Subject: Calibration and Imaging Steps
Memo: 26, Revision 2
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Summary: The steps to calibrate Milky Way Galaxy Observations and Map the Galaxy are presented. The Milky Way was mapped using four horns independently but simultaneously. We describe observations made from December 22 2020 to January 12 2021.

By constructing and observing with multiple radio telescope horns mapping of the Milky Way galaxy is made easier and quicker. The guides for constructing and operating student/home radio telescopes are available on Github.

Background

The horn radio telescopes can be used to understand many aspects of the Milky Way galaxy in a few days observations. Here we describe a more advanced project, producing a map of the structure of the Milky Way from a sequence of observations over a period of two to three weeks. We suggest placing the telescopes outside, with electronics in a weather proof container and allowing the sky to drift overhead, while recording spectra of the radio sky. The dominant feature you can easily see is the structure of the Milky Way, which is a gigantic loop in the sky, surrounding the Sun, Earth and Solar System.

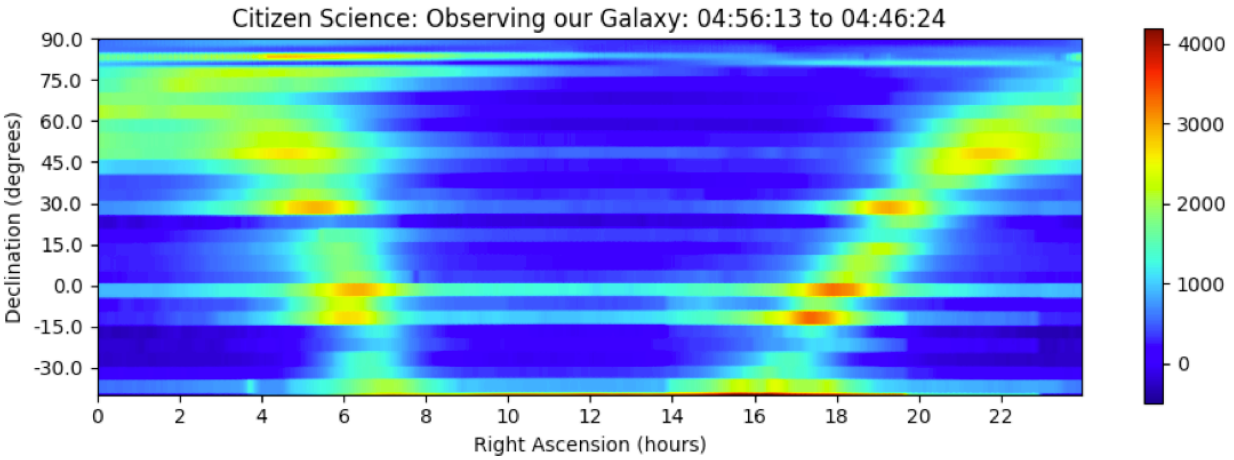
Calibration

Our horns do not include a direct calibration system and we must periodically make astronomical observations to estimate the horn gain and system temperature. Calibration is critical for making a useful map of the Milky Way. Fortunately the calibration steps are simple. First point the telescope straight up (Elevation = 90d) and observe for 10 minutes. Next take the telescope off of the base and point the telescope straight down. Observe for another 10 minutes.

After calibration resume observations and copy the calibration data to a thumb drive for processing on a separate computer.

Observations: 2020

The telescopes observe the sky as it transits the observatory location. The different parts of the Milky Way are observed by selecting different elevations for the horns. The horn radio telescope beam sizes are roughly 15 degrees. Optimum mapping requires sampling the sky every half beam width, 7.5 degrees. To assure complete coverage, we've sampled the sky every 5 degrees of elevation. The telescopes are believed to be pointed correctly to within 3



degrees, based on examination of the horns and measurements of the position of the telescope bases.

The observing observations summaries are included in Appendix A.

slowing down radio waves as they pass from distant objects to our telescopes. The delay in the signal is not constant, but instead depends on the frequency of observations.

Conclusion

Thanks to my family and friends for their support for this work.