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The first 62 AGN observed with SDSS-IV MaNGA - II: resolved stellar populations

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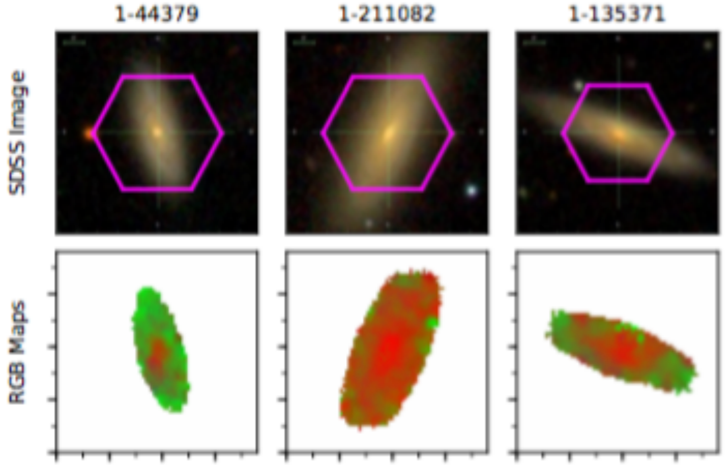
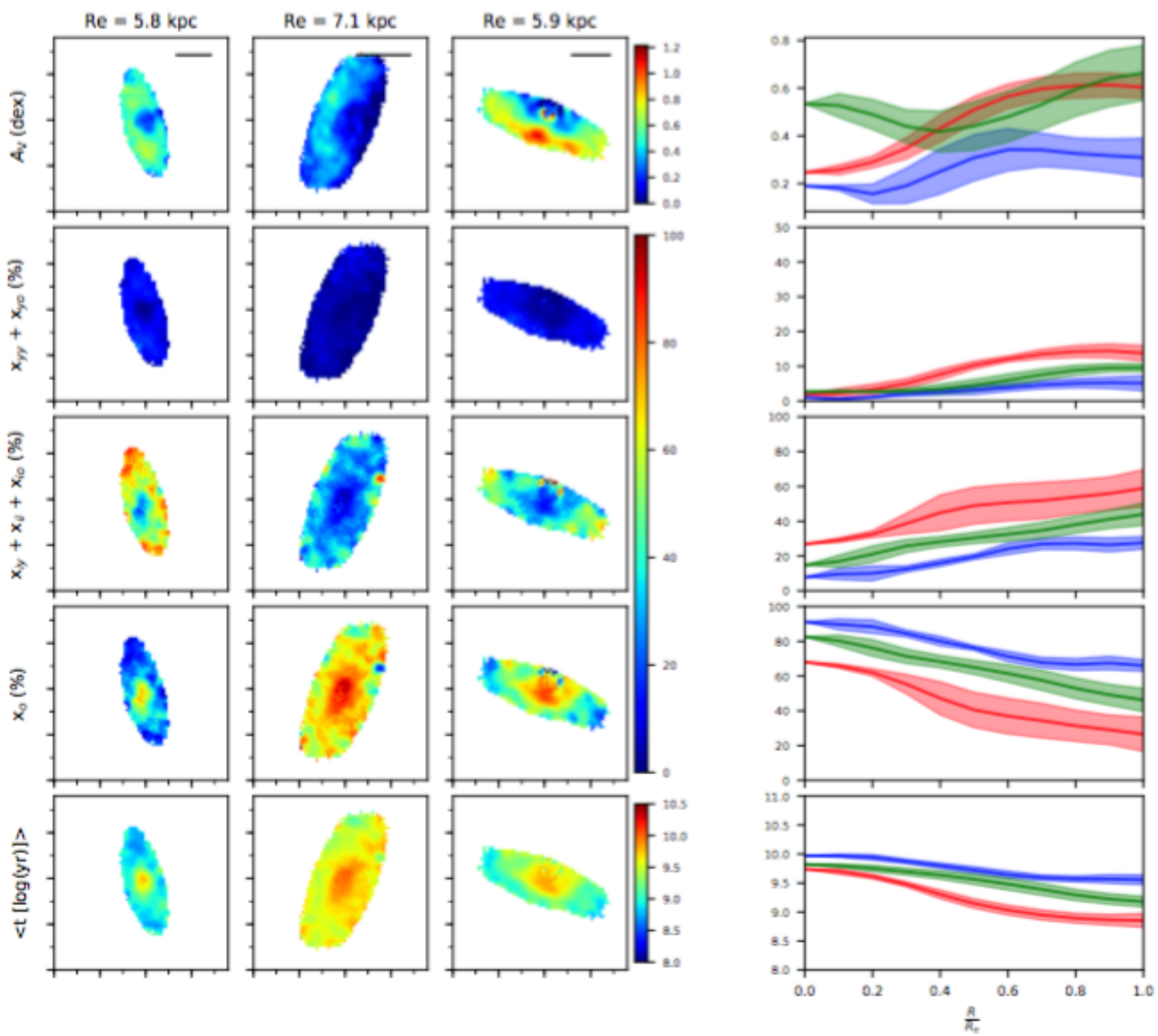
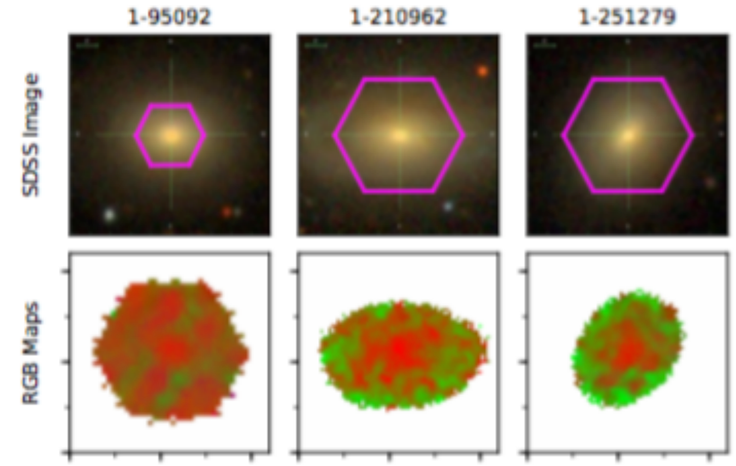
ABSTRACT

We present spatially resolved stellar population age maps, average radial profiles and gradients for the first 62 Active Galactic Nuclei (AGN) observed with SDSS-IV MaNGA to study the effects of the active nuclei on the star formation history of the host galaxies. These results, derived using the STARLIGHT code, are compared with a control sample of non-active galaxies matching the properties of the AGN hosts. We find that the fraction of young stellar populations (SP) in high-luminosity AGN is higher in the inner ($R \leq 0.5\ R_e$) regions when compared with the control sample; low-luminosity AGN, on the other hand, present very similar fractions of young stars to the control sample hosts for the entire studied range ($1\ R_e$). The fraction of intermediate age SP of the AGN hosts increases outwards, with a clear enhancement when compared with the control sample. The inner region of the galaxies (AGN and control galaxies) presents a dominant old SP, whose fraction decreases outwards. We also compare our results (differences between AGN and control galaxies) for the early and late-type hosts and find no significant differences. In summary, our results suggest that the most luminous AGN seems to have been triggered by a recent supply of gas that has also triggered recent star formation ($t \leq 40$ Myrs) in the central region.

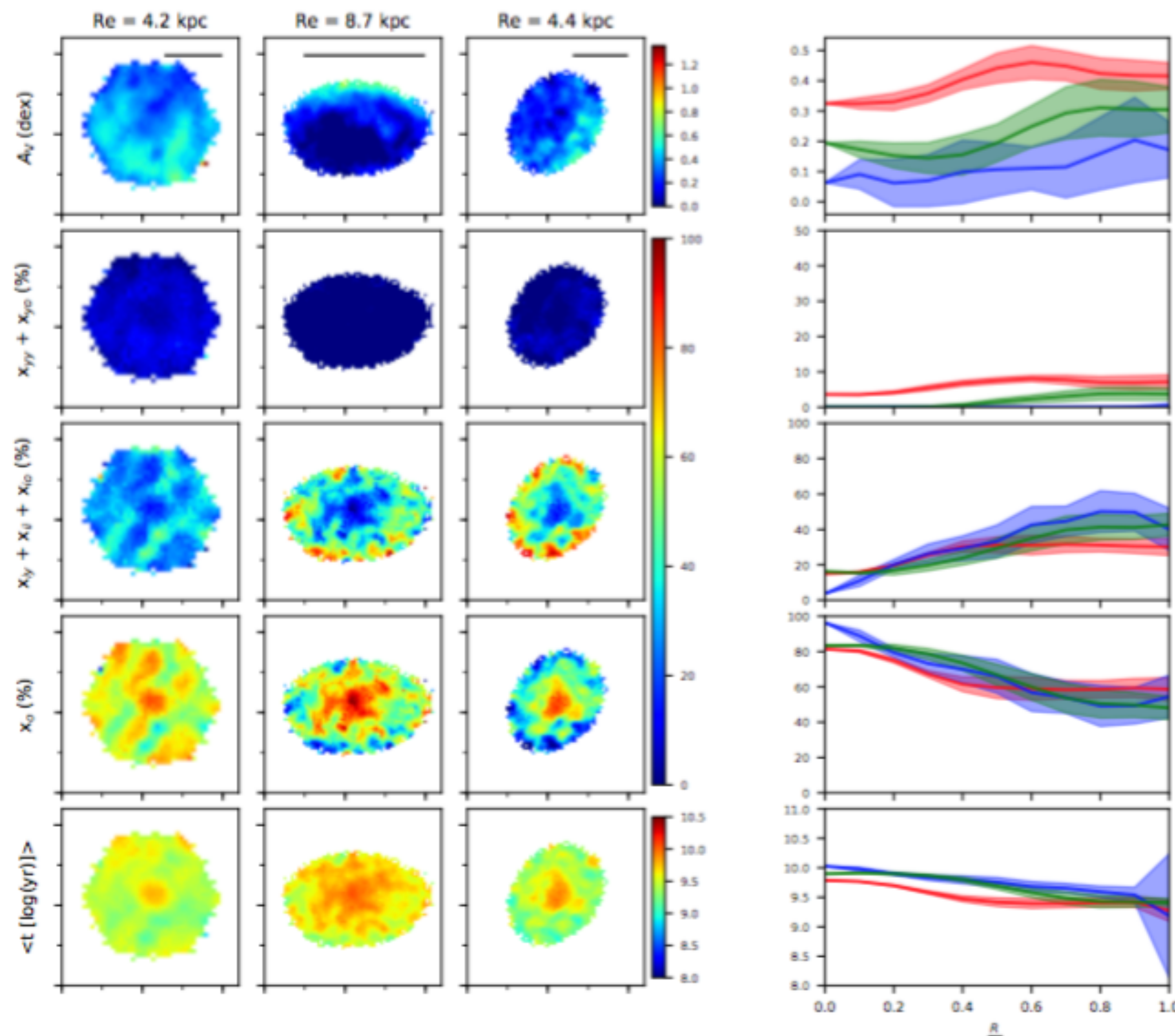


Region		AGN	CTR1	CTR2
$0.0-0.5\,R_e$	A_V	0.55	0.23	-0.30
	x_y	17.43	5.85	2.61
	x_i	49.45	21.40	35.64
	x_o	-58.84	-30.36	-38.25
	$<t>$	-1.24	-0.53	-0.52
$0.5-1.0\,R_e$	A_V	0.18	-0.06	0.50
	x_y	7.57	4.14	11.17
	x_i	18.47	10.02	28.29
	x_o	-27.27	-14.84	-39.61
	$<t>$	-0.58	-0.27	-0.83
$0.0-1.0\,R_e$	A_V	0.47	0.20	0.15
	x_y	15.91	5.65	8.83
	x_i	33.71	23.83	28.80
	x_o	-46.93	-30.19	-37.76
	$<t>$	-1.08	-0.52	-0.71



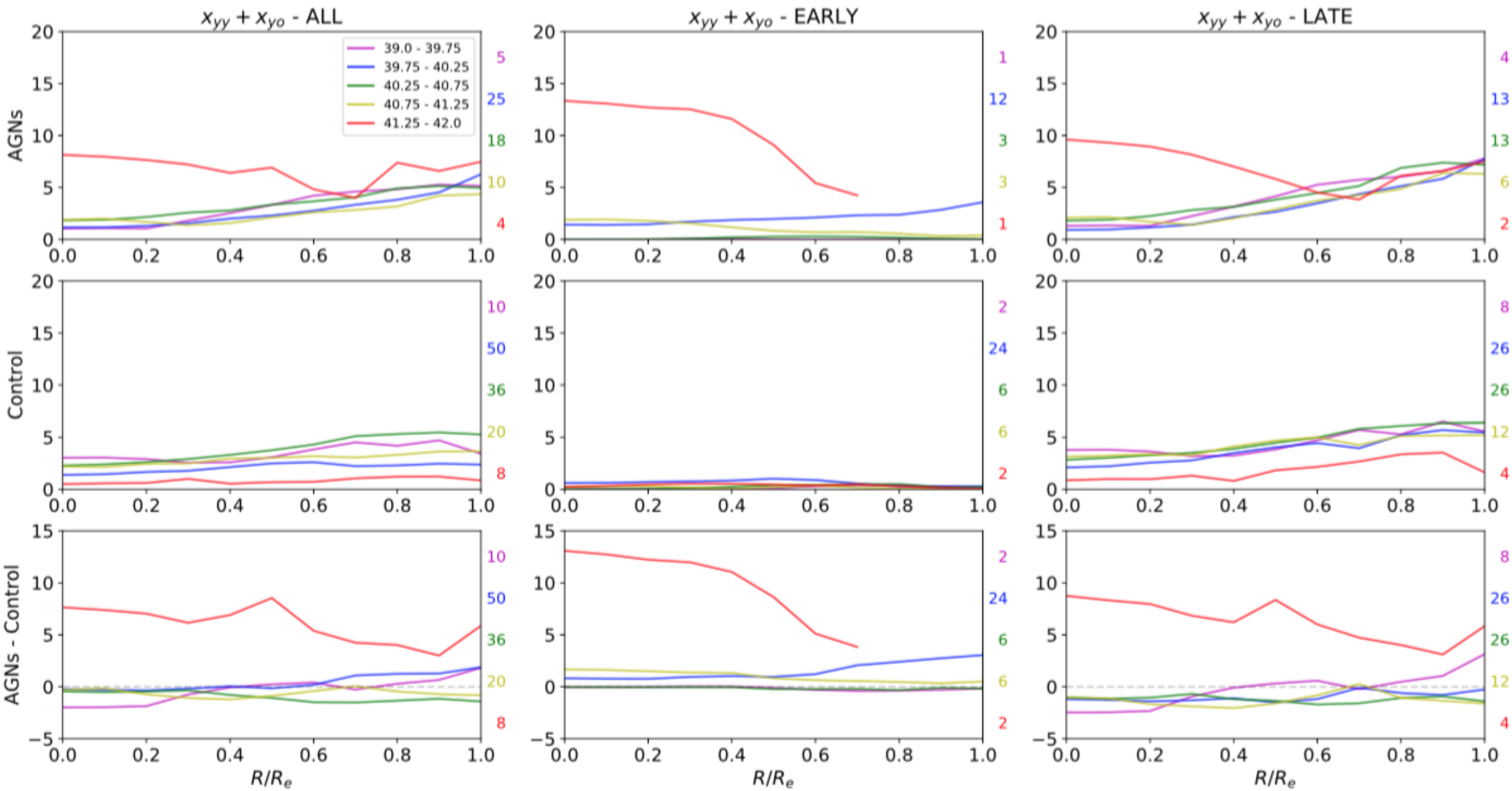


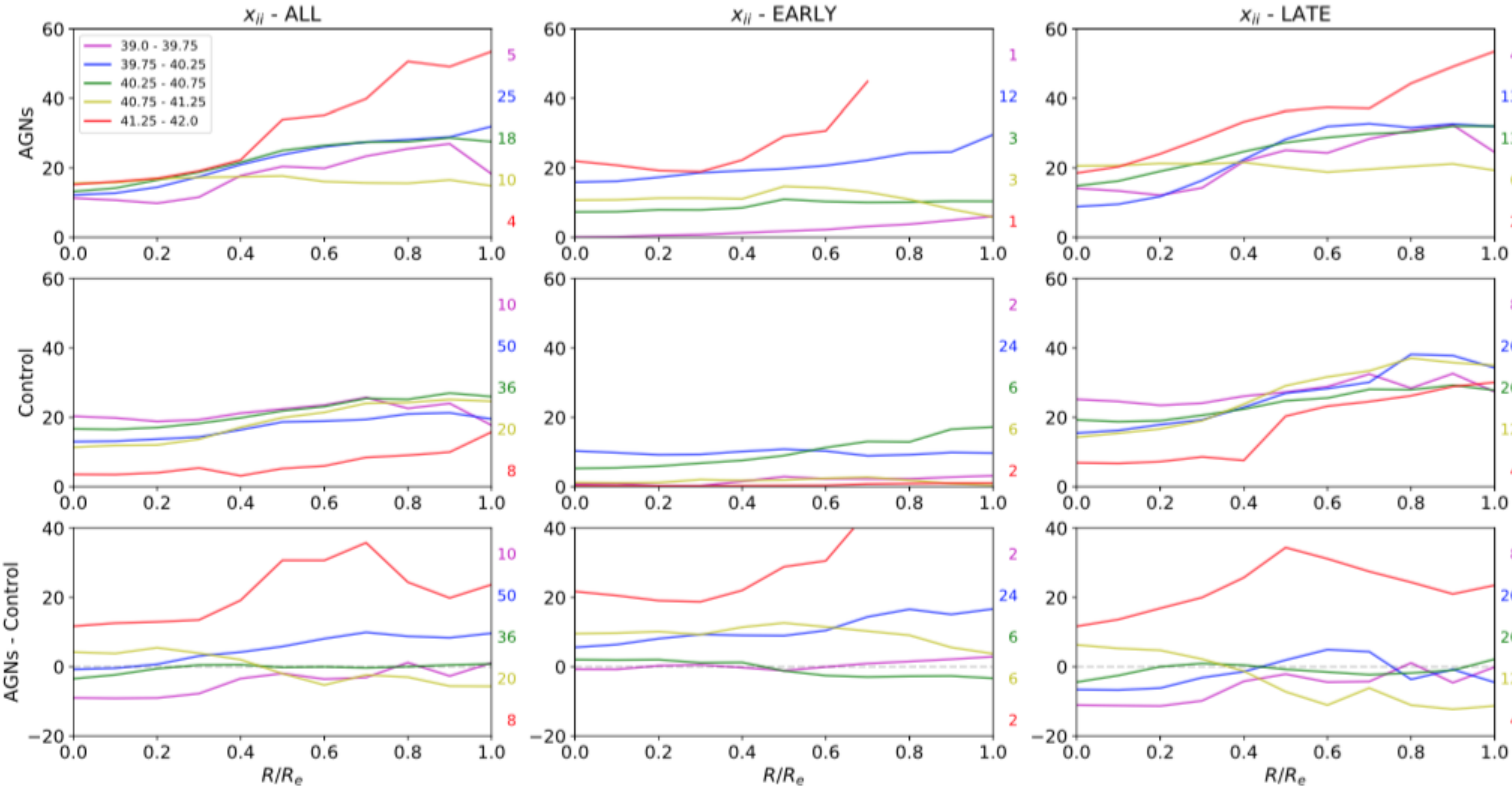
Region		AGN	CTR1	CTR2
$0.0-0.5\,R_e$	A_V	0.25	0.06	-0.04
	x_y	9.34	0.02	2.26
	x_i	41.95	61.83	26.68
	x_o	-54.64	-63.42	-32.24
	$<t>$	-0.87	-0.59	-0.37
$0.5-1.0\,R_e$	A_V	-0.11	0.23	0.20
	x_y	-2.53	0.34	4.71
	x_i	-2.00	22.34	22.69
	x_o	-0.26	-28.06	-35.09
	$<t>$	-0.09	-0.90	-0.53
$0.0-1.0\,R_e$	A_V	0.13	0.13	0.20
	x_y	4.42	0.07	5.16
	x_i	17.22	46.69	34.60
	x_o	-24.99	-48.96	-44.75
	$<t>$	-0.47	-0.64	-0.65



As stated by Cid Fernandes et al. (2005), small differences in ages of individual SSPs are washed away in real data by noise effects. We therefore rebinned the population vectors in six stellar population components (SPCs): x_{yy} (1 Myr $\leq$ t $\leq$ 10 Myr), x_{yo} (10 Myr < t $\leq$ 40 Myr), x_{iy} (40 Myr < t $\leq$ 286 Myr), x_{ii} (286 Myr < t $\leq$ 905 Myr), x_{io} (905 Myr < t $\leq$ 2.5 Gyr), and x_o (2.5 Gyr < t $\leq$ 13 Gyr).

We have also grouped the stellar population vector in





x_{ii} - ALL
x_{ii} - EARLY
x_{ii} - LATE
39.0 - 39.75
39.75 - 40.25
40.25 - 40.75
40.75 - 41.25
41.25 - 42.0
AGNs
Control
AGNs - Control
R/R_e

We found that the fraction of the young stellar population ($t \lesssim 40$ Myr) is related with the AGN luminosity. For high-luminosity AGN ($L_{[\mathrm{O\,III}]} \gtrsim 10^{41.25}$ ergs/s) it increases in the inner ($R \leq 0.5 R_e$) regions when compared with the objects in the control sample. In the case of the low-luminosity AGN, both AGN and control sample hosts, present very similar fractions of young stars. This result indicates that the inflow of material, besides feeding the nuclear engine, is being used to form new stars, thus rejuvenating the stellar content of the nuclear region of the AGN hosts. In addition, this very young starburst could also be enhanced by a positive AGN feedback produced by the high-luminosity AGN.

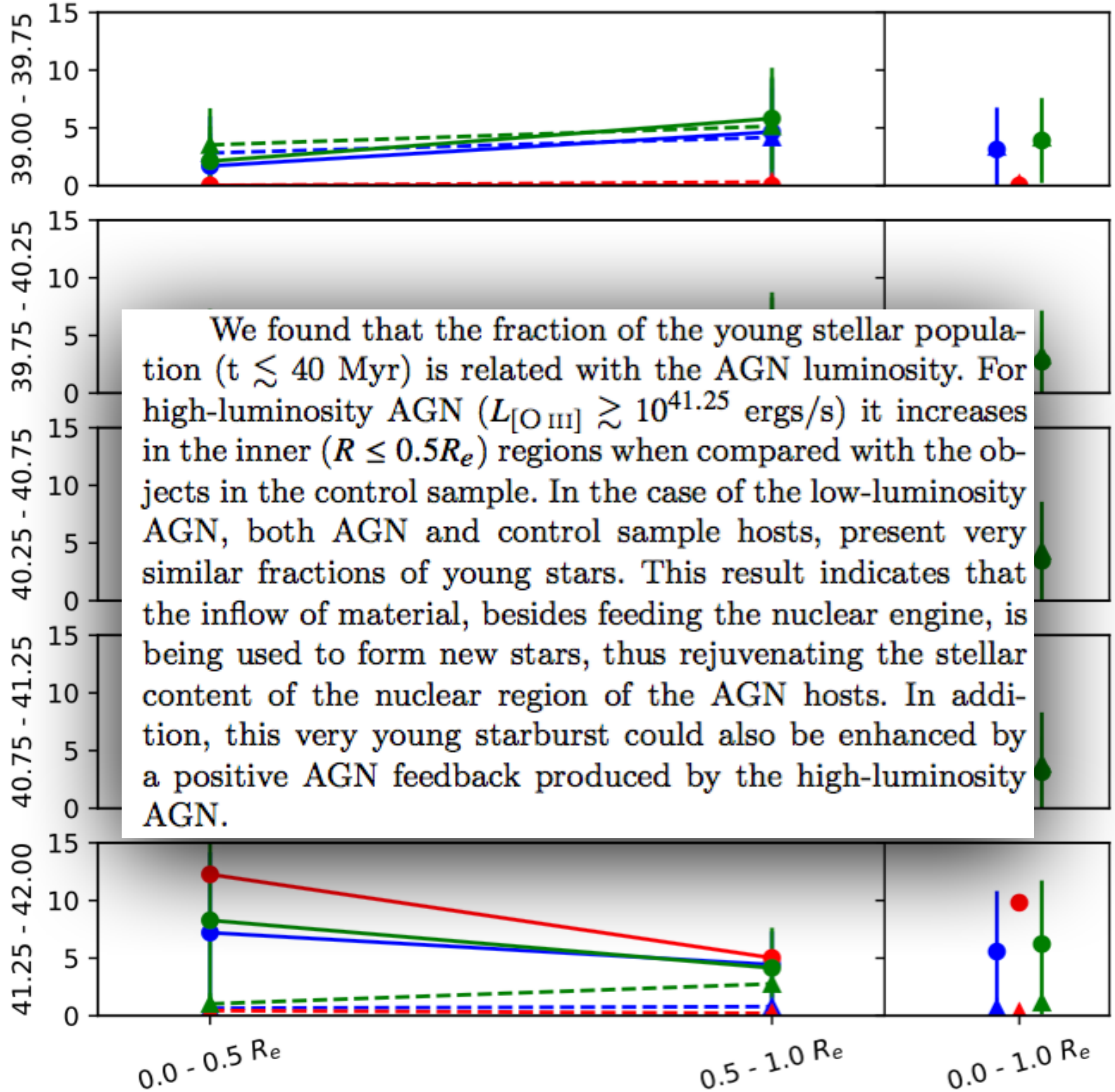


Figure 10. Young stellar population x_y contribution for five different bins of luminosity (39-39.75, 39.75-40.25, 40.25-40.75, 40.75-41.25, 41.25-42), calculated for three different regions (0.0-0.5 R_e, 0.5-1.0 R_e, 0.0-1.0 R_e). Each color represents a different AGN grouping: green for the late-type AGN, red for the early-type AGN, and blue for all the AGN sample. Solid lines correspond to the active galaxies and dashed lines to the control galaxies.

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Spectroscopic decomposition of the galaxy and halo of the cD galaxy NGC 3311

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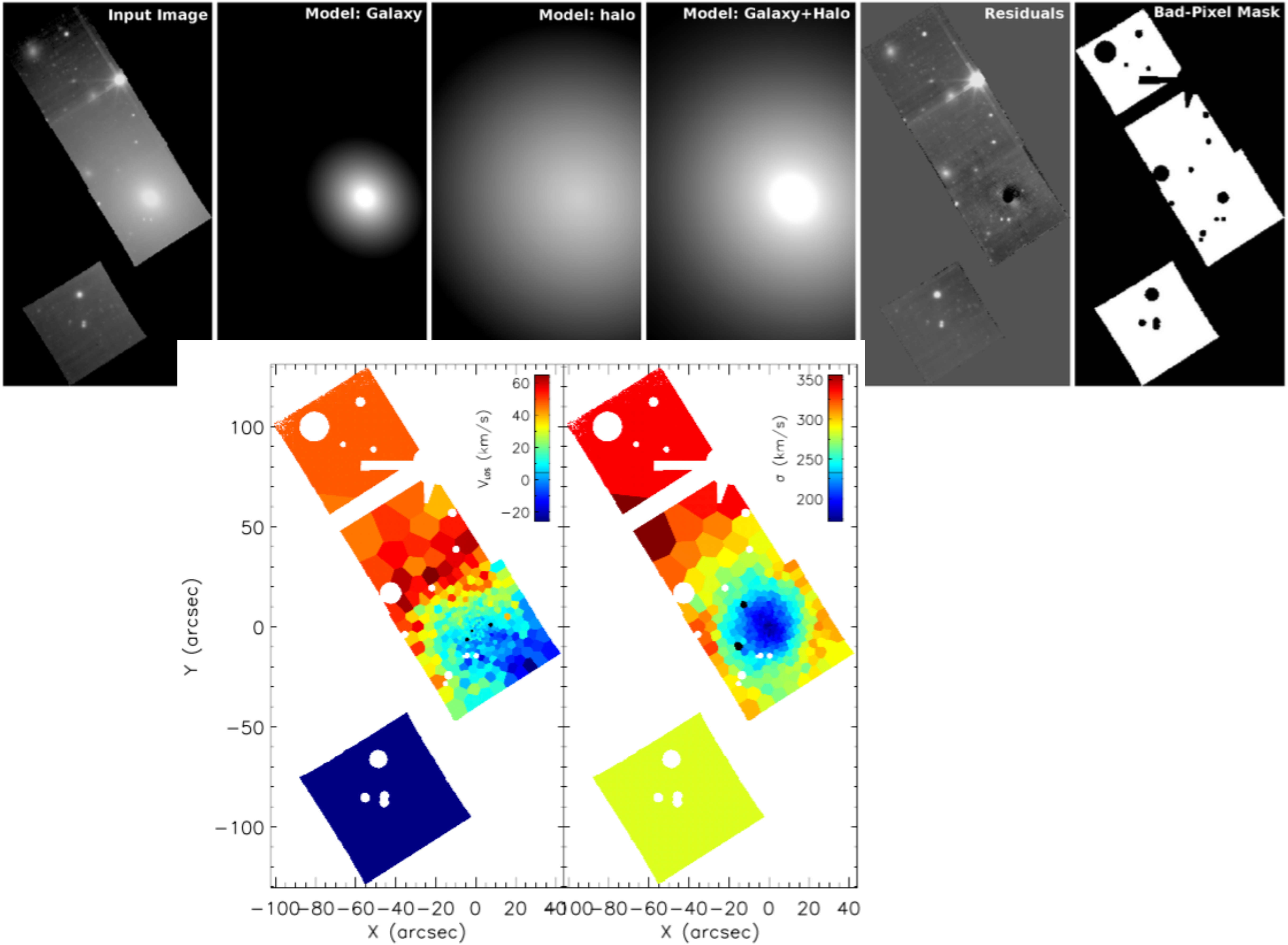
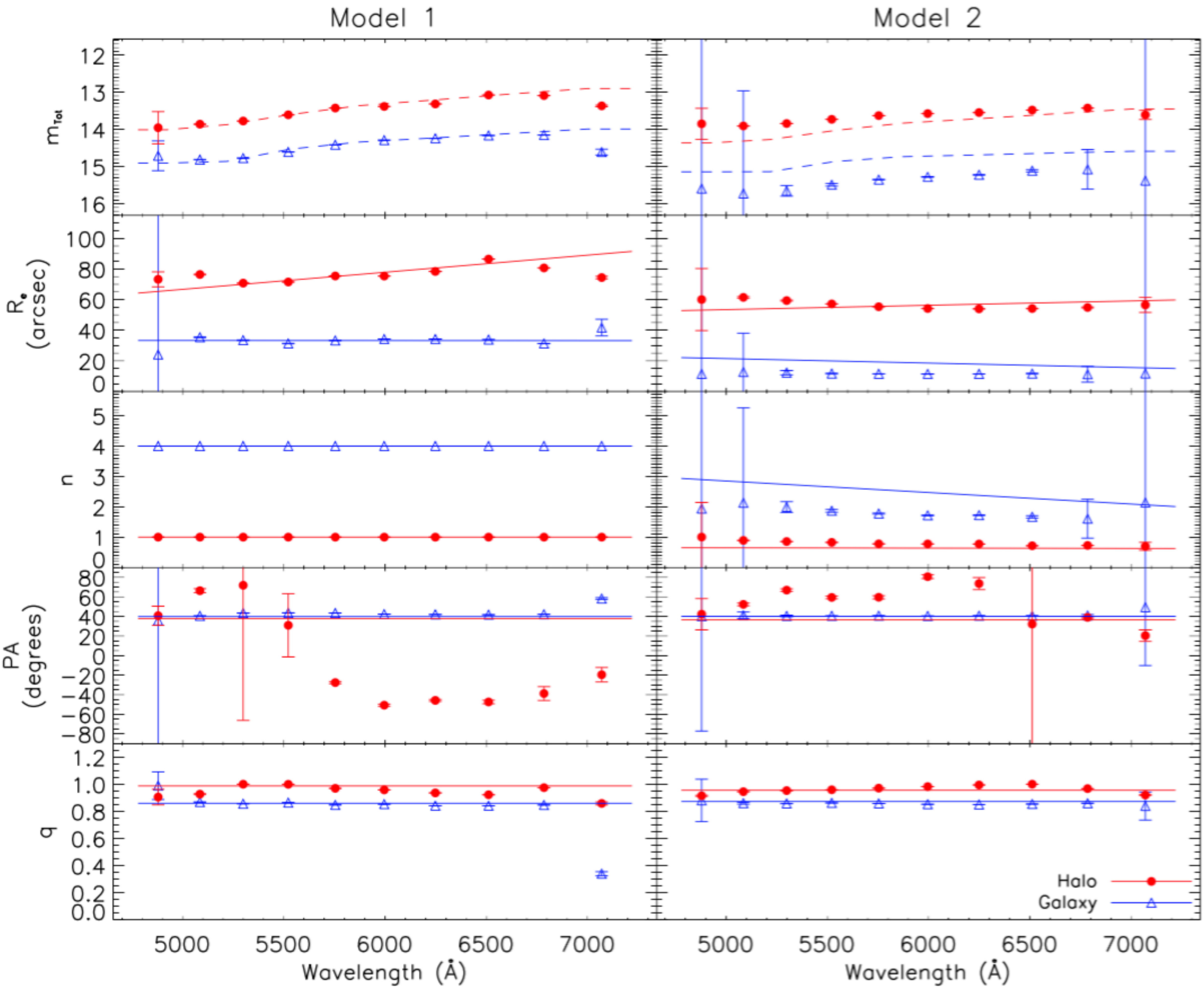
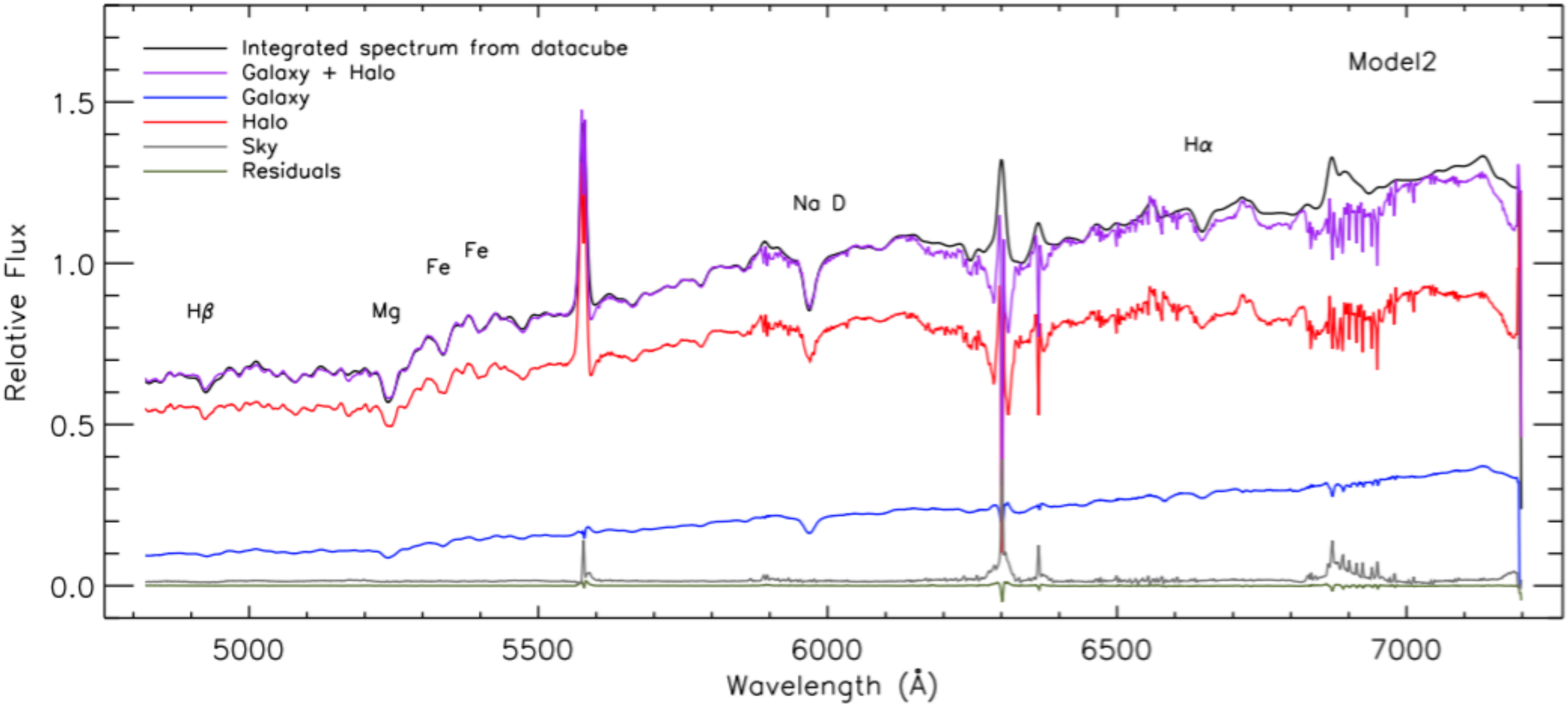
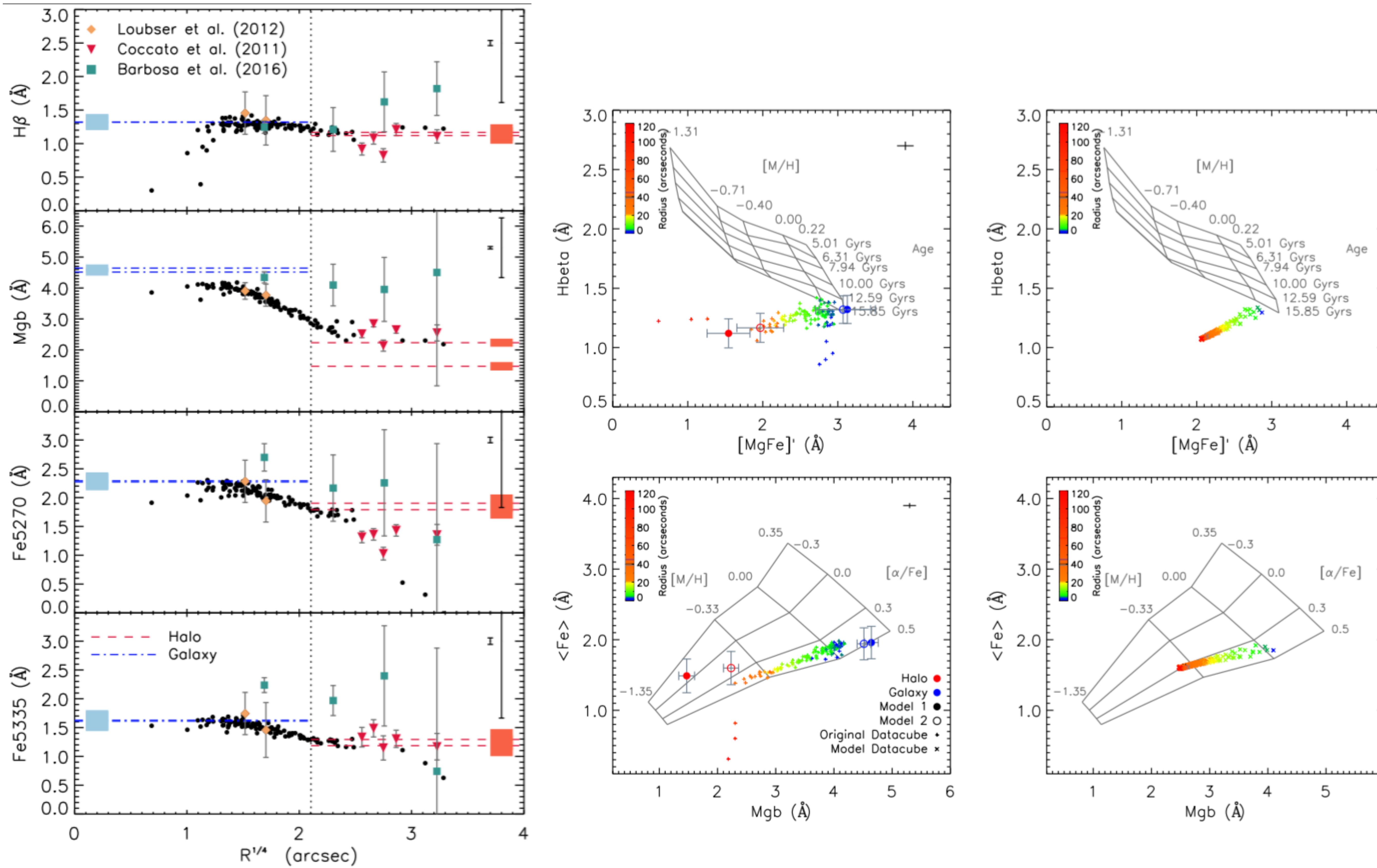
ABSTRACT
Information on the star-formation histories of cD galaxies and their extended stellar haloes lie in their spectra. Therefore, to determine whether these structures evolved together or through a two-phase formation, we need to spectroscopically separate the light from each component. We present a pilot study to use BUDDI to fit and extract the spectra of the cD galaxy NGC 3311 and its halo in an Integral Field Spectroscopy datacube, and carry out a simple stellar populations analysis to study their star-formation histories. Using MUSE data, we were able to isolate the light of the galaxy and its halo throughout the datacube, giving spectra representing purely the light from each of these structures. The stellar populations analysis of the two components indicates that, in this case, the bulk of the stars in both the halo and the central galaxy are very old, but the halo is more metal poor and less α-enriched than the galaxy. This result is consistent with the halo forming through the accretion of much smaller satellite galaxies with more extended star formation. It is noteworthy that the apparent gradients in age and metallicity indicators across the galaxy are entirely consistent with the radially-varying contributions of galaxy and halo components, which individually display no gradients. The success of this study is promising for its application to a larger sample of cD galaxies that are currently being observed by IFU surveys.


Input Image
Model: Galaxy
Model: halo
Model: Galaxy+Halo
Residuals
Bad-Pixel Mask
Y (arcsec)
X (arcsec)
X (arcsec)
V_LOS (km/s)
σ (km/s)
100
50
0
−50
−100
−100 −80 −60 −40 −20 0 20 40
60
40
20
0
−20
350
300
250
200



Model 1
Model 2
m_{Tot}
R_e (arcsec)
n
PA (degrees)
q
Wavelength (Å)
Halo
Galaxy


Integrated spectrum from datacube
Galaxy + Halo
Galaxy
Halo
Sky
Residuals
Model2
Hβ
Mg
Fe
Fe
Na D
Hα
Relative Flux
1.5
1.0
0.5
0.0
5000
5500
6000
6500
7000
Wavelength (Å)



Loubser et al. (2012)
Coccato et al. (2011)
Barbosa et al. (2016)
Hβ (Å)
Mgb (Å)
Fe5270 (Å)
Fe5335 (Å)
Halo
Galaxy
R^1/4 (arcsec)
Hbeta (Å)
[MgFe]' (Å)
Radius (arcseconds)
[M/H]
−1.31
−0.71
−0.40
0.00
0.22
Age
5.01 Gyrs
6.31 Gyrs
7.94 Gyrs
10.00 Gyrs
12.59 Gyrs
15.85 Gyrs
<Fe> (Å)
Mgb (Å)
[α/Fe]
0.35
−0.3
0.0
0.3
0.5
−0.33
−1.35
Halo
Galaxy
Model 1
Model 2
Original Datacube
Model Datacube