

Mass Estimates from Pixel-by-Pixel SED Fitting: The whole is not equal to the sum of the parts

Robert Sorba

Marcin Sawicki

November 20, 2013



Outshining

SED Models

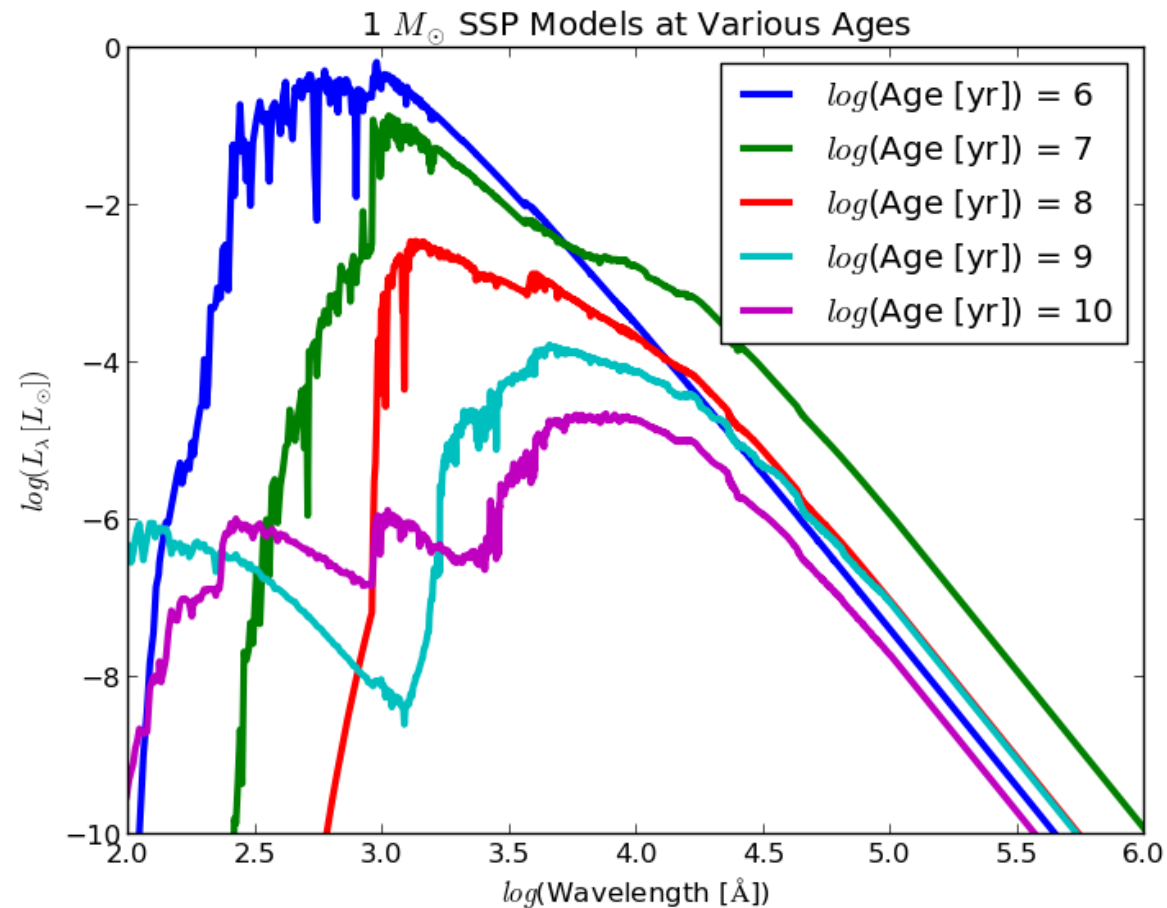
Extremely
Over-Simplified
Example

Method

Results

Implications

Conclusions



Young stars are much brighter than old stars.

Models made using FSPS (Conroy, Gunn, & White 2009; Conroy & Gunn 2010)

Extremely Over-Simplified Example

Outshining

SED Models

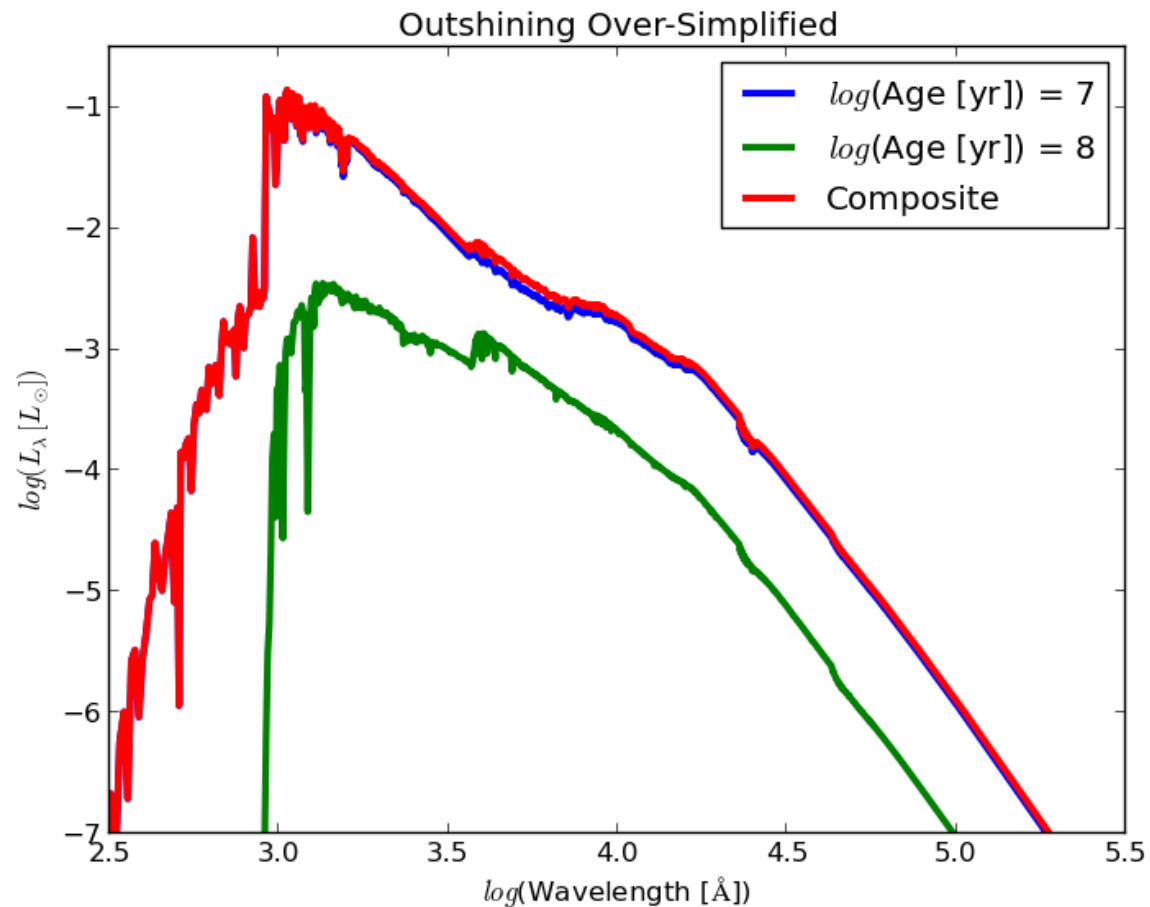
Extremely
Over-Simplified
Example

Method

Results

Implications

Conclusions



Suppose observing galaxy with red spectrum, but only have blue and green spectral models \implies underestimate stellar mass

Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

NGC 4321

Sersic Mass Correction

Results

Implications

Conclusions



NGC 4321 V band flux

Fit SED to each pixel in a galaxy to get resolved stellar property maps.

Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

NGC 4321

Sersic Mass Correction

Results

Implications

Conclusions

- SINGS survey
- Use galaxies with complete NUV, B, V, R, I data
- Focus on face-on galaxies
- 26 galaxies (20 spiral, 5 elliptical, 1 irregular) with $z_{avg} = 0.0025$

Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

NGC 4321

Sersic Mass Correction

Results

Implications

Conclusions

- Background subtraction
- Mask foreground stars and saturated pixels
- Convert to same pixel scale (1.5" from Galex nuv images)
- Convolve to broadest PSF
- Apply S/N mask
- Sum pixel fluxes to create "unresolved" broadband fluxes

Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

NGC 4321

Sersic Mass Correction

Results

Implications

Conclusions

- FSPS models
- Salpeter IMF
- Delayed $\tau = 1$ SFH
- Solar metallicity

Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

NGC 4321

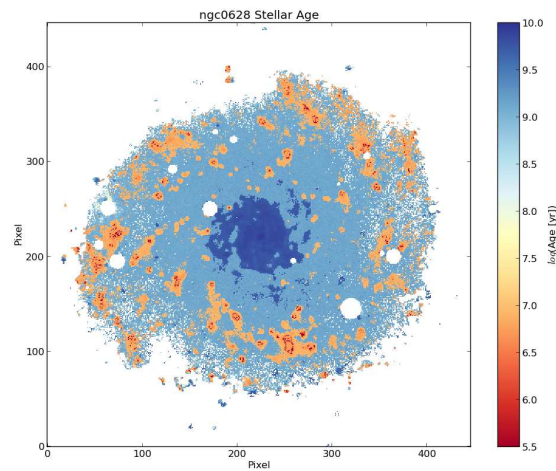
Sersic Mass Correction

Results

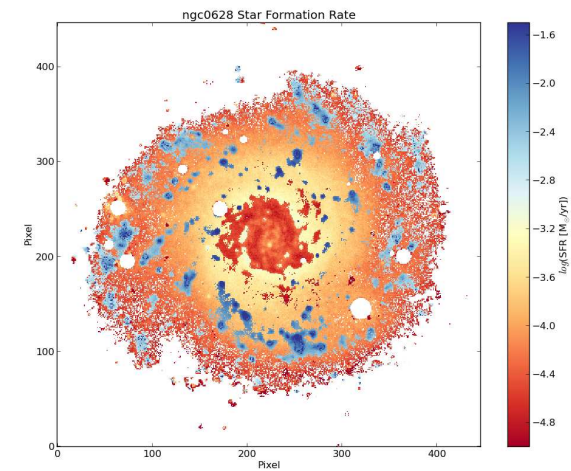
Implications

Conclusions

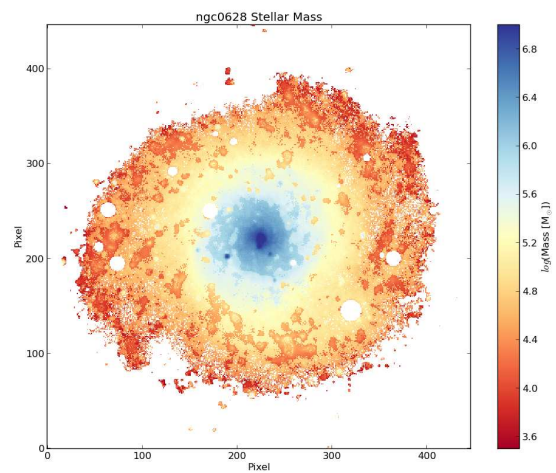
AGE



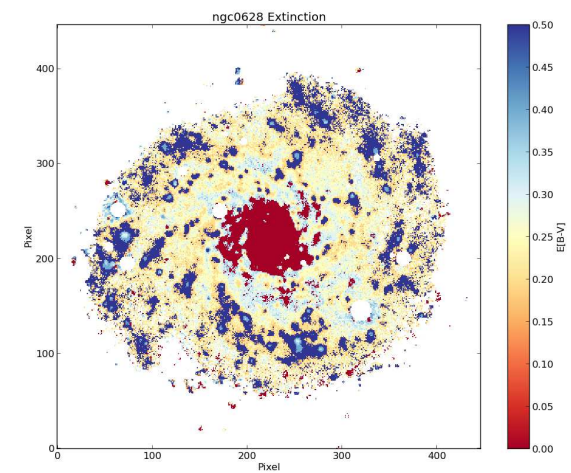
SFR



MASS



E(B-V)



Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

NGC 4321

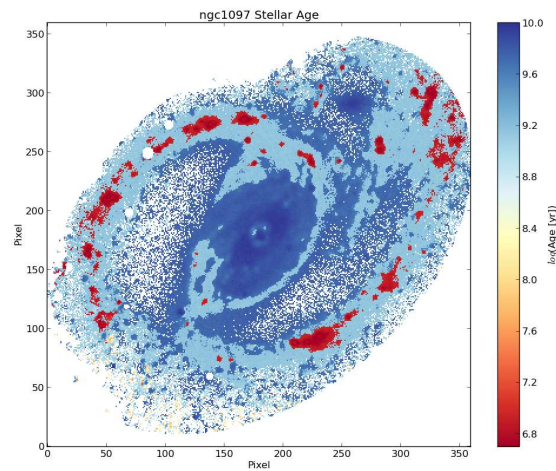
Sersic Mass Correction

Results

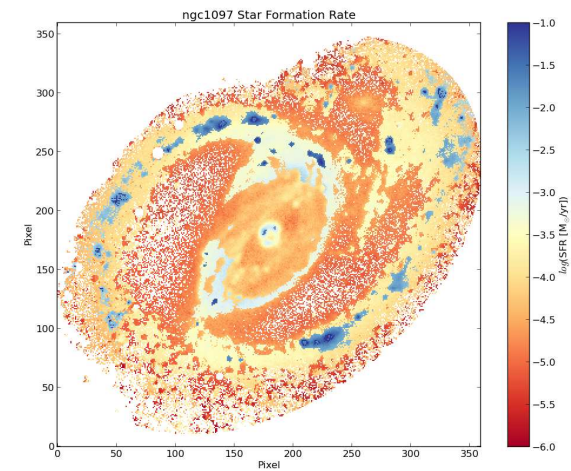
Implications

Conclusions

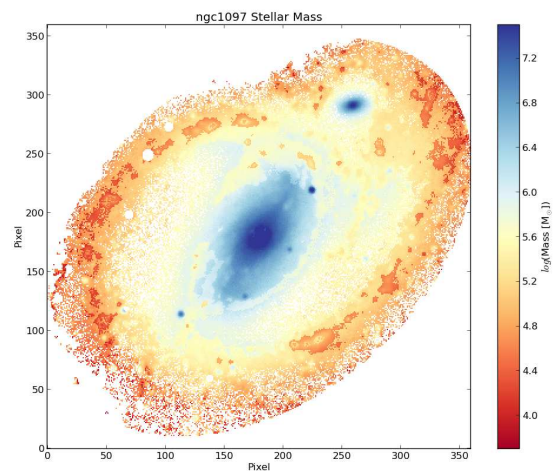
AGE



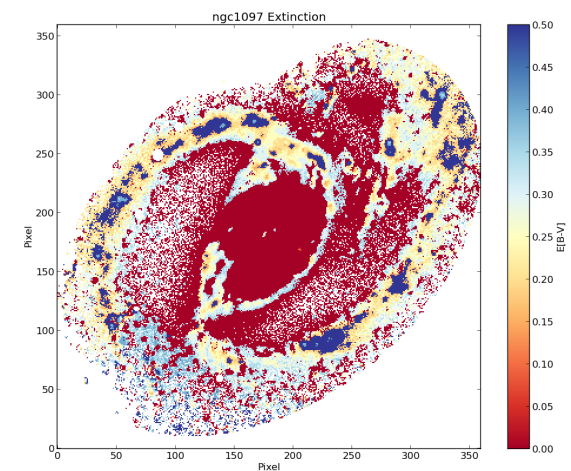
SFR



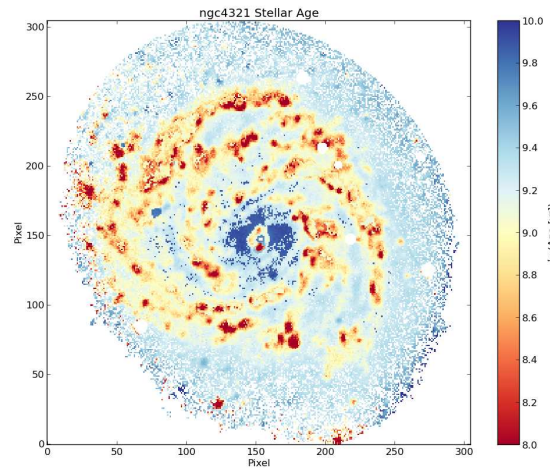
MASS



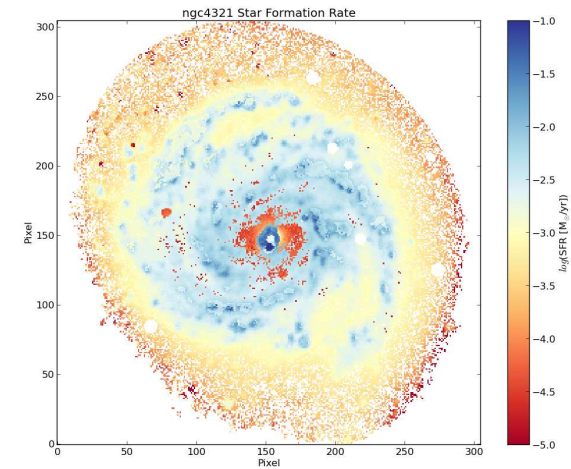
E(B-V)



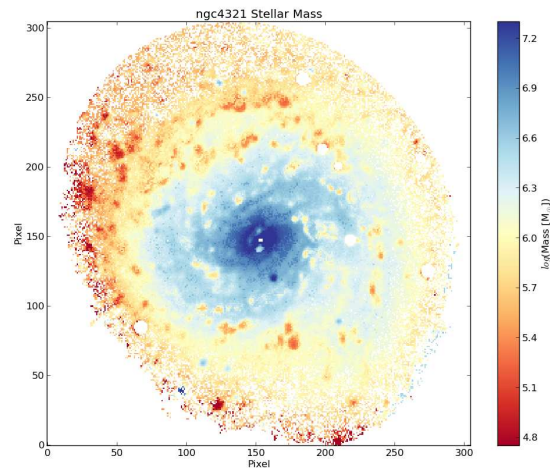
AGE



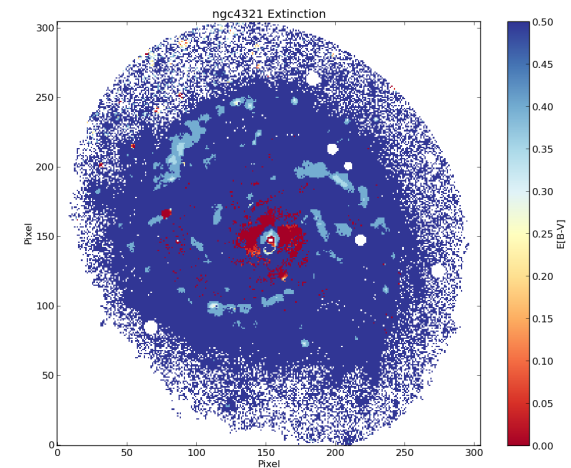
SFR



MASS



E(B-V)



Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

NGC 4321

Sersic Mass Correction

Results

Implications

Conclusions

Sersic Mass Correction

Outshining

Method

PxP Fitting

Data

Data Processing

SED Fitting

NGC 0628

NGC 1097

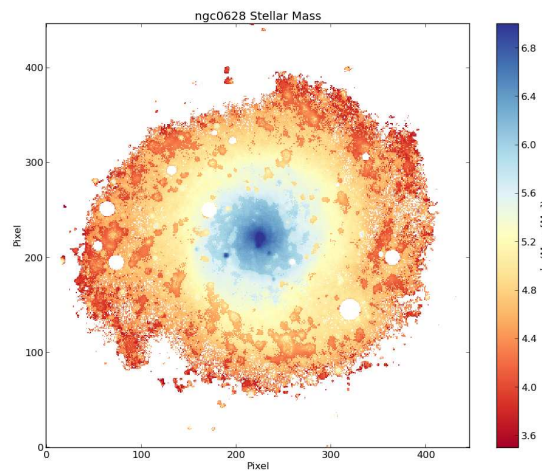
NGC 4321

Sersic Mass Correction

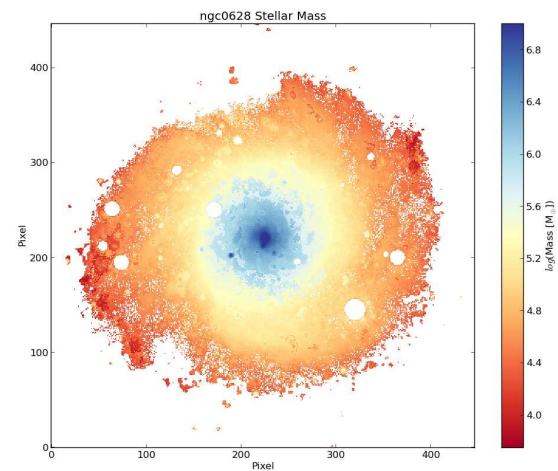
Results

Implications

Conclusions



Before



After

Less-massive bubbles in star-forming regions are mini-example of outshining.

Missing Mass

Outshining

Method

Results

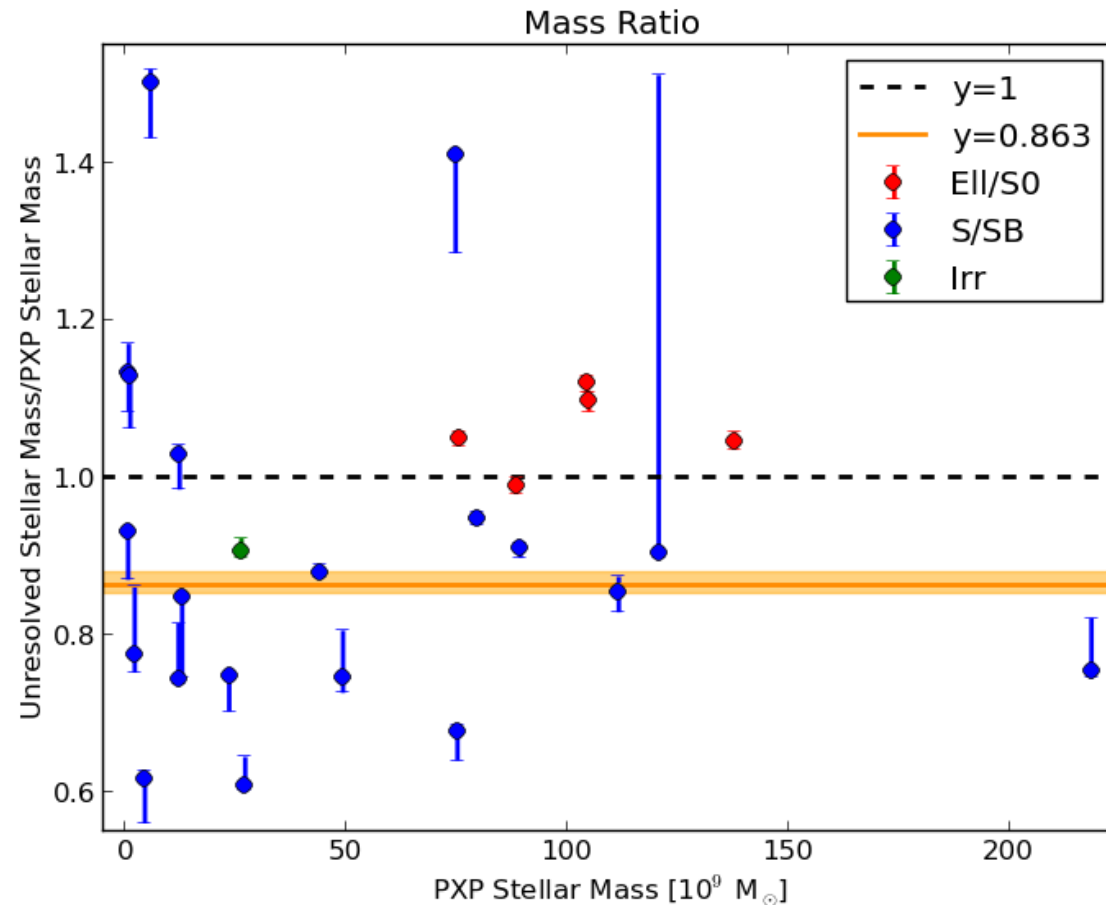
Missing Mass

Changing Resolution

Resolution Effects

Implications

Conclusions



Unresolved SED fitting misses $\sim 15\%$ of the stellar mass for star forming galaxies. Elliptical galaxies are not affected (probably).

Changing Resolution

Outshining

Method

Results

Missing Mass

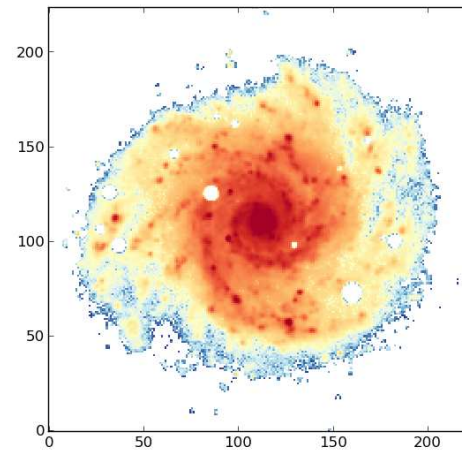
Changing Resolution

Resolution Effects

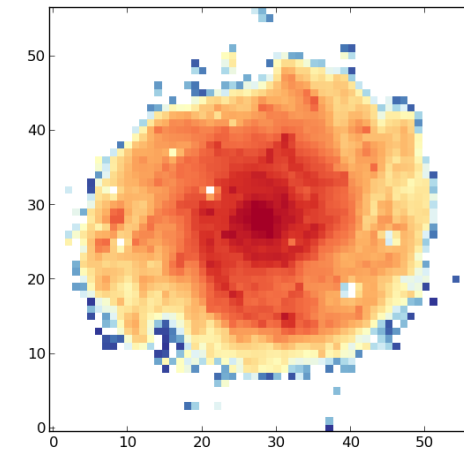
Implications

Conclusions

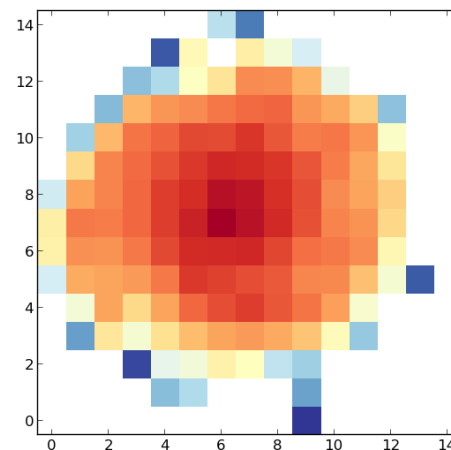
Binning = 1



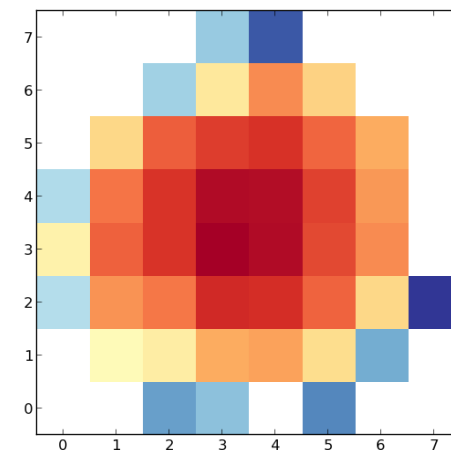
Binning = 3



Binning = 5



Binning = 6



Resolution Effects

Outshining

Method

Results

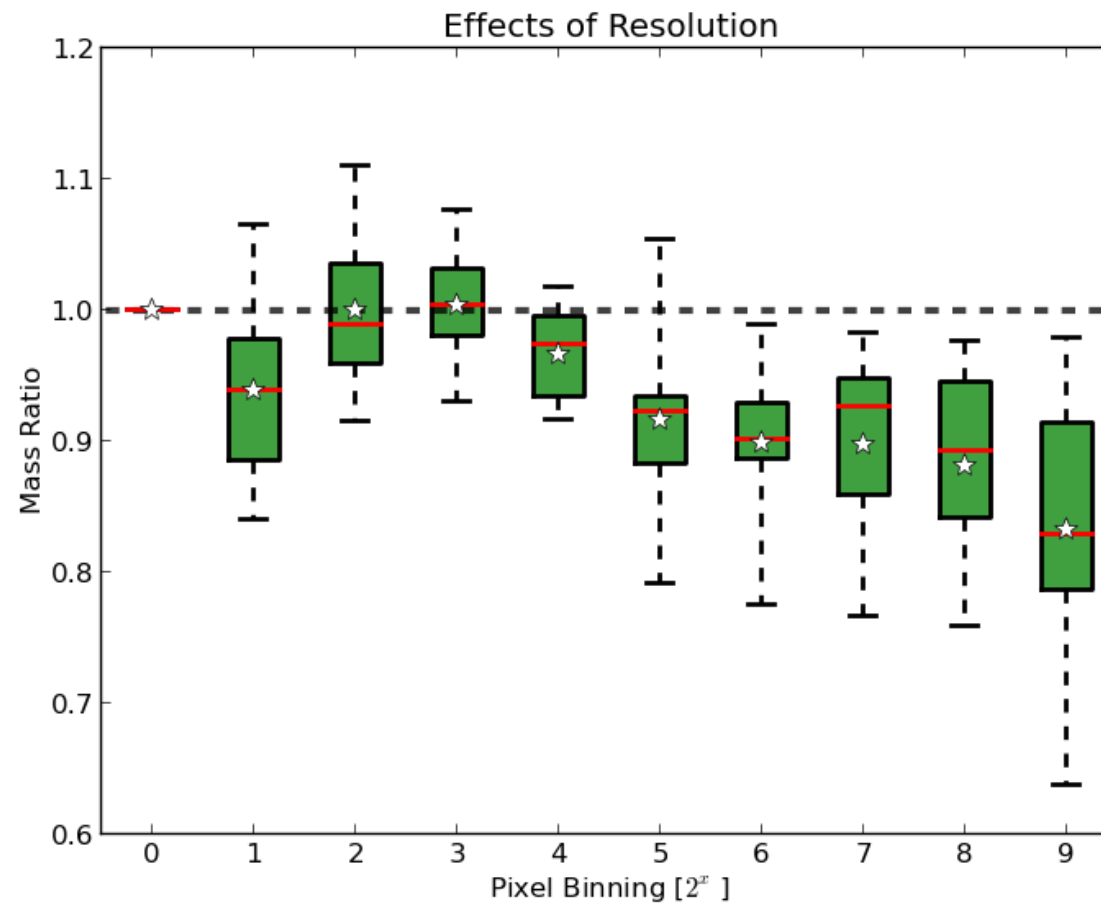
Missing Mass

Changing Resolution

Resolution Effects

Implications

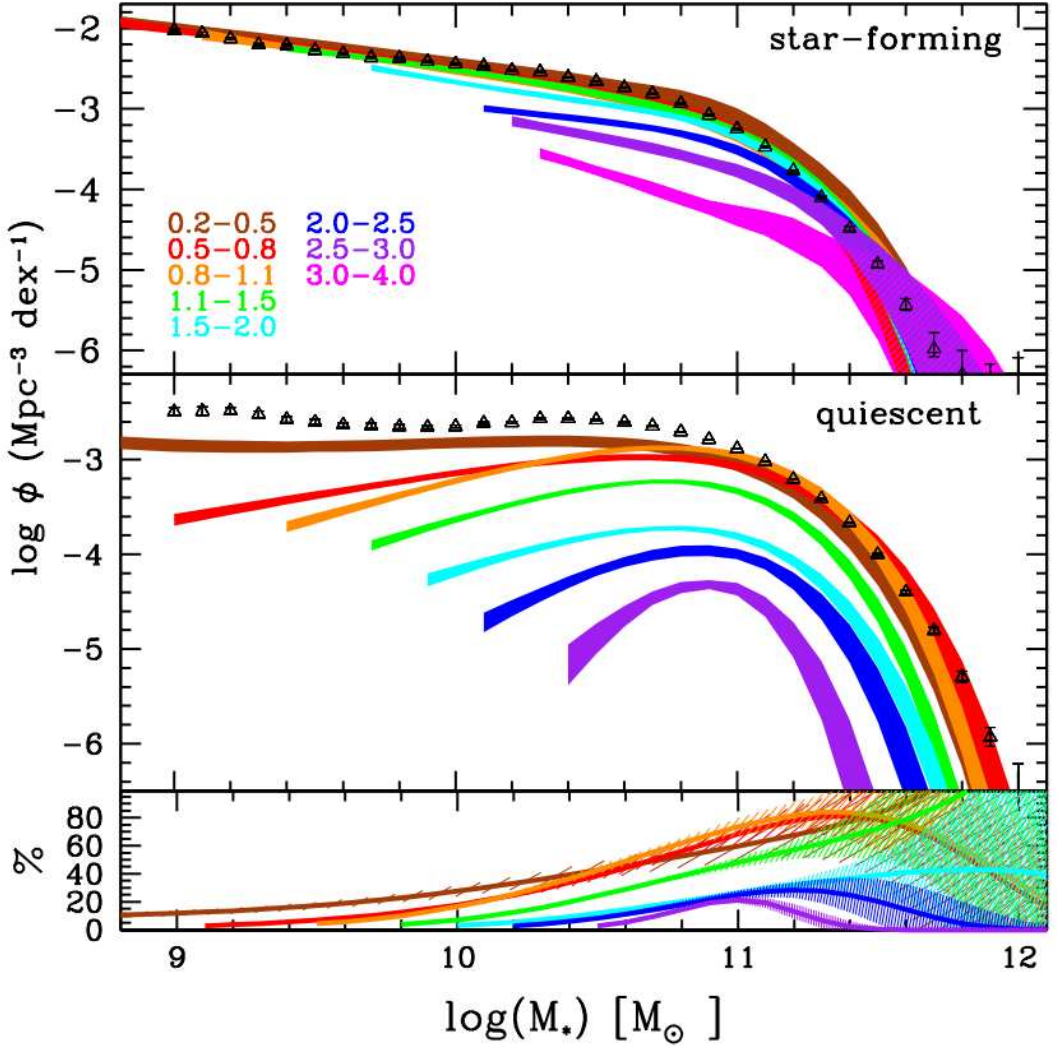
Conclusions



Jump between 16 and 32 pixels corresponds approx. to the width of spiral arms.

Mass Functions

- Outshining
- Method
- Results
- Implications
 - Mass Functions
 - $Z - M_{\star} - SFR$ Relation
 - M_{\star} Tully-Fisher
- Conclusions



Ilbert et al. 2013

$Z - M_{\star} - SFR$ Relation

Outshining

Method

Results

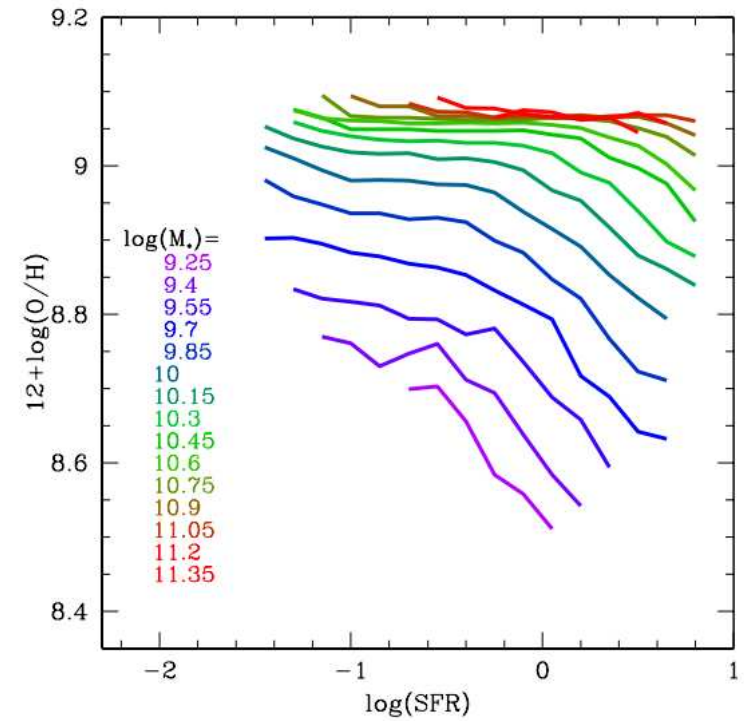
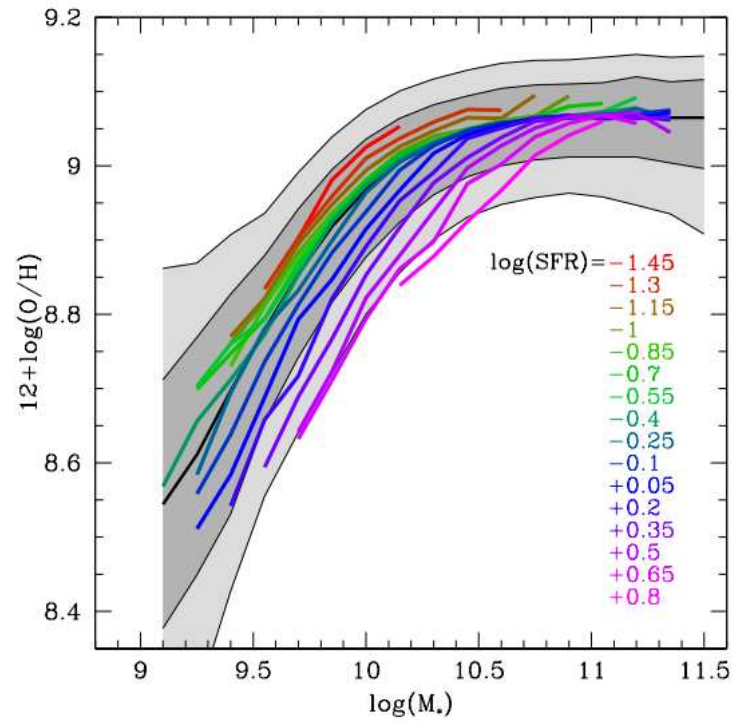
Implications

Mass Functions

$Z - M_{\star} - SFR$
Relation

M_{\star} Tully-Fisher

Conclusions



Mannucci et al. 2010

Outshining

Method

Results

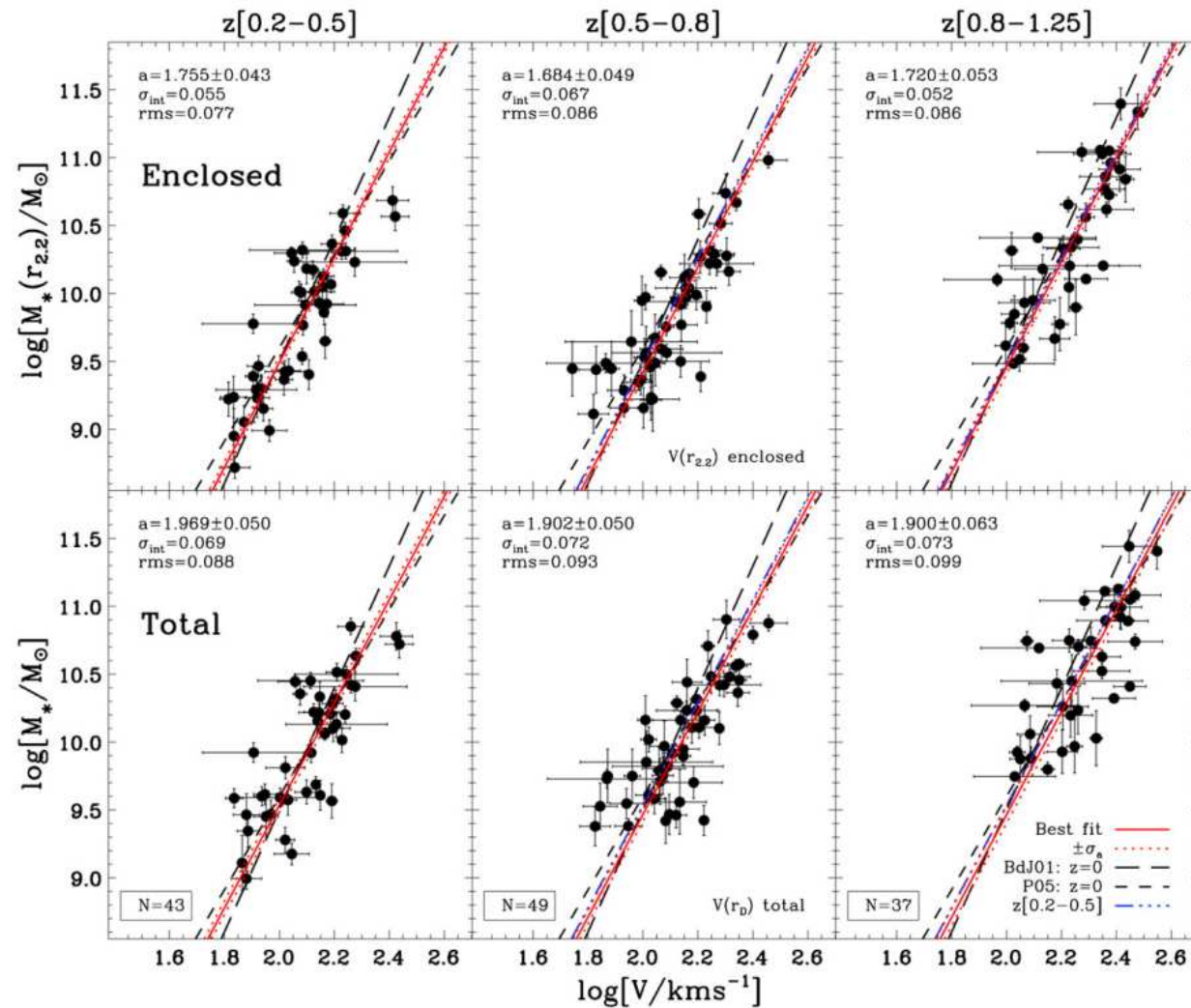
Implications

Mass Functions

$Z - M_* - SFR$
Relation

M_* Tully-Fisher

Conclusions



Miller et al. 2011

Outshining

Method

Results

Implications

Conclusions

Future Questions

Conclusions

Questions?

- Would more data affect the results in any way?
- Are stellar masses of ellipticals over-predicted?
- How does outshining change at higher redshift?

Outshining

Method

Results

Implications

Conclusions

Future Questions

Conclusions

Questions?

- Performed PxP SED fitting on 26 SINGS galaxies and compared with unresolved SED fitting
- Found unresolved stellar masses of star-forming galaxies missed approx. 15% of the mass on average
- Need to resolve at the level of about a kpc to see difference between PxP and unresolved mass estimates
- This systematic offset has small quantitative implications for many current relations, typically shifting the relations by 0.06 dex

Outshining

Method

Results

Implications

Conclusions

Future Questions

Conclusions

Questions?

QUESTIONS?