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Thick boxy bulges caused by interaction?

Conference Poster

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Publication date:
2003

Permanent link:
https://doi.org/10.3929/ethz-a-004582531

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Morphology and Kinematics of Thick Box/Peanut-shaped Bulge Galaxies

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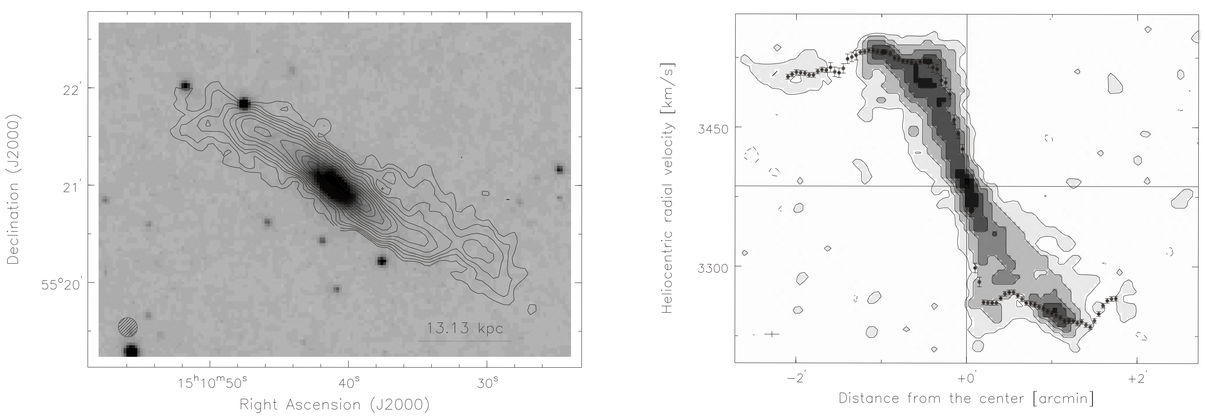
ABSTRACT

The close connection between bars and box/peanut-shaped bulges is observationally and theoretically supported. However, for the class of thick box/peanut-shaped bulges an environmental hypothesis instead of an internal mechanism is suggested to account for the prominence of the box/peanut component.
The main goal of this poster presentation is to report the results of a multi-wavelength study in a sample of thick box/peanut-shaped bulges in order to find out relics of interactions.

INTRODUCTION

A consistent fraction of bulges -- up to 50% -- deviate from the classical spheroidal shape and display excess light above the plane at galactocentric radii which appear box or peanut shaped when viewed edge-on.
There is a general agreement that a bar is related to the box/peanut shape of the light distribution (*secular evolution hypothesis*).
This connection is observationally supported by works on stellar kinematics (Bureau & Freeman 1999, Merrifield & Kuijken 1999), on statistical studies (Luetticke et al. 2000) and on direct cases (e.g. Bettoni & Galletta 1994, Quillen et al. 1996) as well as by recent N-body simulations (e.g. Athanassoula 2002).
All galaxies which a bar is detected in possess a BPS structure. However, cases of BPS bulges without traces of bars are well known. This might be caused either by the dissolution of the bar or by an alternative hypothesis for triggering BPS structures: By mergers without passing through the events of the bar formation (*environmental hypothesis*).



Example of a total HI column density distribution superimposed on an optical (DSS) image for a thick box/peanut shaped bulge galaxy (Left).
Position-velocity diagram obtained from the HI data cube and taken along the major axis (Right).
Rotation velocities for the approaching and the receding sides are superimposed.

AIM OF THE PROJECT

Based on the fact that interaction events produce a highly asymmetric distribution and complex kinematics of the gaseous component, large deviations from symmetry in the morphology and kinematics will indicate a galaxy which is interacting with nearby companions. In order to discern different BPS structure formation scenarios (*secular evolution* or *environmental hypothesis*) one of the diagnostics is the frequency of peculiarities of the thick BPS bulge galaxies.
We have studied the kinematics of the innermost region (by optical long-slit spectroscopy) and at larger scale (via HI 21-cm line) of these galaxies. Investigations of asymmetries in near-infrared images and kinematic indices on the HI observations were also performed. A new technique to derive the rotation curve from the HI observations was developed and applied.

Acknowledgments
DV acknowledges the Deutsche Forschungsgemeinschaft for a fellowship of the Graduiertenkolleg (GRK 118) and the European Commision for a Marie-Curie-Fellowship in the framework of the programme EARASTARGAL.

RESULTS

HI Morphology:
Large fraction of irregularities in the distribution of the HI and strong deviations from the disk planarity are detected: All the target galaxies are warped. Relicts of past interactions and signatures of on-going mergers are detected in the majority of the target galaxies.
Light Distribution:
Peculiarities in the light distribution and dust lanes even on several planes are often observed. They are interpreted as possible relics of recent accretion events.
Using the plateau of the light in the radial profiles, one strong bar and other three possibly weak bars are found among the fourteen galaxies observed in the near-infrared. In total, less than 30% of the target objects are barred galaxies.
From a vertical fit to the light distribution using the Sérsic functional form turns out that bulges are well described with the bulge parameter $n = 2$.
Vertical surface brightnesses in box/peanut bulges are structurally different from those of the more spheroidal bulges: Fainter effective surface brightnesses and larger effective radii are indeed detected in thick box/peanut bulges with respect to the classical box/peanut and spheroidal bulges.
Stellar and Gas Kinematics:
For a subsample of four galaxies, optical long-slit spectroscopy along the major axis was performed in order to investigate the kinematics of the stellar and gaseous components in the optical domain.
In three of the four studied cases the kinematics of the approaching and receding sides present some asymmetries: Rotation velocities rise with a different slope and are slightly differently extended.
In one case, a counter-rotating stellar system with the gaseous component is detected with a signature of a possibly second stellar population rotating with the gas. This system is the final result of a second event that occurred in the history of the host galaxy.
HI Kinematics:
The rotation curves of the observed galaxies are highly lopsided. They have been derived with a method which accounts for the changes in the kinematic axis of warped galaxies. In the case of \HI, which extends far beyond the optical body where self-gravity is weaker and warping more pronounced, the changes in the kinematic axis represent a severe effect to be considered in the procedure when extracting rotation curves.
In order to test the so-built HI rotation curve, model data cubes are developed for three of the galaxies in the sample: the synthesized data match the observations very well.
Asymmetries:
Based on asymmetrical indices, the near-infrared surface brightness in box/peanut bulges are found to be on average more asymmetric compared to the spheroidal bulges.
However, thick box/peanut bulges do not possess larger deviations with respect to the classical box/peanut bulges. There is no relation between morphological and kinematic asymmetries nor between these asymmetries and the general properties of a galaxy.
As a consequence of two or more un-correlated encounters of different

CONCLUSION

All these new results suggest a scenario in which interactions play a significant role in the history of thick box/peanut-shaped bulge galaxies (*environmental hypothesis*), and they have likely experienced a mass infall.

References

Athanassoula E. 2002, ApJ 569, L83
Bettoni D., Galletta G., 1994, A&A 281, 1
Bureau M., Freeman K.C., 1999, AJ 118, 126
Jog C.J., 1997, ApJ 488, 642
Luetticke R., Dettmar R.-J., Pohlen M., 2000, A&AS 145, 405
Merrifield M.R., Kuijken K., 1999, A&A 345, 47