IMPLICATIONS FOR STAR FORMATION IN SPIRAL GALAXIES FROM OBSERVATIONS OF NEARBY MOLECULAR CLOUD COMPLEXES

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I want to make three points about star formation in spiral galaxies that follow from consideration of the internal structure of giant molecular cloud complexes (GMCC). The first point comes from pressure considerations. The total pressure inside the star-forming core of a GMCC may be written $10^6 k) v/3 kms^{-1})^4 (17pc/D)^2$ for virial theorem line width v and cloud diameter D; the pressure from a spiral density wave shock (SDWS) is $10^5 k(n_s/1cm^{-3})(v_s/20 kms^{-1})^2$ and the thermal pressure in the cloud is $10^4 k(n/10^3 cm^{-3})(T/10K)$ for Boltzmann constant k. These three pressures differ by factors of 10. An SDWS has too low a pressure to affect a cloud core; the only way an SDWS could influence a GMCC is if it interacted with the low thermal pressure in the cloud, i.e., the SDWS could propagate into a cloud along the direction of a magnetic field which may be the source of large scale pressure in a transverse dimension. The second point is that the density and mass of a GMCC are so large that the cloud will enter an SDWS like a cannon ball and will not be readily deflected. GMCC in other galaxies would then look like spurs on the spiral pattern and not like dust lanes. The alternative to these two points is that an as yet undiscovered (or uncommon) population of low density ($100 cm^{-3}$) clouds exists involving GMCC-type masses, or that smaller clouds coalesce at the SDWS. This implies that the star-forming clouds studied by molecular observers would be post-SDWS and post-gravitational collapse objects. Finally, the maximum age of a GMCC in the solar neighborhood is probably less than 50 million years. Its destruction is a result of pressure forces from the stars which it creates. Destruction in this sense does not necessarily imply that the molecules are converted into atoms -- only that the cloud is pushed around. In the solar neighborhood, some clouds may, in fact, turn into 21-cm features; e.g., an HI half shell with a radius of 100 pc and a visual extinction through the shell of 0.2 mag. contains $3 \times 10^5 M_0$, the mass of a GMCC. However, in the 5-kpc ring of the Galaxy, there is too much H_2 relative to HI to allow any cycling between H_2 and HI that is in phase with an SDWS unless the cloud remains molecular for 80% of the cycle. More likely, the cloud will be "destroyed" before that time. The implication is that cloud destruction at 5 kpc must produce molecular shells in addition to some atomic shells. This could be observed.

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