

The Calibration Catalog

Ruby Byrne

March 2021

This memo discusses a compact source catalog that has been widely used for sky-based calibration of the Murchison Widefield Array (MWA) using the FHD software package, including in analysis of the Byrne et al. (in prep.) polarized diffuse map. Recently, the catalog has gained usage beyond FHD, motivating the creation of this memo to clarify the catalog contents.

The catalog is available in the FHD GitHub repository: https://github.com/EoRImaging/FHD/blob/master/catalog_data/GLEAM_v2_plus_rlb2019.sav. It is based on the GLEAM point source catalog (Hurley-Walker et al. 2017). GLEAM is plotted as a scatter plot in Figure 1. Notice that the catalog is missing fields near bright sources, doesn't include the galactic plane, and has a missing field from a corrupted night of data at the Northern edge of the catalog.

In addition to the obvious missing fields in the GLEAM catalog that we see in Figure 1, the catalog is missing some of the brightest sources (including most of the so-called “A-Team” sources). In order to make this a workable catalog for calibration, we've supplemented it with models for those sources. The “GLEAM_v2_plus_rlb2019.sav” catalog contains 9 additional sources not included in the GLEAM data release: 3C161, 3C409, Cassiopeia A, Centaurus A, Hera A, Hydra A, Pictor A, Virgo A, and Fornax A. These are listed in Table 1. 6 of these 9 sources are modeled as “extended sources,” meaning we do not approximate them as point sources but rather model some of their structure. In this catalog, that structure is modeled with pointlike components: an extended source is represented as a cluster of point sources.¹ All of the 9 supplemented

¹There has been significant work in the field developing Gaussian or Shapelet source models, but FHD does not fully support those models yet. For that reason, we include pointlike source models only in this catalog. Nichole Barry and I have begun the process of getting FHD to read Gaussian source models

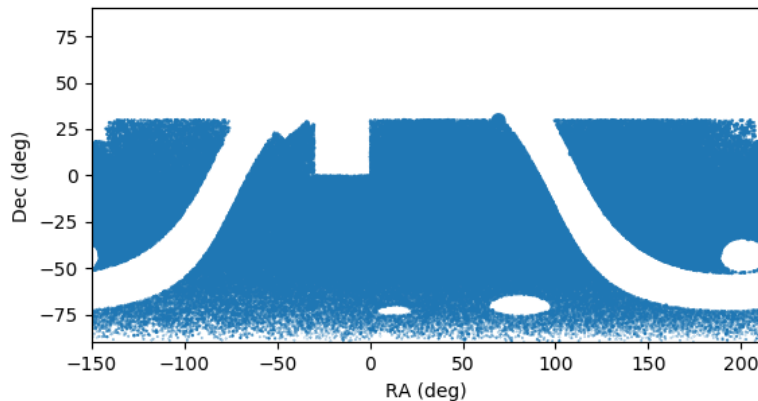


Figure 1

Name	Intensity	Comps.	Center RA	Center Dec.
3C161	99.73 Jy	1	96.8°	−5.9°
3C409	153.68 Jy	1	303.6°	23.6°
Cas. A	17,693.90 Jy	1	350.9°	58.8°
Cen. A	1,154.19 Jy	5,874	201.6°	−43.5°
Hera A	279.36 Jy	27	252.7°	5.0°
Hyd. A	226.32 Jy	58	139.5°	−12.1°
Pic. A	271.16 Jy	88	80.0°	−45.8°
Vir. A	372.73 Jy	171	187.7°	12.4°
For. A	541.77 Jy	1,924	50.6°	−37.2°

Table 1

source models except for Fornax A were developed by Sarah White of the GLEAM collaboration. Fornax A was developed by Patricia Carroll.

This catalog contains 307,464 sources. It is designed to work in the MWA’s EoR “high band,” centered at 182 MHz, and does not include any spectral index information.

The catalog is stored as an FHD-readable IDL save file. It can be easily read with the PYRADIOISKY Python package,² which offers a well-documented Python interface for astrophysical source catalogs. To read this catalog with PYRADIOISKY, use the `read_fhd_catalog` function.

correctly. For more information see this issue: <https://github.com/EoRImaging/FHD/issues/211>.

²<https://github.com/RadioAstronomySoftwareGroup/pyradiosky>