




pyradiosky: A Python package for Radio Sky Models

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Summary

Pyradiosky is a package to fully and generally describe models of compact, extended and diffuse radio sources with full polarization support. It is designed to support simulations and calibrations of radio interferometry data. It emphasizes the provenance and metadata required to understand the errors and covariances associated with sky models built from interferometric data.

Statement of need

The original motivation for the development of pyradiosky was to support high-precision simulation of interferometric data for 21 cm cosmology, but the package was deliberately developed to support a broad range of radio astronomy applications. Sky models are key to the future of 21 cm analyses because high-precision foreground subtraction has the potential to dramatically increase the sensitivity of 21 cm instruments. High-quality sky models are also extremely important for calibration of all radio astronomy data.

Pyradiosky supports reading in catalogs in the widely used VOTable format as well as an HDF5 based format we developed. It also supports some formats used by 21 cm cosmology codes and is easily extensible to other formats. It provides an object interface and useful methods for downselecting and combining multiple catalogs, coordinate transformations (with polarization support) and calculating fluxes at specific frequencies. Pyradiosky uses [astropy](#) ([Astropy Collaboration et al., 2013, 2018, 2022](#)) for most coordinate transforms and for VOTable support, it also interfaces with the [lunarsky](#) ([A. Lanman, 2020](#)) package to support moon-based coordinate systems. Pyradiosky uses [astropy-healpix](#) ([Astropy Developers, 2016](#)) for interfacing with [HEALPix](#) ([Górski et al., 2005](#)) maps.

Pyradiosky is different than other commonly used code to handle catalogs, like TOPCAT ([Taylor, 2005](#)) and [astropy's VOTable sub-package](#), which are primarily table interfaces that support table operations but not the more complicated astronomy-aware operations (e.g. polarization coordinate transformations) supported by pyradiosky. Pyradiosky also provides a unified interface for catalogs and [HEALPix](#) sky maps.

As part of the Radio Astronomy Software Group suite (along with [pyuvdata](#) ([Hazelton et al., 2017](#)) and [pyuvsim](#) ([A. E. Lanman et al., 2019](#))), pyradiosky provides software infrastructure for a broad range of radio astronomy applications including enabling rigorous, seamless testing of 21 cm cosmology analysis developments.

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