Interactions in galaxy evolution: A new perspective from CALIFA and MaNGA surveys

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CALIFA Survey

MaNGA

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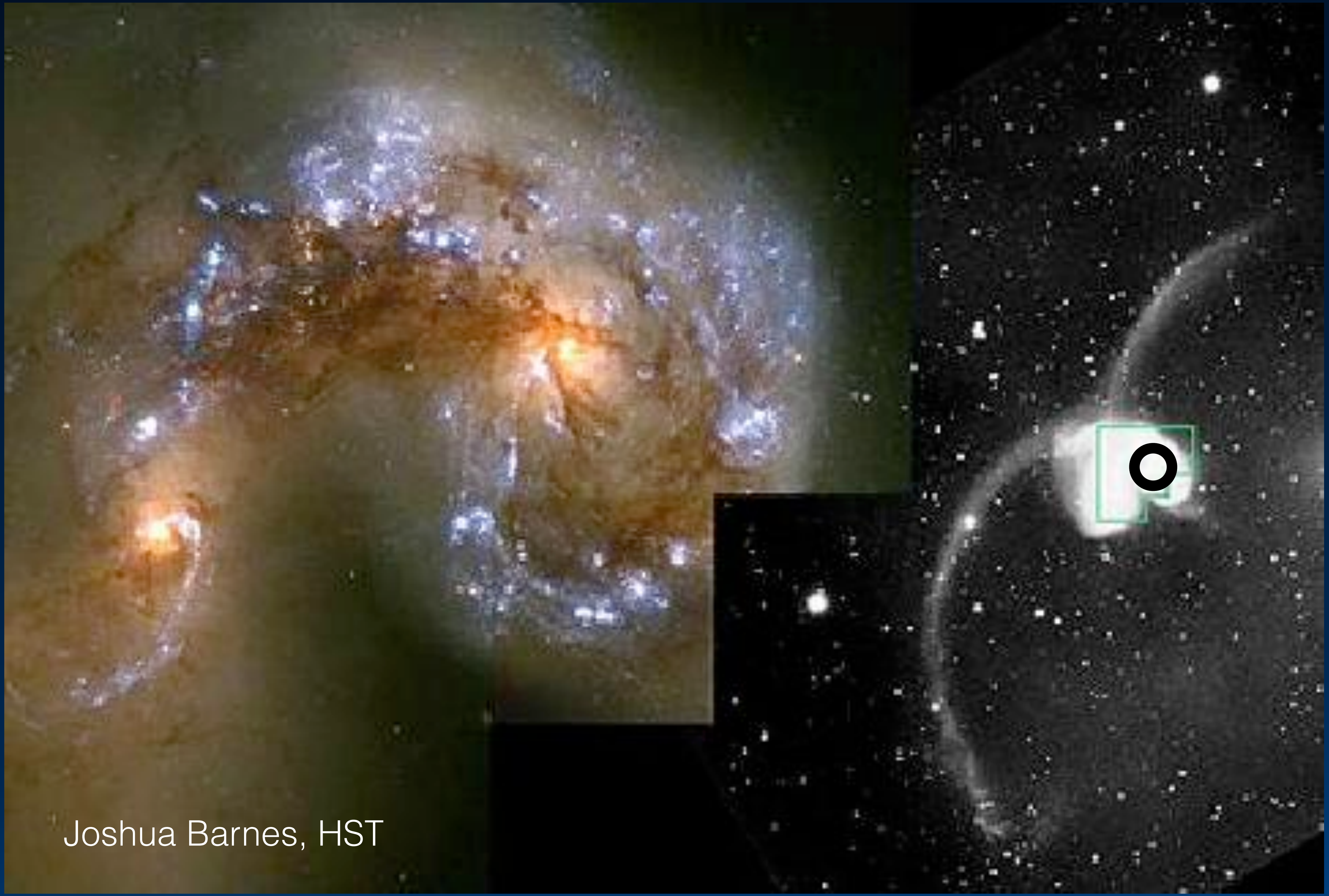
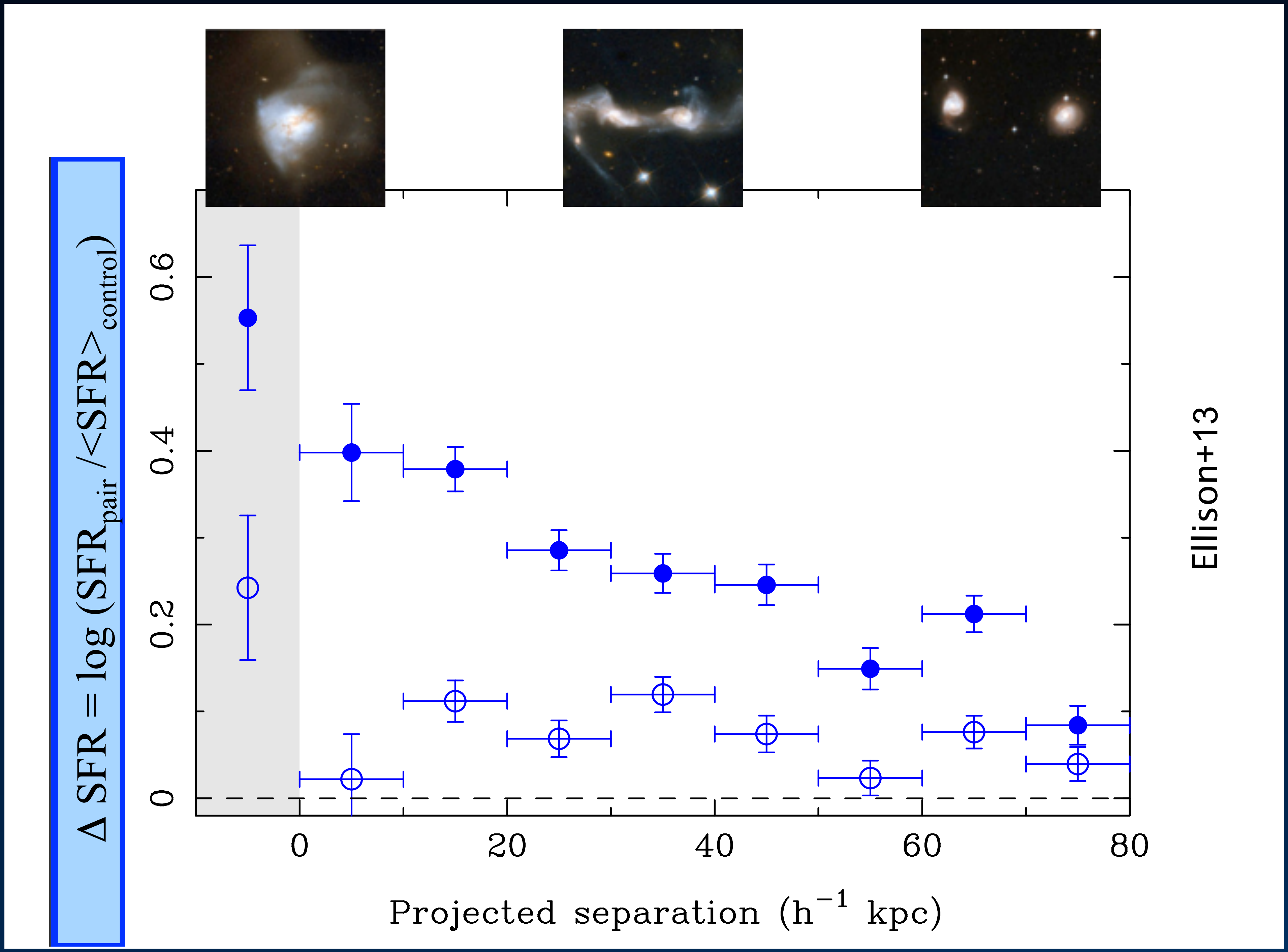
Interactions in Galaxy Evolution

How properties change as merger evolves?



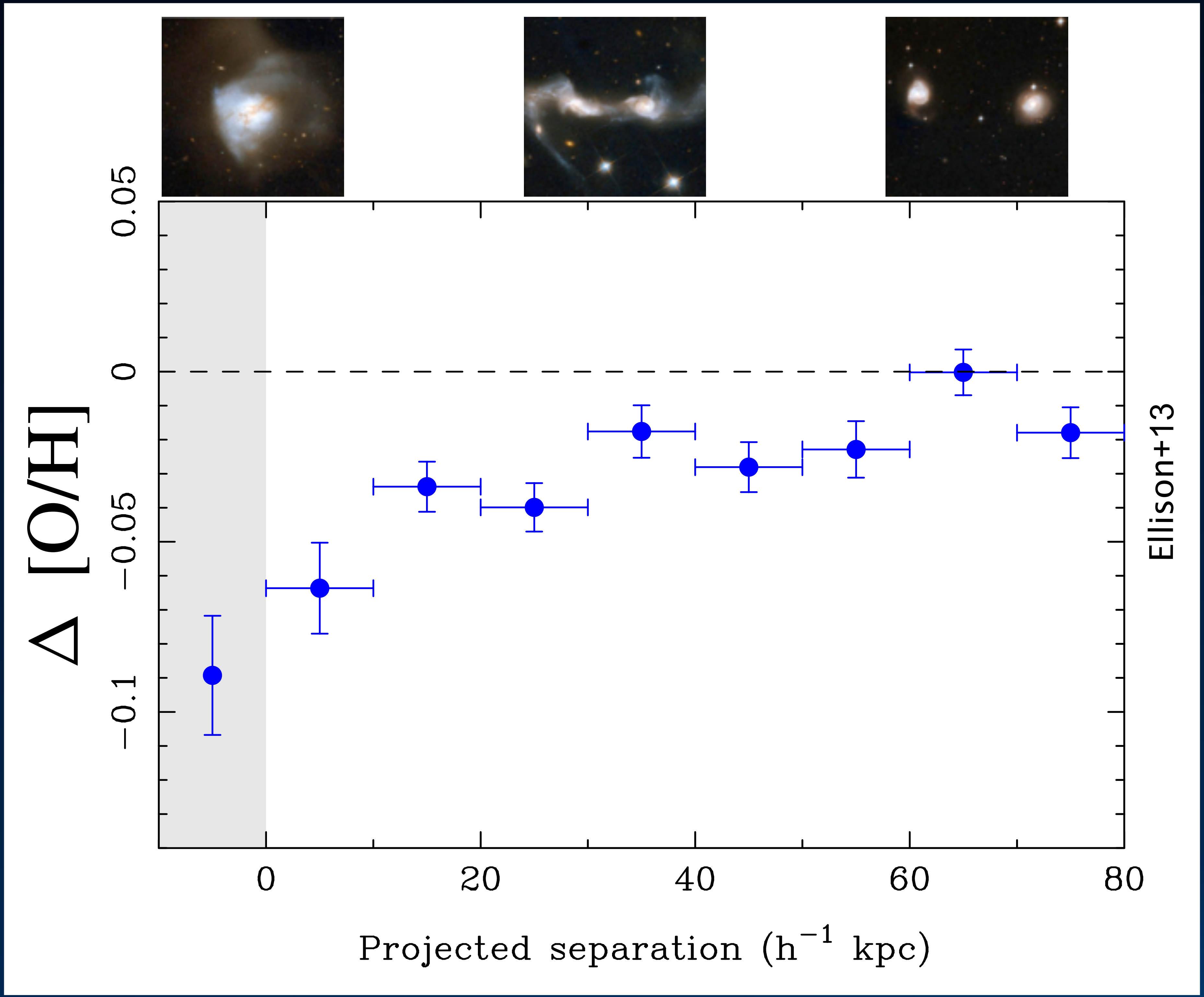
Star Formation Rate (SFR) in Interacting Galaxies



← "Time"

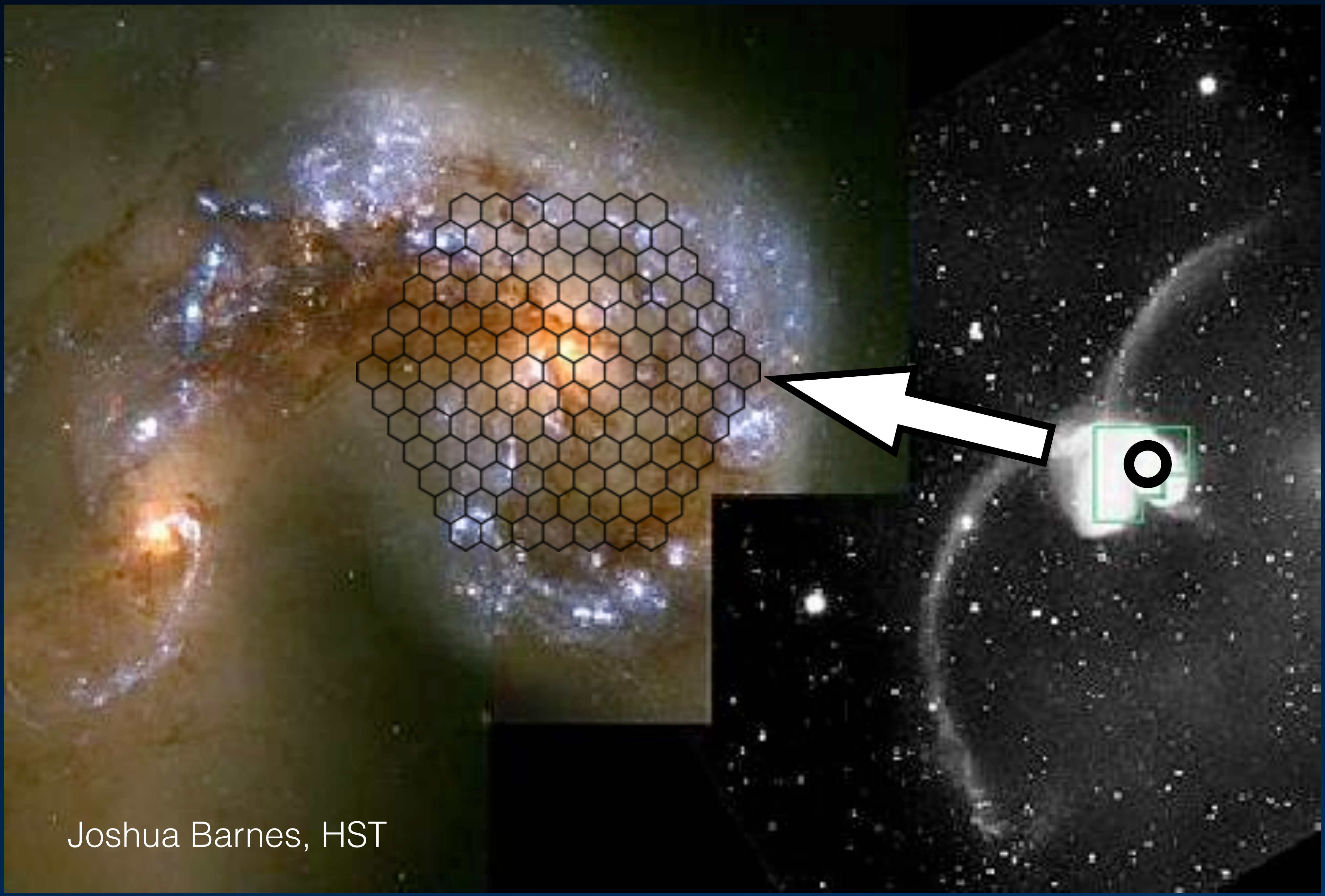
Ellison+13: SFR enhancement in pairs and post-merger SDSS galaxies using single fiber aperture spectra (e.g., Barton+00, Ellison+08, Knapen & James09)

Ionized Gas Metallicity in Interacting galaxies



Metallicity dilution in the central region of pairs and post merger galaxies compared with a control sample (e.g., Kewley+06, Ellison+08, Patton+13)

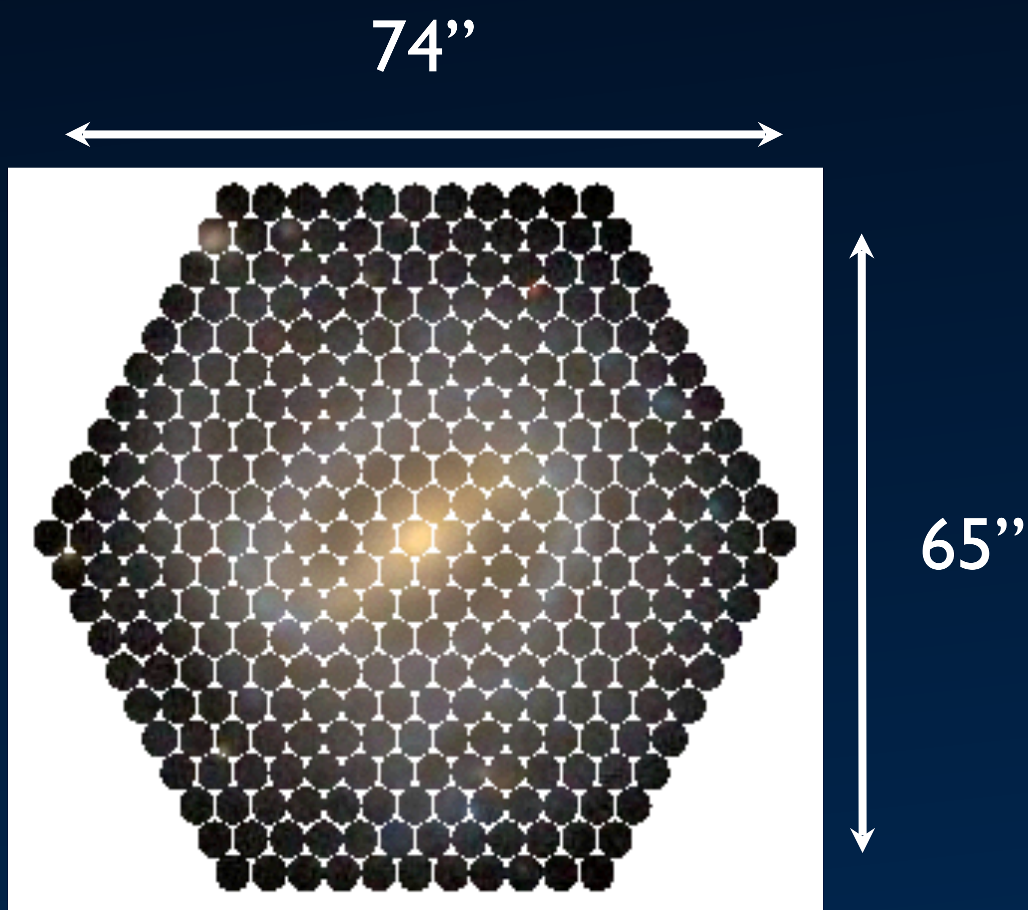
Interactions in Galaxy Evolution



How spatially resolved observables (SFR and metallicity) evolve during the interactions?

CALIFA Survey

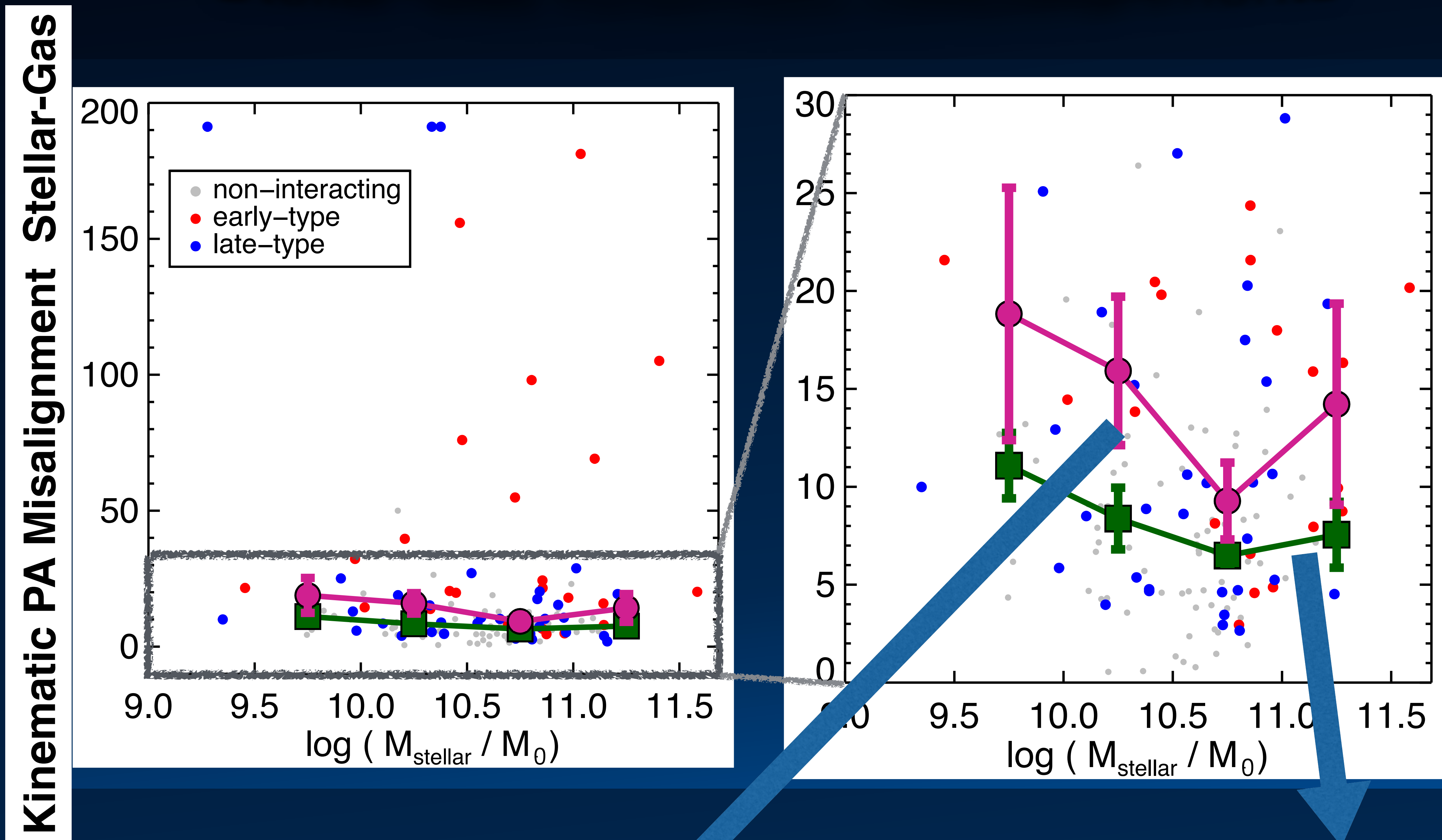
Calar Alto Legacy Integral Field Area



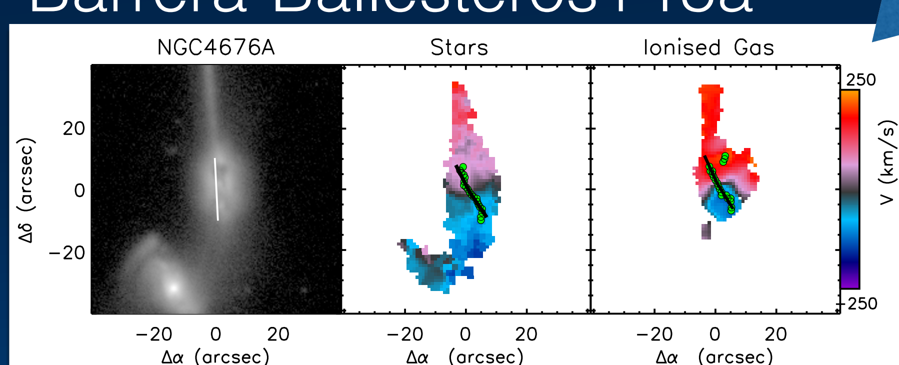
@ 2” ~ 0.5-1.0 kpc

- 937 galaxies from SDSS/DR7 of all Hubble Types
- >**660** galaxies with PMAS/PPAK-IFU @ CAHA 3.5m
- diameter 45” < D_{25} < 80”, redshift 0.005 < z < 0.03
- representative for nearby galaxies in 9.4 < $\log(M_{stellar}/M_{\odot})$ < 11.4
- ~ 550 galaxies observed

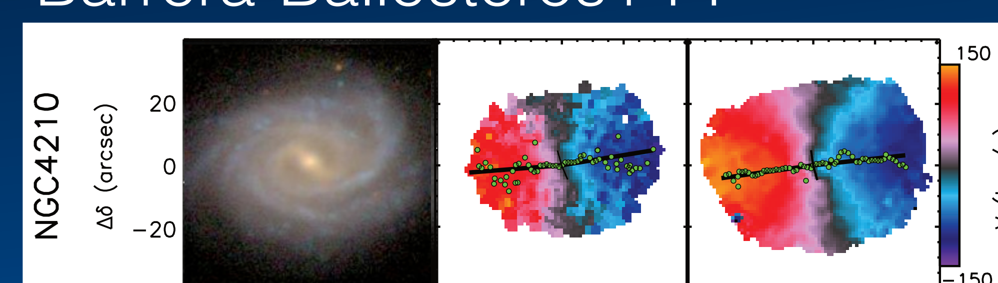
Stellar-Gas Kinematic (Mis)alignments



Barrera-Ballesteros+15a



Barrera-Ballesteros+14



Emission line Fluxes and EW(Hα) maps

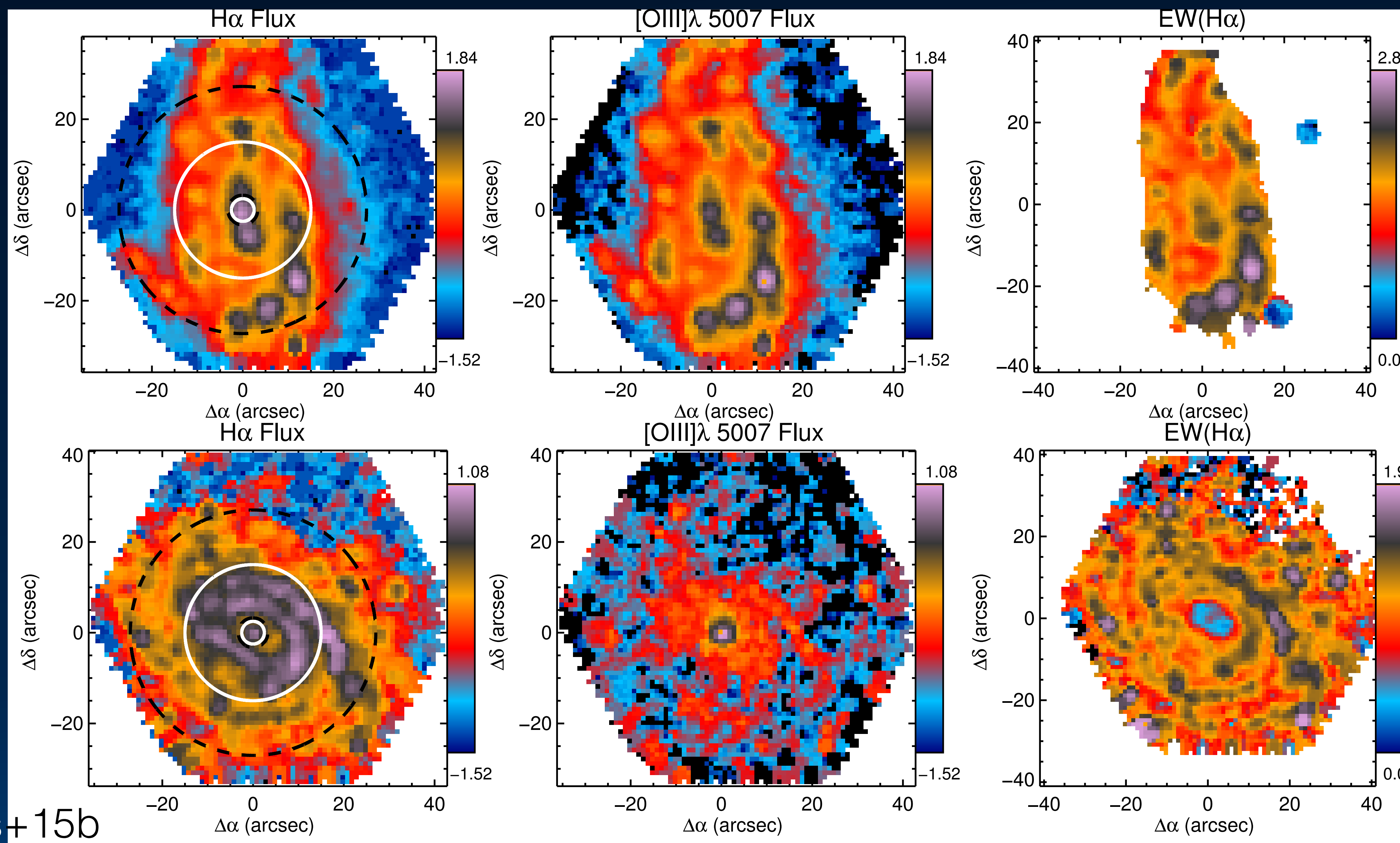
Flux ratios ~ Metallicity

EW(Hα) ~ sSFR

Sample Sizes

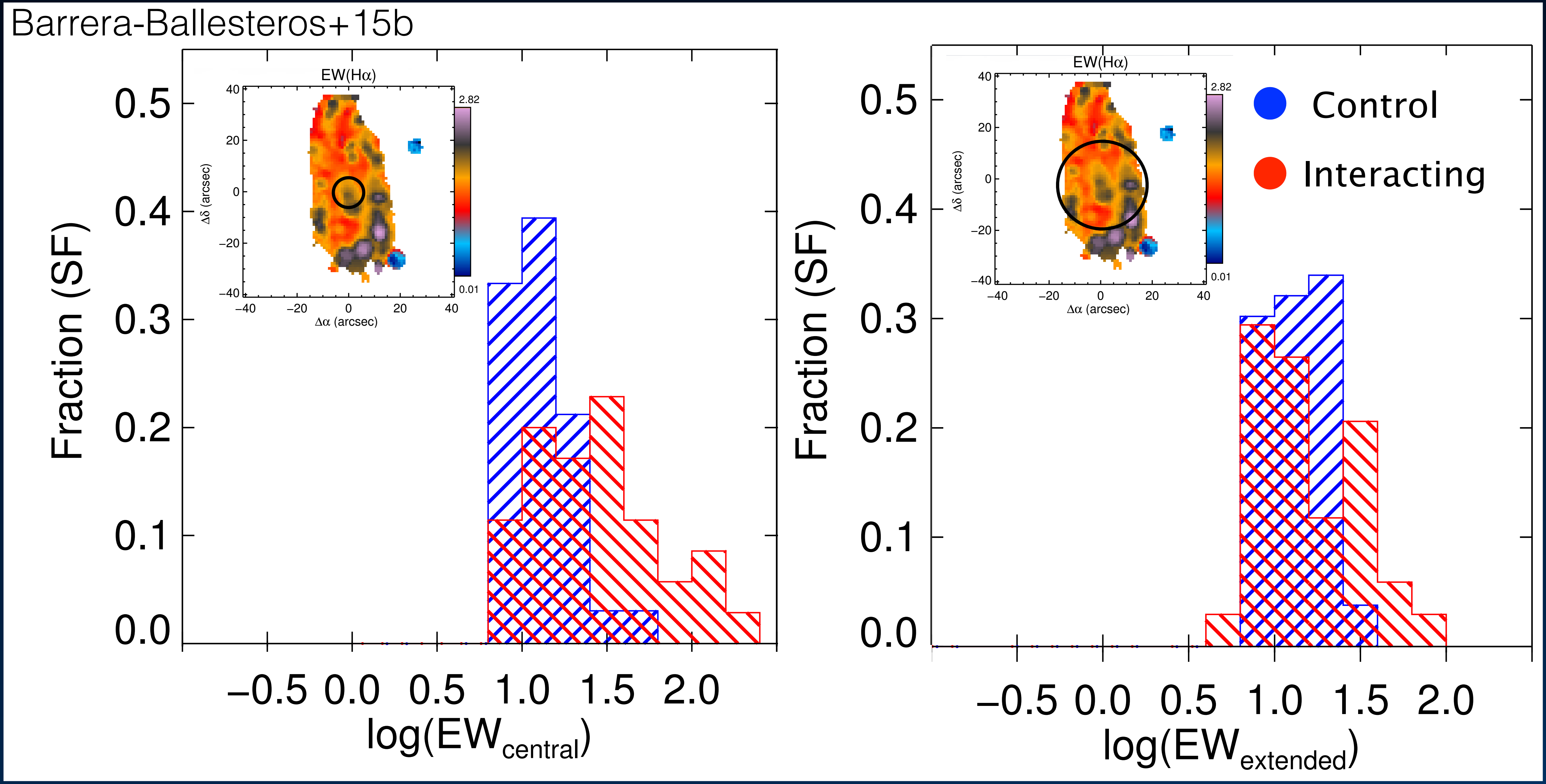
103 Interacting
B-B+15a

80 Control
B-B+14



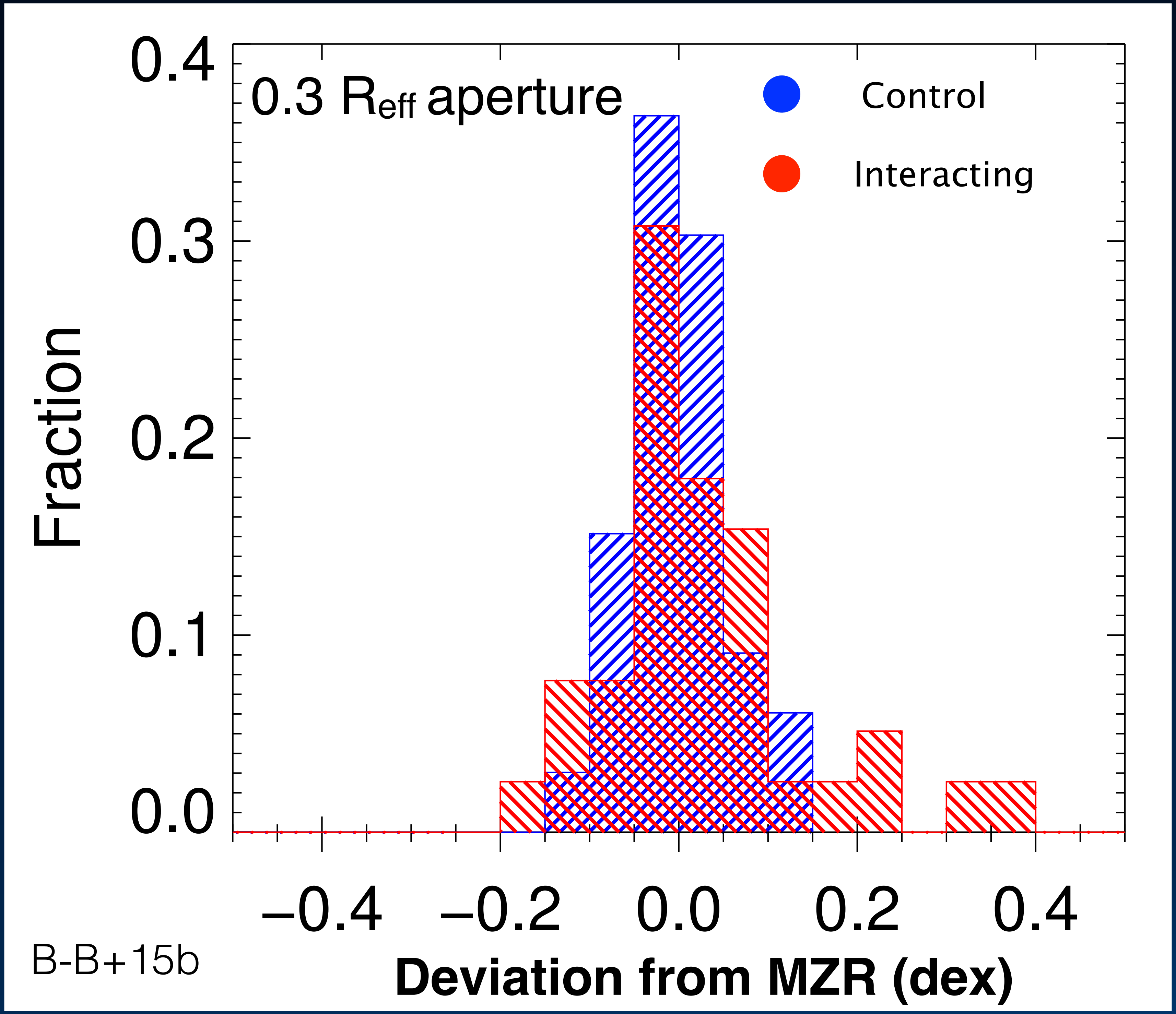
Barrera-Ballesteros+15b

EW(Hα) distributions (as proxy for sSFR)



Increment in central sSFR in interacting sample

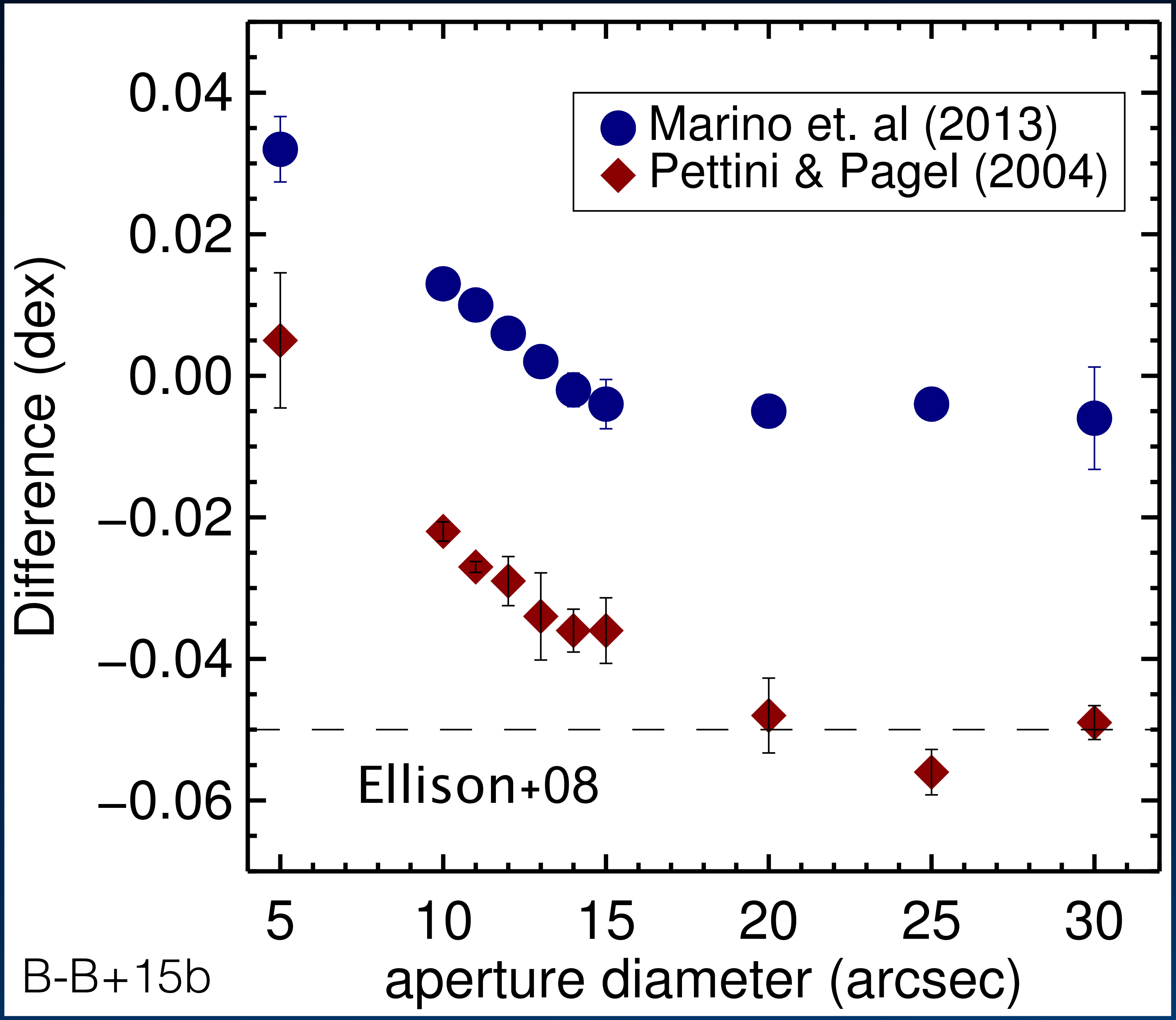
Central Metallicity in Star-forming galaxies



Small deviations in 12+log(O/H) for both samples

Metallicity at different aperture sizes

@ Central: Similar or even larger metallicities in interacting sample
@ Extended: Dilution in metal content for interacting galaxies

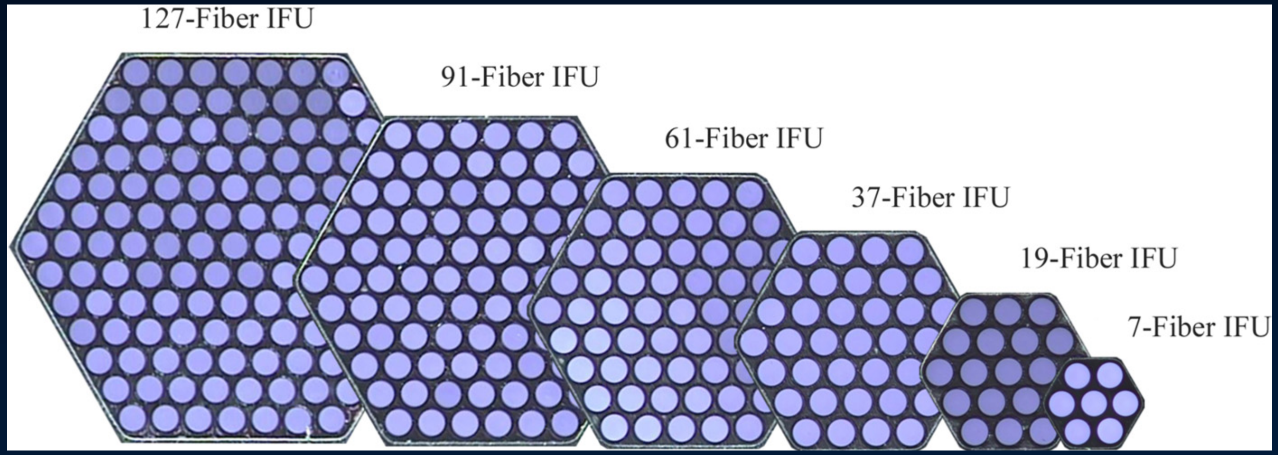


Other process than inflows could enrich the central material in interacting galaxies (stellar/nuclear feedback)

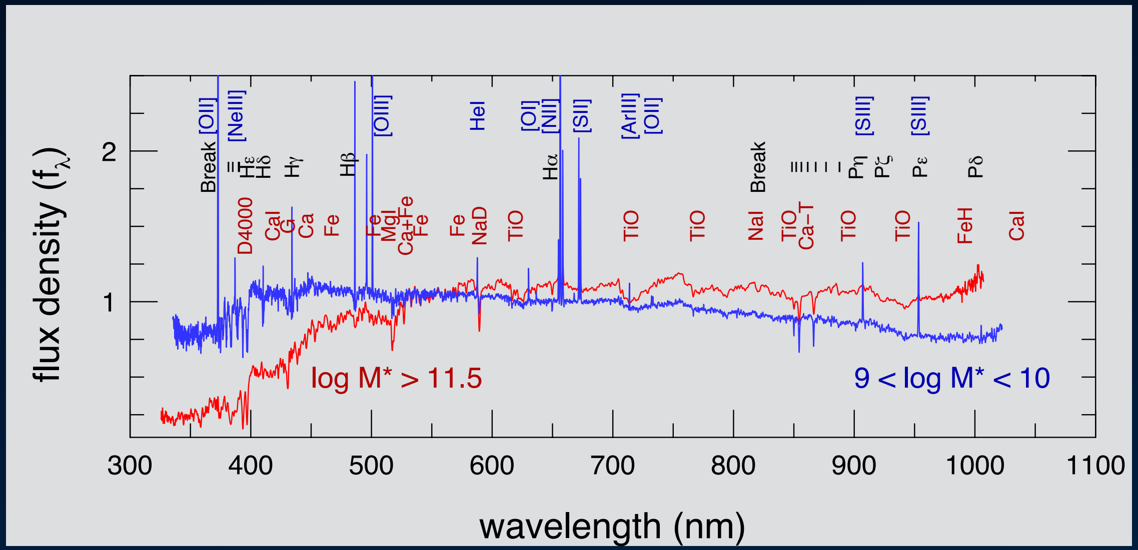
Similar as in numerical simulations (Torrey+2012)

MaNGA Survey

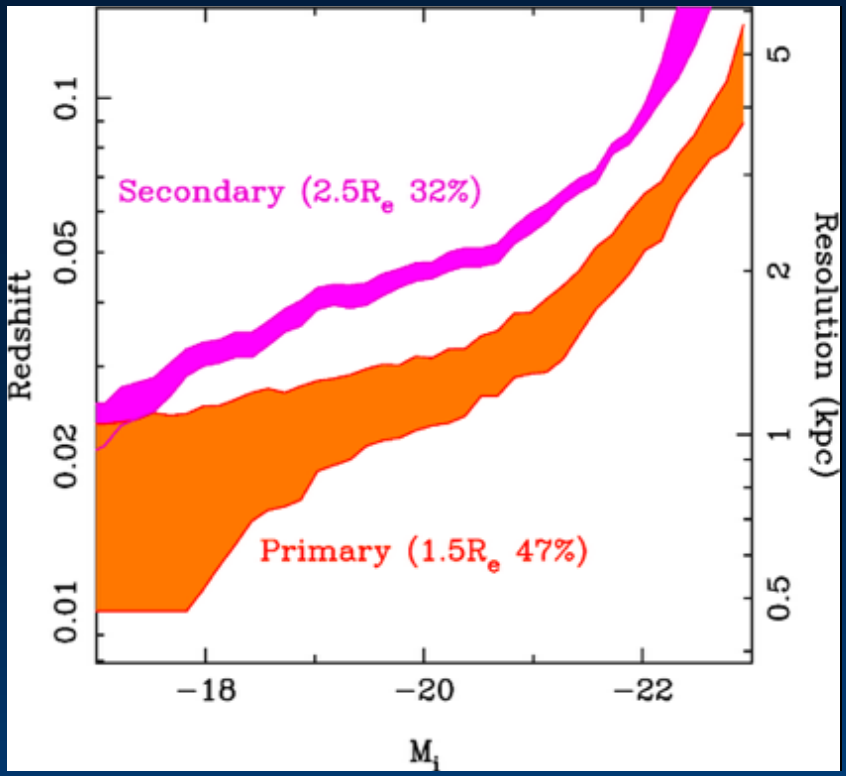
Mapping **N**earby **G**alaxies at **A**PO



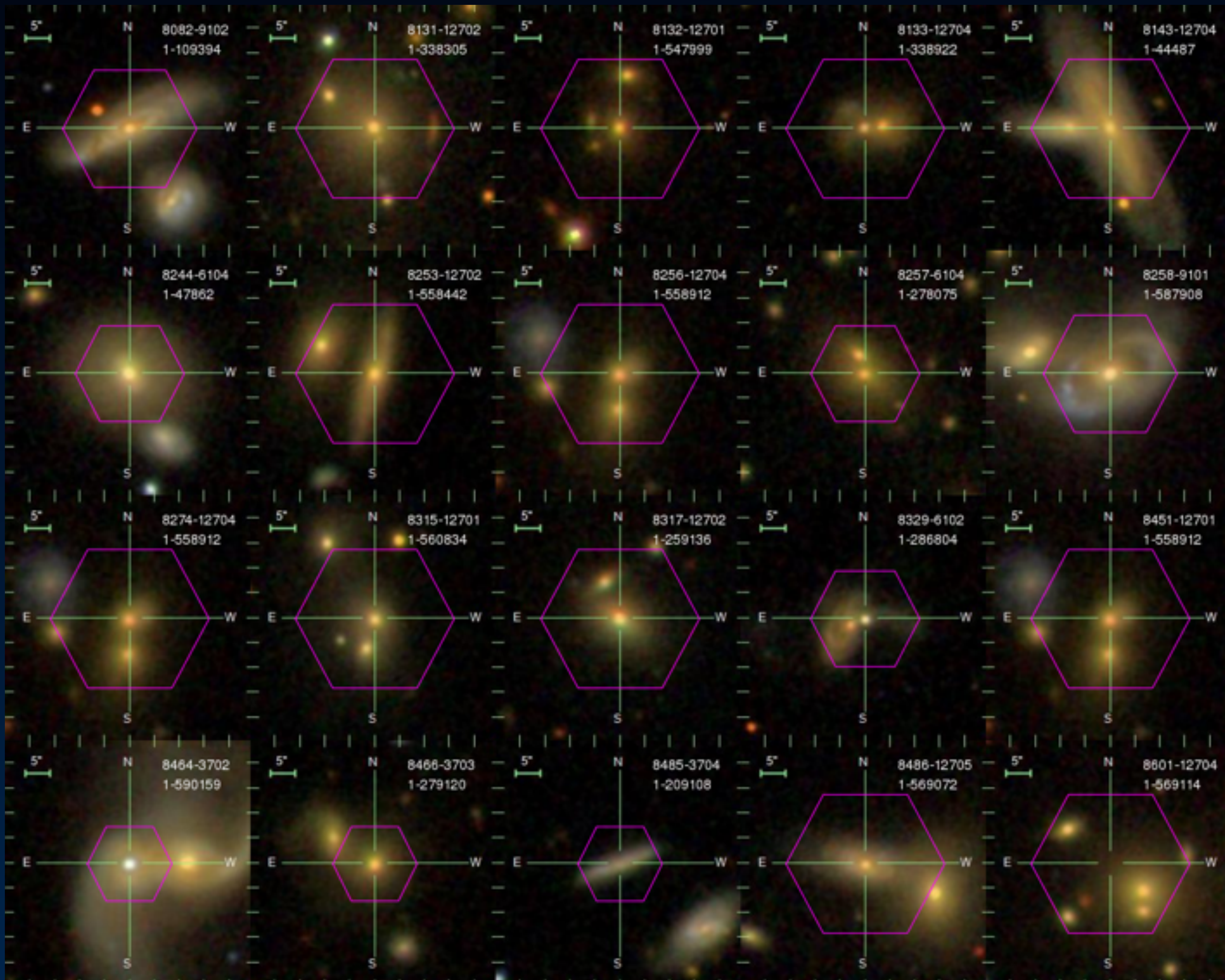
Bundle sizes: 12''-32'', PSF ~ 2.5''



BOSS spectrographs (R~ 2000)



- 10,000 galaxies (!) at z~ 0.03
- Roughly flat mass distribution log(M*) ~ 8.7 - 11
- Coverage to 1.5 and 2.5 Re
- ~1400 galaxies (**MPL-4**) already analyzed (PIPE3D, Sanchez+15)



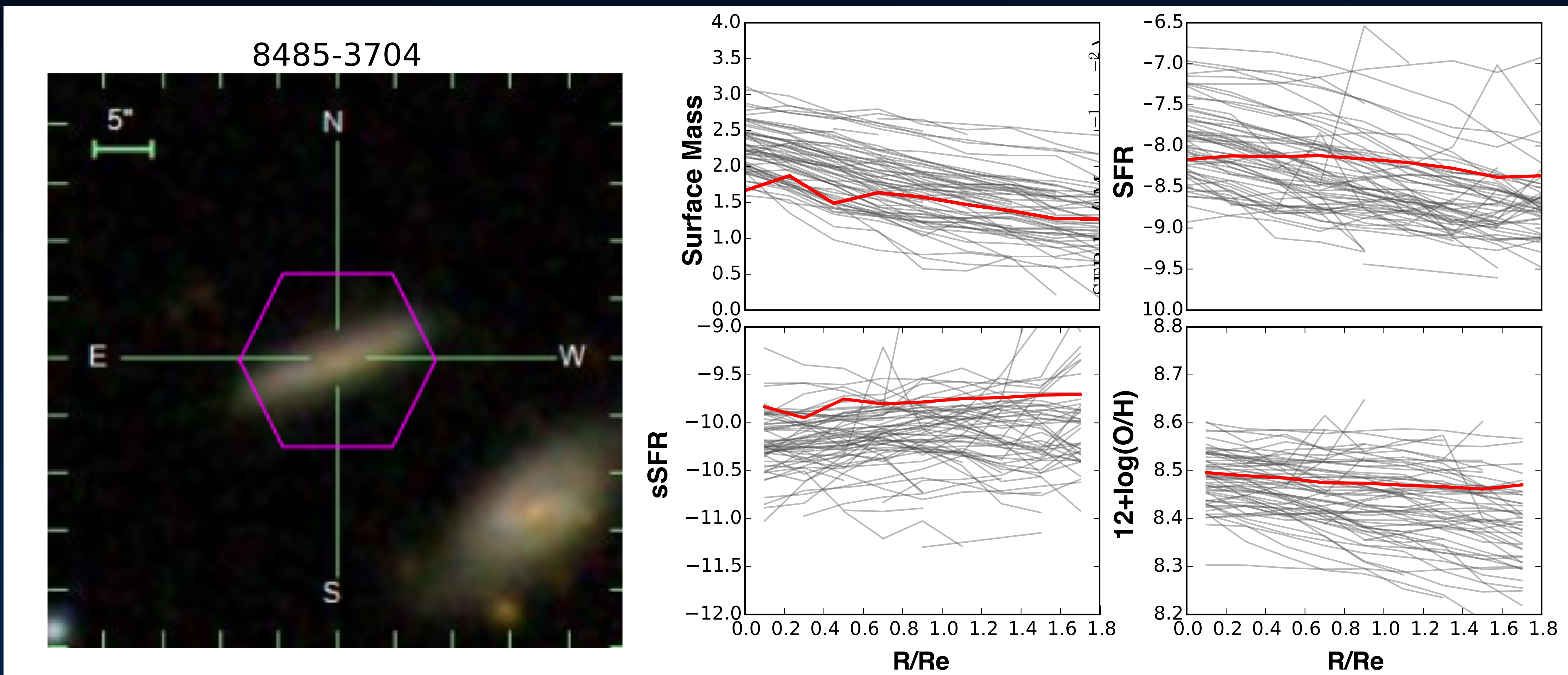
Interacting galaxies in MPL-4

Catalogues:

- -NSA v1.0.0
- -Xiao-Hu Yang's group (ASIAA)
- -Galaxy Zoo classification

240 paired galaxies covering different interaction stages

Radial Variations: Interacting vs Control



Barrera-Ballesteros, Lin et al. (in prep)

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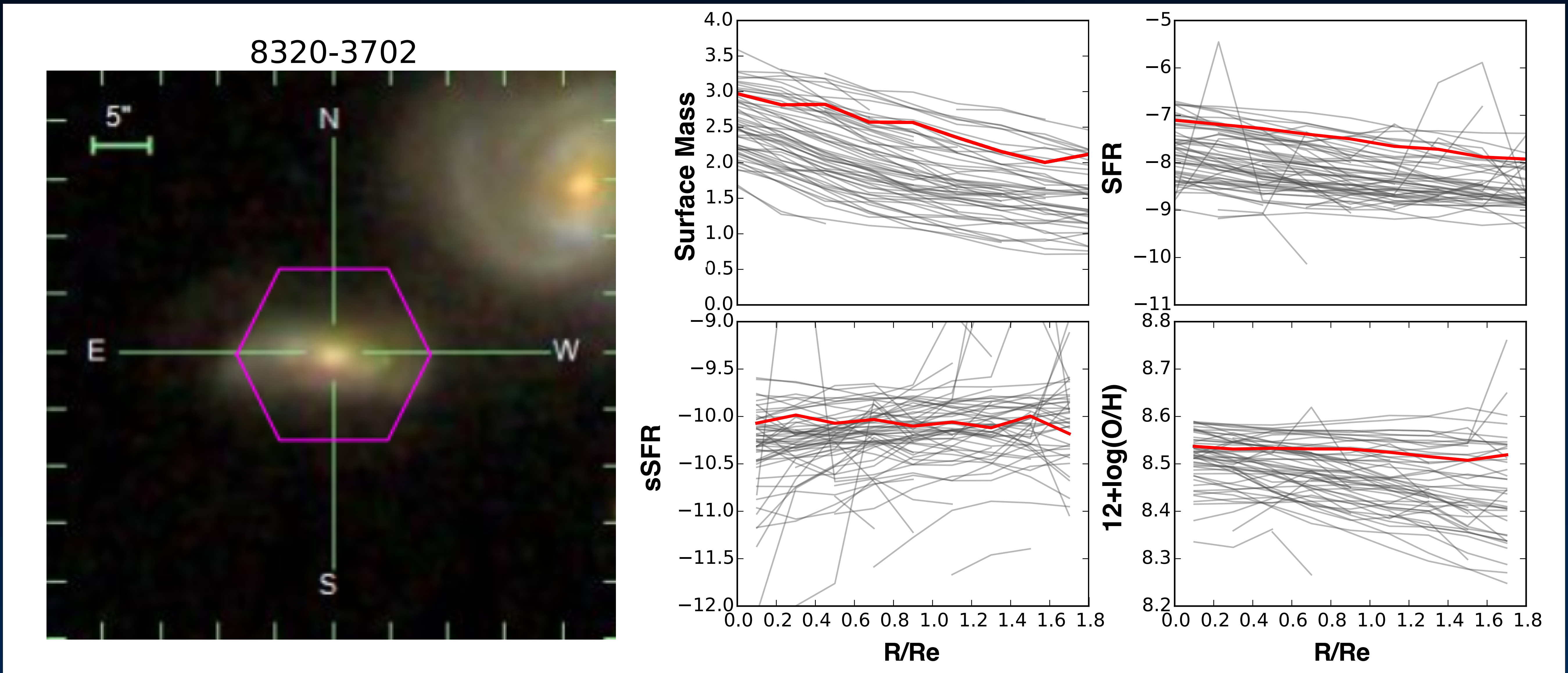

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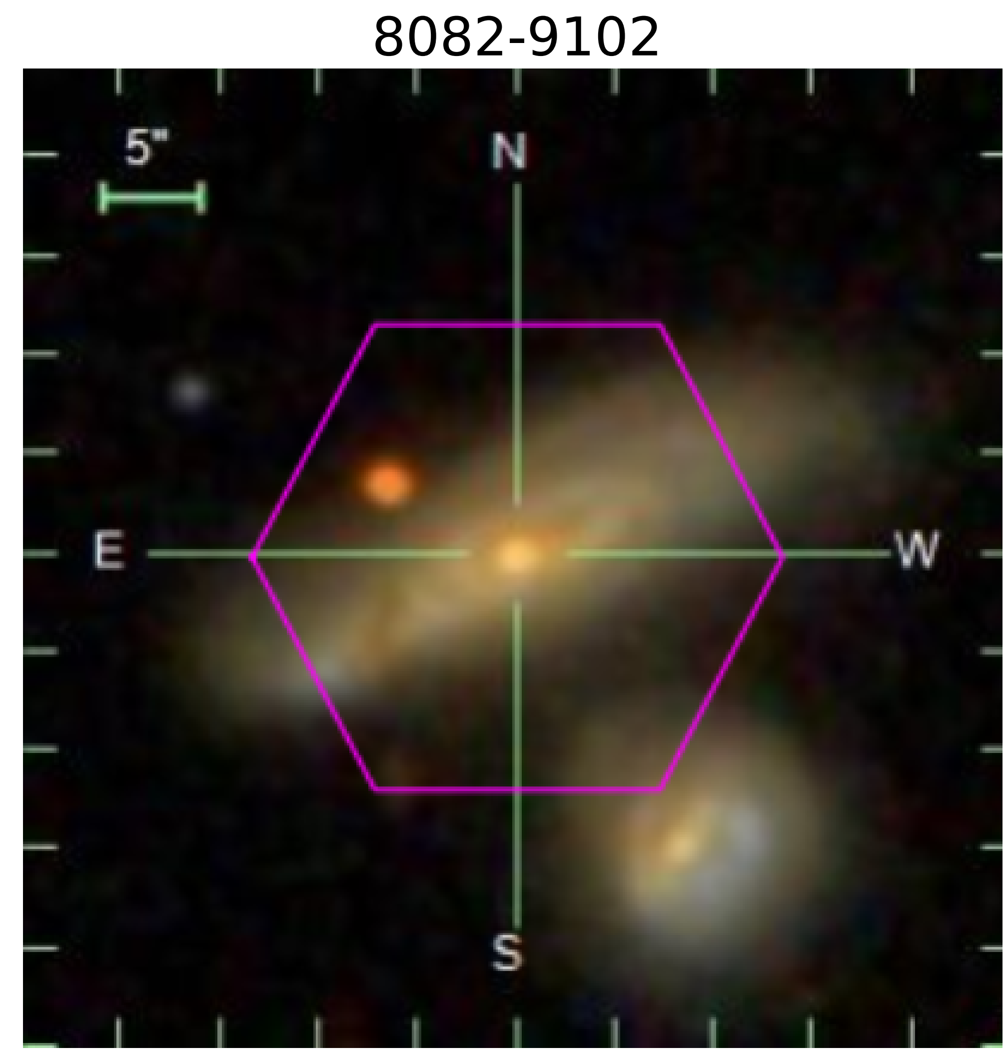

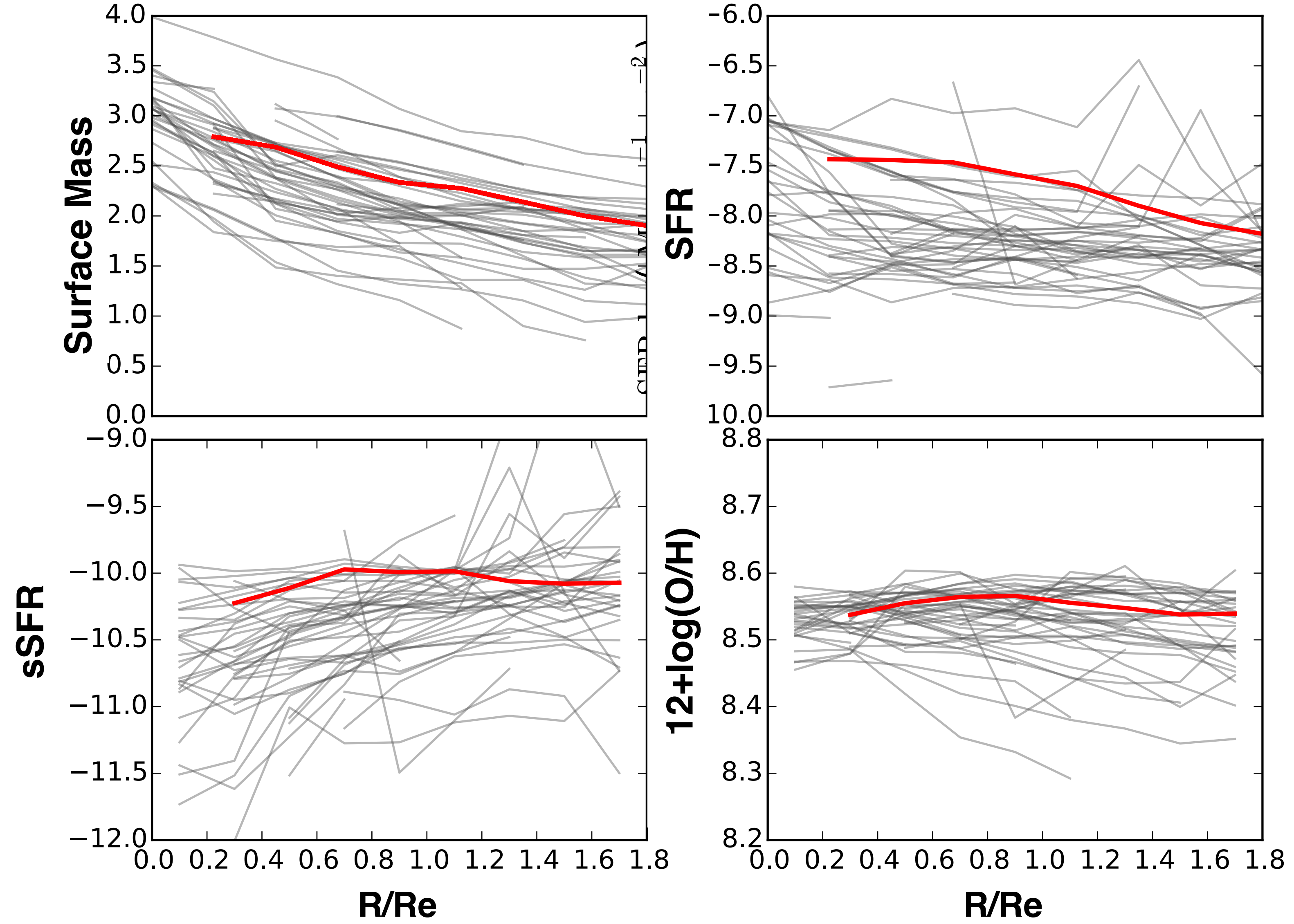

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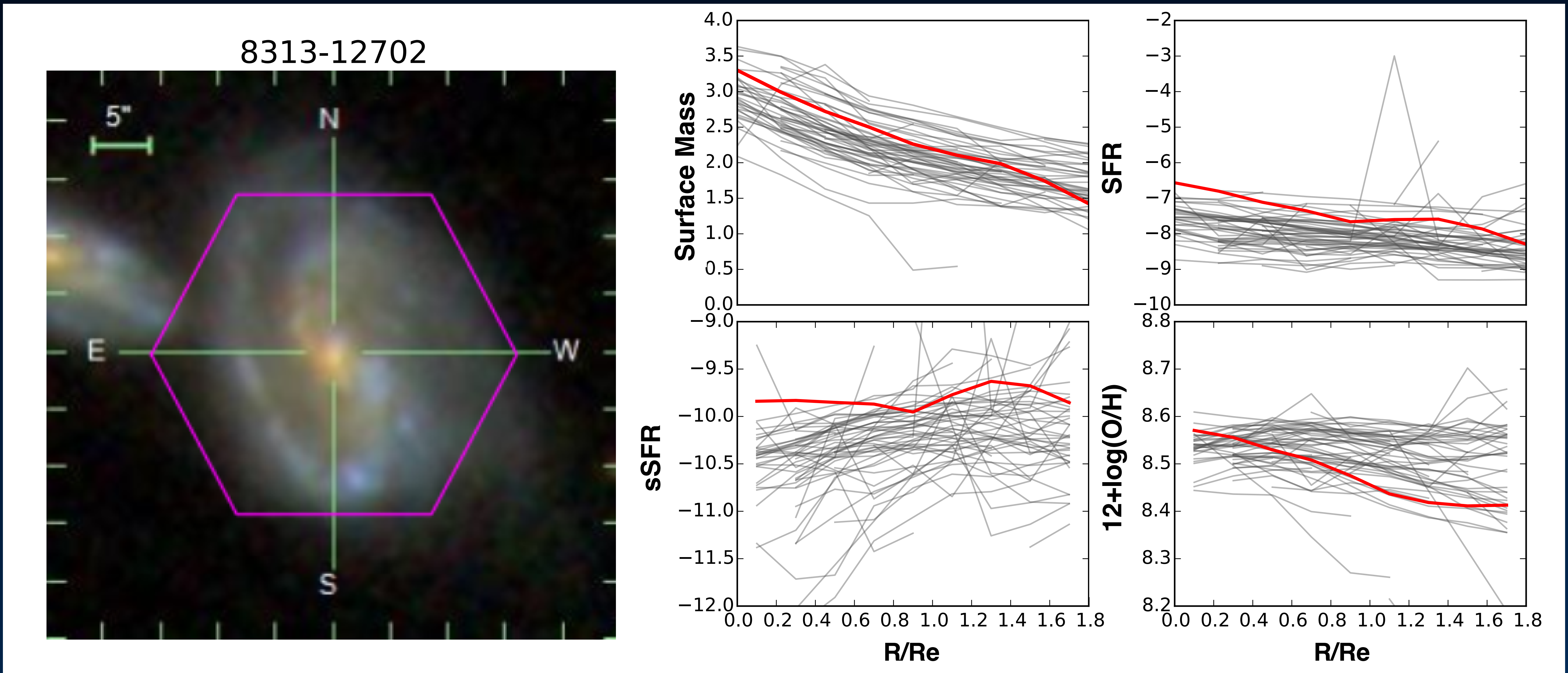

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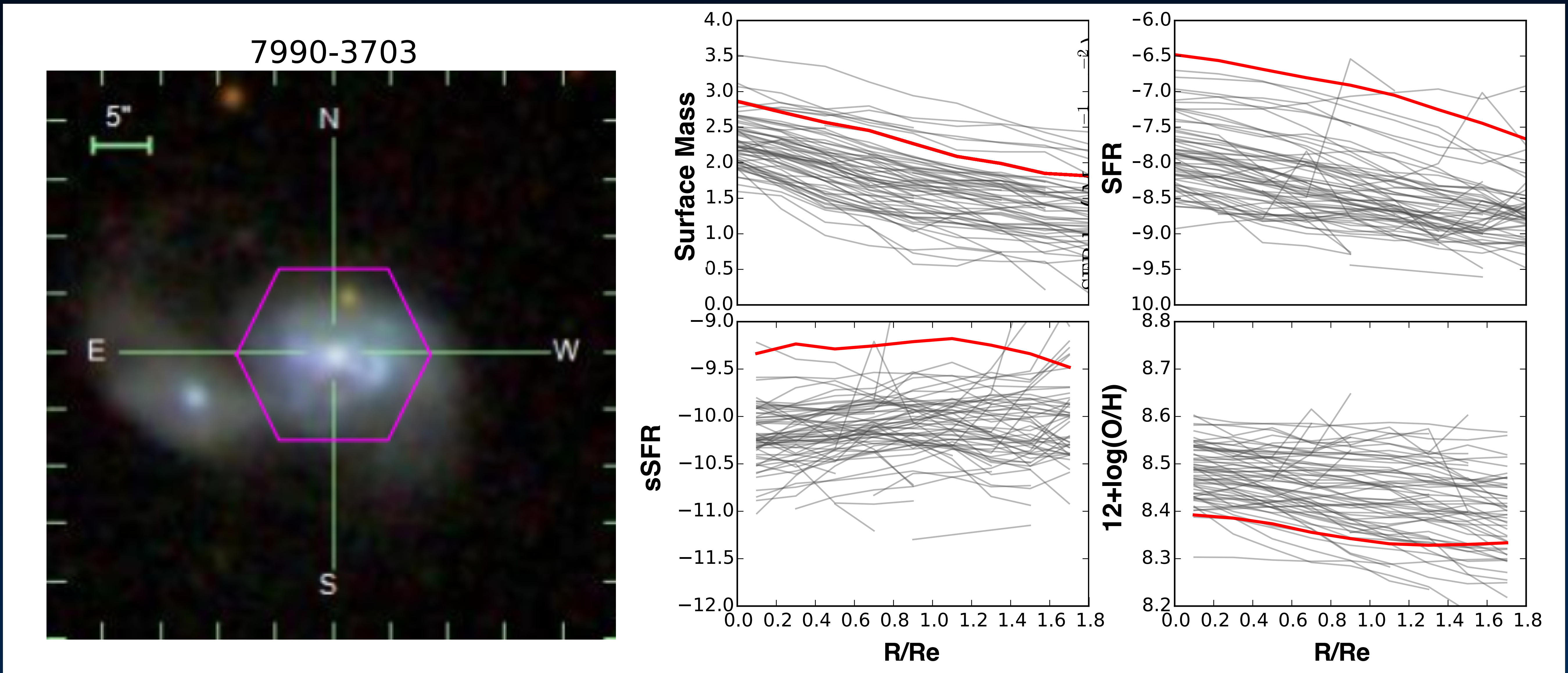

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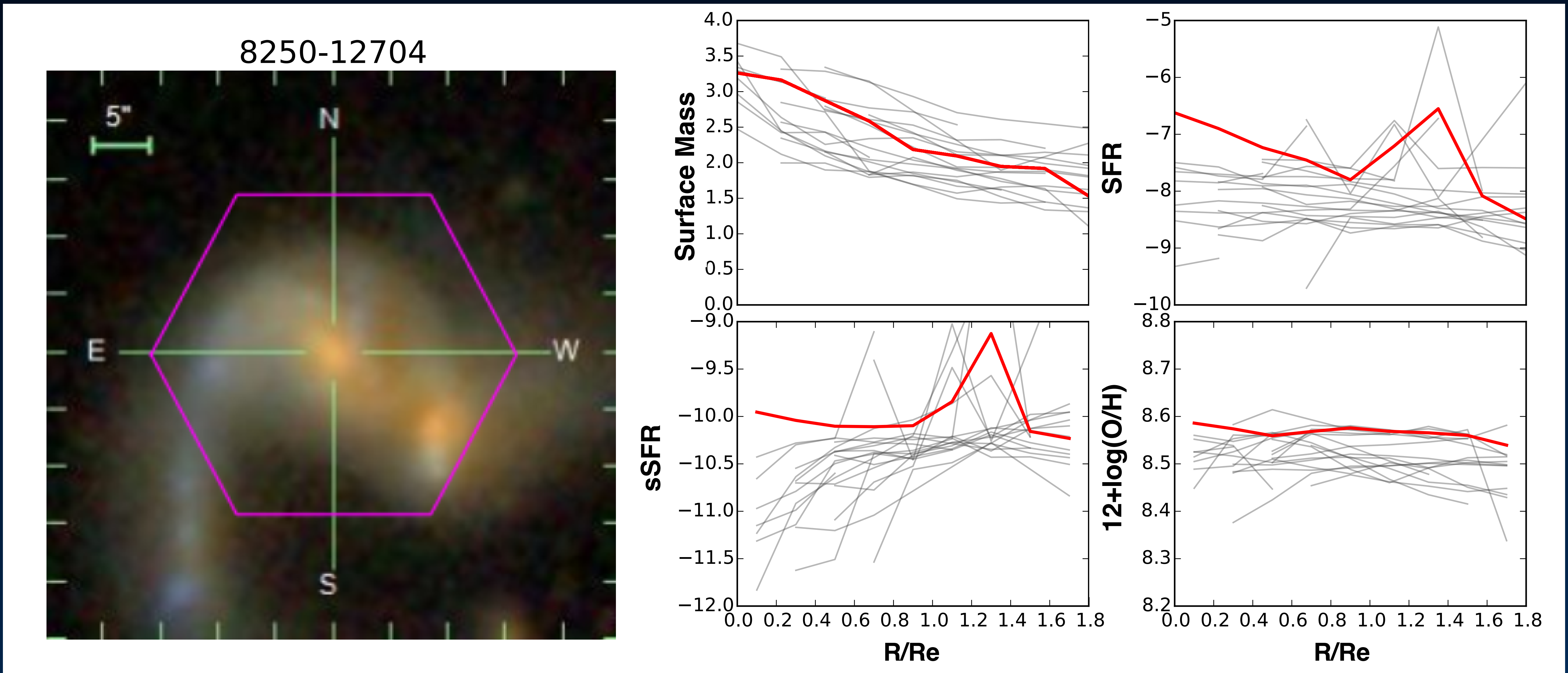

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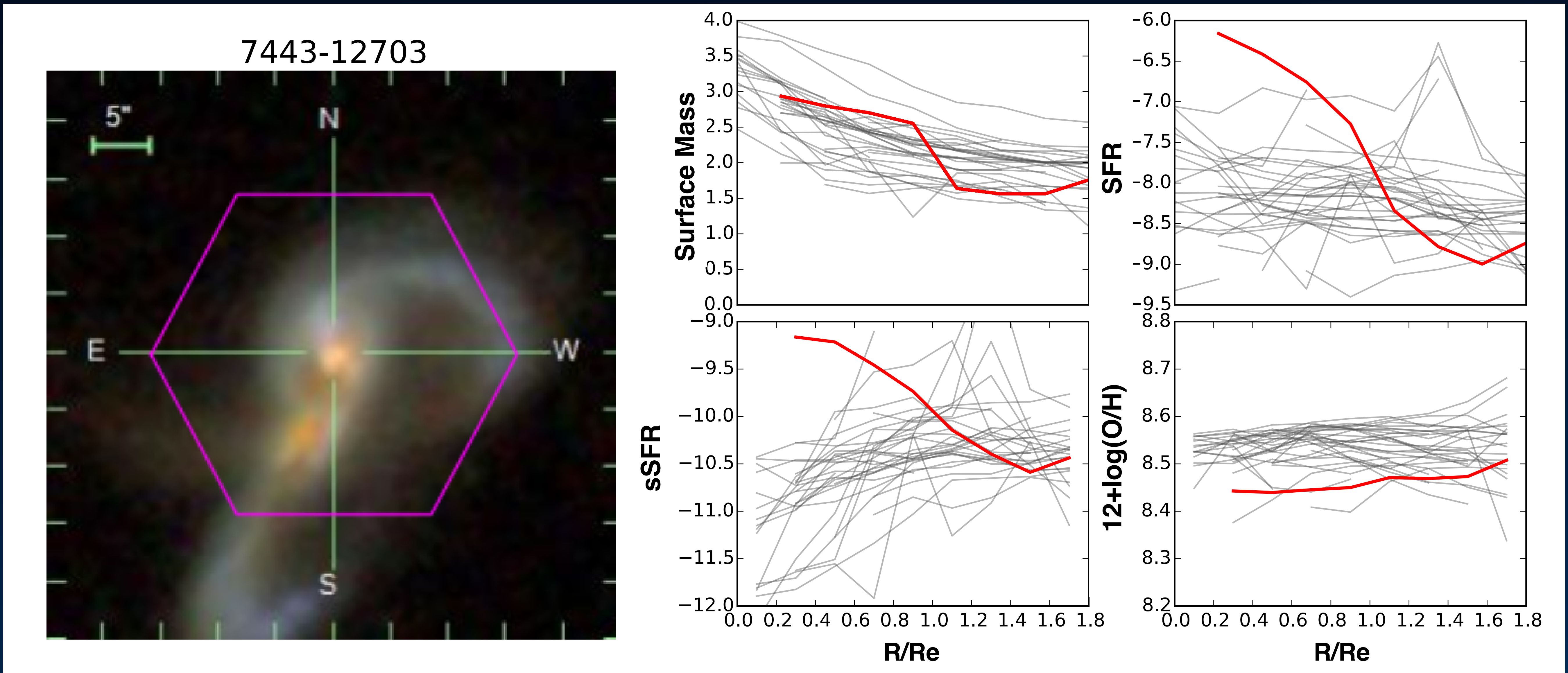

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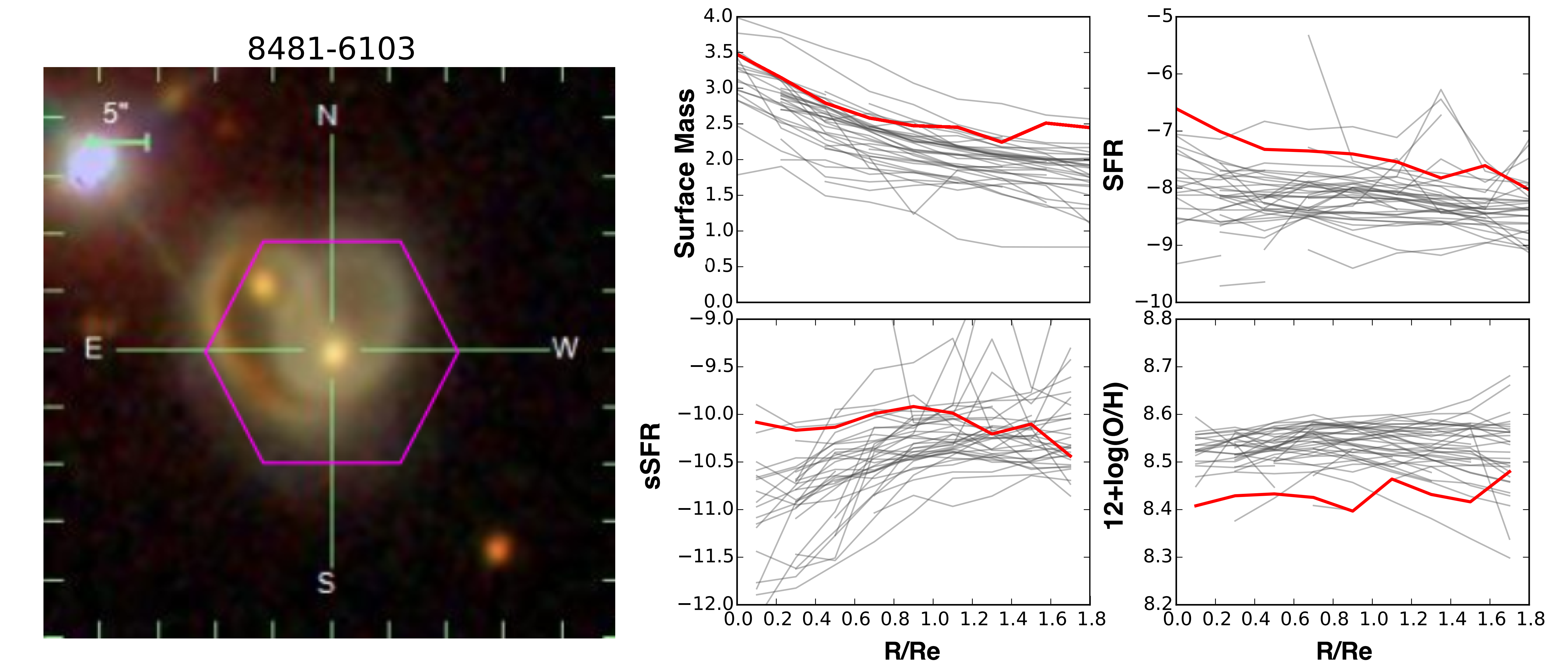

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We are learning a lot from IFUs!

- Central sSFR is enhanced in Interacting galaxies. Moderately suppressed in outer regions (see also numerical simulations by Moreno+15).
- Similar central metallicities (i.e., no dilution) : stellar/AGN feedback also play a significant role (Torrey+13).
- IFU surveys with statistical meaningful samples allows us to understand the complex evolution of interacting galaxies.
- In particular, MaNGA is providing a unique scenario to test the radial change of the SFR and gas metallicity.