

Bulge-disk decomposition of nearby GAMA galaxies



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Abstract

Obtaining reliable structural parameters for the components of galaxies is important for a variety of studies of galaxy properties and evolution. We present our current work on the bulge-disk decomposition of nearby GAMA galaxies in all 9 optical and near-infrared bands covered by KiDS and VIKING. They will be used to derive the stellar mass functions of bulges and disks and study the nature and distribution of dust in galaxy disks.

Background

- Driver et al. (2007)^[7] showed that internal dust attenuation is significant → need to account for that to avoid biases in studies of galaxy structures (e.g. the stellar mass functions of components) and their evolution
- Geometry: bulges and disks affected differently by dust → study separately

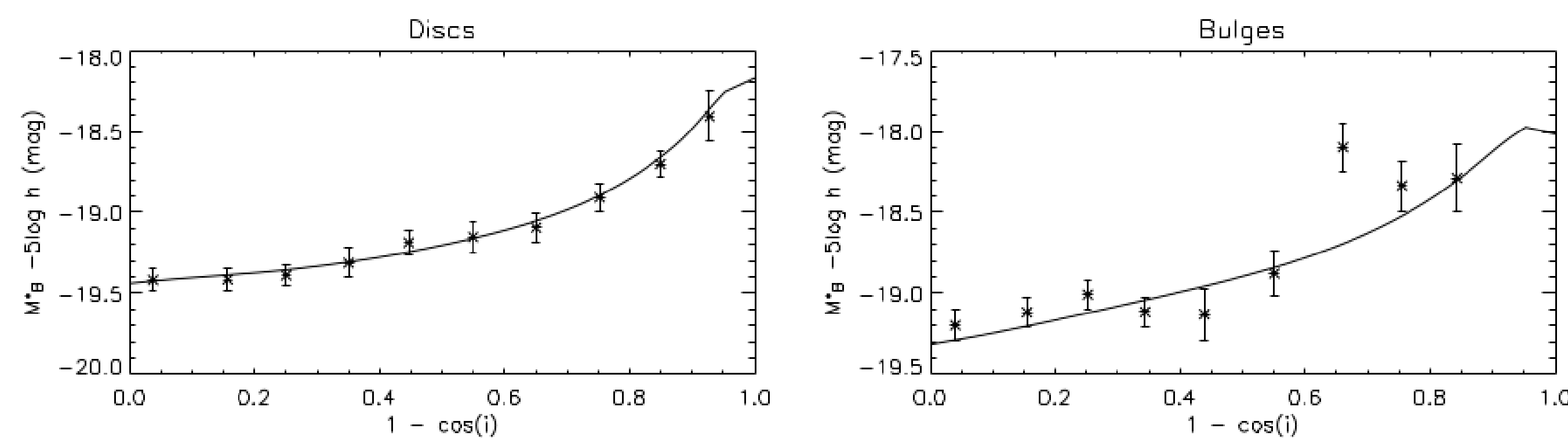


Fig. 11 from Driver et al. (2007)^[7] showing empirical dust attenuation-inclination relation

Aims

- Study distribution of galaxy bulges and disks in luminosity-size plane
- Compare to the radiative transfer models of Tuffs & Popescu^[6]
- Constrain nature and distribution (relative to stars) of dust in disks

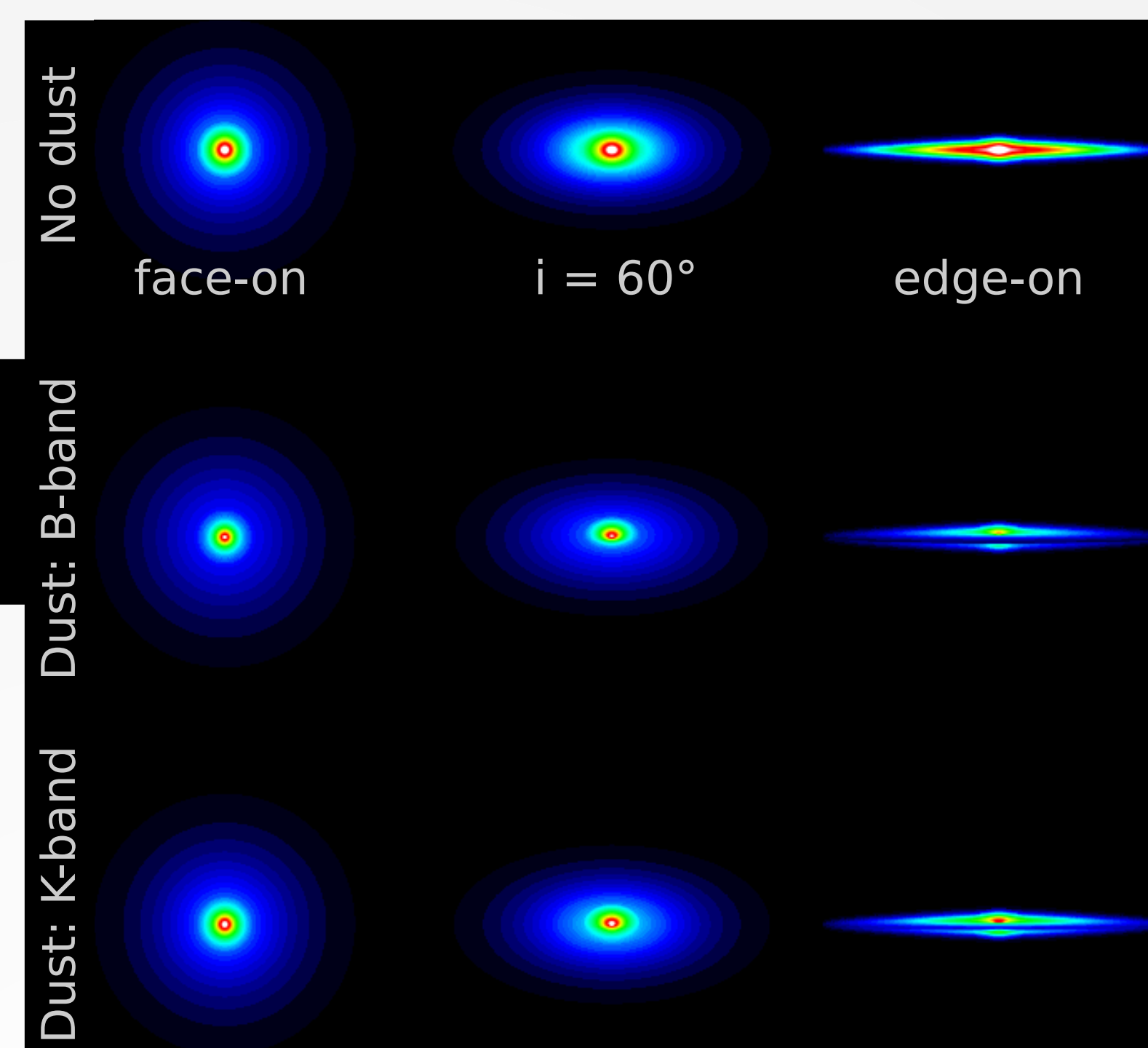
Data

- ~13,000 galaxies ($z < 0.08$) from Galaxy and Mass Assembly (GAMA)^[1] survey
- Imaging data in 9 bands spanning optical & near infrared from Kilo-Degree Survey (KiDS)^[2] and VISTA Kilo-Degree Infrared Galaxy (VIKING)^[3] Survey

Method

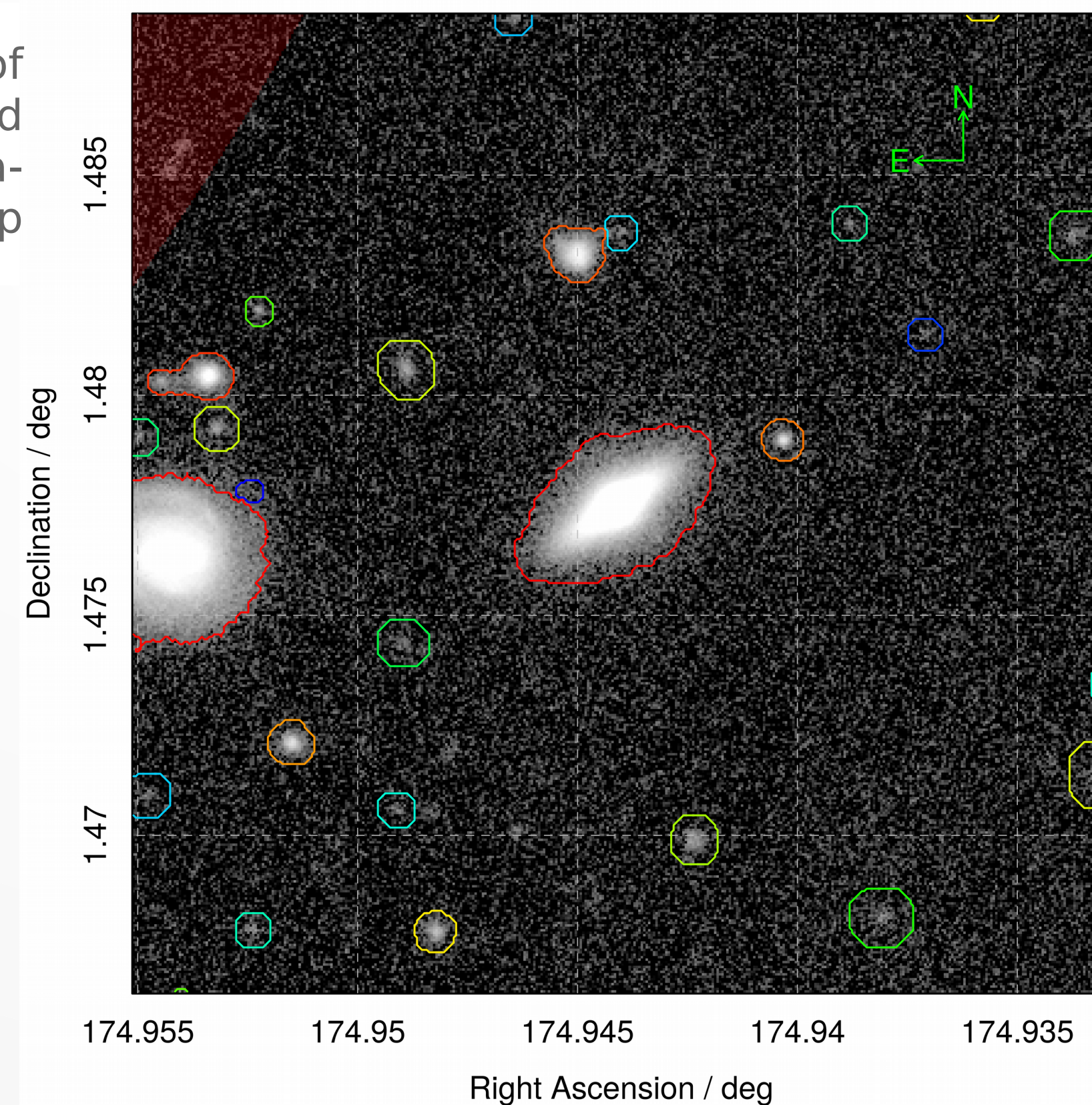
- Use ProFit, a flexible and fully Bayesian two-dimensional profile fitting code of Robotham et al. (2017)^[4]
- Fit galaxies with 3 models: single Sérsic, Sérsic bulge + exponential disk, point source bulge + exponential disk
- Preparatory work carried out with sister package ProFound (Robotham et al. 2018)^[5]: image segmentation/source identification, sky subtraction, initial parameter estimates
- Local PSF from nearby stars with ProFound and ProFit
- After galaxy fitting: rejection of bad fits and model selection

Example of ProFound segmentation map



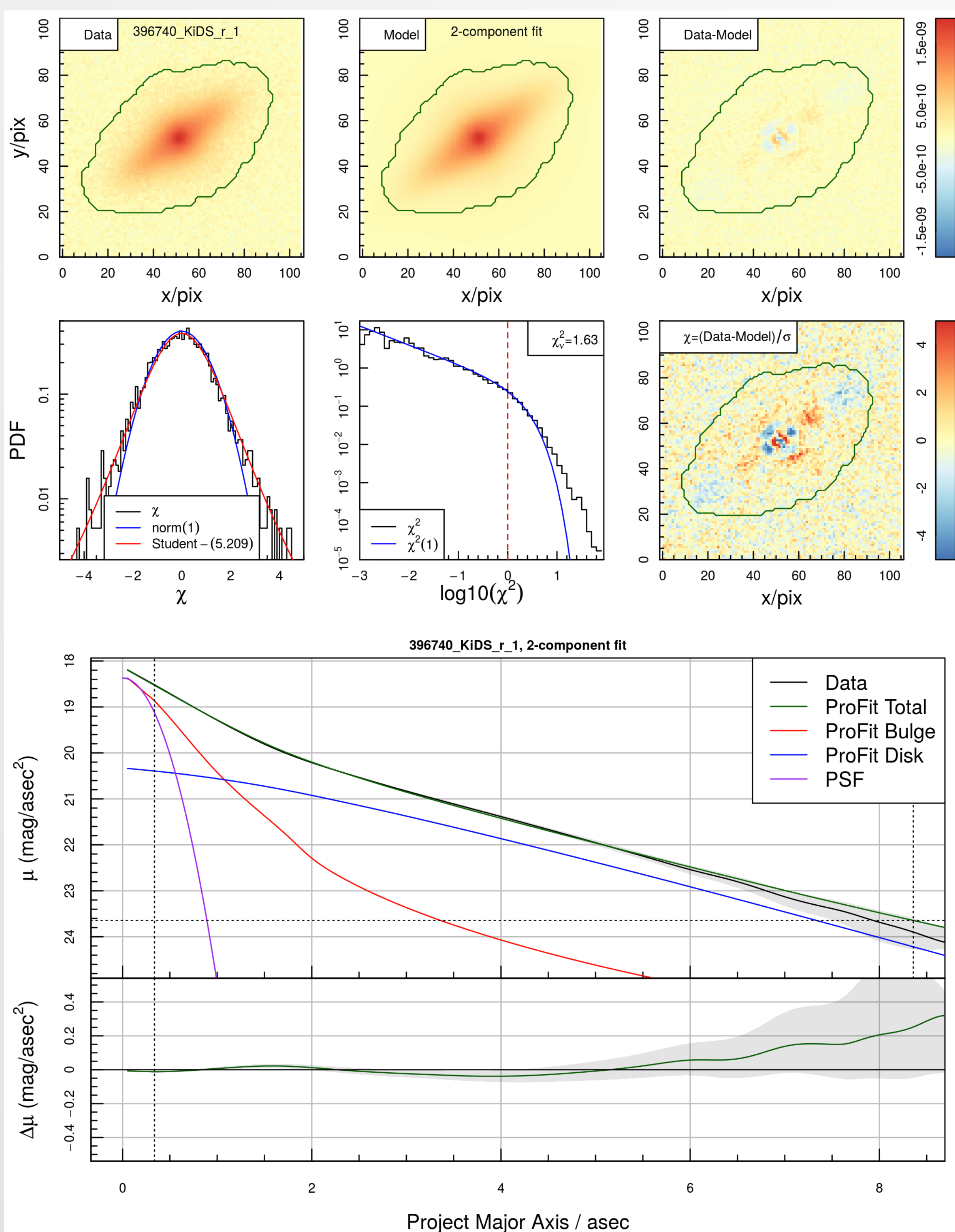
Dust effects (modeled) with inclination and wavelength (Credit: R. Tuffs)

Segmentation map around 396740_KiDS_r_1



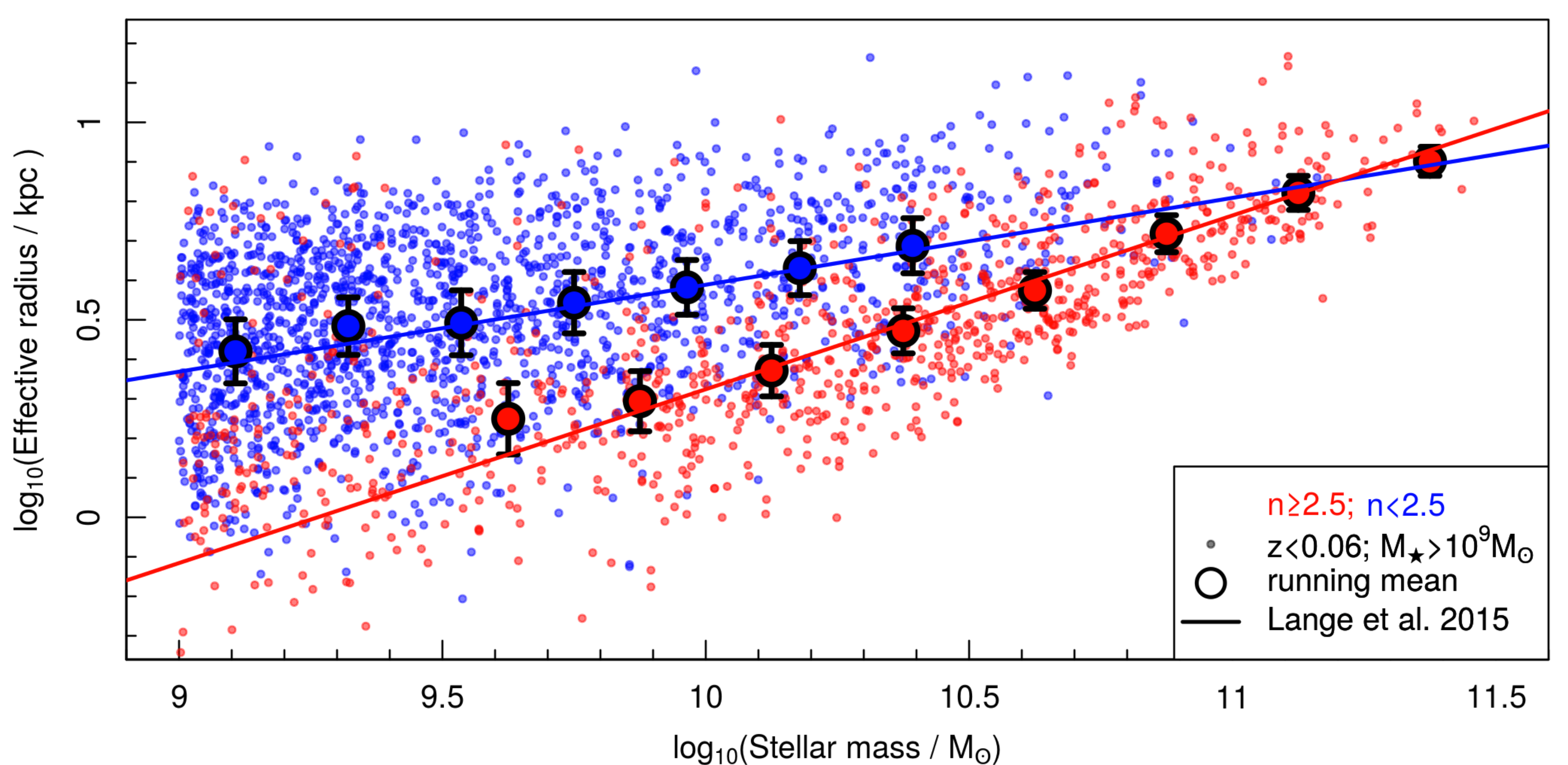
Results

- Bulge-disk decomposition catalogue in KiDS g-, r- and i-bands available (including quality control, bad fit rejection and model selection)
- ProFit + ProFound well-suited for large-scale automatic decompositions
- Outlook: VIKING data, stellar mass functions of components, dust studies



Example 2-component galaxy fit (full 2D and averaged over ellipses top and bottom)

Preliminary mass-size relation compared to previous work



References

- [1] <http://www.gama-survey.org/>
- [2] <http://kids.strw.leidenuniv.nl/>
- [3] <http://www.eso.org/sci/observing/PublicSurveys/sciencePublicSurveys.html#vistacycle1>
- [4] Robotham A. S. G. et al., 2017, MNRAS, 466, 1513
- [5] Robotham A. S. G. et al., 2018, MNRAS, 476, 3137
- [6] Popescu C. C. et al., 2011, A&A, 527, A109 and preceding publications of this series
- [7] Driver, S. P. et al., 2007, MNRAS, 379, 1022

GAMA^[1]

- Galaxy And Mass Assembly
- Spectroscopic survey of ~263 000 galaxies
- 286 deg² to depth $r < 19.8$ mag
- AAOmega multi-object spectrograph on the Anglo-Australian Telescope (AAT)
- Complementary photometry in >20 bands
- Observations completed 2014

KiDS^[2]

- Kilo-Degree Survey
- Photometry in broad optical filters u, g, r, i
- ~1500 deg² in Southern sky
- VST at ESO Paranal Observatory
- Equatorial GAMA regions covered as of DR3
- Complementary to VIKING

VIKING^[3]

- VISTA Kilo-Degree Infrared Galaxy Survey
- Photometry in NIR filters Z, Y, J, H, K_s
- ~1500 deg² in Southern sky (same as KiDS)
- VISTA telescope at ESO Paranal Observatory
- Equatorial GAMA regions covered as of DR3
- Complementary to KiDS

ProFit^[4]

- 2D Bayesian galaxy profile fitting code
- Choice of profiles, several components
- Many optimisation algorithms (incl. >40 MCMCs), priors, constraints, ...
- Main inputs: Image, model, initial guesses, segmentation map, sigma (error) map, PSF

ProFound^[5]

- Source finding and image analysis
- Segmentation & source identification, sky subtraction, segment statistics
- Photometry on segments rather than ellipses; and watershed de-blending
- Complementary to ProFit