



Constructing and Analyzing Spectral Energy Distributions with Iris

Jamie Budynkiewicz, SAO

Download demo data

On flash drives

<path-to-driver>/iris/worksheets/demo

On Github

```
git clone https://github.com/ChandraCXC/aas229iris  
cd aas229iris/worksheets/demo
```

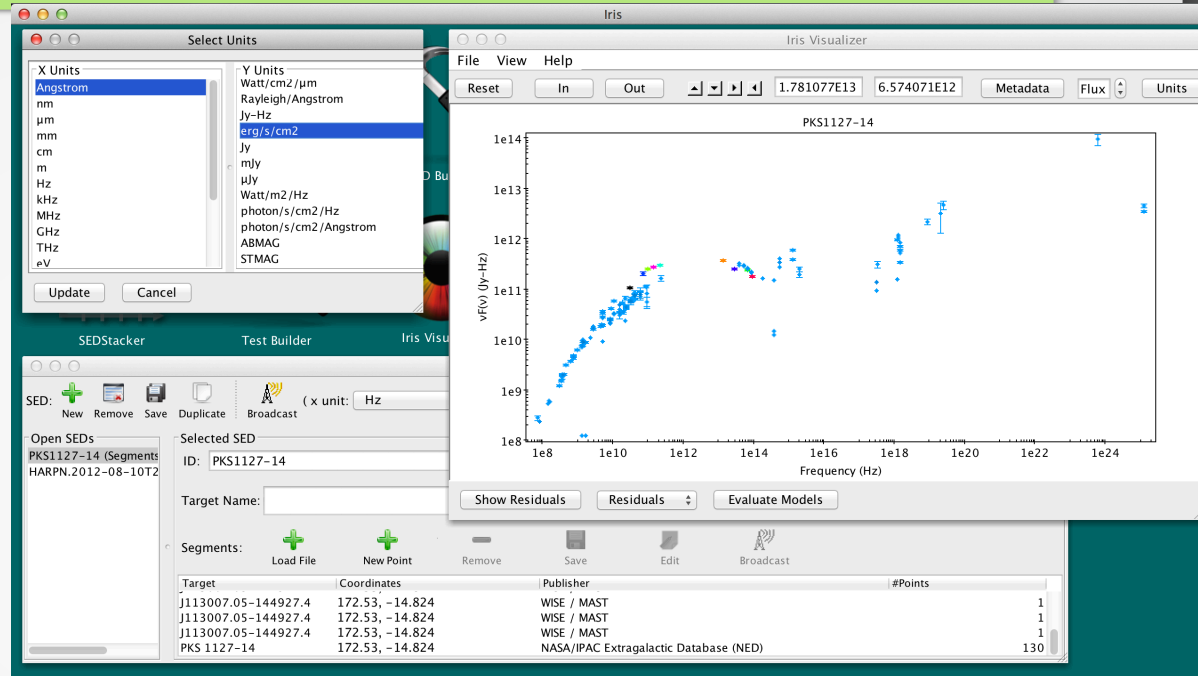
See meeting website for more details

http://bit.ly/aas229_modelingws

In this talk...

- Iris

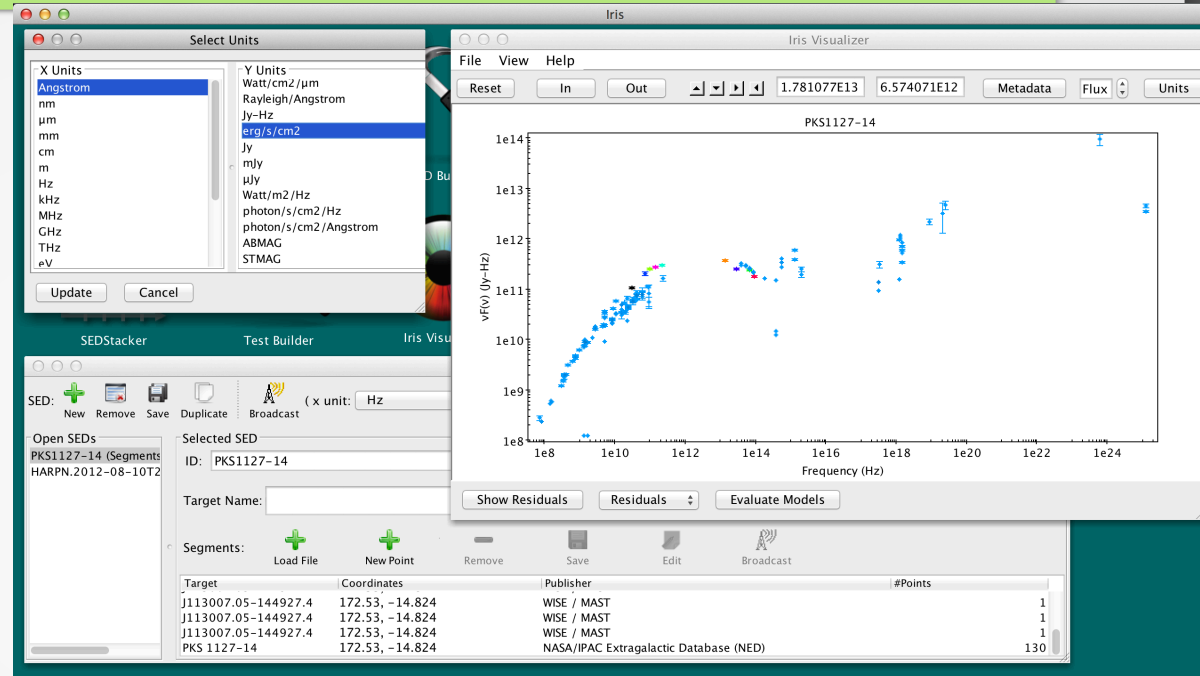
Main features Demonstration



In this talk...

- Iris

Main features Demonstration



Virtual Observatory efforts

Virtual Observatory

Main goal - provide a framework that allows easy data discovery and access on a global scale

Data Access Services

Data Analysis

Data Visualization

Standard Data Formats

TAP, SAMP, SSA, SIA

SAMP (Simple Application Messaging Protocol)
communication between applications and services

For more info:
ivoa.net

Iris Development Efforts



CHANDRA
X-RAY OBSERVATORY



VIRTUAL ASTRONOMICAL OBSERVATORY





What is Iris?

Iris - an interactive desktop app



Iris - an interactive desktop app



Iris



Load File



Load NED SED



SEDStacker

Test Builder



Custom Models Manager Shift, Interpolate, Integrate

Load an input File

Currently selected SED: Sed

Location on Disk: /Users/jbudynk/Desktop/data/pks1127-14_r_3s

URL:

File Format: FITS

Help

Get an SED from the NED Service

NED Service

Target Name: pks1127-14

Change Endpoint

Endpoint: http://vo.ned.ipac.caltech.edu/services/accessSED?REQUES



SAMP status: connected



Sherpa status: connected

Iris - an interactive desktop app

The screenshot displays the Iris desktop application interface. The main menu includes icons for Load File, Load NED SED, SED Builder, SEDStacker, Test Builder, and Iris Visualizer. The Iris Visualizer window shows a plot of $vF(\nu)$ (y-Hz) versus Frequency (Hz) for PKS1127-14. The plot is a log-log scatter plot with data points and error bars. The x-axis ranges from $1e8$ to $1e24$ Hz, and the y-axis ranges from $1e8$ to $1e14$ y-Hz. The plot title is PKS1127-14. The plot window also has a menu (File, View, Help) and buttons for Reset, In, Out, Metadata, and Units. Below the plot are buttons for Show Residuals, Residuals, and Evaluate Models.

The main application window shows the following information:

- SED: (x unit: Hz)
- Open SEDs: PKS1127-14 (Segments: 9), HARP.2012-08-10T2 Sed (Segments: 9), Sed.1 (Segments: 9)
- Selected SED: ID: PKS1127-14, Target Name:
- Segments: Load File, New Point, Remove, Save, Edit, Broadcast
- Table:

| Target | Coordinates | Publisher | #Points |
|-------------------------|-----------------|-------------|---------|
| PLCKERC030 G275.27+4... | 172.52, -14.826 | ASDC | 1 |
| PLCKERC070 G275.27+4... | 172.52, -14.826 | ASDC | 1 |
| PLCKERC100 G275.27+4... | 172.52, -14.826 | ASDC | 1 |
| PLCKERC143 G275.27+4... | 172.52, -14.826 | ASDC | 1 |
| PLCKERC217 G275.28+4... | 172.53, -14.827 | ASDC | 1 |
| J113007.05-144927.4 | 172.53, -14.824 | WISE / MAST | 1 |
| J113007.05-144927.4 | 172.53, -14.824 | WISE / MAST | 1 |
| J113007.05-144927.4 | 172.53, -14.824 | WISE / MAST | 1 |

Iris - an interactive desktop app



ager Shift, Interpolate, Integrate

The screenshot displays the Iris software interface. At the top, the title bar reads "Iris". Below it, the "Fitting Tool" window is active, showing a "Current Sed" of "FilterSed". The "Fit Configuration" section includes a list of "Available Components" on the left, with "blackbody" selected. The "Model Expression" is set to "m5 + m6 + m7 + m8". The "Optimization Method" is "LevenbergMarquardt" and the "Statistic" is "Chi2". A "Fit Failed" message is visible. The "Iris Visualizer" window shows a plot of "FilterSed" with "VF(v) (Jy-Hz)" on the y-axis and "Wavelength (Angstrom)" on the x-axis, both on logarithmic scales. The plot shows data points for "PKS 1127-14" and a red line for "FilterSed_MODEL". Below the plot is a "Ratios" plot. At the bottom, there are buttons for "Show Ratios", "Ratios", and "Evaluate Models".

File

Current Sed: FilterSed

Fit Configuration

Available Components

- Model Components
 - Preset Model Components
 - absorptionedge
 - absorptiongaussian
 - absorptionlorentz
 - absorptionvoigt
 - accretiondisk
 - atten
 - beta1d
 - blackbody
 - box1d
 - bremsstrahlung

Emission from a blackbody

Search

Model Expression: $m5 + m6 + m7 + m8$

Optimization Method: LevenbergMarquardt

Statistic: Chi2

Name: m5.c1

Value: 0.15878493411094996

Min: 1.1754943508222875E-38

Fit Failed

Final Fit Statistic: 3.20498

Reduced Statistic: NaN

Probability (Q-value): NaN

Number of Evaluations: 7

Number of Points: 98

Degrees of Freedom: 97

FilterSed

VF(v) (Jy-Hz)

Wavelength (Angstrom)

PKS 1127-14

FilterSed_MODEL

Ratios

Show Ratios

Ratios

Evaluate Models

SAMP status: connected

Sherpa status: connected

Iris - an interactive desktop app

Iris

The screenshot displays the Iris desktop application interface. At the top, a green banner contains the title "Iris - an interactive desktop app". Below the banner, the application window title bar shows "Iris". The main workspace is a teal-colored desktop with several icons: a notepad with a pencil (Load File), the NED logo (Load NE), a hammer (Test Bu), the asdc logo (ASI Science Data Center), two rulers (Shift, Interpolate, Integrate), and crossed wrench and screwdriver. In the center, four blue vertical panels represent the workflow: "Build" (hammer icon), "View" (CD icon), "Edit" (wrench and screwdriver icon), and "Model" (ruler icon). A large white double-headed arrow spans across the bottom of these panels. In the bottom left corner, there are two status indicators: "SAMP status: connected" and "Sherpa status: connected", each with a syringe icon and a green checkmark. On the left side, there is also a "SEDStacker" icon with a line graph and a "Load NE" icon with a hammer.

Load File

Load NE

Test Bu

SEDStacker

asdc
ASI Science Data Center

Shift, Interpolate, Integrate

SAMP status: connected

Sherpa status: connected

Build

View

Edit

Model



Main Features

Iris - Main Features



SED Builder: Data I/O & Management

Load an input File

Currently selected SED: Sed

Location on Disk: /Users/Jamie/Desktop/PKS-1127-14-IR-UV.dat

URL:

File Format: ASCII Table

Get an SED from the NED Service

NED Service

Target Name:

Endpoint: http://vo.ned.ipac.caltech.edu/services/accessSED?REQUESTS

File

URL



ASDC Catalog Query

Target Name: ngc7714

RA: 354.05874

Dec: 2.15516

TStart Date: 2011-12-01

TStop Date: 2013-12-01

Catalogs Available:

- Radio
- Infrared
 - IRAS
 - AKARI/FIS
 - AKARI/IRC
 - WISE
- Optical UV
 - GALEX
 - Swift
 - Soft X Ray
 - Hard X Ray

Search Radius: 0.1 arcmin

Submit

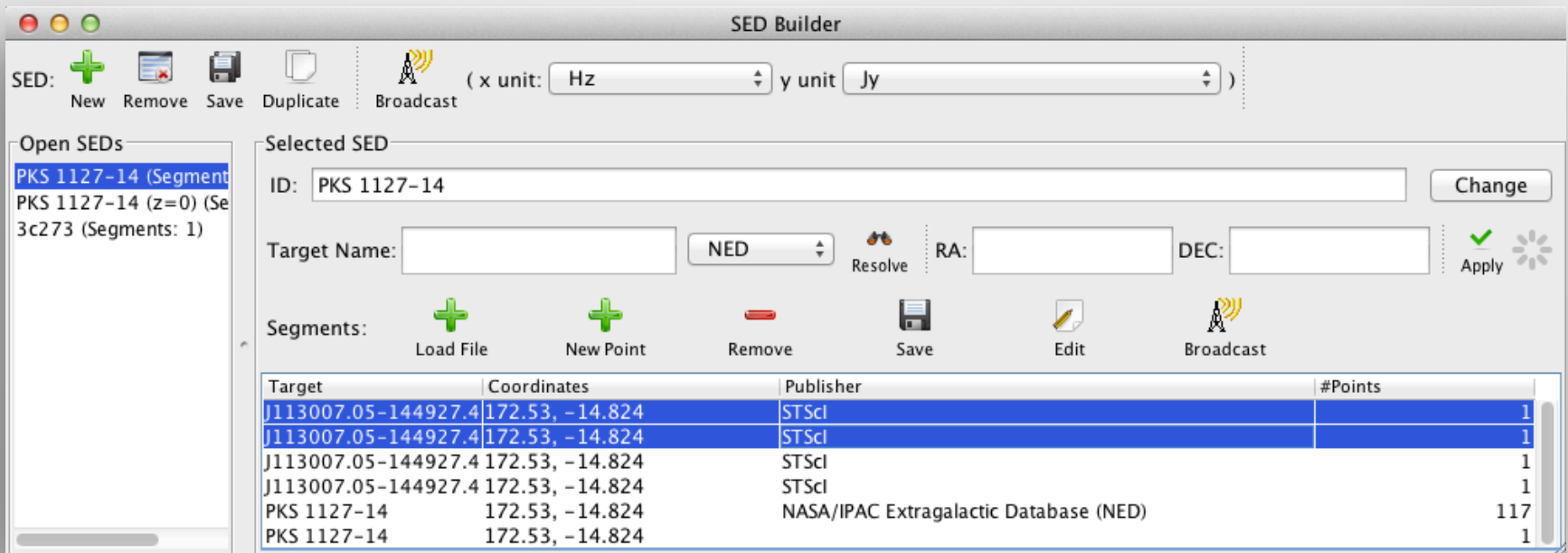
ASDC

Cone Search






Iris - Main Features

SED Builder: Data I/O & Management

- Manage each dataset separately
- **Save** SEDs in VO-compliant **FITS** and **VOT**, also **ASCII**
- Send data between applications via **SAMP**



SED Builder

SED:      (x unit: Hz y unit: Jy)







Open SEDs

- PKS 1127-14 (Segment 1)
- PKS 1127-14 (z=0) (Segment 1)
- 3c273 (Segments: 1)

Selected SED

ID: PKS 1127-14 Change

Target Name: NED Resolve RA: DEC: Apply

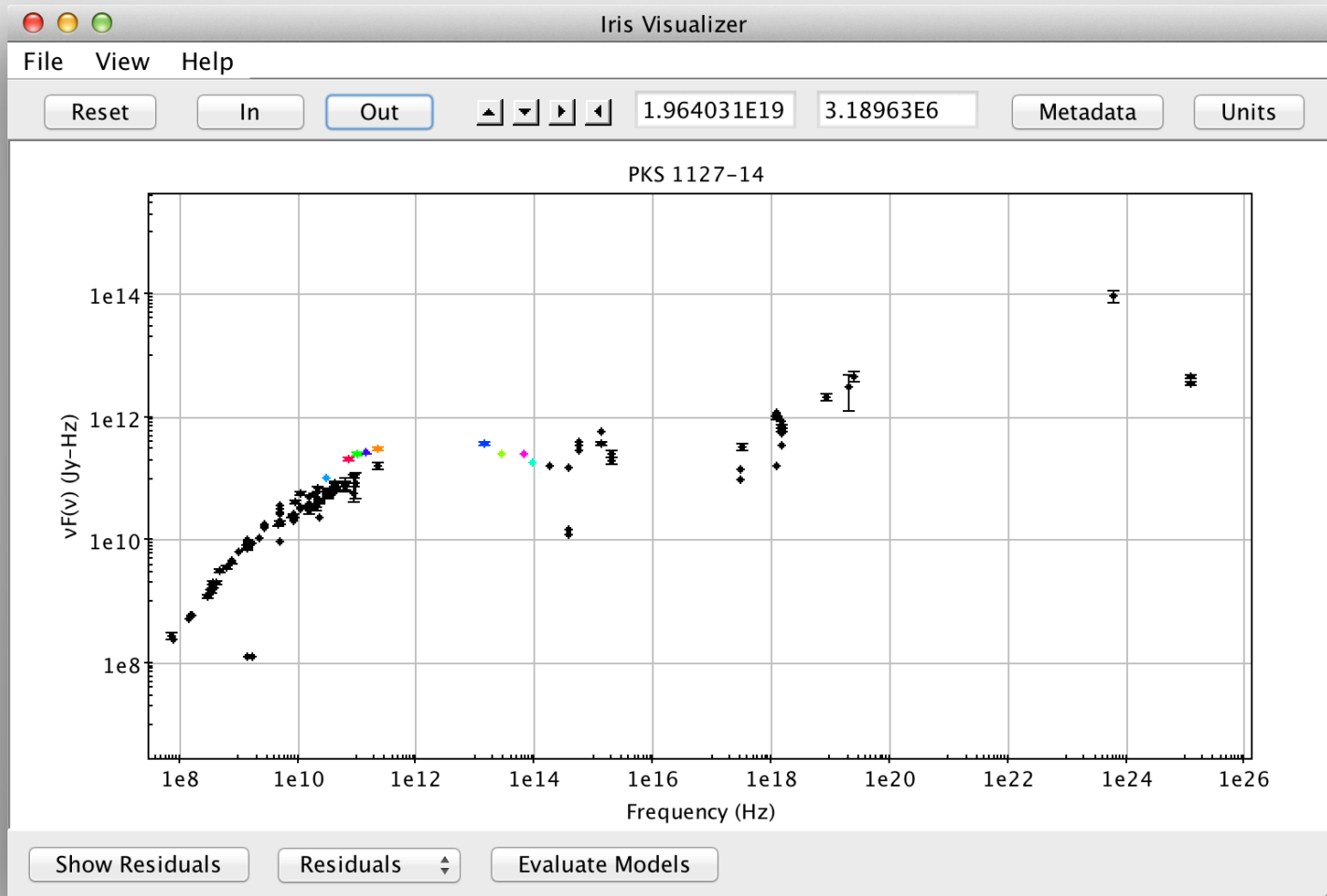
Segments:      

| Target | Coordinates | Publisher | #Points |
|---------------------|-----------------|--|---------|
| J113007.05-144927.4 | 172.53, -14.824 | STScI | 1 |
| J113007.05-144927.4 | 172.53, -14.824 | STScI | 1 |
| J113007.05-144927.4 | 172.53, -14.824 | STScI | 1 |
| J113007.05-144927.4 | 172.53, -14.824 | STScI | 1 |
| PKS 1127-14 | 172.53, -14.824 | NASA/IPAC Extragalactic Database (NED) | 117 |
| PKS 1127-14 | 172.53, -14.824 | | 1 |

Iris - Main Features



Visualizer: Visualization & Data Inspection



Iris - Main Features



Visualizer: Visualization & Data Inspection

- Mask
- Filter
- Create new SEDs

Metadata Browser PKS 1127-14

File Select

PKS 1127-14

- PKS 1127-14
- J113007.05-144927.4
- J113007.05-144927.4
- J113007.05-144927.4
- J113007.05-144927.4
- PLCKERC217 G275.28
- PLCKERC143 G275.27
- PLCKERC100 G275.27
- PLCKERC070 G275.27
- PLCKERC030 G275.27

Data Point Metadata Segment Metadata

| Index | Segment_Id | Spectral_Value ▲ | Flux_Value | Original_Flux_Value | Flux_Error |
|-------|-------------|------------------|------------|---------------------|------------|
| 121 | PKS 1127-14 | 8.000000E7 | 3. | 3. | |
| 119 | PKS 1127-14 | 1.450000E8 | 3.7 | 3.7 | |
| 118 | PKS 1127-14 | 1.510000E8 | 4.04 | 4.04 | |
| 117 | PKS 1127-14 | 1.600000E8 | 3.7 | 3.7 | |
| 116 | PKS 1127-14 | 3.020000E8 | 4.17 | 4.17 | 0.2 |
| 115 | PKS 1127-14 | 3.330000E8 | 4.51 | 4.51 | 0.2 |
| 112 | PKS 1127-14 | 3.650000E8 | 5.03 | 5.03 | 0.41 |
| 113 | PKS 1127-14 | 3.650000E8 | 5.63 | 5.63 | 0.34 |
| 114 | PKS 1127-14 | 3.650000E8 | 5.38 | 5.38 | 0.136 |
| 110 | PKS 1127-14 | 4.080000E8 | 5.07 | 5.07 | 0.28 |
| 111 | PKS 1127-14 | 4.080000E8 | 5.07 | 5.07 | |

\$4 > 0

Select Points

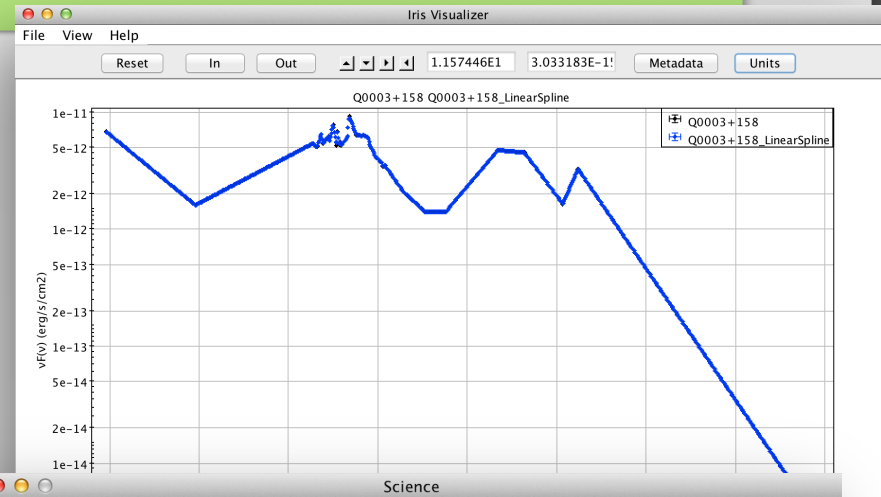
Select All Invert Selection Clear Selection Extract Mask Points Unmask Points Clear All

Iris - Main Features



Science Tools: Shift, Interpolate & Integrate

- Redshift
- Interpolate
- Calculate integrated flux
- Statistically combine (stack) SEDs



Open SEDs

- HARP.2012-08-10T21-PKS1127-14 (Segments: 1)
- Sed (Segments: 9)
- Sed.1 (Segments: 9)
- PKS1127-14_0.0 (Segment: 1)
- FilterSed (Segments: 1)**

Redshift and Interpolation Calculate Flux

Add Passband

Passband Add

Photometry Filter Choose Integrate Model (YES)

Model Integration

Full Model Model evaluation bins #: 10000 Show Model

Model Expression:

Results

| Passband | Eff WL (Angstrom) | Flux (erg/s/cm2) |
|---------------------|-------------------|------------------|
| CFHT/CFHT.I | 8.090449E3 | 7.943904E-16 |
| CFHT/CFHT.Z | 8.777988E3 | 7.753426E-16 |
| 2MASS/2MASS.J | 1.235E4 | 6.790592E-16 |
| 2MASS/2MASS.H | 1.662E4 | 5.983145E-16 |
| 2MASS/2MASS.Ks | 2.159E4 | 5.237492E-16 |
| Herschel/Pacs.blue | 6.892474E5 | 2.989565E-17 |
| Herschel/Pacs.green | 9.790361E5 | 1.985708E-17 |

| Passband | Eff WL (Angstrom) | Flux (erg/s/cm2) |
|-------------|-------------------|------------------|
| CFHT/CFHT.I | 8.090449E3 | 7.943904E-16 |
| CFHT/CFHT.Z | 8.777988E3 | 7.753426E-16 |

Iris - Main Features

Fitting Tool: a GUI for Sherpa

The screenshot displays the Iris Fitting Tool interface. The main window is titled "Fitting Tool" and shows the following configuration:

- Current Sed:** FilterSed
- Fit Configuration:**
 - Available Components:** A list of model components including `absorptionedge`, `absorptiongaussian`, `absorptionlorentz`, `absorptionvoigt`, `accretiondisk`, `atten`, `beta1d`, **`blackbody`**, `box1d`, and `bremstrahlung`.
 - Model Expression:** `m5 + m6 + m7 + m8`
 - Optimization Method:** LevenbergMarquardt
 - Statistic:** Chi2
- Model Components:**
 - `logparabola.m5` (selected):
 - Name: `m5.c1`
 - Value: `0.15878493411094996`
 - Min: `1.1754943508222875E-38`
 - `logparabola.m6` (selected):
 - Name: `m6.ref`
- Fit Failed** (Warning)
- Final Fit Statistic:** 3.20498
- Reduced Statistic:** NaN
- Probability (Q-value):** NaN
- Number of Evaluations:** 7
- Number of Points:** 98
- Degrees of Freedom:** 97

An "Iris Visualizer" window is overlaid on the main interface, showing a plot of flux density $v(F)$ (Jy-Hz) versus Wavelength (Angstrom) on a log-log scale. The plot displays data points for PKS 1127-14 (black dots) and the fitted model (red line). The flux density ranges from 10^{10} to 10^{14} Jy-Hz, and the wavelength ranges from 10^{-6} to 10^{10} Angstrom. A secondary plot below shows the residuals (Ratios) on a linear scale from 0 to 2. The interface includes a "Show Ratios" button and a "Ratios" dropdown menu.

At the bottom of the main window, there are two status indicators: "SAMP status: connected" and "Sherpa status: connected", each accompanied by a green checkmark icon.

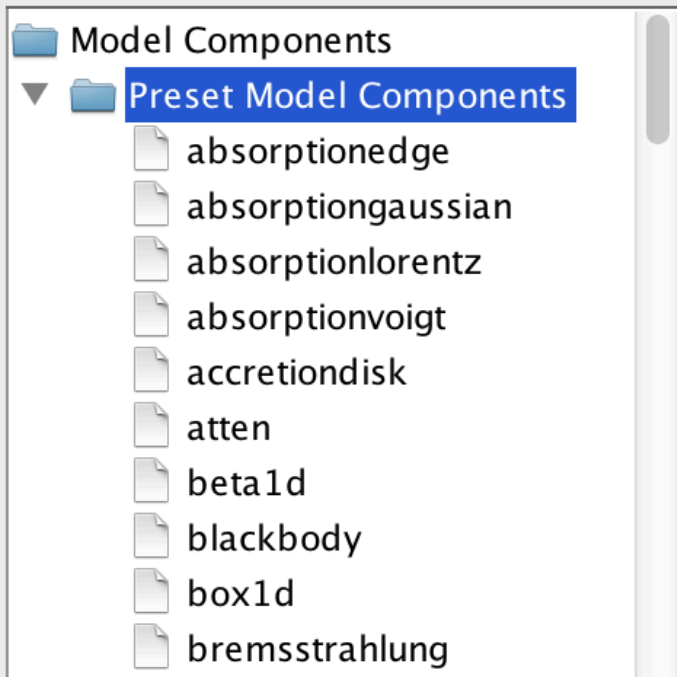
Iris - Main Features

Fitting Tool

Model Components

Preset 1D Sherpa models

Available Components



Upload your own...

- templates
- template libraries
- Python functions

Iris - Main Features

Fitting Tool: a GUI for Sherpa

Arbitrarily combine models together

Model Expression:

Iris - Main Features

Fitting Tool: a GUI for Sherpa

Arbitrarily combine models together

Model Expression:

or

Model Expression:

Iris - Main Features

Fitting Tool: a GUI for Sherpa

Arbitrarily combine models together

Model Expression:

or

Model Expression:

or

Model Expression:

Iris - Main Features

Fitting Tool: a GUI for Sherpa

Arbitrarily combine models together

Model Expression:

or

Model Expression:

or

Model Expression:

- templates
- tables
- functions

Iris - Main Features

Fitting Tool: a GUI for Sherpa

Arbitrarily combine models together

Model Expression:

or

Model Expression:

or

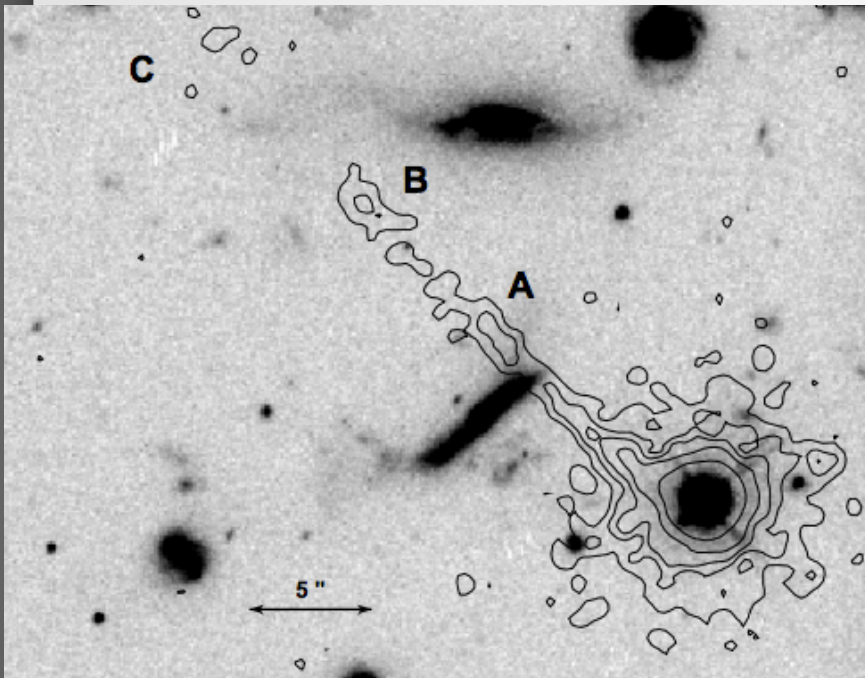
Model Expression:

- templates
- tables
- functions

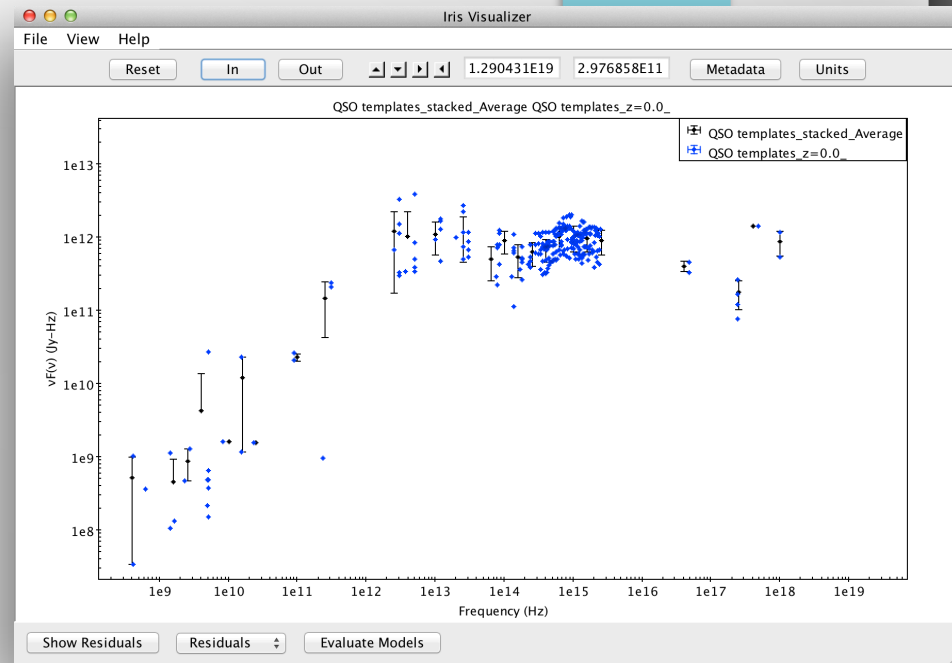
It's just math

*if the expression is mathematically correct,
you can fit it to the data*

Iris - Demonstration



Siemiginowska et al. 2002



- Part 1 -

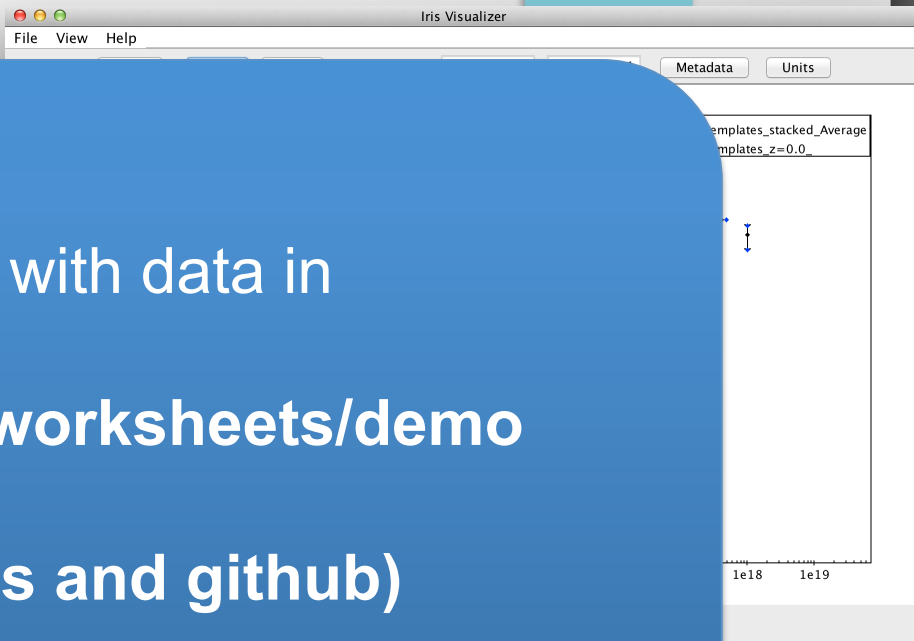
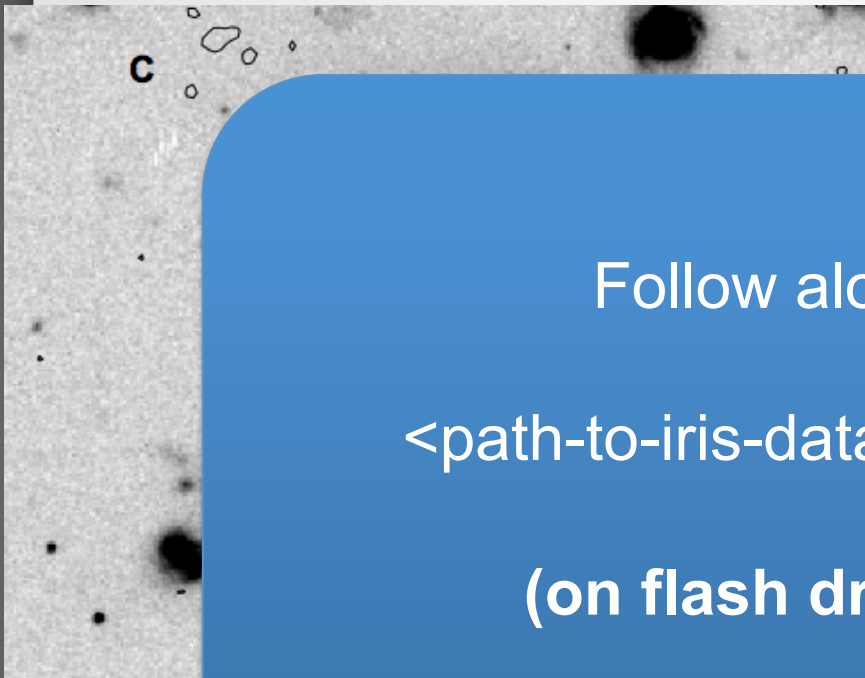
aggregate data for and **model** the SED of blazar PKS 1127-14

- Part 2 -

statistically combine similarly shaped quasar SEDs



Iris - Demonstration



Follow along with data in
`<path-to-iris-data>/worksheets/demo`
(on flash drives and github)

- Part 1 -

aggregate data for and **model**
the SED of blazar PKS 1127-14

- Part 2 -

statistically combine similarly
shaped quasar SEDs

Future Additions to Iris...

- Add more template fitting capabilities
 - Photometric redshift fitting
 - Provide stellar/galaxy templates with Iris package
- Hook-up to Sherpa's MCMC fitting
- Add more statistics options to stacking tool
 - uncertainties shading
 - sparse data statistics
- Add Python framework

Worksheets

Iris worksheets are located in

`<path-to-iris>/worksheets`

Get them at

<https://github.com/ChandraCXC/aas229iris>, or
<http://bit.ly/aas229iris> (tarfile)

Sherpa worksheets are in the Jupyter notebooks at

<http://sherpa.cfa.harvard.edu/>

See us at the Chandra booth

Wednesday

1:30-4:00pm

Omar

4:00-6:30pm

Jamie, Omar

Thursday

4:30-6:30pm

Jamie, Omar

Friday

9:00-1:30pm

Jamie