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EVIDENCE FOR THE PRESENCE OF A WARPING OF THE IONIZED GAS LAYER DERIVED FROM H166α EMISSION OBSERVATIONS IN THE OUTER GALAXY

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RESUMEN

Se presentan resultados de un relevamiento de la emisión de la línea H166α en el rango de longitudes galácticas $270° \leq 1 \leq 300°$ y para tres latitudes galácticas b = 0.0°, b = ±0.5°. De los mismos, resulta que hay evidencia de un alabeo de la capa de gas ionizado en el plano galáctico, en las partes exteriores de la Galaxia.

ABSTRACT

Results from an H166α emission survey in the Galactic longitude range $270° \leq 1 \leq 300°$ and for three Galactic latitudes (b = 0.0°, b = ±0.5°), are presented. From these results, there is evidence for the presence of a warping of the ionized gas layer in the galactic plane, in the outer Galaxy.

Key words: **GALAXY-STRUCTURE – RADIO LINES-RECOMBINATION**

I. INTRODUCTION

The existence of a warping of the H I layer in : outer parts of the Milky Way, has been known ce several years ago, from early 21-cm surveys urke 1957; Kerr 1957; Westerhout 1957; Oort, rr, and Westerhout 1958). The atomic hydrogen systematically warped from the galactic equator ine b = 0.0°.

On the other hand, these systematic deviations m a flat disk are a common characteristic of : H I morphology in the outer regions of spiral axies, as has become clear from several works; for ample the nearest large spirals H31 and H33 are th warped (Brinks and Burton 1984). Kerr *et al.* 986) used the Parkes 18m-telescope to effectively tend the coverage provided by the Weaver and lliams (1973) H I survey in the range $-10° \leq b$ 10° in the north to include all galactic longitudes. Henderson, Jackson, and Kerr (1982) used the nbined $|b| < 10°$ material to obtain a global scription of the detailed shape of the warped H ayer. This general warping above the galactic ine in the north and below the plane in the south clearly shown in the paper by Henderson *et al.* 982).

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From CO ($J = 1 \rightarrow 0$) observations in the range $270° \leq 1 \leq 300°$ and latitudes $-5° \leq b \leq 5°$, Grabelsky *et al.* (1987) show that there is a similar warping of the molecular layer in the galactic plane in the outer Galaxy. Between galactocentric distances R = 10.5 kpc and R = 12.5 kpc, the CO midplane dips from z = −46 to −167 pc below the galactic plane. Clemens, Sanders, and Scoville (1988), have shown something similar, from CO observations in the first quadrant (warping of the CO layer away from b = 0.0°).

In the present paper, we give some results of an H166α emission survey in the galactic coordinate range $270° \leq 1 \leq 300°$, b = 0.0°, b = ±0.5°. This survey was carried out, on the one hand, to complete the published H166α emission survey for $300° \leq 1 \leq 360°$, b = 0.0° (Cersosimo *et al.* 1989) and, on the other hand, with the main purpose of searching for evidence of a similar warping of the low-density ionized gas layer in the outer Galaxy, away from b = 0.0°. We will describe below the observations carried out with this purpose in the Instituto Argentino de Radioastronomía.

II. THE OBSERVATIONS

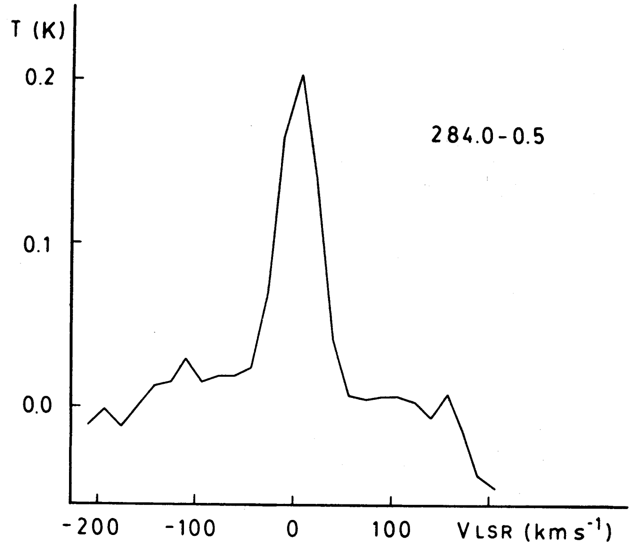
H166α line emission has been observed in the galactic longitude range $270° \leq 1 \leq 300°$, in steps at one degree in longitude and for three galactic latitudes: b = 0.0°, b = ±0.5° for each longitude.

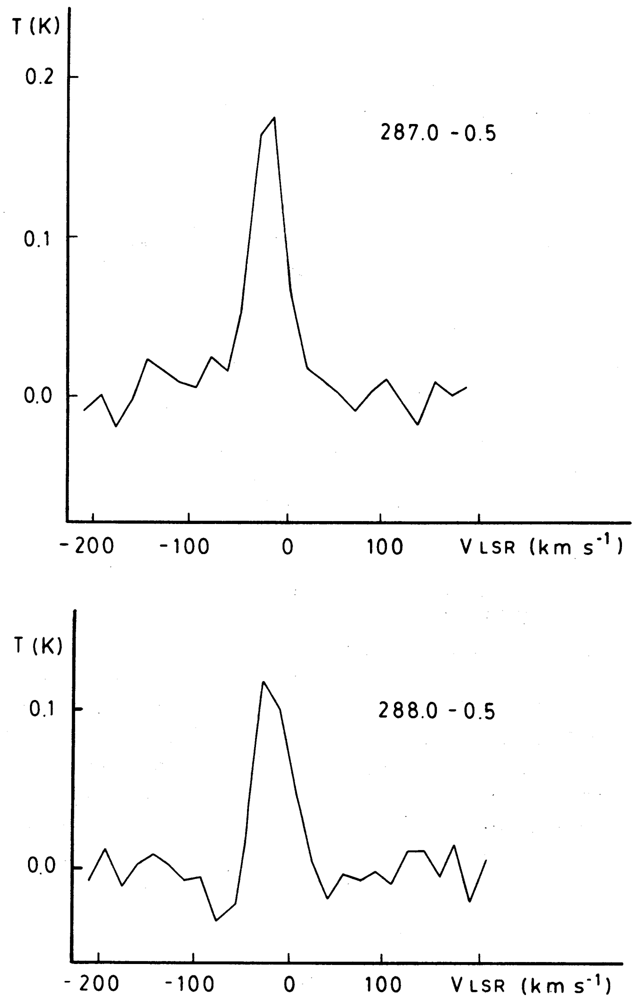
The observations were made with the 30mdiameter antenna of the Instituto Argentino Radioastronomía, with Gaussian beam of 34′ 21-cm. The aperture efficiency was 0.6 and beam efficiency was 0.87 (Loiseau 1979). The fil bank spectrometer had 84 filters of widths 75 kl giving a velocity resolution of 15.8 kms^{-1}. T system temperature on cold sky was 84 K. T local oscillator was switched in frequency by amount less than the observing bandwidth, in orc to obtain two independent spectra, which were th averaged.

The profiles had an integration time of 4-6 That represented a very long observation time the complete survey. The 'r.m.s.' noise of profiles was ≃ 7-8 mK, with a minimum detecta temperature of 20 mK. The instrumental baseli were removed by using third, fourth or fifth orc polynomials.

III. RESULTS

Figure 1 shows some of the observed profil





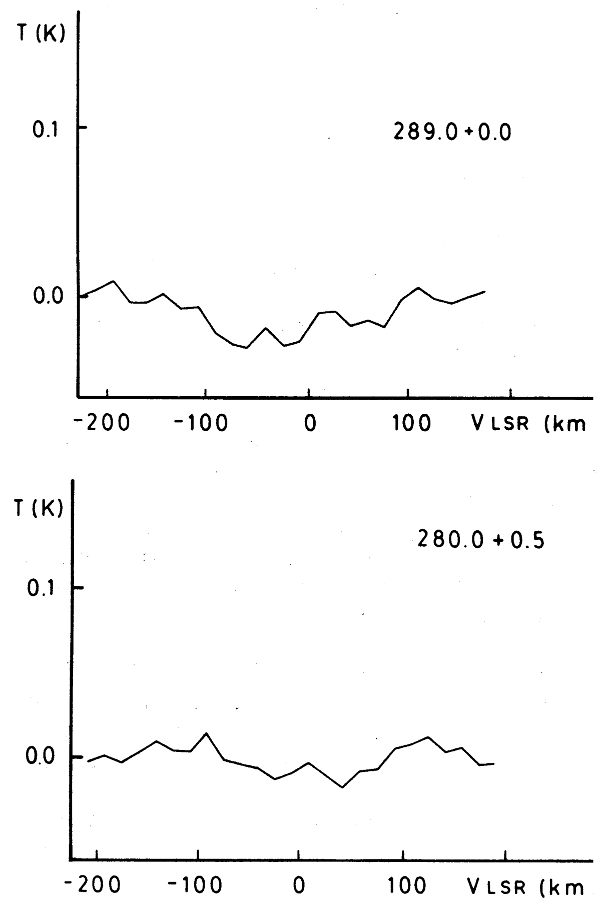


Fig. 1. Some profiles obtained from H166α observations in the range 270° ≤ l ≤ 300° and three galactic latitudes, (l 0.0°, ±0.5°). In two of the points shown there is no signal detected.

ɪm all the observed profiles, the result is that the 66α emission was detected clearly in relatively positions: 4 for b = 0.0°, 4 for b = −0.5°, 1 for b -0.5°, (for 280° ≤ l ≤ 300° and the three galactic tudes). No detection was positive, above the 3σ se level, for the range 270° ≤ l ≤ 280°. The peak : temperature of the obtained profiles, together h their galactic coordinates are shown in Table 1. e range 270° ≤ l ≤ 279° is not considered in the ɪle 1, since there was no positive detection.

ʌs an immediate result, we almost had no ections for b = +0.5°. That is in good agreement h the previously known warping of different eous layers (H I, CO, H_2) in the outer galactic ne, away from b = 0.0° (below the plane in the th and above in the north). That phenomenon uld be also present for the low-density ionized , according to our H166α observations.

IV. COMMENTS

In this paper, we have shown evidence of the presence of the gaseous layer warping in the Milky Way, also for ionized gas (at least for the low density component). It is known that warping is generally also present in the outer regions of spiral galaxies.

These systematic deviations from flatness seem to be a common aspect of spiral galaxy morphology, and their presence in the Milky Way, is established beyond doubt.

We think that the present paper is an observational contribution to confirm this characteristic, in relation to the ionized gas, common to several spiral galaxies.

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TABLE 1

SOME OBSERVED PARAMETERS IN THE H166α OBSERVATIONS

Galactic Longitude l(°)	Galactic Latitude b(°)	Peak Line Temperature T_A (mK)	Galactic Longitude l(°)	Galactic Latitude b(°)	Peak Line Temperature T_A (mK)
280	−0.5	< 20.	291	0.0	< 20.
281	−0.5	< 20.	292	0.0	< 20.
282	−0.5	< 20.	293	0.0	< 20.
283	−0.5	< 20.	294	0.0	< 20.
284	−0.5	284.	295	0.0	< 20.
285	−0.5	< 20.	296	0.0	< 20.
286	−0.5	31.	297	0.0	< 20.
287	−0.5	167.	298	0.0	< 20.
288	−0.5	118.	299	0.0	< 20.
289	−0.5	< 20.	300	0.0	< 20.
290	−0.5	< 20.	280	0.5	< 20.
291	−0.5	< 20.	281	0.5	< 20.
292	−0.5	< 20.	282	0.5	< 20.
293	−0.5	< 20.	283	0.5	< 20.
294	−0.5	< 20.	284	0.5	< 20.
295	−0.5	< 20.	285	0.5	< 20.
296	−0.5	< 20.	286	0.5	< 20.
297	−0.5	< 20.	287	0.5	< 20.
298	−0.5	< 20.	288	0.5	< 20.
299	−0.5	< 20.	289	0.5	< 20.
300	−0.5	< 20.	290	0.5	< 20.
280	0.0	23.	291	0.5	< 20.
281	0.0	< 20.	292	0.5	< 20.
282	0.0	< 20.	293	0.5	22.
283	0.0	< 20.	294	0.5	62.
284	0.0	82.	295	0.5	< 20.
285	0.0	< 20.	296	0.5	< 20.
286	0.0	< 20.	297	0.5	< 20.
287	0.0	44.	298	0.5	< 20.
288	0.0	30.	299	0.5	< 20.
289	0.0	< 20.	300	0.5	< 20.
290	0.0	< 20.			

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