Characterising Luminous Infrared Galaxies With the Southern African Large Telescope

Rajin Ramphul[1,2]

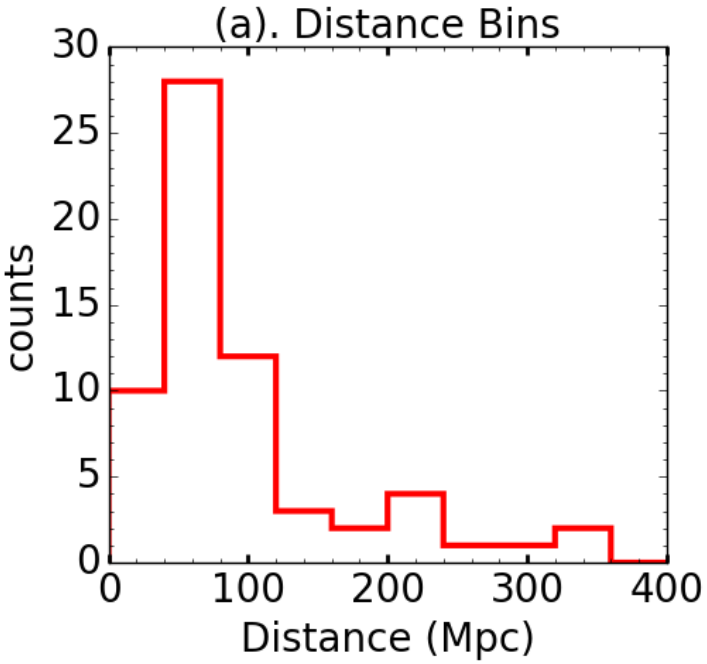
Supervisors: Petri Vaisanen[1], Kurt Van der Heyden[2]

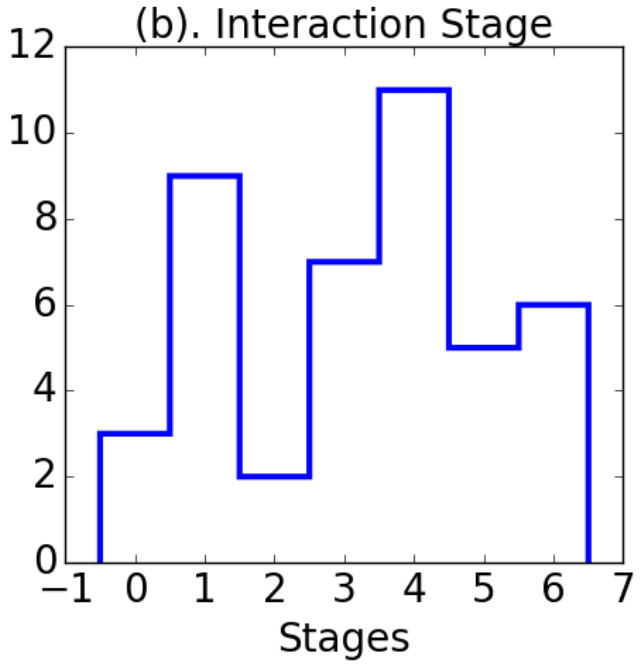
[1]South African Astronomical Observatory
[2]University of Cape Town

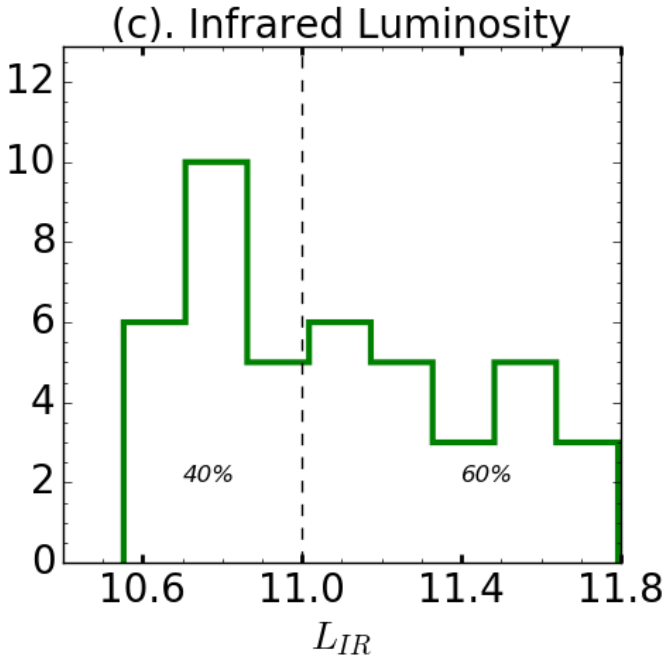
SUNBIRD Workshop Nov. 2017

SUNBIRD SALT survey

- **40+ galaxies**



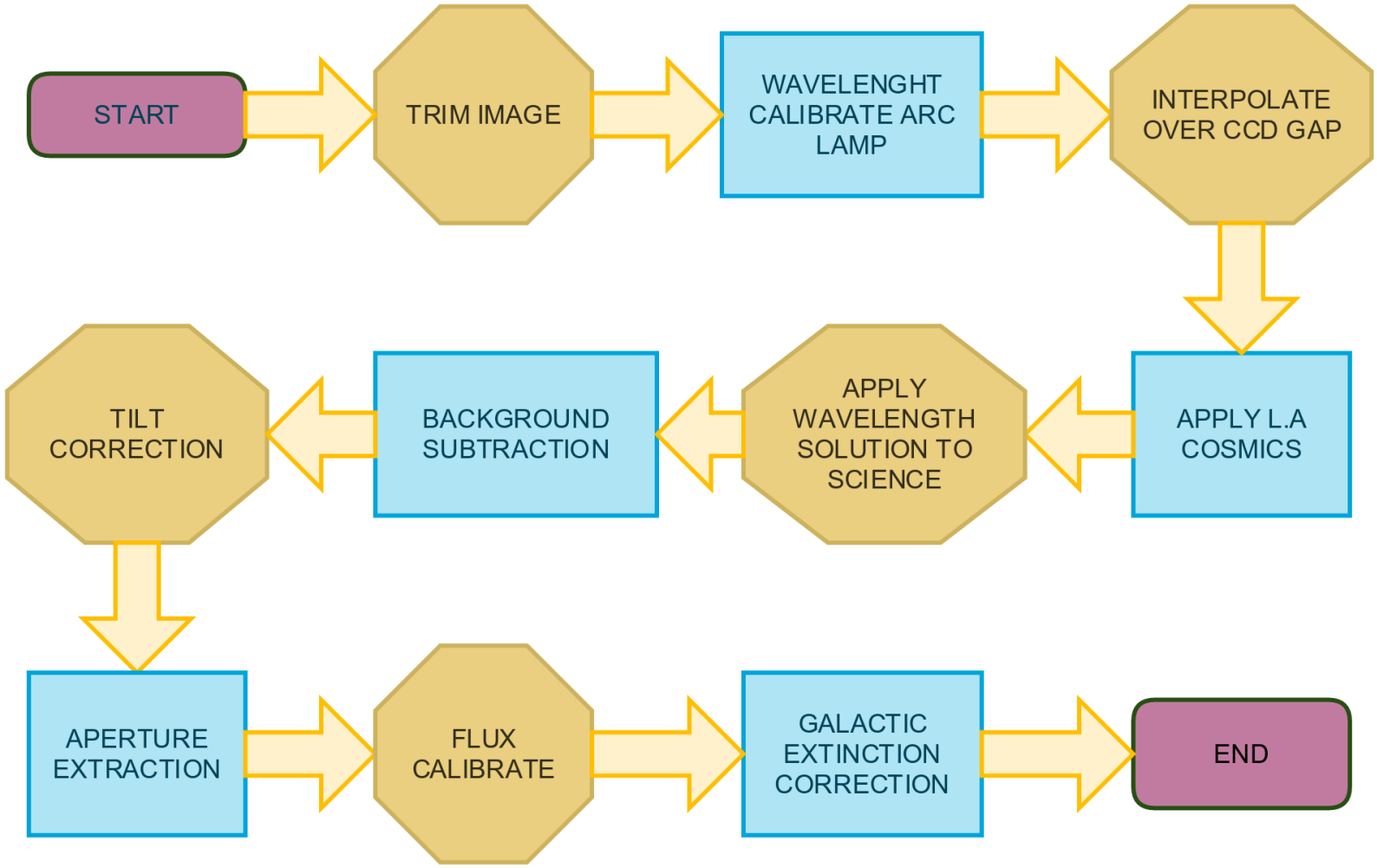




SUNBIRD SALT survey

- **Data observed with current proposal and past SALT proposal (2011 – 2014)**
- **PG0900 (R~1000) for metallicities, extinctions and Stellar population fitting. Wavelength coverage 3600-6700 A**
- **PG1800 (R~3000) for kinematics and gas inflows. Wavelength coverage 5600-6930 A**
- **In total >140 blocks of data to reduce!**

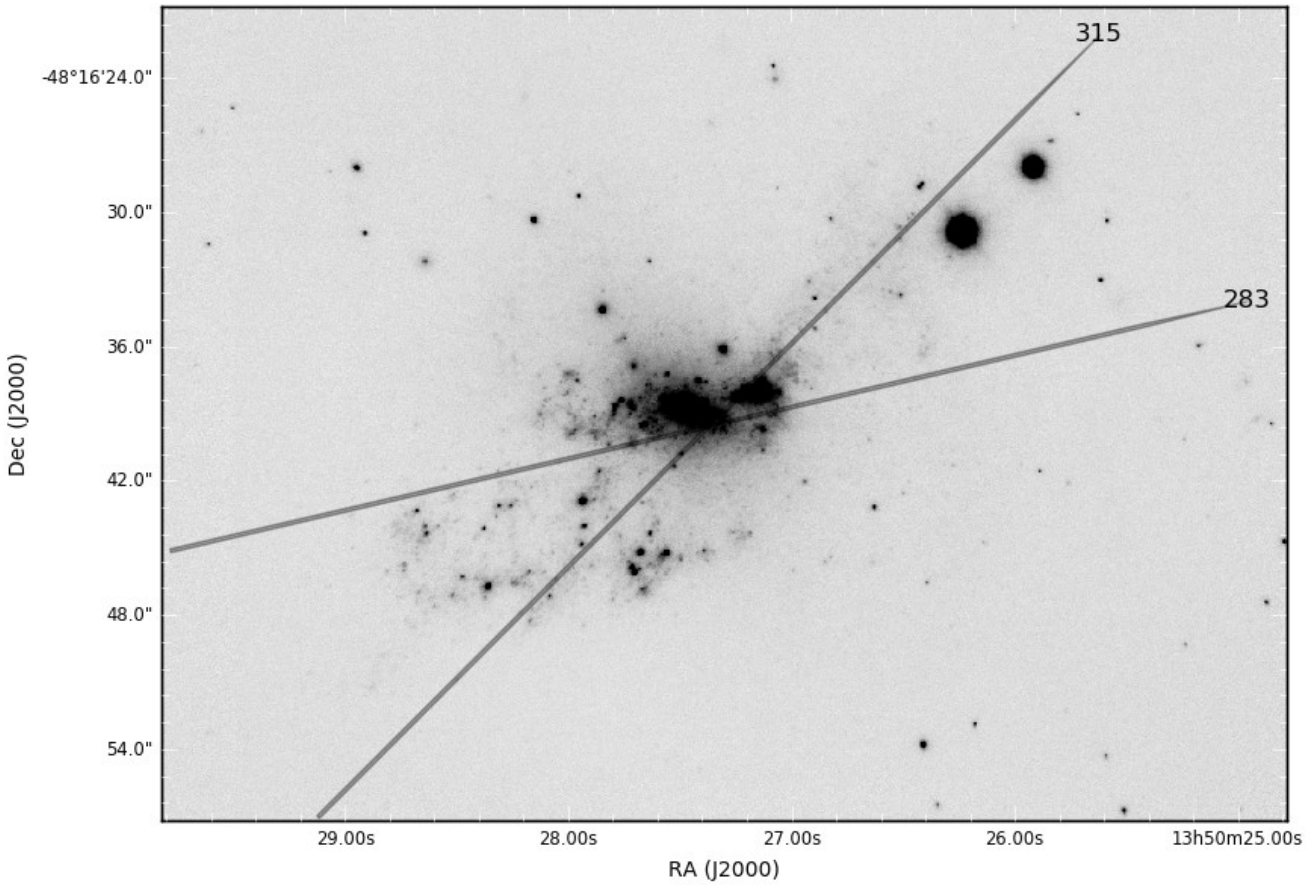
Data Reduction Pipeline



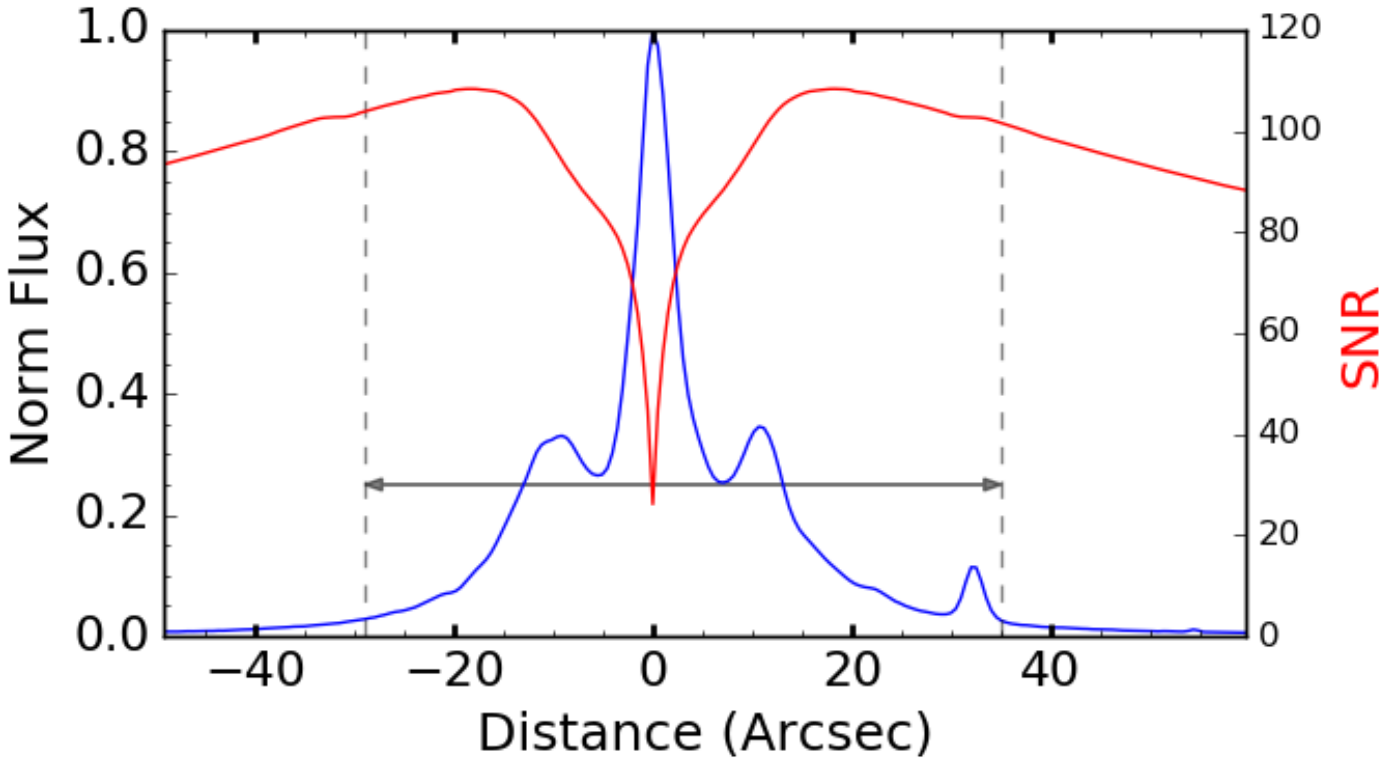
- **Propagate Uncertainties**

SUNBIRD SALT survey

ESO221-IG008

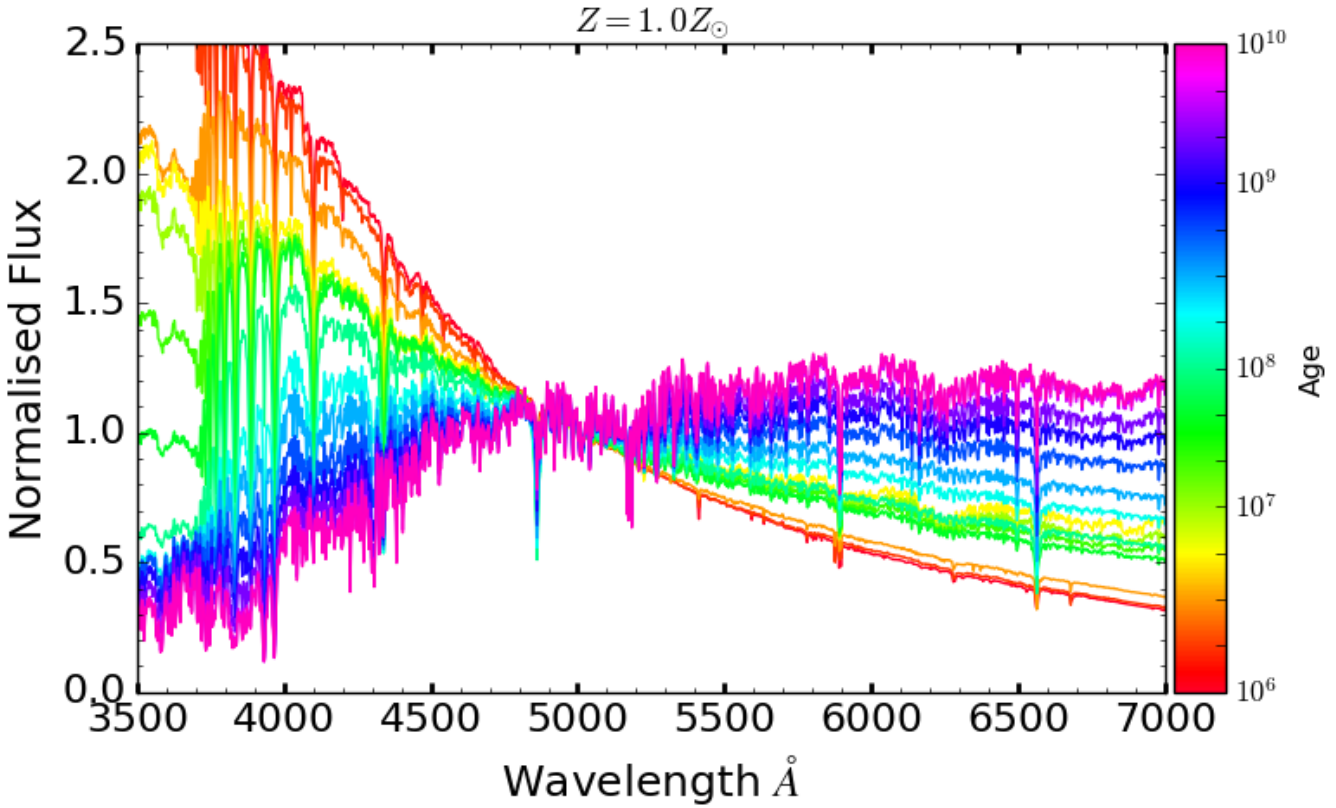


SUNBIRD SALT survey



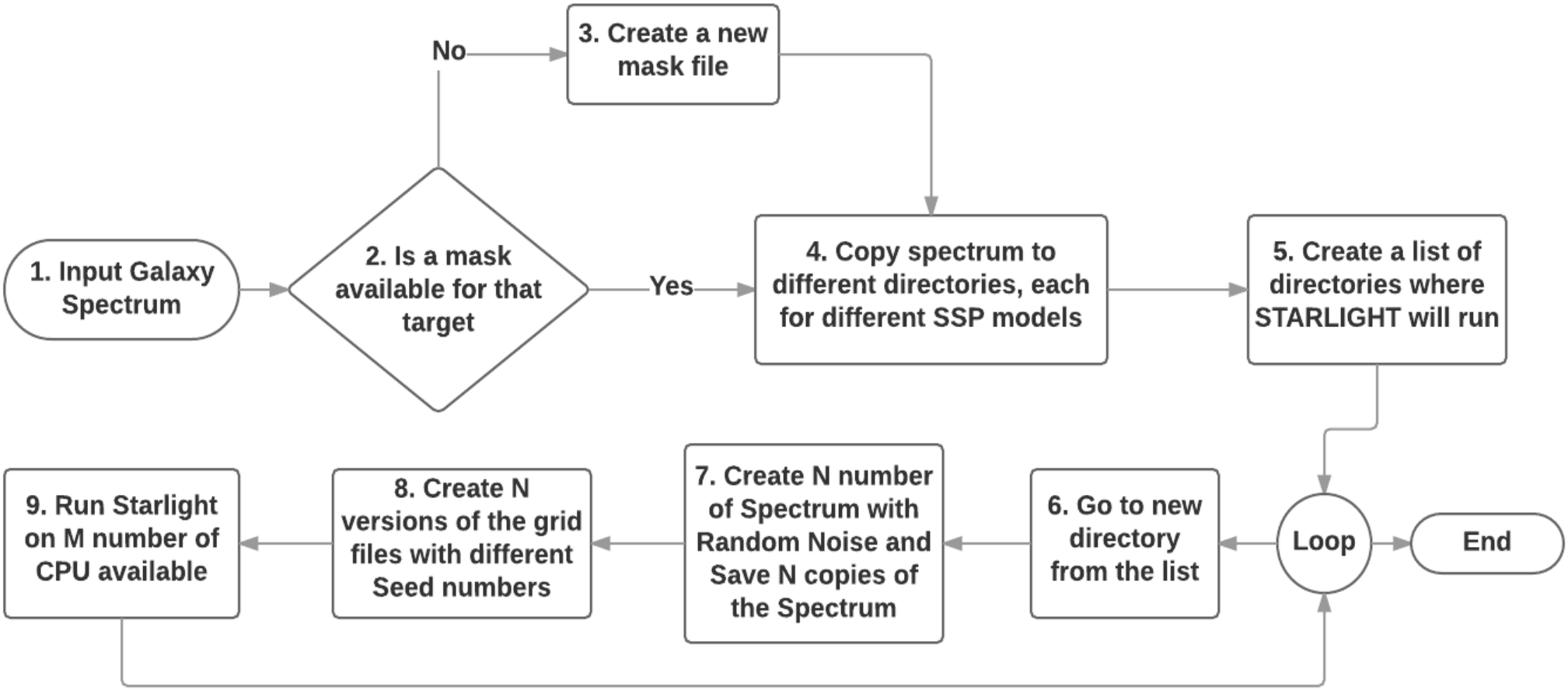
ESO154-G010

Stellar Population Modelling with STARLIGHT

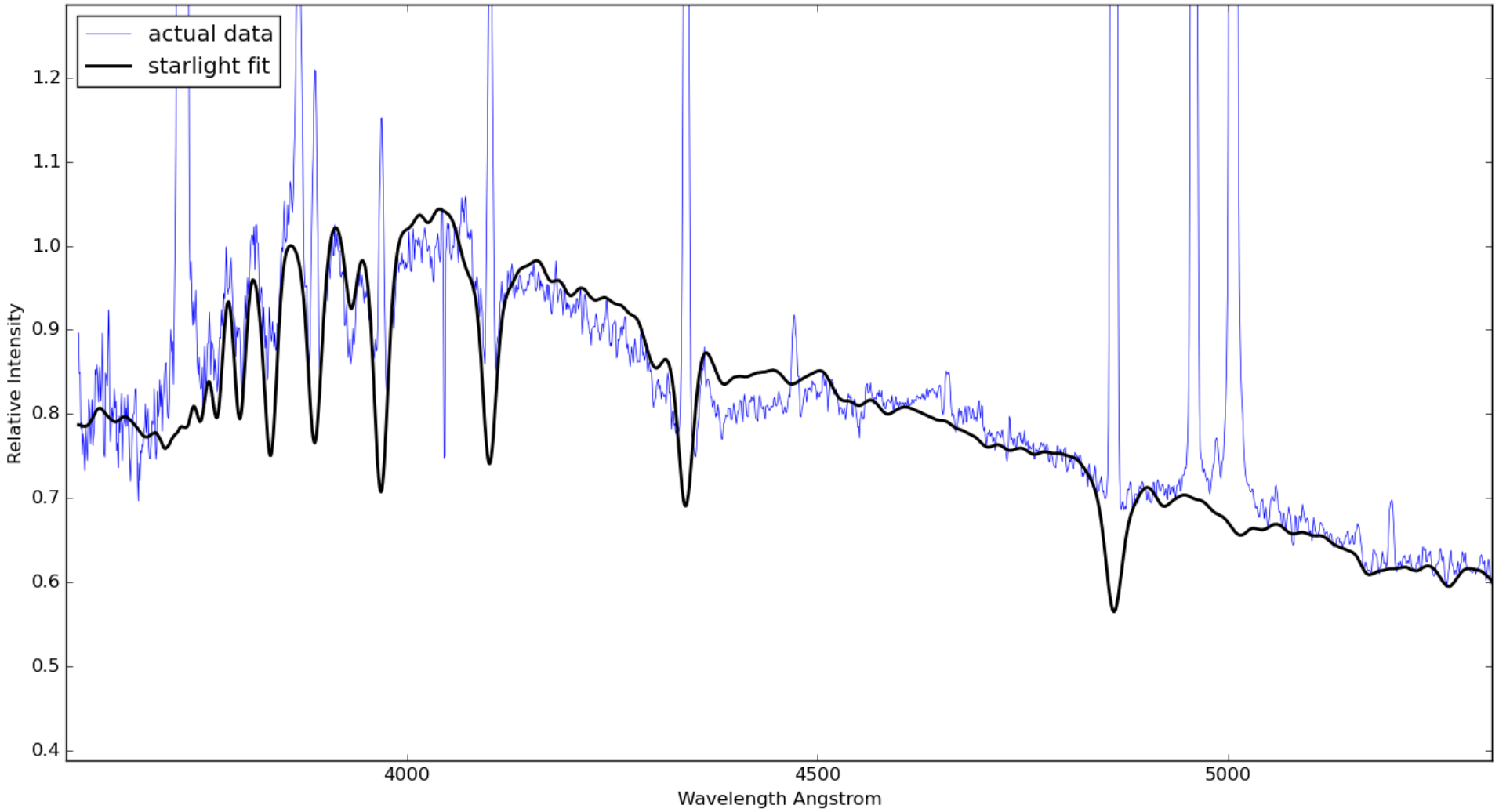


- **Assume IMF**
- **Create stellar library template**
- **Use Inversion code (STARLIGHT) - Fits observed spectra with template of several Single Stellar Population (SSP).**
- **Gives out the Ages and Metallicity of the galaxy fitted**
- **Does not give uncertainty.**

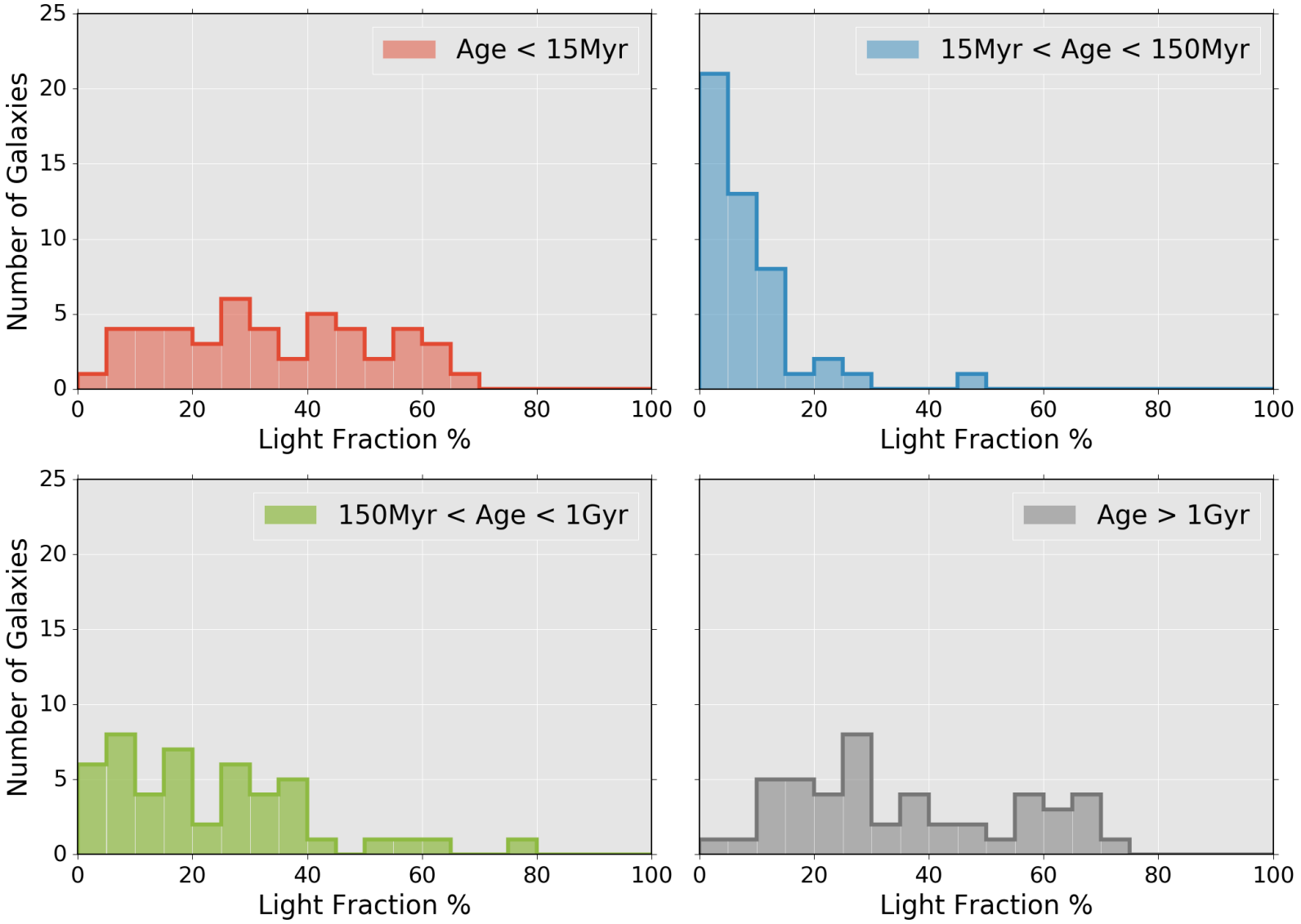
STARLIGHT fitting Pipeline



STARLIGHT fitting

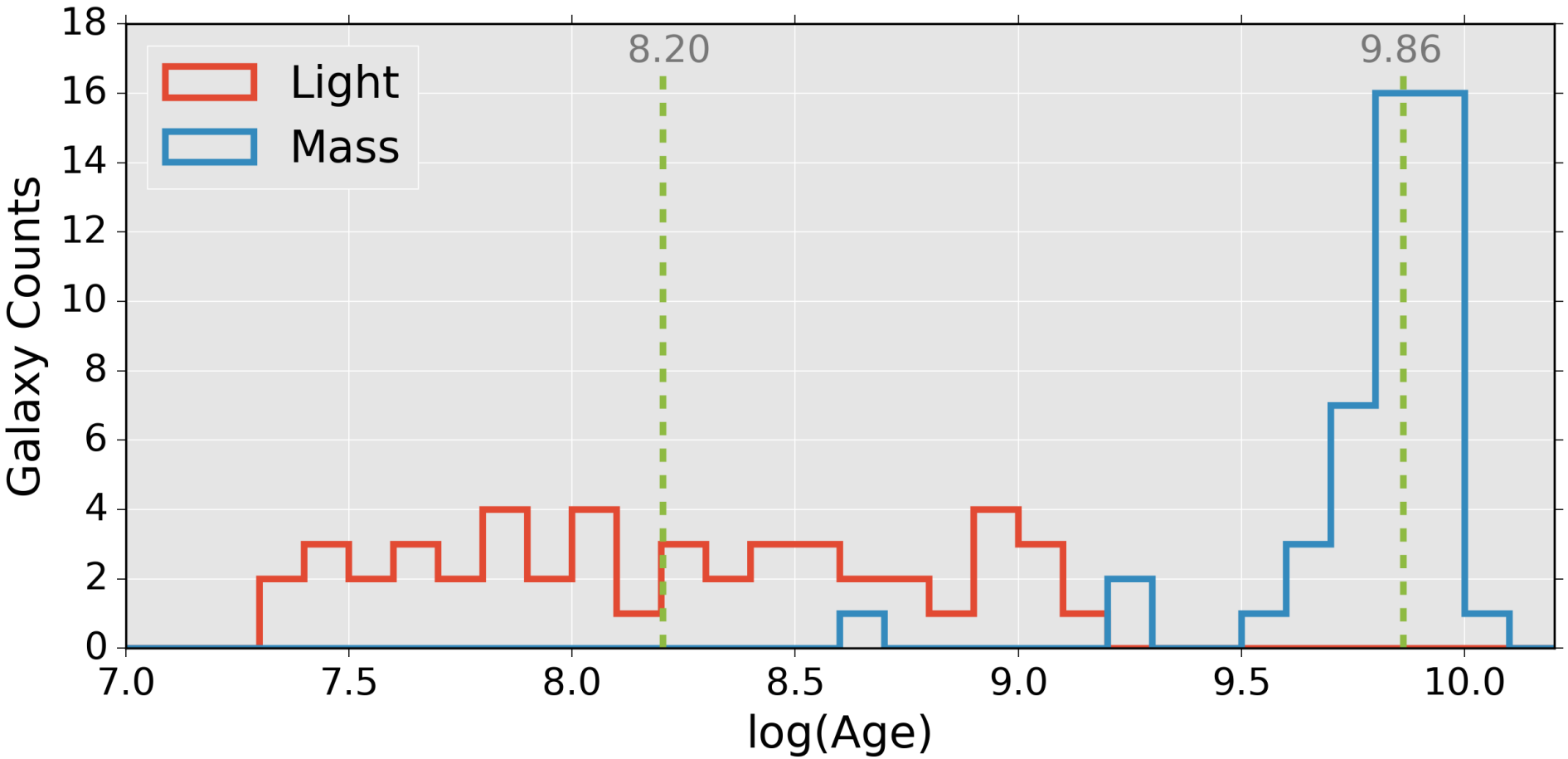


Results – Light Fraction

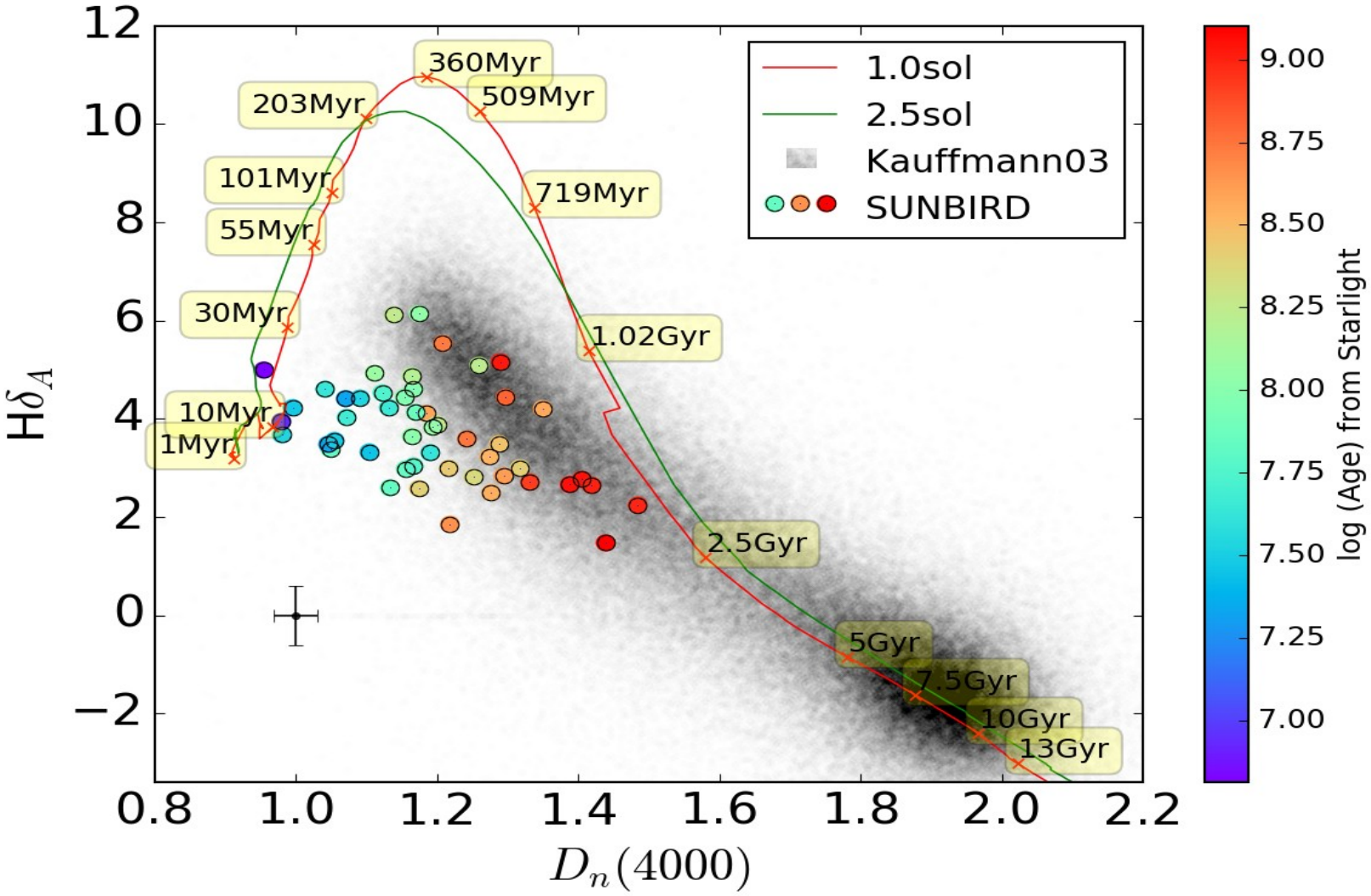


Results - Age

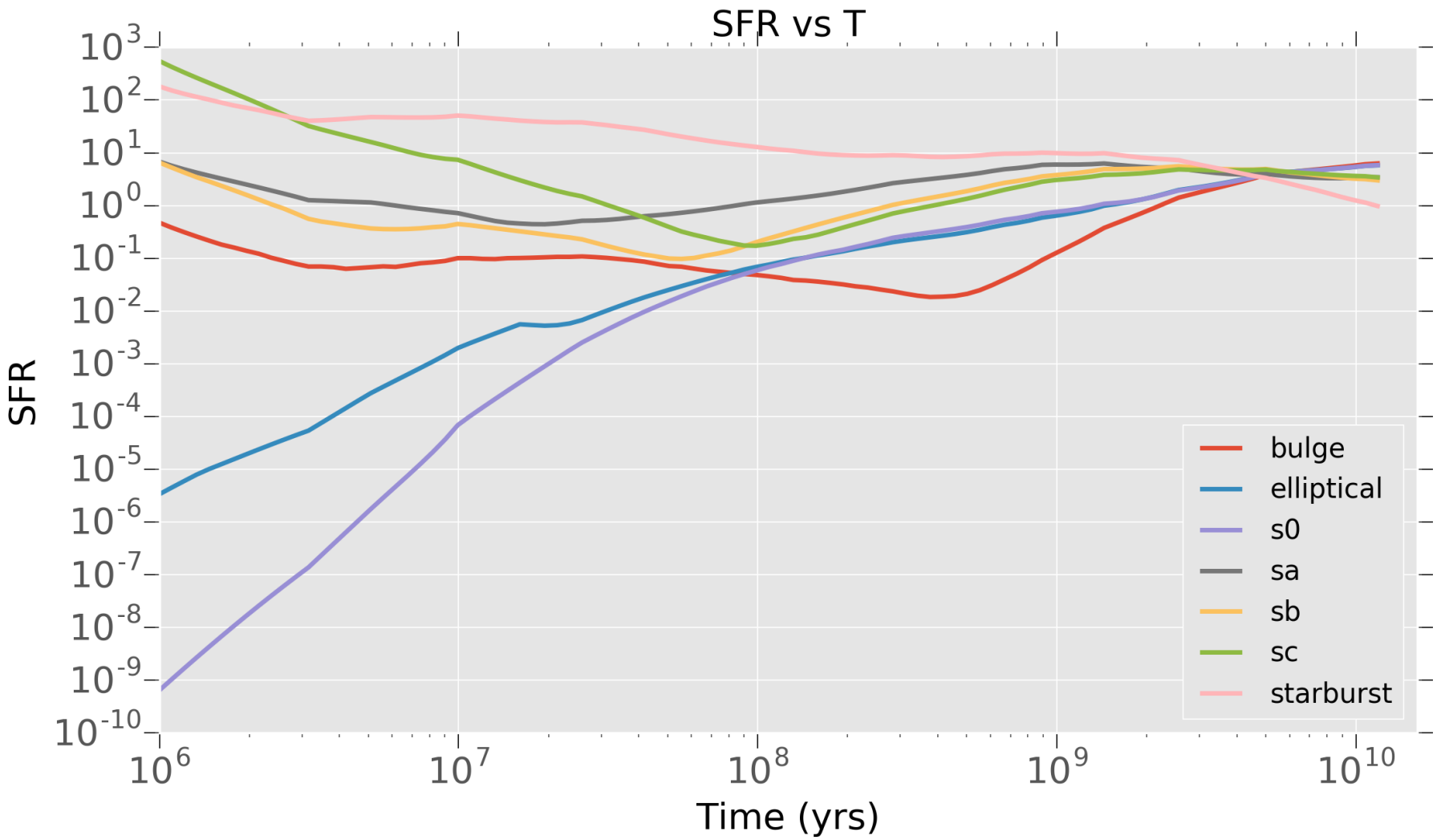
LW – 158Myrs **MW – 7.24 Gyrs**



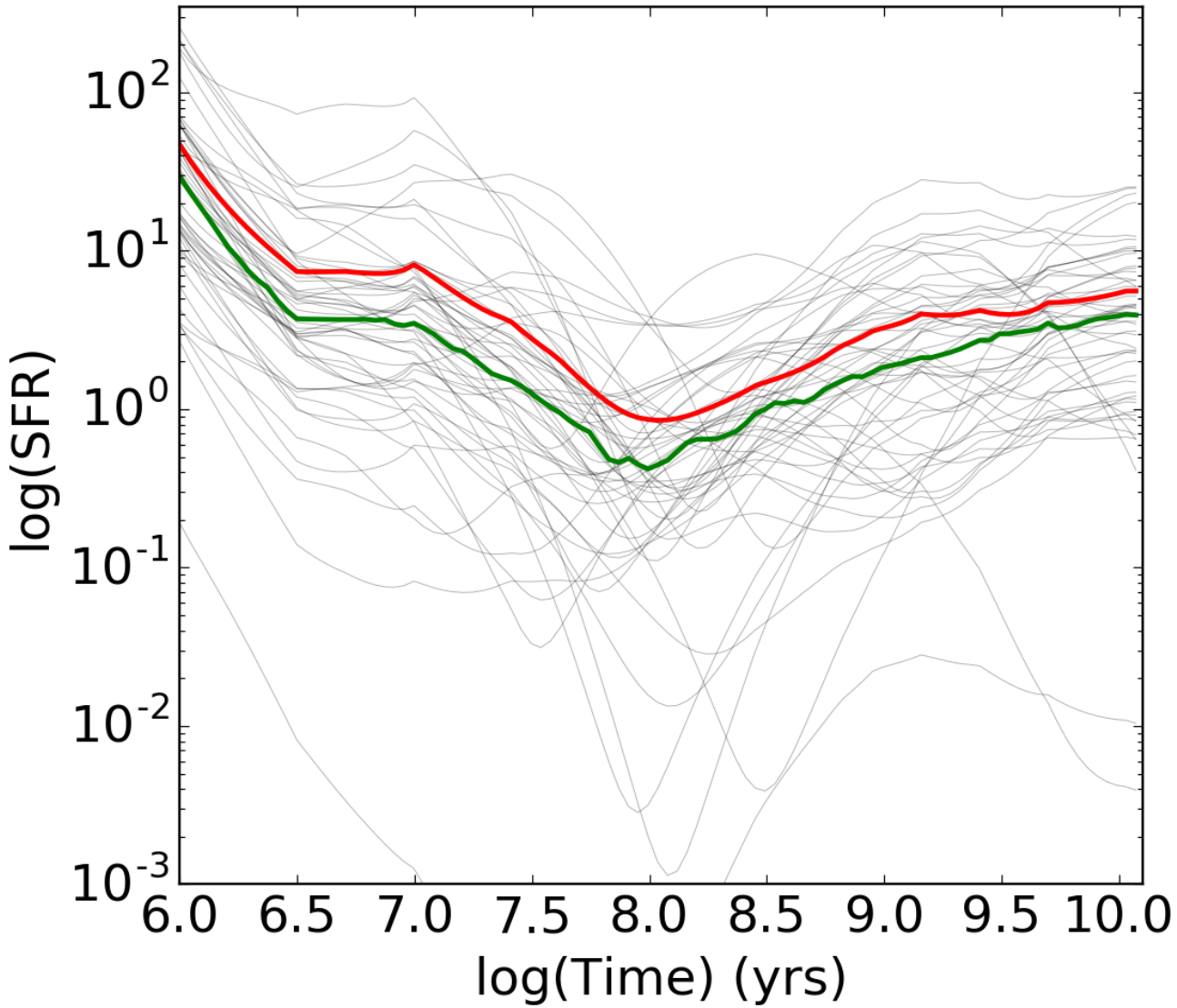
Results - Age


1.0sol
2.5sol
Kauffmann03
SUNBIRD
360Myr
509Myr
203Myr
101Myr
719Myr
55Myr
30Myr
1.02Gyr
10Myr
1Myr
2.5Gyr
5Gyr
7.5Gyr
10Gyr
13Gyr
$H\delta_A$
$D_n(4000)$
log (Age) from Starlight
9.00
8.75
8.50
8.25
8.00
7.75
7.50
7.25
7.00

Results – Star Formation History - Testing

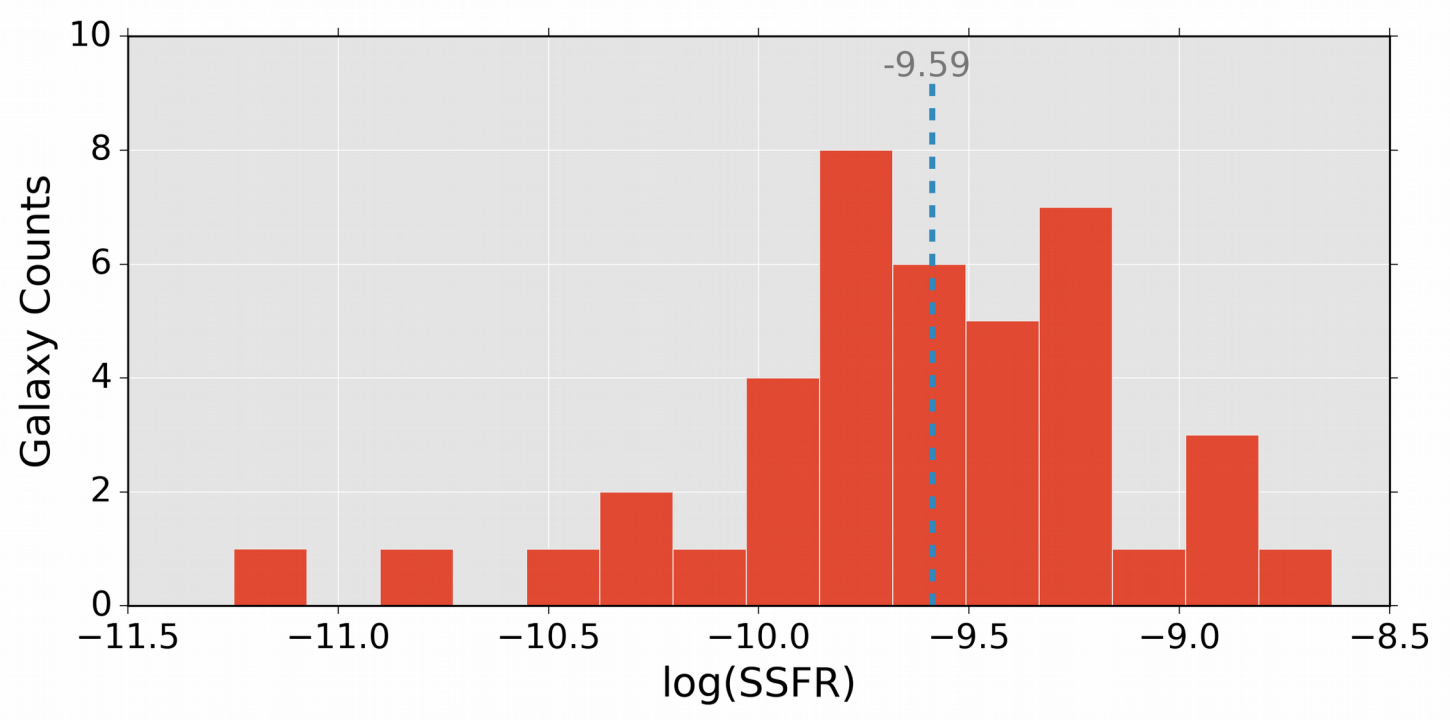


Results – Star Formation History - SUNBIRD

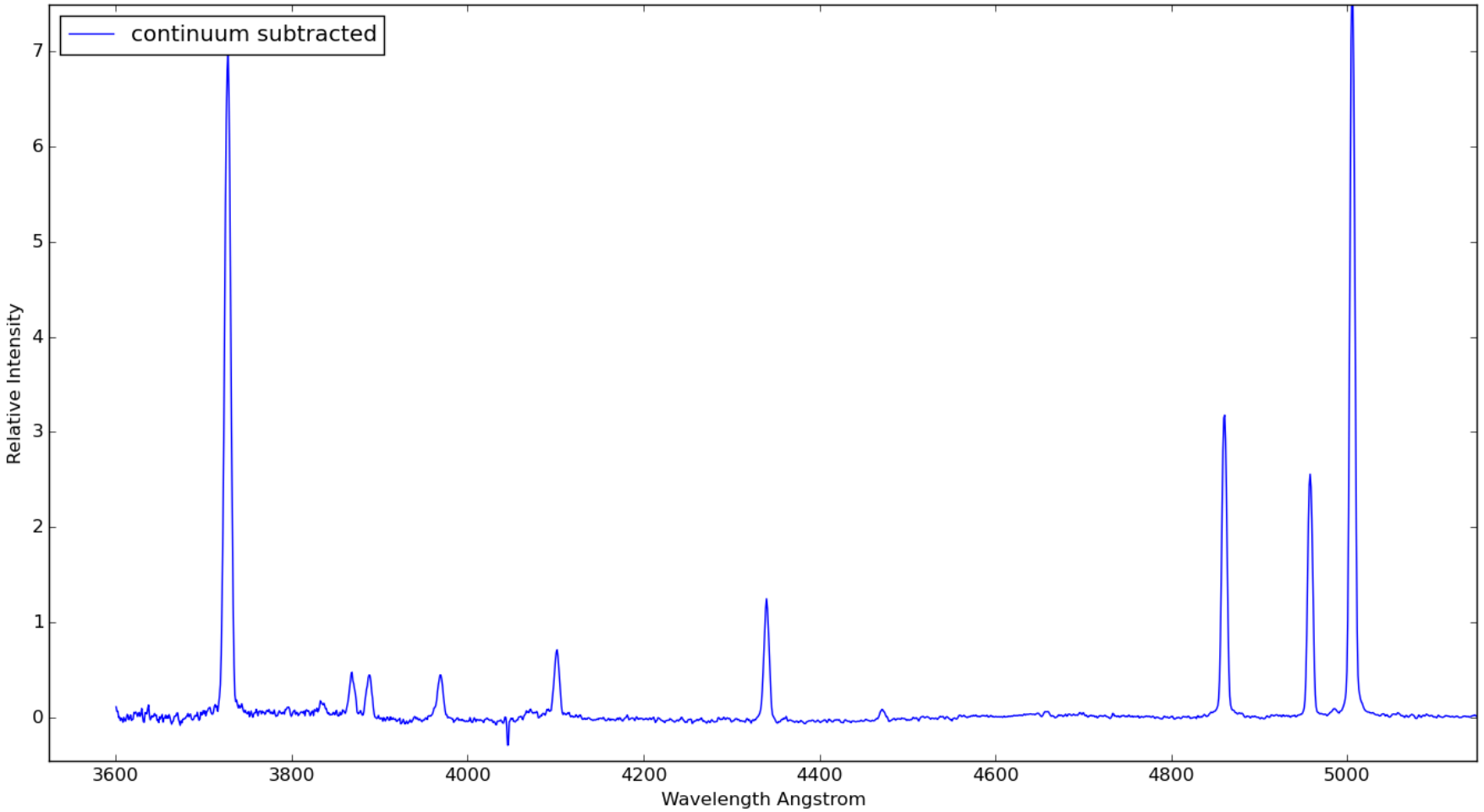


Results - SSFR

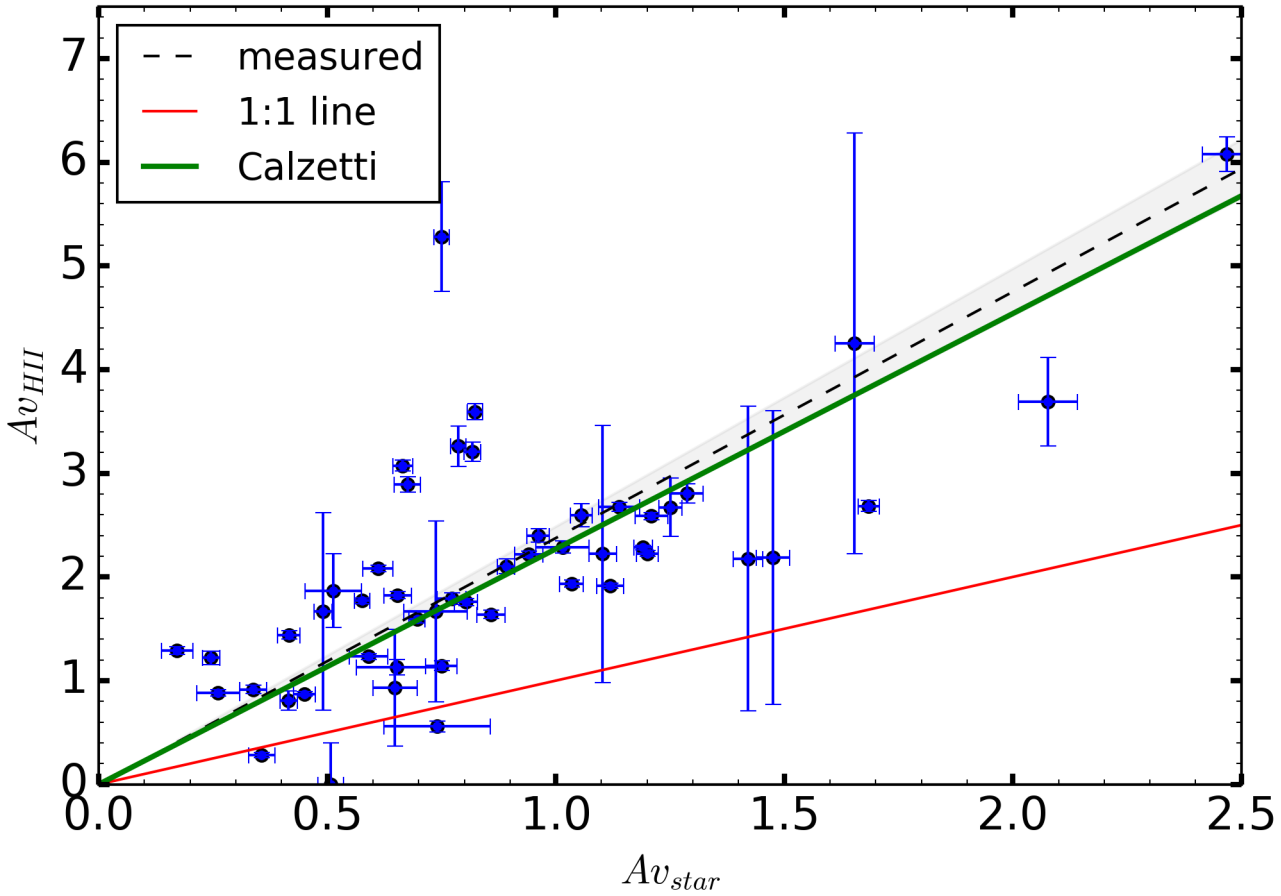
Sample	SSFR	Mass Doubling Rate
CALIFA	$1.20 \times 10^{-10}\,yr^{-1}$	8.3 Gyrs
SUNBIRD	$2.60 \times 10^{-10}\,yr^{-1}$	3.9 Gyrs
GOALS	$3.90 \times 10^{-10}\,yr^{-1}$	2.6 Gyrs



Results – Line Intensity

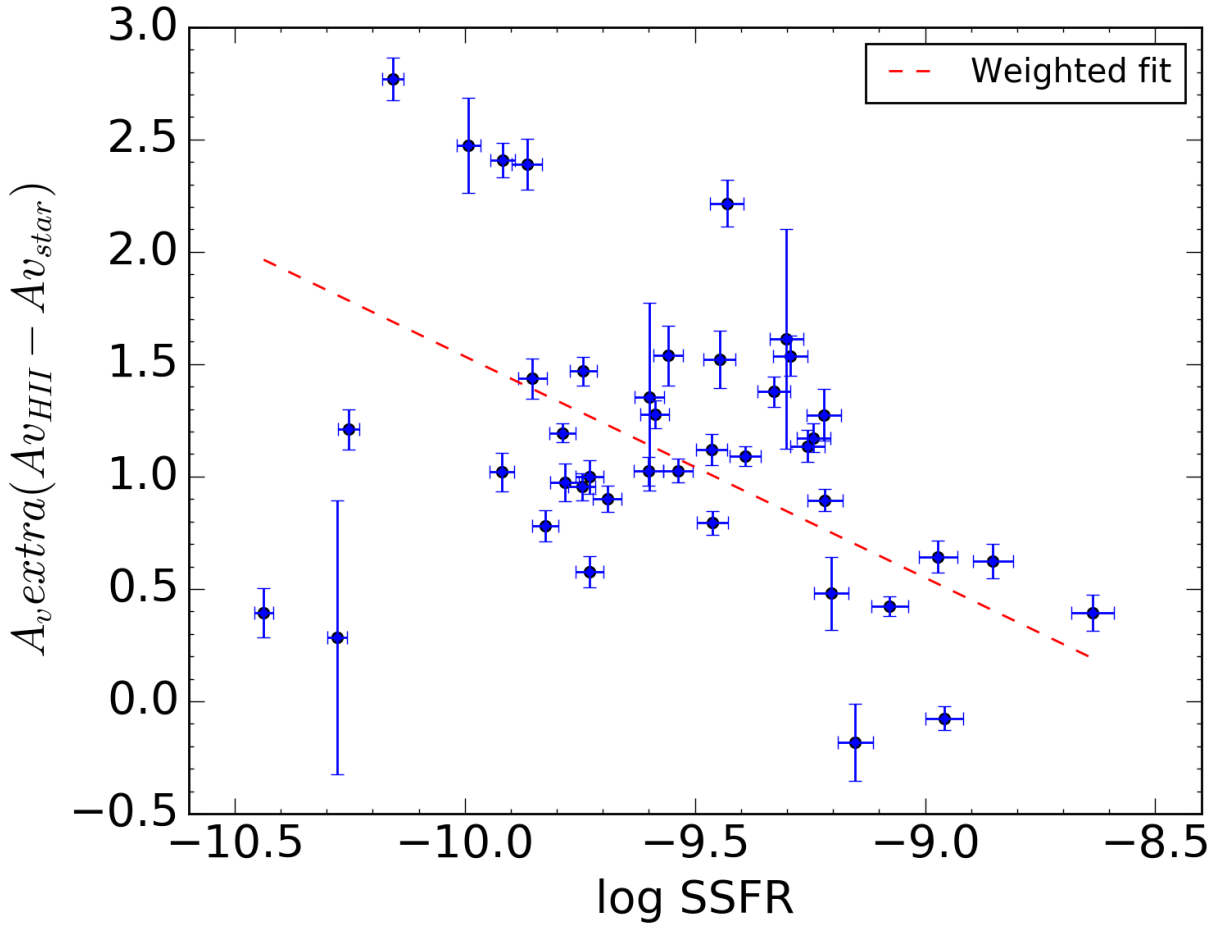


Results – Extinction (Nebula vs Stellar)



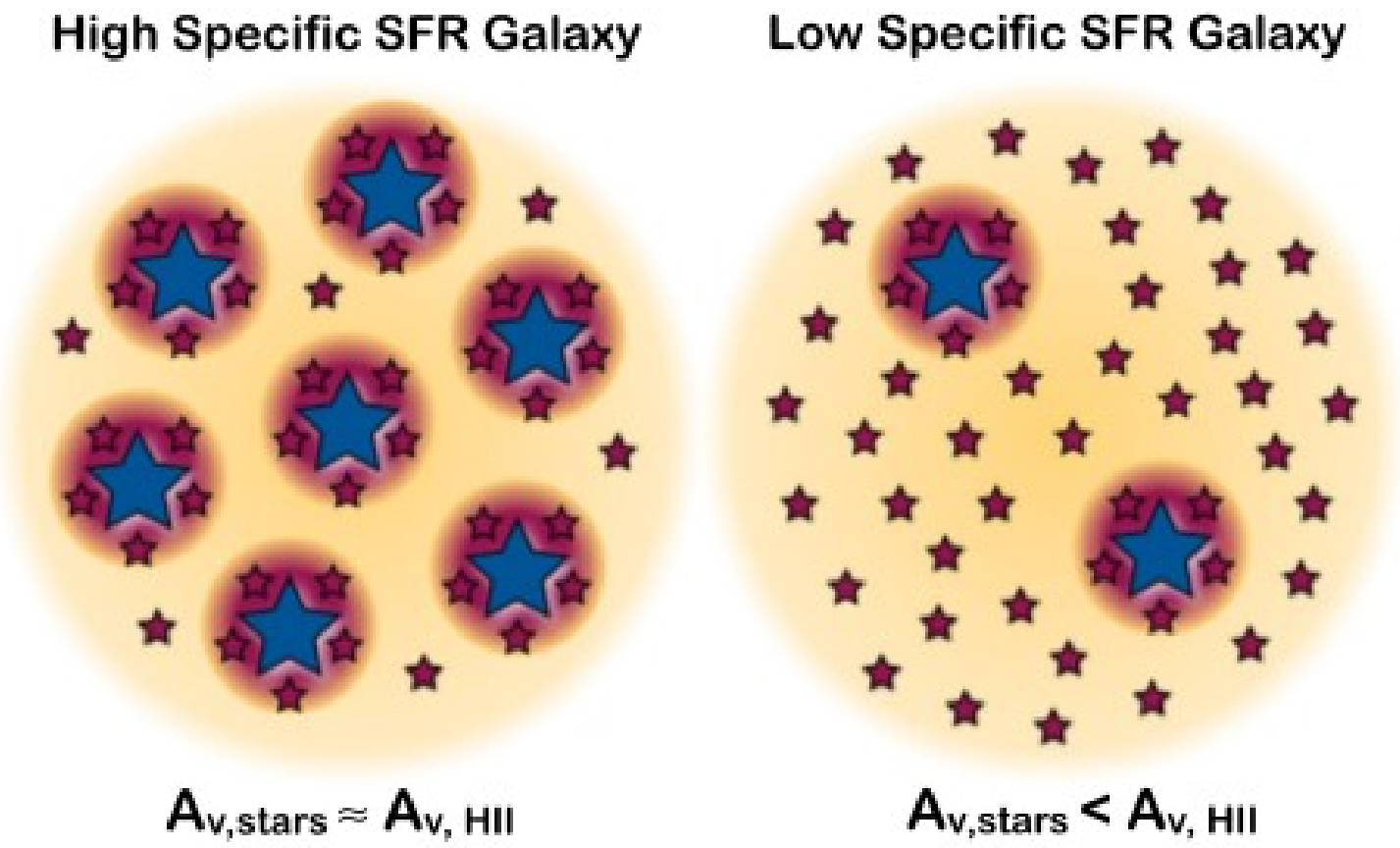
$$A_{\mathrm{v,HII}} = 2.37\ ^{\pm 0.11} \times A_{\mathrm{v,star}}$$

Results – Excess Extinction (Nebula - Stellar)



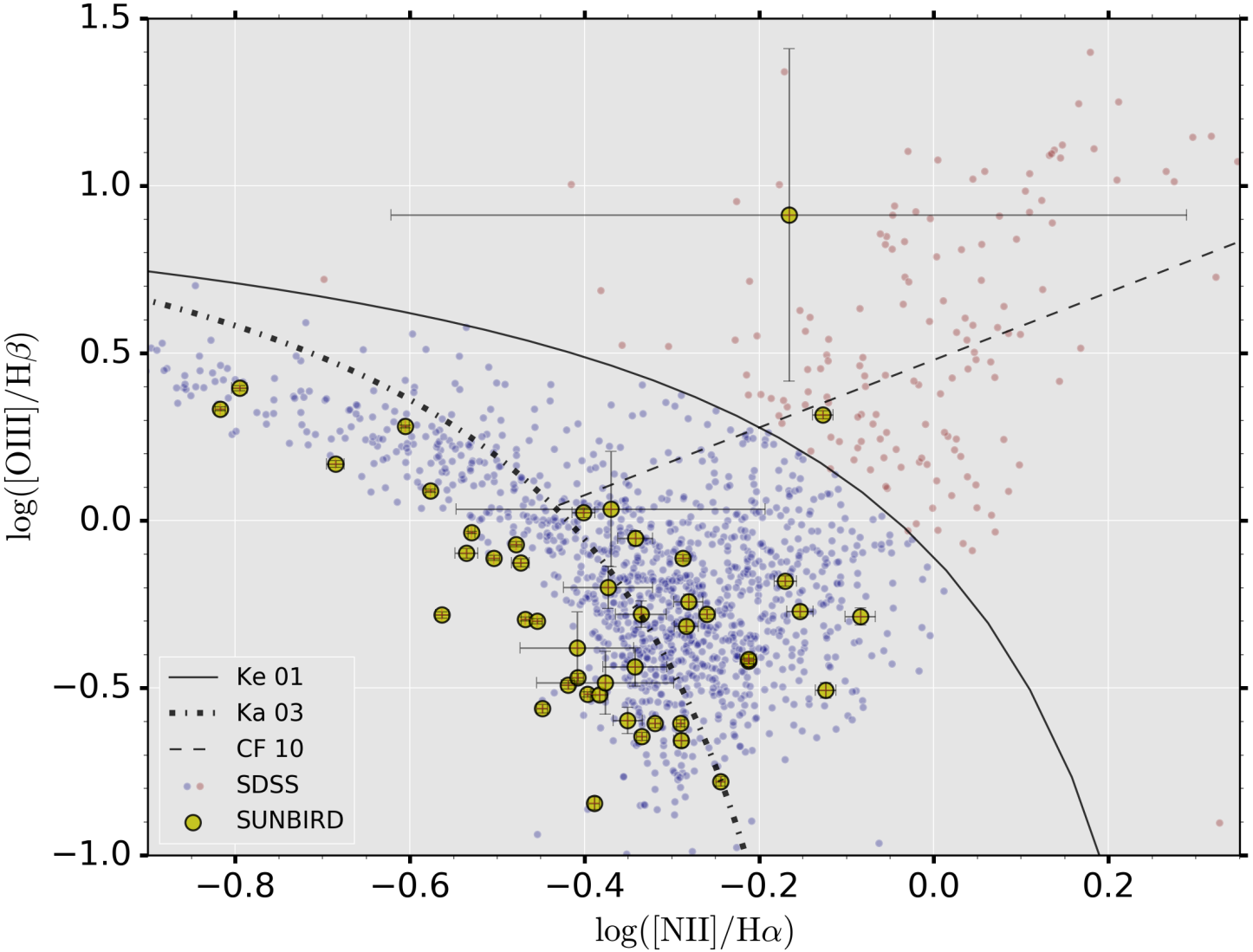
$$A_{\mathrm{v,HII}} - A_{\mathrm{v,star}} = -9.608\ ^{\pm 2.190} - 1.121\ ^{\pm 0.230}\ \mathrm{Log}(\mathrm{SSFR}/\mathrm{yr}^{-1})$$

Results – Extinction Model

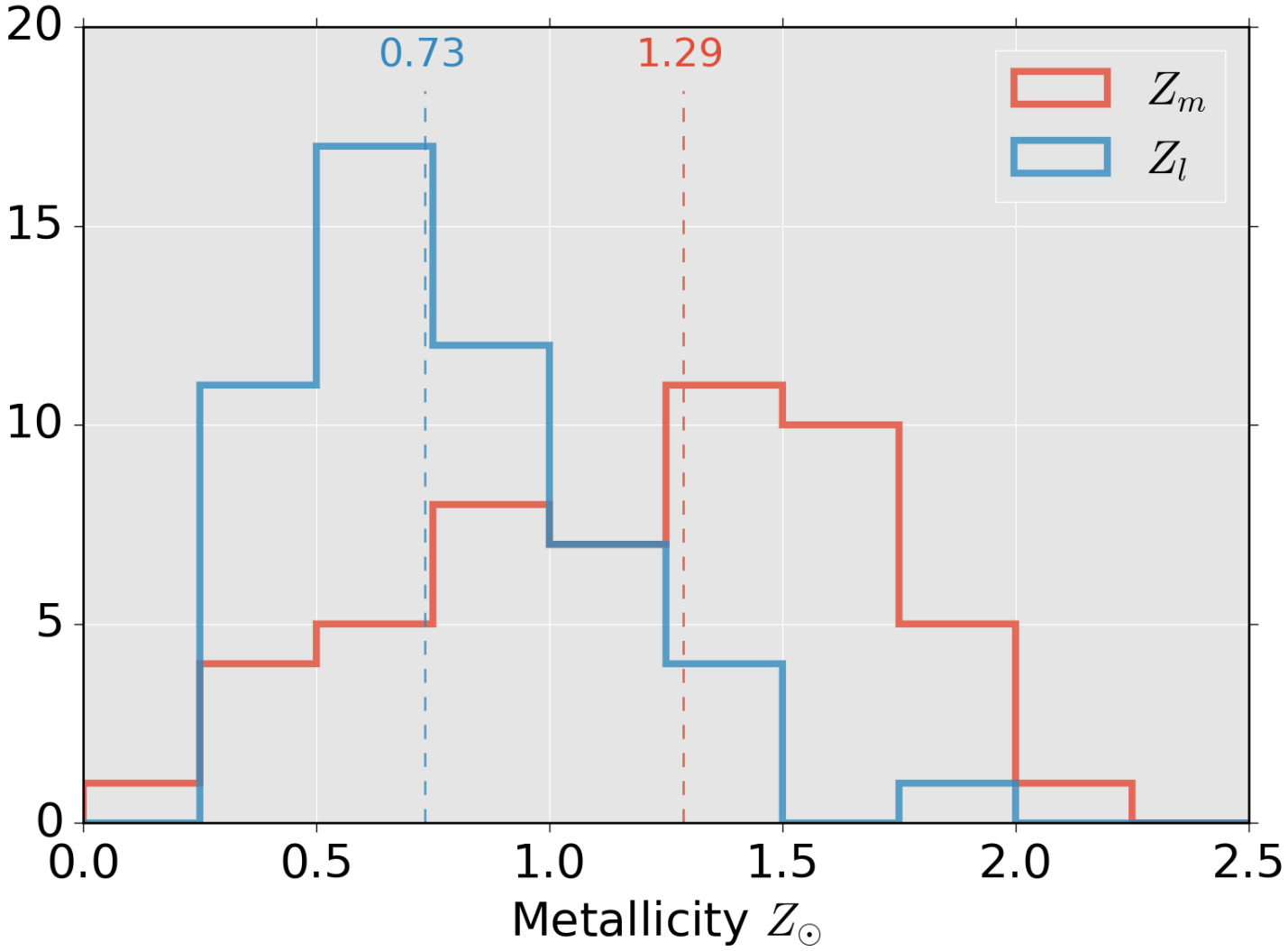


Price et al. 2014

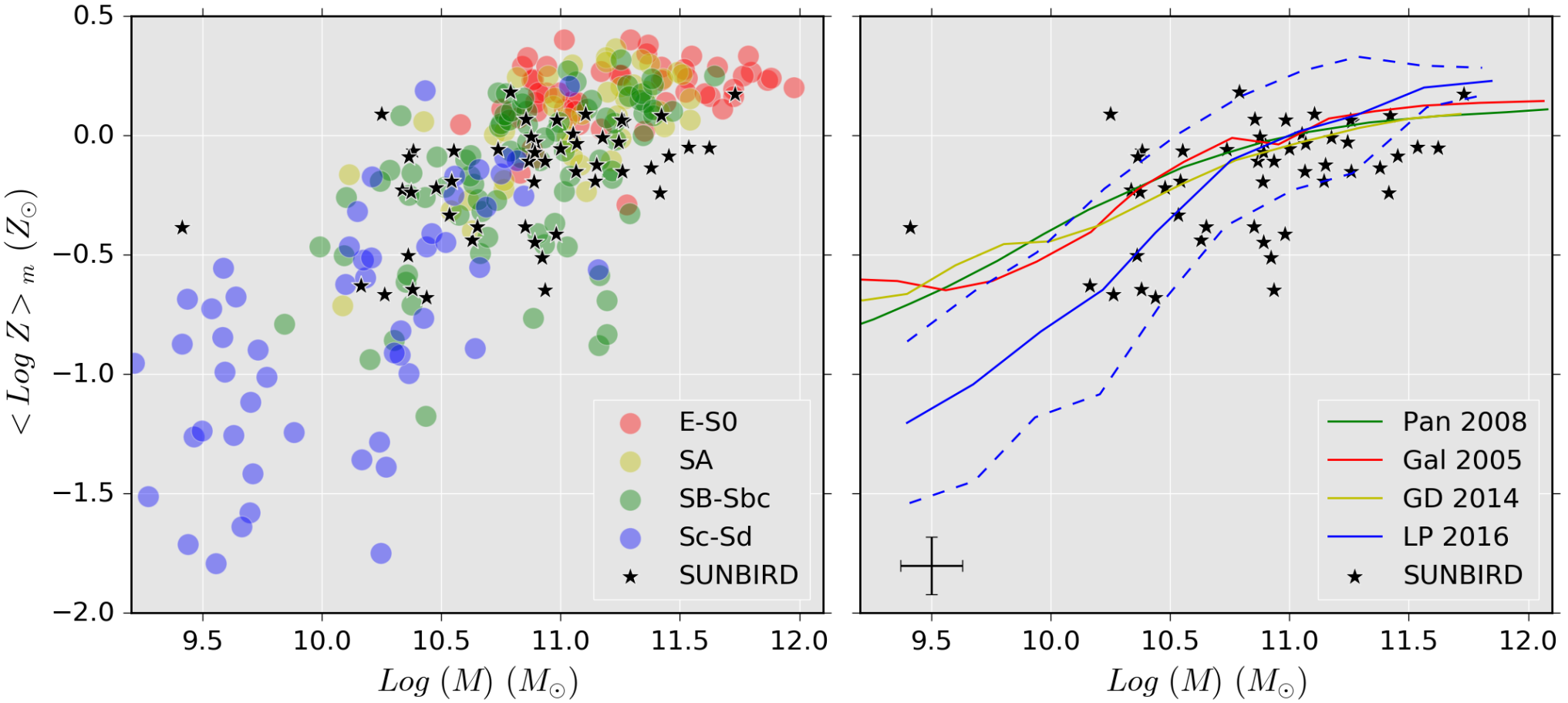
Results – BPT diagram



Results – Stellar Metallicity



Results – Mass vs Stellar Metallicity

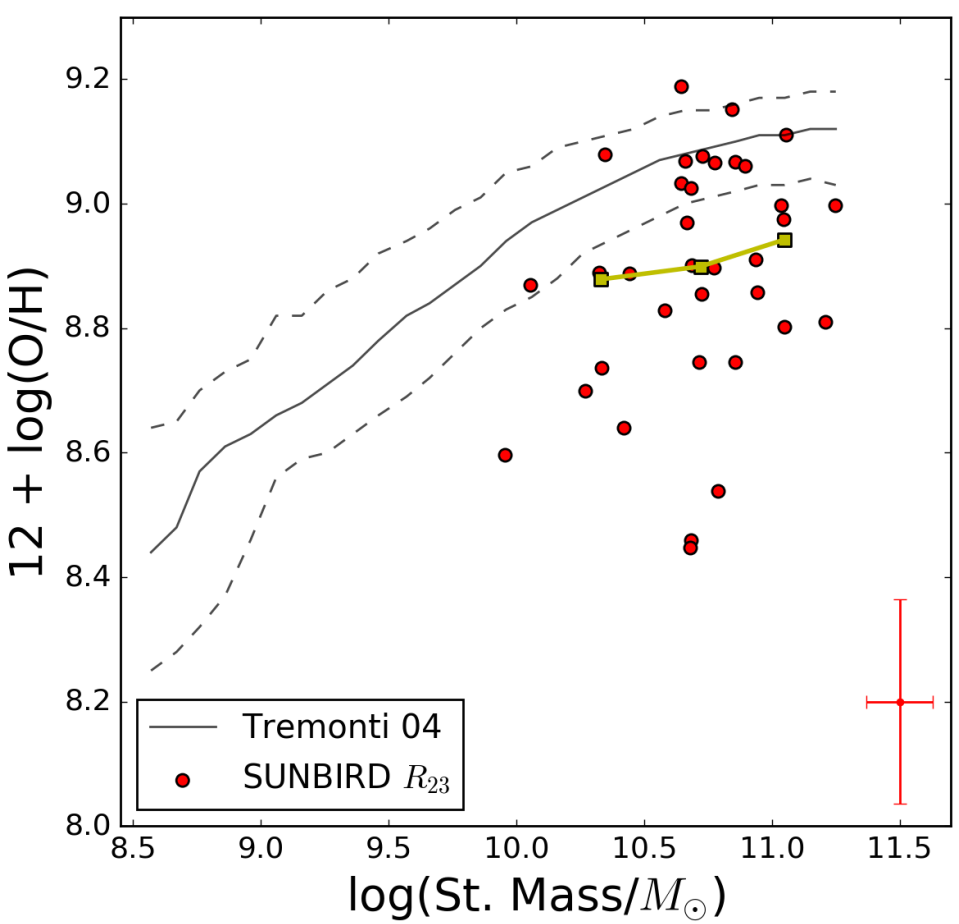


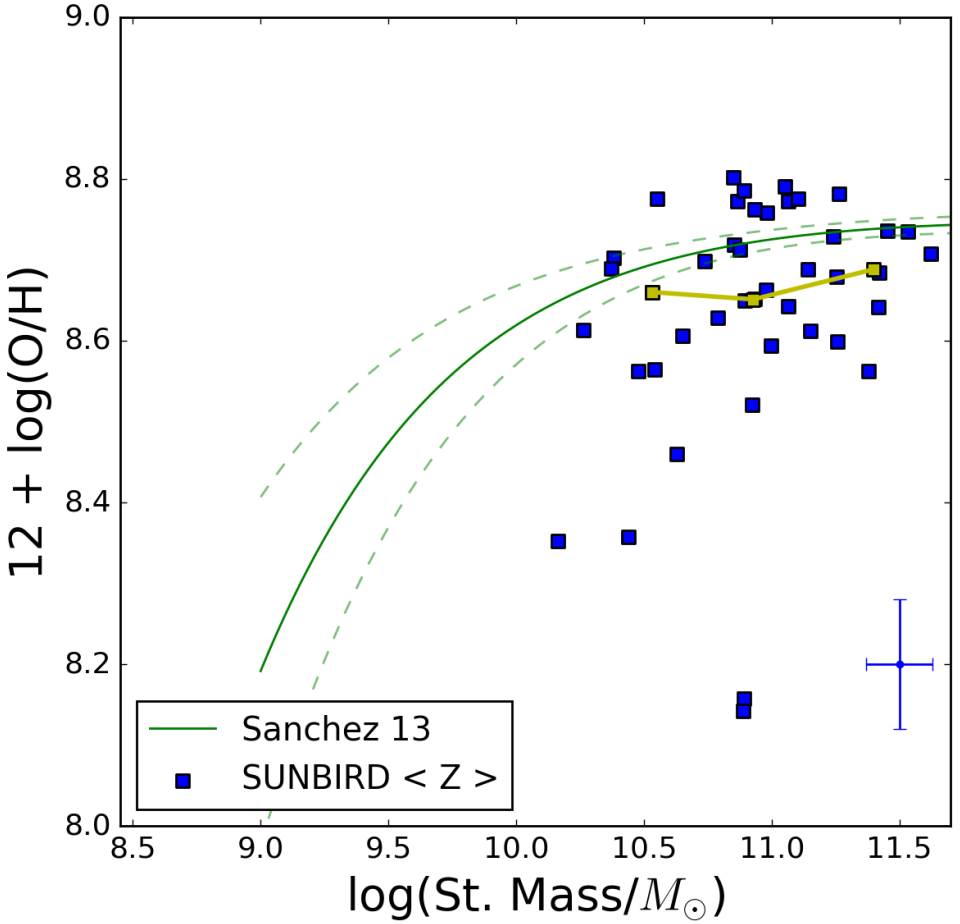
Results – Oxygen Abundances

Name	Original Measurement					PP04 O3N2 Base				$< Z >$
	Z94	M91	D02	N2	O3N2	Z94	M91	D02	N2	
(1)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
ESO221-IG008	8.62	8.57	8.52	8.38	8.36	8.34	8.36	8.29	8.40	8.352 ± 0.036
ESO221-IG010	9.16	8.98	8.89	8.84	8.82	8.80	8.80	8.64	-	8.762 ± 0.074
ESO264-G036	9.08	8.90	8.84	8.76	8.77	8.74	8.74	8.59	8.84	8.736 ± 0.082

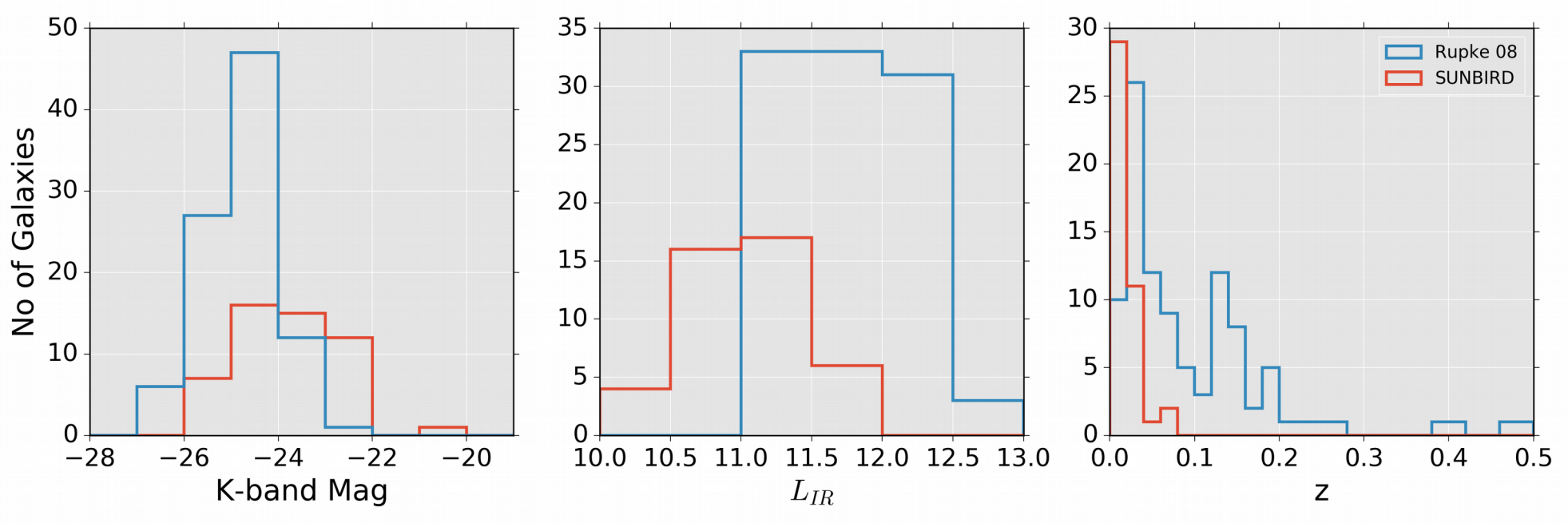
- Measure metallicity using different indices instead of 1
- Use Kewley et al. 2008 to convert to a single base
- Perform mean

Results – Mass Metallicity Relation

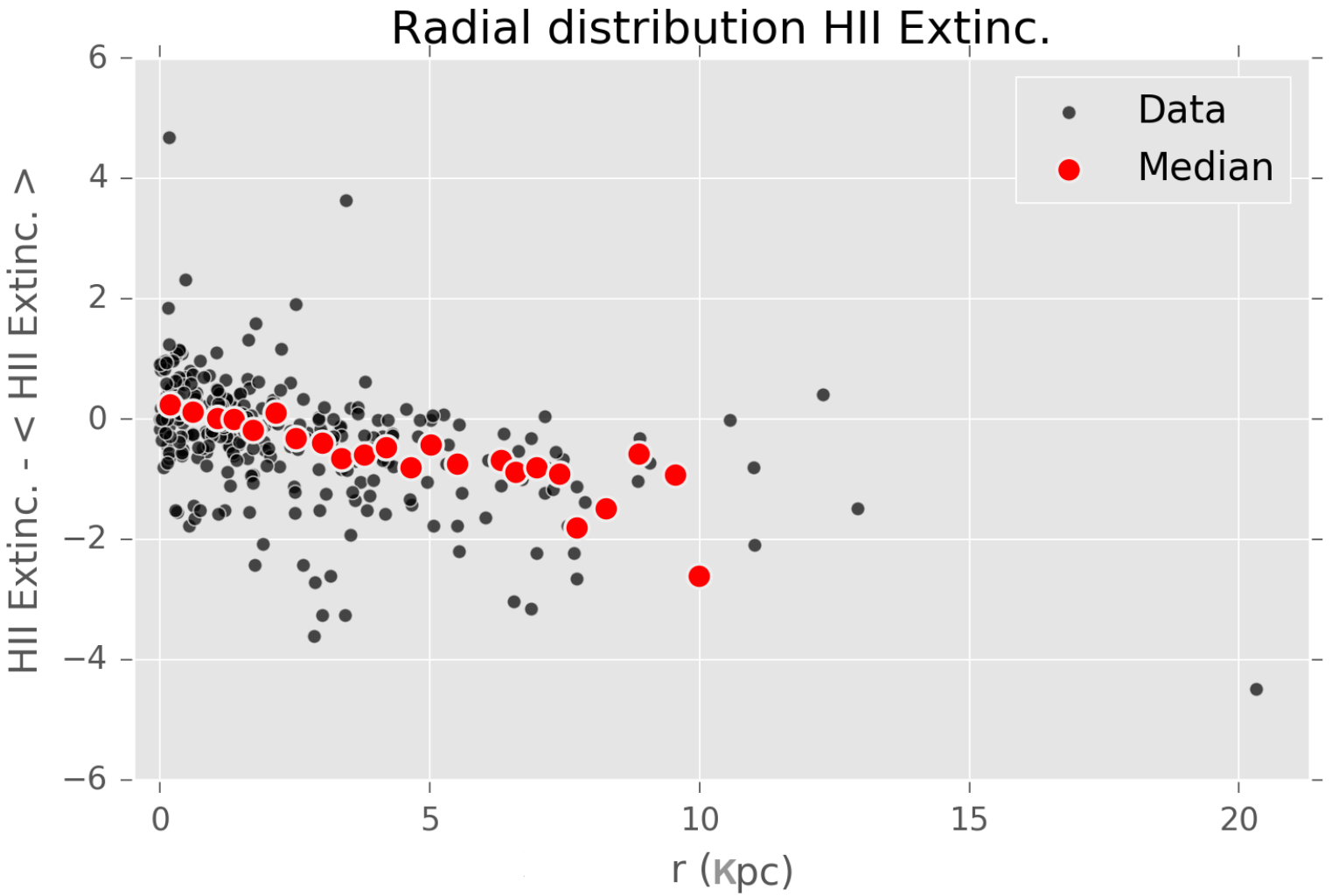




Results – Comparison with Rupke et al. 2008



Results – Radial Analysis



SUNBIRD SALT survey Summary

- **Observed and Reduced all long-slit spectroscopic data**
- **Created Stellar population modelling pipeline and performed fit for integrated apertures and radial apertures**
- **Derived Age, Metalliticity, Oxygen abundances, Ionisation and Extinction for the SUNBIRD sample**
- **Updated the Rupke et al. 2008 Mass-Metallicity relation for LIRGs by showing that the under abundance of LIRGs is smaller than previously thought**

Thank You