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THE INNER GALACTIC STRUCTURE TRACED BY MOLECULAR CLOUDS ASSOCIATED WITH ULTRA-COMPACT HII REGIONS

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RESUMEN

Estamos sometiendo a pruebas un método para determinar las distancias para una muestra de regiones HII ultracompactas con colores en IRAS y con detección de CS(J=2-1). La ambigüedad de las distancias cinemáticas se resuelve mediante simulaciones Monte Carlo. Utilizando nubes moleculares sintéticas simulamos las distribuciones longitud heliocéntrica-radio (l-R) sobre el plano galáctico, y las proyecciones asociadas longitud-velocidad$_{LSR}$ (l-V$_{LSR}$). Se escoge la mejor distribución galáctica por comparación con los mapas observados de CO. Se presentan resultados preliminares para el IV cuadrante galáctico.

ABSTRACT

We are testing a method to solve for the distances of a sample of ultra-compact (UC) HII regions with IRAS colors and CS(J=2-1) detection. The ambiguity in their kinematical distances is solved using Monte-Carlo simulations. We simulated heliocentric longitude-Radius (l-R) on Galactic plane distributions, and their respective longitude-Velocity$_{LSR}$ (l-V$_{LSR}$) projections using synthetic associated molecular clouds. The best Galactic distribution is selected by comparison with observed CO maps. Preliminary results for the Galactic quadrant IV are presented.

Key Words: Galaxy: disk — H II regions

1. METHODOLOGY

A testing to solve the distance ambiguity in the inner galactic disk region using the sample of UC HII regions with IRAS colors and CS(J=2-1) detection (Bronfman, Nyman, & May 1996) is presented. Our basic assumption is that every UC HII region must be associated with a molecular cloud, and in such case, the counterpart could be observed in CO maps. Synthetic l-V$_{LSR}$ diagrams are generated from l-R distributions of UC HII regions (Figure 1) where the ambiguity in distance is solved selecting randomly between near and far cases. The respective l-V$_{LSR}$ distributions (Figure 2) were obtained considering: (1) that the molecular interstellar medium at large scales ($\sim$ kpc) is optically thin, (2) a galactic rotation curve from Luna et al. (2006, overploted in Figure 1a), (3) the background spiral model of the spiral pattern structure from Luna (2003, Figures 1a and 2b), (4) values for $R_{\odot}$=8.5 kpc and $V_{\odot}$=220 km s^{-1} according to the IAU recommendation. Furthermore, the model is based on simple circular orbits, differential rotation, and an inner radial velocity field decreasing exponentially is added. Synthetic giant molecular clouds (GMCs) are spherical with Gaussian intensity profiles and all the GMCs have the same radial dimension, 250 pc. We propose to compare synthetic l-V$_{LSR}$ diagrams against observed CO survey (Figure 2a, Dame, Hartmman, & Thadeuss 2001). The central 10 degrees that correspond to the galactic center are excluded in the present analysis. The outer Carina arm is used as a control reference, locus at: l-V$_{LSR}$ diagrams $-80 < l < -40$ and $0 <$ v < 50.

2. PRELIMINARY GENERAL RESULTS

The synthetic l-V$_{LSR}$ projection with good cross correlation index (0.83, Figure 1c and 2c) was selected from a run of 1000 models where the distance was randomly selected between the near and far possibilities with a normal distribution. The lowest correlation index (0.75) was obtained forcing the near distance for the entire set of UC HII regions. The best cross correlation between the numerical l-V$_{LSR}$ projections and the observed map corresponds to the far distance selection. This result shows that long structures like spiral arms are predominant. The Carina arm used as reference in all the models is well reproduced in the l-V$_{LSR}$ diagrams. Random

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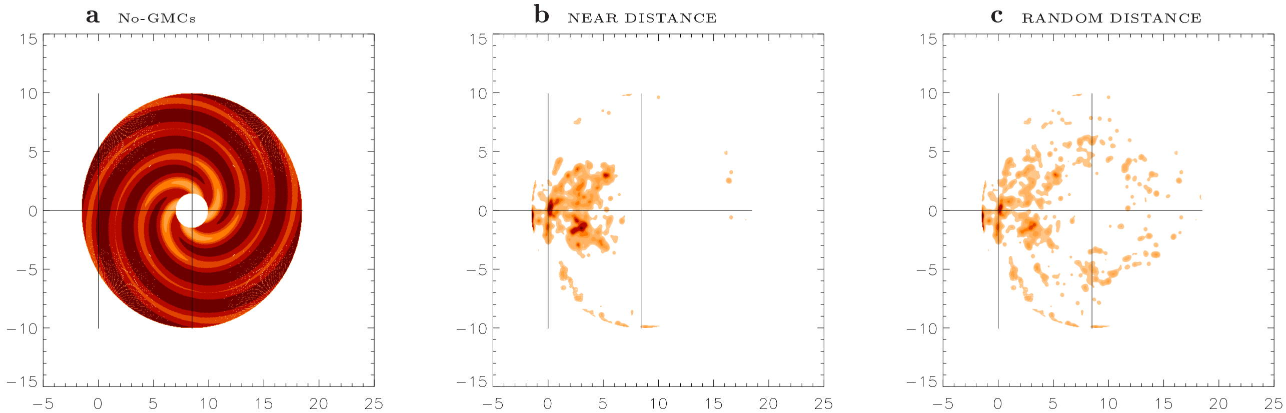

Fig. 1. Heliocentric Longitude-Radius on plane Galactic distributions of CO. (**a**) Obtained from the integration of an exponential disk with the central region evacuated plus an spiral pattern model (Luna 2003), a continuous distribution without GMCs. (**b**) Obtained with GMCs associated to UC HII regions all them at near distances. (**c**) Obtained with GMCs associated to UC HII regions with random selected near or far distance.

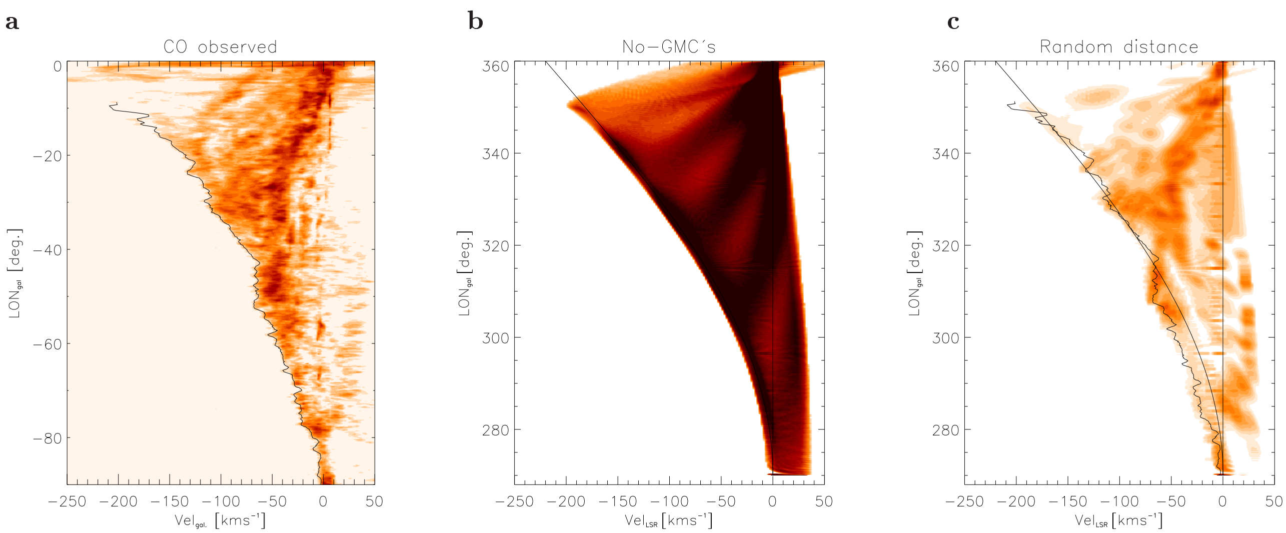

Fig. 2. Longitude-Velocity$_{LSR}$ distributions of CO. (**a**) Integrated CO intensity map from Dame et al. (2001). (**b**) Obtained from the l-R distribution with an exponential disk with the central region evacuated plus an spiral pattern model (Figure 1a) (**c**) Created from the l-R distribution based in a random selection of near and far distance (Figure 1c).

distance selection after 1000 models has a cross correlation average index of 0.80 and standard deviation of 0.01.

Future Work: We intend to improve the radiative transfer model, the set of the UC HII regions and the random normal distribution selection. Also planned is the evaluation of the first Galactic quadrant, and the improvement of the GMC model intensity radial profile and size. We intend to implement a selection criteria based on l-V$_{LSR}$ position by minimizing a chi-square function, and to collect the consistent results of the best models.

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