Barred Galaxies
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Photometrical Mapping in Barred Galaxies: Analysis of the Different Components

D. Bettoni and G. Fasano

Padova Astronomical Observatory, Vicolo Osservatorio 5, 35122 Padova, Italy

G. Galletta

Department of Astronomy, University of Padova, Vicolo Osservatorio 5, 35122 Padova, Italy

Abstract. We analyzed a sample of SB0 galaxies in order to disentangle the structure of the bar and of the other components inside the galaxies. The disk and the bulge components, modeled by using the luminosity and geometrical profiles, have been subtracted from each galaxy image in order to obtain the image of the bar. This allowed us to analyze in detail the bar structure, in particular its shape and its luminosity profile. Both uniform and saddle-shaped bars have been detected.

1. Introduction

To better understand the structure of the bar as a triaxial structure, we started a program of kinematics and photometry of SB0 galaxies. These galaxies are good candidates for this kind of analysis, because of the low quantity of gas and dust present in them.

The morphology of barred galaxies is, in general, very diversified (Sellwood & Wilkinson 1993): the size of the bar relative to the host galaxy can be variable; in some cases there is the presence of an inner and/or an outer ring; the hot and cold gas and the dust content vary considerably from galaxy to galaxy.

In spite of this, only three kinds of bar structure are actually observed: ellipsoidal, pointed and rectangular bars (Bosma 1992). In this paper we analyze the structures of the bars, and we outline the different shapes observed.

2. Observations

Images of the galaxies were obtained, in the V waveband, using the 320×512 RCA CCD at the ESO-Danish 1.5m telescope. The pixel size on the sky was $0''.24$. The frames have been corrected for bias, dark and flat field using the ESO IHAP package.

The luminosity and geometrical profiles, after sky subtraction, have been obtained by means of the Astronomical Images Analysis Package (AIAP, Fasano 1990). This package provides the ellipse fitting of each isophote giving its major axis radius (a''), ellipticity (ϵ) and position angle (PA). In addition, it computes

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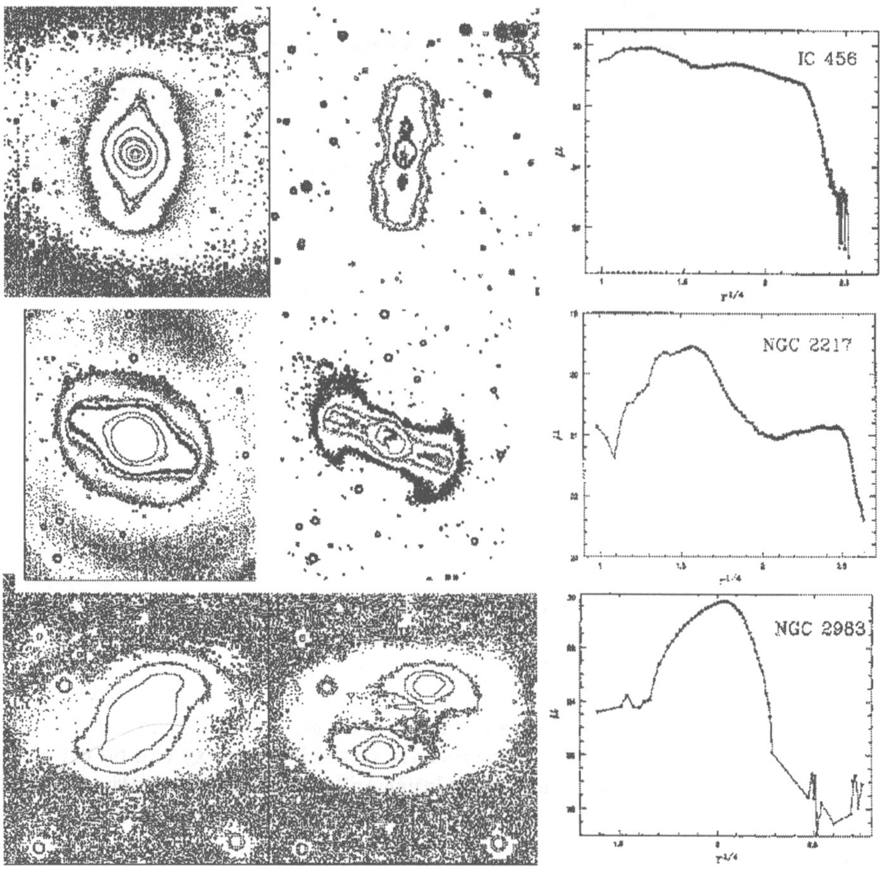

Figure 1. Isophotes of the galaxy (left column), of the bar component, after the subtraction of the bulge and disk model (middle column), and luminosity profile of the bar (right column); the three more common luminosity profiles are shown.

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the a_4 coefficient, quantifying the deviations of the isophotal contour from the perfect ellipse ($a_4 > 0$ for the pointed isophotes; $a_4 < 0$ for the rectangular ones). The AIAP technique allows us to derive, from the observed luminosity and geometrical profiles, the bidimensional models of both bulge and disk components.

Synthetic images produced by these models are subtracted from the original bidimensional frame producing the image of the "naked" bar. We extracted the luminosity profile of this bar image as residual and we analyzed the various kinds of profiles observed.

3. Discussion

The main result of our study confirms that various kinds of bars are present along the Hubble sequence. In Figure 1 the most common bar structures we detected are shown:

- **Uniform bars**: in this case the bar structure is visible along all the disk of the galaxy and its luminosity profile is quite regular. This is, for instance, the case of IC 456.
- **Bars with an inner disk**: in the central regions of the bar there is a disk. This disk can be stellar and/or gaseous. In this case the luminosity profile is less regular and shows a peak of luminosity at intermediate distance from the center of the galaxy, in the region in which the inner disk dominates. A typical case is NGC 2217.
- **Saddle-shaped bars**: the bar is clearly formed as a saddle and only two luminous spots are visible along the bar axis at opposite positions with respect to the center of the galaxy. The luminosity profile shows two peaks located at the bar edges. A good example is NGC 2983.

Uniform bars correspond to models where the bar is a structure filling the inner disk and tumbles as a uniform wave (Sellwood & Wilkinson 1993). Saddle bars are similar to the structure produced by the "modal approach" to the study of the spiral structure (Bertin et al. 1989).

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