



G28.17+0.05, A New Type of Cloud in the ISM?

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21 cm HI observations with the NRAO 140 Foot telescope have revealed a giant HI cloud (G28.17+0.05) in the Galactic plane that has unusual properties. The cloud is 150 pc in diameter, is at a distance of 5 kpc, and contains as much as $10^5 M_{\odot}$ of atomic hydrogen. The cloud consists of a cold core, $T \sim 40$ K, and a hotter outer envelope, $T \geq 200$ K. There is no observable difference in the HI line widths, ~ 7 km s $^{-1}$, between the core and the envelope. Anomalously-excited 1720 MHz OH emission, with a similar line width, is associated with the core of the cloud. The cloud core also exhibits ^{12}CO and ^{13}CO self-absorption which indicates that most of the cloud mass is in molecules. The total mass of the cloud is $> 2 \times 10^5 M_{\odot}$. The cloud has only a few sites of current star formation. If similar clouds are associated with other observed sites of anomalously-excited 1720 MHz OH emission, there may be as many as 100 more of these objects in the inner galaxy.

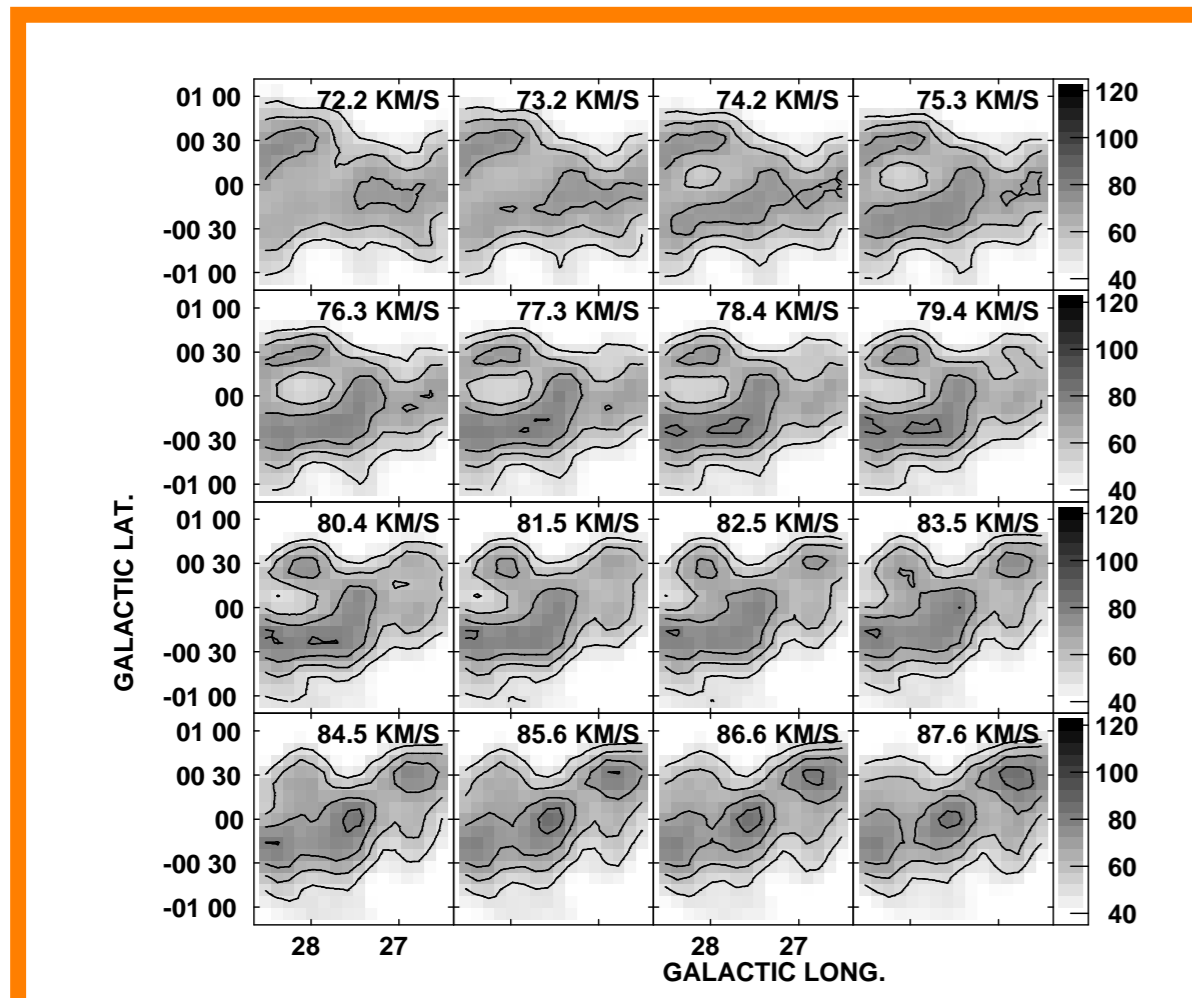


Figure 1. G28.17+0.005 is shown via channel maps of HI brightness vs. Galactic coordinates. The HI self-absorption is centered near $l = 28^{\circ}$ and $v = 74 - 83$ km/s. The self-absorbed core of G28.17+0.005 is surrounded by warmer HI “halo” seen in emission. The contour levels are 50, 60, 70 and 80 K.

G28.17+0.05 PROPERTIES

- $(l, b, v) = 28.17^{\circ}, 0.05^{\circ}, +77$ km/s.
- $D \sim 5$ kpc.
- $R \sim 75$ pc.
- $R_{\text{core}}(l, d, b) \sim 55 \times 75 \times 30$ pc.
- $\Delta v \sim 7$ km/s.
- $T_{\text{core}} < 40$ K.
- $T_{\text{halo}} \sim 150 - 400$ K.
- $N_{\text{HI}} \sim (5 - 12) \times 10^{20}$ cm $^{-2}$.
- $M_{\text{HI}} \sim 10^5 M_{\odot}$.
- $M_{\text{H}_2} > 10^5 M_{\odot}$.

OH EMISSION

- 1665 and 1667 MHz lines in absorption in core of G28.17+0.05.
- 1720 MHz lines in emission in core of G28.17+0.05.
- Requires $T \sim 10 - 40$ K.
- Anomalous OH emission seen for most lines of sight within 50° of the Galactic center.

STAR FORMATION

- No large scale star formation (Myers *et al.*, 1986, ApJ, 301, 398).
- Single “Class 0” object associated with MSX dark cloud at center of G28.17+0.05.
- No HII regions found in Radio Recombination Lines of H.
- Large atomic fraction and little star formation \rightarrow G28.17+0.05 has just made transition from atomic to molecular state.

^{12}CO and ^{13}CO

- G28.17+0.05 barely discernible in ^{12}CO .
- G28.17+0.05 easily found in ^{13}CO .
- Both ^{12}CO and ^{13}CO are self-absorbed ($A_V > 100$)!
- Clouds like G28.17+0.05 have likely gone unnoticed in ^{12}CO surveys.

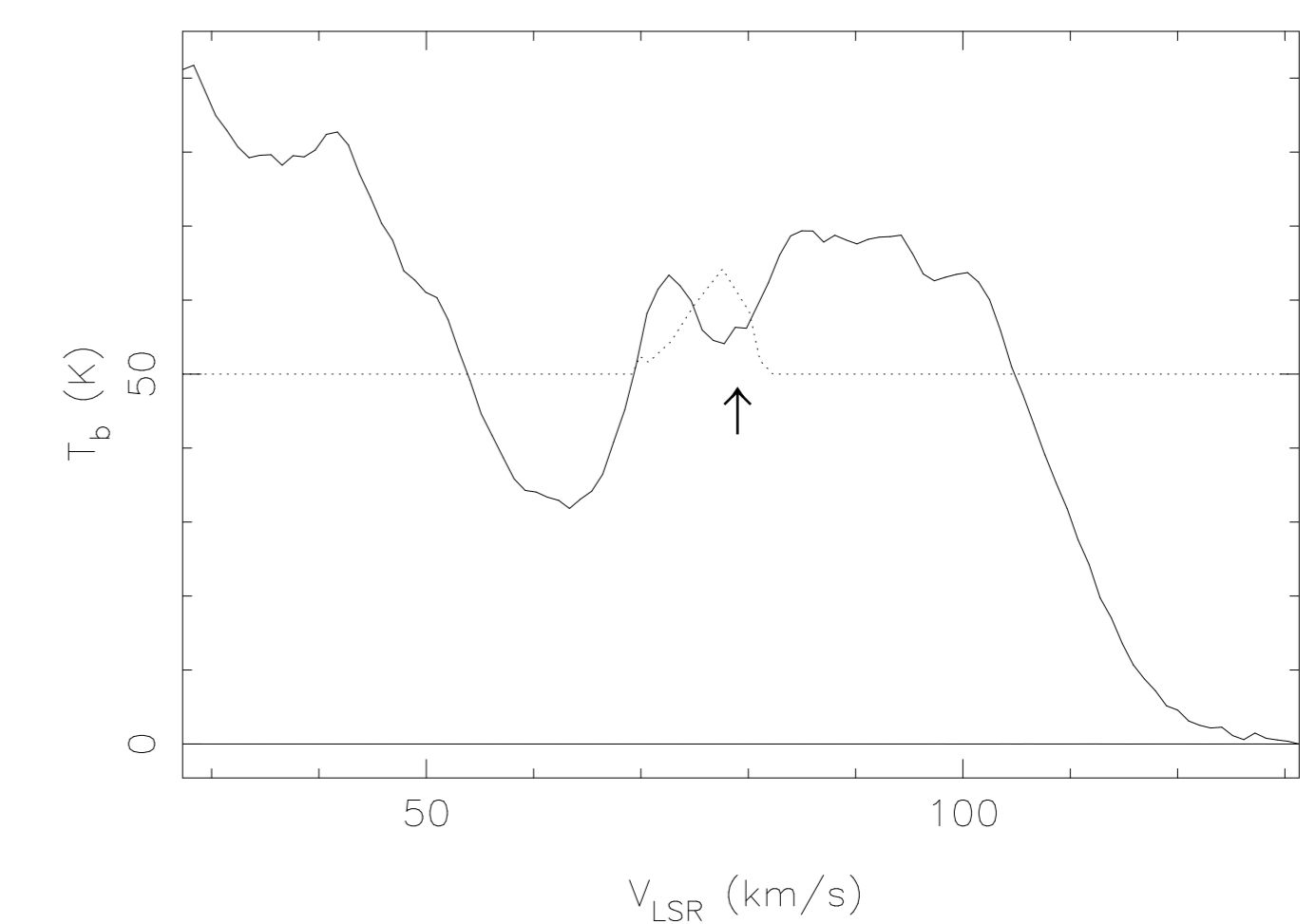


Figure 2. A portion of the spectrum towards G28.17+0.05. The solid line shows the 21 cm HI emission while the dashed line shows the 1720 MHz OH emission (scaled and offset for easier comparison). The self-absorption feature is marked by the arrow.

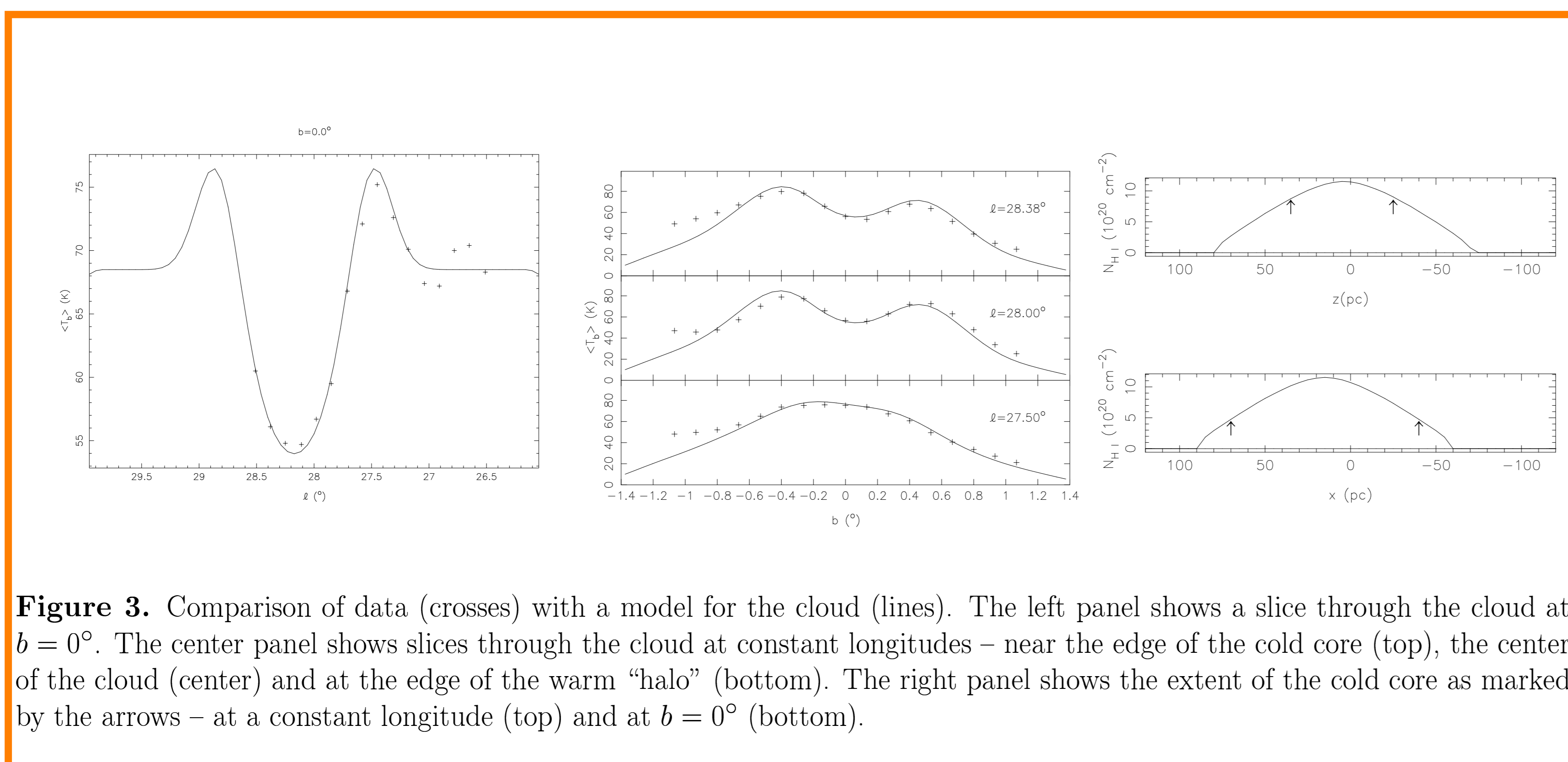


Figure 3. Comparison of data (crosses) with a model for the cloud (lines). The left panel shows a slice through the cloud at $b = 0^{\circ}$. The center panel shows slices through the cloud at constant longitudes – near the edge of the cold core (top), the center of the cloud (center) and at the edge of the warm “halo” (bottom). The right panel shows the extent of the cold core as marked by the arrows – at a constant longitude (top) and at $b = 0^{\circ}$ (bottom).

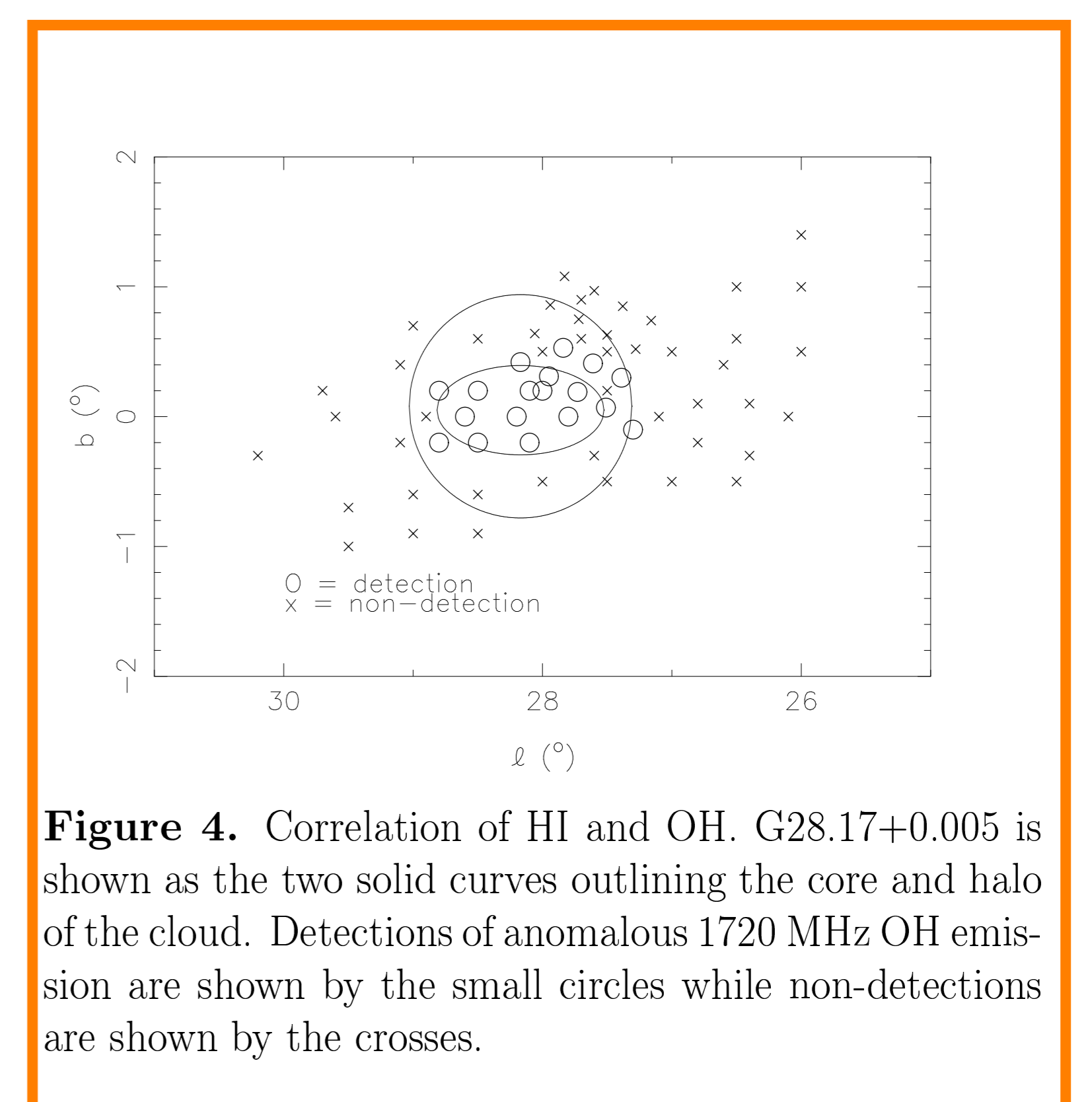


Figure 4. Correlation of HI and OH. G28.17+0.005 is shown as the two solid curves outlining the core and halo of the cloud. Detections of anomalous 1720 MHz OH emission are shown by the small circles while non-detections are shown by the crosses.

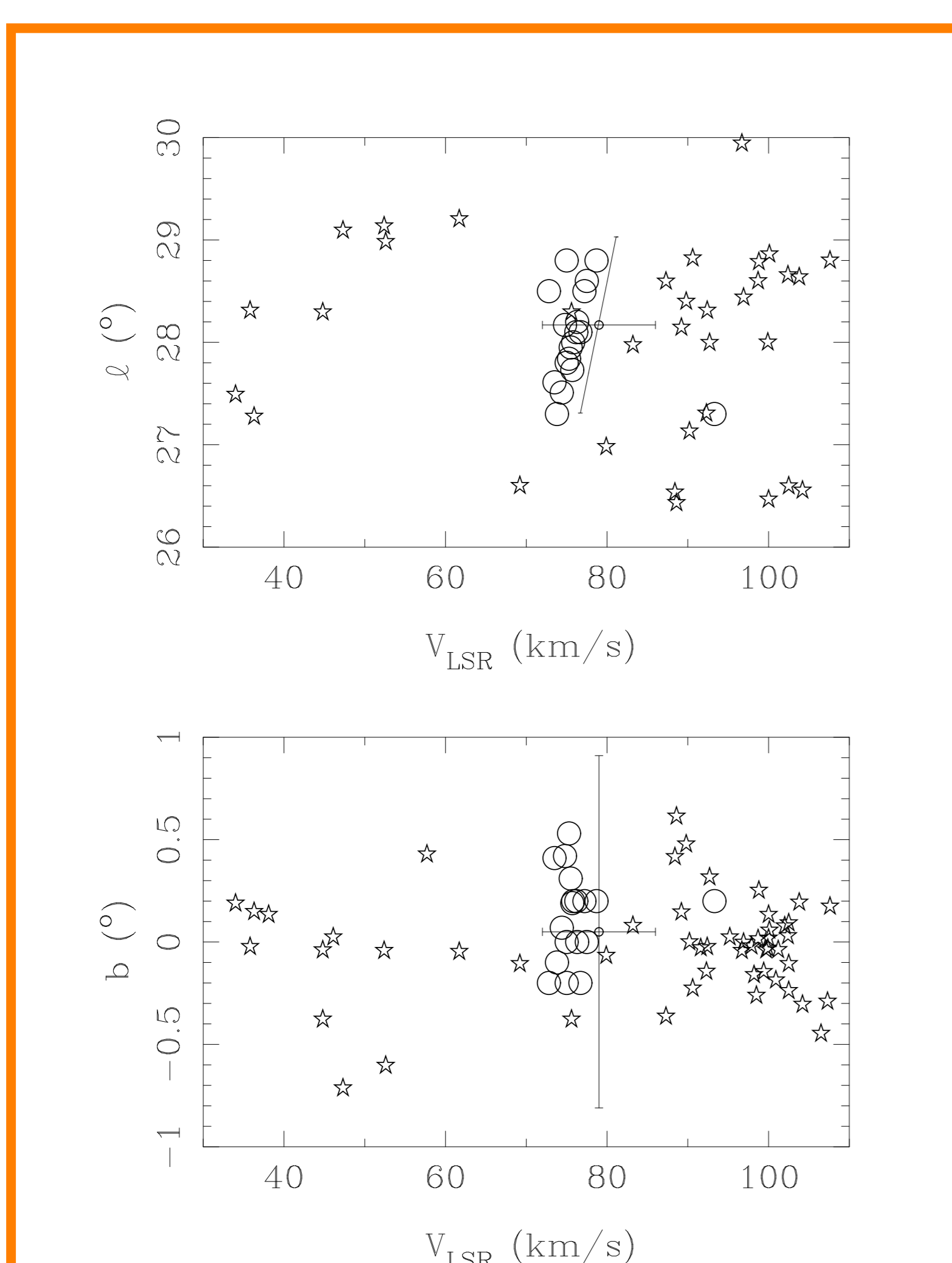


Figure 5. Velocity vs. longitude and latitude of G28.17+0.05. The OH emission is shown by circles. The HI emission extent is given by the large cross. HII regions are shown by stars.

What is G28.17+0.05?

We speculate that G28.17+0.05 is a giant HI/molecular cloud just entering the Scutum spiral arm, in the process of changing from the atomic phase to the molecular phase. This is consistent with G28.17+0.05 containing only the earliest stages of star formation. The velocity difference between the OH and HI could be explained by their being in different parts of a shocked cloud. If this view is correct then we would expect OH blue-shifted relative to the HI for a similar cloud in the fourth quadrant of the galaxy.

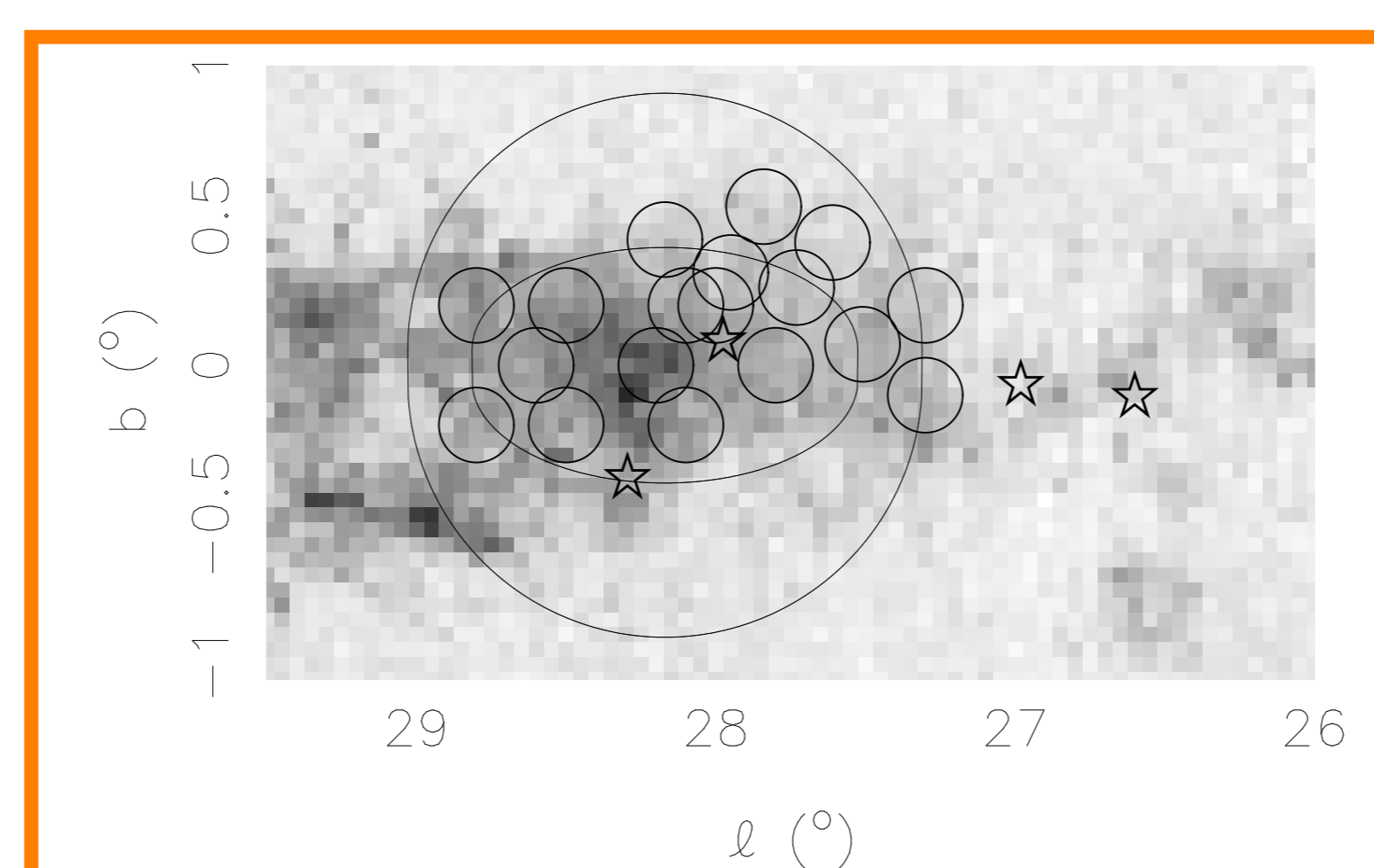


Figure 6. ^{12}CO image (grey-scale) with core and halo of G28.17+0.05 overlaid (lines). Also shown are sites of anomalously excited OH emission (circles) and HII regions (stars) in the velocity range of G28.17+0.05.

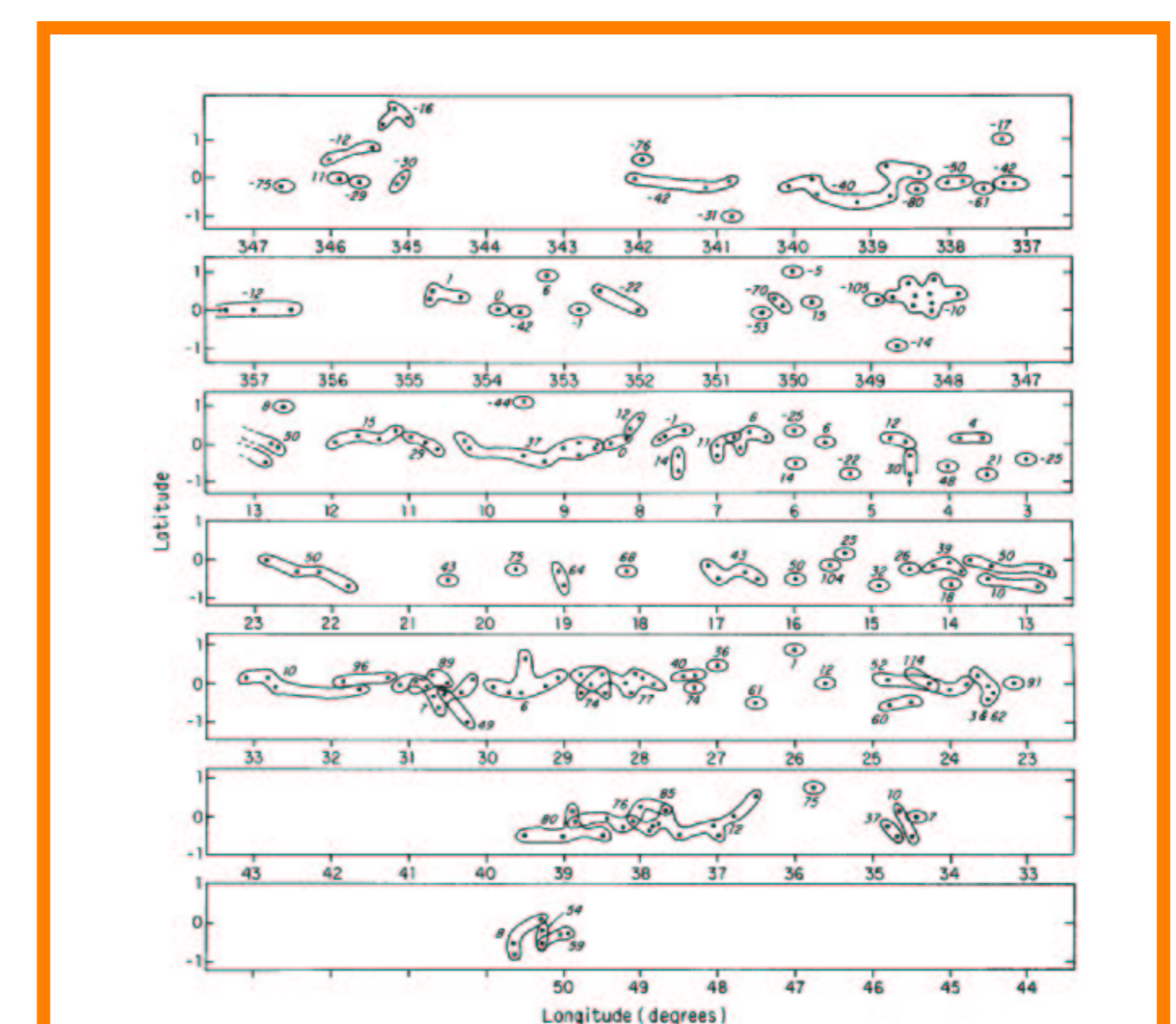


Figure 7. Distribution of anomalous 1720 MHz OH emission in the inner galaxy. LSR velocities (km/s) are given for each cloud.

Image is from Turner, B.E., 1982, ApJ, 255, L33.