

Investigating the Diffuse Ionized Gas throughout the Magellanic Cloud System with WHAM

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Abstract

We present early stages of an H α survey of the Magellanic System using the Wisconsin H α Mapper (WHAM). Our maps of the Small Magellanic Cloud, Large Magellanic Cloud, Magellanic Bridge, and Magellanic Stream are the most sensitive kinematic maps of ionized gas throughout the System. With a velocity resolution of 12 km/s, WHAM observations can cleanly separate diffuse emission at Magellanic velocities from that of the Milky Way and terrestrial sources. These new maps of the MS and SMC compliment observations of the Magellanic Bridge by Barger et al. (2013), who found H α emission extending throughout and beyond the observed H I emission. Using WHAM's unprecedented sensitivity to the limit of atmospheric line confusion (~ 10 s of mR), we find H α emission where H I is traced in recent all-sky surveys (e.g., LAB; Kalberla et al. 2005) throughout our currently observed portion of the MS. The diffuse ionized emission extent is similar to the neutral gas extent as traced by 21 cm. We present spectra comparing H I and H α kinematic signatures throughout the emission region.

Introduction

WHAM is in the process of delivering the first comprehensive surveys of the ionized component in and around the complex, extended gaseous structures related to the Magellanic Clouds and their interaction with each other and the Milky Way. As with studies of the WIM in other galaxies, the Magellanic System presents a much different environment, metallicity, and star formation than the Milky Way. Using the same instrument and the same techniques developed for the Galaxy, we can now compare the emission spectrum from these vastly different environments for the first time and begin to disentangle the processes responsible for establishing the ionization state and temperature within diffuse ionized gas.

The Magellanic Stream

The Magellanic Stream is a difficult complex to observe, with gas at kinematic velocities extending from +400 km/s to -600 km/s. To observe the full extent of the stream we adjust WHAM's velocity window to attempt H α observations that are kinematically similar to the observed H I emission. The blocks in figure 2 show the location of observed portions of the stream. Already several sight lines have shown H I regions with ionized components that match kinematically. Additionally, H α emission has been detected with offset velocities compared to H I observed along the same sight lines. In several sightlines increased emission was observed towards the edge of the velocity windows, far offset from the H I emission. These directions will be re-observed to detect if any H α exists at drastically different velocities than anticipated.

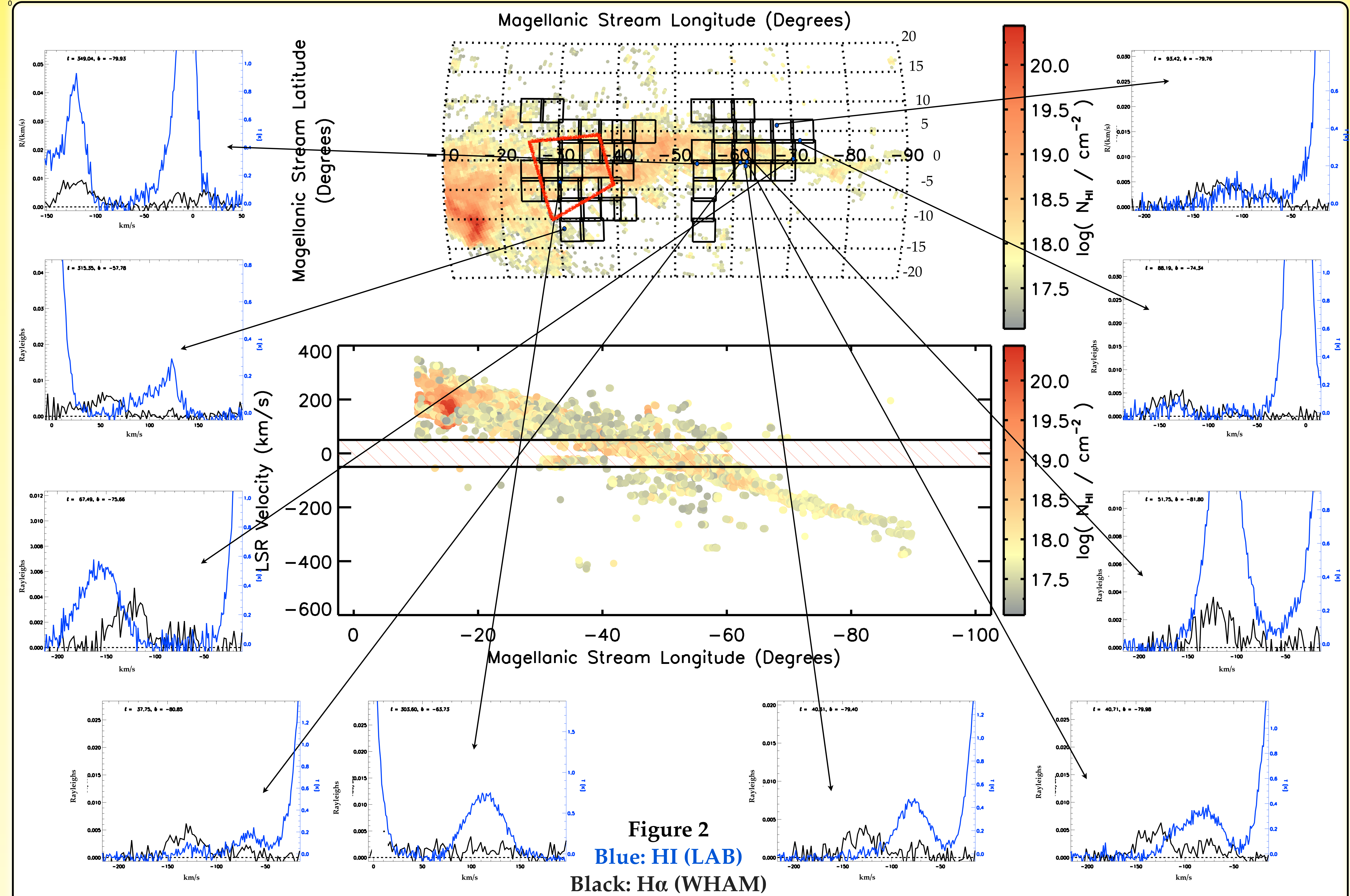


Figure 2
Blue: H I (LAB)
Black: H α (WHAM)

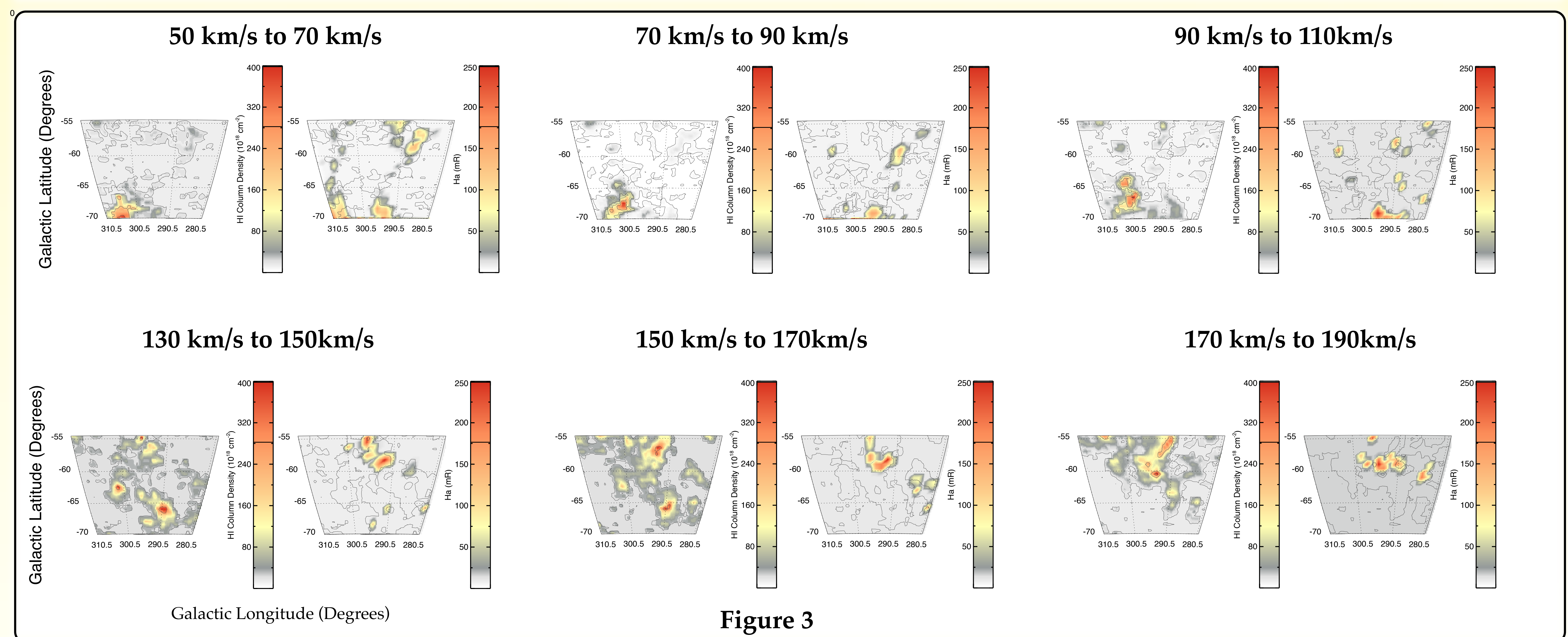


Figure 3

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Figure 2 Magellanic Stream Survey: Figure 2 marks the regions observed by the Magellanic Stream Survey in black. The blue and black snapshots show regions where H α and H I are observed, often with a velocity offset of ~ 50 -100 km/s in kinematic space.

Figure 3: Magellanic Stream Pilot Study. The region of the pilot study by Kat Barger and Mike Hernandez is marked in red above in Figure 2. Figure 3 shows the pilot study region in windows of 20 km/s. While there are regions where the H α traces the H I, there are also isolated regions of H α that are

Figure 1: The Extended Magellanic System. Neutral hydrogen column density as traced by the 21 cm LAB survey (Kalberla et al. 2005) throughout the Magellanic System (figure adapted from Nidever et al. 2008). This representation uses Nidever's "Magellanic System" frame where the LMC is located at $(L_{MS}, B_{MS}) = (0, 0)$. The red boxes mark the planned region of the MS survey.