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Reproject: Projecting the universe anew

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[2] The Image reproject package is a tool that applies resampling methods to astronomical images. The package assumes that the world coordinate system (WCS) information contained in the given data is correct.

[3] I selected this package due to the interesting role that these tools play in processing data across different coordinate systems, such as comparing data between two different telescopes in different wavelengths in a pixel-by-pixel analysis.

[4] Reproject was created in 2015, before reproject was created there were other codes that were aimed at solving the same problem such as NASA/IPAC's Montage that was written in C, SWarp from Astromatic.net which is also written in C have tackled this problem of resampling images. The current version that was installed is v0.14.1.

[5] The reproject package is currently being maintained as of November 19, 2024. It is being maintained by one of authors, Thomas Robitailler and is also being primarily maintained by the python community. There are available instructions on how to contribute to reproject available in the source code: reproject/RELEASE_INSTRUCTIONS.md at main · astropy/reproject · GitHub

[6,7] The reproject package was relatively easy to install as long as you use a safe environment, unfortunately when installing it I ran into issues that did not let me run it in a custom environment and had to resort to using the original anaconda environment that was installed with the anaconda installer. A couple other packages had to be installed to be able to use reproject such as zarr, dask, and fsspec. There is an option to use the standard 'pip' installer in jupyter notebook to install the package.

```
!pip install reproject
```

[8] The source code is available to view on github under astropy as reproject: GitHub - astropy/reproject: Python-based Astronomical image reprojection - maintainer @astrofrog

[9] As of now no other packages have dependencies on the reproject package.

[10] Reproject is used via python script (or in our case jupyter notebook), in the provided example it is used to reproject an image:

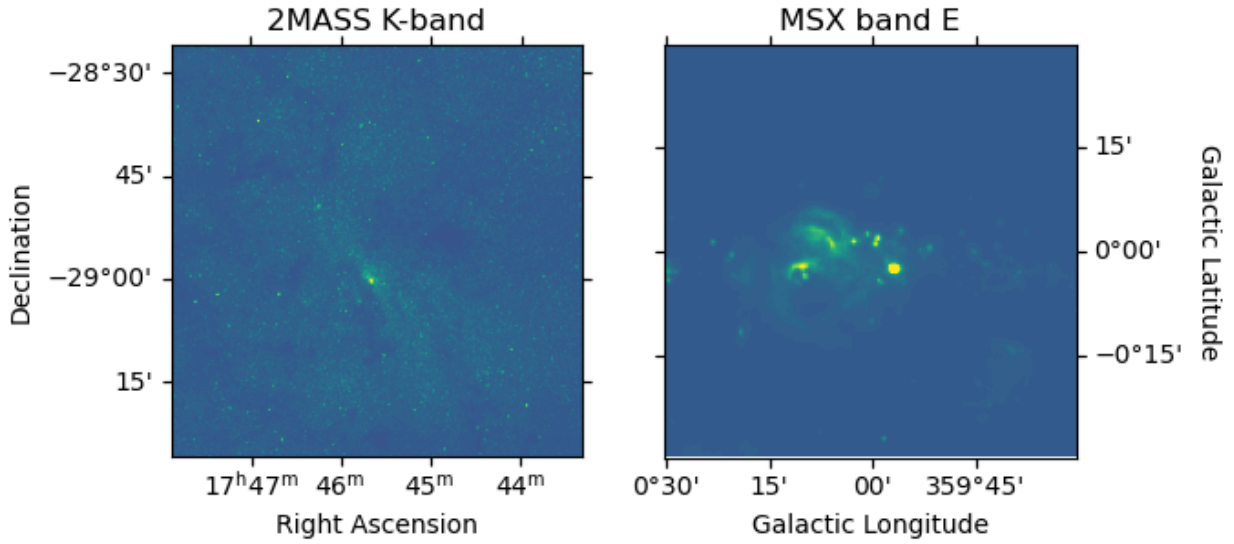
```
array, footprint = reproject_interp(hdu2, hdu1.header)
```

It can also be used through the command line.

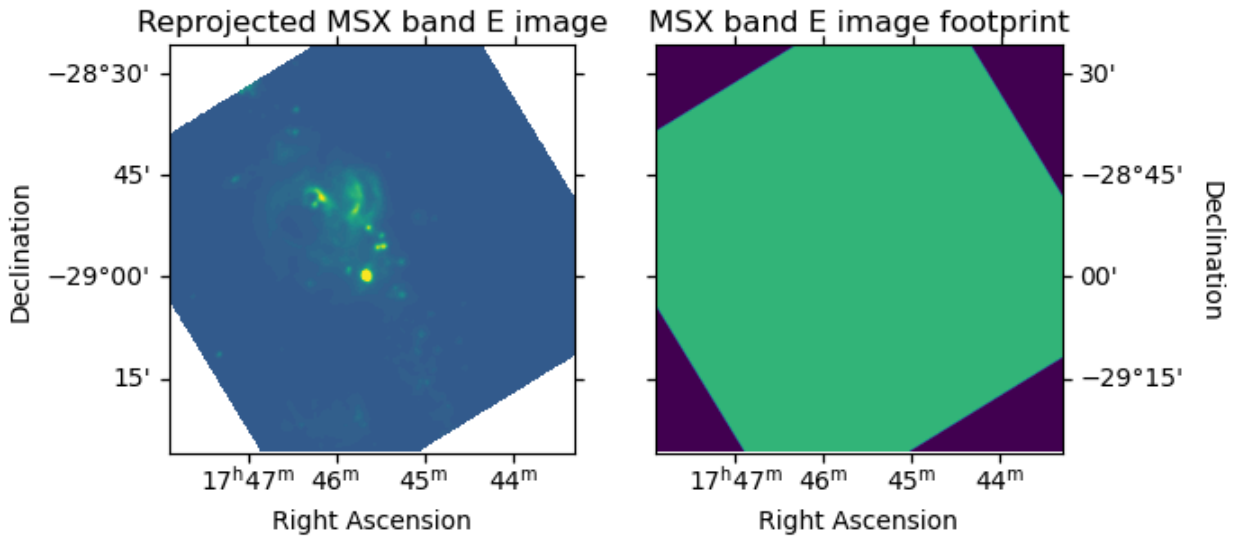
[11] The accompanying notebook shows how reproject has been used on an image.

[12] Reproject uses matplotlib to create figures.

[13] Here is a figure of a 2MASS K-band image and a MSX band E image of the Galactic center.



Next is how the image is reprojected onto another coordinate system.



[14] Reproject uses Python for its core library, but also uses Cython and C for more computationally intensive tasks.

[15] The input for reproject are images and n-dimensional data (spectral cubes, HEALPIX images) to graph and project images with WCS data.

[16] The outputs are arrays which are used to graph images using matplotlib.

[17,18] Reproject supports algorithms run through dask to make sure that the data being projected onto the figure is correct. Being able to visualize the image allows for any corrections that need to be made confidently, although there is no specific command to check the correctness of the projected image.

[19] Reproject depends on a number of python libraries such as Numpy, Astropy, Scipy, astropy-healpix, dask, zarr, fsspec, and has an optional dependency of shapely.

[20] Documentation for reproject can be found in an astropy subpage. Reproject has enough documentation to be able to complete simple reprojection and also has documentation on how its algorithms work depending on the data being reprojected, as well as how to compute optimal WCS. These can be found on their website as hyperlinks at Image reprojection (resampling) — reproject v0.14.1 in the "Documentation" section.

[21,22] References
Reproject Preferred Citation: astropy/reproject: v0.13.1
Reproject Source Code: GitHub - astropy/reproject
Astropy Subpage: Image reprojection (resampling) — reproject v0.14.1

[23] Using ADS there are 54 identified citations for reproject 2020 release: reproject: Python-based astronomical image reprojection - Astrophysics Data System although for its v0.13.1 release it only has 1 citation: reproject: Python-based astronomical image reprojection - Astrophysics Data System

[24] When using reproject I had to learn matplotlib commands to be able to plot necessary figures, commands such 'coords' and 'imshow'. Matplotlib's 'imshow' command allows for imported data to be shown as an image, such as the ones plotted above, 'coords' command to modify specific axis values based on given coordinates.

[25] Prior to this project I had no experience with the reproject package or the data necessary to use the package. I worked with fellow student Ryan Baig, all reported findings are my original work.