FRAGMENTATION OF COLLAPSING GAS CLOUDS

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In simulations of the collapse of gas clouds it is usual to start from a uniform sphere the evolution of which is determined by the two energy ratios = Thermal/Gravitational and = Rotational/Gravitational. In numerical calculations the two parameters are unfortunately supplemented by a number of unknown factors related to the exact numerical treatment of the collapse. It is therefore crucial to compare the results of several different methods before any judgement is made concerning the correct evolutionary track of the cloud.

The first comparative study was made by Bodenheimer and Tscharnuter (1979) of an axisymmetric cloud with = 0.46 and = 0.32 which would reach a state of equilibrium. We have here recalculated this model using two different numerical codes:

	(N)	(S)
Coordinates	Spherical polar	Cylindrical
Difference schemes	First order (FLIC#)	Second order (AFBD)
Selfgravity	SOR	ADI

#) Angular momentum distribution corrected by Lagrangian test particles.

We find our results to be in good agreement with the B-T calculations except that no rings are formed in the later stages of the collapse. Both schemes conserve angular momentum satisfactorily but while the (N) code produces very faint transient rings these are absent from the result of the (S) code.

Bodenheimer, P. and Tscharnuter, W.M.: 1979, Astron & Astrophys. 74

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DISCUSSION

Bodenheimer: As far as the fragmentation problem is concerned, I don't think it is particularly important whether a ring forms or not. In the

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particular case you considered, we (Bodenheimer and Tscharnuter) didn't find that the ring was a dominant feature in the calculation. Equilibrium isothermal disks have been shown to be unstable to fragmentation.

Mike Norman has come to the conclusion that the uniformly rotating uniform sphere is a singular initial condition which probably produces a disk solution rather than a ring solution. However, any slight deviation from that angular momentum distribution results in a ring solution. Thus even very small numerical effects could induce the ring solution. What happens when you apply your calculation to a cloud that is unstable to collapse, rather than to one that reaches an equilibrium?

Sørensen: In these cases I still obtain no ring. The response is increased slightly, but the gradients are also larger. The boundary conditions are, however, unusual and could affect the ring formation.

Roxburgh: Have different codes been used for the same problem and obtained the same results? If not, is this not a cause for concern and why should we believe anyone's results?

Sørensen: No, exactly the same results have not been obtained, but you would not expect that. With more time available, I could point out all the similarites in the results from different codes. The major features are, in fact, quite similar. What we must do is to take the intersection of the different simulations and bilieve in those; but it is just as important to note the differences and to try to determine why they arise.