Constructing and Analyzing Spectral Energy Distributions with the Virtual Observatory

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IRIS
VAO SED ANALYSIS TOOL

Spectral energy distributions (SEDs) are a common and useful means of assessing the relative contributions of different emission processes occurring within an object. Iris, the Virtual Astronomical Observatory (VAO) SED tool, seamlessly combines key features of several existing astronomical software applications to streamline and enhance the SED analysis process.

With Iris, users may build and display SEDs, browse data and metadata and apply filters to them, fit models to SEDs, and calculate confidence limits on best-fit parameters.

SED data may be built from a number of sources using the SED Builder. Iris supports the Simple Application Messaging Protocol for interoperability with other Virtual Observatory applications, like the VAO Data Discovery tool, and can directly fetch SEDs from the NASA Extragalactic Database SED service.

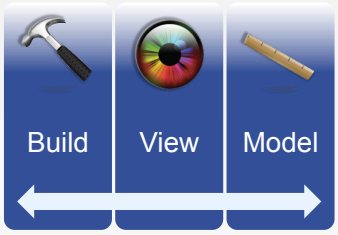
Particular attention has been paid to the integration of user spectrophotometric data from files in several different formats.

File readers for custom formats can be provided at runtime, as well as custom models to fit the data, as template libraries for template fitting or arbitrary python functions.

New functionalities can be added by installing plugins, i.e. third party components that are developed using the Iris Software Development Kit.

Built-in Capabilities

- Iris provides a broad suite of capabilities for building, editing, viewing and analyzing SEDs.



SED Builder

- Load SED Segments from File, URL
- Add/Edit/Save/Delete:
  - Photometry Points
  - Photometry Catalogs
  - Entire SEDs, Spectra
- Import non-compliant user files from many different formats
- Integrated client for NED SED service
- SAMP I/O with SED message extension

SED Viewer

- Metadata Filtering through user defined boolean expressions or interactive selection
- Display single point metadata in tree format
- Interactive Aperture Correction

Fitting Tool

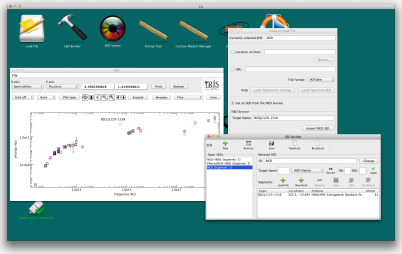
- Arbitrarily combine model components in different spectral ranges
- Compute confidence intervals for best fit parameters
- Template Fitting

Example Thread

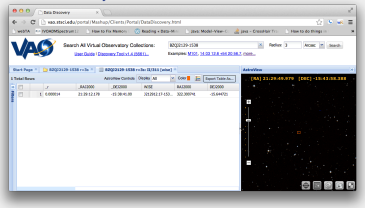
Blazar BZQJ2129-1538

- SEDs are useful for determining the physical processes occurring withing celestial sources.
- We show how Iris allows to build the Blazar's SED using data from different sources and model it as a combination of synchrotron, black body, and Inverse Compton emissions, accounting for the emission of the jet and of the accretion disk.

1. Fetch NED SED

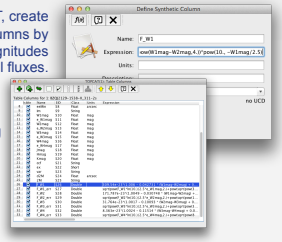


2. Get WISE photometry from VAO Data Discovery Tool



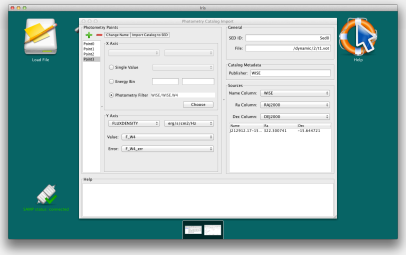
3. *Beam* data to TOPCAT using Virtual Observatory Interoperability (SAMP)

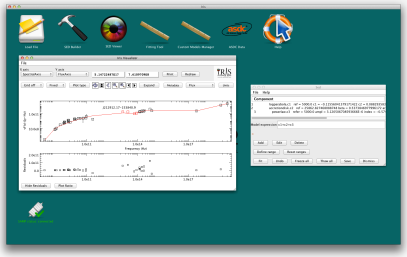
4. In TOPCAT, create new columns by converting magnitudes to differential fluxes.



5. *Beam* data to Iris using Virtual Observatory Interoperability (SAMP)

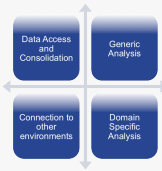
6. In Iris, import the photometry coming from TOPCAT (Differential fluxes in the four WISE bands)





7. Using the Iris SED tool, add the SED components: logparabola for the synchrotron emission, the accretion disk (composition of black bodies) and a power law to account for the few high energy points available in this example

Iris extensibility and plugins



Production plugins

- Query to ASDC catalogs

Experimental plugins

- Iris-R bridge
- Query to Vizier

Future Plans

- Blazar analysis toolbox (with ASDC)
- Evaluation of an Education Plugin

File Filters

- The SED Builder component allows to define new file filters that can be loaded at runtime to import data from non supported file formats, or from particular flavors of supported formats.

This poster describes the features in Iris v1.2, available for download at www.usvao.org/science-tools-services

SED Manager attachments

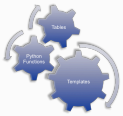
- The SED Manager allows plugins to attach arbitrary files to SEDs, so to store additional information.

SAMP Handlers

- Plugins can directly register as SAMP listeners, and they don't have to worry about the SAMP connection/registration details.

Events

- An extensible Events Framework enables a loosely coupled architecture.
- New Events can be easily added to the framework.



Custom Models

- Sherpa (Iris default fitting engine) allows users to extend the set of existing models by loading:
  - Template Libraries for Template Fitting
  - Custom Python functions
  - Model profiles as custom data tables

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Demonstrations, tutorials, & more information at the VAO Exhibit (231-233) **www.usvao.org**