

Vertical Surface Brightness Profiles of Boxy Bulges

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Abstract. The thickening of the bar in barred disk galaxies has a strong influence in shaping the morphology in the inner regions of a disk galaxy above the galactic plane. The result of such a secular evolutionary process can be observed in galaxies with box/peanut shaped (b/ps) bulges. We have applied a one-dimensional fitting method to our sample of 30 edge-on disk galaxies using different fitting function approaches. A clear increase in scale height can be observed in the area of the most prominent b/ps isophotes compared to the neighbouring disk and bulge areas, in agreement with the predictions of the bar thickening model.

Keywords. infrared: galaxies, methods: data analysis, galaxies: photometry, galaxies: evolution, galaxies: structure, galaxies: spiral, galaxies: bulges, instabilities

1. Box/peanut shaped bulges

The work of Bureau & Freeman (1999) showed that box/peanut shaped (b/ps) bulges can be observed frequently ($\approx 71\%$ of their sample) in barred edge-on disk galaxies. That result and the work of Bureau, Aronica, Athanassoula, *et al.* (2006) corroborated the view of a stellar bar as the primary driver for the formation of the b/ps structure. In fact, those structures can evolve from a vertical instability in the bar (bar buckling, e.g., Pfenniger & Friedli (1991)) causing a vertical thickening of that component (e.g., Patsis, Skokos, & Athanassoula (2002), Athanassoula (2005)) on secular timescales.

2. Analysis and results

In order to analyze the vertical surface brightness distribution we used K_n -band near infrared data of the sample galaxies described in Bureau & Freeman (1999) consisting of 30 galaxies. We have applied to the vertical surface brightness distribution of those galaxies a one-dimensional fitting approach based only on a thin disk component. The functions used were Sersic type functions, Gauss-Hermite polynomials, and the canonical exponential and sech type functions.

The innermost regions of the disk of galaxies with a b/ps structure are characterized by a global minimum in scale height (see Figure 1); a possible indication for a rather flat component like a compact cold disk. Further, the regions with the most prominent b/ps isophotes show higher values for the scale height compared to the neighbouring disk and bulge areas. Also, the shape parameters of all fitting functions used show rather flat-topped vertical surface brightness distributions, contrary to the outer disk regions. Both changes, the local maxima in scale height and the flat-topped shaped distributions in the region with the most prominent b/ps isophotes, are consistent with the model of b/ps bulge formation out of the thickening of the bar in those galaxies.

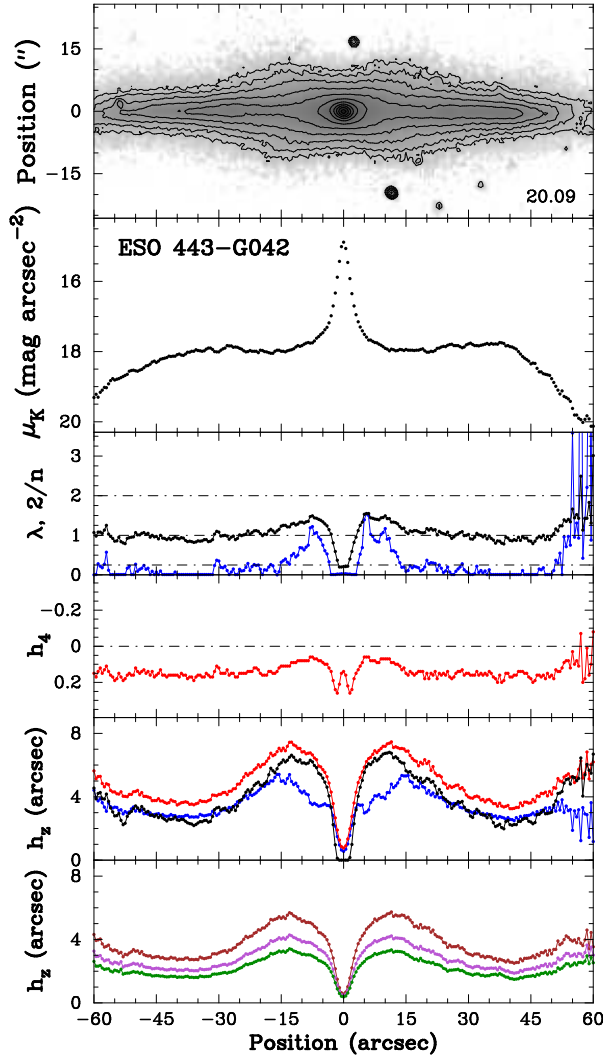


Figure 1. Results of the one-dimensional fitting approaches for the galaxy *ESO 443-G042*. In the first two panels, the grayscale K_n -band image with isocontours, respectively the radial surface brightness profile taken along the major axis of the galactic plane at $z = 0$ are plotted. The next two panels show the results for the shape parameters of a Sersic type (λ), a generalized sech type ($2/n$), and a Gauss-Hermite polynomial type (h_4) fitting approach. All those parameters are a measure for the peakiness of the fitted distribution. In the last two panels the fitted scale height for all fitting functions used is displayed; the upper one shows the results for the functions with varying shape, whereas the lower one the results for fixed shapes (e.g. an exponential function).

References

- Athanassoula, E. 2005, *MNRAS* 358, 1477
 Bureau, M. & Freeman, K.C. 1999, *AJ* 118, 2158
 Bureau, M., Aronica, G., Athanassoula, E., Dettmar, R.-J., Bosma, A., Freeman, K.C. 2006, *MNRAS* 370, 753
 Pfenniger, D. & Friedli, D. 1991, *A&A* 252, 75
 Patsis, P.A., Skokos, Ch. & Athanassoula, E. 2002, *MNRAS* 337, 578