Stockholm University

Oskar Klein centre

The edges of galaxies

Nushkia Chamba

Project and Community Workshop 2022

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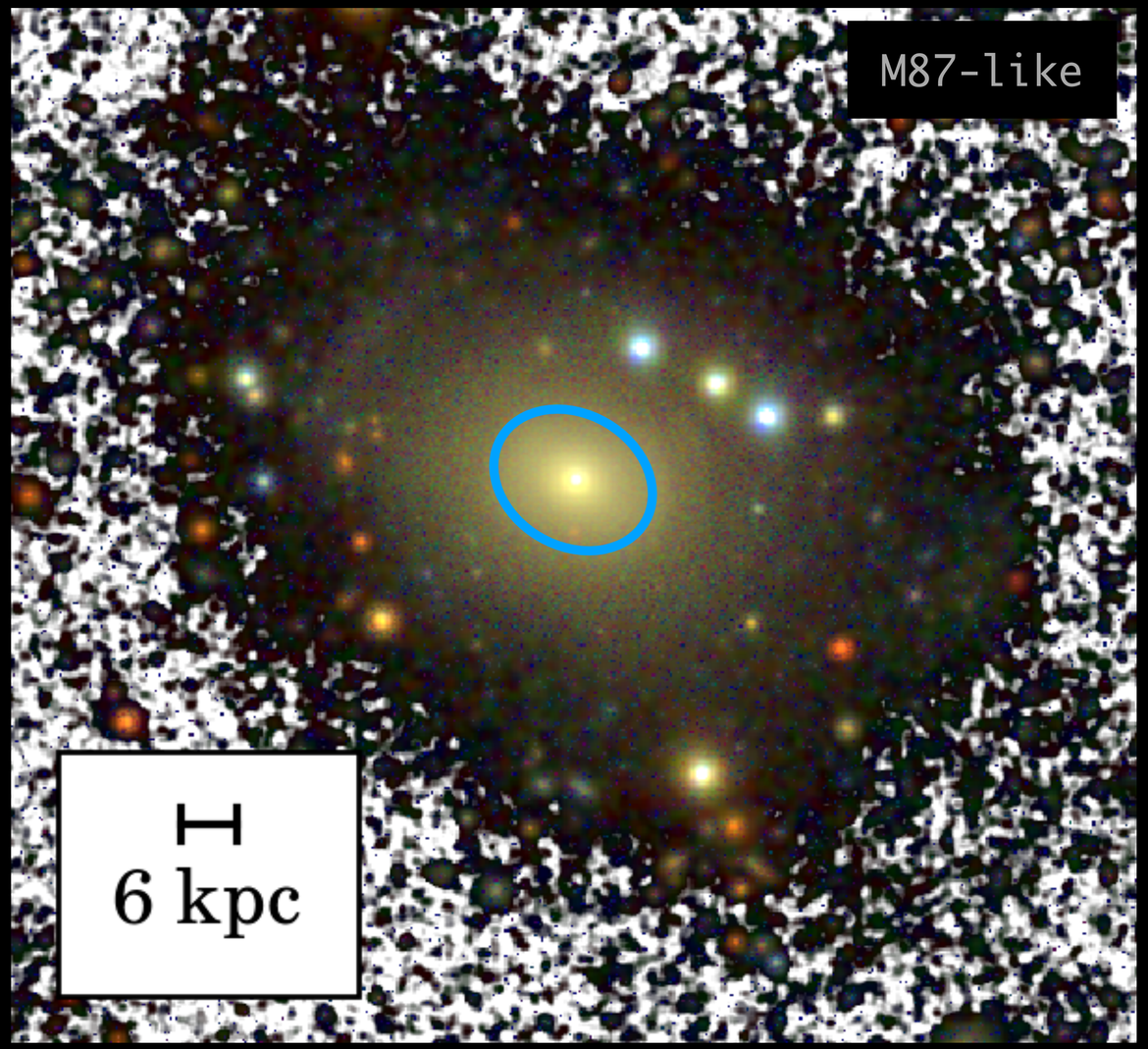
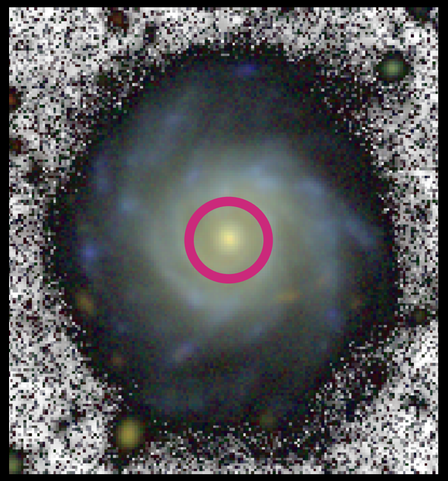
Most popular galaxy size definition is the effective radius

Galaxies scaled to the same distance + images of the same depth

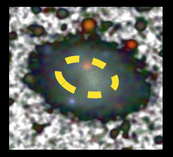
$\mu_{g,lim}$ = 29.1 mag/arcsec^2
(3σ, 10x10 arcsec^2)



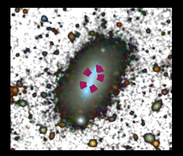
Milky Way-like



UDG



Dwarf



IAC Stripe 82 Legacy Project
research.iac.es/proyecto/stripe82/

Redefining galaxy size - The concept

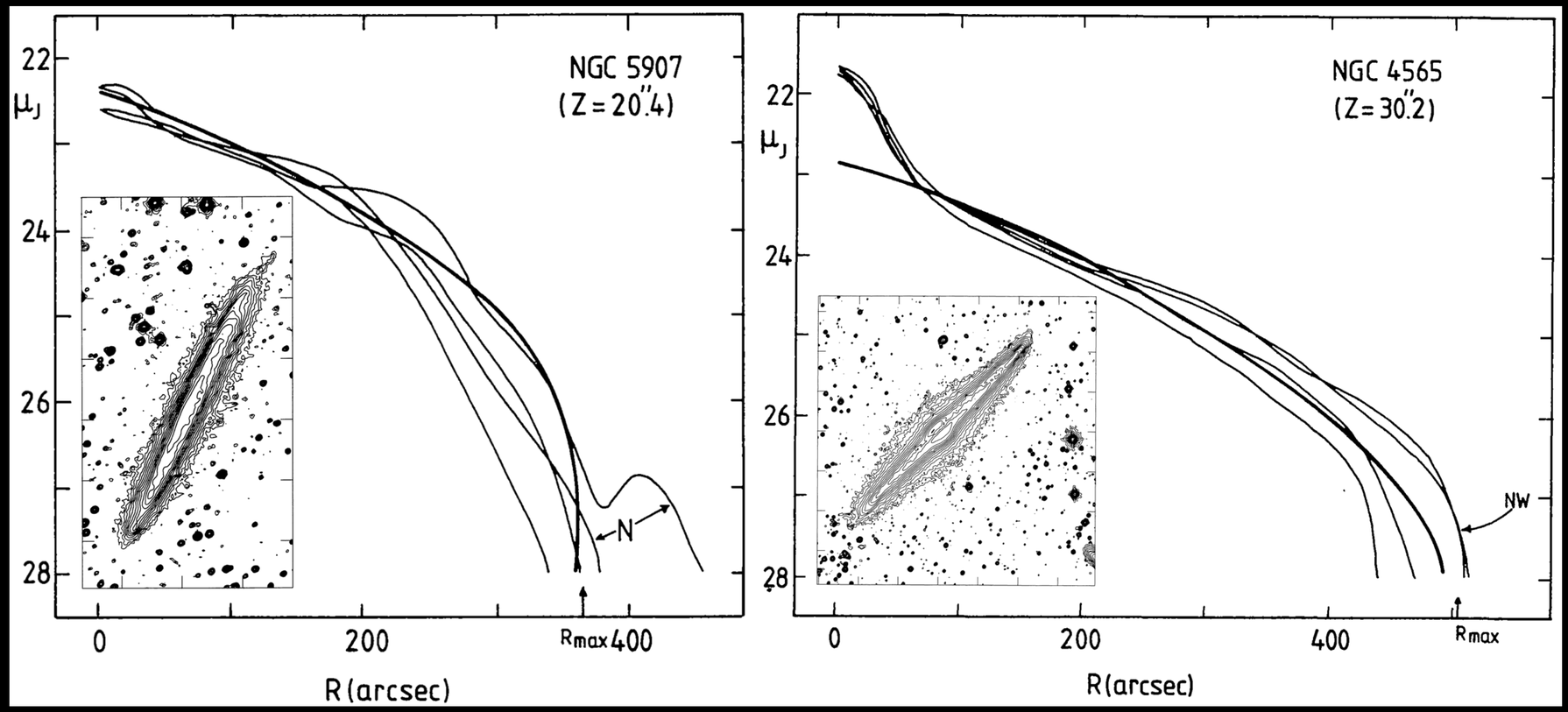
- We developed a new physically motivated galaxy size definition based on the radial location of the gas density *star formation threshold* (e.g. Schaye 2004)
- In 2020 we explored a *fixed* threshold (as a proxy)
- Now: we look for a signature of the ‘edge’ of star formation, i.e. a sudden drop in in-situ star formation (past or ongoing):

References: Trujillo, Chamba & Knapen (2020), Chamba, Trujillo & Knapen (2020), Chamba (2020), Chamba et al. (2022, coming soon!)

A proxy for the edge is a truncation

- van der Kruit (1979) discovered truncations in edge-on discs

- structure of the stellar disc (angular momentum, star formation thresholds)



The edges of galaxies: from dwarfs to giants

Coming soon: Chamba, Trujillo & Knapen (2022)

In this work:

- We identify the edges of ~1000 galaxies, from dwarfs to ellipticals, using radial profiles (surface brightness, colour and stellar mass density)
- Use R_{edge} as a physically motivated measure of galaxy size measure and study the resulting R_{edge} - stellar mass plane

References: Trujillo, Chamba & Knapen (2020), Chamba, Trujillo & Knapen (2020), Chamba (2020)

Data and sample

Multi-band deep imaging + wide range of galaxy types

- *g* and *r* band images of IAC Stripe82 (Fliri & Trujillo 2016; Román and Trujillo 2018)

$\mu_{g,lim}$ = 29.1 mag/arcsec^2 (3σ in 10x10 arcsec^2 boxes)

- 1005 galaxies from Nair & Abraham (2010) and Portsmouth catalogue (Maraston et al. 2013) spanning $10^7\,M_\odot < M_\star < 10^{12}\,M_\odot$

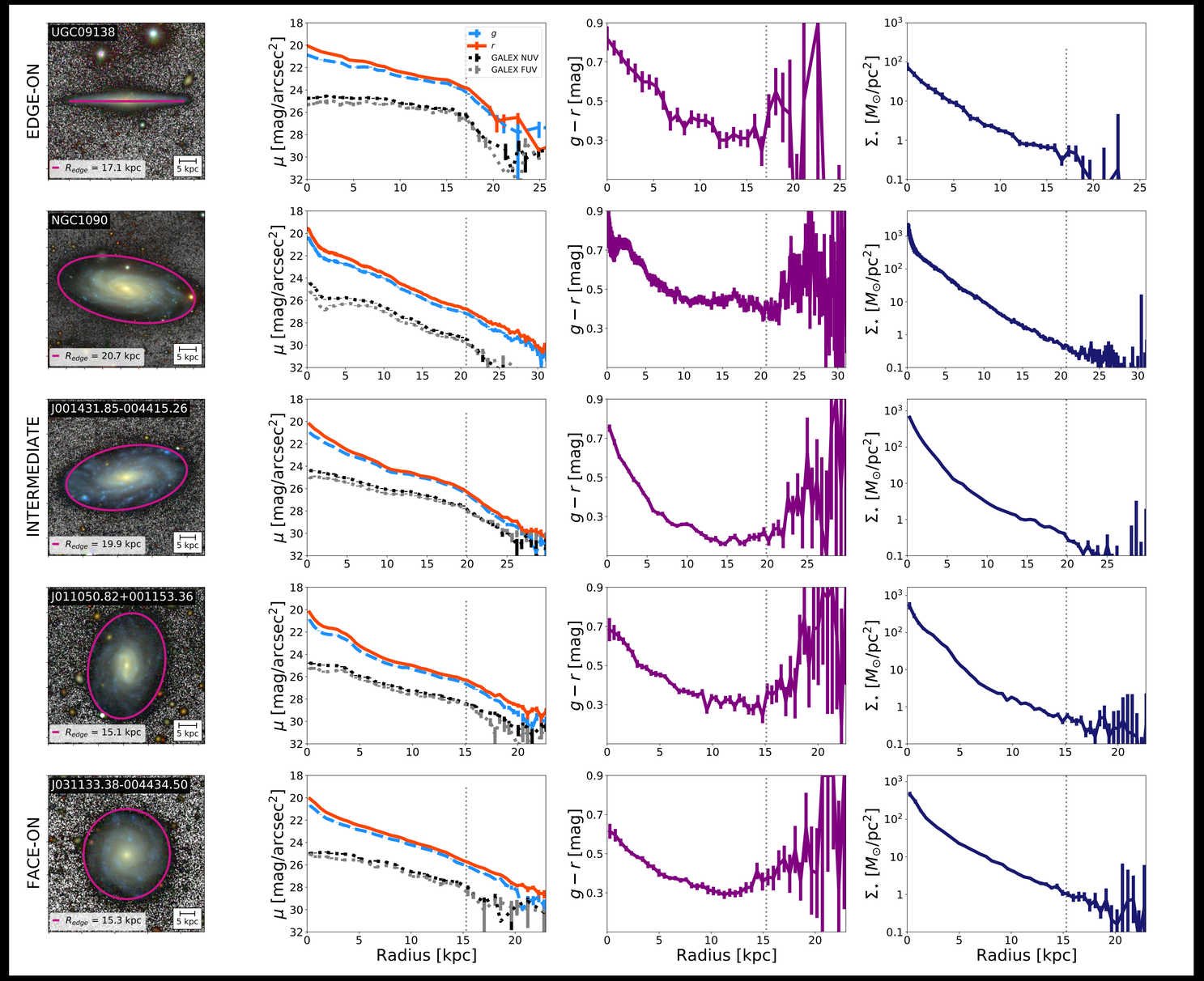
- R_{edge}, $\Sigma_\star(R_{edge})$, $g\text{-}r(R_{edge})$ and $M_\star$ measured from radial profiles.

Locating the edge of star formation

EDGE-ON

INTERMEDIATE

FACE-ON



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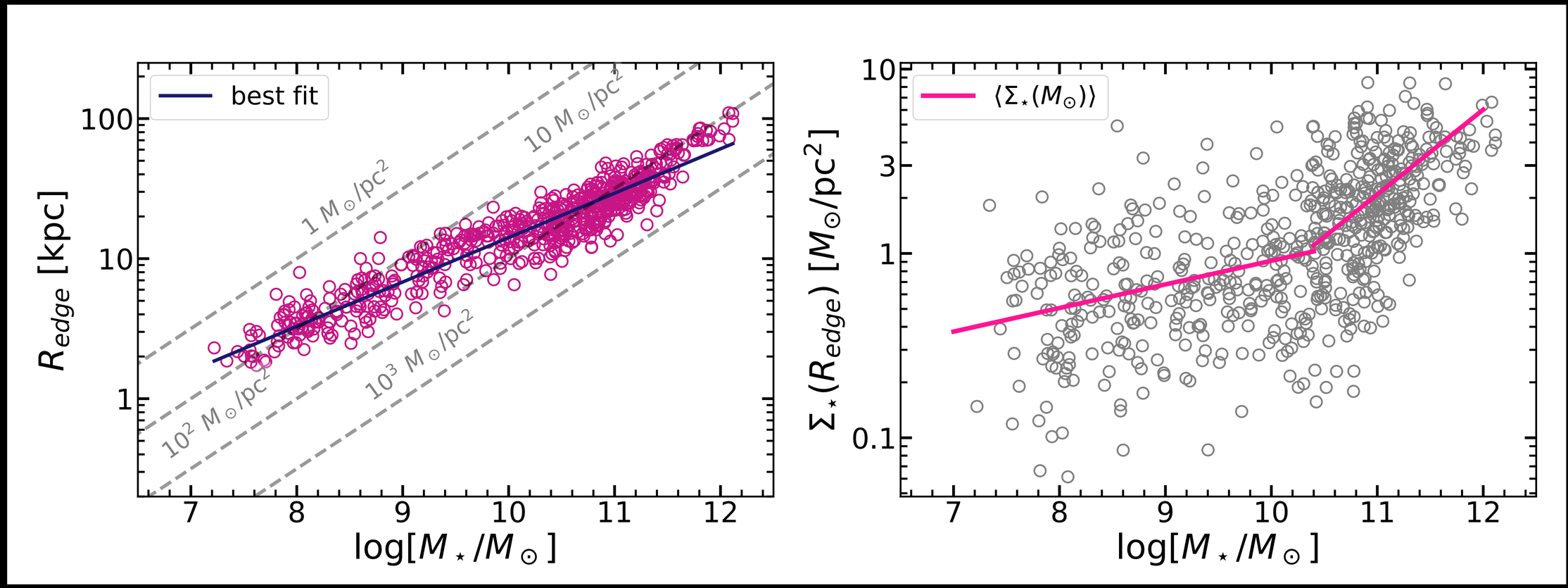
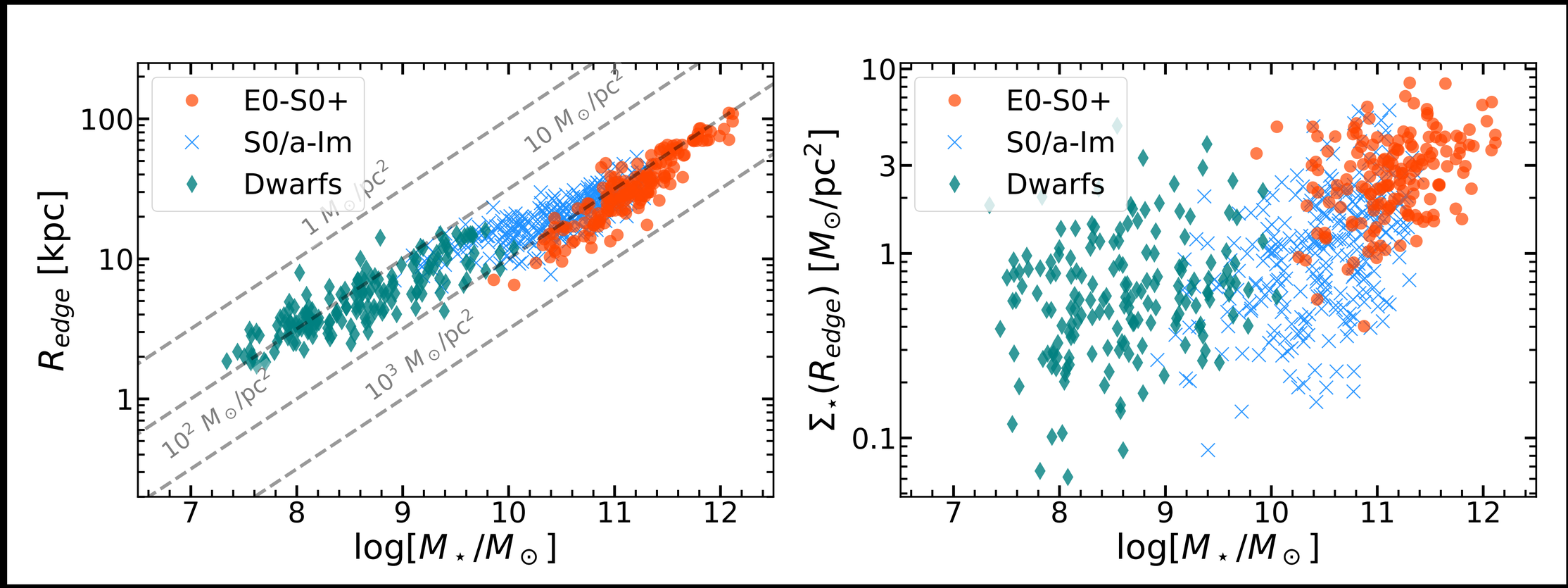
Results

Scaling relations



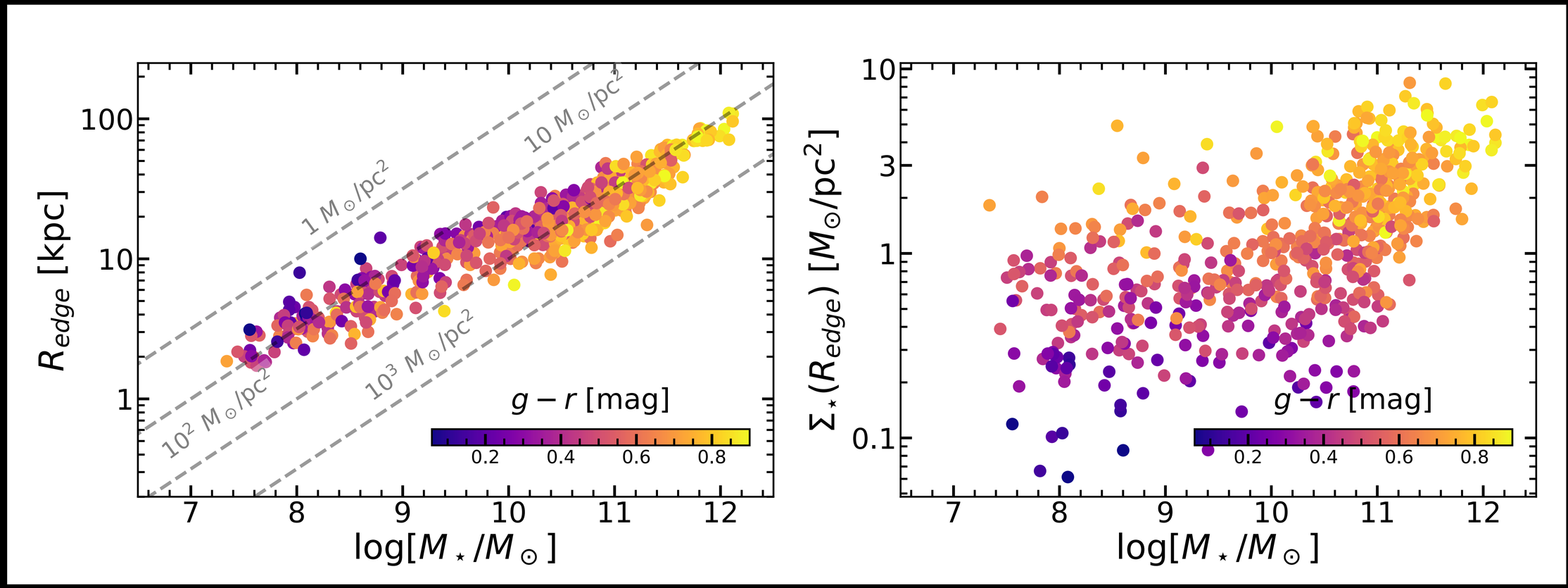
Results

Scaling relations - morphology



Results

Scaling relations - colour



A closer look at edges

Edges appear at varying stellar mass surface densities, as a function of stellar mass and morphology

- $\Sigma_\star(R_{edge}) \sim 1\, M_\odot/\mathrm{pc}^2$ (spirals), $0.6\, M_\odot/\mathrm{pc}^2$ (dwarfs) and $3\, M_\odot/\mathrm{pc}^2$ (or higher for ellipticals)

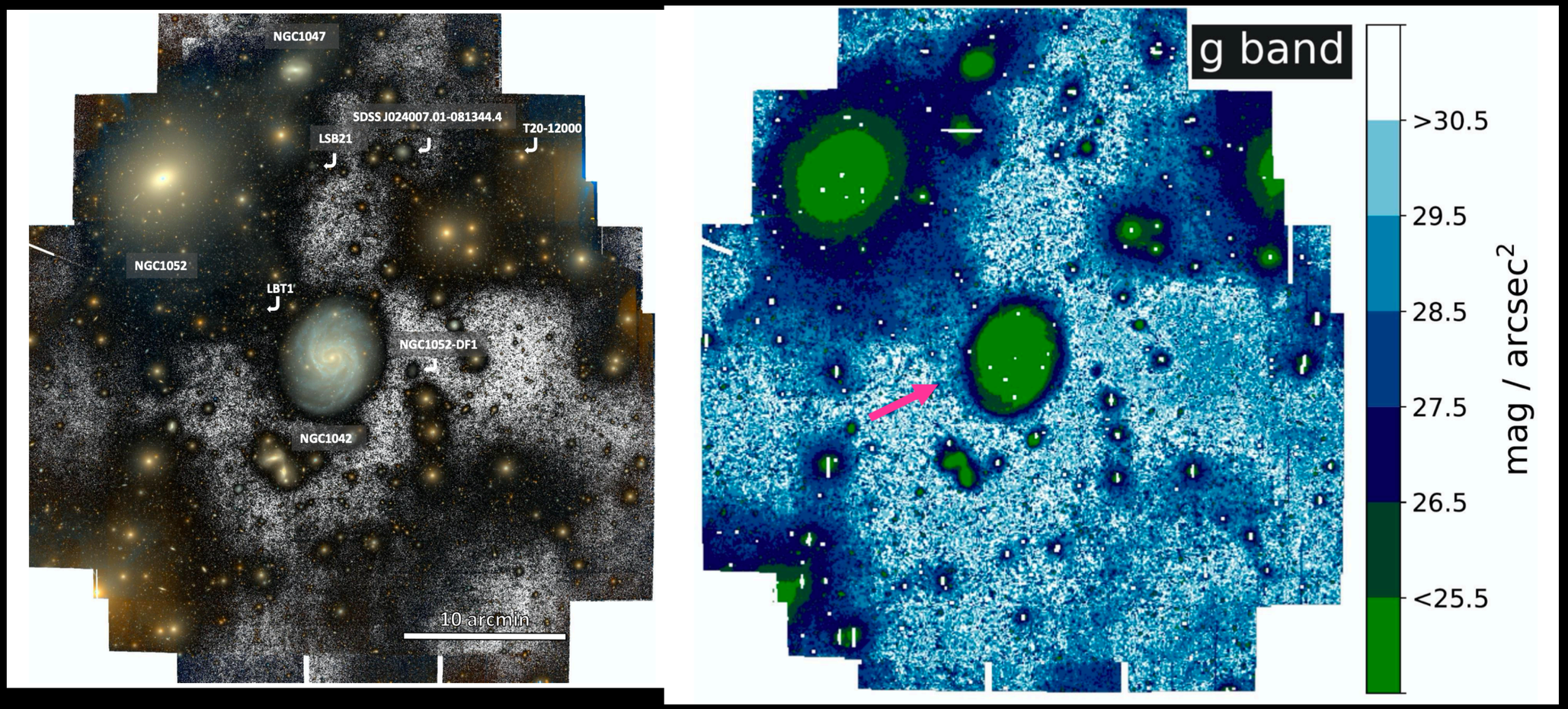
- Stratification of late-type galaxies in colour (*bluer galaxies are larger*)

- A global slope of $R_{edge} \propto M_\star^{1/3}$ with low intrinsic scatter (< 0.06 dex)

Coming up soon (Chamba et al. 2022)!

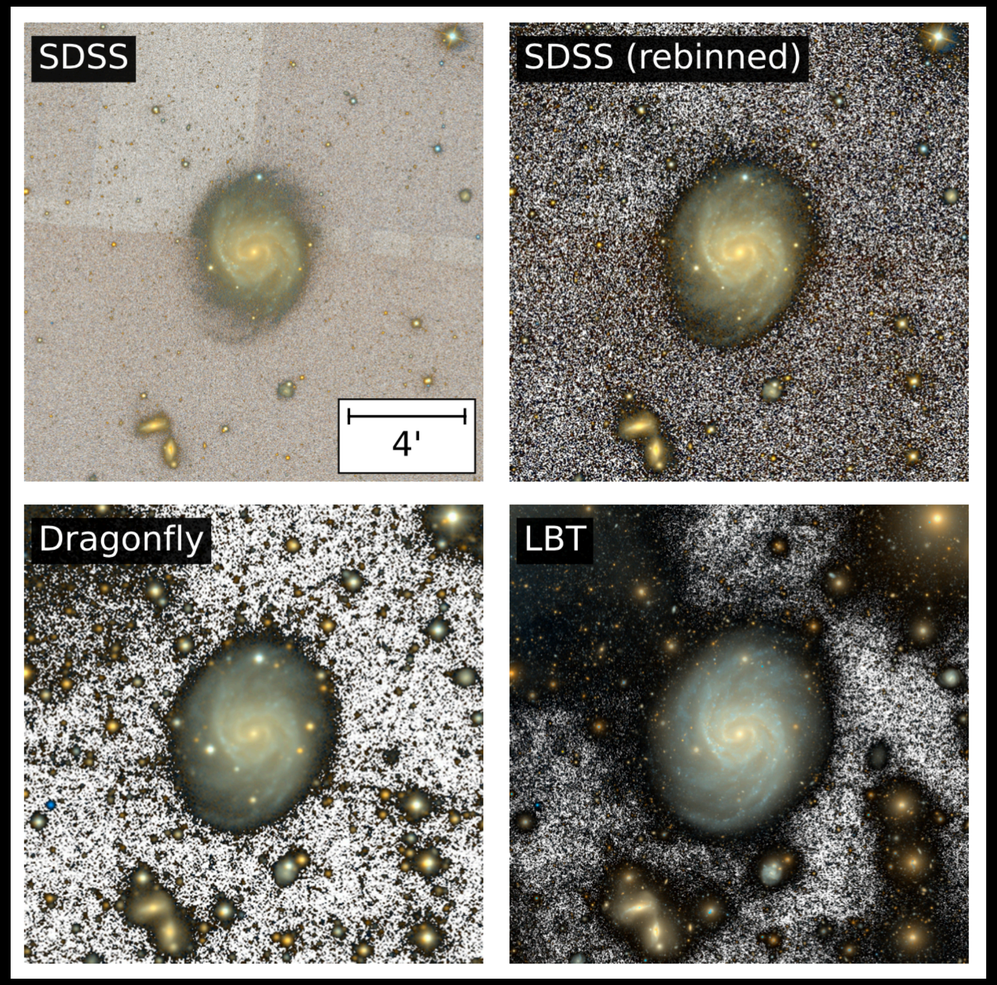
Edges using future, deeper datasets

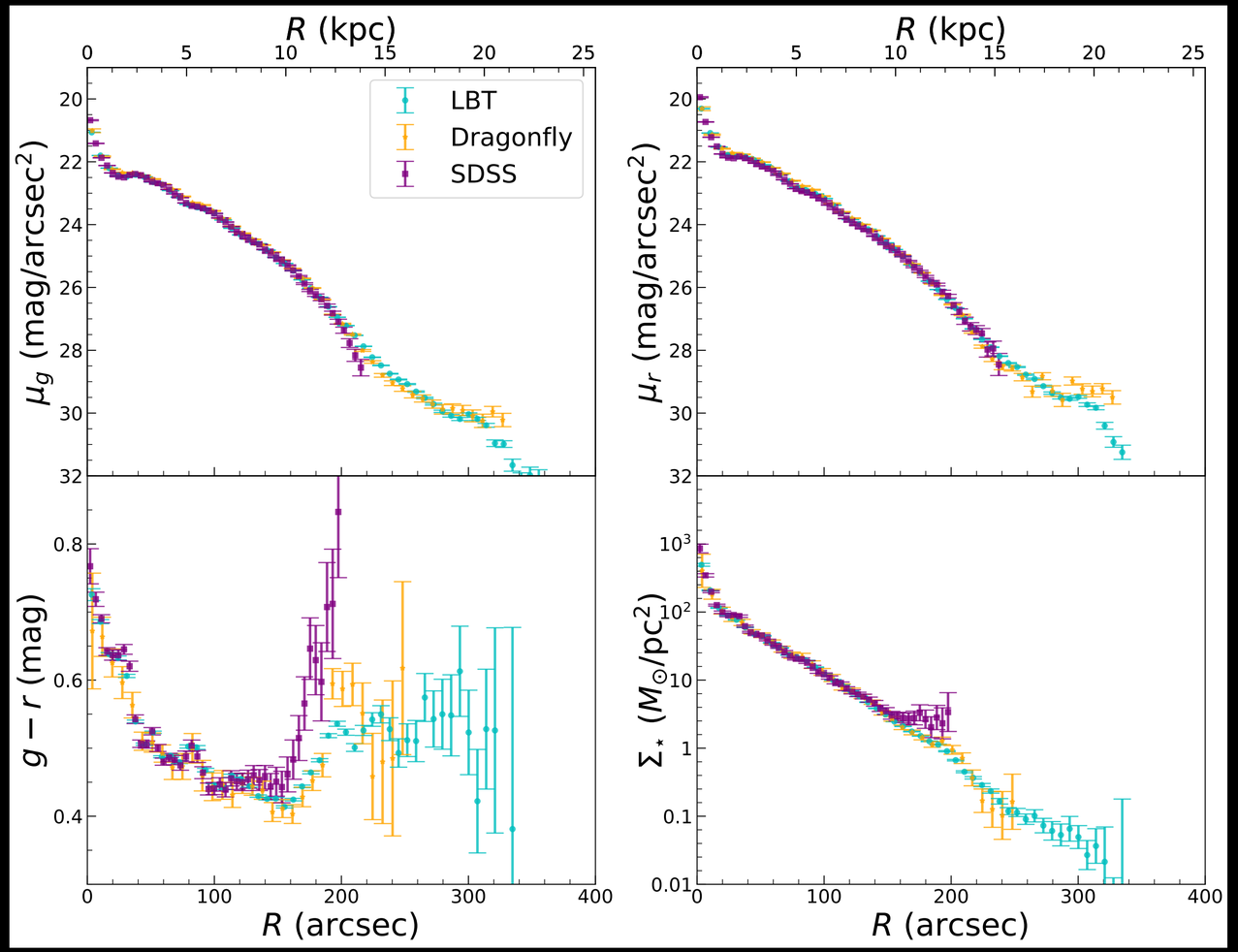
- LBT Imaging of Galactic Haloes and Tidal Structures (LIGHTS) Survey (Trujillo et al. 2021) - LSST (2030s!) resolution and depth!



Edges using future, deeper datasets

Defining the *stellar halo* (e.g. Trujillo et al. 2021)





Take home messages

- Deep imaging has allowed us to re-define a galaxy size in a physically meaningful way and closer to the “edge” of star formation in galaxies!
- We have measured the edges of ~ 1000 galaxies and found that edges appear at varying stellar mass surface densities, as a function of stellar mass and morphology

Email: nushkia.chamba@astro.su.se

Twitter: @NushkiaC

Coming up soon (Chamba et al. 2022)!