Thick Boxy Bulges in NIR

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We present first results from NIR observations of five selected "Thick Boxy Bulge" (TBB) galaxies obtained with the MPIA 1.23m-telescope at Calar Alto (Spain). All galaxies show the presence of strong asymmetries in their light distribution. These (sub-)structures are interpreted as possible relics of recent accretion events.

1 Introduction

In order to explain the high frequency of box- or peanut-shaped bulges in disk galaxies the bar buckling instability (Combes & Sanders 1981) has become the favored model for their formation. This scenario – resulting from N-body simulations and confirmed by gas-kinematical studies (Combes et al. 1990, Raha et al. 1991, Athanassoula & Bureau 1999; Kuijken & Merrifield 1995) – explains most cases well. However, it was reported earlier (Dettmar & Lütticke 1999) that the bar-resonance scenario fails to explain the morphology of bulges in the case of the TBBs class since the scaling relation between bar-size and box/peanut structure as caused by the resonance does not hold.

It has been suggested that after accretion of a satellite by a larger system, the bulge grows and its profile index n increases proportional to the satellite mass from 1 for Sc to 4-6 for S0 (Andredakis et al. 1995), where n is the exponent index in Sersic's law $\mu(r) \approx r^{1/n}$. This hypothesis that accreted material can efficiently drive the growth of the bulge – increasing the index n – is also supported by N-body simulations (Aguerri et al. 2001).

The main goal of the work presented in this progress report is to test the hypothesis of a soft merger as a possible explanation for the thickness and boxiness of these bulges. The galaxies were observed as part of a project to study the relationships between TBBs and the interactions with their external environment in a sample of edge-on disk galaxies. In Tab 1. we present the selected objects.

2 The Data

The presented images were obtained using the MAGIC-camera at the MPIA 1.23m-telescope at Calar Alto (Spain) in September 2000. MAGIC consists of a 256x256 NICMOS-chip and provides a field of view of $300''$ with a resolution of $1\overset{''}{.}2$ /pixel when mounted at the 1.23m-telescope.

Seventy up to hundred exposures of the galaxies, interlaced with equal exposures on the sky were summed and subtracted respectively to give the final images using standard NIR techniques.

3 Results

Fig. 1 shows the resulting isophote images of the surface brightness for the galaxies rotated to the major axis (*left*). The contours are plotted equally spaced, starting from the brighter contour down

"Dwarf Galaxies and their Environment"; Bad Honnef, Germany, 23-27 January 2001; Eds. K.S. de Boer, R.-J.Dettmar, U. Klein; Shaker Verlag.

to the limiting surface brightness. Also shown are the radial profiles along the major axis (*right*).

The individual characteristics of the target galaxies:

- NGC 1030: the contours are distorted and a region of spread emission is observed on the right-hand side, while at the opposite edge the contour lines are pulled out and up. No sign of a bar is present.
- NGC 1055: the contours reveal a strong bulge component of almost quadratic shape. No significant deviations are detected in the covered spatial range, but on the right-hand side the contours line of the disk are bending away from the central plane. A decreasing bump around $30''$ suggests the presence of a weak bar.
- NGC 1589: asymmetries are revealed at the edges of the main body. A strong bar can be detected at position $z = 7''$ above the plane.
- NGC 7183: irregularities in the light contents can be observed with respect to the centre, especially the left side has an elongated profile. No sign of a bar is revealed from the light profile.
- UGC 9759: the asymmetries become important only at low surface brightnesses, where the contours at the NW and SE show similar irregularities. No sign of bar is revealed from the light profile.

In all galaxies the presence of asymmetries in the light distributions are evident. These asymmetries are interpreted as possible relics of recent accretion events. The presence of a bar is revealed in two of the five observed galaxies.

Minimizing the effect of dust, the luminosity profiles were taken along the minor axis, and plotted versus r, $r^{1/2}$, $r^{1/3}$ and $r^{1/4}$. In Tab. 1 we have computed the morphological type and the profile index n. Comparing our values with the results of Andredakis et al. (1995) and Kent (1986), no obvious conclusions can be obtained for the TBBs about the correlation of the bulge profile with the morphological type.

References

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Table 1: **The Selected Objects**

Galaxy	**RA (J2000)**	**DEC (J2000)**	**Morph. Type**	**T**	**n**	**Group**
ESO013-G012	01 07 00.0	−80 18 23.7	S0/a	0		–
NGC1030	02 39 50.8	+18 01 27.0	S0*	−2	2 **	PP2 173
NGC1055	02 41 45.4	+00 26 35.0	SBb	3	2 **	LGG 73
NGC1589	04 30 45.50	+00 51 51.0	Sab	2	2 **	LGG 117
UGC3458	06 25 55.40	+64 44 25.0	Sb	3	3	?
ESO494-G022	08 05 32.37	−24 48 50.0	Sa	1		?
NGC3573	11 11 18.98	−36 52 24.8	S0/a	0		LGG 229
NGC4224	12 16 33.72	+07 27 43.9	Sa	1		LGG 281
ESO506-G003	12 21 49.53	−25 04 38.4	Sab	2	2	?
ESO322-G100	12 49 26.69	−41 27 47.8	S0	−2	2	LGG 305
ESO383-G005	13 29 23.73	−34 16 23.5	Sbc	4	3	LGC 353
ESO021-G004	13 32 39.64	−77 50 31.7	S0/a	0		–
NGC5719	14 40 56.43	−00 19 07.5	Sab	2		LGG 386
UGC09759	15 10 41.10	+55 21 00.0	S0a*	0	3 **	LGG 395
ESO514-G005	15 19 03.07	−23 49 16.4	Sa	1		?
UGC10205	16 06 40.29	+30 05 54.7	Sa	1	4	?
IC4745	18 42 35.68	−64 56 35.3	Sab	2	2	LGG 422
IC4757	18 43 55.73	−57 09 58.2	S0/a	0	3	?
NGC6848	20 02 46.93	−56 05 17.8	Sa	1		LGG 429
NGC7183	22 02 21.64	−18 54 58.5	S0	−2	1 **	–

Morph. Type: Morphological types of galaxies from the Third Reference Catalogue of Bright Galaxies (de Vaucouleurs et al. 1991); morphological types marked with an asterisk are taken from Skiff (1999).
T: numerical Hubble type T.
n, exponent index in Sersic's law: ** present work, else from Lütticke (1999).
Group: Membership in a group from NED, LGC numbers from Garcia (1993); ? = galaxies are fainter than the limit of completeness ($B_0 < 14$ mag) in the sample of Garcia (1993); – = isolated objects. presented ppresented presented sented

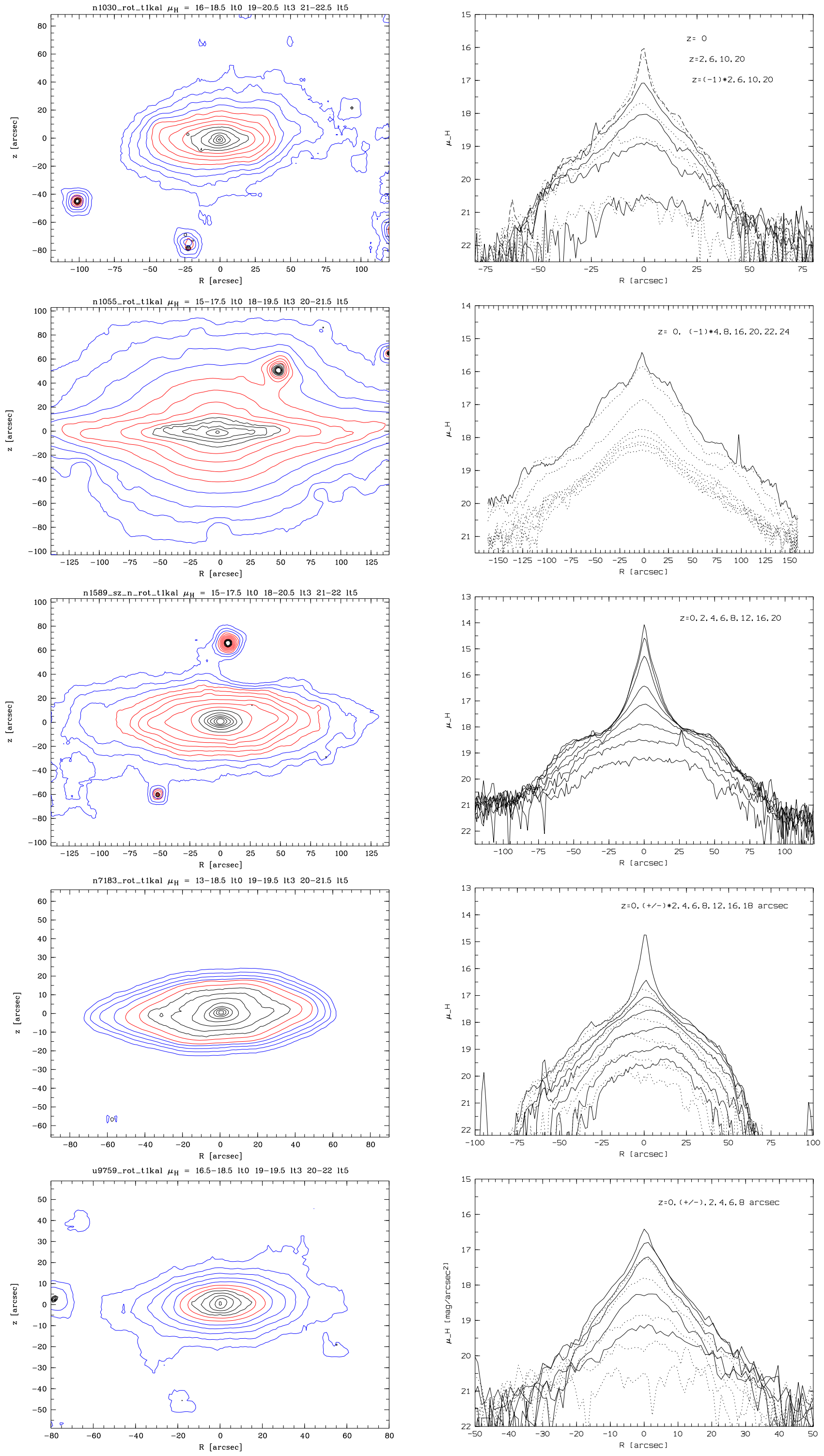

Figure 1: Isophote of the surface brightness rotated to the major axis (*left*), and radial profiles along the major axis (*right*) for NGC 1030, NGC 1055, NGC 1589, NGC 7183, and UGC 9757, respectively.