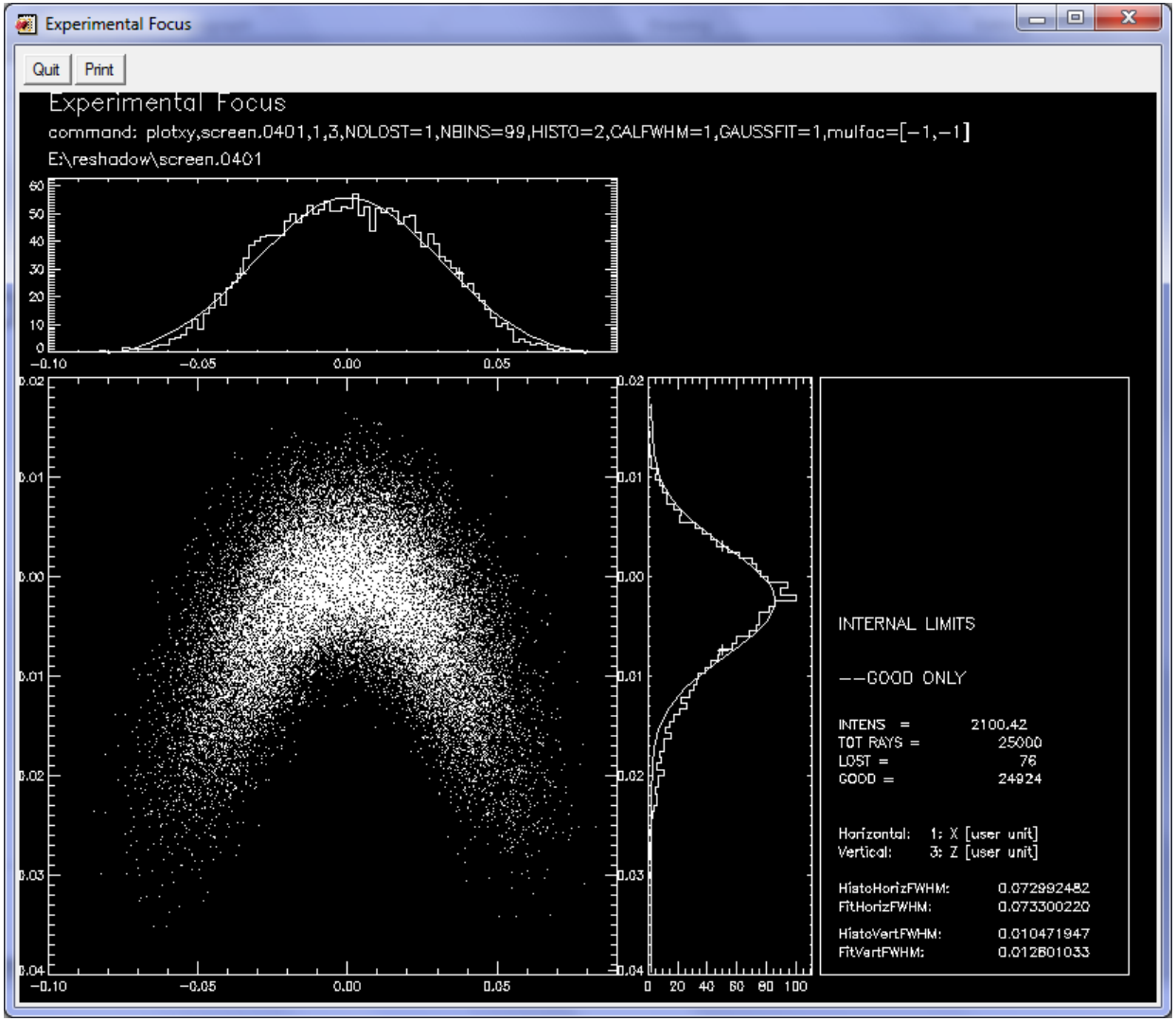
*** gv3.sys - Address F86B5A89 base at F86B5000, DateStamp 3dd991eb

Beginning dump of physical memory
Physical memory dump complete.
Contact your system administrator or technical support group for further
assistance.

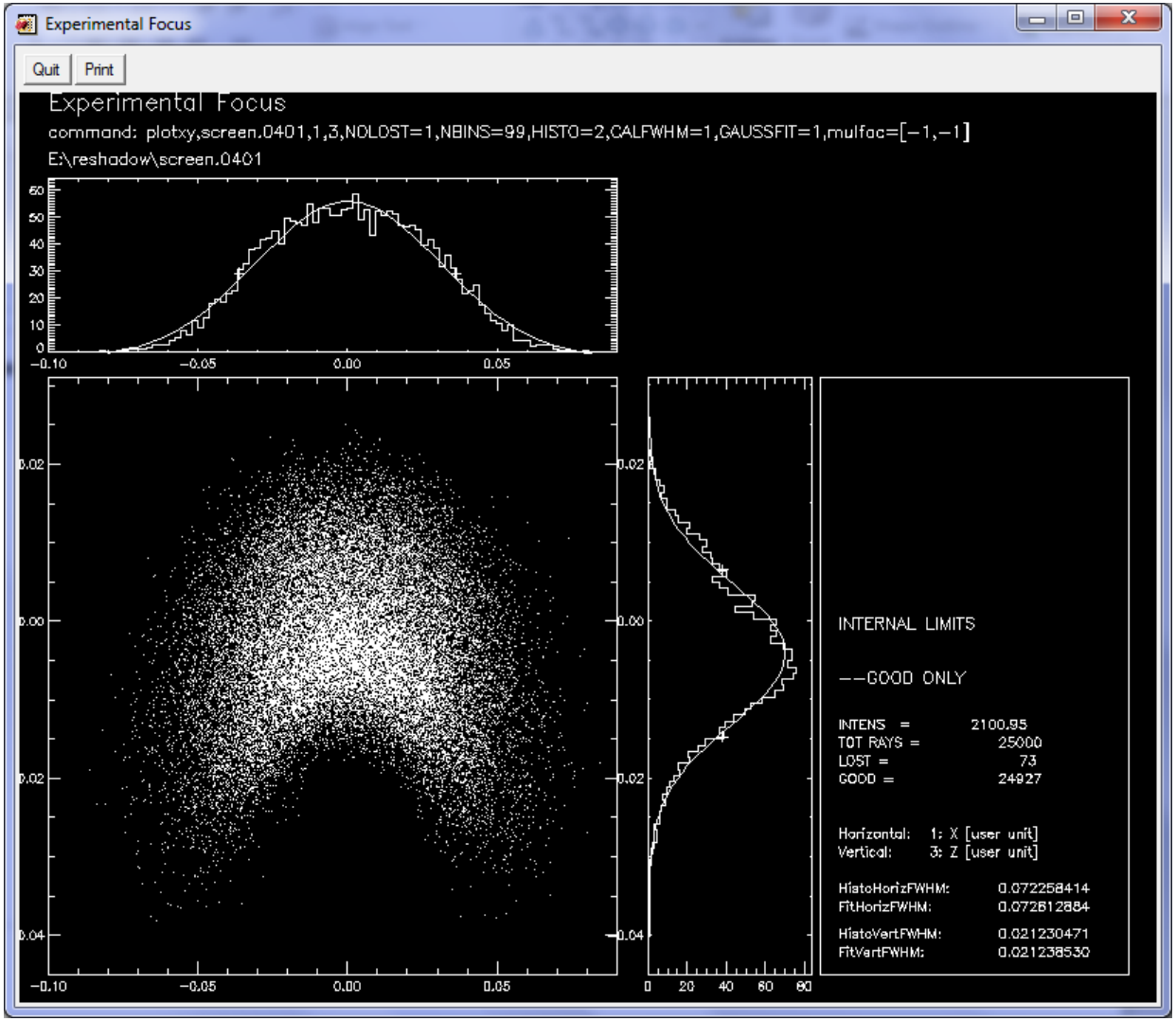
Dynamic Ray-Tracing



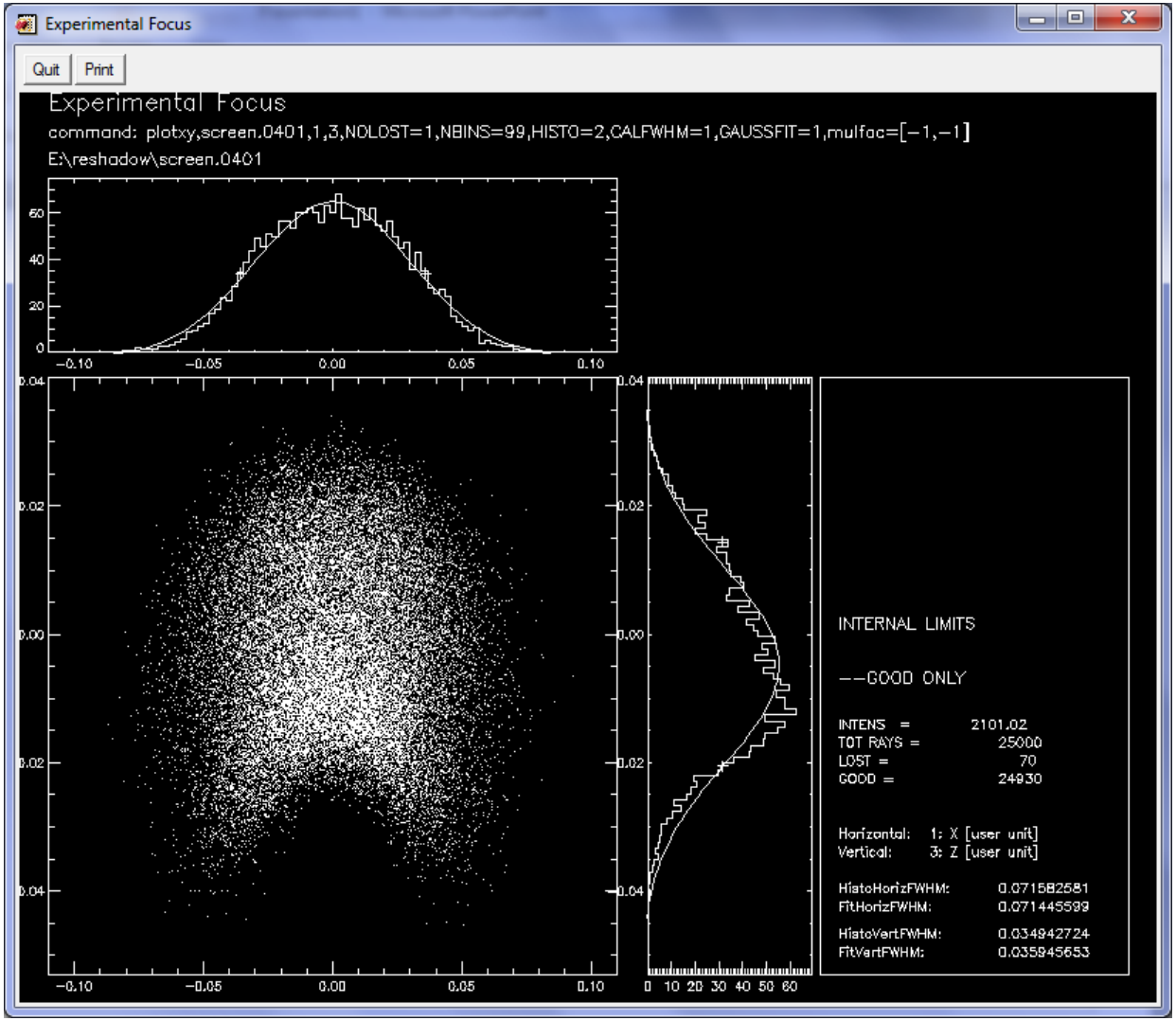
Dynamic Ray-Tracing



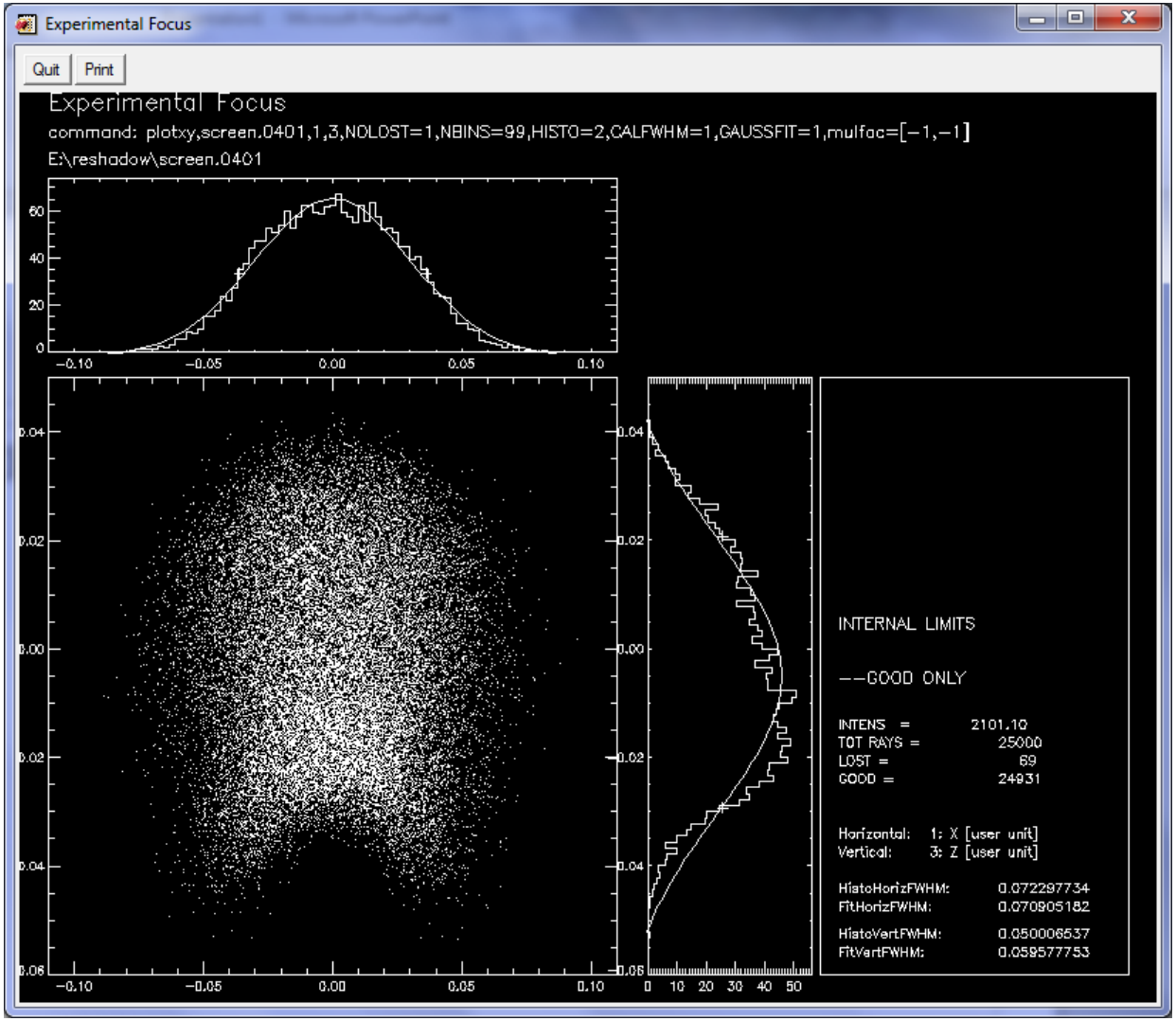
Dynamic Ray-Tracing



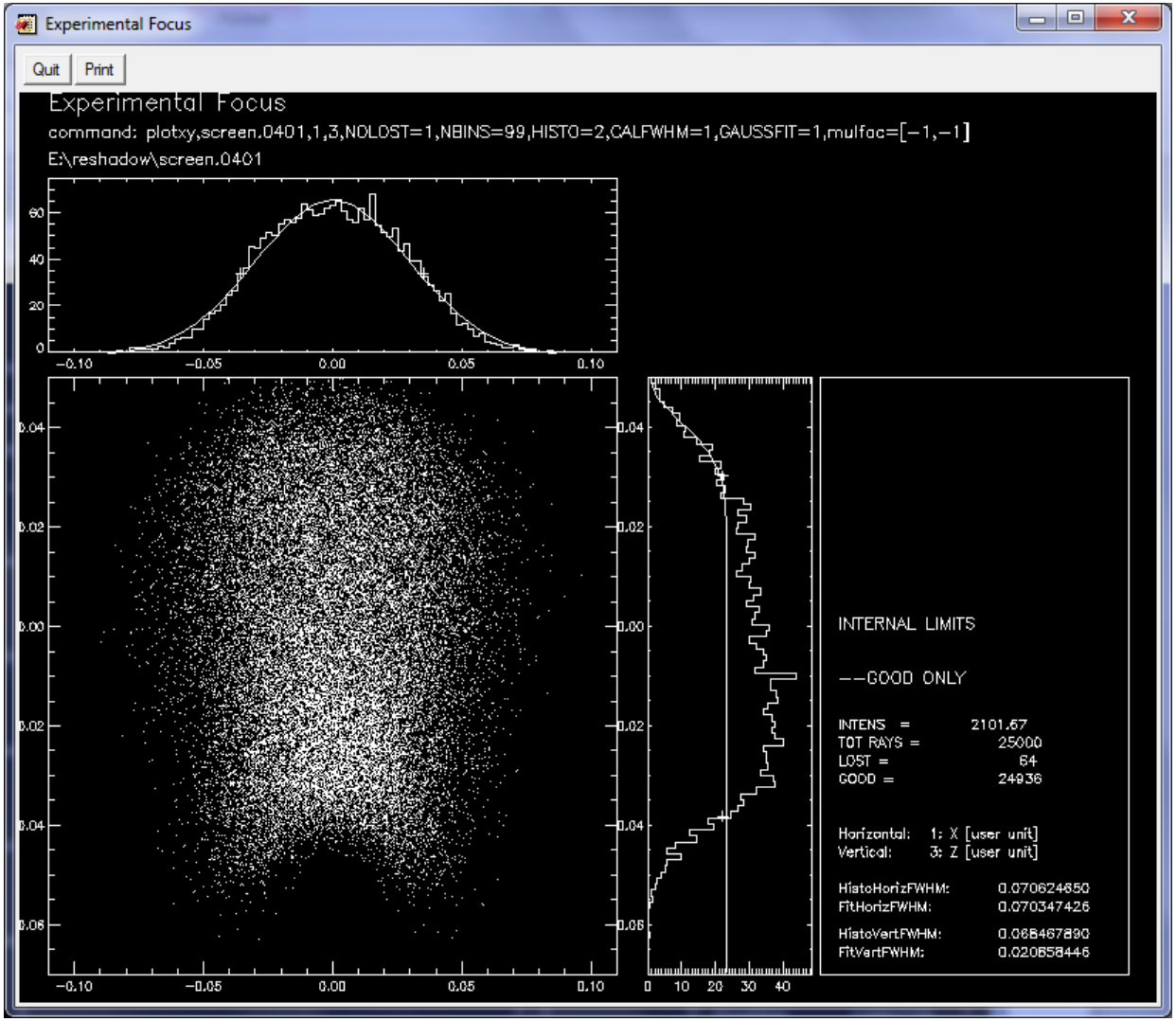
Dynamic Ray-Tracing



Dynamic Ray-Tracing



Dynamic Ray-Tracing



Summary

- SHADOW and XOP + SHADOWVUI
  - Provide ray-tracing engine and user interface
- EPICS extensions ezcaIDL/EZCA
  - allow IDL programs to access PVs
- ezcaSHADOWVUI
  - takes SHADOWVUI model and user defined relationships between PVs and model parameters
  - live positions may be used for dynamic ray tracing

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- National Research Council Canada
- Canadian Institutes of Health Research
- Province of Saskatchewan
- Western Economic Diversification Canada, and
- University of Saskatchewan.

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Fondation canadienne pour l'innovation

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CIHR IRSC
Canadian Institutes of Health Research / Instituts de recherche en santé du Canada

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Natural Resources Canada

SaskPower
Powering the future

University of Alberta

City of Saskatoon

Boehringer Ingelheim

Western

Rockwell Collins

Breast Cancer Society of Canada

RUH Foundation
Your community. Your health. Your foundation.

SHRF
Saskatchewan Health Research Foundation

Heart & Stroke Foundation of Saskatchewan
Finding answers. For life.

Saskatchewan Cancer Agency
Excellence in Patient Care and Cancer Control

Saskatoon Health Region

Regina Qu'Appelle Health Region

Alberta Cancer Foundation
25th Anniversary

Canadian Cancer Society / Société canadienne du cancer

38 supporting University Partners and growing…

Appendix - Prerequisites

- EPICS installed with extensions directory setup
  - /opt/epics/**base**
    - **base**R3.14.9.tar.gz
  - /opt/epics/**extensions**
    - **extensions**Top_20070703.tar.gz
    - **extensions**Configure_20070703.tar.gz
  - /opt/epics/extensions/src/ **(ezca,ezcaIDL,EzcaScan)**
    - **ezca**_20070625.tar.gz
    - **ezcaIDL**_20070625.tar.gz
    - **EzcaScan**_20090319.tar.gz

Install procedure (libezcaIDL.so)

- *cd /opt/epics/extensions && make*
  - ln –s /usr/local/bin/g++ /usr/bin
  - ln –s libncurses.so libcurses.so
  - yum install mingw32-readline
  - ln -s /usr/i686-pc-mingw32/sys-root/mingw/include/readline /opt/epics/base/readline
- Set environment variable EZCA_IDL_SHARE
  - /opt/epics/extensions/lib/linux-x86_64/libezcaIDL.so
- /etc/ld.so.conf.d/
  - create ezcaIDL.conf with path to libezcaIDL.so