[310.02] A 6 GHZ CONTINUUM MAP OF THE INNER GALACTIC PLANE WITH THE GREEN BANK TELESCOPE

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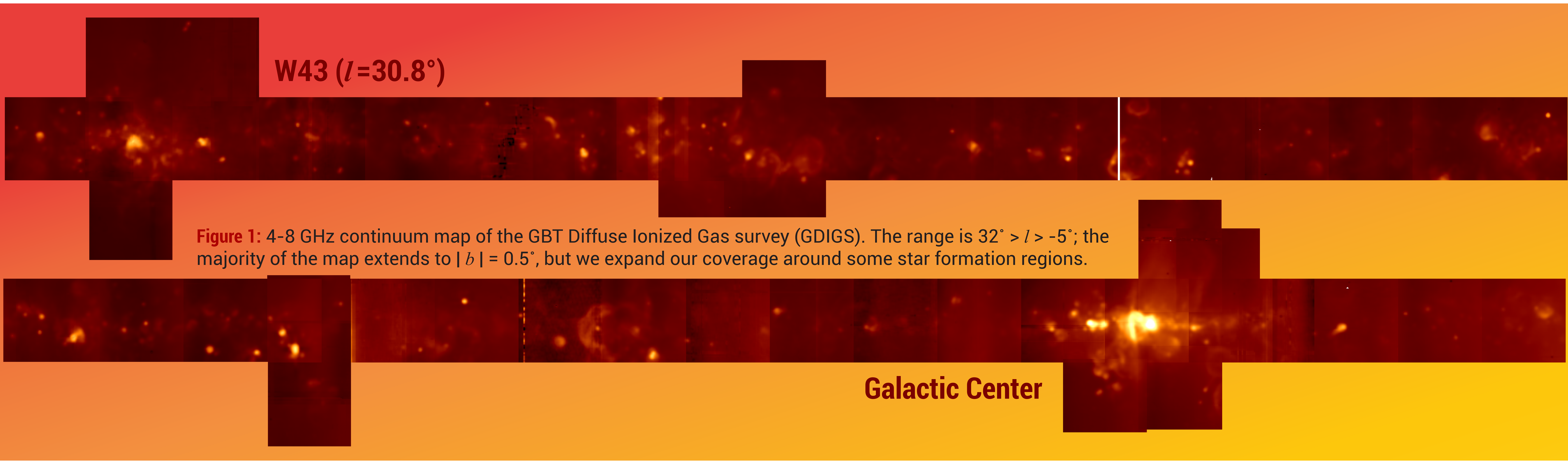

Figure 1: 4-8 GHz continuum map of the GBT Diffuse Ionized Gas survey (GDIGS). The range is 32° > l > -5°; the majority of the map extends to | b | = 0.5°, but we expand our coverage around some star formation regions.

Abstract

Despite the fact that Diffuse Ionized Gas (DIG) is a major component of the Interstellar Medium our knowledge about it and its relationship with HII regions is very limited. The DIG can tell us about the formation of galaxies and evolution of high-mass star formation regions. Previous surveys of the DIG and HII regions had low spectral and spatial resolutions or looked at Hα which suffers from extinction. Here we attempt to get additional value from the Green Bank Telescope Diffuse Ionized Gas Survey (GDIGS), by making continuum maps using the existing data. The goal is to assess whether the GDIGS data can be used to measure the radio recombination line (RRL) to continuum emission ratio for the diffuse ionized gas.

Motivation

HII regions are the main tracers of high-mass star formation in the Milky Way, and they leak ionizing photons (λ < 91.2 nm) into the ambient interstellar medium. These leaking photons create and maintain the Diffuse Ionized Gas (DIG). The DIG can be used to study the effects of high-mass star formation throughout the Milky Way and other galaxies. Understanding the distribution, state, and relationship of HII regions and the DIG tells us about the evolution of gas in the Interstellar Medium.

We have conducted a major DIG survey (GDIGS; Anderson et al., in prep.) The main focus of the survey was to detect RRLs across the inner Galactic plane, but we are attempting to extract additional information from the survey. We produce a 6 GHz continuum map from the GDIGS survey. Continuum maps add to our understanding of the extent of ionized gas far from sites of high-mass star formation regions. The RRL to continuum emission ratio can be used to derive the electron temperature of HII regions, which tells about the metallicity of the region.

Survey parameters

Frequency Range	4-8 GHz
Range	32° > l > -5°, | b | ≤ 0.5°
FWHM Beam Size	~2.3 arcmin @ 6 GHz
Simultaneous Spectrometer Tunings	22 Hnα, 26 Hnβ, 8 Hnγ, H_2CO, CH_3OH, HCN and 5 more molecules

Quality

This is a work in progress, and there are clearly artifacts remaining in the map above. There are things that we can do to improve the quality of the map, such as apply more robust RFI excision techniques and account for elevation of the scanning region during data acquisition. We can also try various techniques to improve intensity matching between neighboring scans.

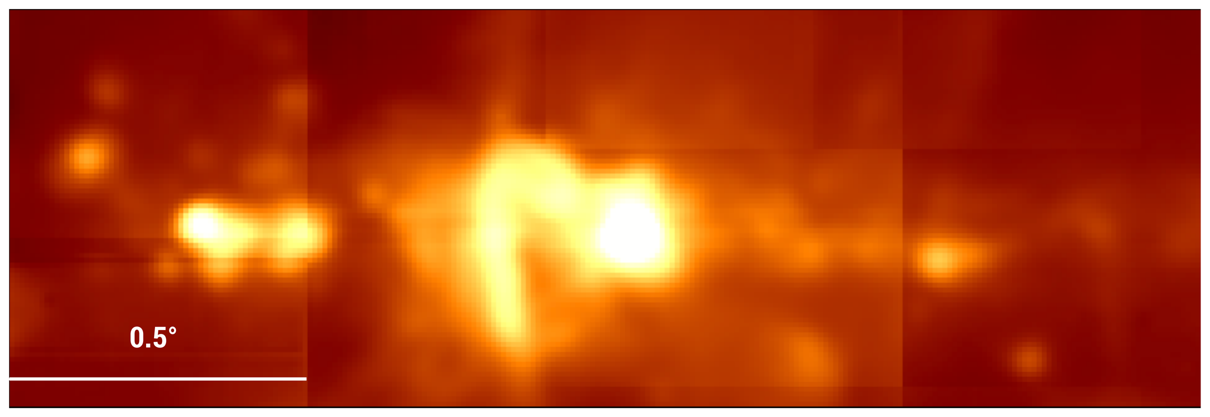

Figure 2: The Galactic Center. $T_{C,max}$ = 90K. | l | < 1°, | b | < 0.5° cutout from Figure 1.

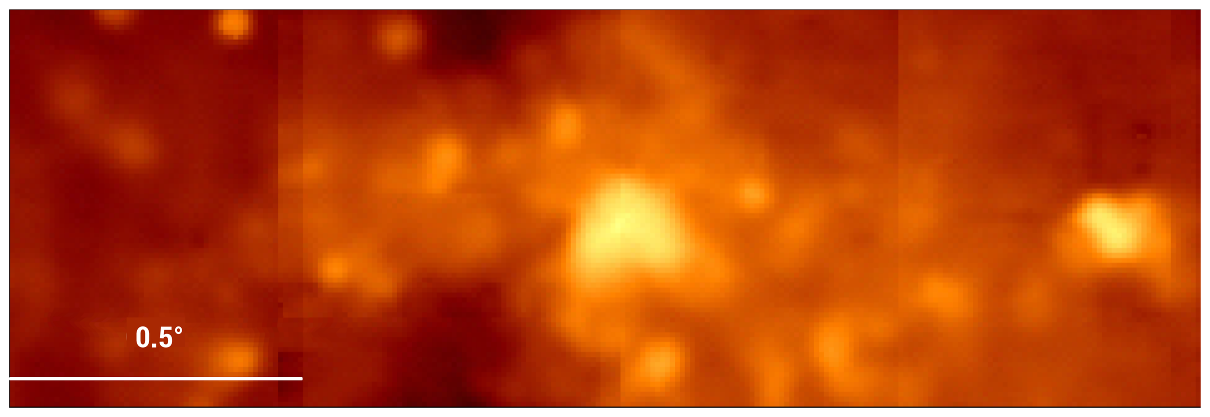

Figure 3: W43, star formation region. $T_{C,max}$ = 13K. 29.8° < l < 31.8°, | b | < 0.5° cutout from Figure 1. Luisi et al. (2019) published the first GDIGS results of the W43 complex.

Data Acquisition & Processing

GDIGS is comprised of a set of 1°× 1° scans that were acquired on-the fly (OTF) using the Green Bank Telescope and VEGAS spectrometer between July 2016 and December 2019. Two maps scanning along Galactic longitude and two maps scanning along Galactic latitude were produced. Continuum intensities are derived from the system temperatures measured using noise diodes during GDIGS data acquisition. The data were run through a calibration pipeline, and radio frequency interference (RFI) was removed using a median filter. The *NOD3* basket weaving algorithm was used to remove scanning artifacts. These calibrated maps were then averaged over all central frequencies and polarizations and mosaicked together using *Montage*.

Future Work

- Compare GDIGS with other radio continuum surveys of the Galactic plane.
  - The complementary Law (2009) map made with the Green Bank Telescope and same C-band receiver.
  - The GLOSTAR survey made using Very Large Array in B- and D- configuration combined with Effelsberg 100m telescope. Medina et al. (2019).
- Create a tool to produce maps of GDIGS RRL to continuum intensity ratio in order to access their quality. The tool will do aperture photometry of the RRL data and continuum data and then produce maps of the RRL to continuum intensity ratio. The tool will be able to use arbitrary aperture sizes to deal with signal-to-noise ratio issues for the RRL emission. The larger the aperture is, the more integration time goes into T_L value. Thus, the goal is to balance T_L /T_C accuracy with resolution. We will also try different methods to calibrate the maps.

References & Acknowledgments

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