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IRAS OBSERVATIONS OF GIANT MOLECULAR CLOUDS IN THE MILKY WAY

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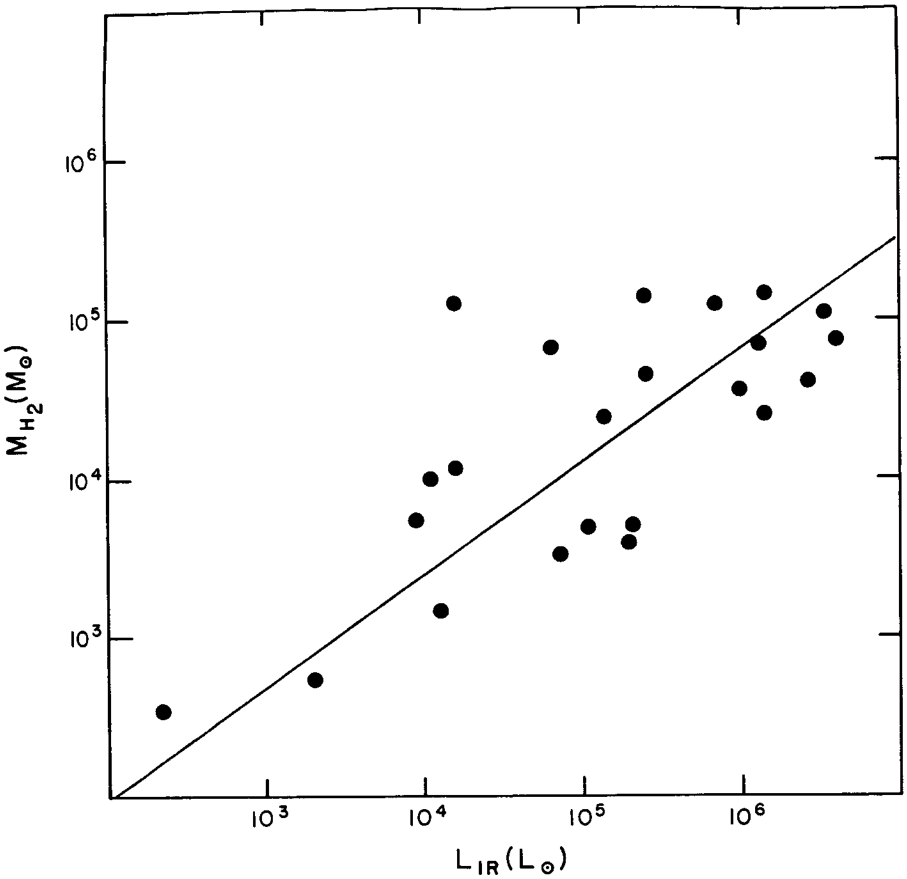
The IRAS data base has been used to study infrared radiation from molecular clouds in our galaxy. The sample of clouds was restricted to those with reliably determined molecular masses from large area, multi-isotope CO maps. They were normalized to $X(^{13}CO) = 2x10^{-6}$. Flux densities at 60μm and 100μm were determined by integrating the flux density within rectangles drawn on the sky flux plates after subtracting a suitable background. The rectangles were chosen to be coextensive with the areas mapped in CO. Color corrections were made and luminosities calculated by assuming the optical depths were proportional to frequency. The flux densities were converted to dust masses with a value for $4a\rho/3Q = .04$ g/cm^2 at 100μm.

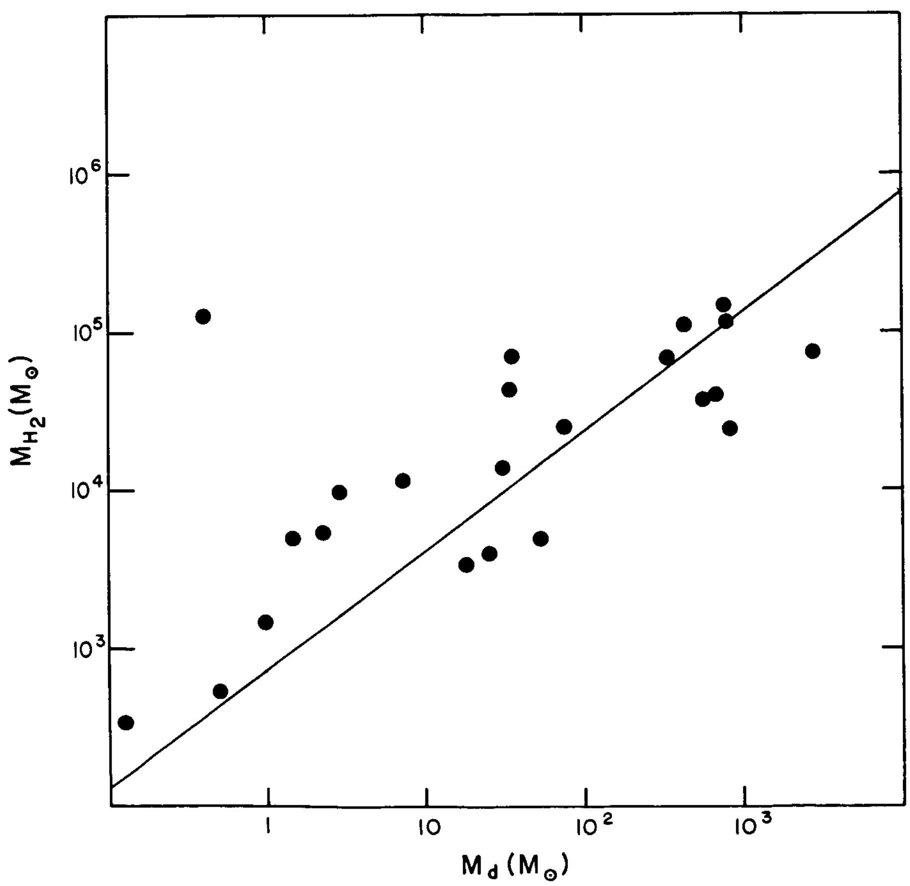
A plot of the infrared luminosity versus the molecular mass is shown in the upper panel. A linear fit to the data, excluding the Rosette (upper left point in both plots), is given by $\log(M_{H_2}) = (.71\pm.22)\log(L_{IR}) + 0.53\pm.14$ and has a correlation coefficient of 0.81. Formal 2σ uncertainties are quoted. We calculated the stellar mass in each cloud using the Salpeter initial mass function for young clusters with mass cutoffs at 0.1 and 100 $M_\odot$. The mean star formation efficiency in this sample is 0.01. The efficiency of star formation will be larger if the upper mass limit is lower for some of the objects, particularly the lower mass clouds.

The cloud molecular mass is plotted versus dust mass in the lower panel. The data is fit by $\log(M_{H_2}) = (.70\pm.22)\log(M_d) - 3.10\pm0.16$ with a correlation coefficient of 0.84. Again, the Rosette was not included in the fit. The mean gas to dust ratio is 420 with an uncertainty of a factor of two, rather than the commonly adopted value of 100. This supports the usual assertion that the 100μm fluxes are only sensitive to the warm dust and hence trace star formation.

These relationships are in good agreement, quantitatively, with the results by Young et al. (1986, Ap. J. 304, 443) for galaxies, supporting the view that the far infrared emission they observed is associated with the molecular gas.



10^6
10^5
10^4
10^3
$M_{H_2}(M_\odot)$
10^3
10^4
10^5
10^6
$L_{IR}(L_\odot)$



10^6
10^5
10^4
10^3
$M_{H_2}(M_\odot)$
1
10
10^2
10^3
$M_d(M_\odot)$