Needs from other Facilities for Nearby Universe Science

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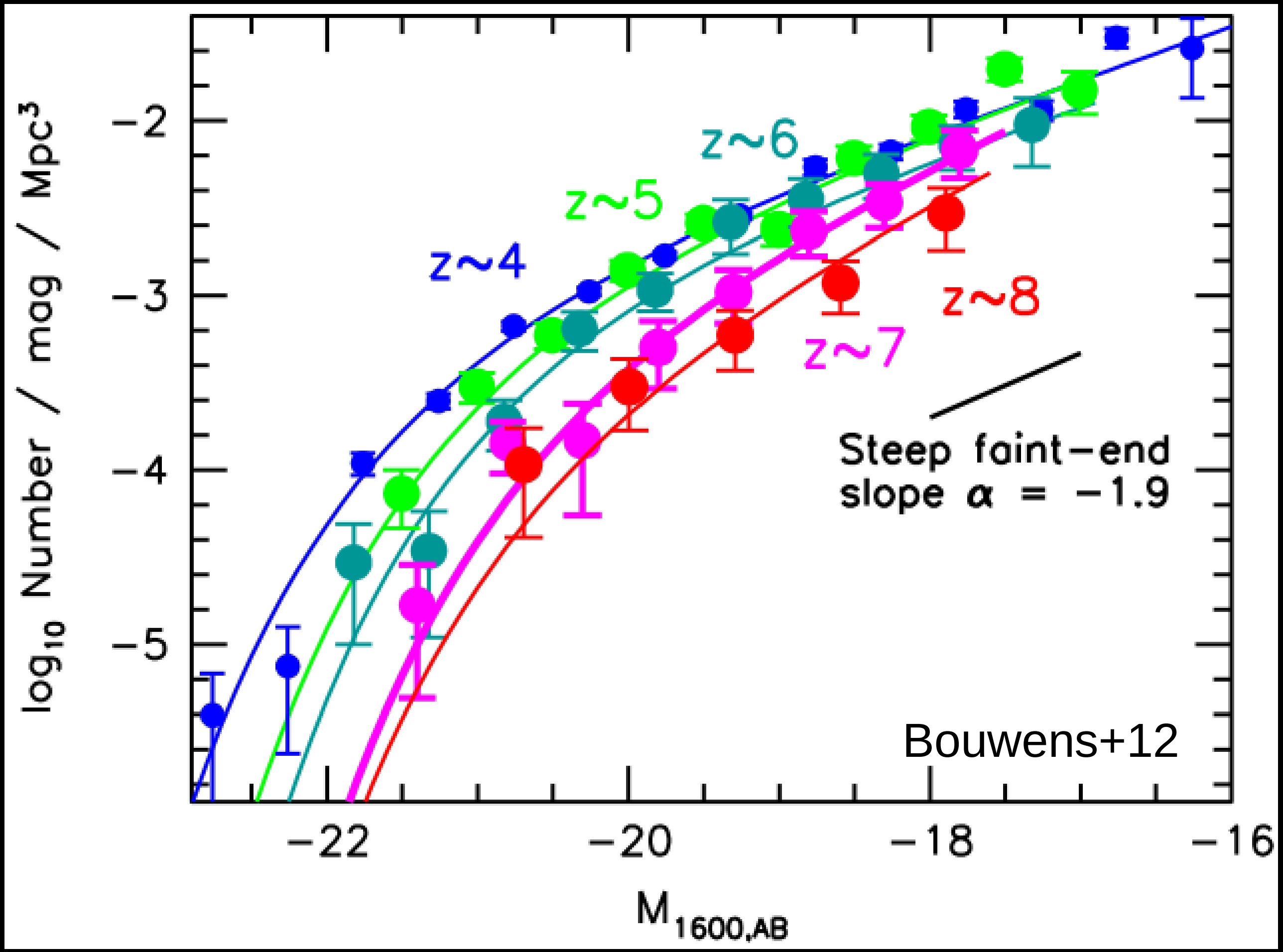
Outline

The far-ultraviolet and galaxy star formation histories

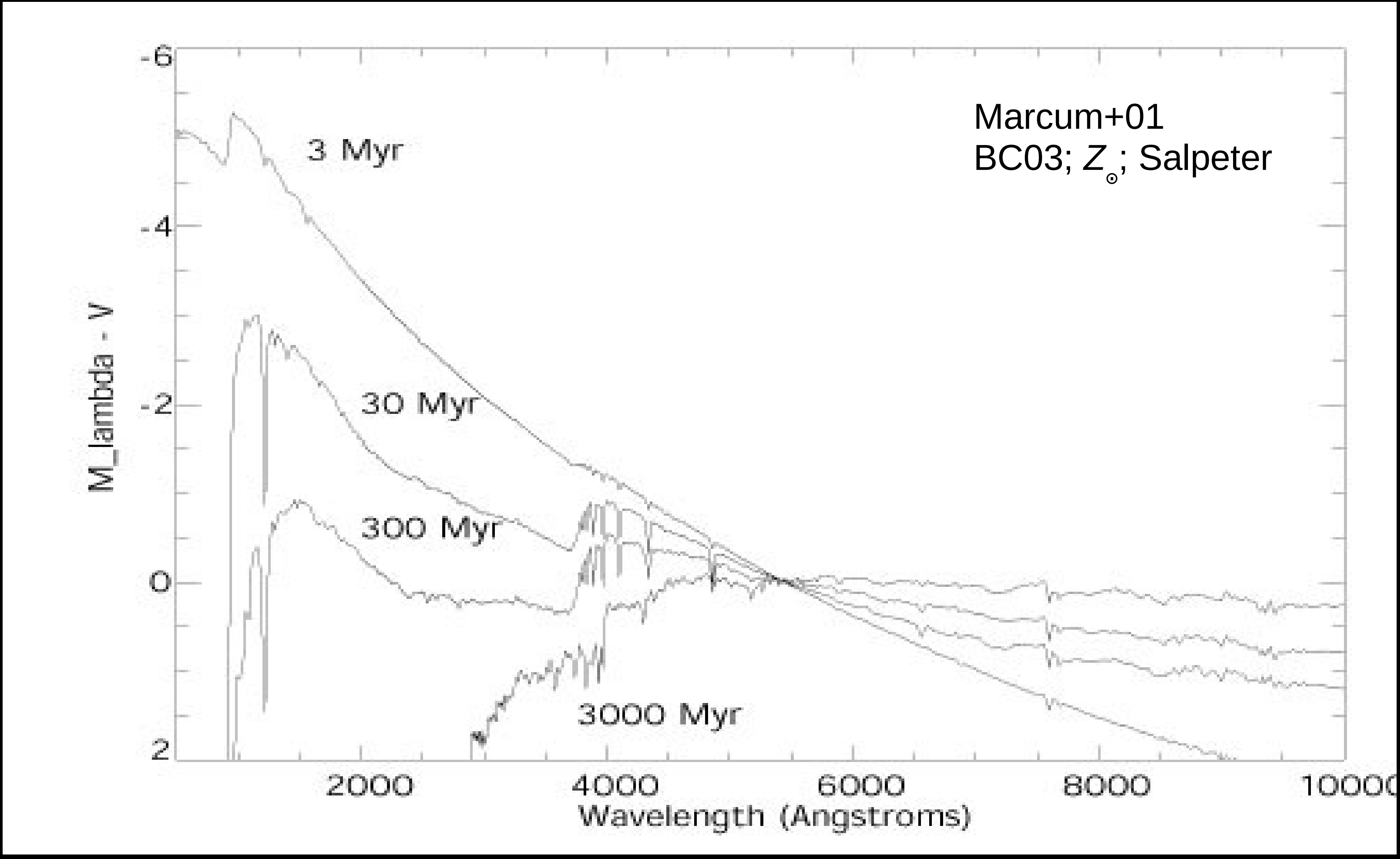
Characterizing physical conditions within nearby galaxies

To interpret higher *z* data, need similar rest-frame low *z* data



Rest-frame 1600Å FUV LF over 4<*z*<8

FUV data are extremely helpful in constraining galaxy SFH



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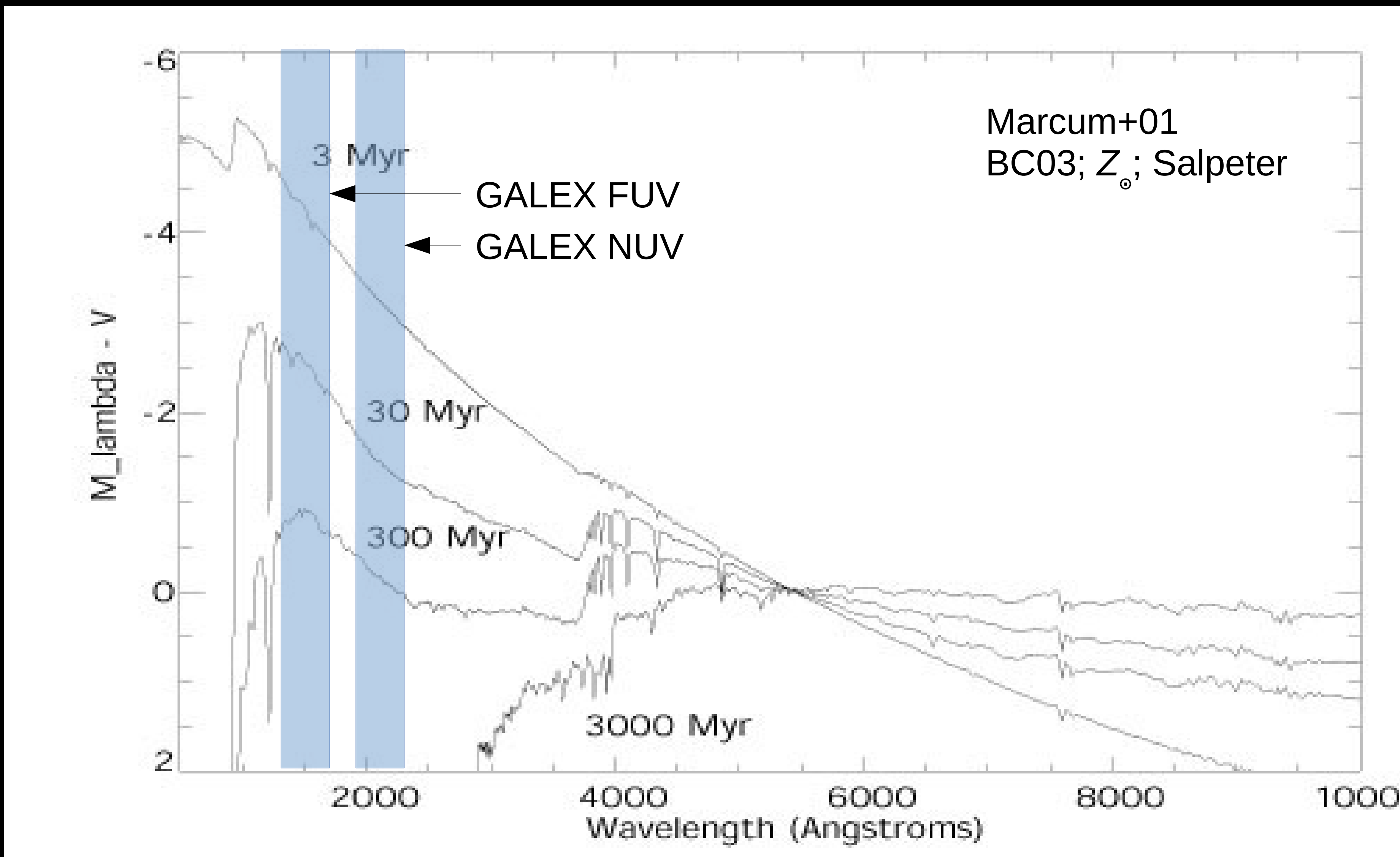
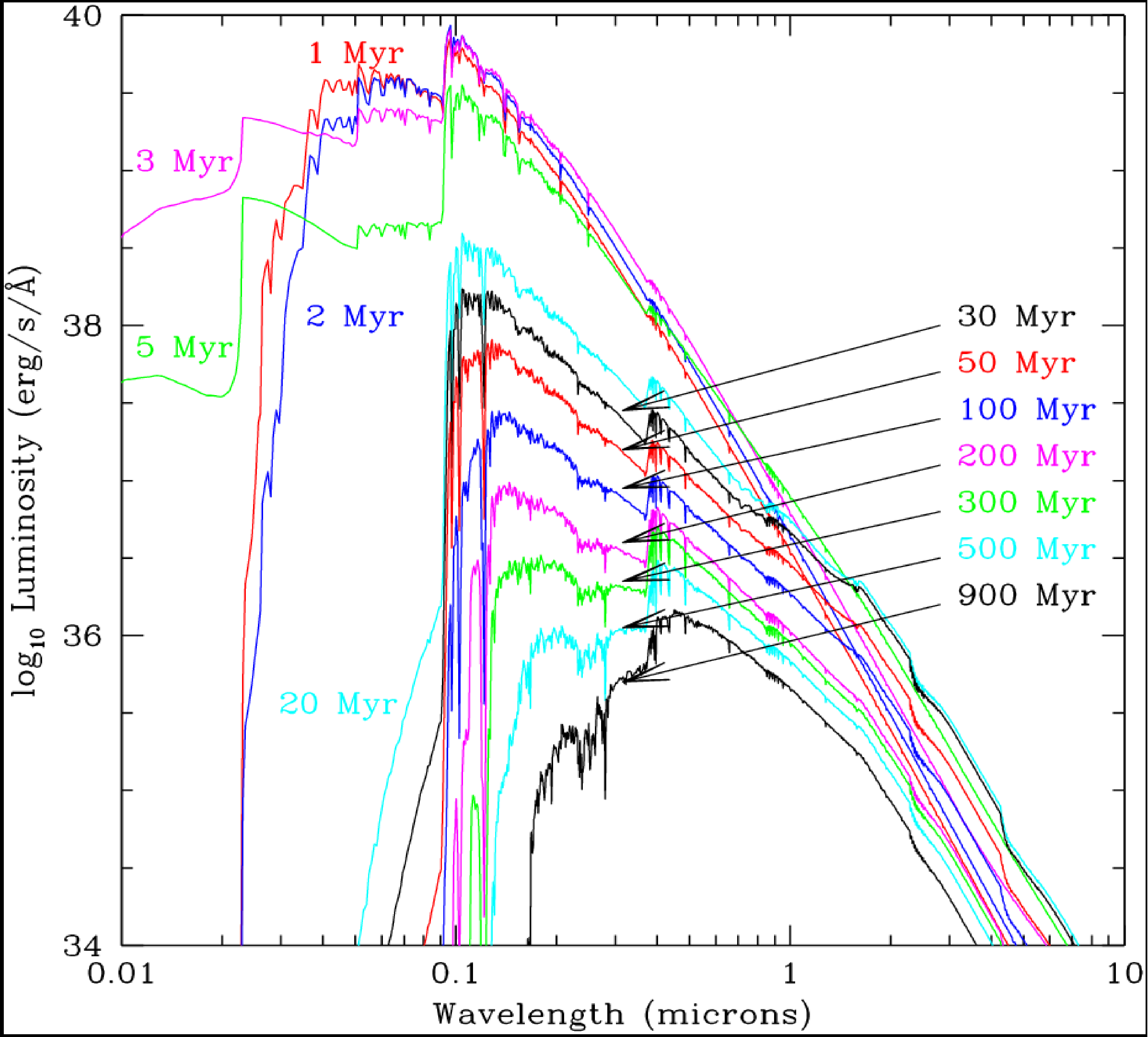


FUV data crucial for constraining SFH

Starburst99
Leitherer et al.
Instantaneous
$Z_\odot$



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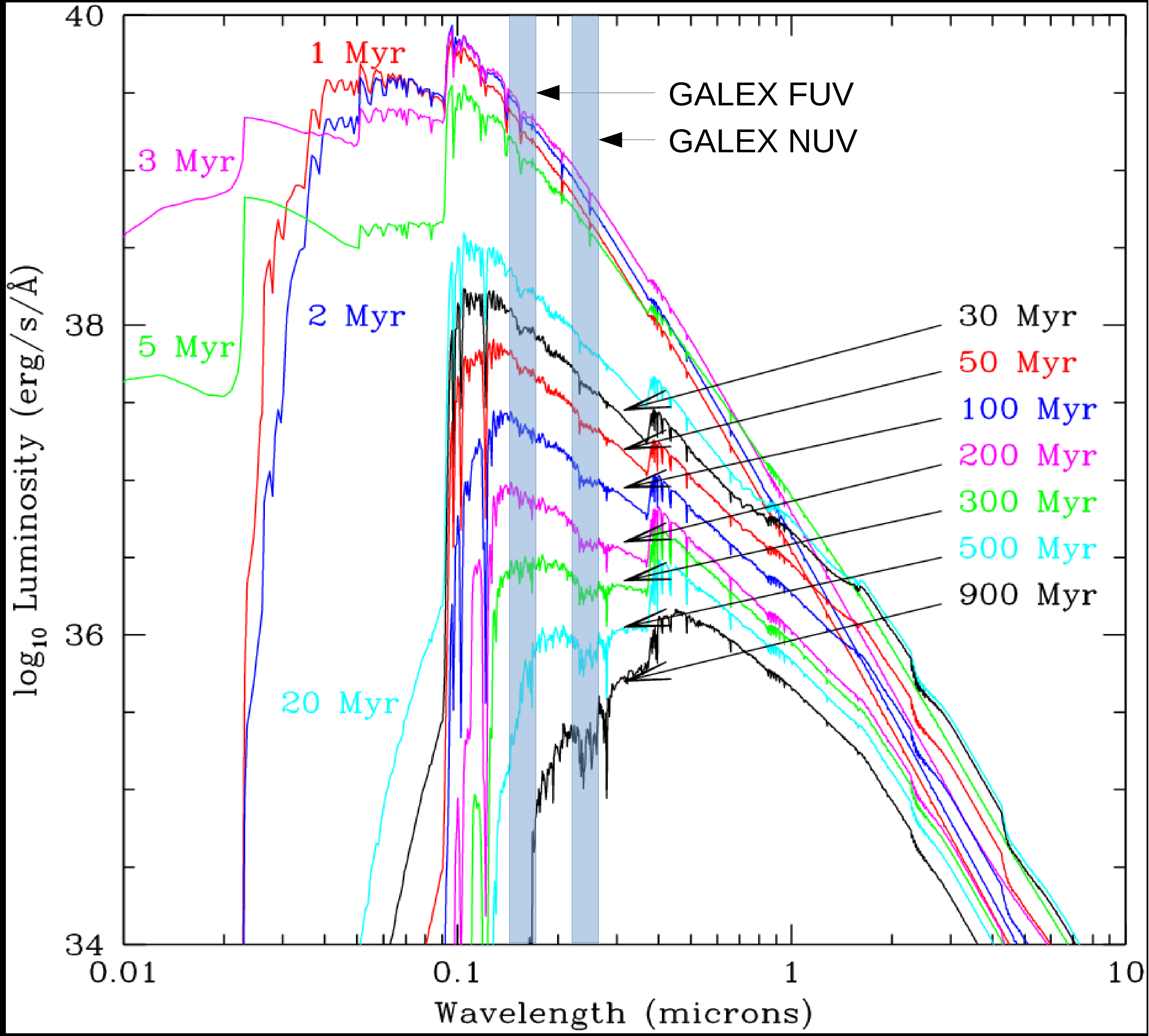


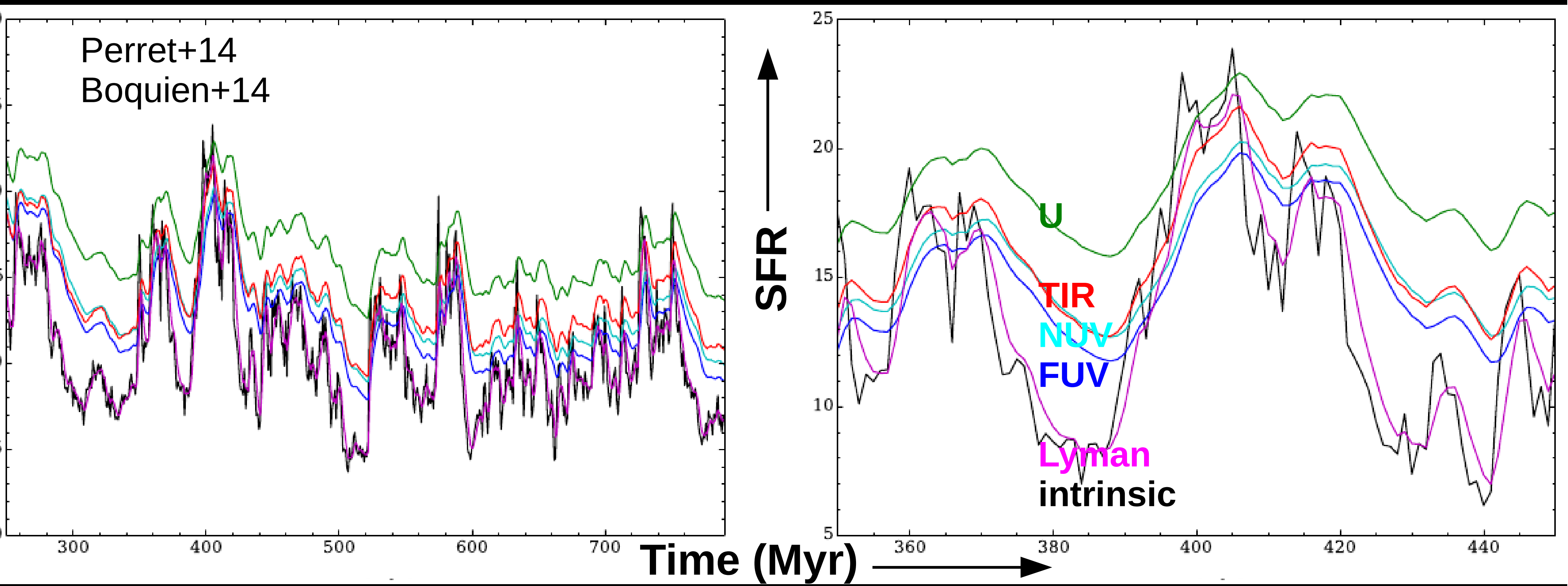
MIRAGE simulations of 1<z<2 main sequence galaxies

$\sigma_{SFR} \sim 0.3 \langle SFR \rangle$

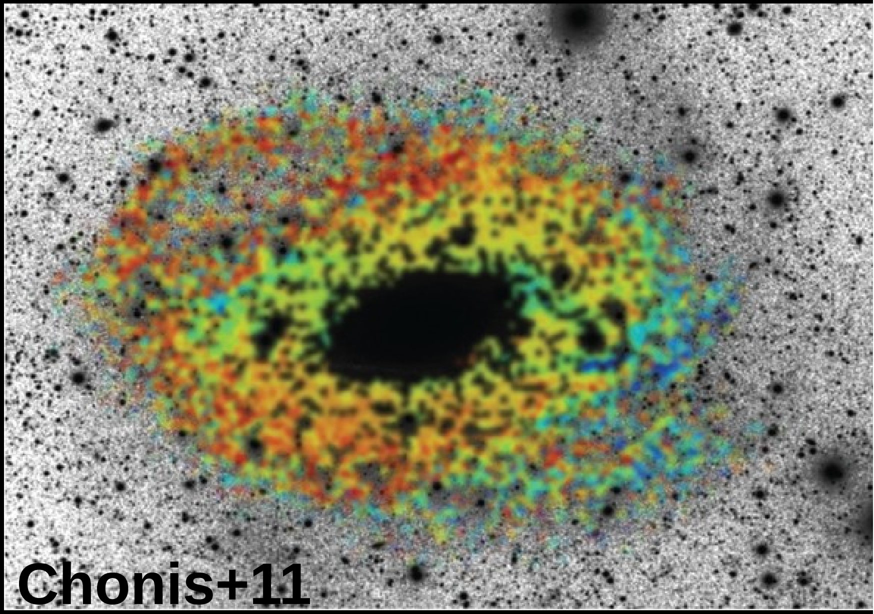
SFRs extracted using common recipes

Classical SFRs overestimate by 25% (FUV) to 65% (U)

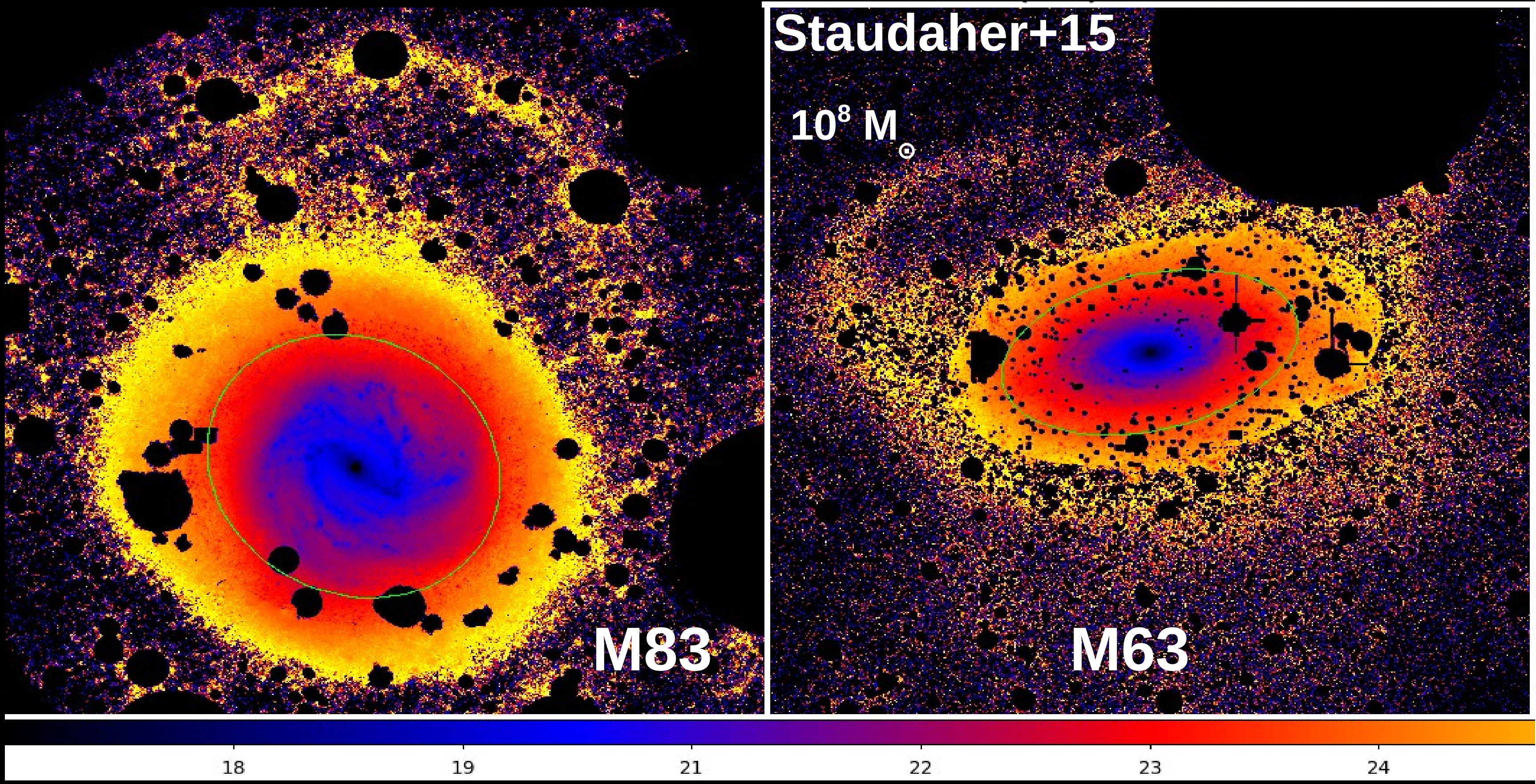
→ increasing accumulation of longer-lived stars



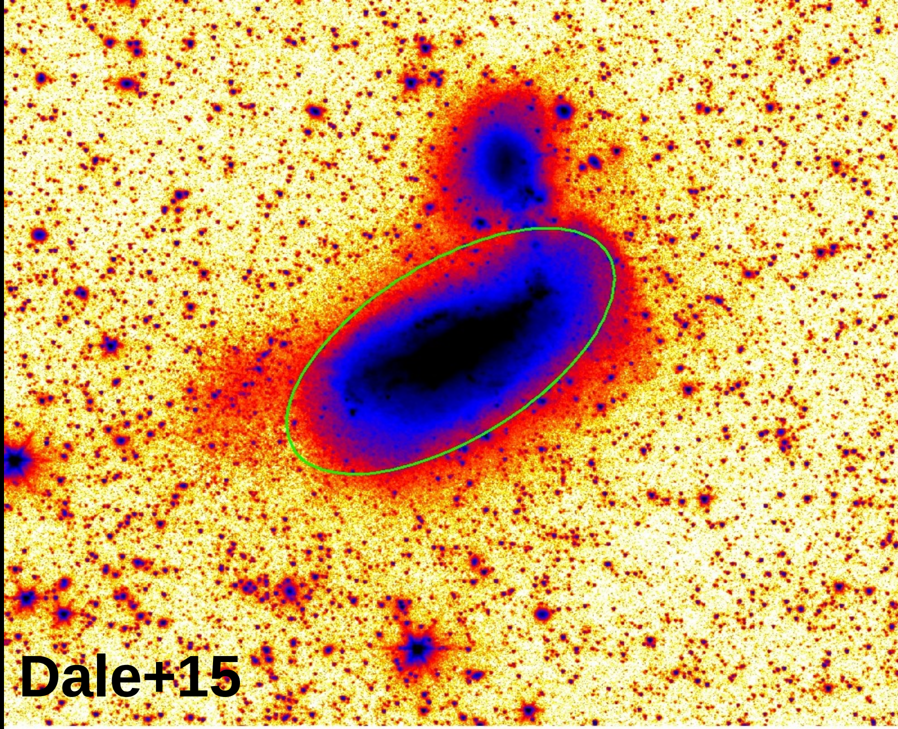
Deep multi-λ photometry provides spatially-resolved SFH for nearby galaxies, even in the outskirts where mergers are evident



Spitzer 3.6μm
1800 s/pix
EDGES survey
van Zee+12
Barnes+14

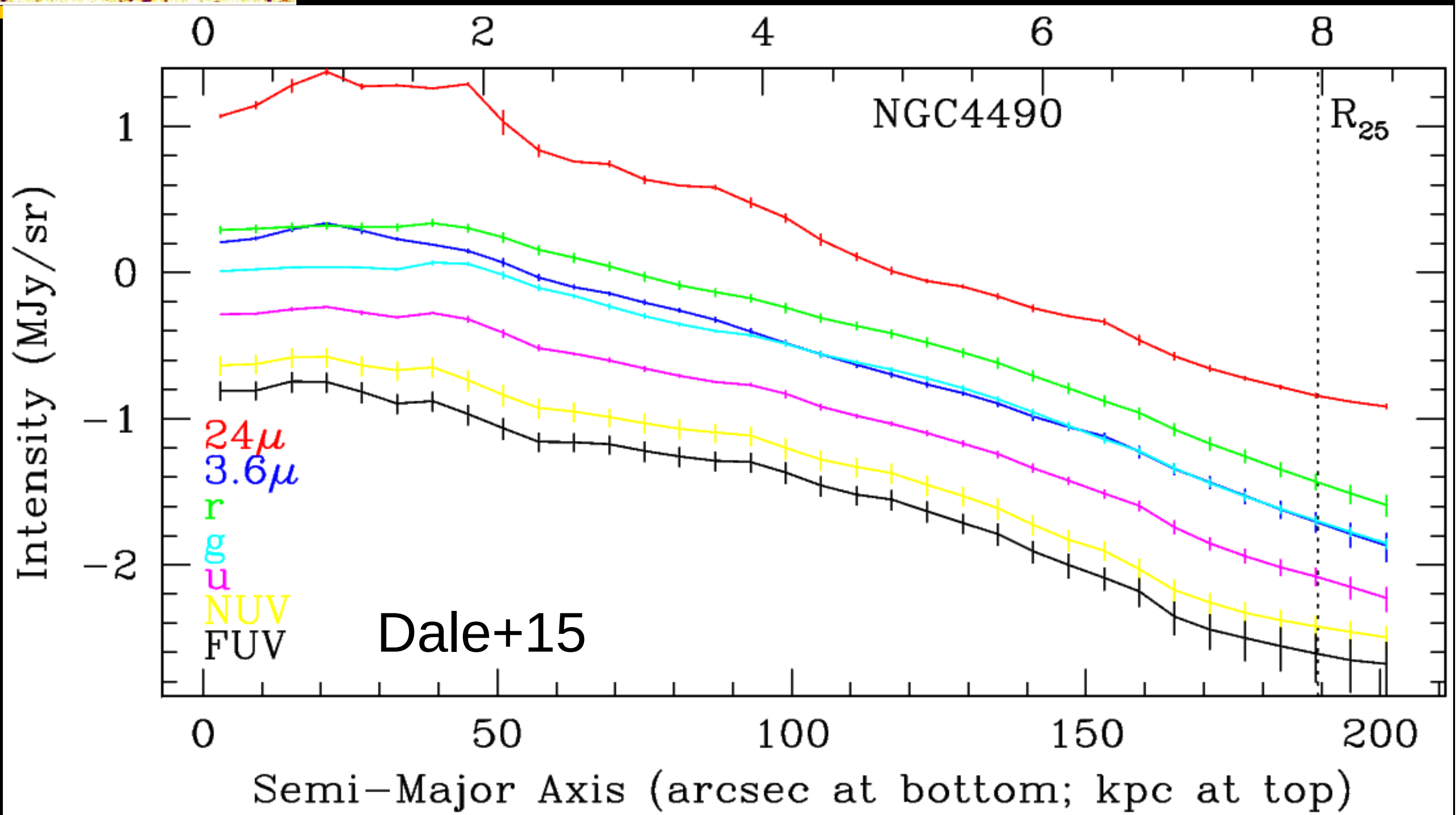


Radial age gradients in NGC4490



Deep FUV, NUV, ugr, 3.6μm, 24μm

Spitzer 3.6μm
1800 s/pix
EDGES survey
van Zee+12



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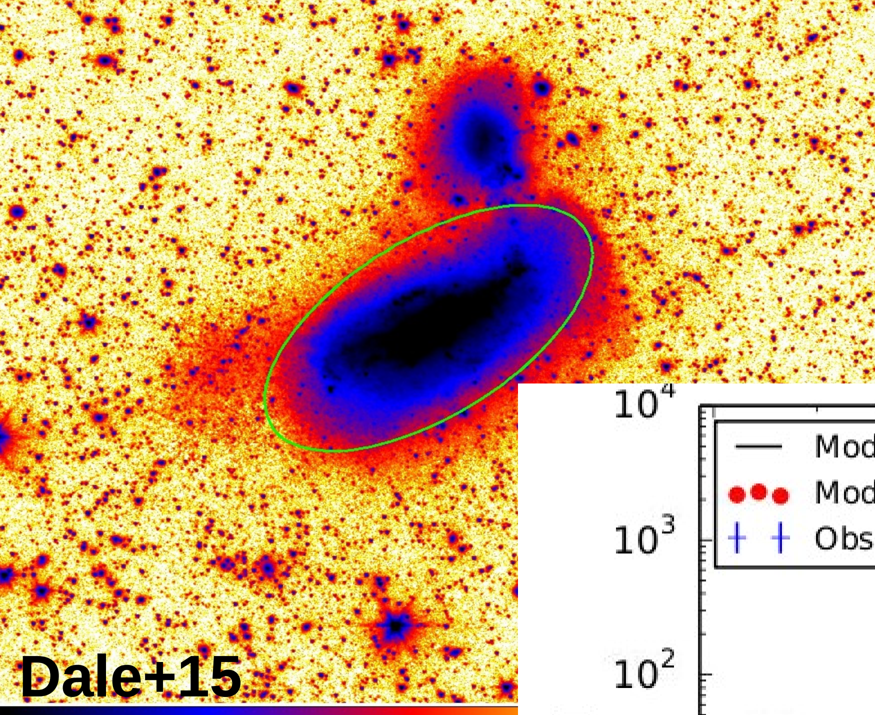

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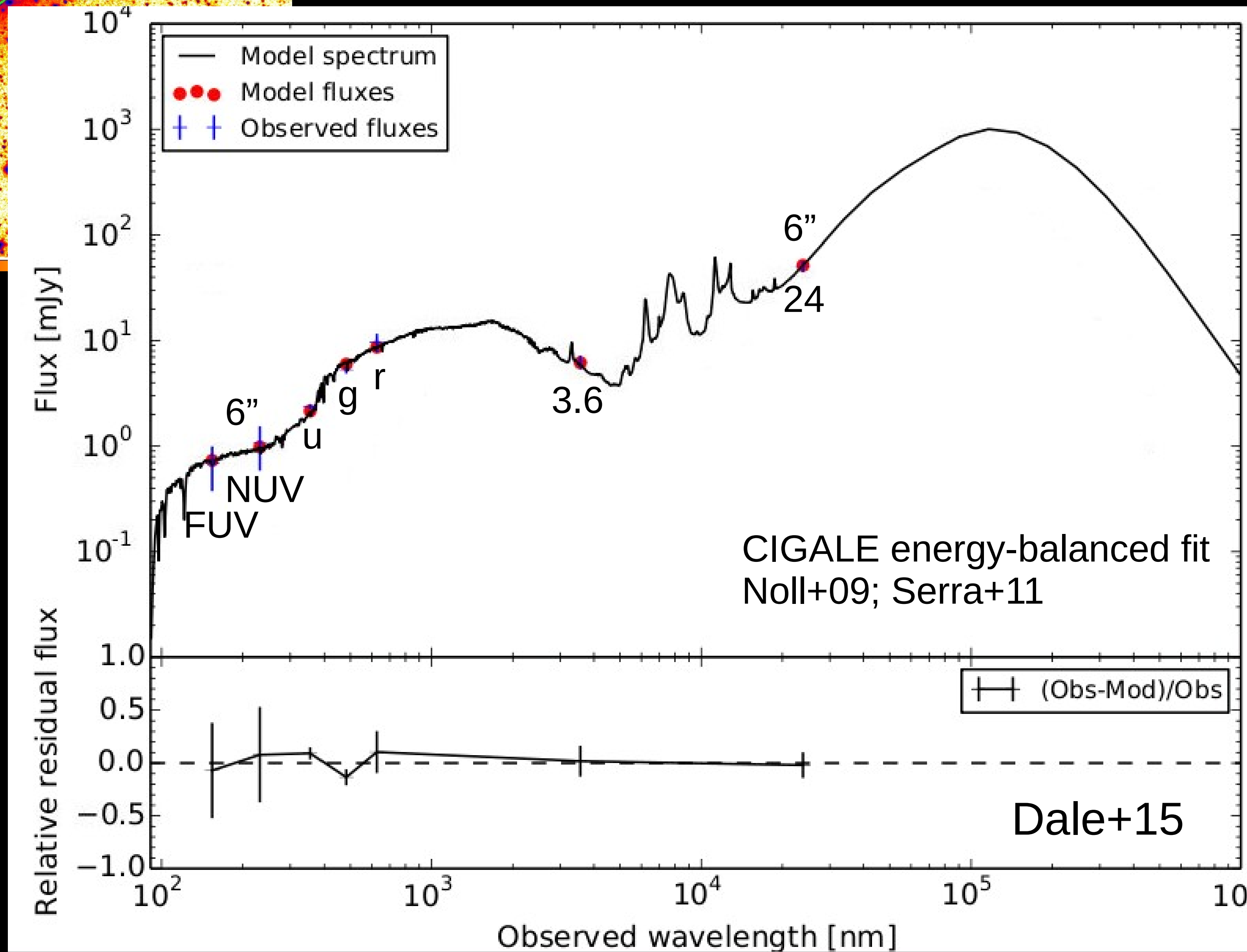
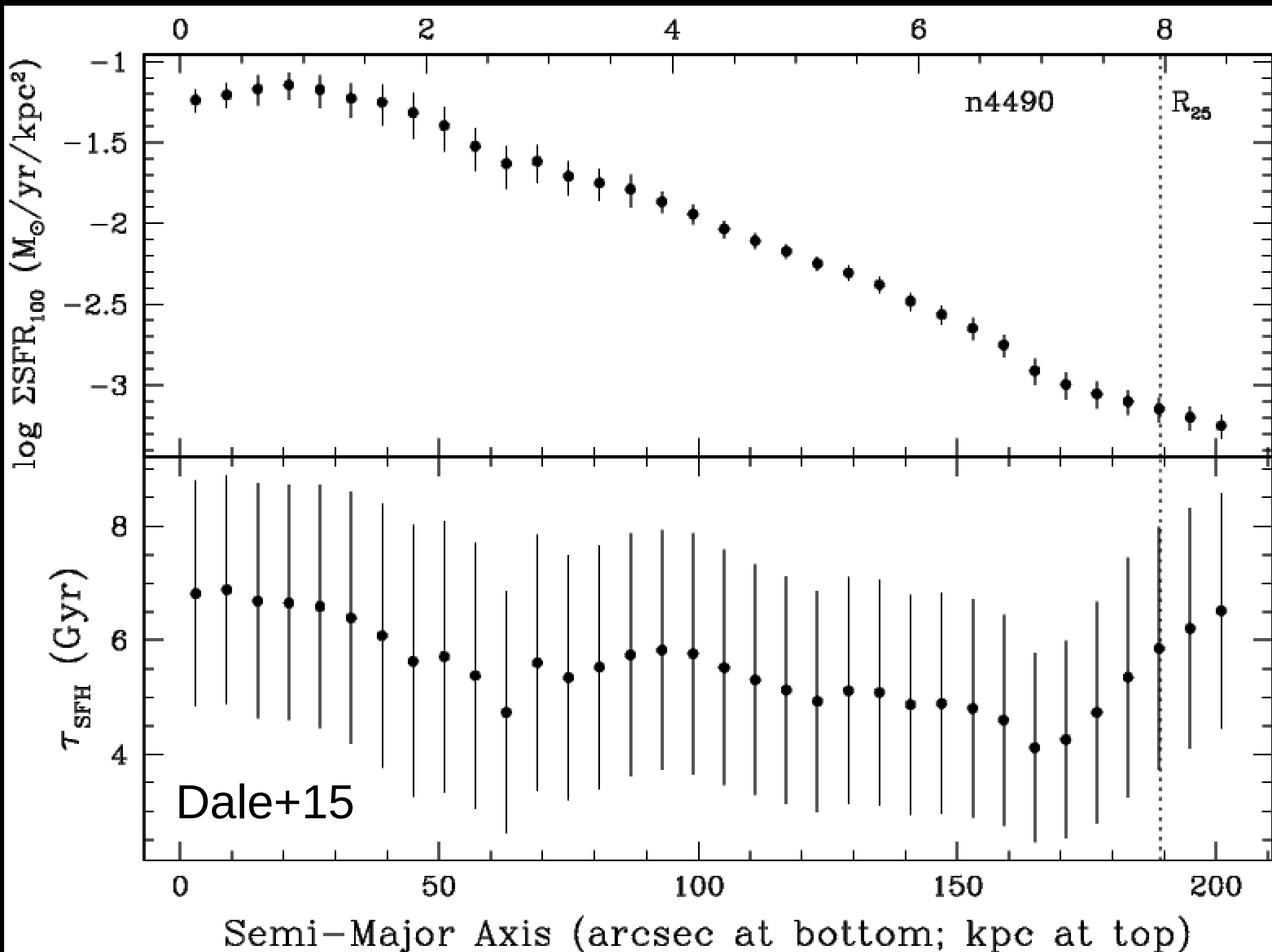


Radial age gradients in NGC4490

Delayed SF: SFR(t) µ t exp(-t/τ)



FUV crucial

Deep GALEX

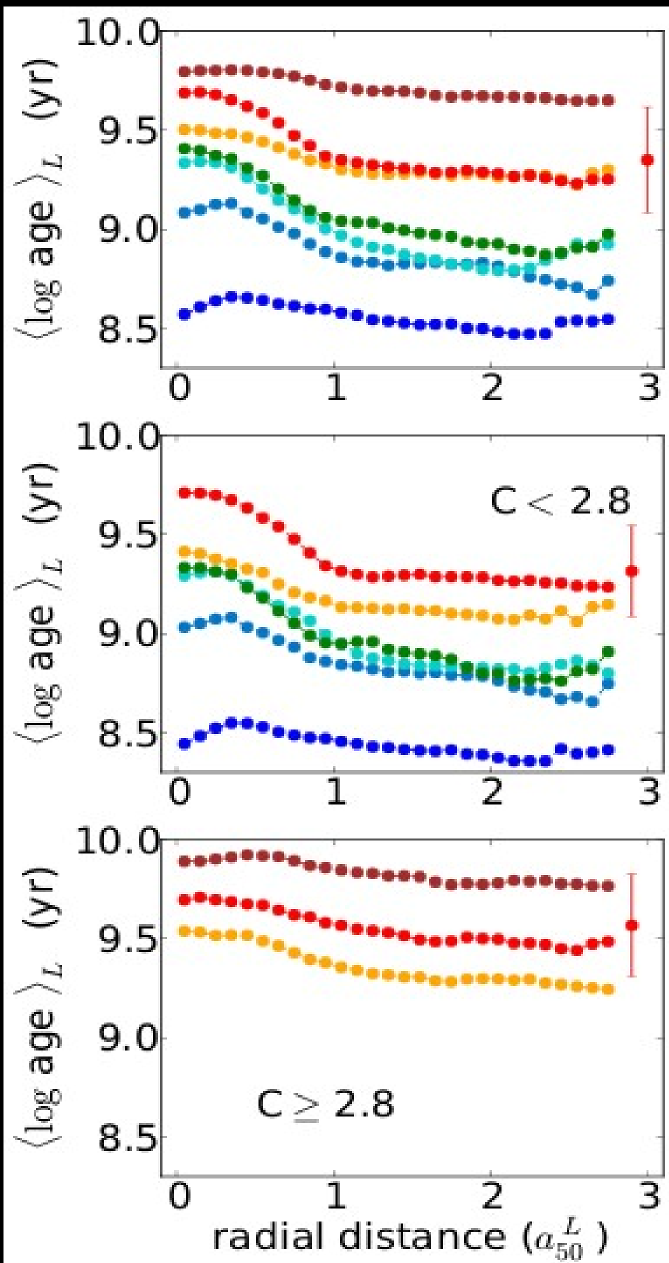
~10[3] galaxies

Gil de Paz+07

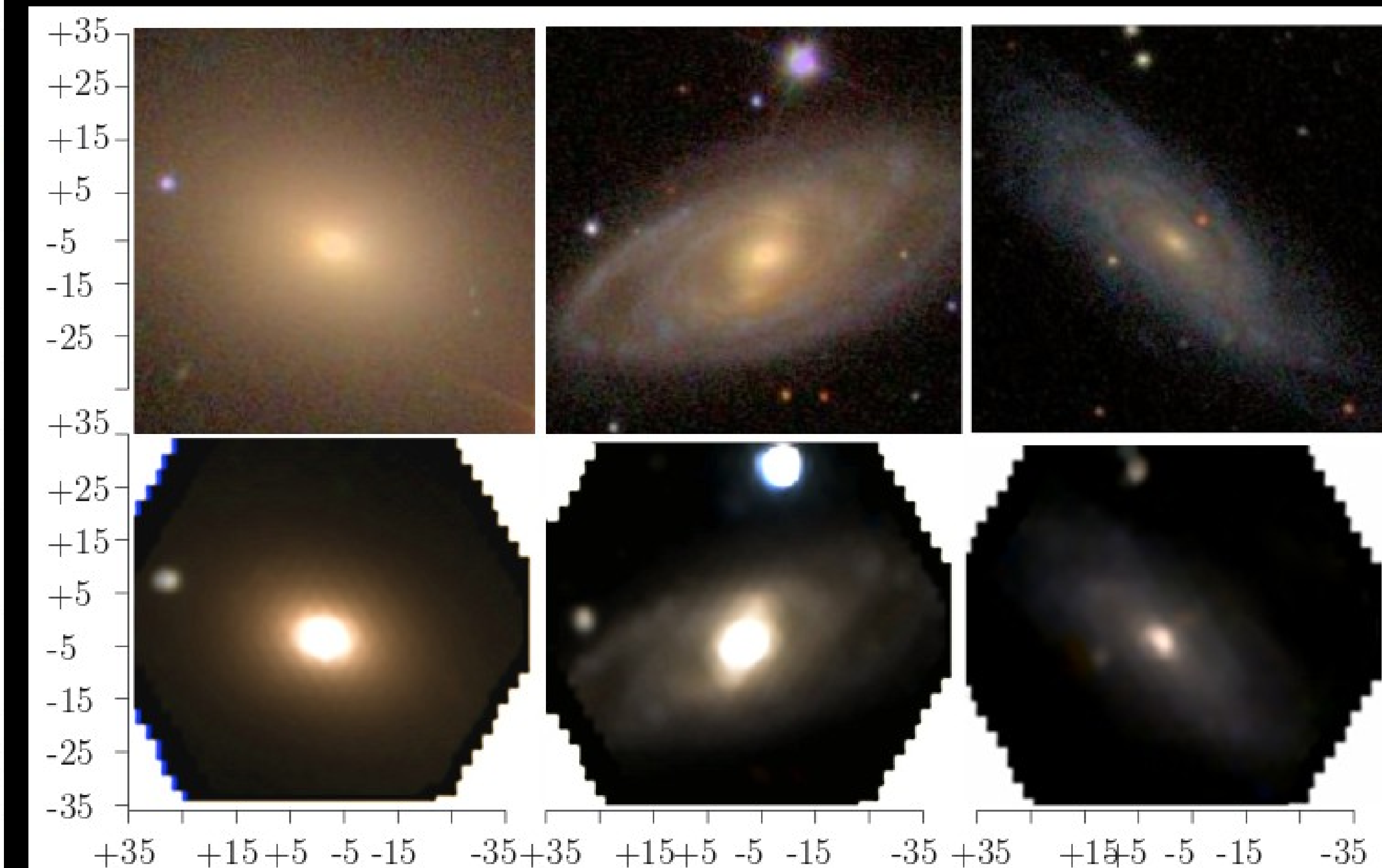
FWHM ~ 6”

CALIFA survey: 600 galaxies; 74”x64” IFU

Gonzalez-Delgado+14



Sanchez+12

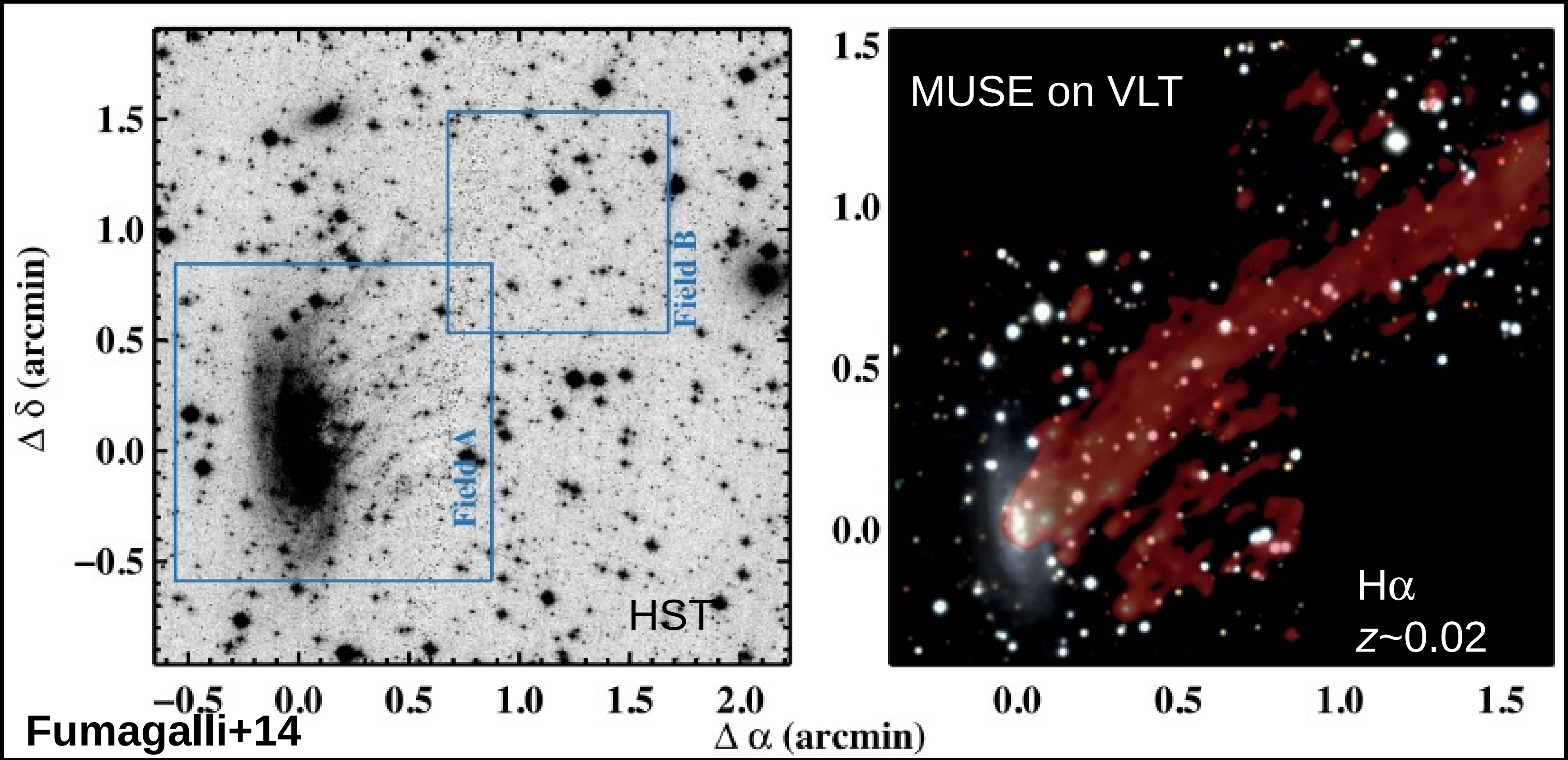


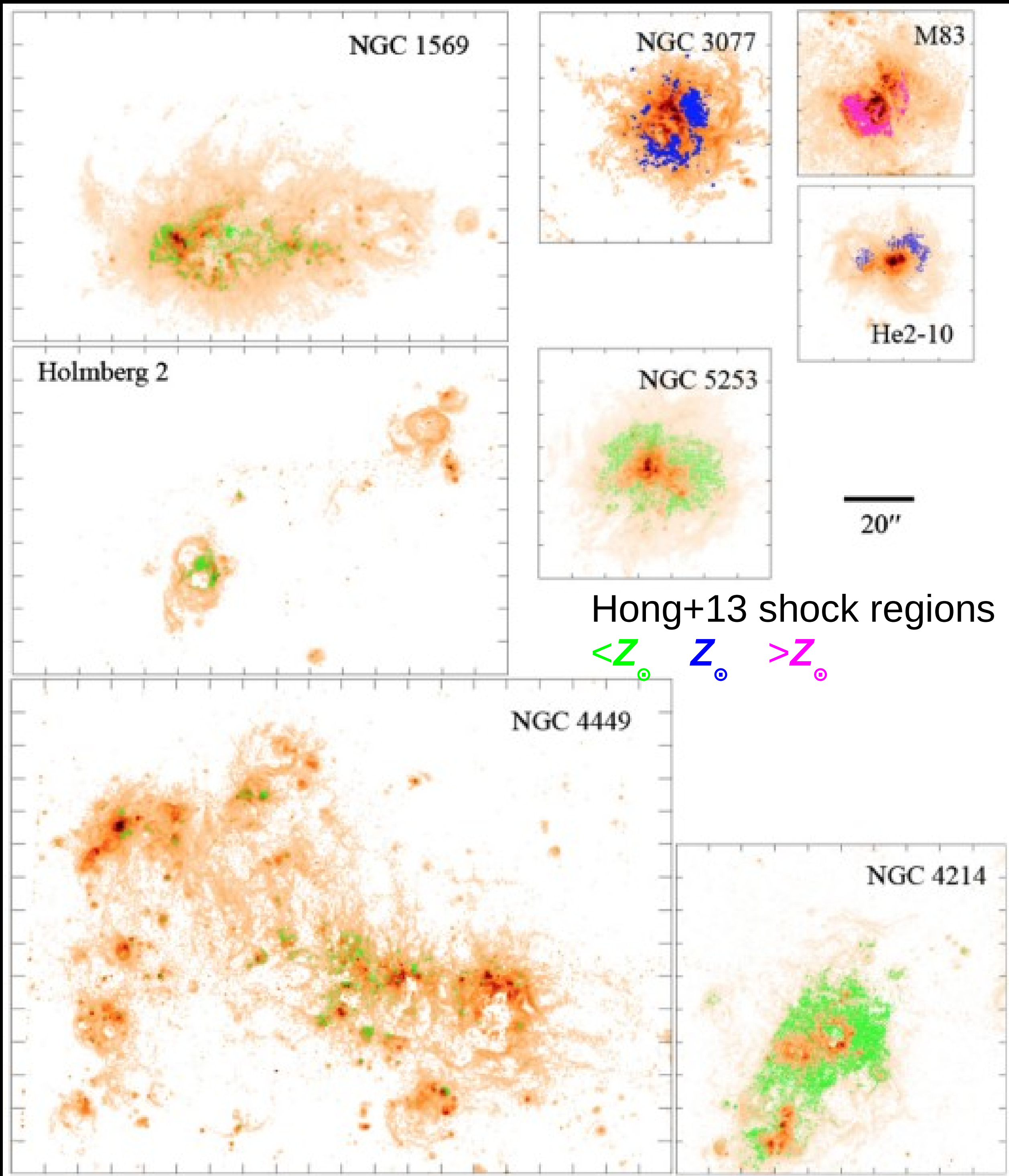
Inner age gradients for massive disk galaxies
Flat age profiles for low-mass disks and ellipticals

IFUs excellent tools for characterizing the physical conditions across a galaxy disk

Single pointing studies miss out on discoveries (XUV disks)

IFUs on 8-10 meter telescopes can probe more than just bright HII regions in nearby galaxies





Example IFU application ripe for study: Diffuse Ionized Gas which accounts for 30-50% of total Hα

What powers DIG?

- HII leakage (<50%)
- Diffuse SF
- Shocks

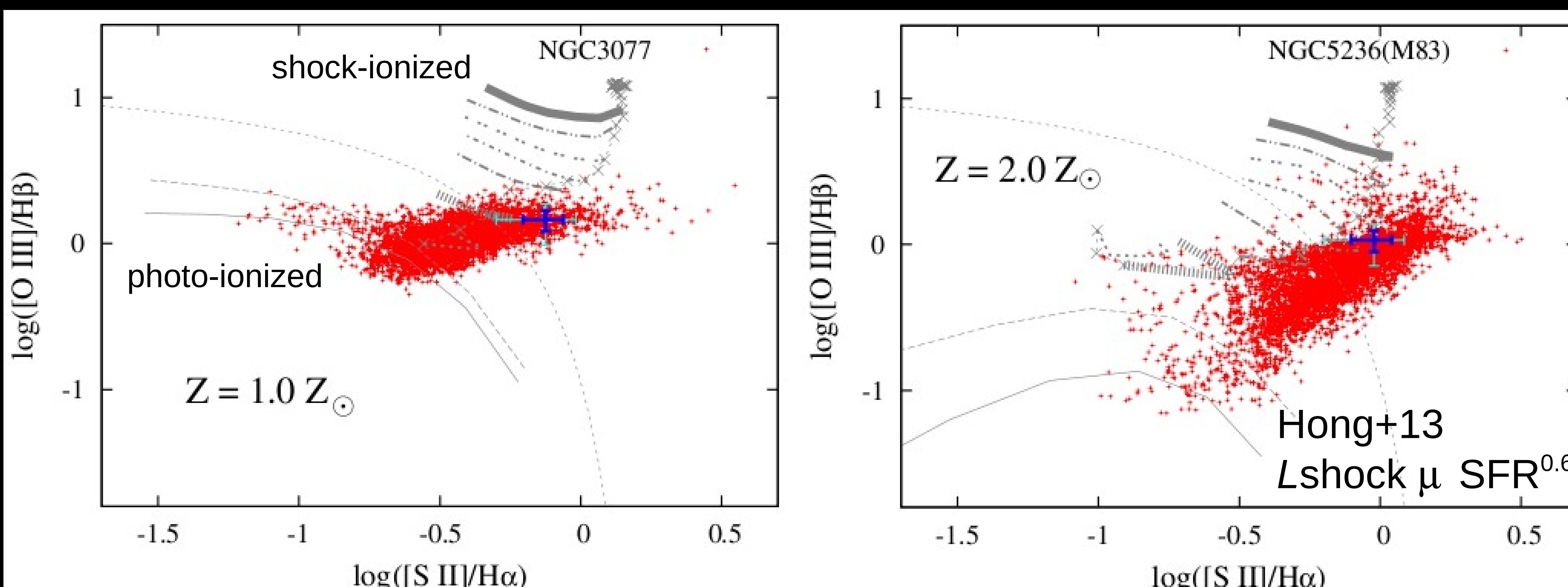
Hoopes & Walterbos 2003
Martin & Kennicutt 1997
Hong et al. 2013

$20 \cdot 10^6$ Hα emitters!
$2 \cdot 10^6$ [OII]

If the additional DIG arises from diffuse SF, then how are gas outflows powered?

If there is a transition between diffuse SF and shocks in dominating the heating of the DIG, when does it occur?

Are the shocks enough to explain recipes for the SK Law that decouple the small scale to the large scale?



Summary

Deep imaging, especially higher res FUV, on younger stellar populations in nearby galaxies would be a key complement to WFIRST data on older stellar populations.

→ better understand detailed star formation histories

→ higher resolution ancillary best leverages WFIRST

Precursor or follow-up observations with optical IFUs on 8-10 m telescopes would be important for more fully understanding physical conditions across galaxy disks.

→ better understand widespread presence of outflows in distant galaxies

Quasars at moderate redshift

Quasars peak in abundance near z~2-3 so science that requires a high number density of quasars should target this redshift range

z~2-3 quasars may be best way to determine f_{NL} and other subtle large-scale clustering features because they probe such large volumes (Ho+14; Leistedt+14)

Quasar studies near the major era of proposed feedback mechanisms help constrain models of galaxy evolution via the distribution of quasars themselves (White+12) or by studying correlations between quasars and cosmic backgrounds (Viero+14; Wang+14)

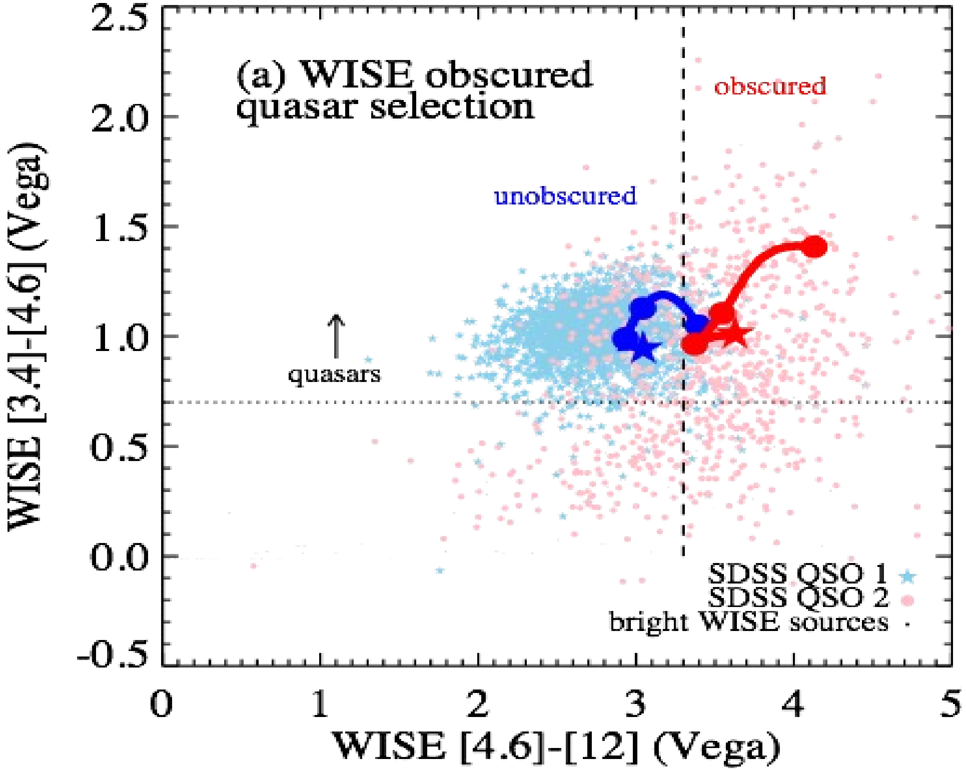
Rare, close quasar pairs are useful for using the background quasar to trace the foreground quasar in absorption to study quasar environments, outflows, the Transverse Proximity Effect, etc. (Hennawi+13; Prochaska+14)

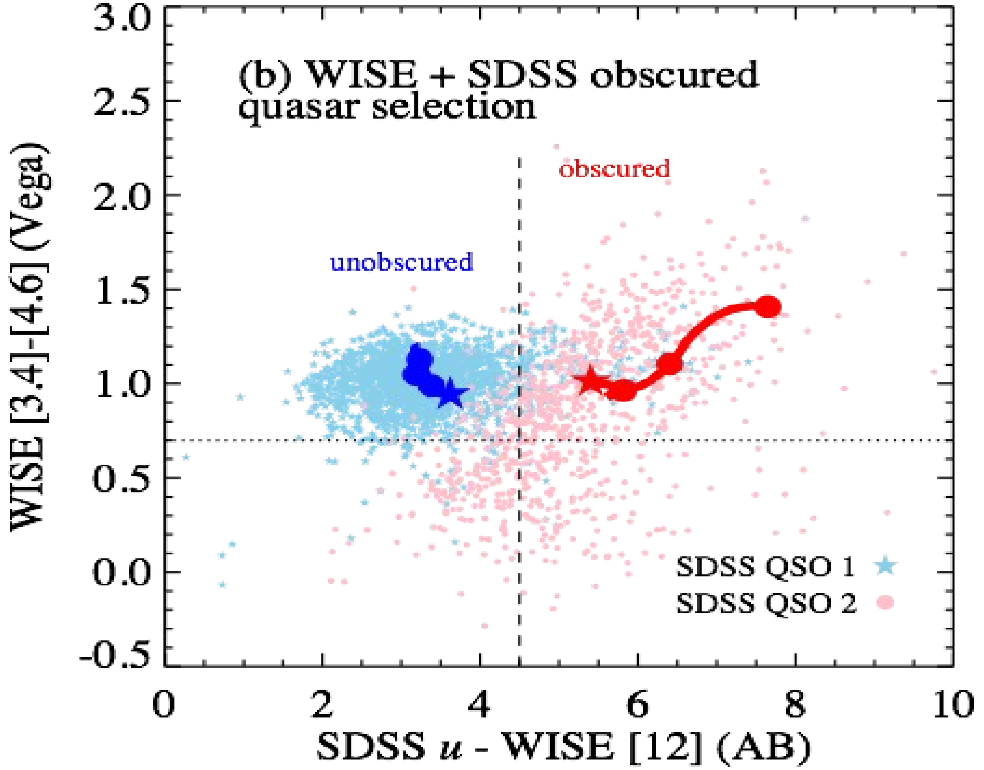
At lower redshift, characterizing black hole accretion modes using quasars and galaxies in overlapping redshift ranges (z~1) by measuring the host dark matter halos of quasars as a function of Eddington rate (Shen+13)

Quasars at moderate redshift

A topical question is the fraction of quasars that are faint or missing in current optical surveys because they are behind galactic-scale dust (which would obscure the broad and narrow line region in the optical) or a torus of dust around the central engine (which would obscure only the broad line region).

In particular, mid-IR(WISE)+optical selection finds both obscured and unobscured quasars over 0.5 < z < 5 and perhaps beyond (Hickox+07, Stern+12, Assef+13, Yan+13) and the WFIRST grism survey, in being blind and deep, should finally characterize the nature of these sources.





The utility of the WFIRST grism

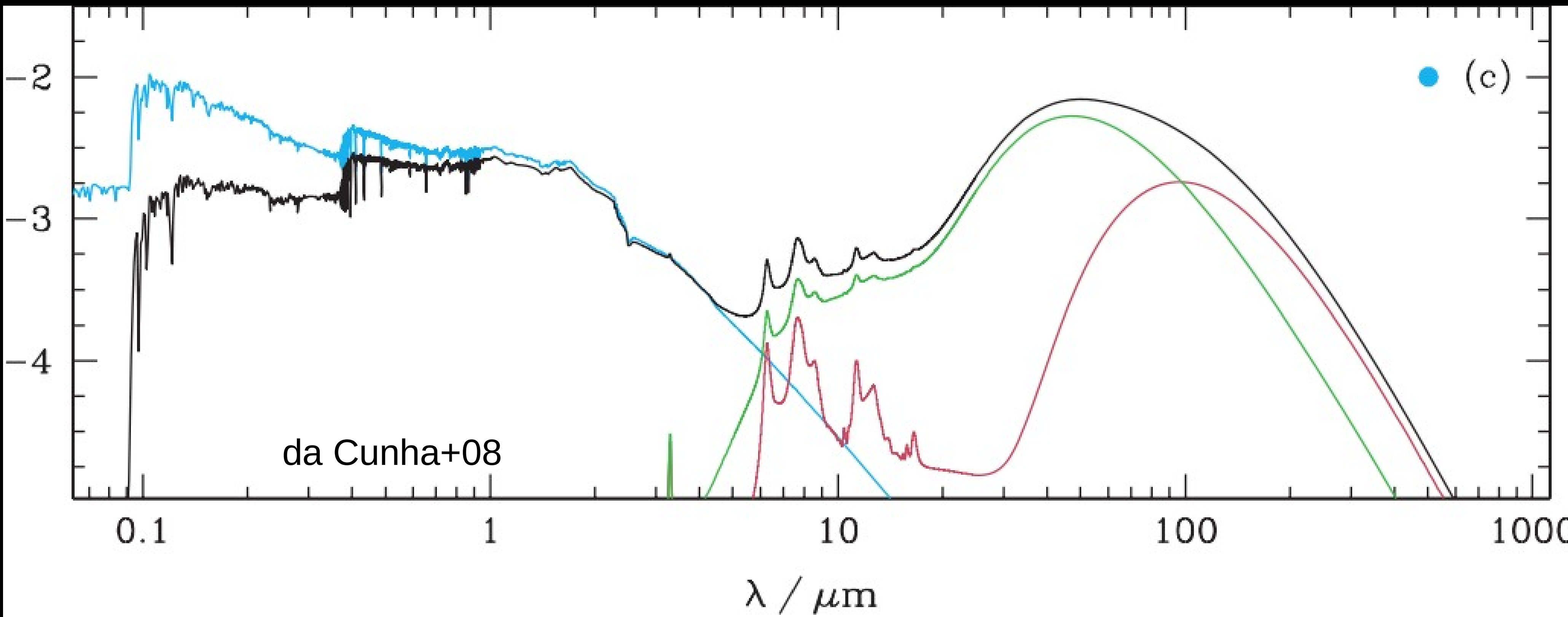
At $z > 2$ quasar distances based on broad-line redshifts may be systematically incorrect by ~200 km s^{-1} as well as scattered by ~500 km s^{-1} (Font-Ribera+14)

The WFIRST grism (1.35 - 1.95μm) should identify the systemic [OIII]5007 over $1.7 < z < 2.9$, directly calibrating high-z quasar redshifts in large samples for the first time

The most trusted line for measuring black hole masses for quasars is Hβ4863 which the WFIRST grism should directly characterize over $1.8 < z < 3.0$

Similarly, the redshifts for partially obscured quasars, or quasars for which the broad line region is fully obscured, at $2 < z < 3$ can be determined using [OIII] and/or Hβ (typically, by definition, obscured quasars have very weak or completely absent lines in the optical)

Energy-balanced SED fitting (e.g., CIGALE Noll+09; Serra+11)



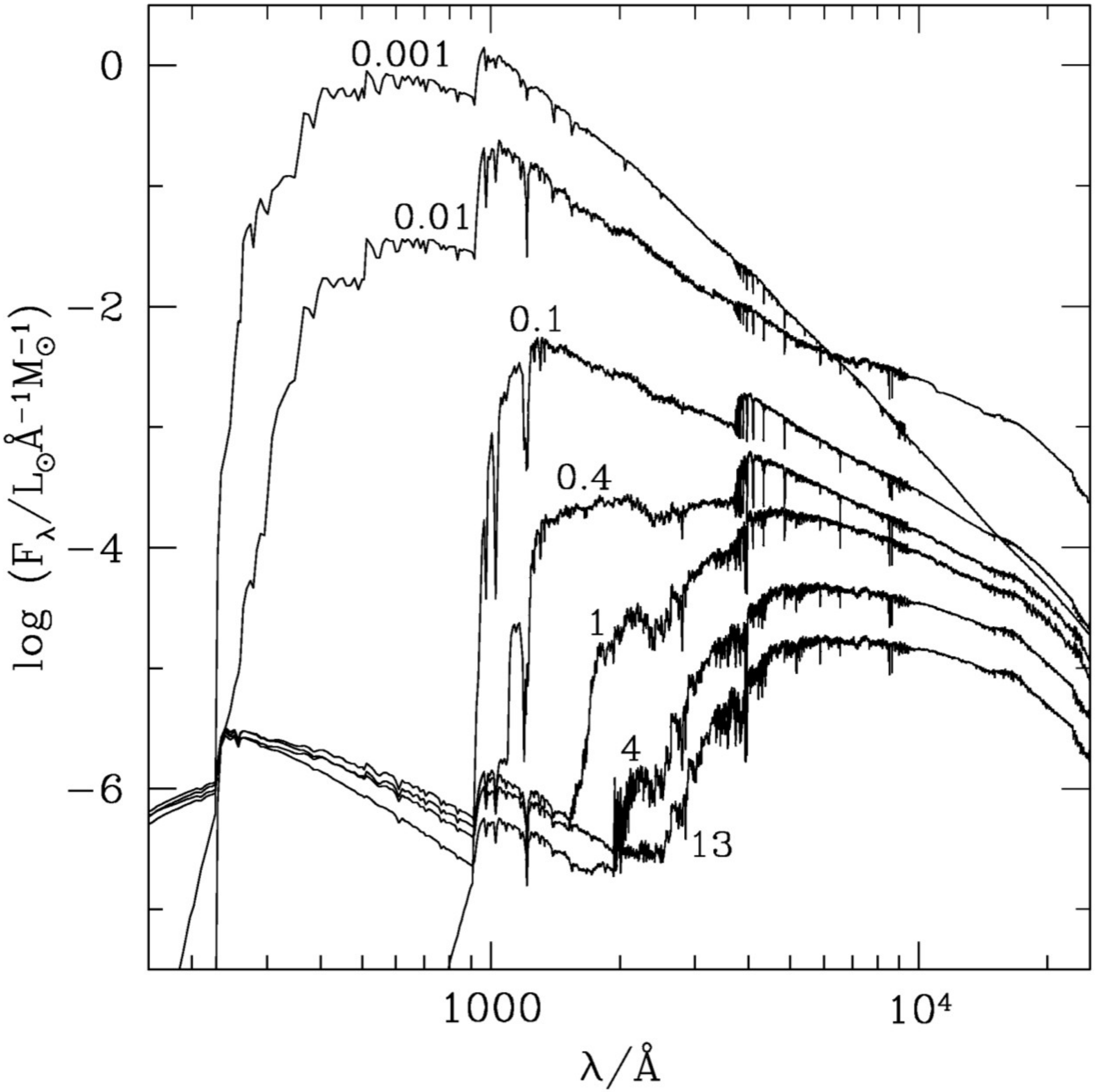
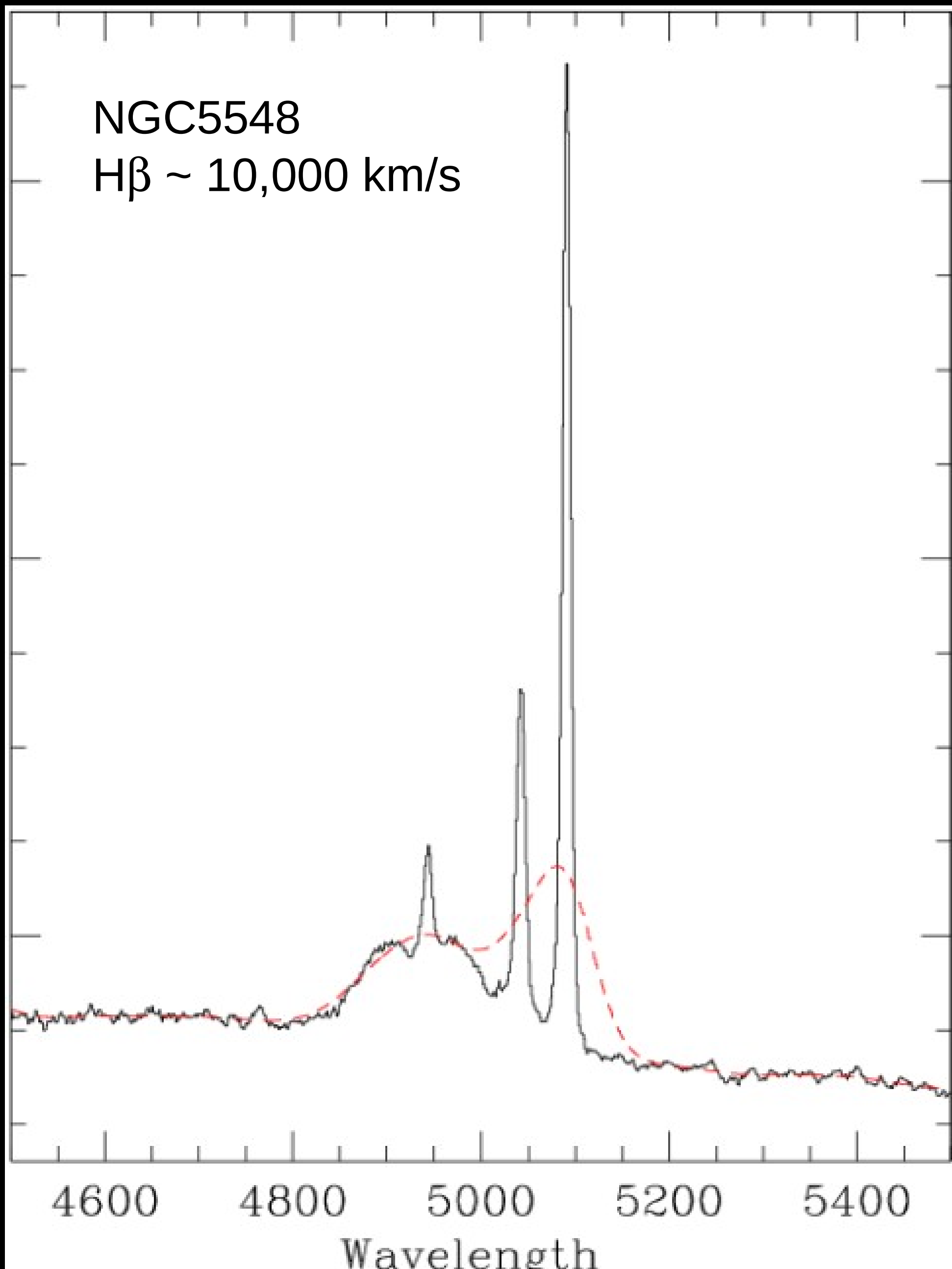
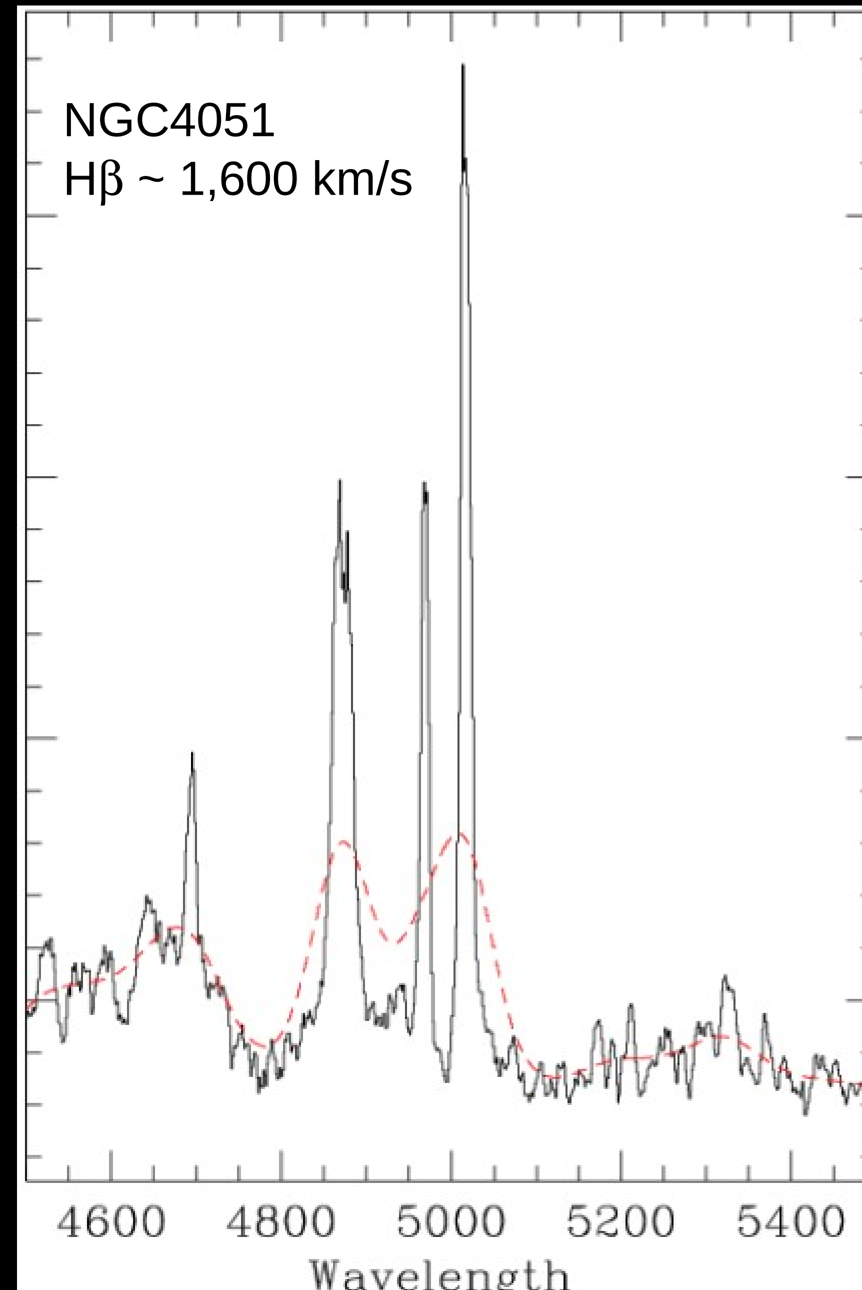


Figure 9. Spectral evolution of the standard SSP model of Section 3 for the solar metallicity. The STELIB/BaSeL 3.1 spectra have been extended blueward of 3200 Å and redward of 9500 Å using the Pickles medium-resolution library. Ages are indicated next to the spectra (in Gyr).

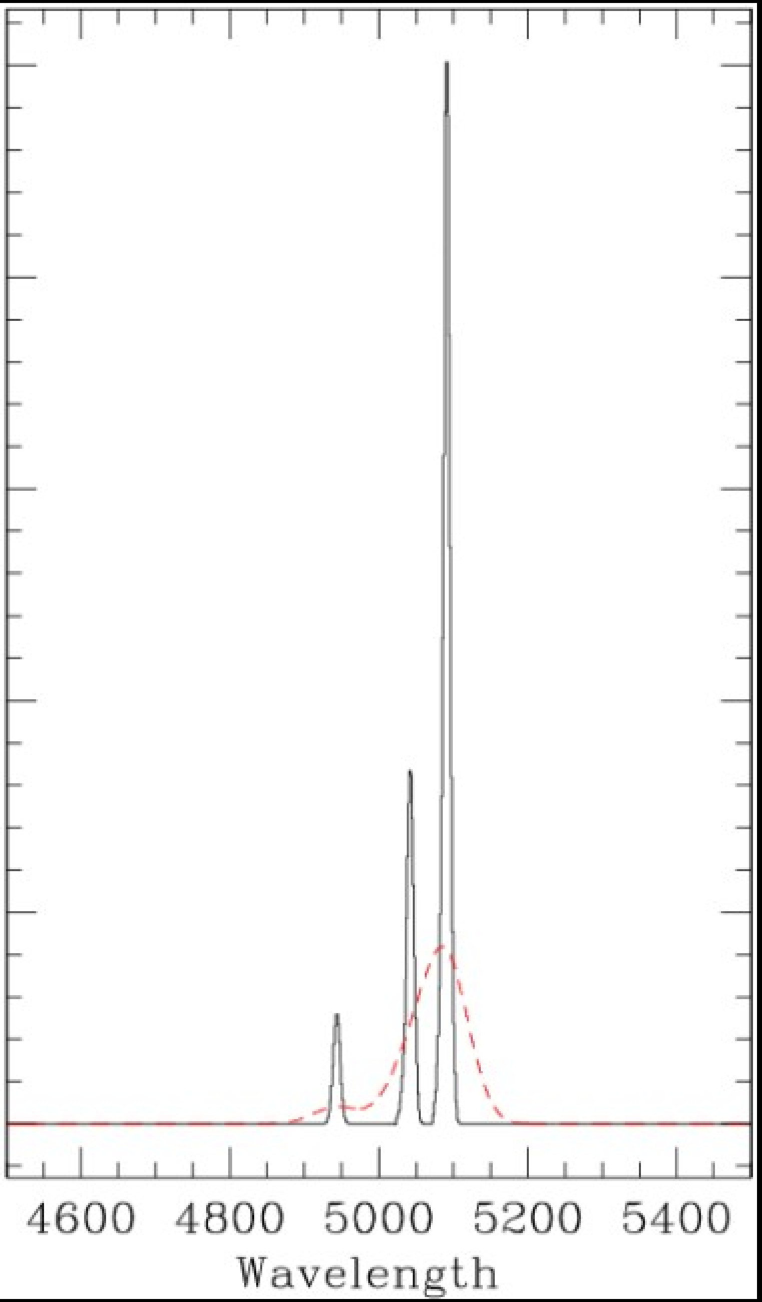
BC03 solar

Simulated R~70 AGN spectroscopy





M. Brotherton, priv. comm.



4600
4800
5000
5200
5400
Wavelength