If a sheet-like cloud is made by some triggering mechanism in interstellar region, the probability that the ratios of k_y/k_x of perturbations are greater than 1.2 may be large. Therefore the sheet-like cloud will fragment to form many filamentary structures and each filamentary cloud will collapse further and refragment. This scenario is very suggestive for interpretation of observed cloud's morphology such as TMC.

Simulations of fragmentations of isothermal sheet-like clouds with uniform rotation or uniform magnetic field are also computed.

RESOLUTION OF THE ANGULAR MOMENTUM AND MAGNETIC FLUX PROBLEMS DURING STAR FORMATION, AND OBSERVATIONAL CONSEQUENCES

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Detailed calculations show that the two most important dynamical problems in the formulation of a theory of star formation (namely, the angular momentum and magnetic flux problems) can be resolved in that order by magnetic braking and ambipolar diffusion, respectively, relatively early during the collapse of an interstellar cloud or fragment. Although the physical processes involved are complicated and highly nonlinear and the formal solutions are mathematically nontrivial, they can often be elucidated by *exact* analogies with small-amplitude, transverse waves on strings, by a mechanical (or quantum mechanical) "leaky" system of N coupled oscillators, and by spinning coaxial metal disks joined by rubber bands and sharing (as well as losing to an external medium) energy and angular momentum (see Mouschovias and Morton 1985a, Astrophys. J. 298, 190; 1985b,Astrophys. J. 298, 205, Mouschovias and Paleologuo 1979, Astrophys. J. 230, 204; 1980, Astrophys. J. 237, 877).

Torsional Alfvén waves generated by a fragment's rotation bounce back and forth among magnetically linked fragments or cores (with a crossing time $\tau_0 \cong 10^6$yr between consecutive fragments) setting the fragments into successive high and low spin states before they eventually carry the rotational kinetic energy of the system of fragments plus interfragment medium away into the medium beyond the outermost fragments. There is only one dimensionless free parameter σ in the problem, namely, the ratio of half the moment of inertia of a fragment and that of the medium between two consecutive fragments; it normally decreases as a fragment of constant mass contracts gravitationally. Observations suggest that $\sigma < 1$. A fragment's angular momentum decreases exponentially in time with a characteristic time $\tau_{11} = \sigma\tau_0$. Resolution of the angular momentum problem for an individual fragment can be achieved in a fraction of the Alfvén crossing time in the low-σ cases, whereas it takes many bounces of the torsional waves between fragments in the high-σ cases. Even if the physically more meaningful, low-σ cases, however, the problem is regenerated by returning torsional waves. For star formation to take place in magnetically linked fragments (or cores), the magnetic field should decouple from the matter during the low-spin phase — not only a likely, but perhaps an inevitable possibility because gravity is unopposed by centrifugal forces at that stage. In the low-σ cases, the *net* angular momentum of the system decreases to a negligible value in a time less than $2\tau_0$, but considerably energy and rms angular momentum remain in the system for a much longer time. These quantities (normalized to their initial values) decrease in time in a step-function manner, with the mean behavior being represented by the power laws $< E_{sys}(t) > = [2(t/\tau_0)+1]^{-\frac{1}{2}}$ and $J_{sys,rms}(t) = [2(t/\tau_0) + 1]^{-\frac{1}{4}}$, respectively. This sharing and trapping of energy in a system of magnetically linked fragments has important consequences for star formation and for interpretation of observations of rotating fragments or cores (e.g. it can cause a fragment to rotate near or even above breakup).

Detailed calculations of collapsing model fragments (Paleologou and Mouschovias 1983, Astrophys. J. 275, 838; Mouschovias, Paleologou, and Fiedler 1985, Astrophys. J. 291, 772) show that, typically, ambipolar diffusion sets in molecular cloud cores at densities as low as 10^4 cm^{-3}, progresses relatively rapidly by a density 10^6 cm^{-3}, and resolves the magnetic flux problem at neutral densities $< 10^9$ cm^{-3}, but larger than those by which the angular momentum problem is resolved by magnetic braking. Other predictions of these calculations concern differential velocities between ionized and neutral species, the existence of shocks in cloud cores as well as envelopes, and the strength of the magnetic field for neutral densities above about 10^5 cm^{-3}. [The relation between the field strength B and the gas density n in self-gravitating clouds while flux-freezing still holds was determined earlier (Mouschovias 1976a, Astrophys. J. 206, 753; 1976b, Astrophys. J. 207, 141), and is given by $B/B_0 = (n/n_0)^{\frac{1}{2}}$, where $B_0 \cong 3$ μG and n_0 is the density of protons at which self-gravity becomes strong enough to compress the field lines in the lateral direction and beyond which the above B-n relation is established; it is given by $n_0 = 137\ B_0{}^{3/2}/M^{\frac{1}{2}}$, where B_0 is measured in microgauss and the cloud mass M in solar masses (see review 1985, Astron. and Astrophys. 142, 41)].