CORRELATION OF INFRARED EMISSION WITH H I AND CO GAS IN THE HIGH LATITUDE CLOUD AREA L1642

T. Liljeström
Helsinki University Observatory
Tähtitorninmäki,
SF-00130 Helsinki Finland

R. Laureijs
Kapteyn Astronomical Institute and
Laboratory for Space Research
P.O. Box 800
9700 AV Groningen The Netherlands

The high-galactic-latitude cloud L1642 (l = 210.8°, b = –36.7°) is a suitable candidate to relate IR measurements with atomic and molecular data because it has a reasonable size with respect to the rather poor (*IRAS*) IR resolution, a moderate optical extinction and an isolated location in the direction towards the galactic anticenter. The exceptionally high galactic latitude of –36.7° implies that L1642 is some 60 pc below the galactic plane (if $r \approx 100$ pc is adopted for its distance). L1642 is thus sufficiently far off the galactic plane to minimize the confusion by background gas and dust clouds.

The large scale structure of the 100 μm emission in the L1642 area, presented in Laureijs et al. (1987) and Liljeström and Mattila (1988), shows that the dark cloud L1642 is located in the head of a comet-shaped nebula with a long tail pointing towards the galactic plane. Figures 1*a* and *b* show the *IRAS* surface brightness maps of L1642 at 12 μm and 100 μm smoothed to a 9′ Gaussian beam. It is seen that the 100 μm emission has a maximum in the center of the cloud whereas the brightness distribution at 12 μm shows maximum intensities in the outer parts of the cloud. The large scale structure of the integrated H I line intensity has a morphology similar to the *IRAS* 12 μm map whereas the integrated CO line emission shows a morphology similar to the *IRAS* 100 μm map.

The relationship I(CO) vs. A_V reveals a linear correlation of 3.3 K km s^{-1} mag^{-1} for

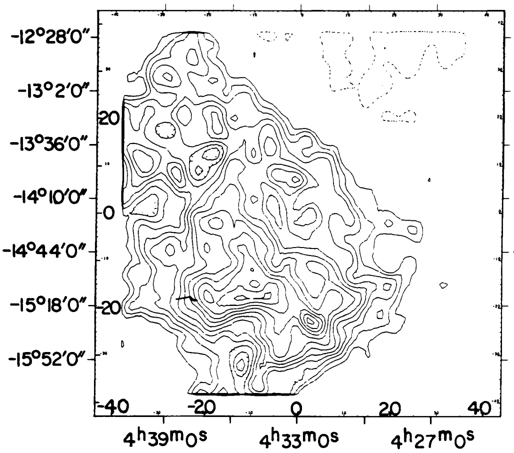

Figure 1*a*. *IRAS* surface brightness distributions at 12 μm. The contour levels are in steps of 0.05 MJy sr^{-1} with the highest contour at 0.75 MJy sr^{-1}.

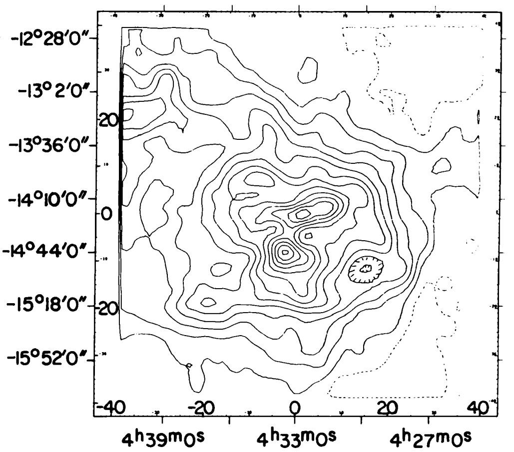

Figure 1*b*. *IRAS* surface brightness distribution at 100 μm. The contour levels are in steps of 1.0 MJy sr^{-1} with the highest contour at 13 MJy sr^{-1}.

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$A_V > 1.1$ mag. When $A_V < 1.1$ mag there is a big scatter in the data, which is best understood with the inhomogeneous cloud structure in the outer parts of the molecular cloud where the CO abundance is sensitive to temperature (Langer 1976). Also, the I(CO) vs. I(100 μm) relationship shows this scatter, probably due to the same reason as above, or to a dust confusion of the expanding Eridanus H I shell present in the L1642 area (Liljeström and Mattila 1988). If all data points are considered a correlation I(CO)/I(100 μm) = (0.5 ± 0.1) K km s^{-1}/(MJy sr^{-1}) is obtained. However, if only the stronger 100 μm emission (> 10 MJy sr^{-1}) is considered the I(CO) vs. I(100 μm) correlation factor is (0.86 ± 0.35) K km s^{-1}/(MJy sr^{-1}), which agrees with the mean value of 0.9 K km s^{-1}/(MJy sr^{-1}) found by Weiland et al. (1986).

The contour map of the H I line width (Figure 2) in the SE area of the cloud shows an increase from 2.6 to 4.0 km s^{-1}. The spectra do not reveal any sign of a second velocity component at the L1642 cloud velocity (~1 km s^{-1}), which could explain the line broadening as a blend effect. Although an explanation in terms of increased turbulence cannot be excluded, the fact that the *IRAS* 12 μm surface brightness map (Figure 1*a*) shows the big maximum close to the H I line broadening maximum supports a thermal line broadening model, where the heating of the H I gas is due to the photoelectric emission from very small grains and/or PAHs.

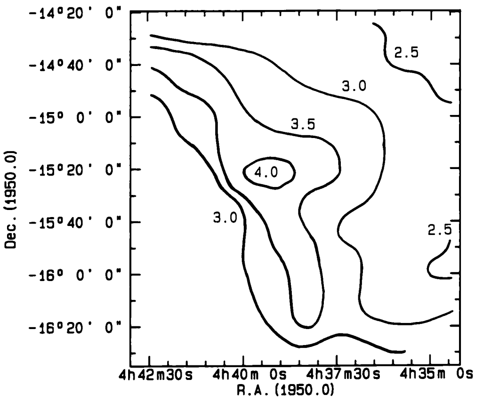

Figure 2. Spatial distribution of the H I line width in the SE area of the cloud. Unit is km s^{-1}.

Assuming that the turbulent and large scale motions are the same in the broadened H I line region and immediately outside this area, a temperature enhancement of about 200 K is obtained for the H I gas according to the increase of the line width from 2.6 to 4.0 km s^{-1}. Adopting for the L1642 H I cloud the temperature $T_K = 81$ K, an average value for diffuse clouds (Spitzer and Cochran 1973), the increase of the H I line width corresponds to an increase of T_K from ~80 to 280 K. This result indicates that the dark cloud L1642 is embedded in a lukewarm H I envelope. As in the case of L1642, filamentary structures are often associated with these warm H I envelopes. Additionally, it is known that H I clouds get warmer at higher $|z|$ (Kulkarni and Heiles 1988).

REFERENCES

Kulkarni, S.R. and Heiles, C. 1988, in *Galactic and Extragalactic Radio Astronomy*, eds. G.L. Verschuur and K.I. Kellermann (New York: Springer-Verlag, Inc.), p. 132–133.
Langer, W. 1976, *Ap. J.*, **184**, 269.
Laureijs, R., Mattila, K., and Schnur, G. 1987, *Astron. Astrophys.*, **184**, 269.
Liljeström, T. and Mattila, K. 1988, *Astron. Astrophys.*, **196**, 243.
Spitzer, L., Jr. and Cochran, W. D. 1973, *Ap. J. (Letters)*, **186**, L23.
Weiland, J. et al. 1986, *Ap. J. (Letters)*, **306**, L101.