The GBT Diffuse Ionized Gas Survey (GDIGS)

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GBT Surveys Workshop
GDIGS is a survey to map the diffuse ionized gas in the Galactic Plane!
Motivation

• Diffuse ionized gas (DIG), also known as Warm Ionized Medium (WIM) is major component of the interstellar medium

• It is believed that the DIG maintains its ionization due to leaking radiation from HII regions

• However, distribution & kinematics of the DIG in our Galaxy is still not fully understood

• DIG has never been studied at high spatial and spectral resolution

• Thus, the connection between DIG and high-mass star formation is still unclear
GDIGS

• VEGAS: can simultaneously observe 64 spectral windows at C-band
  • 22 Hnα recombination lines
  • 25 Hnβ recombination lines
  • 8 Hnγ recombination lines
  • 9 molecular lines

• Can average together all Hnα lines to increase sensitivity!
  • rms sensitivity ~3 mJy/beam at velocity resolution of 0.5 km/s
  • Nyquist sampled on 1 arcmin spatial grid

• Measure continuum temperature at ~60 frequencies
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• Measure continuum temperature at $\sim$60 frequencies
- Mapping the range $32^\circ > l > -5^\circ$, $|b| < 0.5^\circ$
- Filler time; mapping observations are operator-run
- Supplement data with deep pointed GBT observations of discrete HII regions
- $\sim 70\%$ completed, expect to finish survey mid 2019
Observing

Using C-band receiver (4-8 GHz) with VEGAS:

- Observing in total-power mode
- 8 bandpasses × 8 banks = 64 spectral windows
- Bandpass width 23.44 MHz, 8192 channels
  → Velocity resolution of 0.1 to 0.2 km/s

We observe 1° x 1° OTF maps with reference position 3° off the plane

- Observe each area 4 times to minimize streaking
- Nyquist-sampled for highest frequency between rows → 89 rows
- Double-Nyquist sampled along rows (t_{int} = 0.4 s)
- Each map takes 2.5 h
Data Processing

All data processing done on Lustre filesystem using public server machines (Newton, Planck, Fourier)

Data reduction steps:

1) Filling data with sdfits

2) Generating keep files

3) Gridding all spectral windows separately using gbtgriddler
   - Rebinning to common velocity resolution (0.5 km/s)

4) Averaging all Hnα, Hnβ, and Hnγ spectral windows, respectively
   - Calibration, RFI removal, and baseline fitting during this stage
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• Connection between DIG and HII regions
  • Constrain fraction of leaking photons from individual HII regions and estimate global leaking fraction
• Dynamics of the Milky Way bar
• Impact leaking radiation has on dust emission
Conclusions

• GDIGS will provide first detailed look at inner-Galaxy DIG

• Observations ~70% complete and data reduction pipeline fully functional

• Data will allow us to disentangle HII region emission from DIG emission

• Expect first GDIGS publication early/mid 2019