# 13. KINEMATICS OF M 33, M 51 AND THE L. M. C.

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## 1. M 33

First interferometric results on M 33 in the Hα line at a dispersion of 20 Å/mm, involving 1048 radial velocities, have already been published (Carranza *et al.*, 1968). A new analysis with 3000 measures more will be published soon.

The main results are (see Figure 1):

(a) The arms and the disk of ionized hydrogen show pure circular motions, i.e. no systematic expansion greater than 5 km $s^{-1}$.

(b) The rotational velocity $\Theta$ in the arms at a distance $\varpi$ from the nucleus is given by $\Theta$ km $s^{-1} = 38\ \varpi^{1/2}$ kpc ($\varpi < 3.5$ kpc). The distance assumed is 690 kpc.

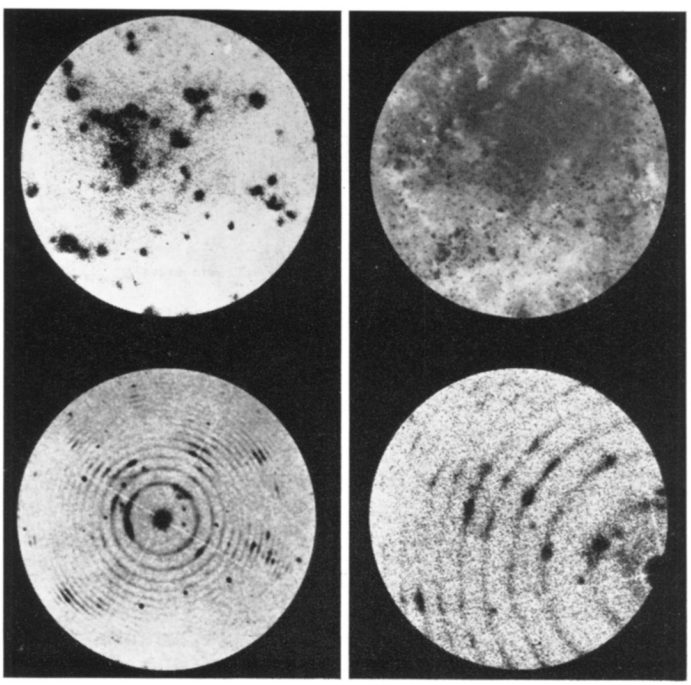

Fig. 1. This plate shows a field of 6′ diameter centered on M 33. *Upper right:* taken with a blue filter at the 77 inch Telescope of the Haute Provence Observatory. *Upper left:* taken with an interference filter 4 Å wide, in the Hα line with the 77 inch Telescope. *Lower right:* Pérot Fabry rings projected on M 33. Dispersion 20 Å/mm. Spatial resolution 2.5 second of arc with the 77 inch Telescope. *Lower left:* Pérot-Fabry rings projected on M 33. Dispersion 20 Å/mm. Spatial resolution: 1 second of arc. Taken with the Palomar 200 inch Telescope.

*Becker and Contopoulos (eds.), The Spiral Structure of Our Galaxy*, 73–78. 

(c) The mass of luminosity ratio increases from $\sim 1$ in the center to 10–15 at 7 kpc from the nucleus – in good agreement with previous results of Brandt (1965) and Gordon (1969). This suggests that even in an early type galaxy like M 33, the bulk of the mass distribution comes from population II stars.

(d) On the major axis, the rotational velocity in the concavity of the arms is smaller – by about 15 km $s^{-1}$ – than in the arms. This remarkable property seems to be closely related to the gravitational waves postulated by Lin and Shu (1964) to explain the persistence of spiral patterns in the disk of galaxies. However Lin's theory foresaw that a gravitational potential created by a density concentration in the arms gives a velocity perturbation where the disk material rotates faster in the concave side of the arms, in contradiction with the experimental result. (See Figure 2).

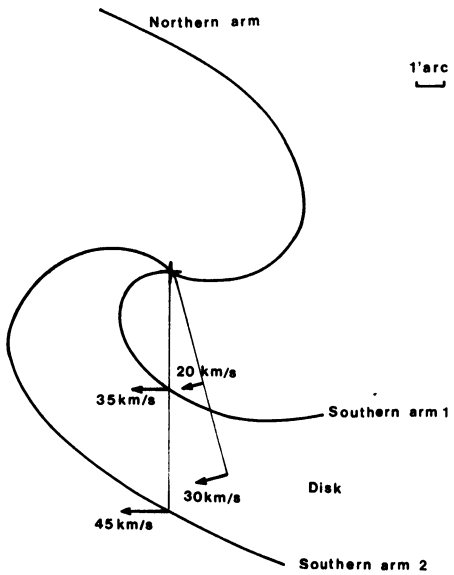


Fig. 2. Observed velocity perturbation in M 33.

## 2. M 51

A detailed kinematic study of M 51 has been given by Carranza *et al.* (1969).

The two photographs show M 51 (Figures 3 and 4) in blue light (stars continuum) and in Hα light. One can see that the well-known spurs are no longer visible in Hα. Very often pieces of spiral arms in our Galaxy are called spurs, for instance in Orion or in Vela: they have probably nothing to do with spurs, as they are rich in bright H II regions. On the other hand, they may be like broken fragments of spiral arms as one can see in M 51 itself and on many other galaxies.

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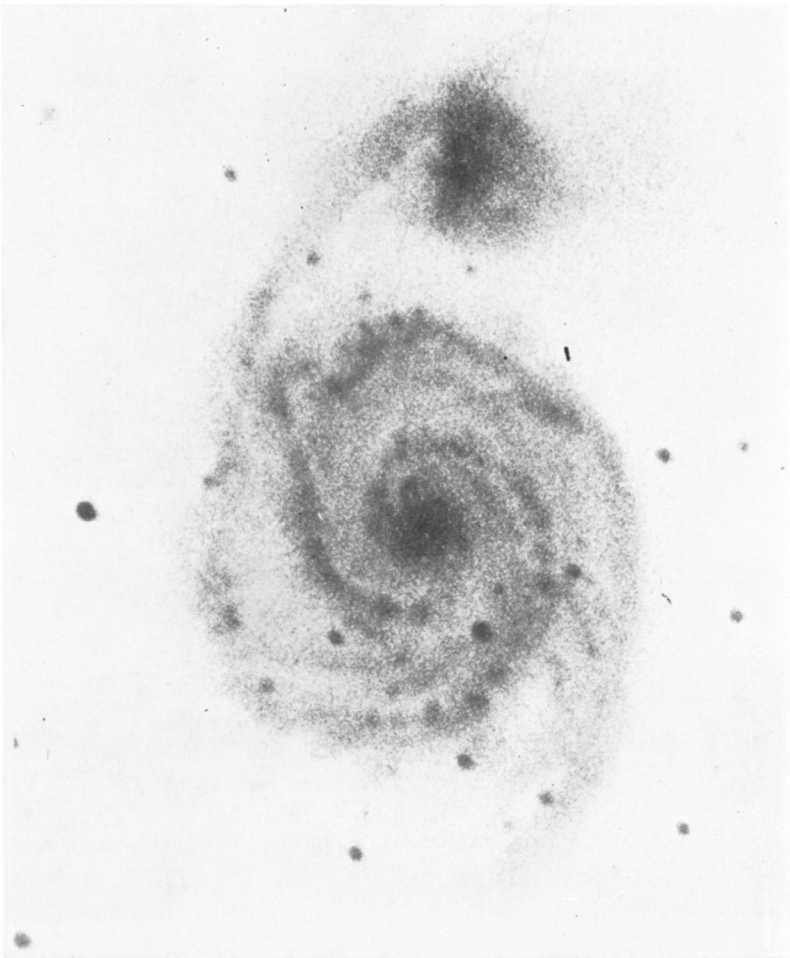

Fig. 3. Photograph of M 51 taken through a color filter centered at 4600 Å. One can see numerous inter-arm links between the main arms.

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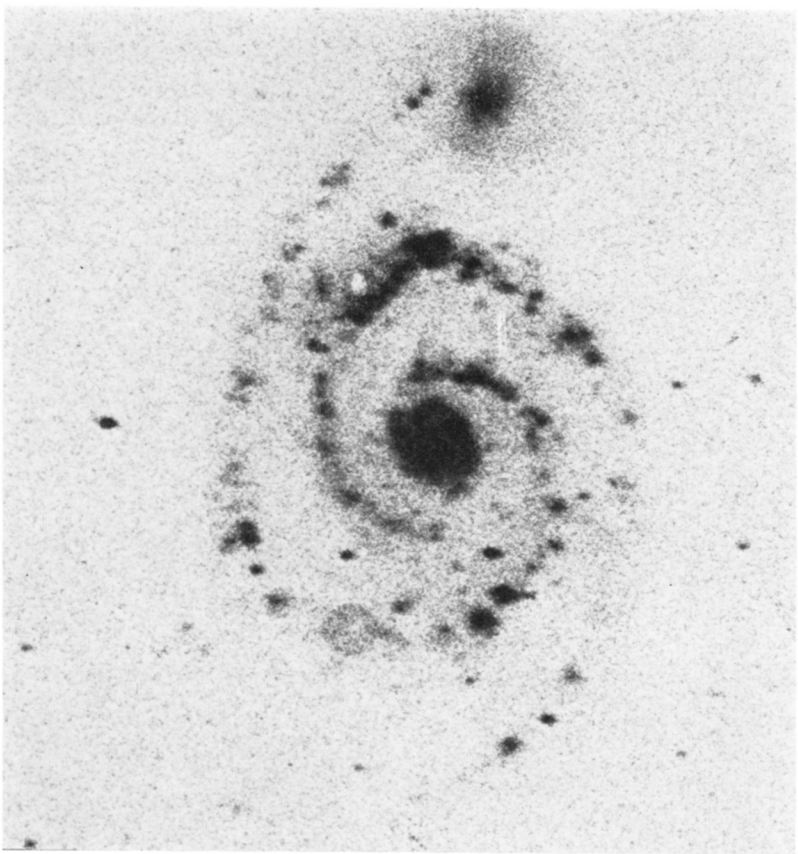

Fig. 4. Photograph of M 51 in Hα light (interference filter 8 Å wide). The arms are specially well defined from HII regions.

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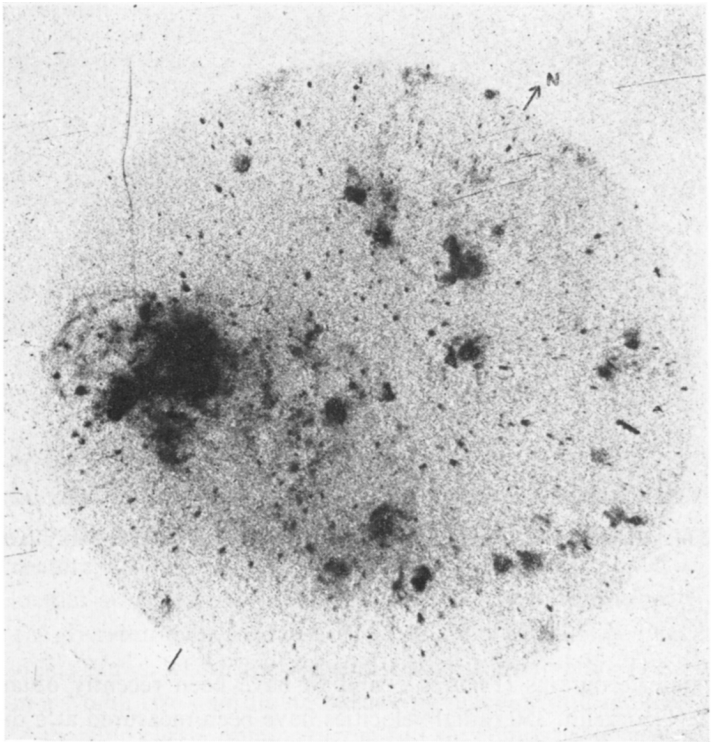


Fig. 5. Large Magellanic cloud. Photograph in Hα light with an interference filter of 10 Å wide. Field 4°.5 in diameter.

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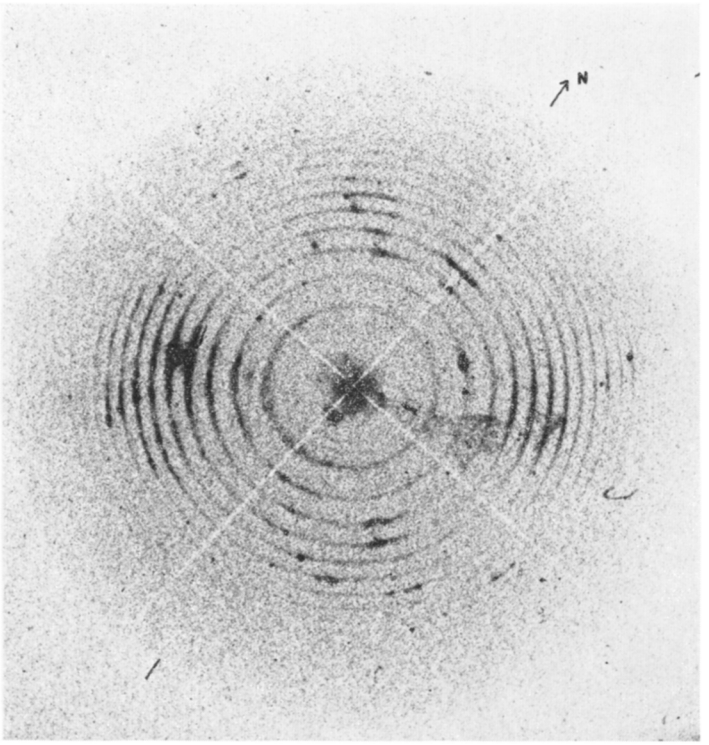


Fig. 6. Large Magellanic cloud. The same field as in Figure 5. Rings of Pérot-Fabry in Hα ($p = 1060$).

## 3. L. M. C.

Pérot-Fabry interferograms (Figures 5 and 6) have been recently obtained in the L.M.C. by Y. Georgelin. 350 radial velocities have been measured at a dispersion of 20 Å/mm.

The first results are:

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|---|---|---|
| – Systematic velocity (sun): | 253 | km $s^{-1}$ |
| – Maximum gradient of radial velocity: | 12 | km $s^{-1}$ $degree^{-1}$ |
| to be compared with the Feast (1964) value: | 14 | km $s^{-1}$ $degree^{-1}$ |
| – Mean velocity of the Doradus Nebula: | 261 | km $s^{-1}$ |
| (Feast, 1964: | 259.7 | km $s^{-1}$) |

## References

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