

---

# **VO Community Days Documentation**

***Release 2011.1***

**2011, US-VAO, August Muench**

November 30, 2011



# CONTENTS

<b>1</b>	<b>2011.1 Boston Logistics</b>	<b>3</b>
1.1	Quick Answers . . . . .	3
1.2	People . . . . .	3
1.3	Curiosities . . . . .	4
<b>2</b>	<b>Software</b>	<b>5</b>
2.1	Big Software List . . . . .	5
2.2	Install Tips . . . . .	5
<b>3</b>	<b>Science Stories</b>	<b>7</b>
3.1	Discovering new data on the Enigmatic T Tau YSO . . . . .	7
3.2	Quasars, Fermi, ALMA, oh my! . . . . .	7
3.3	Connecting Young Star Magnetospheres & Circumstellar Disks . . . . .	8
3.4	Evidence for Galaxy Mergers . . . . .	8
<b>4</b>	<b>Tutorials</b>	<b>9</b>
4.1	ADS Labs: The Next Generation Data/Literature Search Tool(s) . . . . .	9
4.2	Data Discovery Portal: Pan-Archive Search and Retrieval . . . . .	12
4.3	Seleste: A Tool For Querying Remote tables . . . . .	13
4.4	Iris: Build and Model Spectral Energy Distributions . . . . .	15
<b>5</b>	<b>History, Indices and Search</b>	<b>21</b>



The Virtual Observatory (VO) is realizing global electronic integration of astronomy data, tools, and services for use by individuals around the world. This new environment of interoperability will facilitate astronomy research with a speed, efficiency, and effectiveness not previously possible, and it will be available to all researchers, independent of their affiliation or access to observing facilities.

During this “VO Day”, aimed at research astronomers, VO experts from the Virtual Astronomical Observatory (VAO) - one of many VO projects worldwide - will demonstrate new tools and services for data-intensive astronomy in the context of a range of science use cases and tutorials.

The tutorials will be structured to permit the audience to follow along with their laptops; wireless access and power will be provided. Please see the [2011.1 Boston Logistics](#) page for more details.

Workshop Contents (Agenda follow the Tutorials):



# 2011.1 BOSTON LOGISTICS

## 1.1 Quick Answers

### Parking information

There is no Free parking at the CfA. We recommend that Boston Area participants [take the MBTA](#) and do not drive.

Out of town participants driving to Boston are encouraged to contact the [organizers](#) to make individual parking arrangements.

### Time/Date

Wednesday, 30 November 2011

2:30 – 5:00 pm

### Location

[Phillip Auditorium](#)

[Harvard-Smithsonian Center for Astrophysics](#)

[Cambridge, Massachusetts](#)

### Wireless

Wireless access is available via two mechanisms:

- Login via the *Harvard University* access point.
  - Non-CfA folks were given 1 day access
    - \* (check your email/spam with sender:networkaccess@guest.noc.harvard.edu)
  - CfA folks can use their standard wireless accounts.
- Login via the *Harvard Guest* (**This will timeout frequently.**)

## 1.2 People

**Registrants** [Listed by Surname \(offsite\)](#)

### Organizers

August Muench ([gmuench \(at\) cfa harvard edu](#))

Raffele D'Abrusco ([dabrusco \(at\) head cfa harvard edu](#))

## 1.3 Curiosities

Some useful OS statistics based on registrants responses (total of 47):

**Mac** Thirty-five (35) or 74.5% of the registrants listed Mac as the OS of their laptops.

**Windows** Nine (9) or 19.1% of the registrants listed Windows as the OS of their laptops.

**Linux** Three (3) or 6.4% of the registrants listed Linux as the OS of their laptops.



# SOFTWARE

Each tutorial will contain an independent summary of the applications used, required versions, platforms, browsers, etc.

This is a summary document that synthesizes all the tutorials into a one stop shop for what will be necessary to participate in the event.

## 2.1 Big Software List

Software or Website	OS(s)	Tutorials
Firefox	Mac, Win, Lin	<a href="#">ADS Labs: The Next Generation Data/Literature Search Tool(s)</a> <a href="#">Data Discovery Portal: Pan-Archive Search and Retrieval</a>
ADS Labs	Mac, Win, Lin	<a href="#">ADS Labs: The Next Generation Data/Literature Search Tool(s)</a>
Discovery Portal	Mac, Win, Lin	<a href="#">Data Discovery Portal: Pan-Archive Search and Retrieval</a>
TOPCAT	Mac, Win, Lin	<a href="#">Data Discovery Portal: Pan-Archive Search and Retrieval</a> <a href="#">Seleste: A Tool For Querying Remote tables</a> <a href="#">Iris: Build and Model Spectral Energy Distributions</a>
ds9	Mac, Win, Lin	<a href="#">Data Discovery Portal: Pan-Archive Search and Retrieval</a>
Seleste	Mac, Win, Lin	<a href="#">Seleste: A Tool For Querying Remote tables</a>
Iris	Mac, Lin	<a href="#">Iris: Build and Model Spectral Energy Distributions</a>

## 2.2 Install Tips

### 2.2.1 Firefox

Web based tools like [ADS Labs](#) and [Discovery Portal](#) are known to run on Firefox 5.0+. Please do not use Internet Explorer for these tutorials.

#### Java Applications

A few of our tools are built on the Java technology and depend upon Oracle Java to be [installed](#) to run. Java for your Mac is installed via the Software Update tool within Mac OS X 10.5, 10.6 and 10.7.

### 2.2.2 TOPCAT, ds9

Both [TOPCAT](#) and [ds9](#) have versions for all major operating systems. See also notes on Java applications.

### 2.2.3 Seleste

[Seleste](#) is a Java based tool that is launched with Java Web Start file. You download the webstart file from the [Graphical Interface](#) section of the Seleste website.

### 2.2.4 Iris

[Iris](#) is a Java+Python tool that runs on Mac and Linux. It does not currently run on Windows due in part to the Python dependencies. While Iris is not officially supported on Mac OS X 10.7 *Lion*, it will work for the purposes of this demo.

# SCIENCE STORIES

When we use the term “Story” we are talking about a narrative version of a research problem. Science stories can vary in many ways: focusing on different object types (quasars versus young stars); spanning all sky or on a single object or cluster; identifying correlations to deducing causation to explicit modeling.

The tutorials build on this narrative by inserting the specific tools into the narrative as a means to solve part of the overall problem.

One to two stories should be used for the VO Day.

## Individual Science Stories

### 3.1 Discovering new data on the Enigmatic T Tau YSO

**T Tau** is a multiple component protostar in the Taurus molecular cloud. It has companions on a scales of a few arcseconds and a reflection nebula between 45 and 60” from the system (Hind’s Nebula).

Scientific reasons for studying T-Tau include:

- How do recently released measurements in infrared catalogs like WISE or UKIDSS augment the source’s SED?
- How variable has T Tau been in the near-IR, comparing UKIDSS to 2MASS or in the mid-IR, comparing Spitzer to WISE?
- Are there new high resolution images of the binary components?

### 3.2 Quasars, Fermi, ALMA, oh my!

Recent (and future) surveys that observe the whole sky at high energy and mm/submm wavelengths will help fill the gaps in the multi-wavelength observations of some of the most interesting astronomical sources (like quasars), and constrain their emission mechanisms.

Our story begins under the following hypothetical: one has just acquired ALMA data on a Fermi source. Not just any Fermi source but the famous source [3C273](#), the first quasar ever to be identified. This radio-loud quasar was also very recently detected by Fermi as 2FGL J1229.1+0202, and has already has a large amount of multi-wavelength data.

How do these new data (Fermi, ALMA) augment the extant SED and what physical knowledge can be deduced by their incorporation?

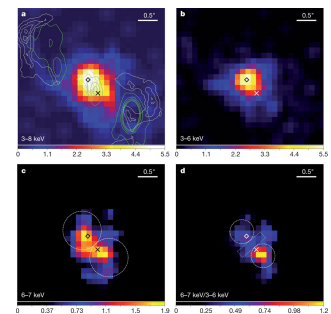
### 3.3 Connecting Young Star Magnetospheres & Circumstellar Disks

As with many of these science stories, including *Quasars*, *Fermi*, *ALMA*, *oh my!*, one overarching question is how new, especially panchromatic data can be folded together to deduce new physical connections and processes.

Is there a relationship between the magnetosphere and the disk of young stars? This topic has been frequently in the literature. Past studies have been focused on correlations in emission in different **optical** bands, e.g., U, B, V optical photometry from a single catalog. With recent surveys (IR, X-ray) this has become wider in scope as we better understand the physics of young stars. If young stars have IR excess due to circumstellar disks and young stars emit X-rays due to hot accretion spots and from enhanced magnetic activity due to rapid rotation:

- Can we deduce a relationship between the disk flux and X-ray flux that might reveal or constrain their coupling?

### 3.4 Evidence for Galaxy Mergers



Consider the recent paper [A close nuclear black-hole pair in the spiral galaxy NGC 3393](#) by Fabbiano et al. (2011).

For this object, [NGC 3393](#) is there evidence from wider fielddeep optical images or radio HI data that would help to deduce the characteristics of the merger event(s) that may have propagated this close black hole pair?

# TUTORIALS

Remember that all the tutorials are set within 1 or more *Science Stories*!

The workshop's agenda follow these four tutorials. Each tutorial will last approximately 30 minutes.

## 4.1 ADS Labs: The Next Generation Data/Literature Search Tool(s)

### Contents

- ADS Labs: The Next Generation Data/Literature Search Tool(s)
  - Science Story
  - Tools and Files
  - Overview of ADS Labs
  - Author Based Queries
  - Topic Search: Blazars
  - AstroExplorer

### 4.1.1 Science Story

One begins to search the literature for many reasons during ones research: when one is looking for new data or new collaborations or learning a new field. Here are a couple of ways ADS and [ADS Labs](#) might be used for some of the *Science Stories*:

### Questions

- What are people reading about accretion regulated rotation or disk / magnetic field connections? (*Connecting Young Star Magnetospheres & Circumstellar Disks*)
- What are other papers on black holes in NGC 3393? Signatures of galaxy mergers? (*Evidence for Galaxy Mergers*)
- How is a blazar not a quasar? (*Quasars, Fermi, ALMA, oh my!*)

### 4.1.2 Tools and Files



This tutorial uses the

- [ADS Labs](#) web application

### 4.1.3 Overview of ADS Labs

[ADS Labs](#) is an experimental interface incorporating new search capabilities, and result visualizations. Not all functionality from “classic” ADS is available yet and search limitations exist (only 200 records appear in the facets).

**Note:** For best results users should be [logged into ADS](#); this login is shared with ADS Labs. Simply click on the [Sign on](#) link on the top-right of the screen.

---

#### Filters, Facets, Future

There are a couple of interesting points about Filtering, Facets and the Future of [ADS Labs](#):

- Each facet category is orthogonal to others (and performs an AND);
- Facet values within a category are combined using OR;
- Any of the visualizations create a rendering of (some property of) the articles currently selected, and selection within the visualization can be reapplied back to the results in ADS Labs using a filter similar to what a facet selection would do.
- The current system is limited to displaying (and manipulating) the top 200 papers returned by a query, so facets are built exclusively on this partial list. This limitation will be removed in the near future.

### 4.1.4 Author Based Queries

Author searches are the most popular searches in ADS. We all want to see what our favorite {collaborators|competitors|friends} have been up to. Let’s walk through a typical author search in ADS Labs, starting from the ADS Labs’ [streamlined search form](#).

1. We’re interested in papers by Steve Murray. Let’s find out what papers he wrote as first author. Click on “first author” link and enter: “Murray, S”

---

**Note:** Did you know that you could request first-author papers only?

---

---

**Note:** a long list of results, some by “Murray, Sophie” etc.

---

2. Go back to search form, enter full first name: “Murray, Stephen”
3. Look at results, now many fewer. Click on [Authors](#) facet for “Murray, S” and show all name variations.
4. Tick off only the author names in the [Authors](#) facet that correspond to Steve (whose middle initial is S).
5. Click on the [View as . . .](#) tab and pull up a [Word cloud](#), which is generated from all words in the title and abstract of the papers.
  - Select “ACIS,” “HRC” words and click [View papers for selected words to facets](#) to show a list of Chandra observing proposals.

---

**Note:** Yes, ADS has records for many observing proposals, including Chandra ones. You will see more of this in the second part of this tutorial.

---

- Click on first record in result list (about observations on [Abell 2199](#)), and follow links to Chandra data.

#### Exercise

As an exercise, try searching for your own publications (or your adviser's, if you only have a few), and then visualize the results via the word cloud. Is there anything that jumps out at you? Select a few words and then filter papers by clicking on “view papers for selected words.”

Consider the science story, *Evidence for Galaxy Mergers*: has the lead author, G. Fabbiano, written other papers on this subject? What is the scope of the literature for the targeted object, [NGC 3393](#)?

### 4.1.5 Topic Search: Blazars

Let's now go to a topic search and consider one of our original science questions about blazars.

**Note:** The ADS Labs user interface supports many different rankings of results, some of which are not straightforward. Let's go over some of them as part of this exercise.

- We are interested in papers published on “blazars.” In this case, we don't want to see results ranked by publication date, but rather see the papers that best match the input term, so we select `Most relevant` as the ranking method and submit the query.
- We get a list of 200 papers, and under the option `View as...` we select the `Author Network` associated with them to understand what the different groups of collaborators working on this topic are.
- We use the slider to remove some of the complexity in the network and see that one of the most prolific authors is Ghisellini; we select this author and its immediate co-authorship nodes (`alt + shift` or use the proper selector in the author network screen).
- We apply the selection back to the list of records in our result set and are now down to 55 records.
- Let us now see what archives have data related to these articles; if we open the `Archives` tab we see that there are data in different places; we notice that there are 33 papers in the original list which have datasets available from HEASARC; if we click on this facet our list of results shrinks to 11 papers.

#### Exercise

As an exercise, can you guess what the “paper network” option does to visualize the selected set of papers? What do you think it could be useful for?

Let us try a different approach to our problem. Let us say that we are entirely new to the field of blazars and want to read review articles as an introduction to the subject.

**Note:** While the first column of search options provide “**Sort by**” capability, the second, “**Explore the field**” provide additional second order operators to the search itself.

- Type “blazars” in the search field, select “Reviews and introductory papers” and submit.
- We find a list of 200 papers, but we want to restrict ourselves to reviews written in the last 3 years, so use the slider under the `Dates` facet to manipulate the histogram and select the proper range of dates.
- The remaining list shows the paper [2010arXiv1006.5048B](#) up top. We can't really tell if this is a review paper from the title, but look! We see links under the record saying `matches in abstract` and `matches in`

preprint which allow us to take a peek inside the paper. Click on the abstract link and find that, in fact this is a recent review of the field.

4. We want to find out which objects in the sky these papers are studying; thanks to [SIMBAD](#), we can open the corresponding facet and select first a class of objects, then a set of object names within that class.
5. As an alternative, we can use a sky map visualization of the list of SIMBAD objects to perform a selection based on position and object type; as an example, select “other objects” and then box the cluster of objects near (ra=200, dec=-45), then click on `Apply to facets`.
6. We are left with one paper: 2010ApJ...719.1433A; we click on the link to see the full abstract page.

---

**Note:** Notice that the list of authors is truncated to a reasonable amount, but which can be expanded to the complete list, and the affiliations can be displayed in-line as an option.

---

#### Exercise

Perform a search using keywords describing your field of study. Can you guess what type of results are returned if one selects the search options labeled “what people are reading” and “what experts are citing”? First you should find out more by clicking on the icon next to the label to understand how the search is structured, then try each option and see if the results make sense to you.

### 4.1.6 AstroExplorer

The next, next generation tool, [AstroExplorer](#), is further integrating aspects of the data and the literature. Go ahead and log on, along the way try and save queries, publications, and datasets.

1. Type in blazars into search box on publications page. See the 10 results autocomplete as keywords but larger set of 37 when you hit ESC to remove the autocomplete.
2. See top keywords, active people, most studied CDS objects, targets (mention combining these). Click in left on B1101+384 object, one of the most studied.
3. Choose the one that has chandra mission. Note that it also has data with FUSE.
4. Pivot on QSO B1101+384, notice Schull as main author, and Sembachs on proposals.
5. Go to Observations tab, type in and autocomplete QSO B1101+384.

#### Exercise

Repeat these steps for the [3C273](#) object that will be used in other of today’s tutorials.

## 4.2 Data Discovery Portal: Pan-Archive Search and Retrieval



**Contents**

- [Data Discovery Portal: Pan-Archive Search and Retrieval](#)
  - [Science Story](#)
  - [Tools and Files](#)
  - [Finding High Resolution Images of T Tau](#)
  - [Finding Infrared Catalogs about T Tau](#)
  - [Independent Exercise](#)

## 4.2.1 Science Story

The two science stories for the Discovery Portal tutorial are *Discovering new data on the Enigmatic T Tau YSO* and *Evidence for Galaxy Mergers*. In both cases we are trying to discover images about these objects; in the first case to study the protostellar binary and in the latter to look for tidal tails indicative of a merger event.

**Questions**

- What HST ACS images of T Tau are available?
- Are tidal tails optically visible in NGC 3393?
- What mid-IR catalogs are available to use for T Tau?

## 4.2.2 Tools and Files

This tutorial uses the

- [Discovery Portal](#) web application
- [ds9](#) desktop imaging and data visualization application
- [TOPCAT](#) Java based desktop application

## 4.2.3 Finding High Resolution Images of T Tau

1. Load the [Discovery Portal](#) website.
2. Enter “T Tau” as the object.
3. Given the small size of the object enter 10 and “arcsec” into the search radius boxes.

---

**Note:** The Discovery Portal is an asynchronous search. New results stream in as remote services respond unless the query has been cached. T Tau r=10s will be cached!

---

1. Filter on “Images” in the `Category` facet.
2. Enter “ACS” into the free text search to narrow the results list.
3. Select HLA.ACS. A popup window will tell you about that resource.
4. From the popup window, hit `Load` to render the results into a new table.
5. Scan the results different columns reflecting passband, duration, etc.
6. Use the `Format` facet to find a JPG version. For each row a popup window describes the individual image. At this point you can spawn a JPG version into a new tab.

#### 4.2.4 Finding Infrared Catalogs about T Tau

This example picks up from the previous one, except instead of looking for images one is looking for catalogs.

1. Reset the filters for “Catalogs” and “Infrared”
2. Load the 2MASS data into a new table.
3. Export the results to one of CSV or if [TOPCAT](#) is open Broadcast the table there.

#### 4.2.5 Independent Exercise

##### Question

Can we identify tidal tails in NGC 3393 from archival data?

##### Approach

Find optical HST or radio HI images of NGC 3393 and visually inspect them.

##### Resources & Outline

Target HST ACS datasets.

##### Analysis

Download the images and load them into ds9.

### 4.3 Seleste: A Tool For Querying Remote tables

##### Contents

- Seleste: A Tool For Querying Remote tables
  - Science Story
  - Tools and Files
  - Combining X-ray and near-IR data on Orion
  - Independent Exercise

#### 4.3.1 Science Story

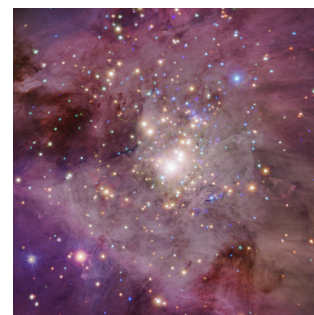
The main science story for this tutorial is *Connecting Young Star Magnetospheres & Circumstellar Disks* but one should also consider reading *Quasars, Fermi, ALMA, oh my!*: the underlying story is how do we **discover** and merge panchromatic data from different wavelength regimes to give us insight into underlying physical processes.

**Questions**

- Can we deduce a relationship between the disk flux and X-ray flux that might reveal or constrain their coupling?

**4.3.2 Tools and Files****This tutorial uses the**

- [Seleste](#) Java based desktop application
- [TOPCAT](#) Java based desktop application

**4.3.3 Combining X-ray and near-IR data on Orion**

The goal of this part of the tutorial is to search the Chandra Source Catalog for sources near the Orion Nebula and retrieve their flux and positions. With this data you will then cross-correlate the sources to the 2MASS catalog with a 1 arcsec radius from each and retrieve their magnitudes. Using the merged catalog of X-ray and near-IR measurements we will look for a simple correlation in flux/magnitude.

1. The application starts in the `Guide` mode. Click on the `Form` icon to start building a query.
2. Click on `Services` and select *Chandra Source Catalog (CSC) TAP Service*. This opens the remote tables in the application.
3. Now you want to select the columns you wish to retain from this service. Open the *master\_source* table in the Contents area on the left.
  - (a) Select `ra`, `dec`, `flux_aper90_b` and add (+) in the Output Columns area.
4. We will now build the query to find sources near the center of the Orion nebula and that are close to on-axis for Chandra.
  - (a) Select the `err_ellipse_r0` column and add in the Column Criteria.
  - (b) Set the filter to `< 3` to select on-axis sources; note that the units for the column are given in the metadata panel at the bottom of Seleste.
  - (c) Add a spatial range search: `* (ra < 83.82) AND ra > 83.78) AND (dec < -5.3) AND dec > -5.5)`

(d) Hit Submit

5. In the Jobs window, once the job status shows as Pending hit Run.
6. When the status becomes *Completed* view the results and hit Save to save them in a file e.g. *csc\_orion.xml*

---

**Note:** If your query fails to run you can continue this tutorial by downloading the *csc\_orion.xml* file from [here](#).

---

7. Return to the Query form and under *Services* select *GAVO Data Center TAP Service*
8. Hit Upload and upload the table of previously saved Chandra sources (e.g. *csc\_orion.xml*) it will appear as *TAP\_UPLOAD.user\_table* in Contents.
  - (a) Select *user\_table* and add all columns into Output Columns.
9. From the GAVO tables select the *twomass.data* table and add the *raj2000*, *dej2000*, *Jmag*, *Hmag* and *Kmag* columns to the Output Columns.
10. Add a Position Search.
  - (a) Select *TAP\_UPLOAD.user\_table* from drop down menu
  - (b) Select Center around: Other table and Select Table *twomass.data*
  - (c) Set Radius 1.0 arcsec
  - (d) Submit
11. In the Jobs window hit run
12. When completed send results to TOPCAT
  - (a) Calculate *hmag-kmag* in TOPCAT
  - (b) Scatter plot  $\log(\text{flux\_aper90\_b})$  vs *hmag-kmag* color.

### 4.3.4 Independent Exercise

#### Question

What is the incidence of X-ray activity in different types of galaxies?

#### Approach

Find optical and X-ray emitting galaxies with redshift  $> .1$  and study their X-ray and optical properties

#### Resources & Outline

Use the *Chandra Source Catalog (CSC) TAP Service* and the *SDSS DR7 - SLOan Digital Sky Survey Data Release 7* services to extract the relevant X-ray and Optical Properties.

#### Analysis

Export the merged catalog to TOPCAT for visualization and analysis.

You can download the script `seleste_independent_exercise.txt` for doing this exercise off this website.

## 4.4 Iris: Build and Model Spectral Energy Distributions

### Contents

- Iris: Build and Model Spectral Energy Distributions
  - Science Story
  - Tools and Files
  - Building the SED
  - Modeling the SED
  - Independent Exercise

### 4.4.1 Science Story

This tutorial is sourced in the *Quasars, Fermi, ALMA, oh my!* science story, which is about the acquiring multi-wavelength data on  $\gamma$ -ray sources, either to determine their counterparts or to determine the emission mechanisms. From the standpoint of the Iris SED Tool, this tutorial is intended to demonstrate how one could construct a Spectral Energy Distribution (SED) using a mix of Virtual Observatory (VO) services and tools.

### Questions

- How do we now incorporate new data into a larger set of multi-wavelength data to assess the SED of 3C273?
- What new information have we gained?

### 4.4.2 Tools and Files



#### This tutorial uses the

- Iris Python+Java based desktop application
- TOPCAT Java based desktop application

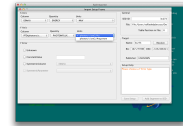
desktop applications.

We provide two files for the purposes of working through this tutorial. Fermi data from the literature are contained in `3c273_fermi.dat`. The file `3c273_alma.dat` contains hypothetical ALMA data from an observation that we have just finished reducing (you can have a look at the content of these files with any text editor before beginning the script).

### 4.4.3 Building the SED



1. Start the **Iris** SED Importer tool, the **SEDImporter**.
2. Select **Load SED**. A text box will open; provide a name for the new SED (e.g., **3C273**). A new window should appear, with the ID specified.
3. In the Target Info area, enter the name **3C273** to resolve the source name into coordinates. Select **Resolve** and the coordinates should be filled in. (RA = 187.277896334, DEC = 2.052406321).



1. At the time of the writing of this document, the Year 2 Fermi data has not been incorporated into the NASA Extragalactic Database (NED). We must, therefore, do it ourselves. Included in this tutorial should be a file named `3c273_fermi.dat` containing the relevant Fermi data (Abdo et al. 2011).
  - (a) Select **New Segment** to begin adding data. A new window should appear. Since we are loading Fermi data from an external file, ensure that the **Location on Disk** radio box is selected. Browse one's disk to select the file, ensure that the **File Format** is **ASCII Table**, and then load the data.
  - (b) A new **Import Setup** window should appear. This step is necessary to tell **Iris** what the relevant units are. The external Fermi file should be structured so that the first column (*col1*) is energy in units of Mev, the second column is photon flux density in units of photons/cm<sup>2</sup>/s/Hz, and the third column contains the uncertainties as a **SymmetricColumn**. Because these data are being loaded from an external file, the **Publisher** is specified as **UNKNOWN**. For ease of keeping track of various data segments, it is recommended that one change this field to something meaningful, e.g., **Fermi**.
  - (c) Select **Add Segment to SED**.
2. At this point, the SED window should show a record listing 5 data from the publisher Fermi, with the coordinates of 3C273.
3. We now add the published data from NED. Select **New Segment**. A new window should appear, but this time select **Get an SED from the NED Service**. The target Name field should already be completed. Select **Import NED SED**, and a new listing should appear with 67 data from the publisher NASA/IPAC Extragalactic Database.
4. We now add our hypothetical data from ALMA. This time we won't import the file directly into the **SEDImporter** from the file, but we will imagine the ALMA data have been retrieved from a VO service that searches tabular data, using **TOPCAT**. So, if you know how to use **TOPCAT**, import the second file `3c273_alma.dat` into **TOPCAT**.
  - (a) Select the file in **TOPCAT** main window the file and sent it to the **SEDImporter** using the SAMP interoperability between the **SEDImporter** and **TOPCAT** (click on the icon with the radio tower).
  - (b) From this point on, the steps are similar to adding the Fermi data, but are listed here for completeness. A new **Import Setup** window should appear automatically when the file is "broadcast" from **TOPCAT**. The second column (col2) is frequency in units of GHz, the fourth column (col4) is flux density in units of Jy, and the fifth column (col5) is the uncertainties as a **SymmetricColumn**. Because these data are being loaded from an external file, the **Publisher** is specified as **UNKNOWN**. For ease of keeping track of various data segments, it is recommended that one change this field to something meaningful, e.g., **ALMA**.

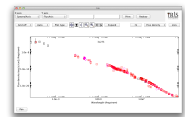
- (c) Select `Add Segment to SED`.



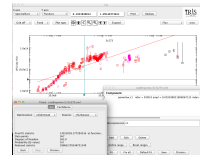
1. At this point, the SED window should show a record listing 4 data from the publisher ALMA, with the coordinates of 3C273.
2. Save this SED, which should contain 3 segments from the publishers Fermi, NASA/IPAC Extragalactic Database, and ALMA, to an external file. Save it as a VOTable (data/metdata formatted in XML).

#### 4.4.4 Modeling the SED

1. In order to display this SED, click on `Launch Iris` icon from the main **SEDImporter** window. A new window should appear.



1. Go back to the main SED window of the **SEDImporter** and click on `Broadcast SED` to seamlessly send the whole SED to **Iris**. The plot of the SED should appear. Black boxes show data from the NED SED service, with purple associated to data points with no error estimates available. Red boxed show data contained in the two files that have been imported into the **SEDImporter**.
2. You can change the units of measure of the SED plot, zoom in or out or/and change the representation of the SED. For example, you can select `Flux` in the quantity selector that is by default set to `density flux`. You will be asked to select the units of measure for the spectral and flux axes, a good choice is `Hz` and `Jy-Hz` respectively for the  $\nu*f(\nu)$  visualization of the SED.



1. Clicking on `Fit`, you will see that the powerlaw model from the models list is added by default. You can click on `Fit`, pick an `Optimization method` and one `Statistics` and perform the fit with this model.
2. If you are not satisfied with the fit, you can edit the model. For example, select the powerlaw model and delete it by clicking on `Delete`, then click on the `Add` box to add another model. Select `brokenpowerlaw (c1 component)` should be automatically added in the `Model expression` text field; you can use the broken powerlaw to perform a first fit by clicking again on `Fit`, then leave the fit statistic to its default value and change the optimization method to `chi2davatar`;
3. You can build an arbitrarily complex model function for the fit by mathematically combining the elementary function in the `Model expression` field. You can try to combine the brokenpowerlaw model with other models to improve the fit of the SED of 3C273.
4. By selecting `Define range` in the main `Fit` window, you can interactively define the range of the fit by clicking on the two extremes of the range.
5. The custom fitted model parameters can be saved to a local file before exiting the fitting session, by selecting `Write to a text file` option from the `File` menu of the `Fit` window and then by clicking on `Write active components`.

### 4.4.5 Independent Exercise

In [Iris](#), you can compare multiple SEDs by overplotting them. As an example, you can build the SED for a different source, say the blazar 4C+28.07 for which a decent amount of multiwavelength observations and Fermi data are available (provided in `4c28.07_fermi.dat`). Try to build the SED for 4C+28.07 within the SEDImporter using both NED SED data and the Fermi data contained in the “4C+28.07\_fermi.dat”, while [Iris](#) is still showing 3C273 SED. Then, send the newly created SED to [Iris](#) and overplot it to the previously plotted SED.

---

**Note:** If you can’t find out how to coplot SEDs, have a look at the [official documentation](#).

---



# HISTORY, INDICES AND SEARCH

- *timeline*
- *genindex*
- *search*