Resolving Issues:

Resolved and integrated mock observables of EAGLE galaxies using the SKIRT code

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Contents

- Forward modelling & simulations
- Developing a SKIRT model for the EAGLE simulations & low redshift results
- SF activity proxies
- Mass estimates with resolved and unresolved photometry
- Data products & projects

Forward Modelling & EAGLE

Inverse Modelling: Inferring physical properties from observations
Forward Modelling: Predicting observables from physical models

- *Inverse modelling* allows us to interpret observation in lieu of theoretical predictions. However, it often employs necessarily bold simplifications (eg. *exponential SFHs*, *single metallicities*, *screen models* for *dust*), and suffers from degeneracies.

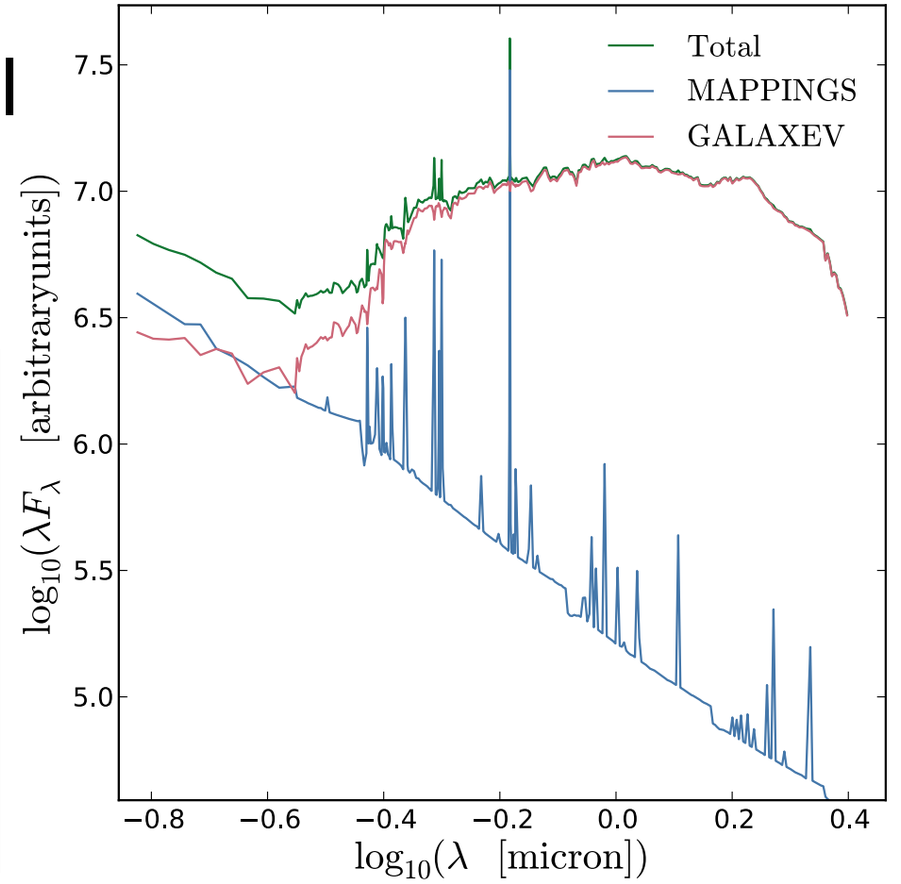
- *Forward Modelling* is arguably the aim of a complete model. Allows us to represent arbitrarily complex star formation and enrichment histories without assuming parametric form

- ***EAGLE*** provides a provides a sample of ~10^4 morphologically diverse galaxies with stellar mass > 10^9 M_{sun} at $z = 0.1$. EAGLE has no explicit dust phase, but we can represent it using the 3D enriched ISM

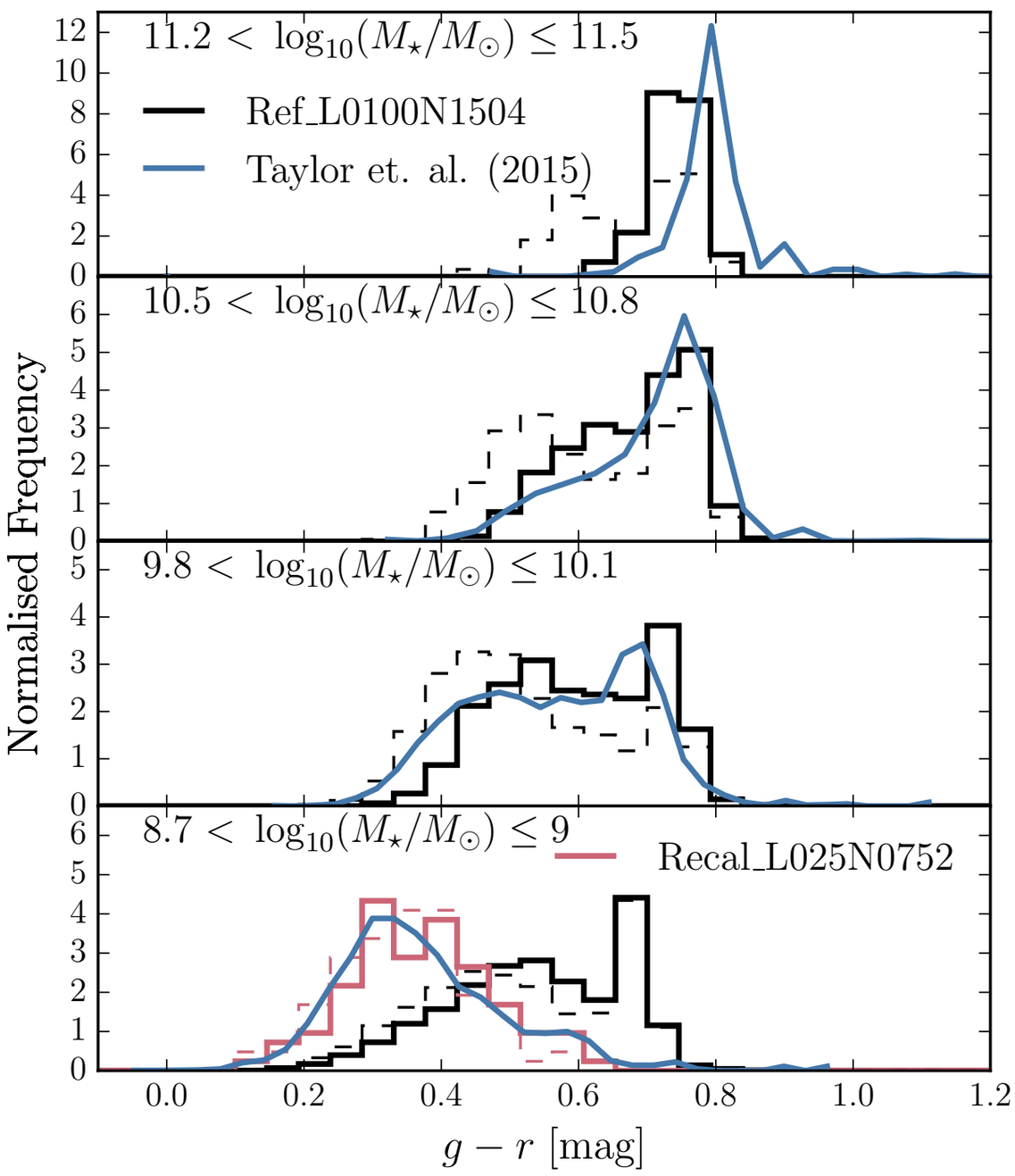
*SKIRT*ing the Problem...

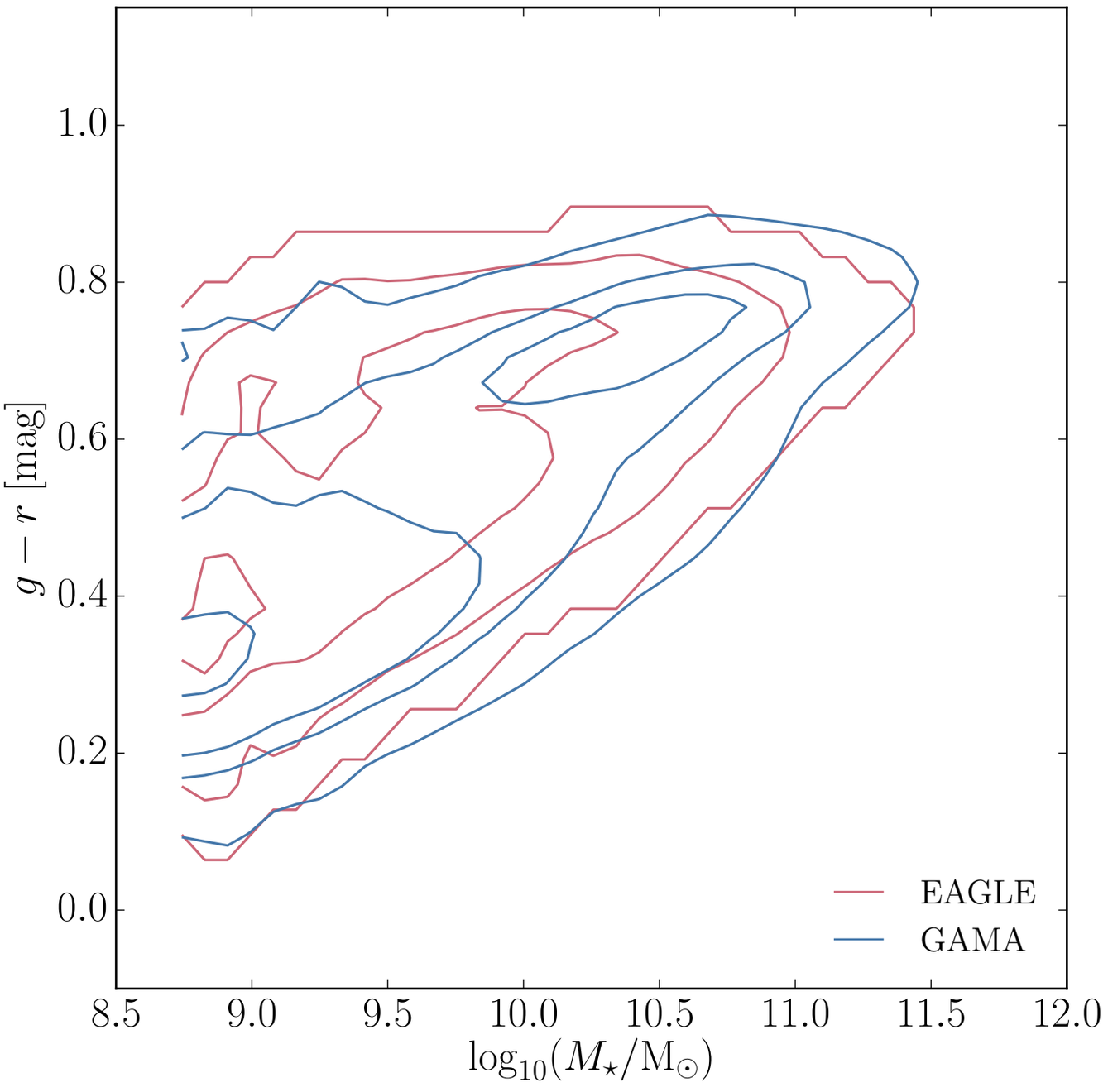
- *Trayford et. al (2015)* showed that a screen model performs reasonably at *z=0.1*, but parameter evolution is highly speculative
- SKIRT (Camps & Baes 2015) is a radiative transfer (RT) code that can exploit the complex geometry of EAGLE galaxies.
- We include MAPPINGS SEDs to model sub-resolution dust attenuation (*Camps+ 2016, Trayford+ submitted*)

Camps et al (2016) calibrates dust model using FIR scaling relations: T_{max} = 8000 K f_{dust} = 0.3 and f_{PDR} = 0.1



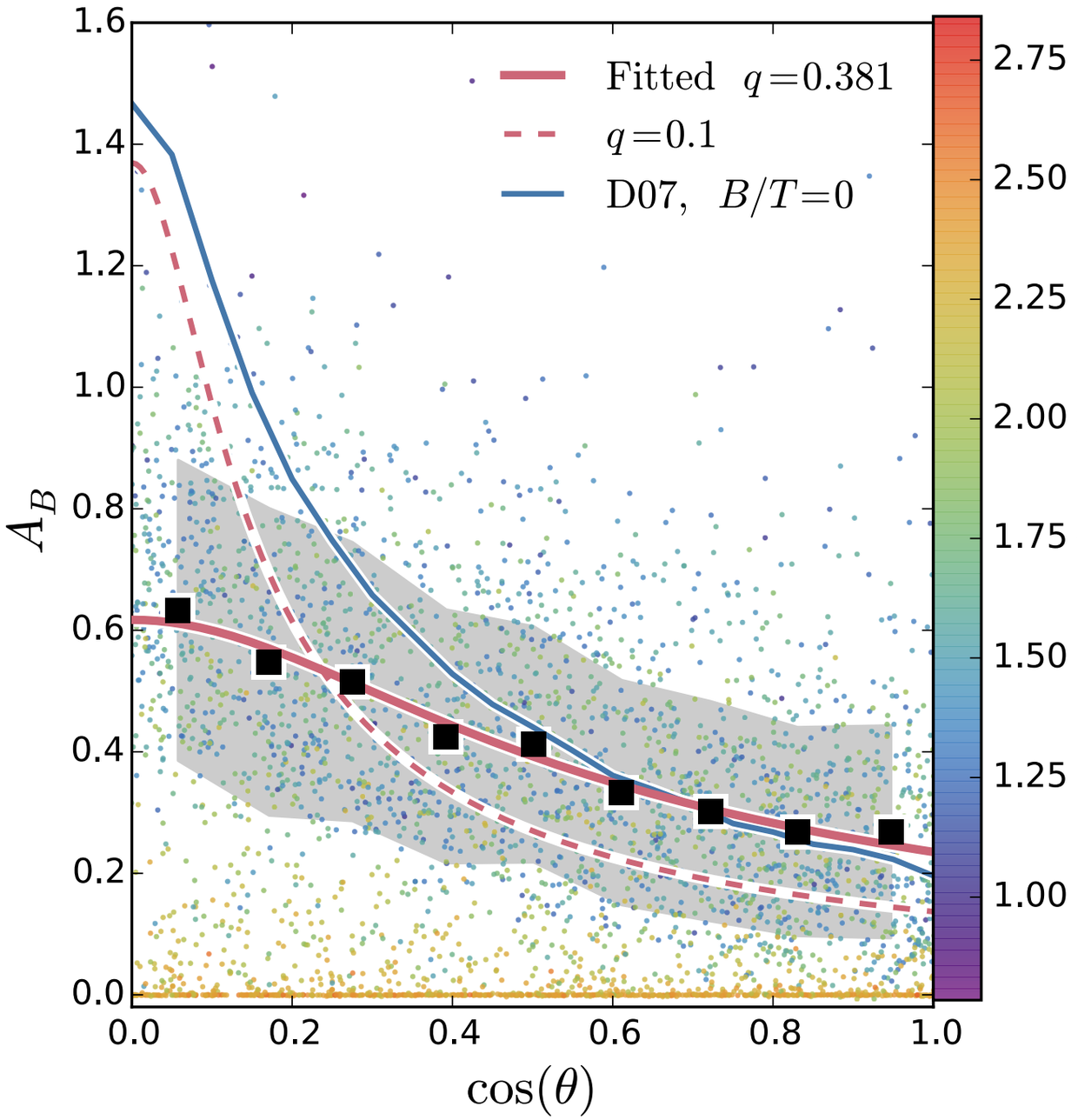
The EAGLE CMD



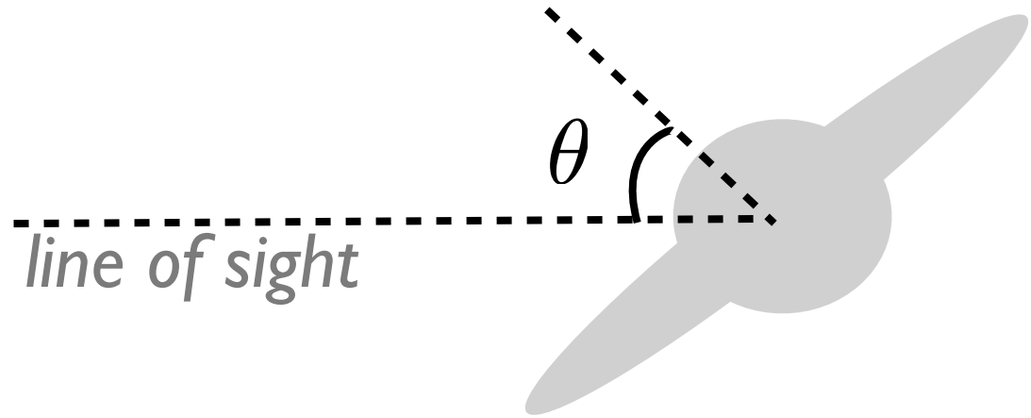


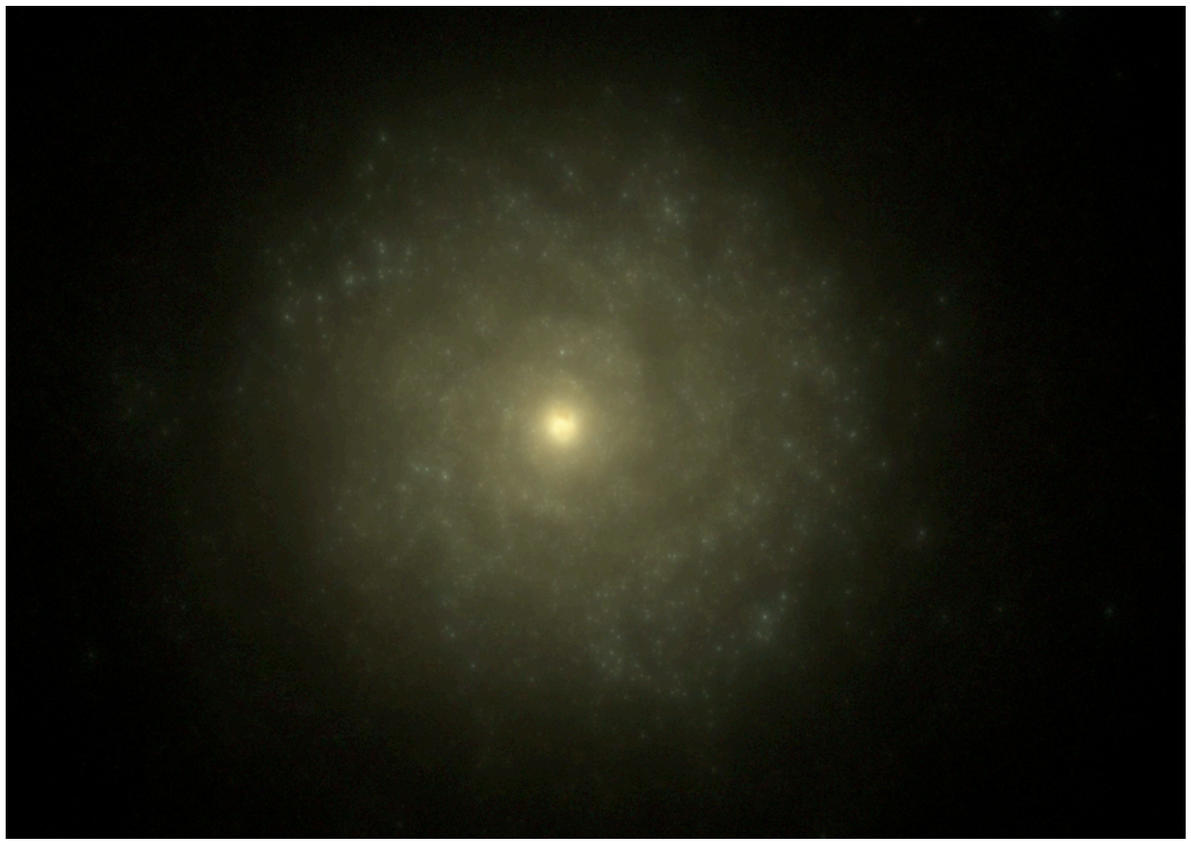
EAGLE colours with a SKIRT model *(Trayford et. al. 2016, submitted)*

Attenuation vs. Inclination



Trayford et. al. 2016, submitted



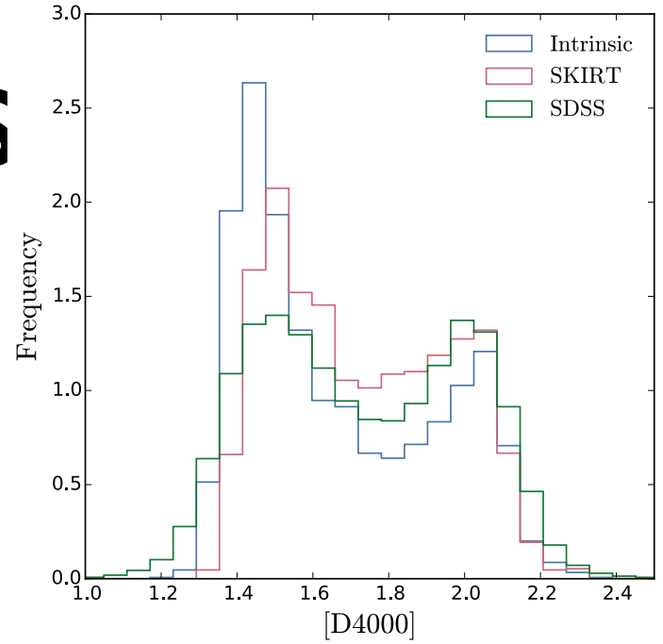


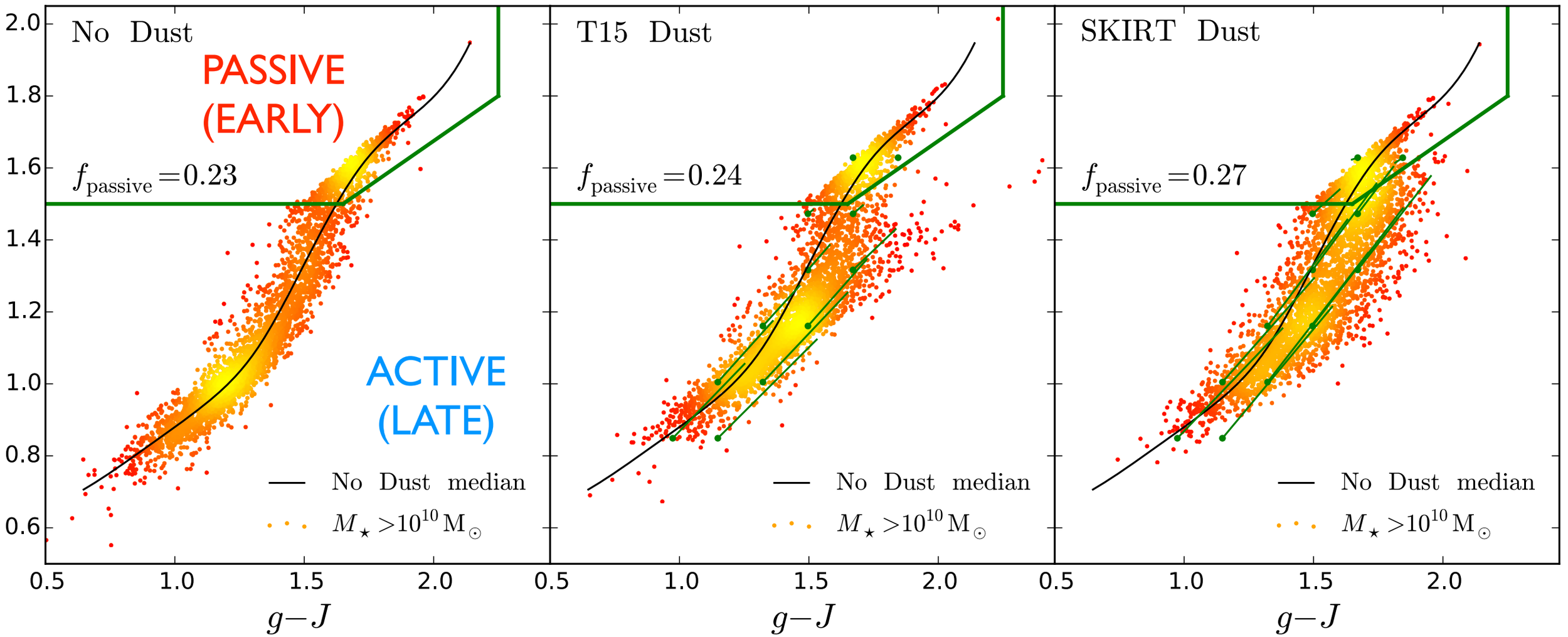
Why the edge-on deficit?

EAGLE can't get cold enough...

SF activity proxies

We find that the preferential obscuration of young stellar populations in our SKIRT modelling can cause galaxies to appear passive in optical proxies for star formation





Trayford et. al. 2016, submitted

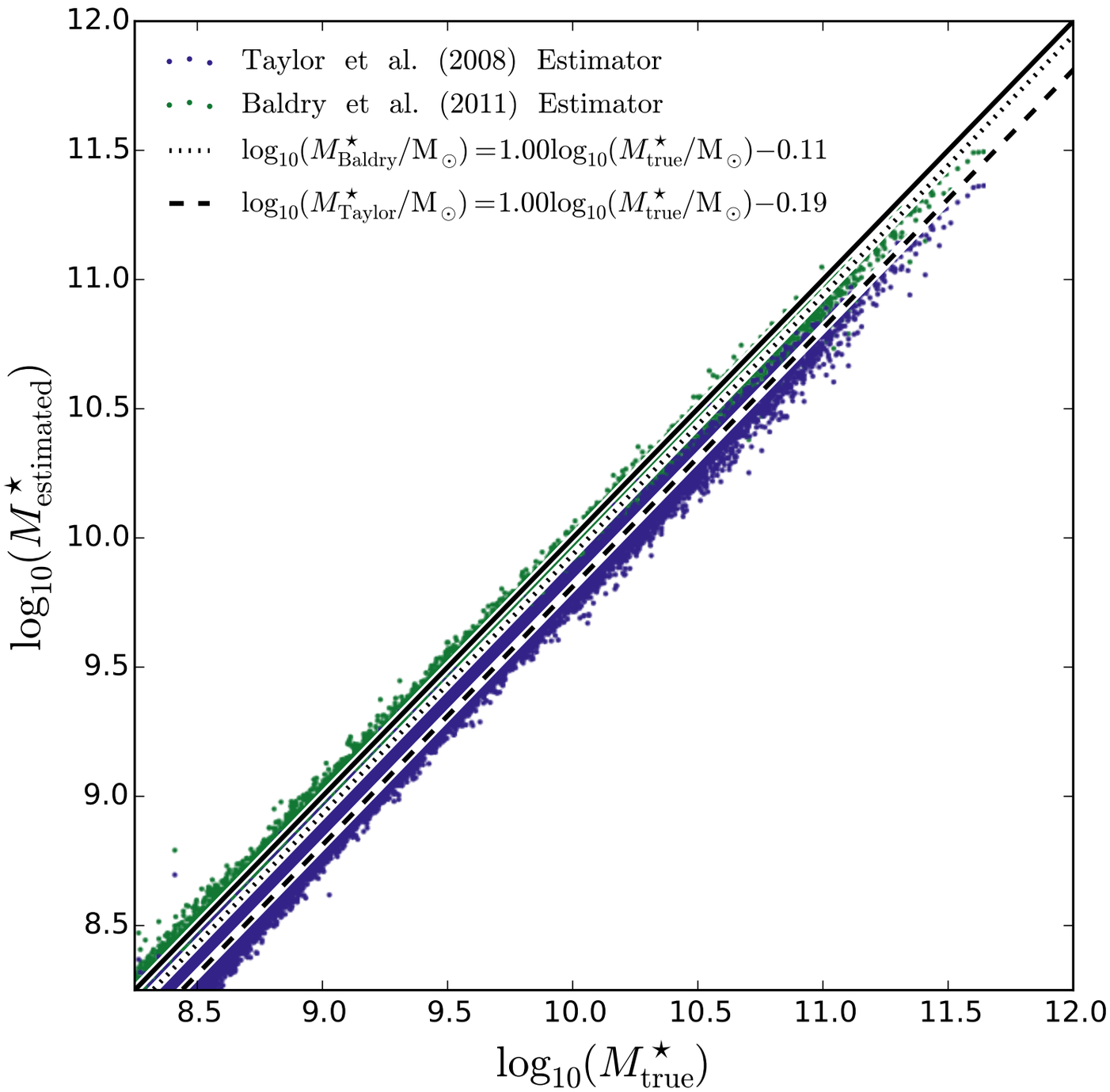
Mass inference

$$\log(M^*/L_i) = a + b\,(g\text{-}i)$$

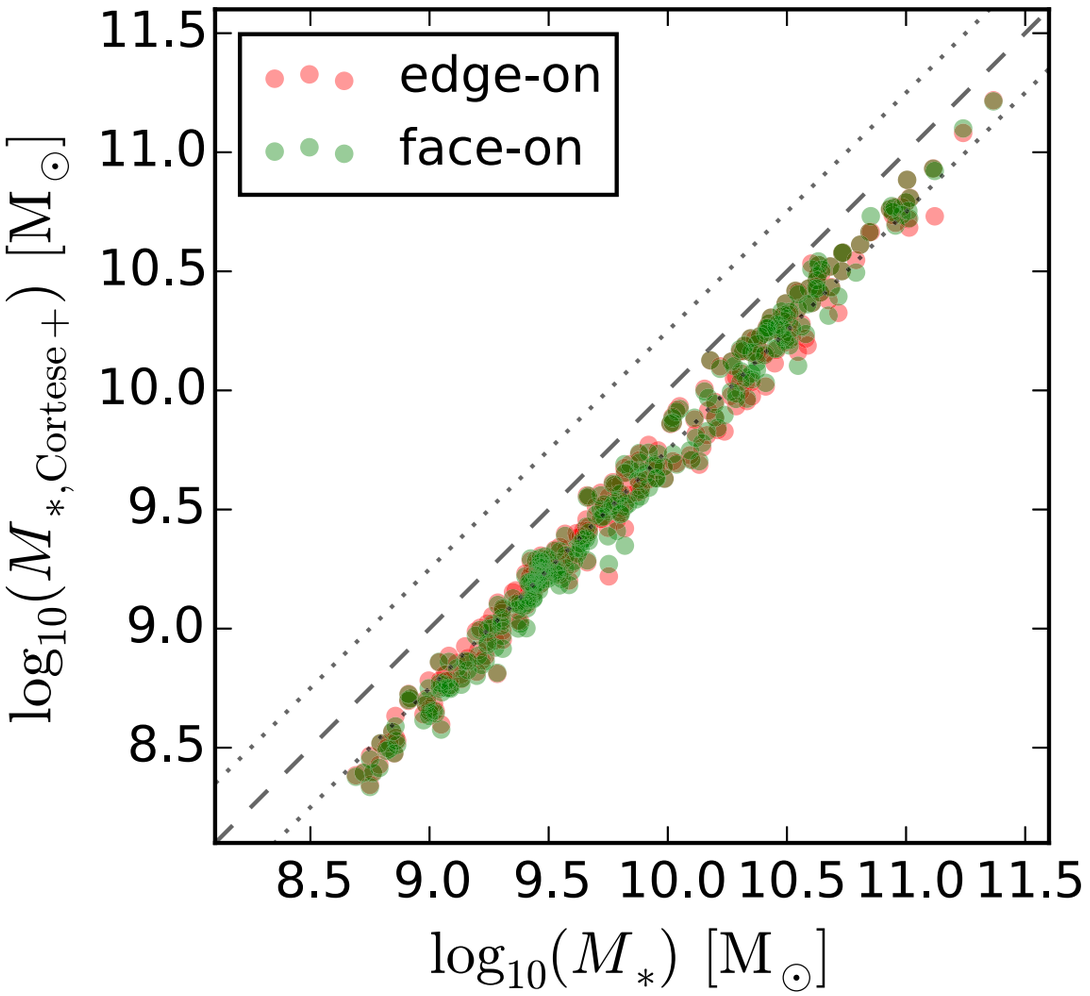
Colour correction

Luminosity in ‘red’ band

Empirically derived factors



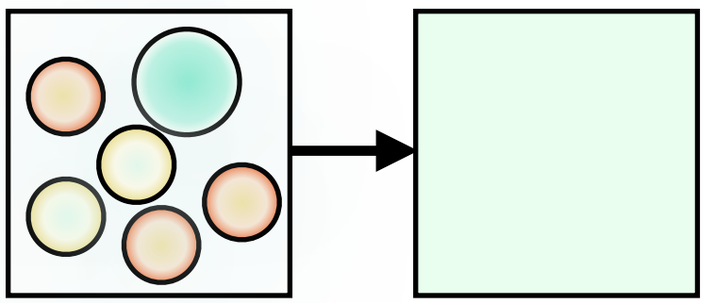
Camps et al. (2016)

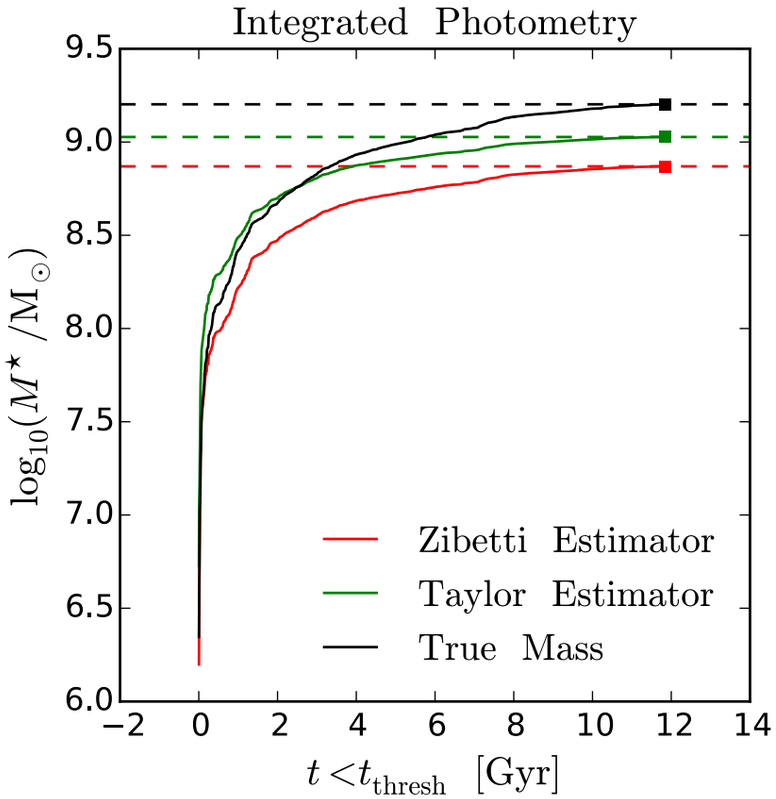


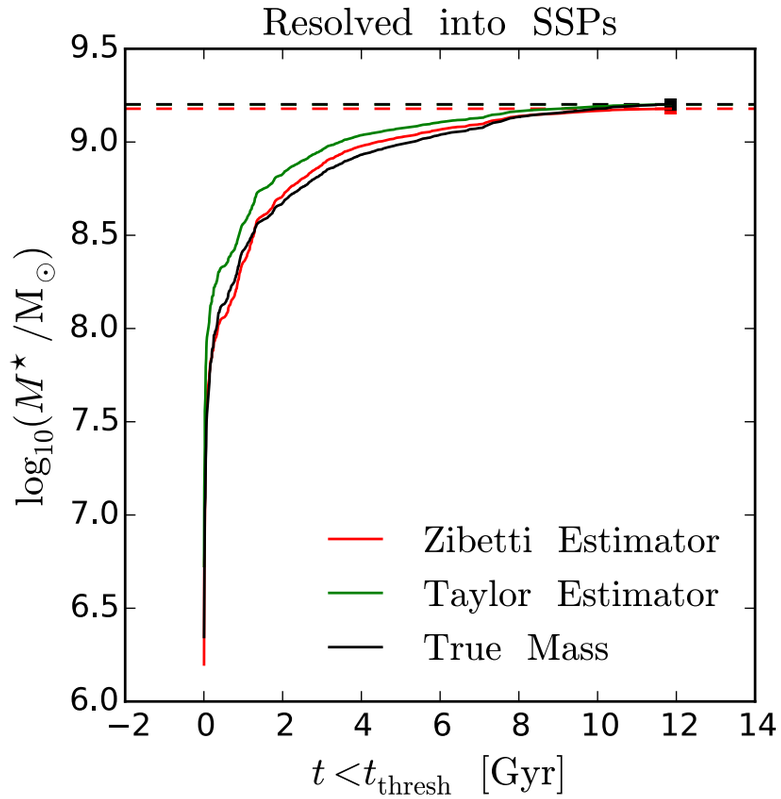
Resolving the problem

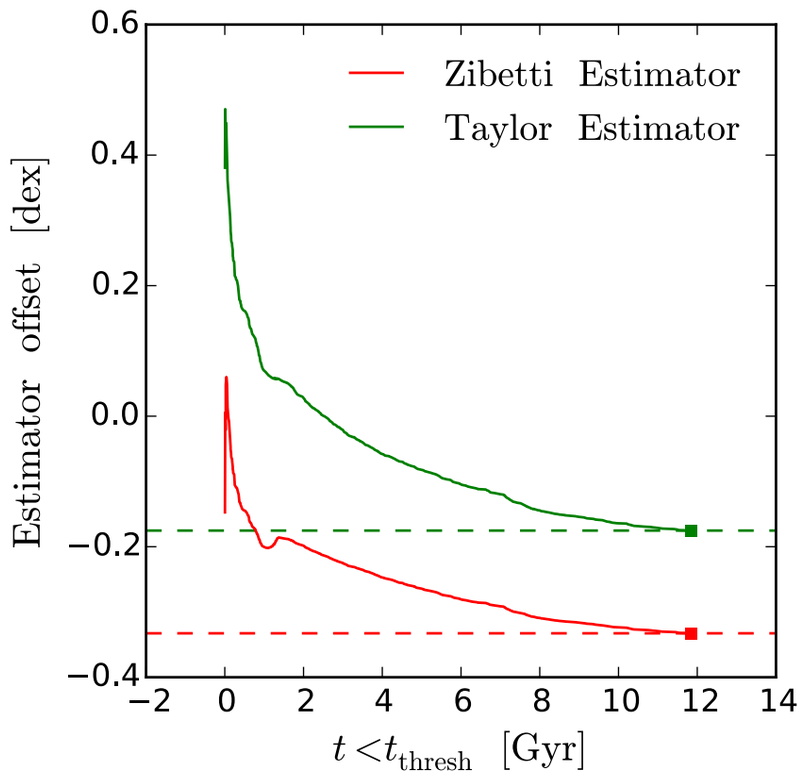
These systematic offsets appear to go away if we resolve the galaxy into SSPs.

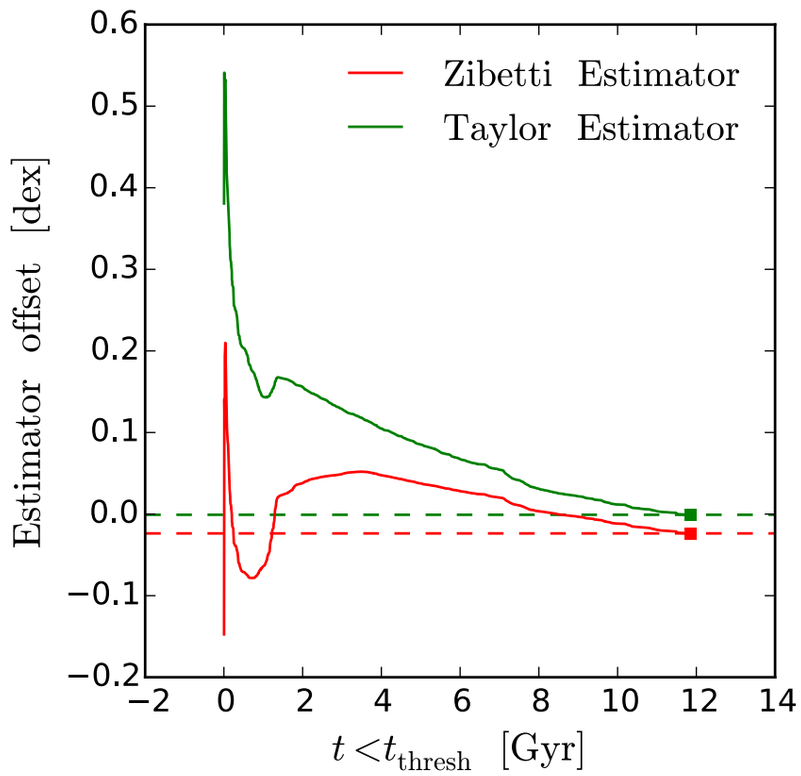
The younger SSPs outshine the old: blinds photometric measures to the old stellar component





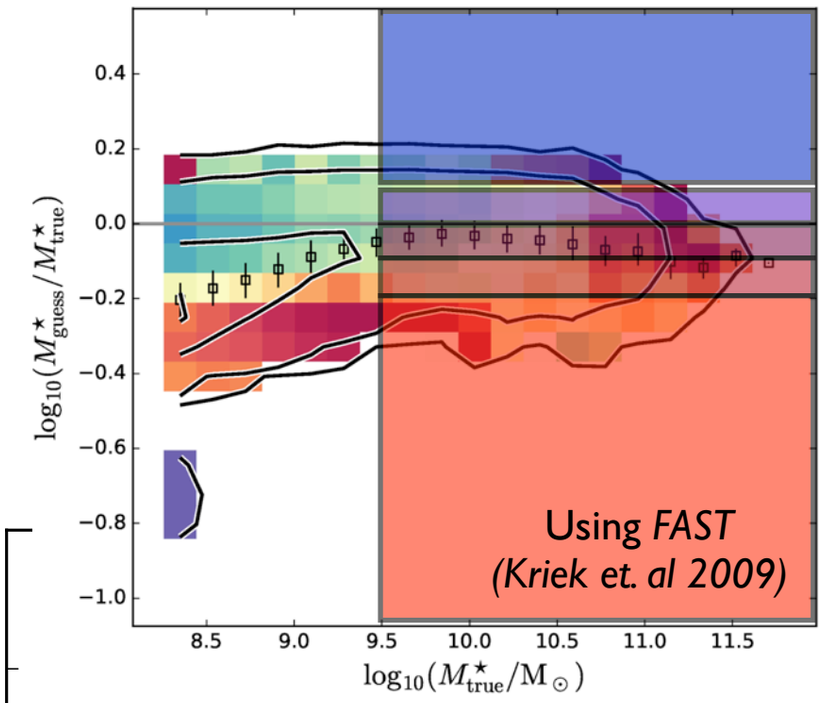


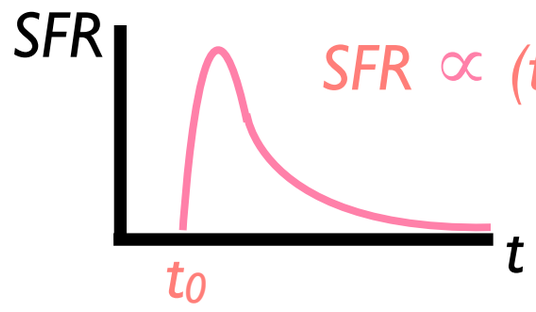




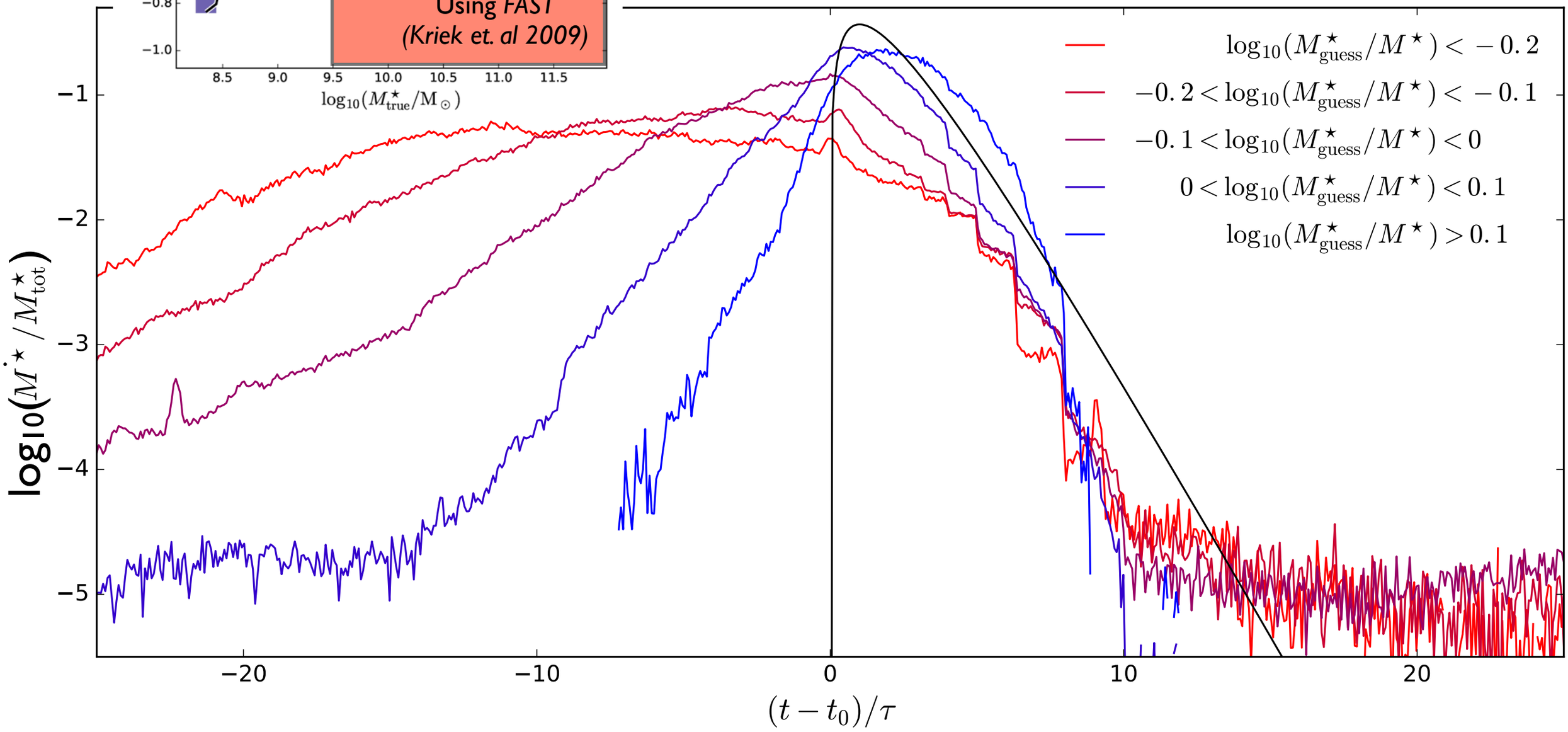
(similar to e.g. *Sorba et al. 2015*)

Histories

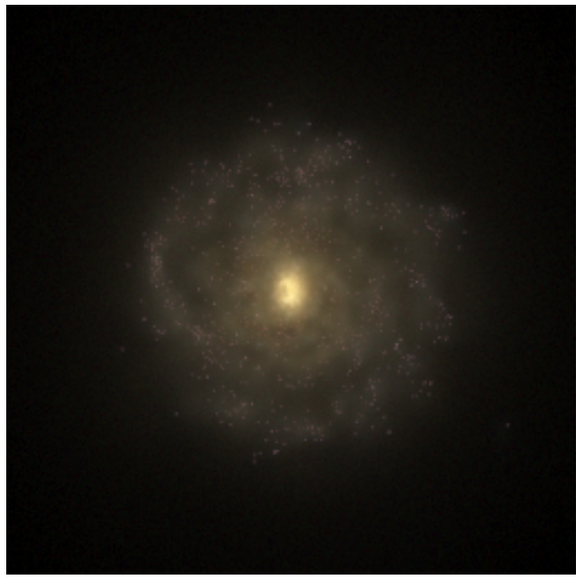


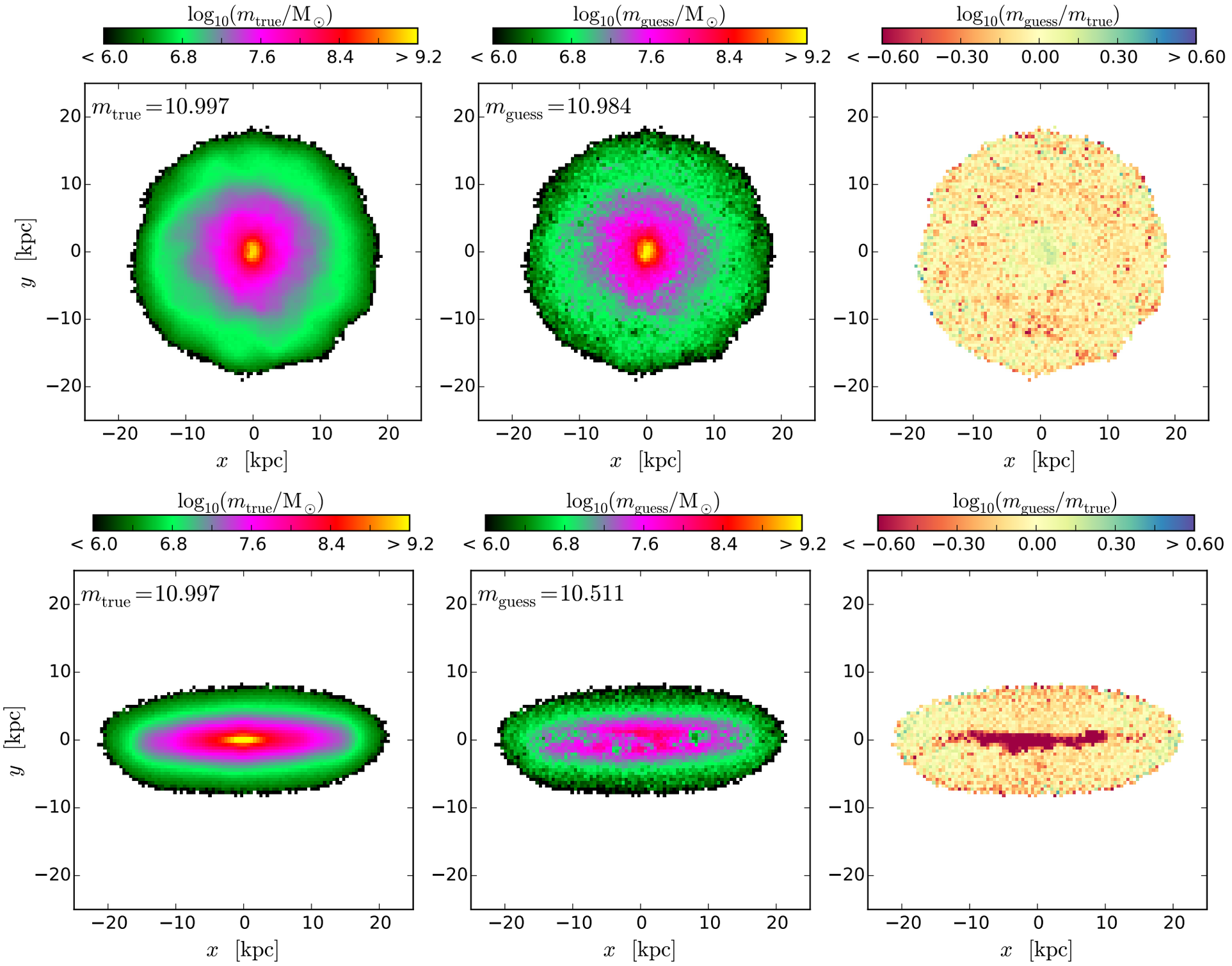


$SFR \propto (t\text{-}t_0)\exp([t_0]/\tau)$



Resolved mass-estimation





Data Products

Welcome James Trayford.
Streaming queries return unlimited number of rows in CSV format and are cancelled after 1800 seconds.
Browser queries return maximum of 1000 rows in HTML format and are cancelled after 90 seconds.

```
select
        gal.redshift as z,
        gal.Image_box as 'Box xy-projection',
        gal.image_edge as 'Edge-on',
        gal.image_face as 'Face-on'
    from
        Eagle..RefL0025N0752_Subhalo as gal,
        Eagle..RefL0025N0752_Subhalo as ref
    where
        ref.galaxyid=1612845 and gal.redshift < 2.1 and
        ((gal.snapnum >  ref.snapnum and ref.galaxyid between gal.galaxyid and gal.lastprogid) or
        (gal.snapnum <= ref.snapnum and gal.galaxyid between ref.galaxyid and ref.topleafid))

    order by
       gal.galaxyid
```

Maximum number of rows to return to the query form: 10

Query (stream) Query (browser) Help

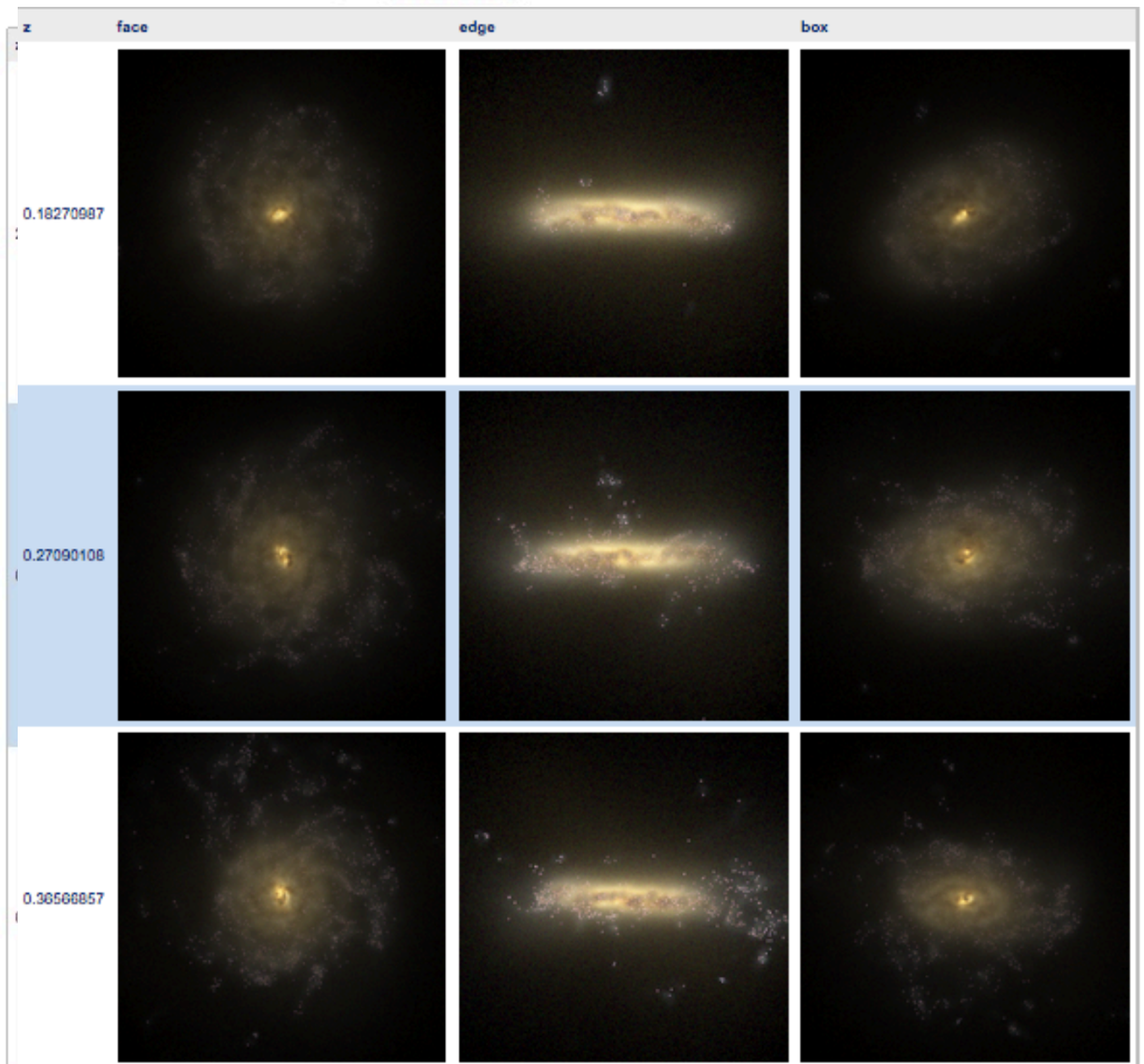
A spiral galaxy evolving in EAGLE, and imaged using SKIRT. This is one of ~1e5 galaxies that we are providing data for

http://icc.dur.ac.uk/Eagle/database.php

We are producing a number of data products that will be accessible via the database

- *UV-FIR Photometry* ✓
- *UV-FIR Spectra* ✓
- *Broad band FITS files*
- *IFU data cubes*

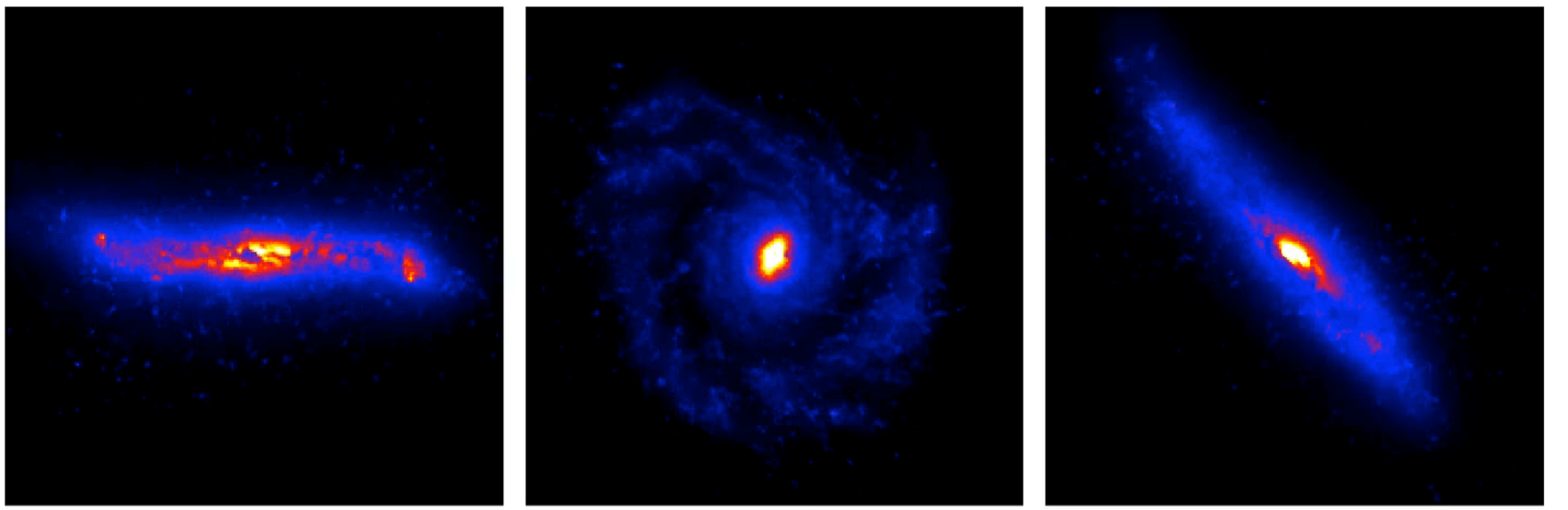
Plot (VOPlot)

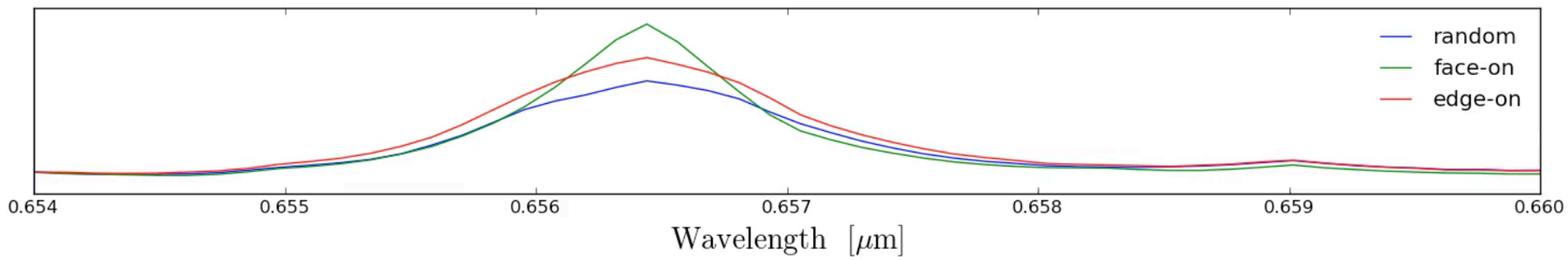


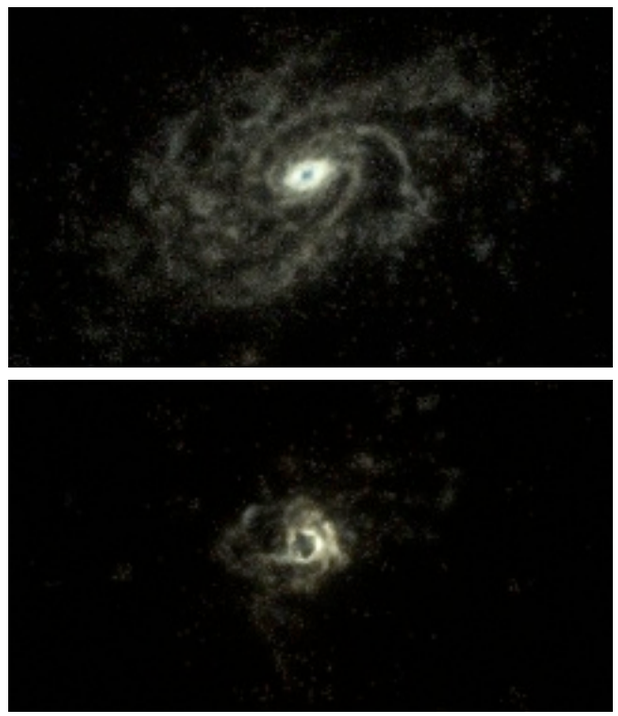
More Data

We can also exploit the sub-galaxy resolution of EAGLE to emulate other types of Data.

Using our radiative transfer prescription we produce *IFU data* and *FIR maps* of EAGLE galaxies







Left: Mock IFU data of an EAGLE spiral galaxy, scrolling through the Hα *Above:* Herschel PACS-like image of EAGLE galaxies at z = 1 - 2

Summary:

- We forward model EAGLE galaxies to exploit their diverse structure and histories for comparison to observation
- We develop a SKIRT model calibrated to local FIR scaling relation, reproducing z=0.1 colour distributions well.
- Dust effects can hide star formation in EAGLE galaxies, so they appear passive
- We can test systematic effects in galaxy mass estimates for resolved and unresolved photometry
- Data products and future applications of our SKIRT model