FOURIER ANALYSIS OF A SPIRAL GALAXIES SAMPLE:
DETERMINATION OF KINEMATIC AND MORPHOLOGICAL
PARAMETERS

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RESUMEN
Presentamos resultados parciales de un trabajo mas extenso que busca determinar las corrotaciones en una gran
muestra de galaxias espirales del tipo grand design. Hemos buscado resonancias de corrotación (CRs) en cinco
galaxias espirales del hemisferio norte: NGC 266, NGC 1520, NGC 1530, NGC 2543 y NGC 7479. Podemos
descartar algunos de valores de CRs detectados cuando percibimos la presencia de bandas de polvo en barras,
están asociados con características locales o simplemente existe una baja relación señal-ruido en tales regiones.
Detectamos dos CRs en NGC 2543 y NGC 7479. Por medio de la transformada de Fourier bidimensional
determinamos las componentes principales del espectro de Fourier y el ángulo de avance de los brazos espirales
para 19 galaxias de nuestra muestra. En todas las galaxias el modo m=2 es el más importante. Sin embargo,
detectamos la presencia del modo m=3 en 5 de tales galaxias (NGC 151, NGC 1241, NGC 4254, NGC 5427 y
NGC 7753). No encontramos correlación entre el ángulo de avance de la componente principal de las galaxias
y su tipo morfológico.

ABSTRACT
We present partial results of a larger work searching for corotations in a large sample of grand design spi-
ral galaxies. We have searched for corotation resonances (CRs) in five northern spiral galaxies: NGC 266, NGC 1520,
NGC 1530, NGC 2543, and NGC 7479. We can reject some detected CRs values in those galaxies
when we perceive dust lanes in bars, we can associate the (CR) with local features or simply there is a low
signal-noise in these regions. We have detected two CRs in NGC 2543 and NGC 7479. Using the 2D Fourier
technique we have determined the main spectrum components for the spiral pattern and the pitch angles of
the spiral arms for 19 galaxies of our sample. In all the galaxies the m=2 mode is the most important one. How-
ever, we have detected the presence of strong m=3 modes in five galaxies of our sample (NGC 151, NGC 1241,
NGC 4254, NGC 5427, and NGC 7753). We did not find correlation between the main pitch angle of the galaxies
and the morphological type.

Key Words: GALAXIES: KINEMATICS AND DYNAMICS — GALAXIES: SPIRAL — GALAXIES:
STRUCTURE — METHODS: NUMERICAL

1. INTRODUCTION
Shock-induced star formation in a stellar density
wave scenario produces an azimuthal spread of
ages across the spiral arms. At the CR, the angu-
lar velocity of the perturbation (Ωp) and that of the
stellar disk (Ω) coincide. A comoving observer at
the CR will see outward and inward the shock front
change from one side of the spiral to the other, conse-
quently reversing the order in which young and older
disk stellar populations appear in azimuthal profiles
across the arm.

2. THE METHOD
In order to detect the shock front jump, we ana-
lyze the relative behavior of the spiral density wave
and shock front phases, Θdw and Θsf, respectively,
by means of the Fourier transform of azimuthal pro-
files Jr(θ) given by:

\[ F_2(r) = \int_{-\pi}^{+\pi} I_r(\theta)e^{-2\pi i \theta} d\theta \tag{1} \]

The phase Θ(r) can be obtained for m=2 as:

\[ \Theta_2(r) = tan^{-1} \frac{Re[F_2(r)]}{Im[F_2(r)]} \tag{2} \]

where Re and Im mean the real and imaginary parts
of the complex Fourier coefficients (Puerari & Dot-
tori, 1997).

3. OBSERVATIONS
The galaxies presented in this work were observed
in 1998 November at INAOE (Cananea) 2.11 m tele-
scope. For each galaxy, one image in B and three
images in I filters were taken. The standard re-
duction was carried out using the IRAF package.

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4. COROTATIONS

In Figure 1 we present the azimuthal profile phase difference (APPD, see Vera-Villamizar et al., 2001) diagram and the B image of NGC 2543 showing the CRs radii. In this case we have two CRs located at 27 and 43 arcsec. We assume that an azimuthal profile phase difference that locally reaches values larger than 3σ constitutes a real signal. We present in Table 1 the CRs values for the five galaxies analyzed and the arm character (leading or trailing) at CR.

5. M=3 COMPONENT

We follow EEM92 (Elmegreen et al., 1992) procedure to detect 3-fold symmetries. In our case, we detect the presence of a strong m=3 component in five galaxies of our sample (NGC 151, NGC 1241, NGC 4254, NGC 5427, and NGC 7753).

6. PITCH ANGLES

We use the main pitch angle of the principal component obtained from the 2D Fourier transform computed in all the 19 galaxies of our sample to search for a correlation between the morphological type. We do not found a clear tendency showing that the later morphological types were more open.

REFERENCES


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