

IRISpy: Expanding IRIS Data Analysis into Python and Upgrading the Paradigm for a New Generation

Daniel F. Ryan¹, Stuart Mumford², Ankit Baruah³, Steven D. Christe¹, Baptiste Pellorce⁴, Tiago Pereira⁴
¹NASA GSFC ²University of Sheffield ³Indian Institute of Technology Kharagpur ⁴University of Oslo



IRISpy:

- Inspect, manipulate and visualize IRIS data in the Python programming language;
- Free, open-source, community-developed;
- Facilitate cross-instrument collaborations with those using Python-based analysis tools, e.g. DKIST.
- Increase longevity of IRIS data analysis. Python is increasingly preferred by younger scientists.
- Help increase size and geographic diversity of IRIS's user base by supplying free tools in a free language.
- Gateway to scientific analysis tools not available in IDL, e.g. for machine learning (scikit-learn)
- Version control enables reversion to and citation of former versions of IRISpy, making science more transparent and reproducible.



To learn more, install and use go to <http://docs.sunpy.org/projects/irispy>
To see the code and contribute, go to <https://github.com/sunpy/irispy>

IRISpy provides:

- Data objects that link SJI or Spectrograph data with real world coordinate transformations, uncertainties, units, data mask, and metadata;
- Unified array-like and world coordinate-based slicing APIs that increase speed and accuracy of data analysis by:
 - simultaneously manipulate arrays, coordinate transformations, uncertainties, and data mask in a single operation;
 - in the case of spectrograph, can be indexed as a 4D (repeat number, raster position, slit position, wavelength) or 3D (time, slit position, wavelength) as the user wishes.
- Easy-to-use convenience methods for performing the transformations from array indices to real world coordinate and vice-versa;
- A unified visualization API that can produce static plots and animations of the data within minimal effort.
- Easy-to-use routines to convert units between DN, photons, and energies.



IRISpy: Expanding IRIS Data Analysis into Python and Upgrading the Data Analysis Paradigm for a New Generation

Daniel F. Ryan¹, Stuart Mumford², Ankit Baruah³, Steven D. Christe¹, Baptiste Pellorce⁴

¹*NASA Goddard Space Flight Center*

²*University of Sheffield*

³*Indian Institute of Technology, Kharagpur*

⁴*University of Oslo*

As IRIS becomes a mature mission, it continues to seek new ways to expand its user base and foster science collaborations with new instruments, thus ensuring it remains a valuable member of the solar satellite fleet. One such strategy is to develop IRIS data analysis tools in the Python programming language which is becoming increasingly prevalent in solar physics. Open-source packages such as SunPy have made the analysis of solar images and timeseries in Python far more common. A new generation of students is arriving in the field increasingly proficient in Python relative to IDL. And new ground-based facilities, like DKIST, increasingly prefer to implement their data analysis tools in Python. To help IRIS keep pace with this changing demand, a new open-source Python package, IRISpy, is currently being developed to read, manipulate, and visualise IRIS slit-jaw and spectrograph data. In this presentation, we outline the current capabilities and future direction of the IRISpy package as well as the benefits of developing and using Python-based IRIS analysis tools. These include, but are not limited to: increasing the longevity of IRIS data analysis by providing tools in a language increasingly preferred by a new generation of scientists; facilitating cross-instrument collaborations by reducing the need to switch languages; increasing the size and geographic diversity of IRIS's user base by providing free analysis tools in a free language; and access to a range of scientific data analysis tools not available in IDL, e.g. for machine learning (scikit-learn). In addition, the use of sophisticated version control and package distribution tools (git, github and anaconda) make it simple to cite and revert to an exact historical version of IRISpy and its dependencies. This makes it easier to ensure IRIS science results are transparent and reproducible. IRISpy is a community-driven effort and encourages contributions from anyone interested in IRIS science and in keeping IRIS a highly utilized member of the solar satellite fleet.