The Galactic All-Sky Survey

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Introduction

Galactic atomic hydrogen (HI) emission is observed in all directions of the sky. While high resolution HI surveys like the Canadian and Southern Galactic Plane Surveys (Taylor et al. 2003, McClure-Griffiths et al. 2005) have allowed us to carefully explore the bulk of the Galactic HI emission in the disk, these surveys are restricted to a few degrees around the Galactic Plane. Meanwhile, our knowledge of the structure of Galactic HI away from the plane is limited to ~1 deg angular scales provided by Leiden-Argentine-Bonn Survey (Kalberla et al 2005).

The Galactic All Sky Survey (GASS) is a large-scale project underway to study with 15' angular resolution the atomic hydrogen (HI) distribution in the Milky Way. The first stage of this project has mapped the entire sky south of declination zero degrees using the thirteen beam 20 cm multibeam on the Parkes Radio Telescope.

Survey Goals

The primary scientific goals of GASS are the exploration of the disk-halo interaction and the study of the nature and evolution of high and intermediate velocity clouds.

Disk-Halo Interaction: The evolution of the Milky Way is significantly impacted by the two-way flow of gas and energy between the disk and halo. It is often suggested that large-sale chimneys may play a role in this constant matter exchange, but observational proof is hindered by the low resolution of current surveys. GASS provides a complete, high resolution dataset for the study of the disk-halo interaction. We hope that GASS will help us answer questions like:

- How is structure formed in the lower halo?
- What are the kinematics of lower halo gas?
- What is the fate of gas expelled to the halo?
- And how long does it take hot expelled gas to cool?

Origin and Nature of High Velocity Clouds: It is known that High Velocity Clouds (HVCs) represent a variety of phenomena. Although a great deal is known about the classification of HVCs, their nature and origin is unclear. Three key topics related to HVCs that will be addressed by GASS are:

- Thermal state of high velocity clouds
- Interaction HI clouds and ambient halo gas
- Physical state of the halo as probed by HVCs

Conclusions

The Galactic All Sky Survey (GASS) is a project to produce a full atlas of all atomic hydrogen (HI) emission associated with the Milky Way. Thefirst initial stage of this project has mapped the entire sky south of declination zero degrees using the thirteen beam 20 cm multibeam on the Parkes Radio Telescope. An initial data release, not corrected for stray radiation, is planned for late in 2007 with a full corrected data release planned for 2008.

Results

Though observations were only completed in November 2006, GASS is already producing exciting results on the disk-halo interaction.

Chimney Breakout of the Supershell GSH 242-03+42: Through the sensitivity of GASS we identified chimney breakout of the enormous Galactic supershell, GSH 242-03+42. GSH 242-03+42 was initially discovered by Heiles (1984), who noted that it is one of the largest and most energetic supershells in the Milky Way with a radius of 565 pc. Figure 1 shows a GASS image at v=42 km/s of the supershell. This image has revealed a complicated shell structure with multiple chimneys on both sides of the Galactic plane. These chimneys appear capped by narrow filaments 1.5 kpc above and below the midplane. These filaments appear to be fragmenting into clumps with sizes of a few tens of parsecs and velocity widths of ~10 km/s. We noted the similarity between these clumps and the halo cloudlets discovered by Lockman (2002) and suggested that the later may be formed from fragmentation of large supershell caps.

Galactic Halo Cloudlets: Lockman (2002) revealed a class of compact HI clouds in the lower halo near a Galactic longtiude of l=29°. In that work Lockman posited that a significant fraction, maybe as much as 50%, of the mass of the halo may exist in these clouds. This work immediately raised questions about the distribution of these clouds and their origin. A study of GASS data by Ford et al (2007, in prep) has shown that compact halo clouds are prevalent over at least twenty degrees of longitude in the fourth Galactic quadrant. The GASS clouds show very similar properties to the Lockman (2002) clouds with a median diameter of 28 pc and a median z-height of 850 pc. Although many of these clouds are completely isolated, many are also associated with faint, extended filaments. Ford et al have conducted hydrodynamic simulations that show that these neutral clouds could form through fragmentation of supershell caps.

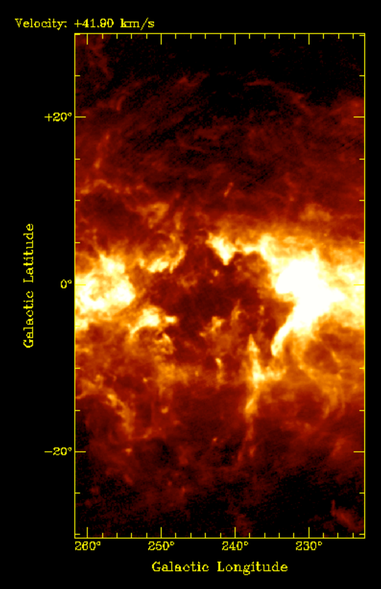

Fig 1: HI image of GSH 242-03 +42 showing the chimney breakout and high latitude caps.

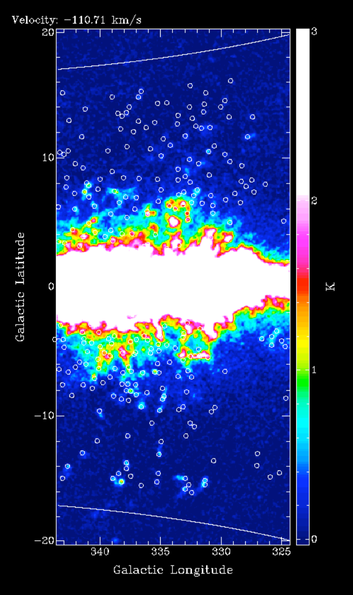

Fig 2: GASS HI image showing catalogued HI halo cloudlets in the region 325° ≤ *l* ≤ 345°

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