# Revisiting JVLA's 3C147 High Dynamic-range Data Reduction

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Self-calibration, i.e., deriving antenna gains from the target field using a sky model inferred from corrupted target field visibilities, is crucial for making high dynamic range images. Self-calibration is usually performed iteratively, with both antenna gains and sky models improved at every stage. However, self-calibration routines are still ad hoc and specific to each data set, hence challenging to automate. The data rates from the current generation of radio telescopes such as MeerKAT, JVLA, and Lofar require automatic data reduction pipelines with scalable calibration and imaging algorithms. Additionally, we have witnessed the emergence of a few scalable and flexible calibration and imaging tools over recent years. In this work, we revisit the data reduction of the Jansky Very Large Array (JVLA) observation of the field around the source 3C147. We use the recently developed pipeline framework, Stimela [1], for this purpose. We build a simple and reproducible self-calibration pipeline to achieve an 8 million to 1 dynamic range of the 3C147 field. Furthermore, we discussed several factors that make developing fully automated self-calibration pipelines particularly challenging. One such challenge we focus on is choosing optimal solution intervals for calibration. The choice of solution intervals inextricably is linked to the intrinsic variability of the gains, the signal to noise ratio, the level of radio frequency interference (RFI) in the data, and the amount of data flagged in the various data chunks. We incorporate a native dask implementation of a solution intervals search algorithm [2] in our data reduction pipeline to select adequate solution intervals during calibration automatically.

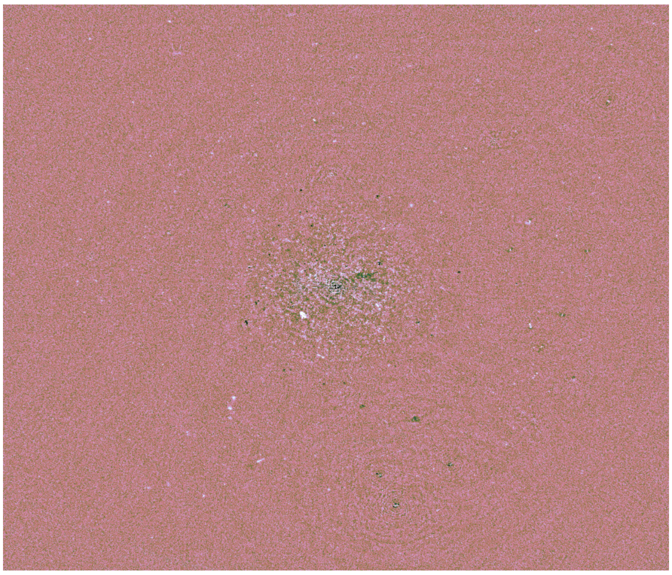

**Figure 1.** Multi-frequency average image of the residual visibilities after the final calibration step. This image shows that we have a done a good job at subtracting all bright emissions and correcting for direction dependent effects. The rms in the image is $\approx 2.8\ \mu$Jy, thus providing a Dynamic range of $\approx$ 8M:1.

## References

[1] S. Makhathini, "Advanced radio interferometric simulation and data reduction techniques," *Rhodes University*, **PhD thesis**, April 2018, doi:http://hdl.handle.net/10962/57348

[2] U. M. Sob and H. L. Bester, O. M. Smirnov, J. S. Kenyon and C. Russeeawon, "Solution intervals considered harmful: on the optimality of radio interferometric gain solutions," *MNRAS*, **504**, April 2021, pp. 1714–1732, doi:10.1093/mnras/stab928.