RELATION BETWEEN STAR FORMATION AND ANGULAR MOMENTUM IN SPIRAL GALAXIES.

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Abstract. We derive the radial distribution of the specific angular momentum $j=J/M$, for the gas in M31, M51 and the galaxy, objects for which well observed unsmoothed rotation curves are available in the literature. We find the specific angular momentum to be anti-correlated with the present stellar formation rate, i.e. minima of spin angular momentum correspond to the loci of spiral arms. We find that the stellar formation rate is an inverse function of j. We derive new values of Oort's A constant for the arm and interarm regions in the solar neighborhood.

High quality Hα or 21-cm rotation curves of galaxies give rise to the angular velocity, Ω, as a function of radius. This unsmoothed rotation curve refers to a particular direction to the galaxy. Through numerical differentiation one obtains the curve of Oort's A constant $A(r) = -r/2\ [d\Omega(r)/dr]$. Since A is the vorticity, the specific angular momentum j of a cloud, due to differential rotation, is given by

$$j = A\ R^2$$

where R is the radius of the cloud. In this way, A is proportional to j, for "standard" clouds of a given R. A comparison of A(r) and the stellar formation rates (the latter determined by the emission measure of radio recombination lines) is shown in Figure 1 for the Galaxy. One can easily notice that minima of j correspond to an efficient star forma-

TABLE 1

Object	k (adopted)	s (derived)	correlation coefficient
The Galaxy	1	1.21±0.3	0.67
	2	1.26±0.3	0.66
M31	1	0.7 ±0.4	0.57
	2	0.12±0.3	0.74
M51	1	0.66±0.3	0.77
	2	0.51±0.3	0.68

$$\langle s \rangle = 0.91 \pm 0.3$$

E. Athanassoula (ed.), Internal Kinematics and Dynamics of Galaxies, 135–136.

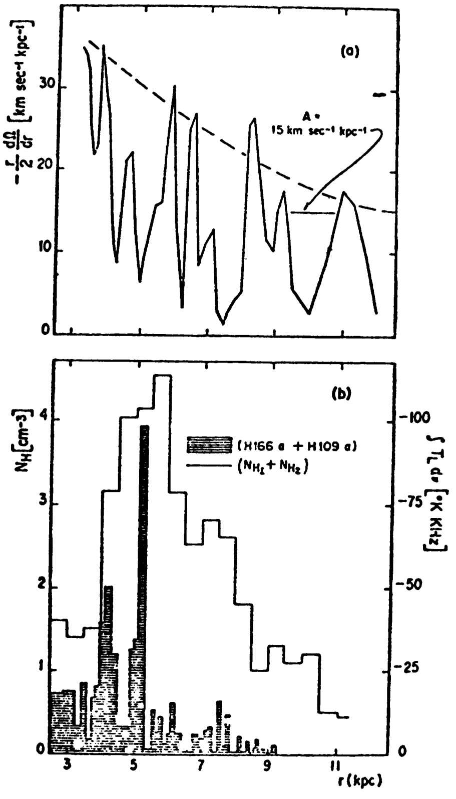

Figure 1. The derived values of Oort's A constant are plotted as a function of galactocentric distance r for the Milky Way. The dashed curve represents the value of A associated with a differentially rotating disk with σ=8 km s^{-1}. IAU's value of A for the solar vicinity is plotted as reference. 1b.- Histograms of the radial distribution of gas (solid line, Gordon and Burton 1976), and of the radial distribution of H II regions (hatched area) for the Galaxy. The latter being proportional to the stellar formation rate.

tion. This indicates that the gas located in spiral arms is rotating -to a first approximation- as a rigid body. Equality of radial an tangential velocity dispersions for OB stars is consistent with a value A=0. The rotational data used in this paper is that of Burton and Gordon (1978) and Jackson et.al. (1979). While the recombination line data are those by Lockman (1976) and Hart and Pedlar (1976). From Figure 1 one can derive new local values of Oort's A constant for the arm and interarm regions

$$A(\text{interarm}) = 18 \text{ km s}^{-1} \text{Kpc}^{-1}$$
$$A(\text{arm}) = 3.5 \text{ km s}^{-1} \text{ Kpc}^{-1}$$

We propose a stellar formation value of the form

$$dN_*/dt \propto \rho^k \ j^{-s}$$

A least squares analysis of the Galaxy M31 and M51 is summarized in Table 1. From Figure 1 it is clear that gas density alone cannot describe in detail the radial trend of the star formation rate. The results presented in Table 1, for the exponent s, indicate that the stellar formation rates in spiral arns indeed vary as the inverse of the specific angular momentum j of the clouds.

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