47.18

Observational Constraints on an Embedded Cloud Model of the Soft X-ray Diffuse Background

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Jakobsen and Kahn (1986) have constructed a model of the soft X-ray diffuse background that uses absorption by clouds embedded in the hot X-ray emitting gas to produce the observed anticorrelation between soft X-ray intensity and neutral hydrogen column densities. Burrows (1986) showed that this model does not fit the observed B/C or Be/B band ratios. Here, I show that this model cannot even fit the observations from a single soft X-ray band. The addition of a local, unabsorbed component to the model helps considerably, but the model still cannot produce an acceptable fit without assuming unreasonably large clumping of the neutral gas.

47.19

The Association of High Galactic Latitude Molecular Clouds with Atomic Hydrogen Gas

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A relationship between the high galactic latitude molecular clouds (HLCs) and the atomic hydrogen gas (HI) is determined in this paper. Recent research has shown that the HLCs are very young objects with an age < 10^6 years, a years, and a typical distance and size of 100 pc and 2 pc respectively (Blitz, Magnani and Mundy 1984). Most of them are bound neither by gravity nor by the mean pressure of the interstellar medium (Magnani, Blitz, Mundy 1985; MBM; Keto and Myers 1986; KM). One possible formation mechanism for those HLCs is suggested that they formed by interstellar shocks (e.g. Magnani 1987). These shocks could, in principle, have been generated by supernova explosions or stellar winds, which would, in a uniform interstellar medium, produce HI shells, as suggested by Heiles (1979, 1984). If this is the case, a strong correlation between the HLCs and the HI gas would be expected. From a global HI-HLCs comparison, a total of 75 HLCs observed in the CO (J=1-0) transition have been analyzed, and it was found that all HLCs are associated with HI, with most of them lying along filamentary of loop-like structures. A more detailed examination using higher spatial resolution and better sampled HI data in the vicinity of 19 HLCs, shows that the CO and HI peaks are typically offset from one another by ~1^o. At a distance of 100 pc this corresponds to a 2 pc spatial separation of the core of an HI cloud. We suggest that these offsets result from the molecular cloud condensing out of the atomic gas. The physical mechanism for this phase transition is not yet clear. Two groups of the HLCs, MBM53-55 and MBM27-29, are associated with expanding HI shells. An expansion velocity for the of about 6-7 km/s is obtained by using a uniformly expanding, non-rotating HI shell model. We also estimate the kinetic energy of these expanding HI shells to be 10^{47} to 10^{48} ergs. This indicates that the HLCs could have been formed by supernova explosions only if the supernova remnant sheds a very large fraction of its energy in the radiative phase of its expansion, more than is generally thought to be the case in standard models.

47.20

Molecular Clouds without Detectable CO Emission

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In an attempt to find an objective way of identifying the locations of high latitude molecular clouds, Desert, Bazell and Boulanger (DBB-Ap.J. in press), looked for regions of 100 μm excesses over the tight linear relationship between HI column density and 100 μm surface brightness using the IRAS data base and high latitude HI surveys (Heiles and Habing, 1974; Colomb, Poppel and Heiles 1980). Clouds that they identified as having more than 4 σ IR excesses over the mean relation were found to cover 4% of the sky at latitudes greater than |b| = 25 degrees compared to the 0.5% found for high latitude molecular clouds identified by means of their CO (J=1-0) transition (Magnani, Lada and Blitz 1985). We searched the clouds in the DBB catalogue for CO emission and found that 14% had detectable radio emission, consistent with the Magnani, Lada an Blitz survey. The remainder appear to be classical diffuse molecular clouds with CO abundances of 10^{-6}, and thus have CO column densities too low to be measured in the radio. The average number density of clouds and the average column density of H_2 in these clouds is consistent with observations of Copernicus stars in the galactic plane at large distances from the Sun. It therefore appears that we have a complete survey of molecular hydrogen within 100 pc of the Sun. The surface density of these IR diffuse clouds in 0.2-1 $M_\odot pc^{-2}$ depending on the conversion used to obtain molecular hydrogen column density. Including the contribution from CO rich HLCs, the total surface density of H_2 within 100 pc is then 0.4-1.2 $M_\odot pc^{-2}$ compared to the value of 2 $M_\odot pc^{-2}$ for larger clouds found by Dame et al. (1987).

47.21

A Simple Explanation for the Molecular Cloud Correlations and CO Mass Calibration

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The size-linewidth and constant column density relations for molecular clouds can be derived from the virial theorem if molecular clouds and their atomic envelopes are virialized, magnetic objects with an external pressure equal to the observed kinematic pressure of the interstellar medium. The boundary pressure of the molecular part of the cloud is mostly from the weight of the atomic gas in the shielding layer. The conversion factor between CO integrated brightness temperature and H_2 column density can also be derived. Use of these local calibrators to determine the molecular mass of an unresolved ensemble of clouds in another galaxy may require a correction factor of 1.5 if the clouds are identical to those in our Galaxy. Clouds with extremely large masses, low metallicities, low boundary pressures or large radiation fields should have smaller angular filling factors of optically thick molecular clumps. This explains why the largest self-gravitating clouds in galaxies with moderate gas densities are mostly atomic and why the CO brightness temperatures in Magellanic irregular and dwarf galaxies are low.

WEDNESDAY

47.22

Giant Molecular Clouds with no High-Mass Stars

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The principal source of the far-infrared emission from molecular clouds is dust grains heated by the UV radiation of young, high-mass stars embedded in, or associated with the clouds. Far-infrared emission in the Galactic plane from neighboring molecular clouds along the line of sight, and from dust in low-density (H I) regions heated by the general interstellar radiation field, contribute to a substantial IR background, which must be removed before the flux from a candidate cloud can be determined. We have developed an IR surface photometry technique in which the *IRAS* 60 and 100 μm surface brightnesses within a rectangular area containing the cloud are iteratively fitted by multiple regression with a background surface function $S_\lambda(\ell,b) = a_0 + a_1\ell + a_2\ell b + a_3 b$, coupled with clipping of source pixels which deviate more than 2σ above the fit. Examples of the IR surface photometry method for molecular clouds with well defined IR sources (H II region or IR-strong clouds) and for those with low-IR surface brightness (IR-quiet clouds) are presented. This technique allowed us to obtain the far-IR flux from molecular clouds, particularly for IR-quiet clouds whose source fluxes are typically only 5% above the local background. Using the *IRAS* Galactic plane images and the Massachusetts–Stony Brook CO Galactic Plane Survey, the far-IR luminosity L_{IR}, CO luminosity L_{CO}, and virial mass M_{VT} of 42 IR-strong and 13 IR-quiet molecular clouds have been determined. The high-mass star formation rate per available molecular mass as measured by L_{IR}/M_{VT} is independent of cloud mass, with $\langle L_{IR}/M_{VT}\rangle = 4$ ($L_\odot/M_\odot$) for IR-strong clouds and $\langle L_{IR}/M_{VT}\rangle = 0.5$ ($L_\odot/M_\odot$) for IR-quiet clouds. Of particular interest are the group of massive (2×10^5 to 2×10^6 $M_\odot$) IR-quiet clouds without any O star formation. They are not rare and therefore not very young, implying that they may have had previous star formation that has left the cloud intact and produced no current generation of high-mass stars.