THE RESPONSE OF THE ENSEMBLE OF MOLECULAR CLOUDS TO BAR FORCING IN A GALAXY DISK.

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How a bar potential can force a spiral structure in the gas component is now well understood. This response is due to the dissipative character of the gas. Results of the computations of the response differ greatly with the numerical code adopted, either particle (Schwarz 1981), or hydrodynamic (e.g. Sanders and Huntley, 1976) and within a given code, with the spatial resolution used, since the artificial viscosity is thus varied (see e.g. van Albada et al 1981). According to observations, the gas component is mostly cloudy. Hence our aim is to compute the response to a bar potential of the ensemble of molecular clouds for which collision rate (and therefore dissipation rate) is relatively well-known.Using a particle code and explicitly treating the collisions between clouds, the viscosity parameter is more easily controlled and less artificial. Also, since the mass transfer between clouds is taken into account, we will obtain insight into the formation of large molecular clouds, which are the preferential sites of active star formation.

The model = The bar potentials we use come from previous N-body computations (Combes and Sanders 1981), after transformation in analytic functions (polynomial fits). The collision model is described in Casoli and Combes (1982). The gas component is described by molecular clouds from $5\ 10^2$ to $5\ 10^5\ M_\odot$. The result of a collision is 1,2 or 3 fragments according to the impact parameter. Giant Molecular Clouds ($M > 2\ 10^5\ M_\odot$) have a finite lifetime of $\tau = 4\ 10^7$ years, and are dispersed by star formation. Their mass is recycled in small fragments with velocities of 15 Km/s.
Results = Figures 1 and 2 show the gas response to a strong bar (Qt the ratio of total tangential force to radial one is 70 %). An open spiral structure arises in the cloudy medium in less than one rotation and lasts until the end of the simulation (7 rotations). GMC are concentrated in the spiral arms. The spiral structure is even more contrasted in the plot of the total energy dissipated in collisions (fig. 2) = most collisions occur in the arms. A test run has been computed with the same potential but without collisions. A transient spiral structure also arises, but disappears in less than one rotation. In the case of a weaker bar (Qt $\sim$ 20 %) the spiral structure is less contrasted in the gas component, but collisions also occur only in the arms. This case has

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been run for 10 rotations. The spiral structure remains in the disk and no ring is found to appear at outer Lindblad resonance.

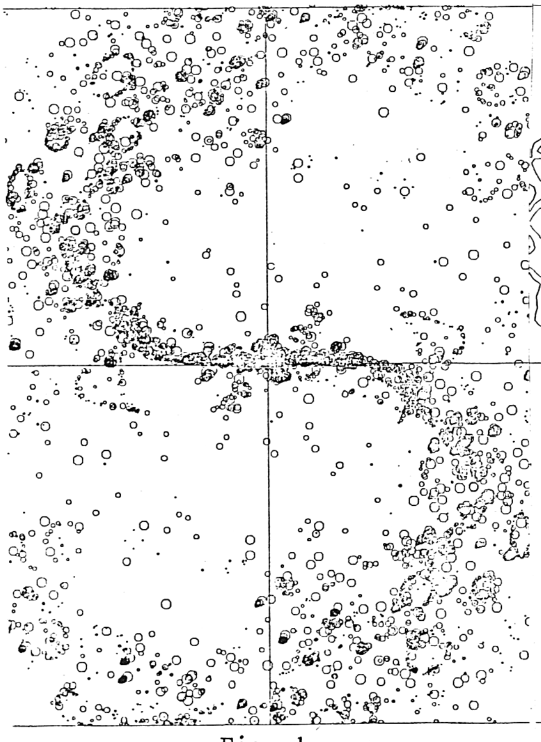

Fig. 1

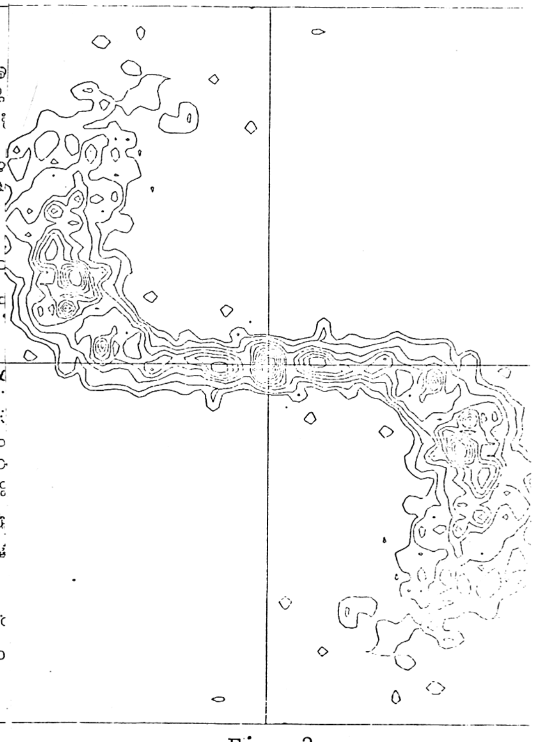

Fig. 2

Fig. 1 : plot of molecular clouds of different sizes in a strong bar (bar // Ox) at 2 rotations. Note the kinds of shell, consequences of recycling of mass after star formation.

Fig. 2 : Plot of total energy dissipated in collisions for the same run.

References

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