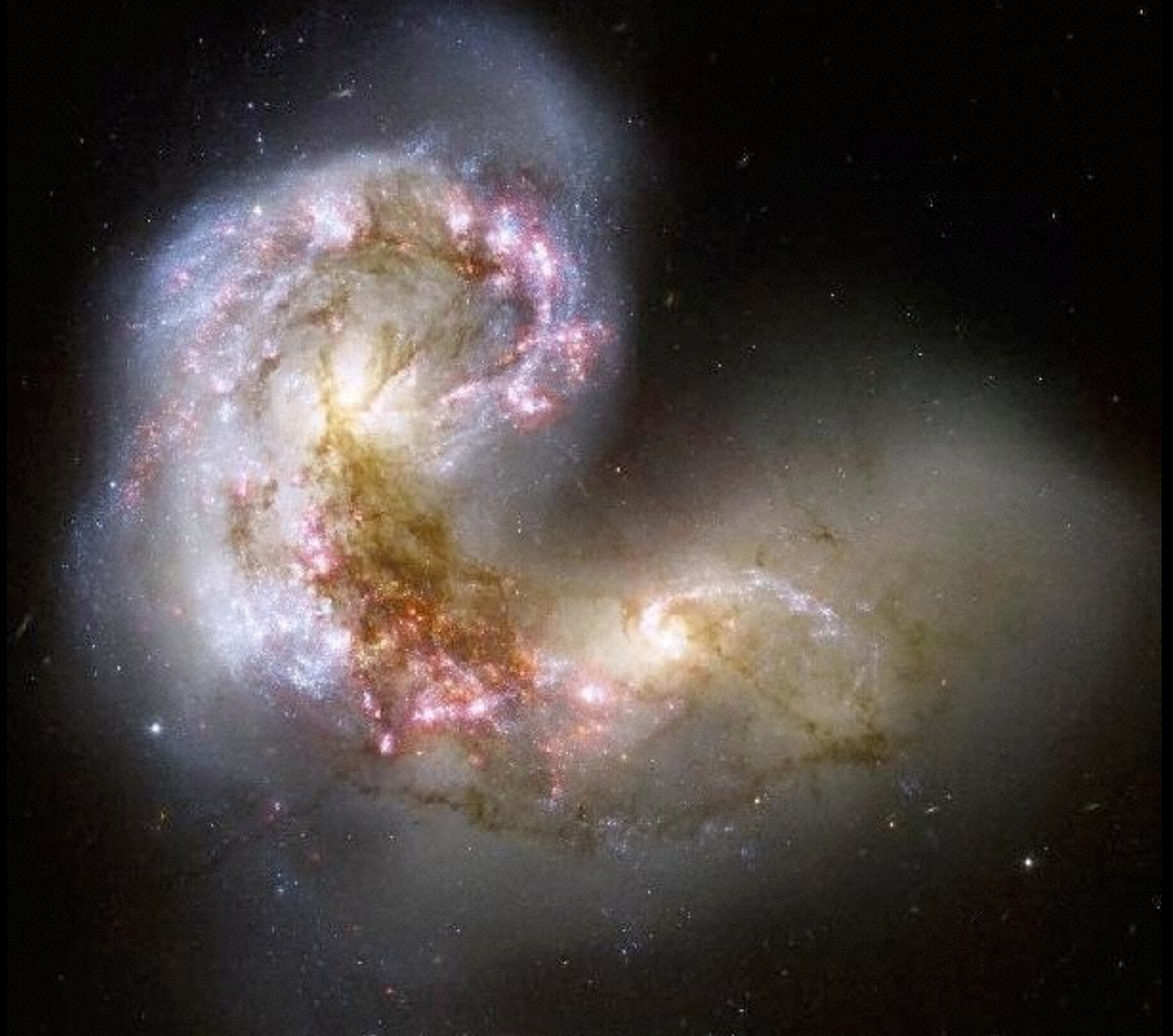
Photometric redshifts in the (rest-frame) UV: Lessons from Post Starburst Galaxies (PSG)

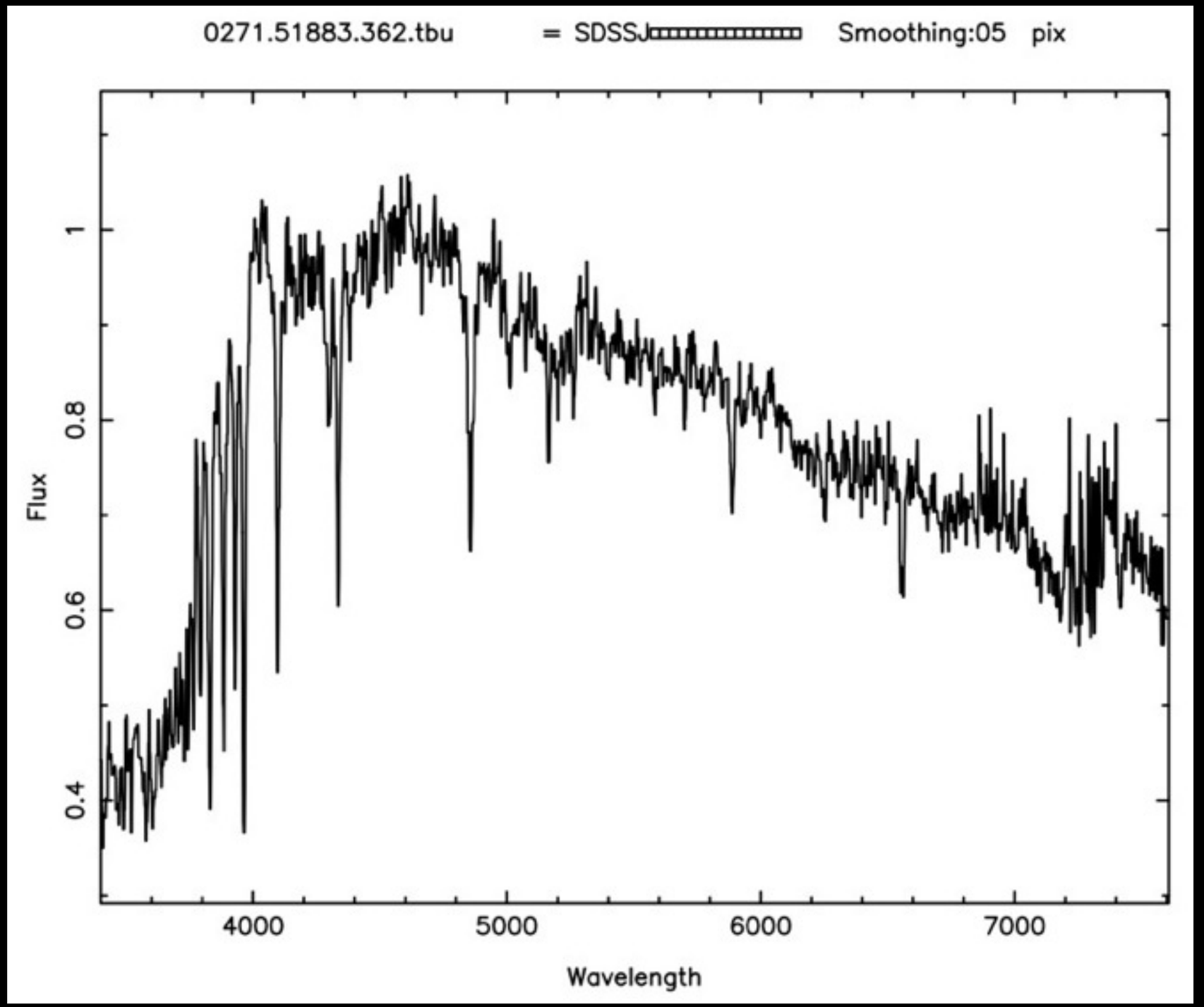
Jorge Melnick (ESO) & Roberto De Propris (FINCA)



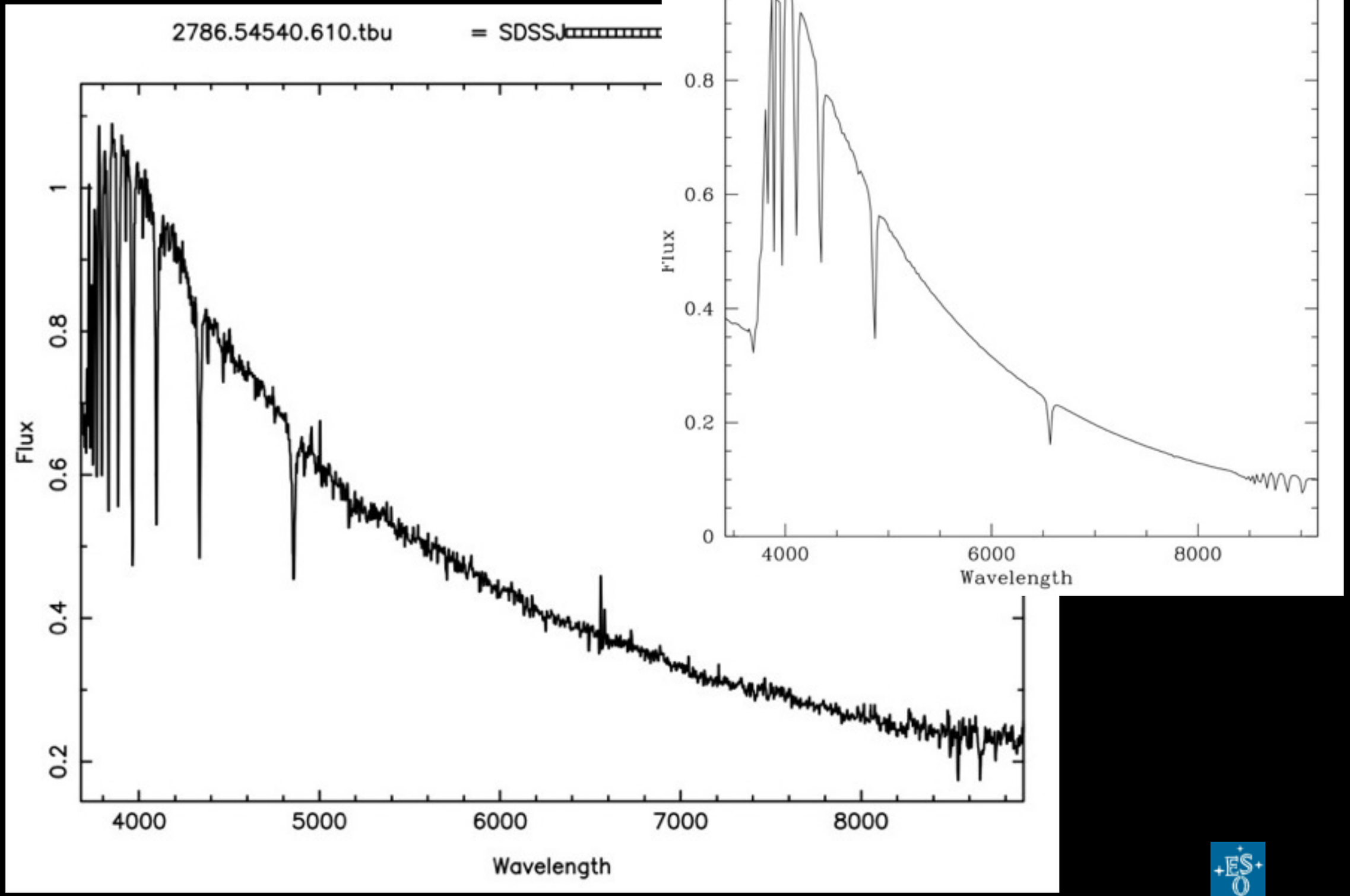
Outline

1. Global properties of post-starburst (aka K+A or E+A) galaxies
2. AGB stars in K+A galaxies
3. The Starburst-AGN connection
4. Conclusions

Post Starburst Galaxies (PSG) have dominant intermediate age (~0.5Gy) stellar populations

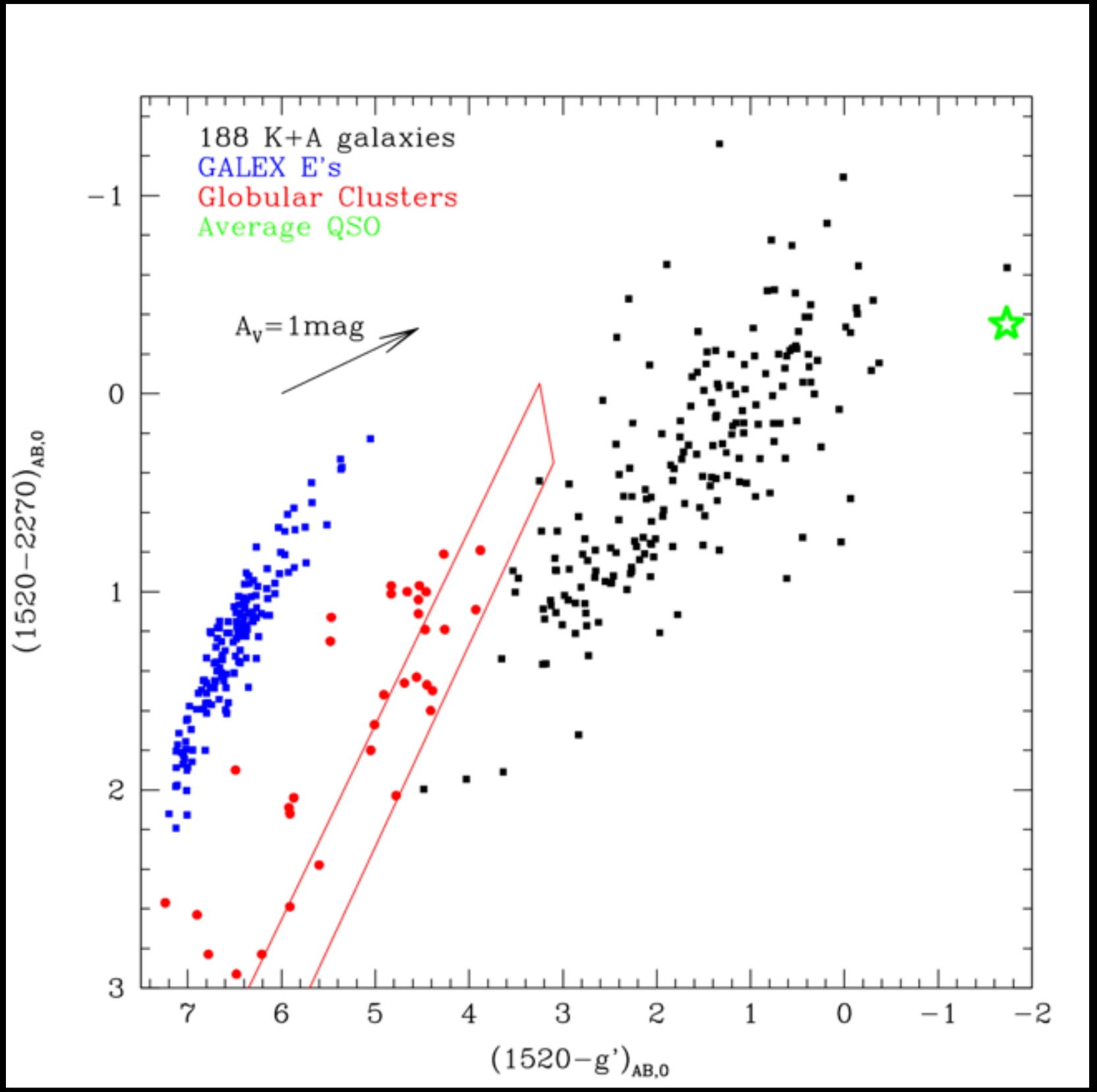


Some PSGs even look like A stars, hence the names K+A or E+A galaxies

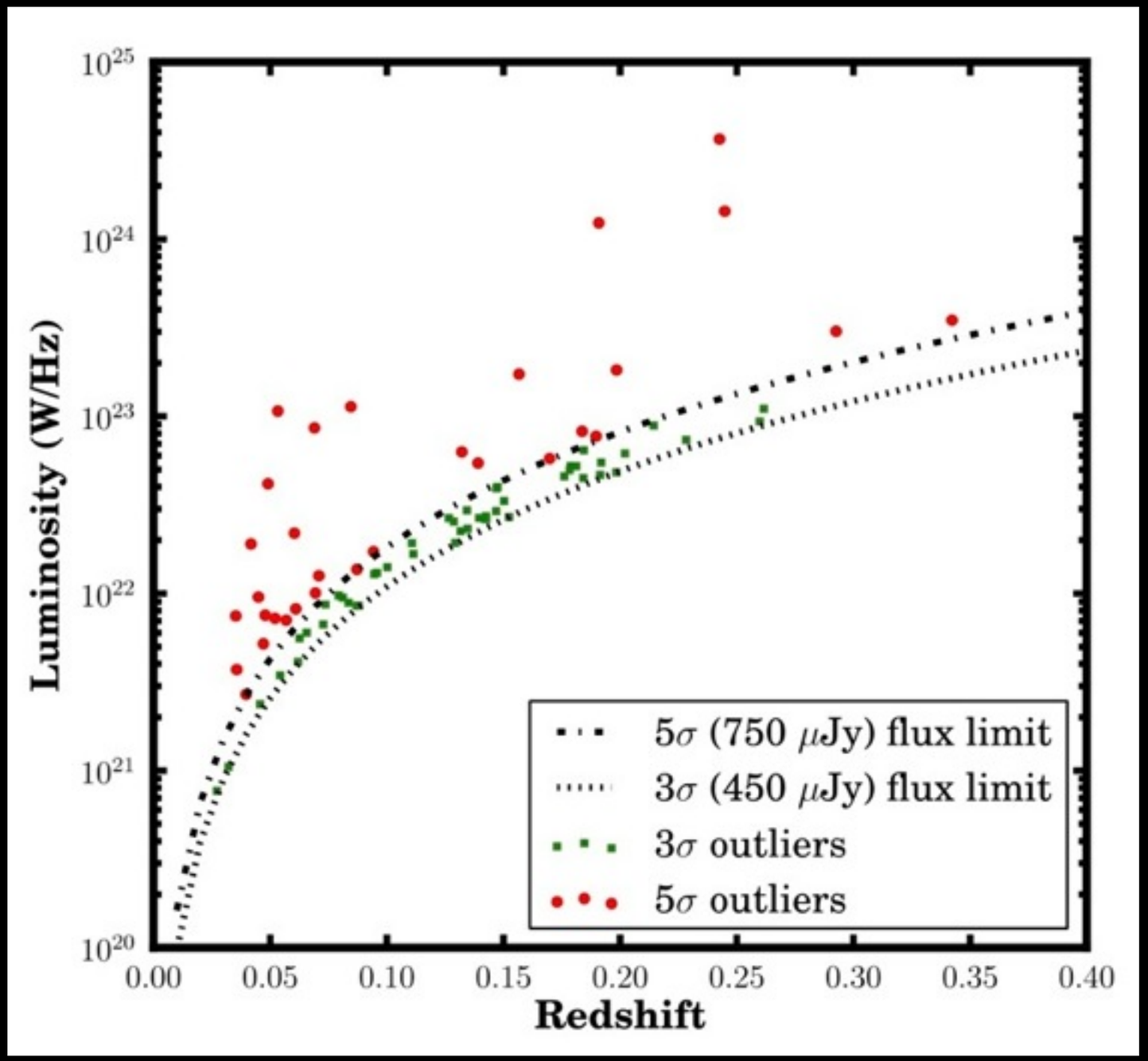


A significant fraction of PSGs show clear signs of interaction

Post Starburst Galaxies are very blue in the UV

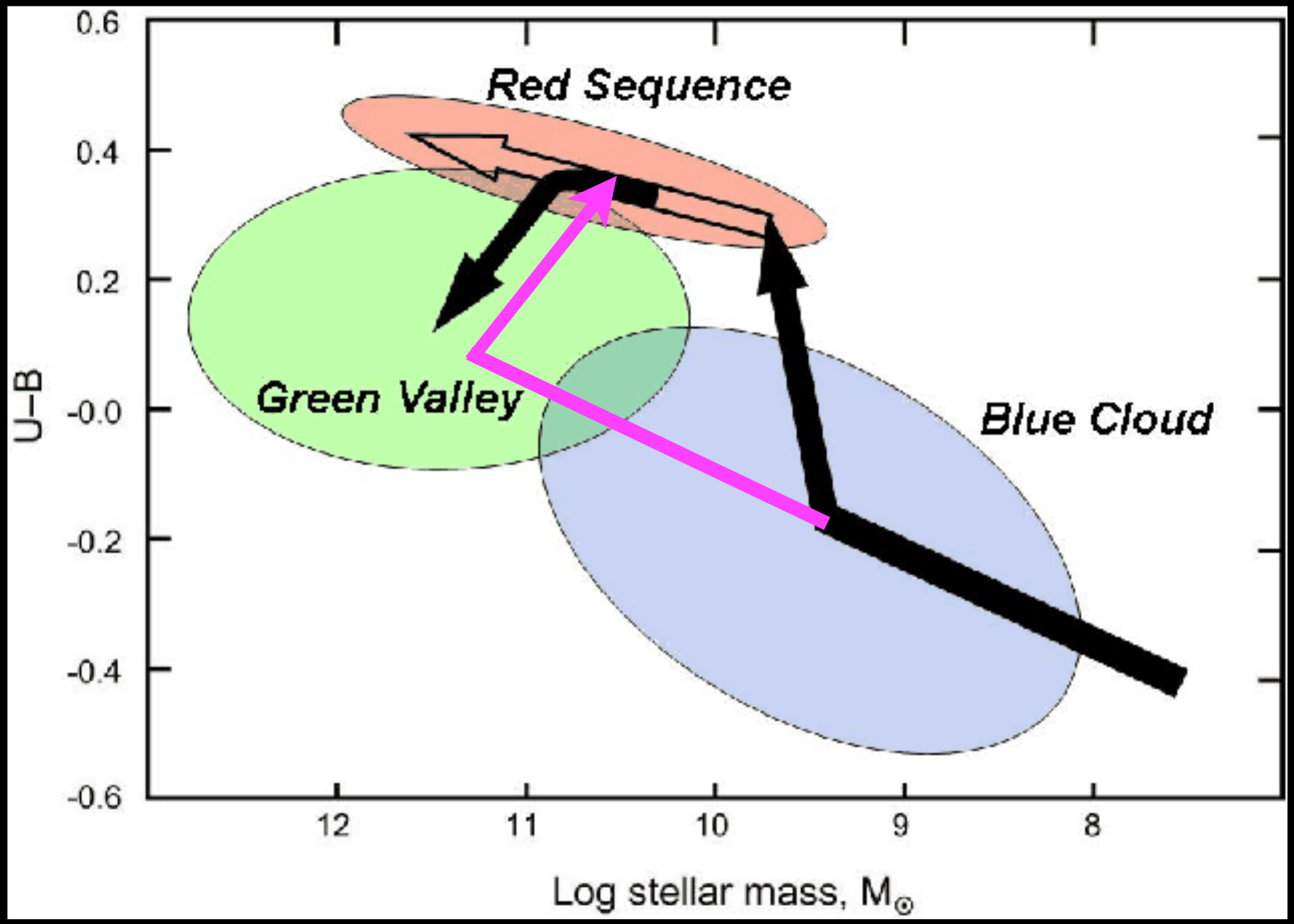


Only a few percent of PSGs show evidence
of on-going star-formation activity in the radio



Nielsen et al. (2012) 20cm FIRST data

PSGs are rare `green-valley' galaxies pressumably in transit from the blue-cloud to the red-sequence



They should provide unique clues to understand the rapid and efficient 'quenching' of star formation in the `blue cloud'.

Multi-wavelength study of 811 PSGs

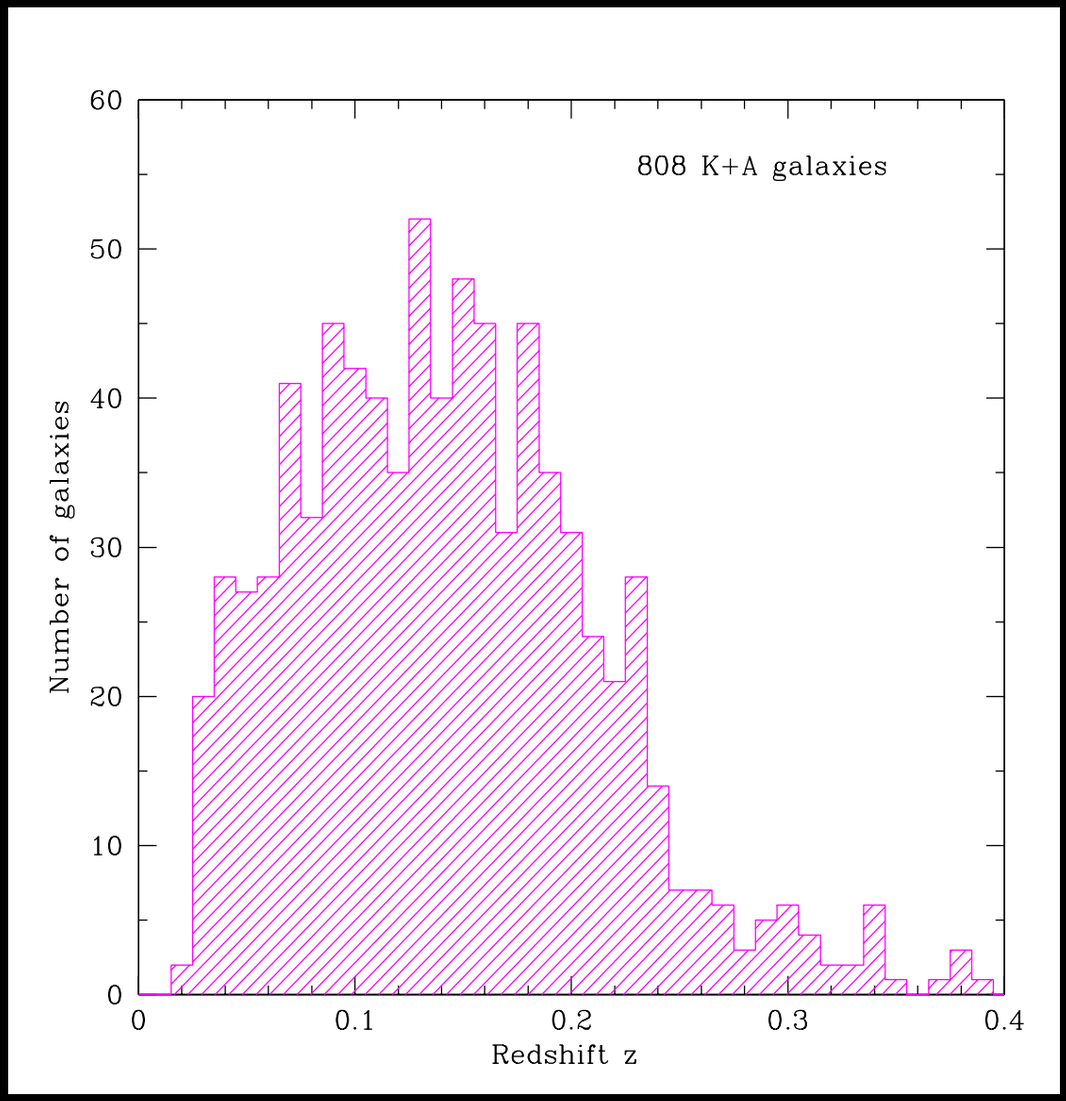
Melnick & De Propris, MNRAS 2013
De Propris & Melnick, MNRAS 2014
Melnick & De Propris, A&A 2014 submitted

SDSS Spectra and photometry;

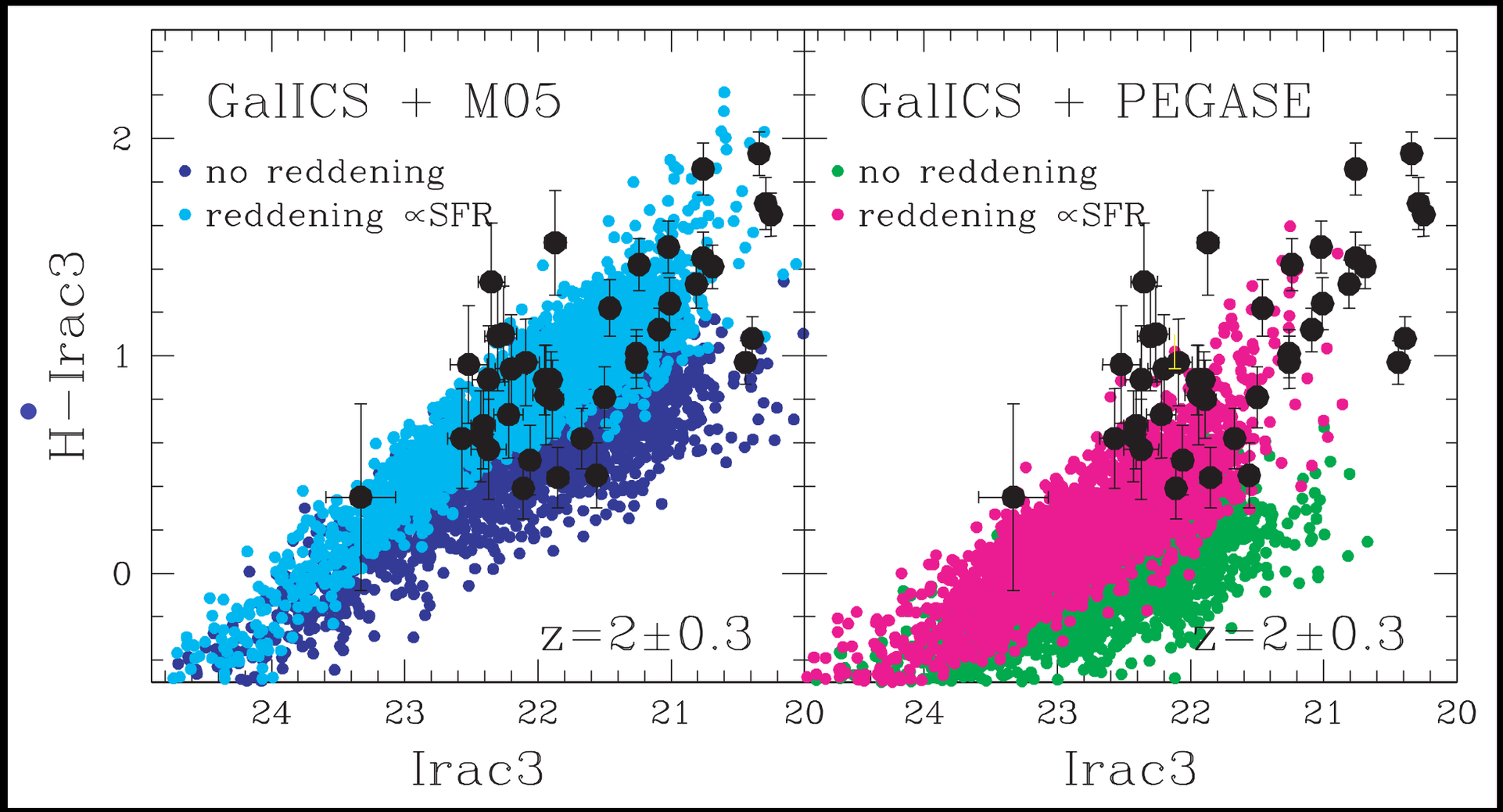
STARLIGHT pop. synthesis models;

SEDs over 2 decades in wavelength:

- GALEX 150 & 227 nm
- SDSS u' g' r' l' z'
- 2MASS & UKIDSS Y J H Ks
- WISE 3.4. 4.6, 12, & 22 microns
- SPITZER for a few objects

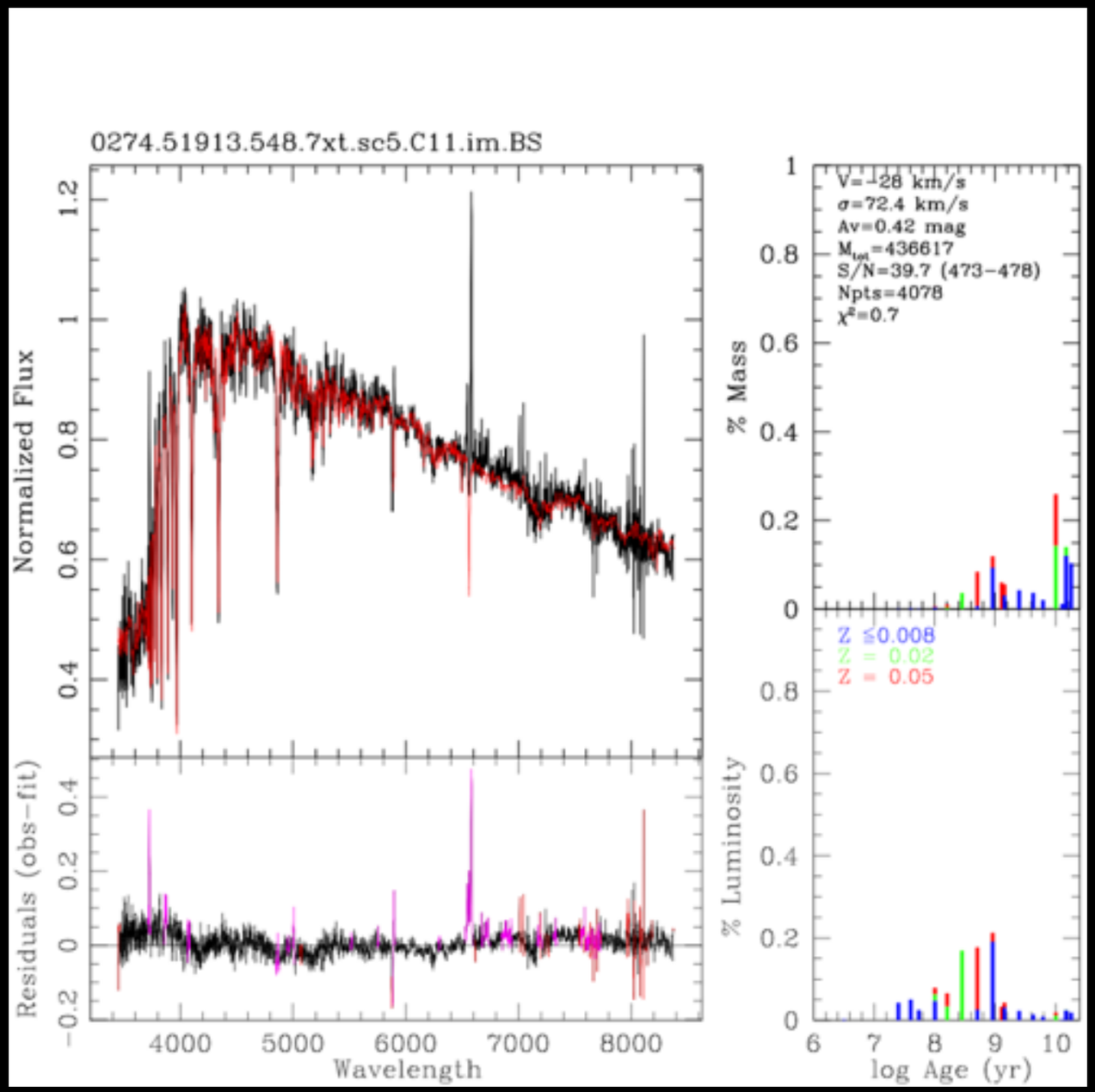


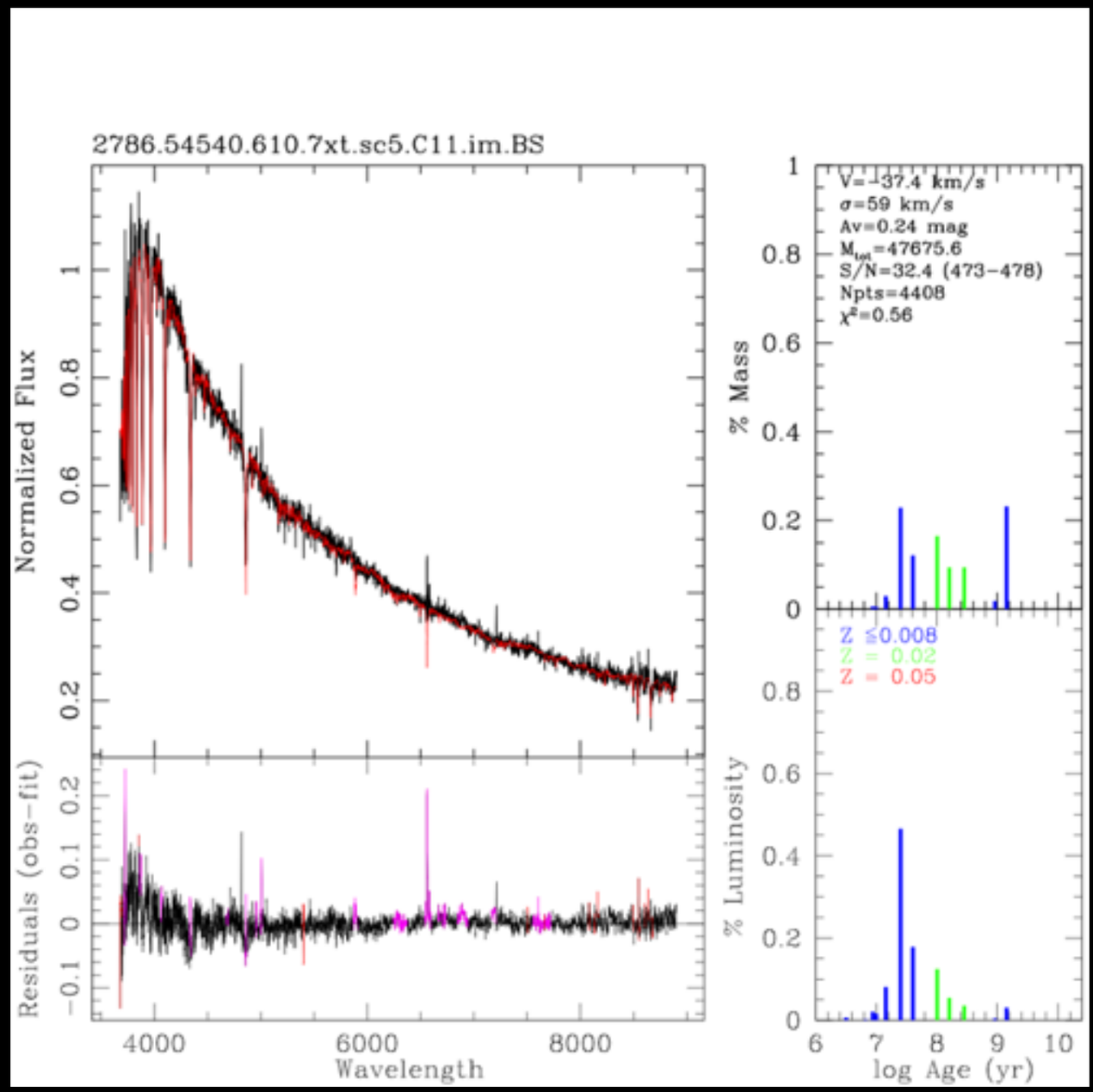
Motivation: TP-AGB stars are postulated to solve the problems posed by the observed colours and luminosities of hight-z (z~2.5) passive and star-forming galaxies.



Tonini et al., (2010)

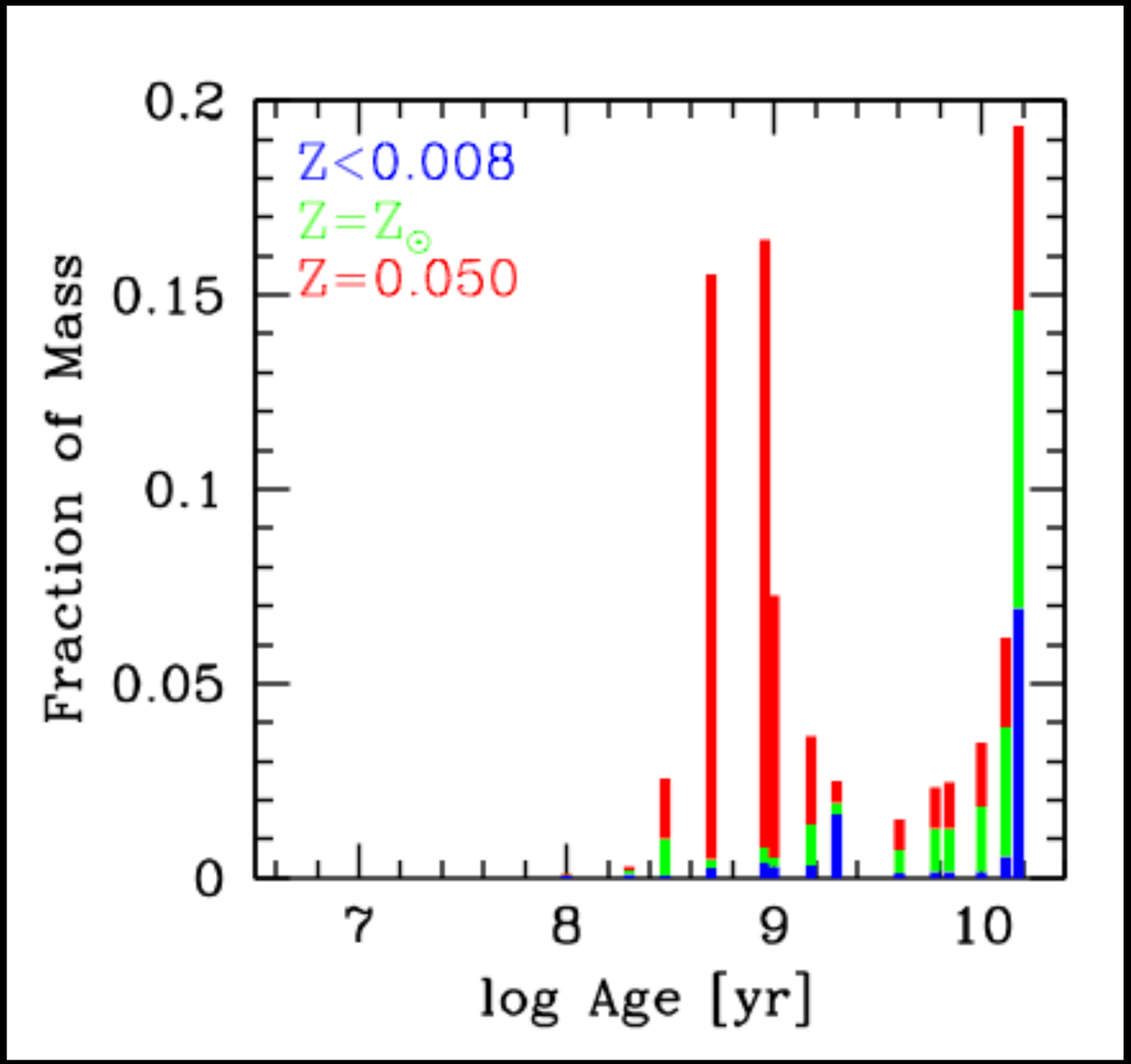
Examples of STARLIGHT model fits





Melnick & De Propris (2013; 2014)

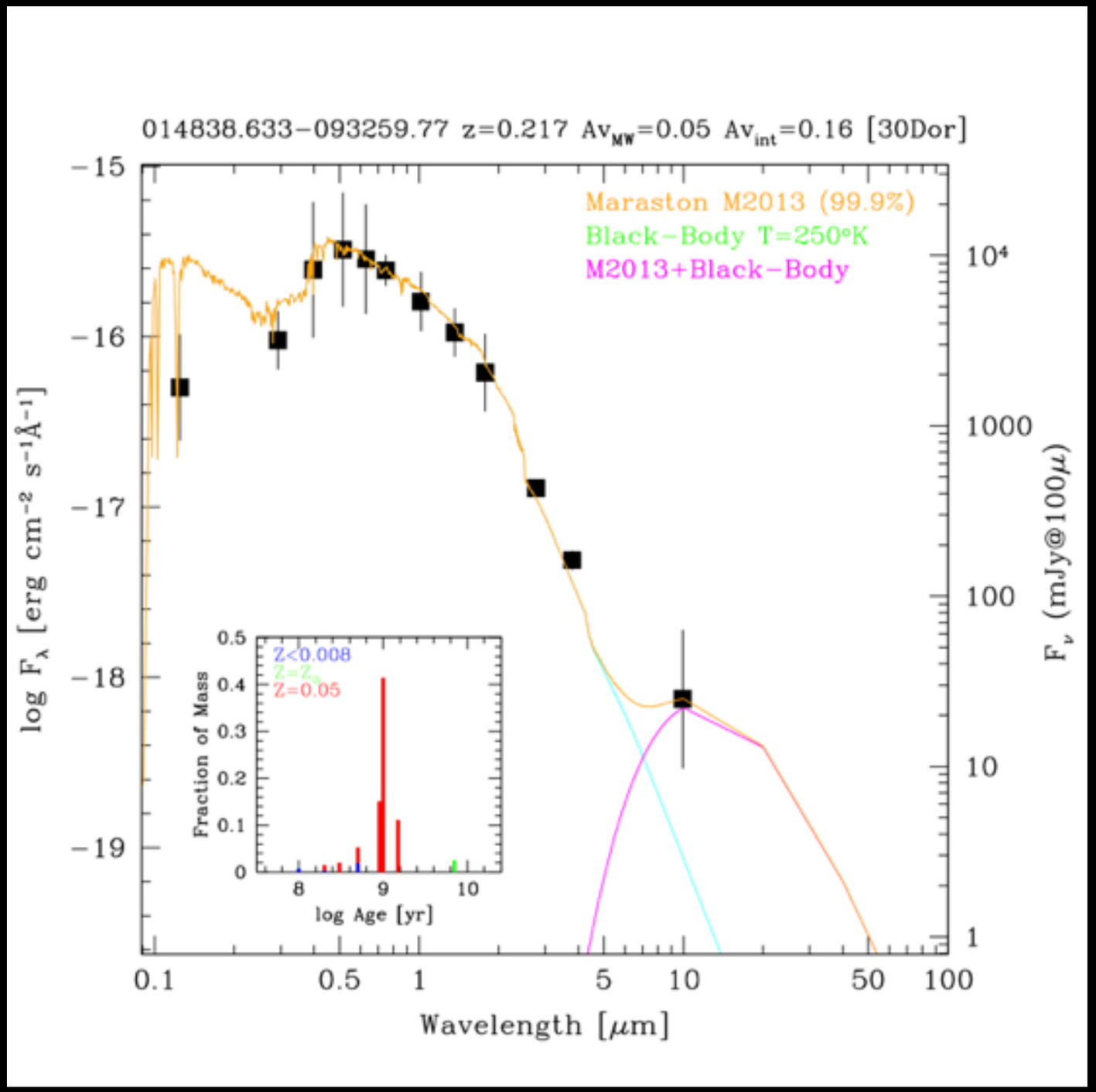
The intermediate-age (A) stellar populations contain a median 50% of the stellar mass, and are metal rich



Average star formation histories of 808 galaxies

No traces of young stellar populations in the SDSS spectra

Synthetic SEDs: the *Maraston-Mix*



The Maraston-Mix

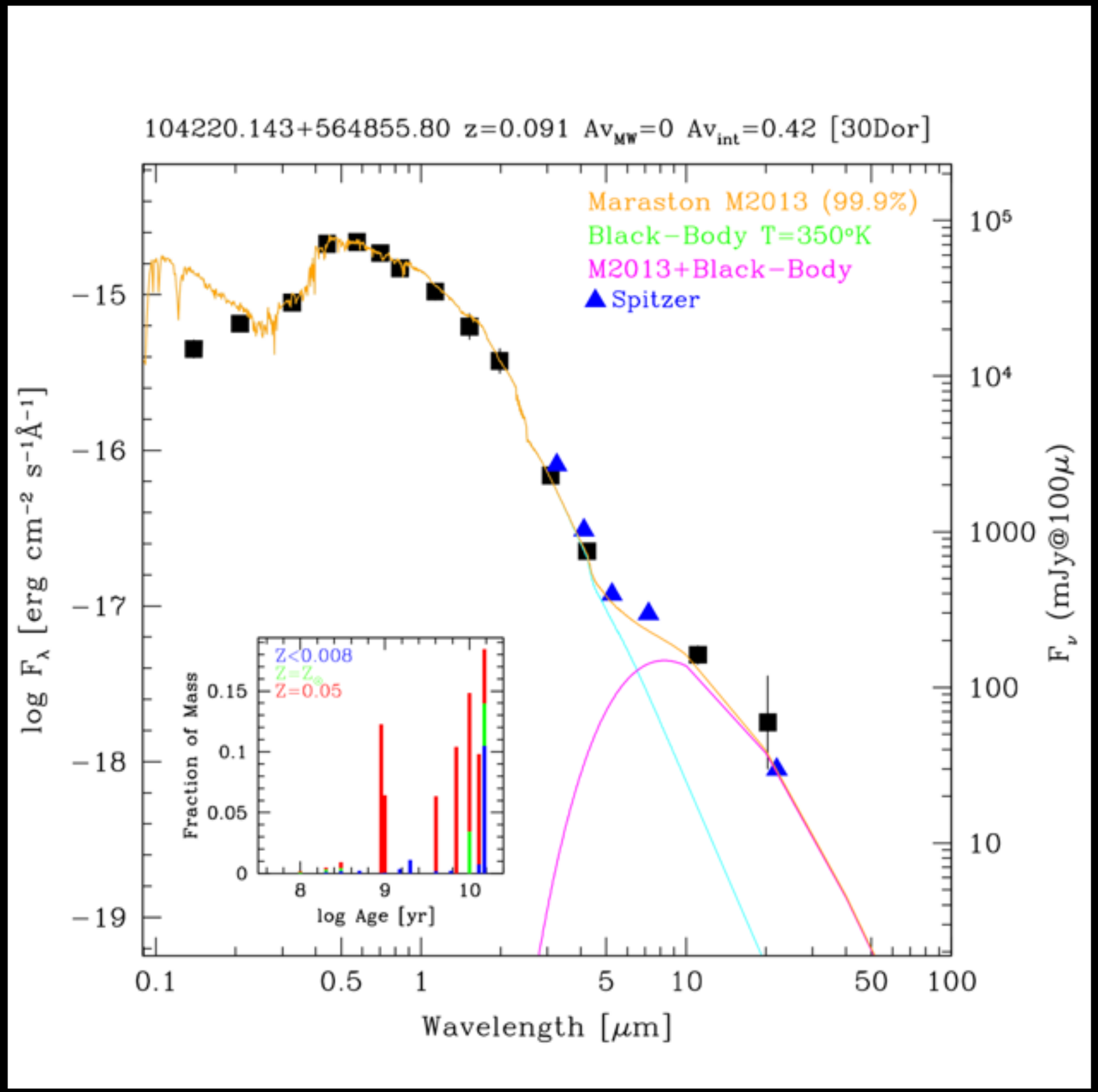
$$F(\lambda) = k \sum_{i=1}^{24} \sum_{j=1}^{5} S_{ij} M_{ij}(\lambda)$$

***M**ij* =** Maraston 2013 Models
***S**ij* = STARLIGHT star-formation histories
k = photometric zero point (*i*')

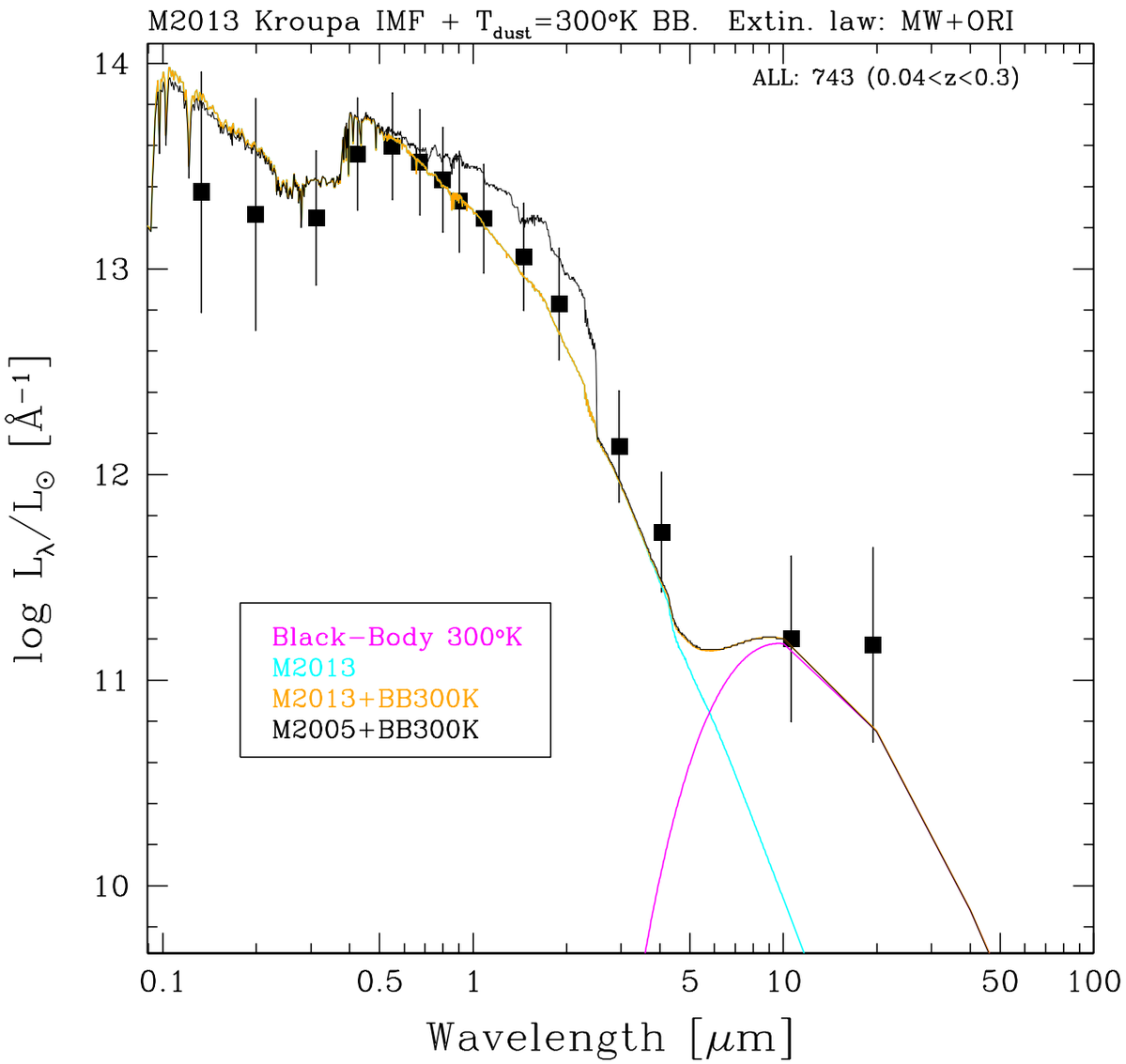
Table 2. Metallicity bins used to match STARLIGHT and M2013 models

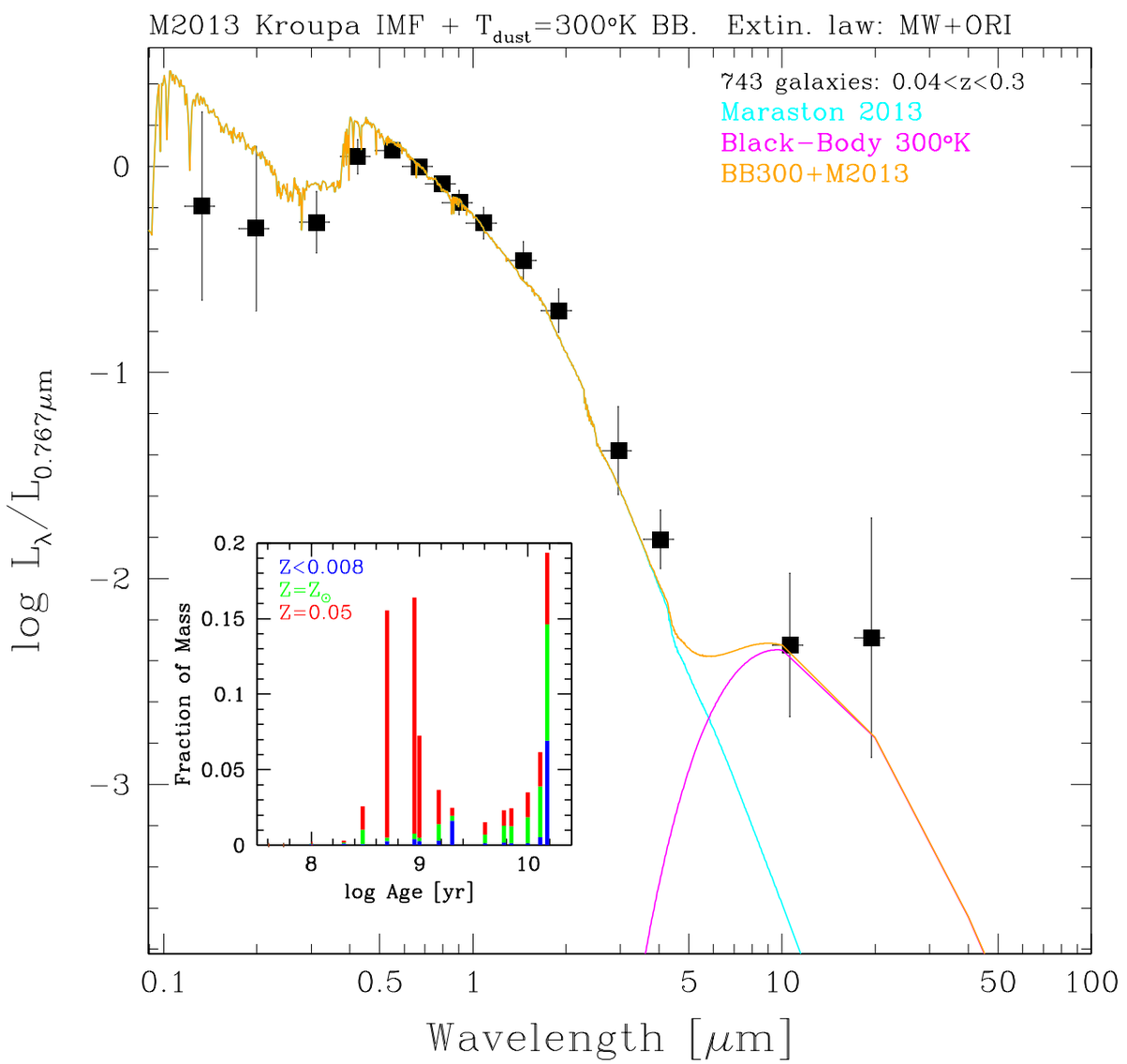
Metallicity	STARLIGHT BC03+Chabrier	MARASTON M2013+Kroupa
extremely poor	Z=(0.0001+0.0004)	use logZ=-1.35
very poor	Z=0.004	use logZ=-[1.35+0.58(logZ=-0.33)]/1.58
poor	Z=0.008	use logZ=-[0.33+0.19(logZ=-1.35)]/1.19
solar	Z=0.02	use logZ=0
rich	Z=0.05	use logZ=+0.35

All PSGs show a significant MIR excess



PSGs are a remarkably homogenous class at optical bands, but not in the UV or mid-IR.





Summary: Global Properties of K+A galaxies

1. The intermediate-age stellar population of K+A galaxies accounts for a median 50% of the total stellar mass and is metal rich Z>Zsun;
2. The SEDs of K+A galaxies are very well reproduced by the new Maraston (2013) models from the FUV (0.150mu) to the K-band (2.2mu). At longer wavelengths, K+As show substantial MIR excess, which is roughly consistent with emission by hot-dust;
3. K+A galaxies are a remarkably homogenous class of objects when observed at optical wavelengths, but display a substantial variance of integrated colors in the UV and mid-IR bands;
4. The large variance in the mid-IR can be due to differences in the temperature and mass of the hot dust component but we do not have a plausible explanation for the large variance in UV properties. The correlation between mid-IR and UV fluxes are correlated indicates that the UV variance could be related to differential extinction.

Outline

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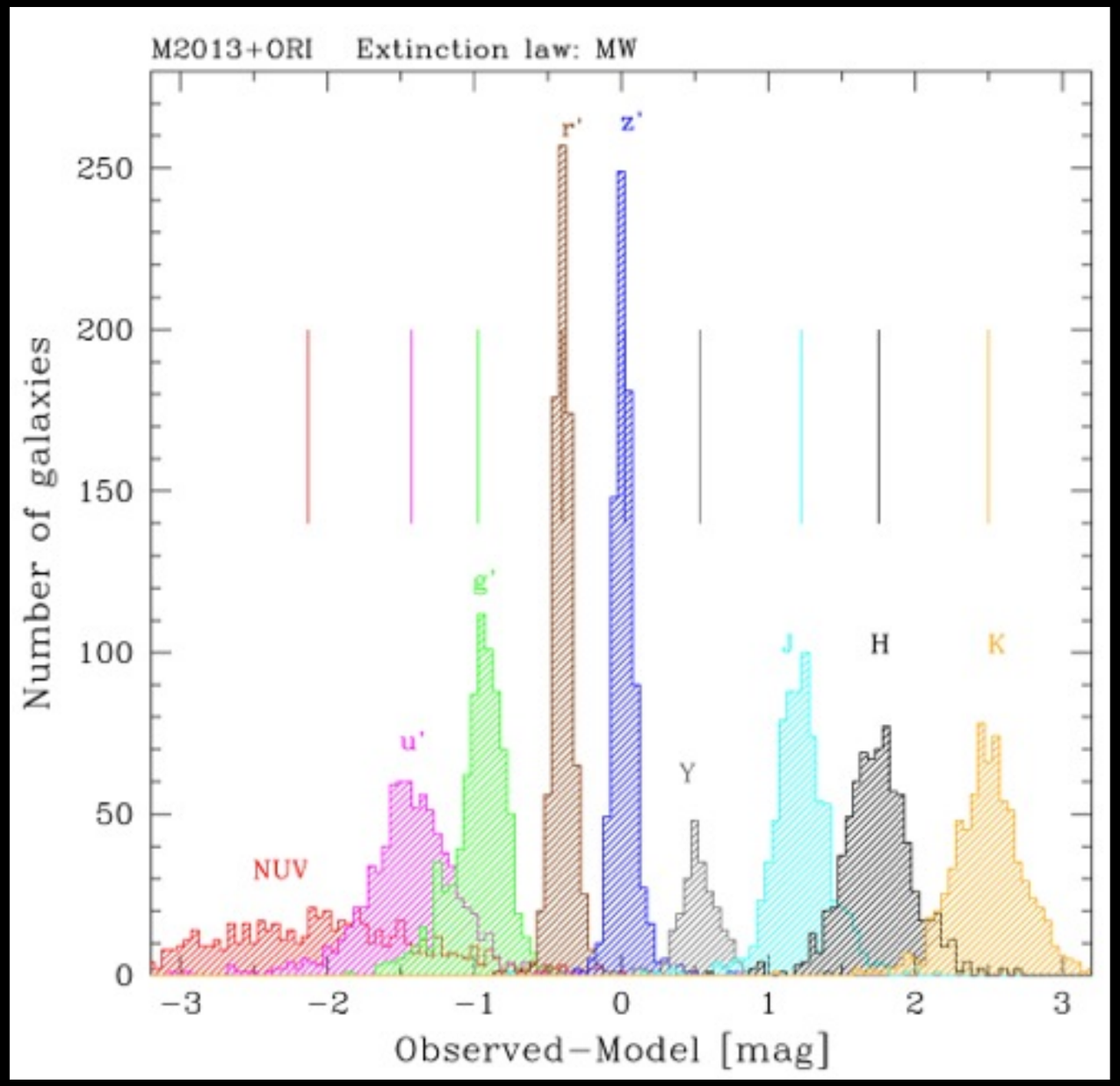
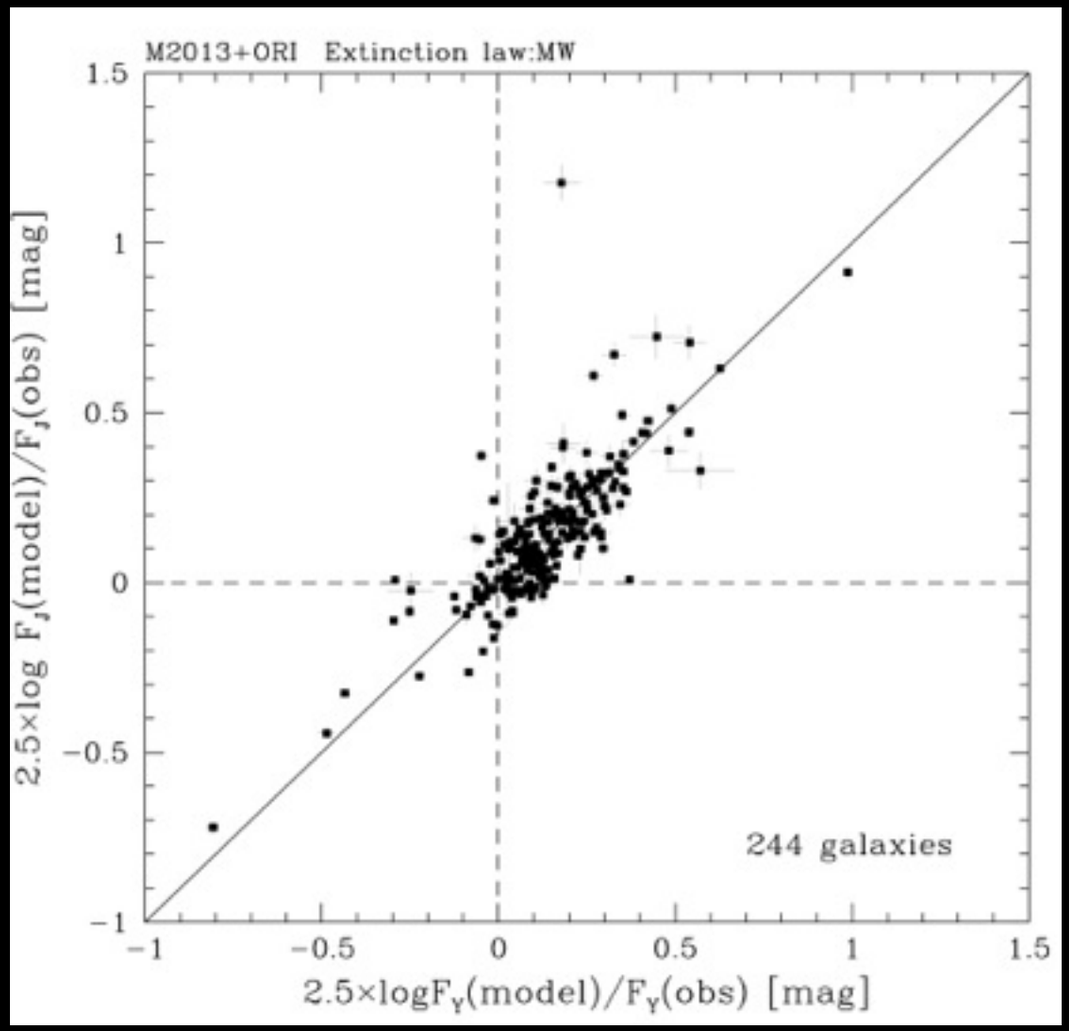
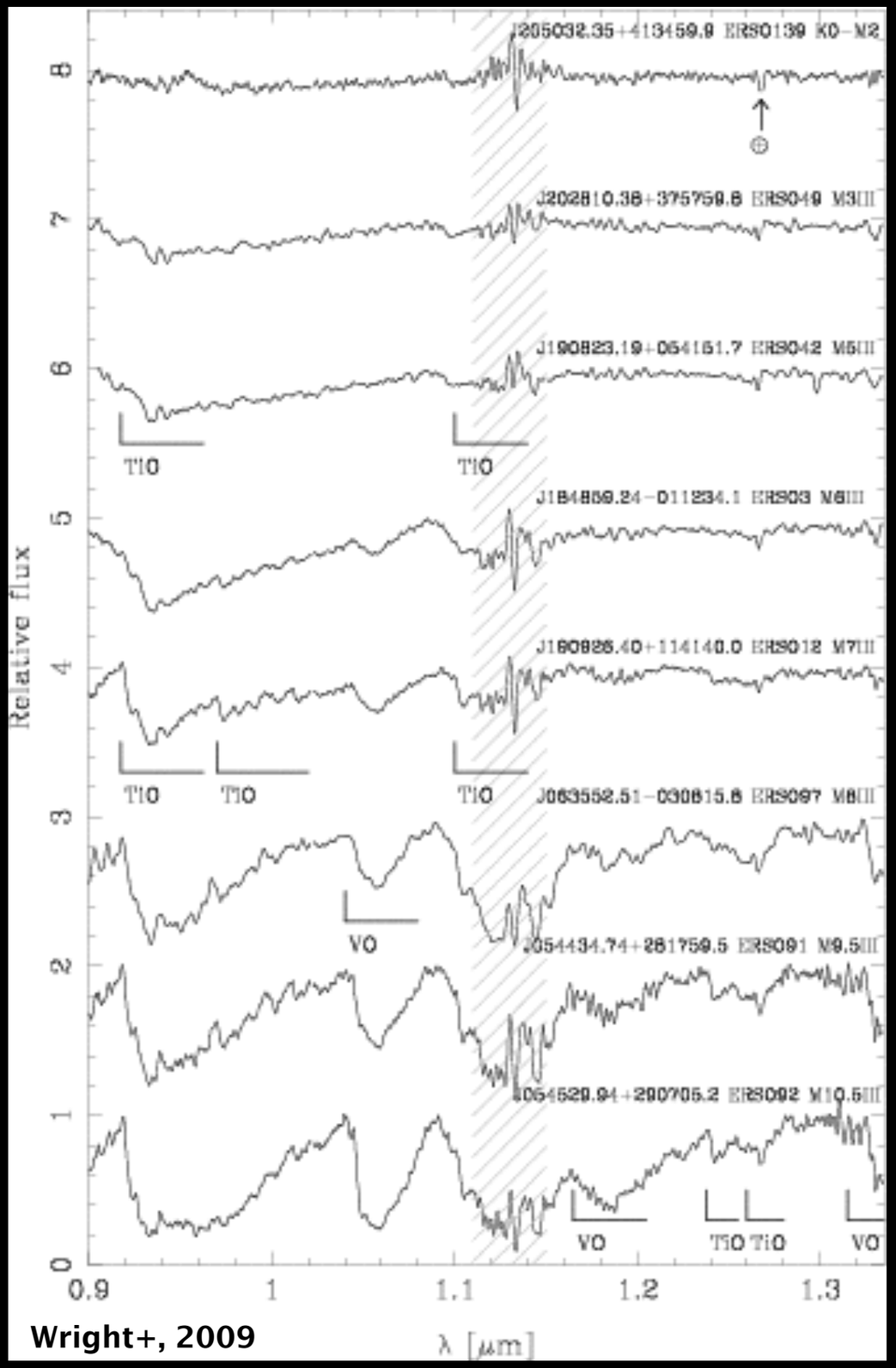
The Maraston-Mix reproduces remarkably well the observed colors of Post-starburst galaxies except in the Y and J bands

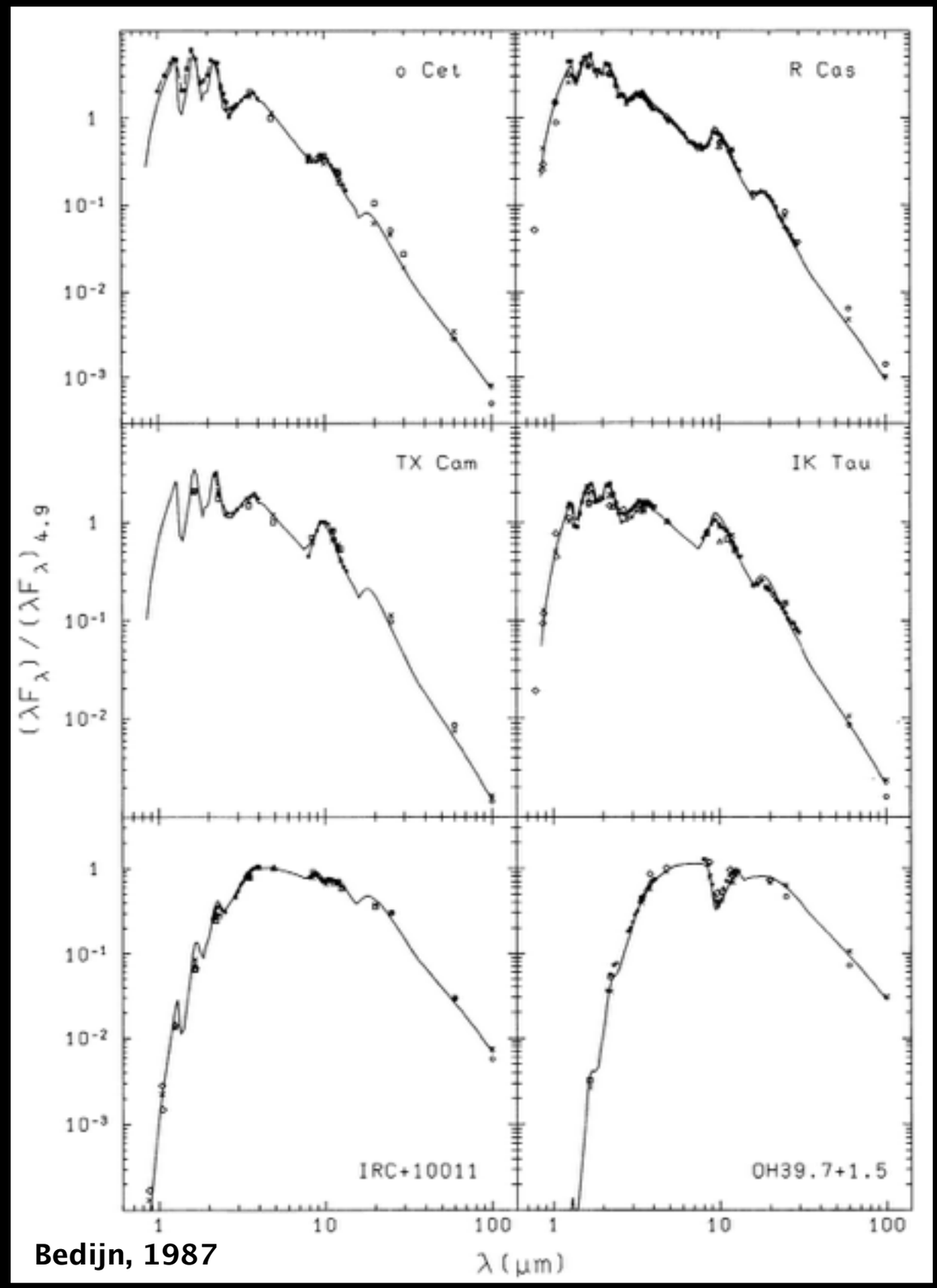




Late M-type AGB giants (Miras & OH/IR) have strong molecular bands in the Y & J bands and hot dust emission in the MIR

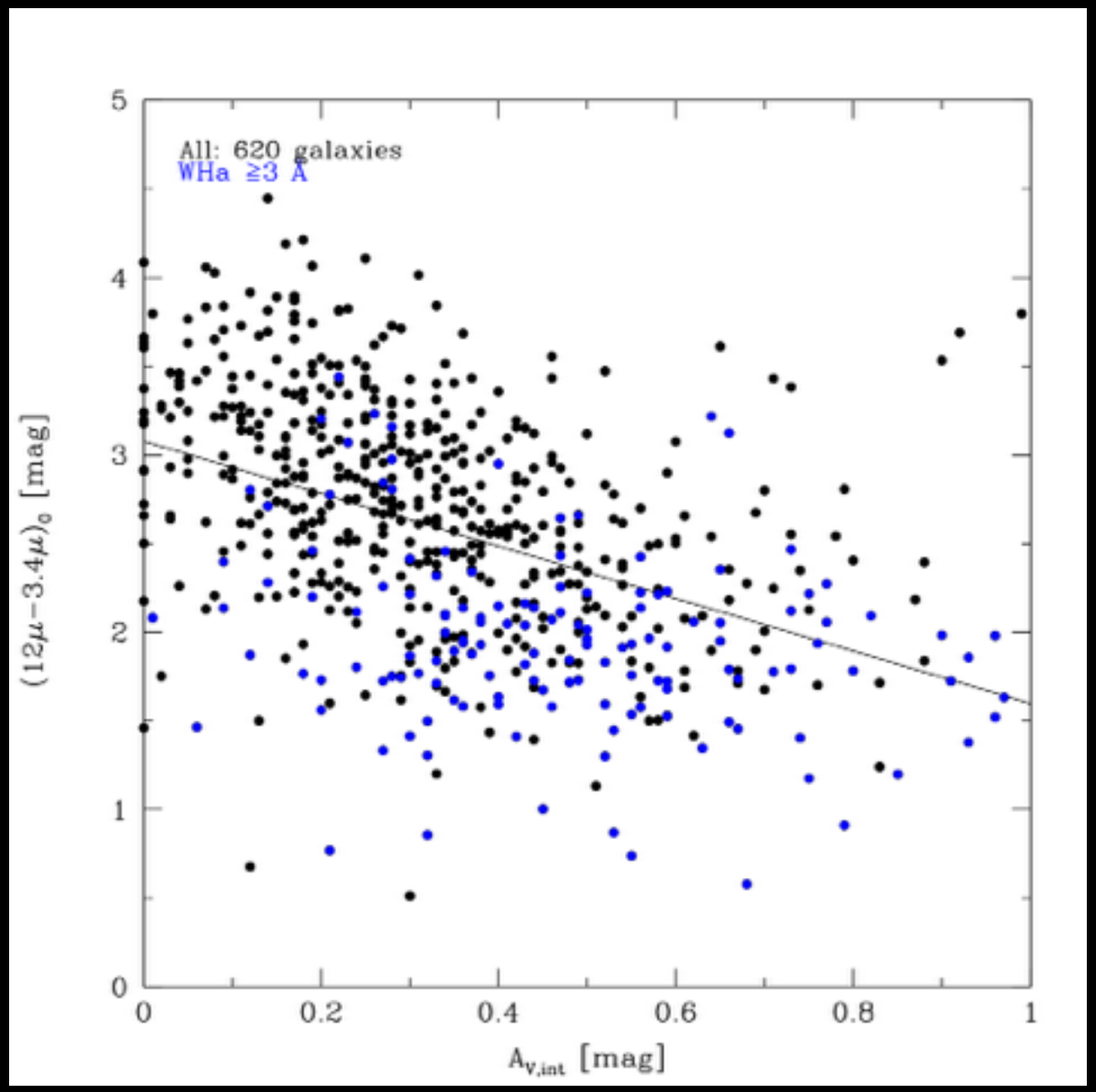


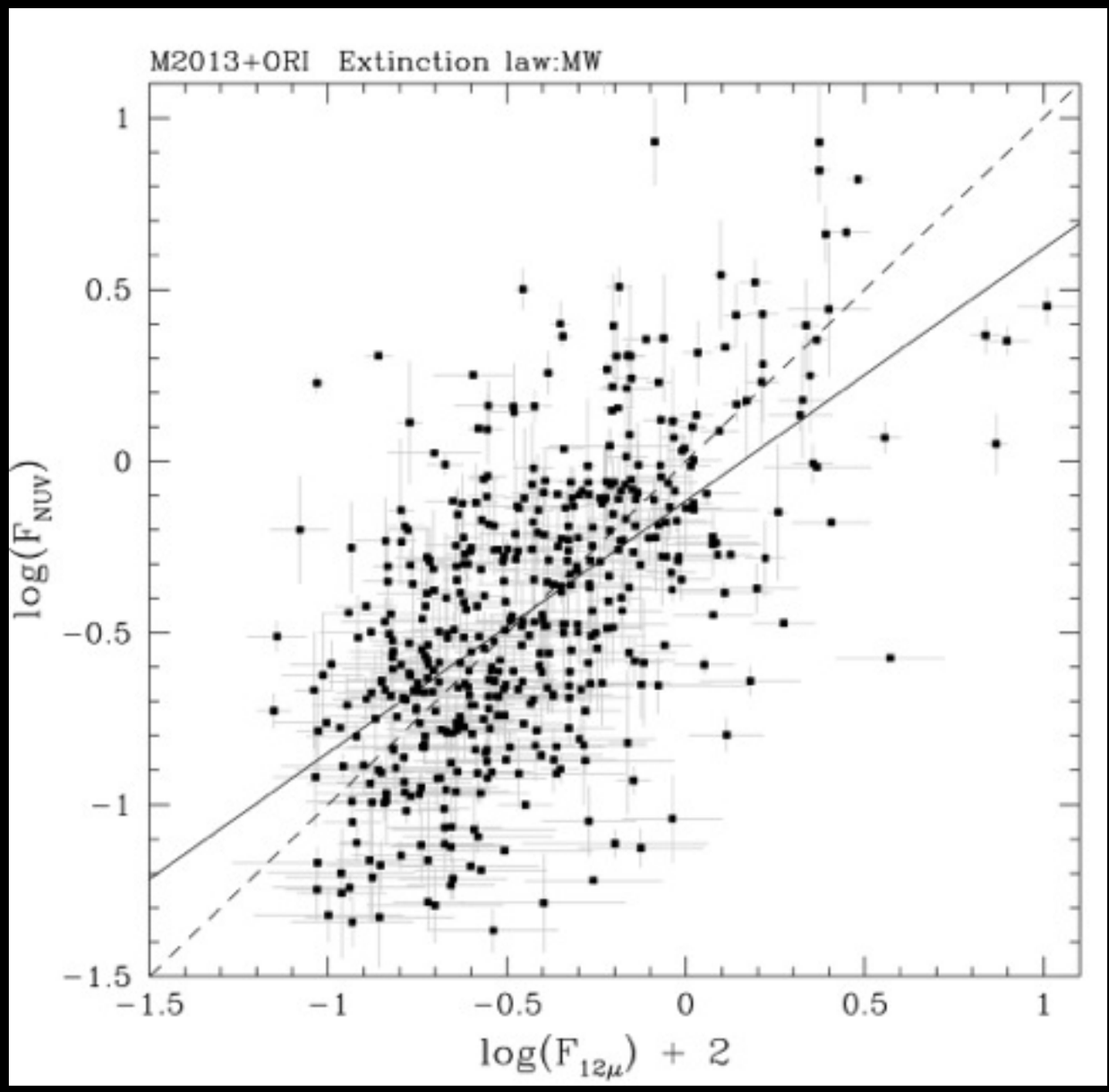
Wright+, 2009



Bedijn, 1987

What causes the MIR excess in K+A galaxies?





The MIR excess correlates with the extinction of the stellar populations and the mid-IR and UV fluxes are correlated

Summary: AGB stellar populations in K+A galaxies

1. Intermediate-age AGB populations in post-starburst galaxies are dominated by late M-type giants, consistent with their high metallicities ([Fe/H]~0.4);
2. The correlation between mid-IR and UV fluxes indicates that the large variance in UV properties may be related to differential extinction
3. More realistic pop. synthesis models and stellar libraries including AGB and post-AGB populations are required to improve the synthetic SEDs;
4. Differential extinction may be a serious problem in the (rest frame) UV.

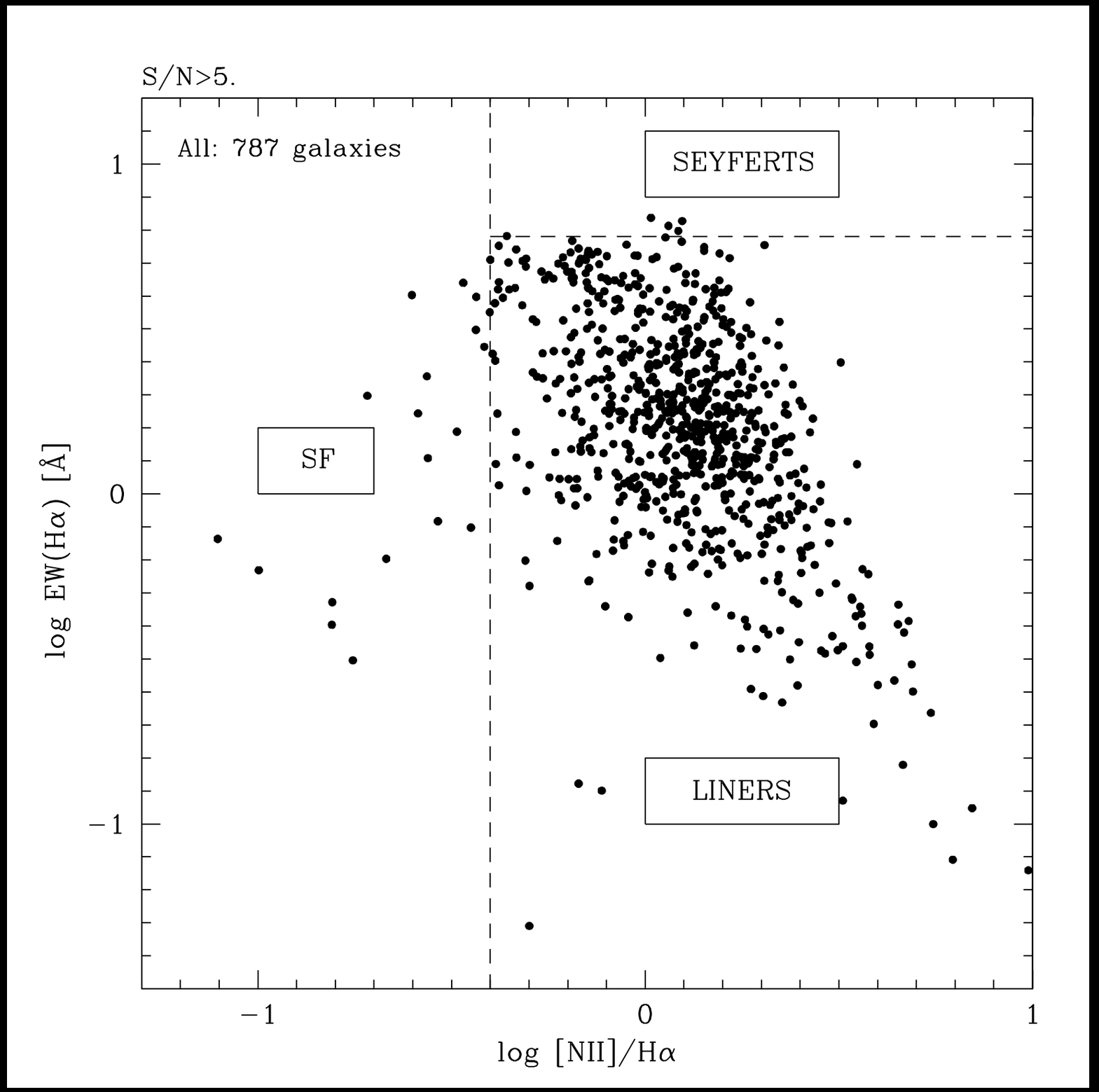

Thank you !

Auxiliary Material

Outline

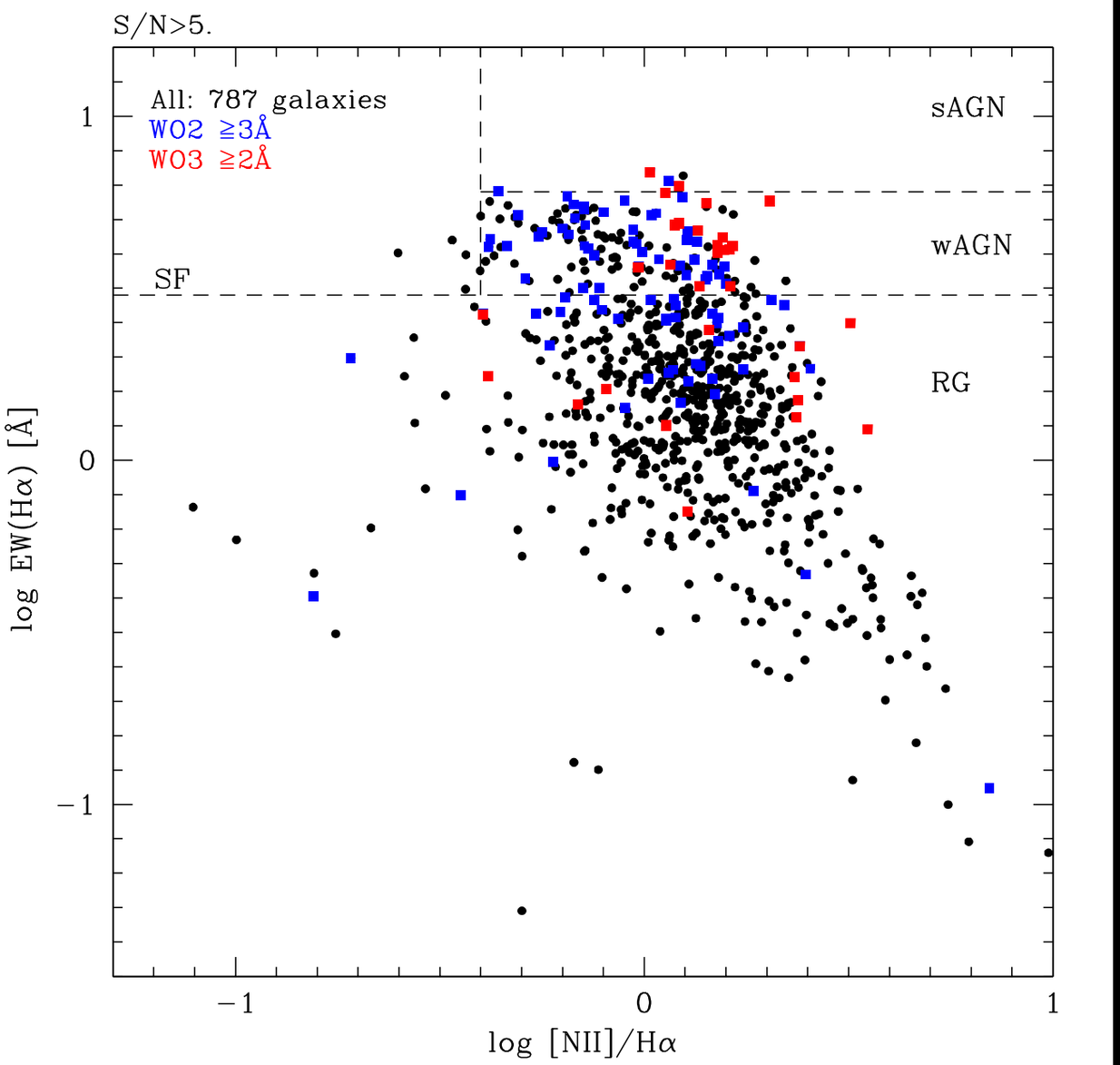
1. Global properties of post-starburst (aka K+A or E+A) galaxies
2. AGB stars in K+A galaxies
3. The Starburst-AGN connection (De Propris & Melnick, MNRAS 2014, in press).
4. Conclusions

In the standard classification scheme, K+A galaxies are LINERS

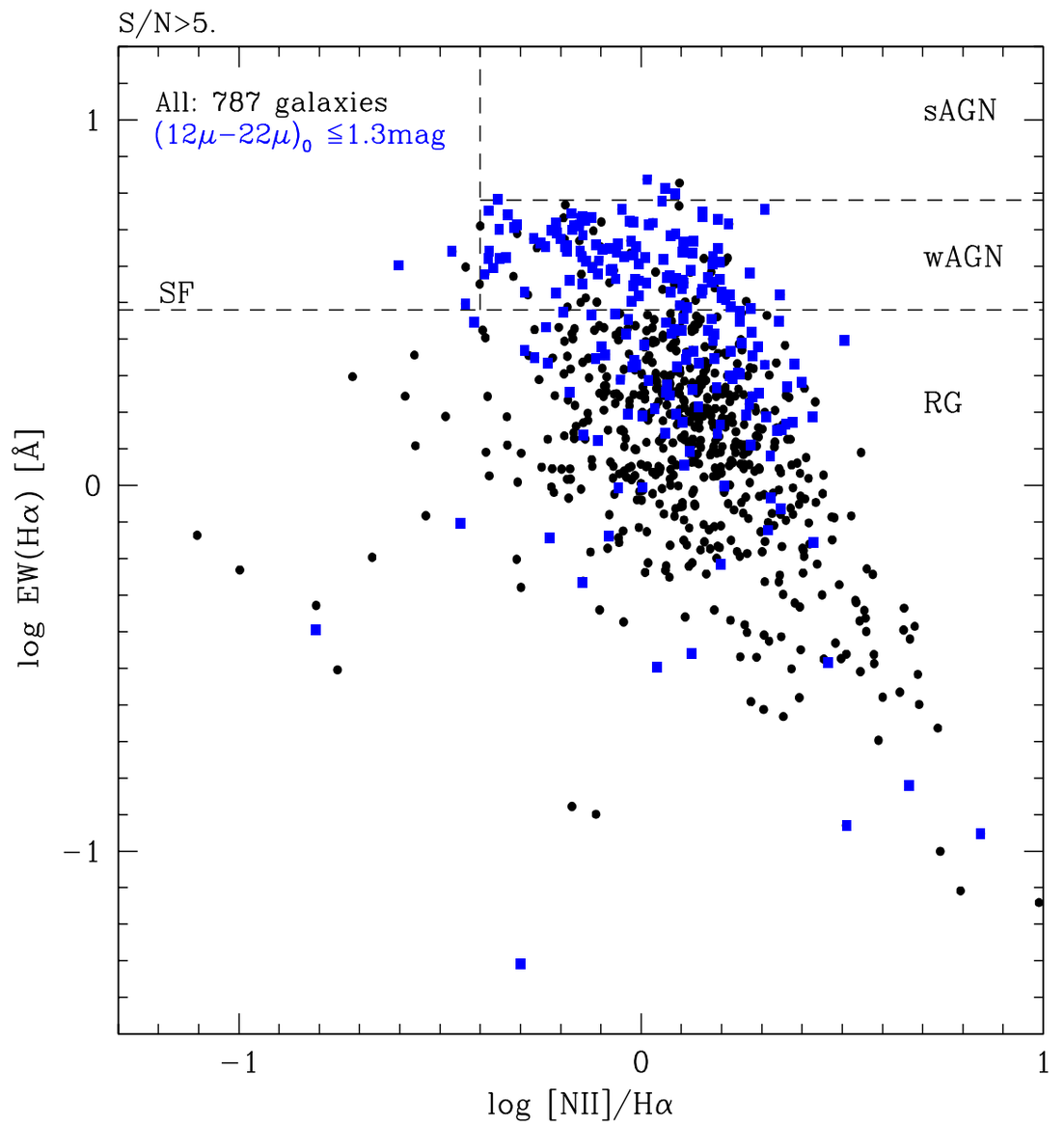


The WHAN diagrams* are more suitable for galaxies with weak lines and/or difficult reddening corrections

* Stansinska, Cid-Fernandes et al.

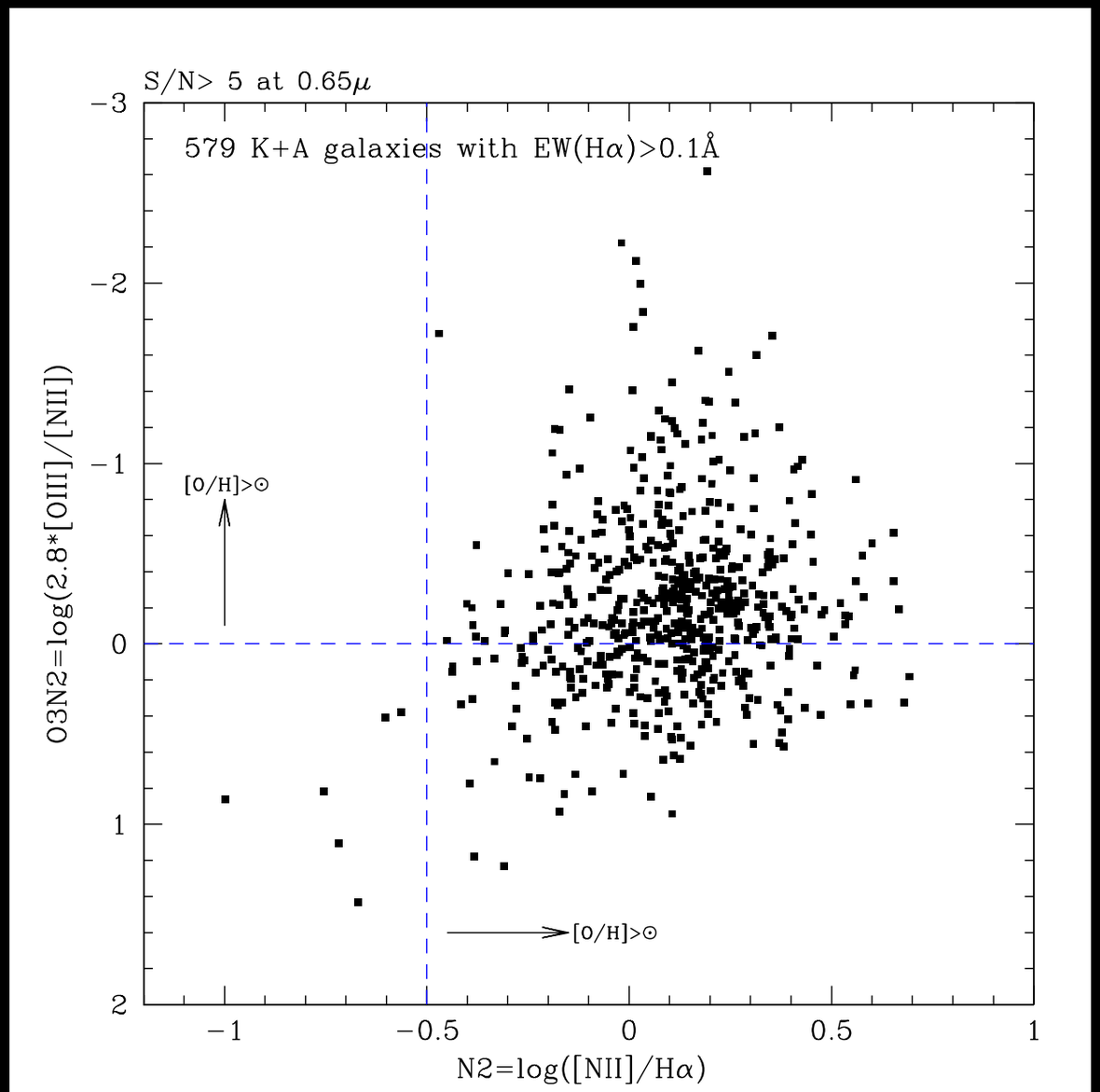


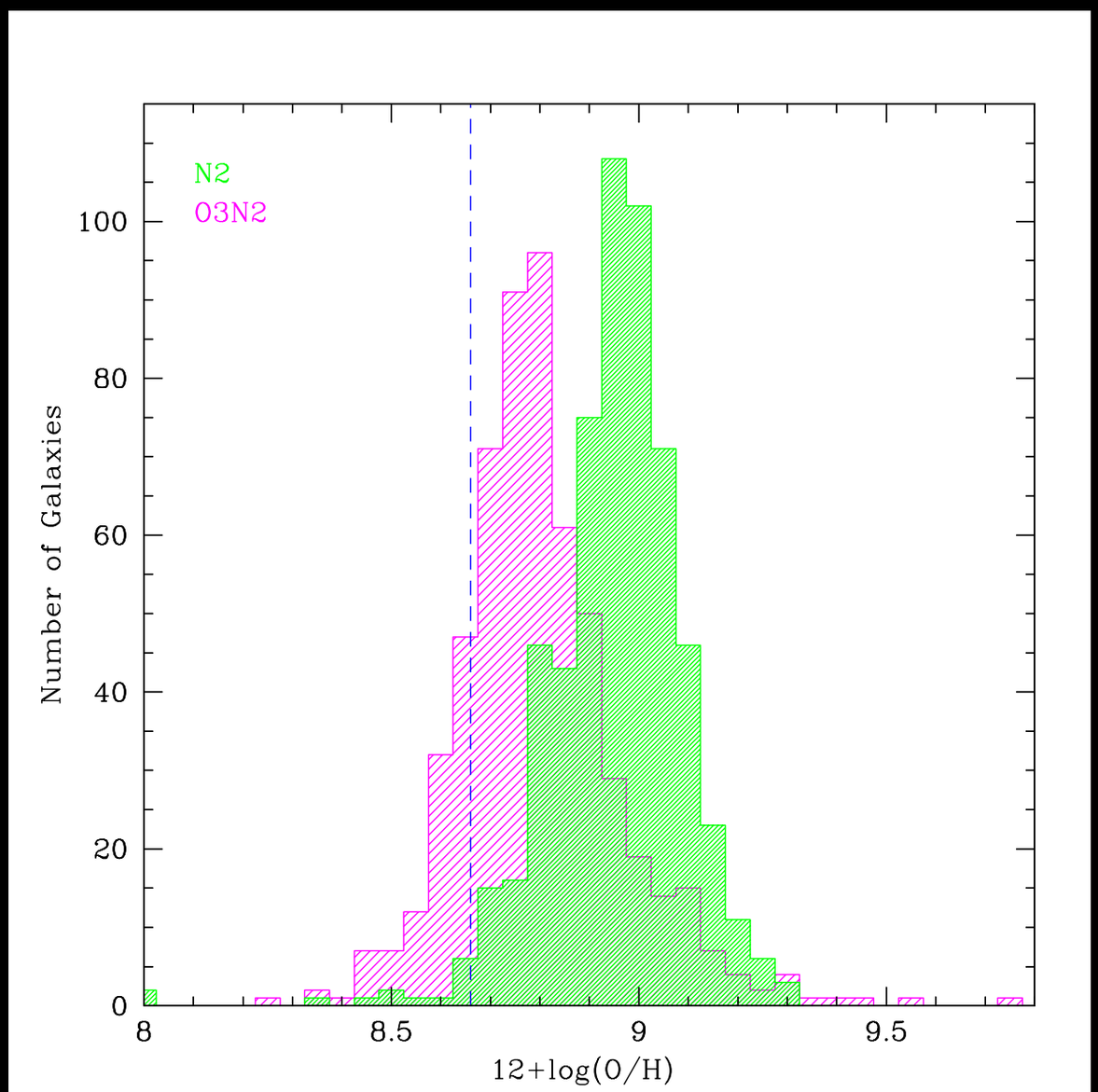
K+A galaxies are mostly `retired galaxies' (RG) or weak AGN (wAGN); very few are strong AGN (sAGN) or star-forming (SF) galaxies



wAGN appear to have hotter dust components

The nebulae in K+A galaxies are also metal rich





The intermediate-age populations of wAGNs tend to have lower-metallicities