Structural properties of edge-on galaxies

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Abstract. We performed two-dimensional bulge/disk decompositions based on a representative sample of edge-on galaxies mainly selected from the Sloan Digital Sky Survey in the optical and near-infrared passbands. Galaxies of all morphological types, i.e., bulge-dominated and bulgeless galaxies (including superthin galaxies), were analyzed. The new software pipeline DECA for performing automated decompositions and estimating structural parameters of galaxies is presented. This algorithm incorporated into DECA provides new capabilities to study large samples of edge-on galaxies allowing to find truncation radii and warp parameters of edge-on disks as well as to investigate the shape of the inner parts of galaxies (e.g., boxy/peanut-shaped bulges). The dust lane masking is applied to decrease the influence of the dust attenuation on the extracted bulge and disk parameters. Correlations of the resulting structural parameters of disks and bulges are investigated. Classical bulges and pseudobulges well differ in the correlations which can give a clue to the processes causing the formation of these different types of bulges. This work summarizes the main structural properties of edge-on galaxies that can be derived via photometric decomposition analysis.

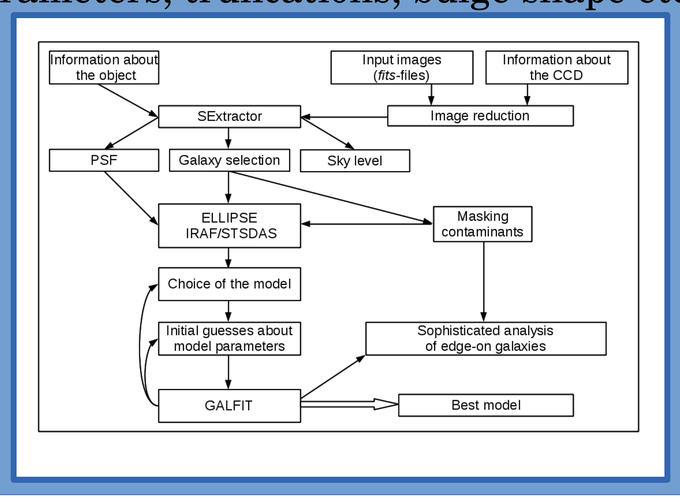
DEComposition Analysis

MAIN FEATURES AND ADVANTAGES

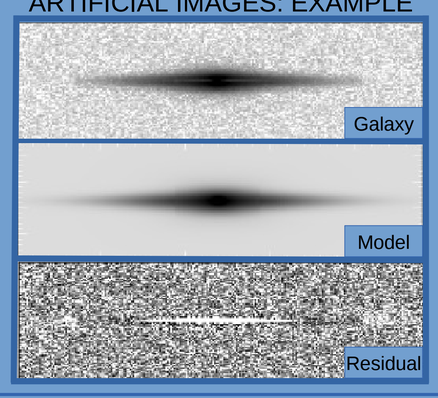
- Python wrapper with the implementation of IRAF, SExtractor and GALFIT
- Works with one image (object) or a list of images
- Initial guesses of fitting parameters are not required
- Flexible configuring if necessary
- Sophisticated analysis of edge-on galaxies (e.g., disk warp parameters, truncations, bulge shape etc.)

ROBUSTNESS

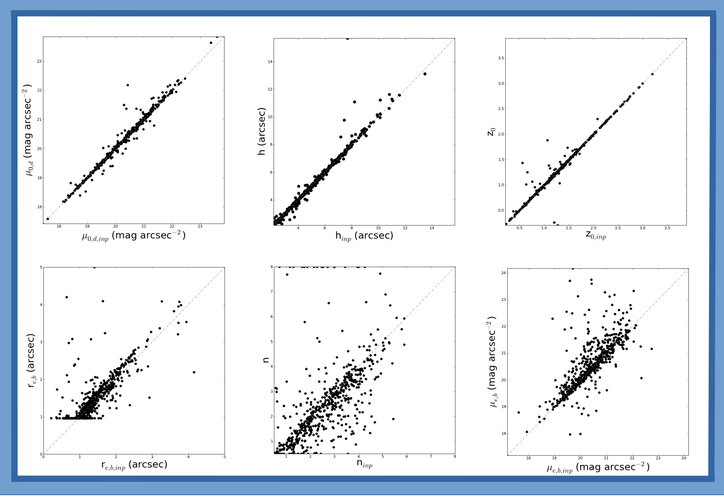
Tested on artificial images imitating SDSS-fields. Dust lane, Poisson noise and PSF convolution were applied to each galaxy image. Disk and bulge parameters were taken in large ranges of values.
RESULTS: DECA performs robust decompositions of galaxies (including **edge-on galaxies!**).



ARTIFICIAL IMAGES: EXAMPLE



Get source at: *http://lacerta.astro.spbu.ru/?q=node/96*

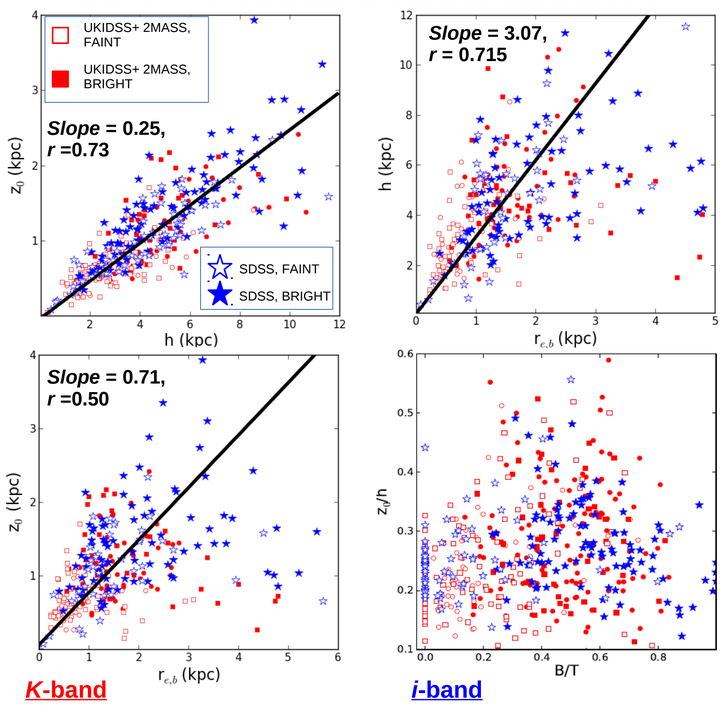


THE SAMPLES

The DECA code was applied to SDSS and UKIDSS samples. SDSS: **192** galaxies (*i*-band) & UKIDSS: **171** galaxies (*K*-band). Additional sample (Mosenkov et al. 2010): **175** galaxies (2MASS, *Ks*-band). TOTAL NUMBER OF UNIQUE EDGE-ON GLAXIES: **497**!
The largest sample of edge-on galaxies with 2D decompositions!

MAIN RESULTS

LINK BETWEEN BULGE AND DISK STRUCTURAL PARAMETERS

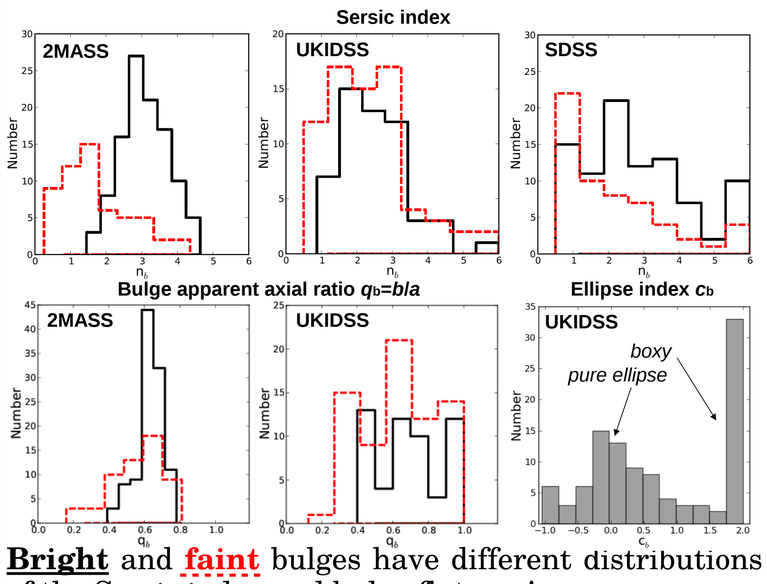


***K*-band**
Bright bulges: Mb<-22.5 mag
Faint bulges: Mb≥-22.5 mag

***i*-band**
Bright bulges: Mb<-19.5 mag
Faint bulges: Mb≥-19.5 mag

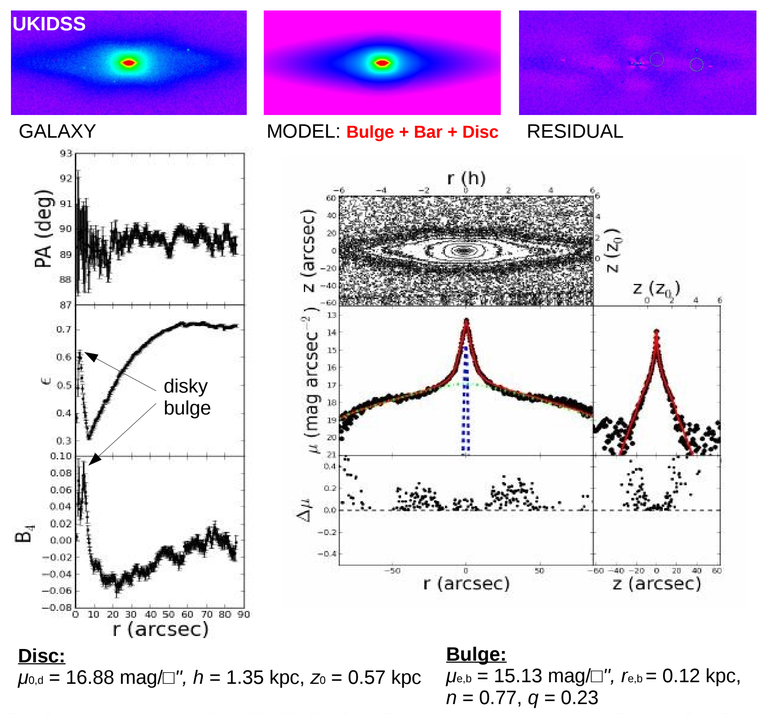
Bulge and disk parameters are correlated!
The relative thickness of disks does not depend on the ratio of bulge-to-total luminosities!

MORPHOLOGY OF BULGES



Bright and **faint** bulges have different distributions of the Sersic index and bulge flatness!
Bright bulges have a large profile index: **classical bulges** (***n*b~3**). Faint bulges have a small profile index: **pseudobulges** (***n*b~1**). Bright bulges are almost oblate spheroids, whereas faint bulges are triaxial structures!
Wide flat distributions of ***n*b** for the SDSS and UKIDSS samples can be connected with B/PS bulges.
The fraction of such B/PS bulges in the UKIDSS sample is up to 50%!

B/PS BULGES: NGC 4469



Disc:
$\mu_{0,d}$ = 16.88 mag/□″, h = 1.35 kpc, z_0 = 0.57 kpc

Bulge:
$\mu_{e,b}$ = 15.13 mag/□″, $r_{e,b}$ = 0.12 kpc, n = 0.77, q = 0.23

Galaxies with B/PS bulges consist of a disky bulge, a peanut shaped bulge and a stellar disk (Bureau et al. 2006). In order to receive physically reasonable results of decomposition the three-component model should be used!

CONCLUSIONS

A new code for mass-decomposition of edge-on galaxies is presented. Bulge and disk scale parameters are well-correlated which testifies of the physical link between these components. Bright bulges have larger n_b and are almost oblate spheroids with flattening around 0.63. Faint bulges are less-concentrated and are triaxial structures.
Half of galaxies studied shows B/PS bulges and should be decomposed by the three-component model:
disky bulge + bar + exponential disk.

References:
Mosenkov A.V., Sotnikova N.Ya., Reshetnikov V.P., 2010, MNRAS, 401, 559
Sotnikova N.Ya., Reshetnikov V.P., Mosenkov A.V., 2012, Astr. Astroph. Trans., 27, 325
Bureau M., Aronica G., Athanassoula E., et al., 2006, MNRAS, 370, 753

Acknowledgments:
The authors express gratitude for the grant of the Russian Foundation for Basic Researches number 11-02-00471

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