

****Volume Title****

*ASP Conference Series, Vol. **Volume Number***

****Author****

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Iris: The VAO SED Application

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Abstract. We present Iris, the VAO (Virtual Astronomical Observatory) application for analyzing SEDs (spectral energy distributions). Iris is the result of one of the major science initiatives of the VAO, and the first version was released in September 2011. Iris seamlessly combines key features of several existing astronomical software applications to streamline and enhance the SED analysis process. With Iris, users may read in and display SEDs, select data ranges for analysis, fit models to SEDs, and calculate confidence limits on best-fit parameters. SED data may be uploaded into the application from IVOA-compliant VOTable and FITS format files, or retrieved directly from NED (the NASA/IPAC Extragalactic Database). Data written in unsupported formats may be converted for upload using SedImporter, a new application provided with the package. The components of Iris have been contributed by members of the VAO. Specview, contributed by STScI (the Space Telescope Science Institute), provides a GUI for reading, editing, and displaying SEDs, as well as defining model expressions and setting initial model parameter values. Sherpa, contributed by the Chandra project at SAO (the Smithsonian Astrophysical Observatory), provides a library of models, fit statistics, and optimization methods for analyzing SEDs; the underlying I/O library, SEDLib, is a VAO product written by SAO to current IVOA (International Virtual Observatory Alliance) data model standards. NED is a service provided by IPAC (the Infrared Processing and Analysis Center) at Caltech for easy location of data for a given extragalactic astronomical source, including SEDs. SedImporter is a new tool for converting non-standard SED data files into a format supported by Iris. We demonstrate the use of SedImporter to retrieve SEDs from a variety of sources—from the NED SED service, from the user’s own data, and from other VO applications using SAMP (Simple Application Messaging Protocol). We also demonstrate the use of Iris to read, display, select ranges from, and fit models to SEDs. Finally, we discuss the architecture of Iris, and the use of IVOA standards so that Specview, Sherpa, SEDLib and SedImporter work together seamlessly.

1. Introduction

The VAO (Virtual Astronomical Observatory)¹ is the US VO (Virtual Observatory) effort, funded by the NSF and NASA. In its first year of development, the VAO has worked on several projects to support its major science initiatives (Hanisch et al. 2012).

Our teams at SAO, STScI and IPAC have collaborated to support analysis of SEDs (spectral energy distributions). The results are Iris,² an application for SED analysis; SedImporter, a tool to make SEDs from data collected from many sources; a SED service³ provided by NED⁴; and a library, SEDLib,⁵ providing functions to read and write VO-compliant files. The VAO distributes Iris and SedImporter in a single package, for Linux and Mac OS X systems.

In this paper, we discuss importing SEDs with SedImporter; retrieving SEDs from NED; and analyzing SEDs in Iris. We also discuss the IVOA standards and protocols that allowed us to provide this software and service, using code from previous projects.

2. Build a SED with SedImporter

The new SedImporter tool provides functions to build SEDs. SedImporter can read and write SEDs in formats compliant with the IVOA Spectrum Data Model, v1.03.⁶

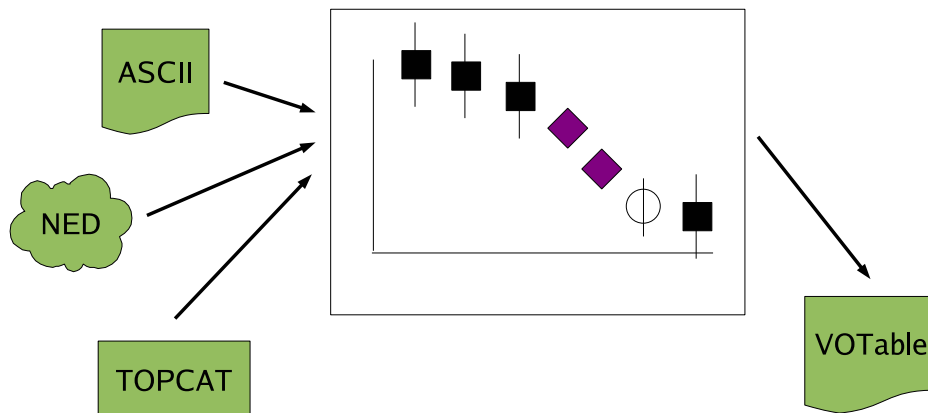


Figure 1. SedImporter combines SED data from different sources.

¹<http://www.usvao.org/>

²<http://cxc.cfa.harvard.edu/iris/>

³<http://vo.ned.ipac.caltech.edu/services/accessSED?REQUEST=getData&TARGETNAME=:targetName>

⁴<http://ned.ipac.caltech.edu/>

⁵<http://cxc.cfa.harvard.edu/iris/sedlib/>

⁶<http://ivoa.net/Documents/cover/SpectrumDM-20071029.html>

SedImporter also provides functions to read data from non-compliant files; and also has a SAMP⁷ interface, to import data from other VO-enabled applications (see Figure 1). SedImporter can write the SED to a file, or send it to Iris via SAMP.

3. Analyze a SED with Iris

Iris provides functions for displaying SEDs and their metadata, and selecting data ranges for analysis. It also provides a set of basic models, which can be combined to model continuum and features. Iris can fit models to data and report back fit results.

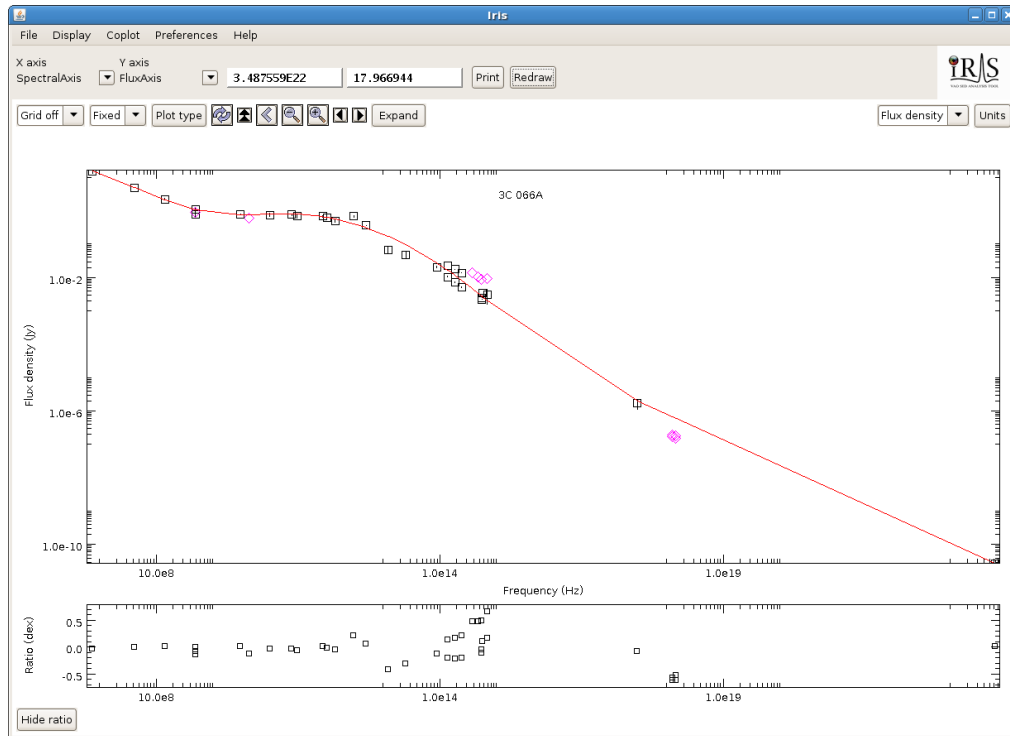


Figure 2. Iris fit to the SED for 3C 066A. The best-fit model is indicated in red.

Figure 2 shows the best fit for 3C 066A, for the sum of a broken power-law and a logparabola model. The best-fit model can be saved and used in future Iris sessions.

4. Structure of Iris and SedImporter

Iris and SedImporter include code from mature projects, bound with code implementing IVOA standards and protocols. Figure 3 shows a high-level view of their structure.

SEDLib is a Java library, providing functions to read and write SED files, in compliance with the Spectrum DM v1.03. Both SedImporter and Iris link to this library.

⁷<http://ivoa.net/Documents/SAMP/20101216/index.html>

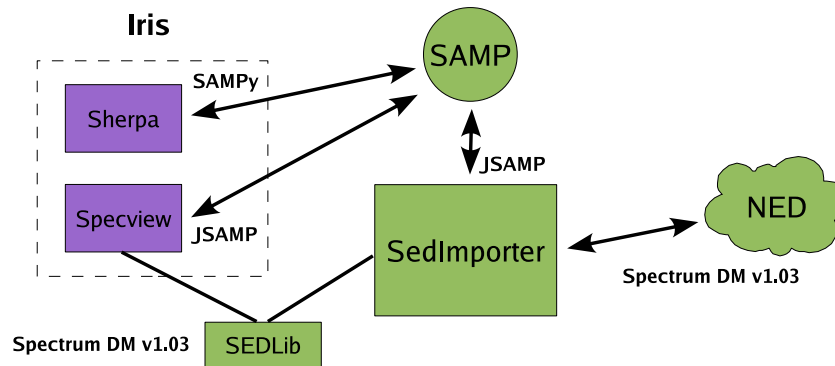


Figure 3. Structure of Iris and SedImporter.

Iris is composed of two applications: Specview (GUI) and Sherpa (fitting). Communication is managed via SAMP (with Sherpa using the SAMPy module,⁸ and Specview and SedImporter using JSAMP⁹). To the user, Iris acts like a single application.

NED provides a SED service for the objects in its database. Given a target name or sky coordinates, NED returns a SED file that complies with Spectrum DM v1.03.

5. Conclusions

In our first year, our SED team has produced a NED SED service, a tool for building VO-compliant SEDs, a library for developers, and an application for analyzing SEDs. We have done this using existing software coupled with IVOA standards and protocols.

In our second year of development we plan to add to Iris science functionality, refine its GUI, and comply with updates to the IVOA Spectrum and SED Data Models.

Acknowledgments. Support for the development of Iris/SedImporter is provided by the Virtual Astronomical Observatory contract AST0834235. Support for Sherpa is provided by the National Aeronautics and Space Administration through the Chandra X-ray Center, which is operated by the Smithsonian Astrophysical Observatory for and on behalf of the National Aeronautics and Space Administration contract NAS8-03060. Support for Specview is provided by the Space Telescope Science Institute, operated by the Association of Universities for Research in Astronomy, Inc., under National Aeronautics and Space Administration contract NAS5-26555. This research has made use of the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

References

Hanisch, R., et al. 2012, in ADASS XXI, edited by P. Ballester, & D. Egret (San Francisco: ASP), vol. TBD of ASP Conf. Ser., TBD

⁸<http://pypi.python.org/pypi/sampy/>

⁹<http://software.astrogrid.org/doc/p/samp/1.3/>