NEW LIGHT ON THE CORRUGATION PHENOMENON IN OUR GALAXY

J.V. Feitzinger and J. Spicker
Astronomical Institute, Ruhr-University Bochum

This investigation presents a total picture of the well-known corrugation-phenomenon for the (heliocentric) longitude range 10° ≤ l ≤ 240° as derived from HI-studies. For each spiral arm of the spiral pattern of Simonson (1976), we derived the centroid of the HI distribution from the 21-cm line surveys of Weaver and Williams (1974), Sinha (1979), and Westerhout and Wendlandt (1982). The three-component mass model of Rohlfs and Kreitschmann (1981) was used to derive a radial-velocity field, which was supplemented by a radial expansion field and by density-wave kinematics. This combined field served to calculated kinematic distances. The warp was taken into account according to Henderson et al. (1982) and Kulkarni et al. (1982).

Fig. 1 shows the corrugated spiral arms as viewed from the NGP. Plus sign denotes above, minus sign below, circle in the plane. Fig. 2 gives the detailed configuration for the Perseus Arm (-I).

The corrugation scale length λ is defined as a wavelength, i.e., from maximum to maximum. The corrugation scale amplitude Δ is defined like a wave amplitude, i.e., between extreme values. Table 1 summarizes optical and radio observations in azimuthal direction, Table 2 the same in radial direction. In azimuthal direction, Schmidt-Kaler and House (1976) predict values of λ = 1.2 - 1.4 kpc and Δ = 200 pc for arm -I. In radial direction, Nelson (1976, 1980) predicts hydrodynamical oscillations with λ = 1 - 2 kpc and Δ = 140 pc. In azimuthal direction, three corrugation scales are clearly visible in almost every arm: 1) 1 ≤ λ ≤ 2 kpc, 2) 4 ≤ λ ≤ 7 kpc, 3) λ > 10 kpc. These scale lengths do not depend on the distances R_0 from the centre and have nearly the same value for every arm. The scale amplitude increases with increasing R_0, perhaps exponentially. In radial direction (across the galactic plane), there may be two different scale lengths ($\lambda \lesssim 3$ kpc and $\lambda \gtrsim 4$ kpc), one of which is not completely covered by our observations. Difficulties arise, because λ and Δ are of the same order in radial and in azimuthal direction, so that some sort of interference occurs. In conclusion, a corrugation effect is clearly visible in spiral arms as well as in the plane itself.

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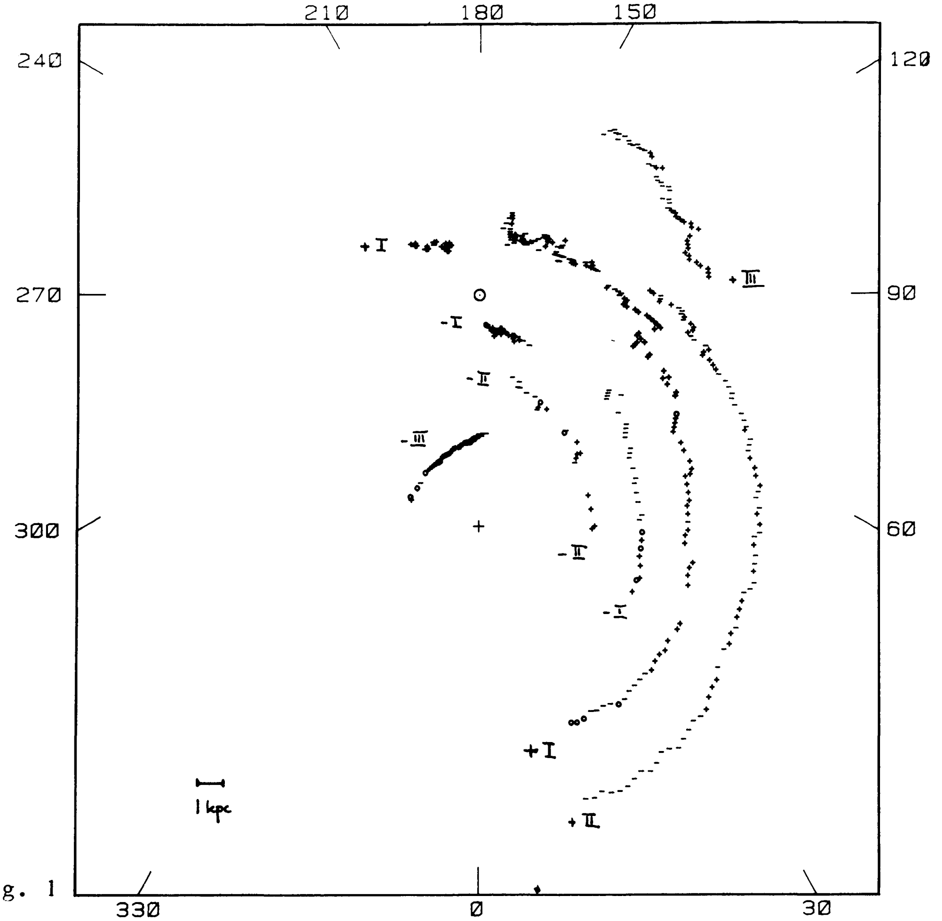

Fig. 1

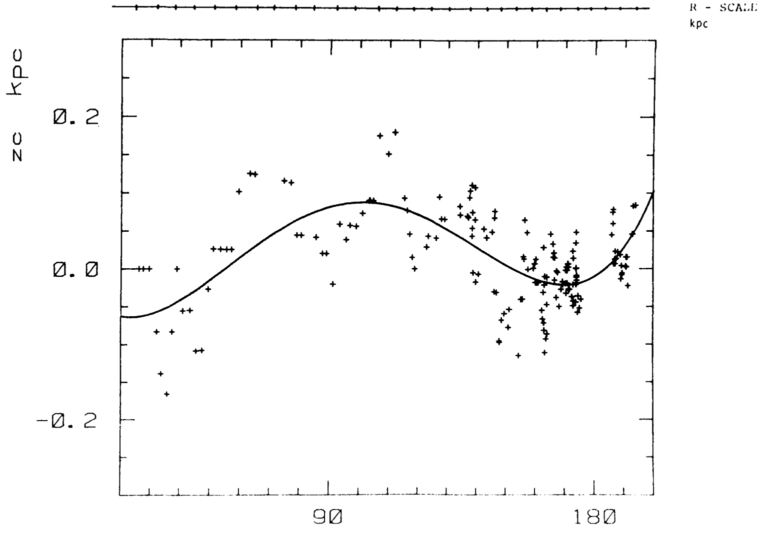

Fig. 2

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TABLE 1
Corrugations in azimuthal direction

Reference	Spiral Arm	Object	L-Range	λ kpc	Δ pc	Scale Assignment
This paper	-III	HI	350- 10	1.0	60	1
This paper		HI		4.2	90	2
This paper	-II	HI	30- 60	15.6	110	3
Schmidt-Kaler, Schlosser 1973	-I	Clusters, OB-assoc.		1.2	70	1
This paper		HI	30- 60	1.8	40	1
This paper		HI		6.0	125	2
This paper		HI		13.6	160	3
Dixon 1967	0	B0-B2 Stars		1.7	300	1
Lyngå 1970		OB Stars		0.8		1
Quiroga,		HI	60- 90	1.6	200	1
Schlosser 1977				1.3	300	1
Kolesnik, Vedenisheva 1979, 1981	+I	O-B2 Stars	80-270	2.0	150	1
Hidayat et al. 1982		WR-Stars		2.3	300	1
This paper		HI	10-250	1.7	140	1
Kolesnik, Vedenisheva 1979, 1981		O-B2 Stars	70-185	4.5	200	2
This paper		HI	10-250	6.0	180	2
This paper		HI		23.5	350	3
This paper	+II	HI	10-100	6.6	260	2
This paper	+III	HI	90-160	2.0	200	1
This paper		HI		4.3	350	2

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TABLE 2
Corrugations in radial direction

Reference		Object	R-Range kpc	λ kpc	Δ pc
Varsavsky, Quiroga	1970	HI	4 - 10	2.8	80
				2.8	90
				2.2	85
Quiroga	1974	HI	4 - 9	2.5	150
				2.8	160
				2.6	170
				1.5	100
Quiroga	1977	HI	4 - 8	2.3	160
				2.6	190
Lockman	1977	HII	3 - 9	4.5	100
				3.8	110
				2.2	80
Quiroga	1978	CO	4 - 8	2.3	240
Milne	1979	SNR	3 - 13	6.0	280
Janes, Adler	1982	Open clusters	6 - 10	1.3	150
Sanders	1983	CO	3 - 8	4.2	40
This paper		HI	4 - 12	4.0	120
				4.2	180
			4 - 11	3.8	90
				4.3	90
			6 - 11	4.3	130

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