The Distribution of Gas Densities in the Milky Way

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Abstract

We use observations of molecular and atomic Hydrogen from several surveys that coincide with the 20° by 6° CHaMP region to derive mass estimates and a mass probability density function. The Southern Galactic Plane Survey (McClure-Griffiths et al. 2005) & the Galactic All Sky Survey (McClure-Griffiths et al. 2009) are used for the HI, while the Nanten survey (Yonekura et al. 2005) is used for the H₂ tracers of ¹²CO, ¹³CO, C¹⁸O and HCO⁺.

Methods

We use a standard column density calculation to derive the masses, with values of N_{H₂} = 1x10⁴ N_{¹²CO}, N_{¹³CO} = 70 N_{¹²CO}, and N_{C¹⁸O} = 560 N_{¹²CO}. Our mass estimates try to account for the distance ambiguity that arises within the solar radius by setting all ambiguous points at the far point and then at the near point, for a maximum and minimum mass range. We assume a flat rotation curve model using values r=8.4 kpc and v=254 km s⁻¹ as suggested by Reid (2009). From our mass results we were able to generate maps of the distribution of HI and H₂ covering galactic longitudes 280° to 300° as viewed from above. The maps display the amount of mass summed up into .5 by .5 kpc boxes.

With total mass calculated for HI and H₂, mass fractions have been derived for the region. We assigned density ranges for each of the tracers, HI: 1-100 cm⁻³, ¹²CO: 60-600 cm⁻³, ¹³CO: 300-3000 cm⁻³, C¹⁸O: 600-6000 cm⁻³, HCO⁺: 3000-30000 cm⁻³. Our mass probability density function displays the variance of the mass with the range of densities covered by each tracer and can be compared to the simulations run by Tasker & Tan (2009).

Results

In our maps the Carina Arm can be distinctly seen within each plot and it contains most of the massive clumps seen in each tracer. Clumps within 5 kpc may be shifted due to any distance ambiguity.

The mass pdf generally agrees with the model. The ¹³CO is a lower limit since it is based on the assumption of being optically thin. We are working on a way to include the effects of optical depth.

References