STELLAR PROPERTIES OF HOST GALAXIES OF TYPE 2 QSOS

Dongyao Zhao, Luis C. Ho

Kavli Institute for Astronomy & Astrophysics, Peking University

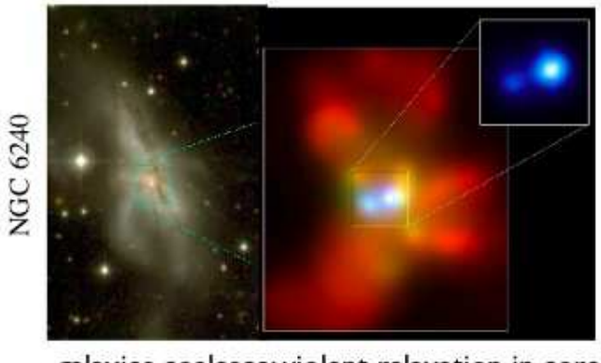
5th December, EAAGN2017, Kagoshima

MOTIVATION

(c) Interaction/"Merger"

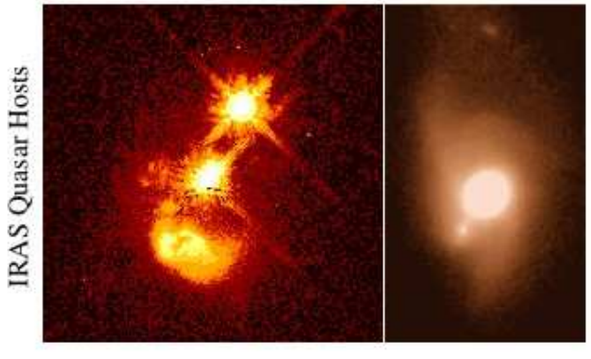
- now within one halo, galaxies interact & lose angular momentum
- SFR starts to increase
- stellar winds dominate feedback
- rarely excite QSOs (only special orbits)

(d) Coalescence/(U)LIRG



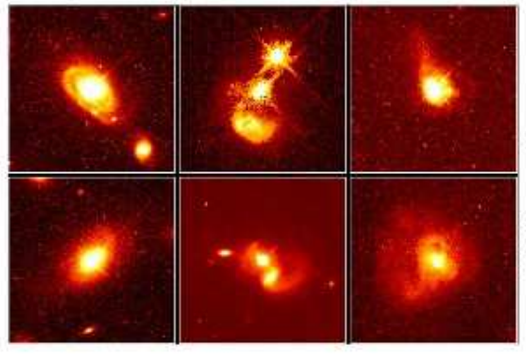
- galaxies coalesce: violent relaxation in core
- gas inflows to center: starburst & buried (X-ray) AGN
- starburst dominates luminosity/feedback, but, total stellar mass formed is small

(e) "Blowout"



- BH grows rapidly: briefly dominates luminosity/feedback
- remaining dust/gas expelled
- get reddened (but not Type II) QSO: recent/ongoing SF in host, high Eddington ratios, merger signatures still visible

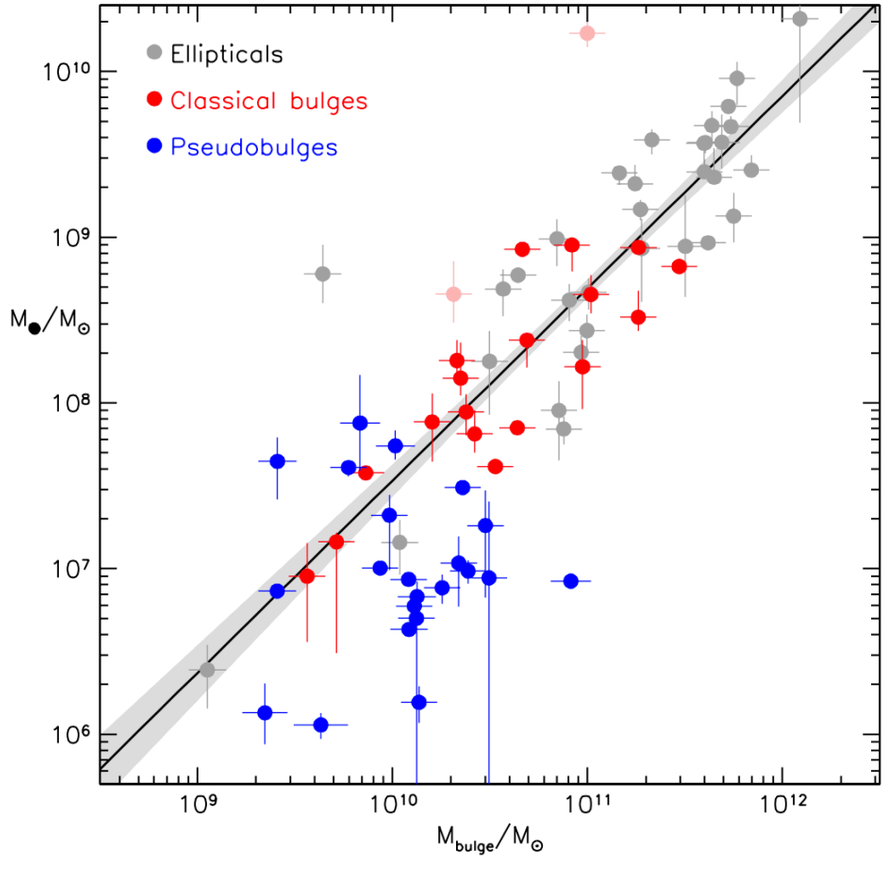
(f) Quasar



- dust removed: now a "traditional" QSO
- host morphology difficult to observe: tidal features fade rapidly
- characteristically blue/young spheroid

Hopkins+09

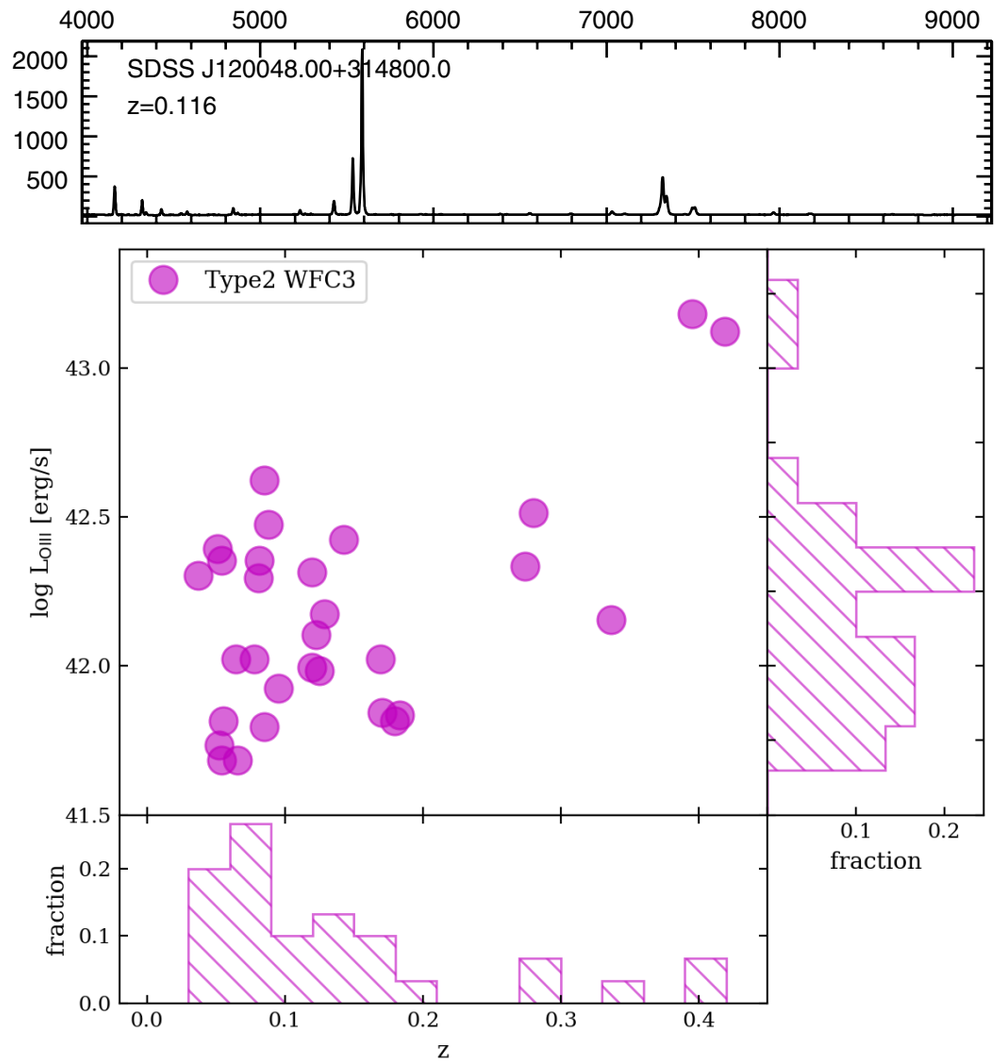
- QSO2s are 'obscured' luminous AGNs ($L_{bol} > 10^{45}$ erg s^{-1}) whose spectra show no broad emission lines.
- Is merging an important mechanism to trigger luminous AGNs in local universe?
- Do host galaxies of QSO2s have special properties, which are different from normal galaxies?
- Studying morphologies, structures, colors and stellar masses of QSO2 host galaxies.
- Discussing them with M_{BH} and star formation rate to explore the triggering and evolution of QSO2.

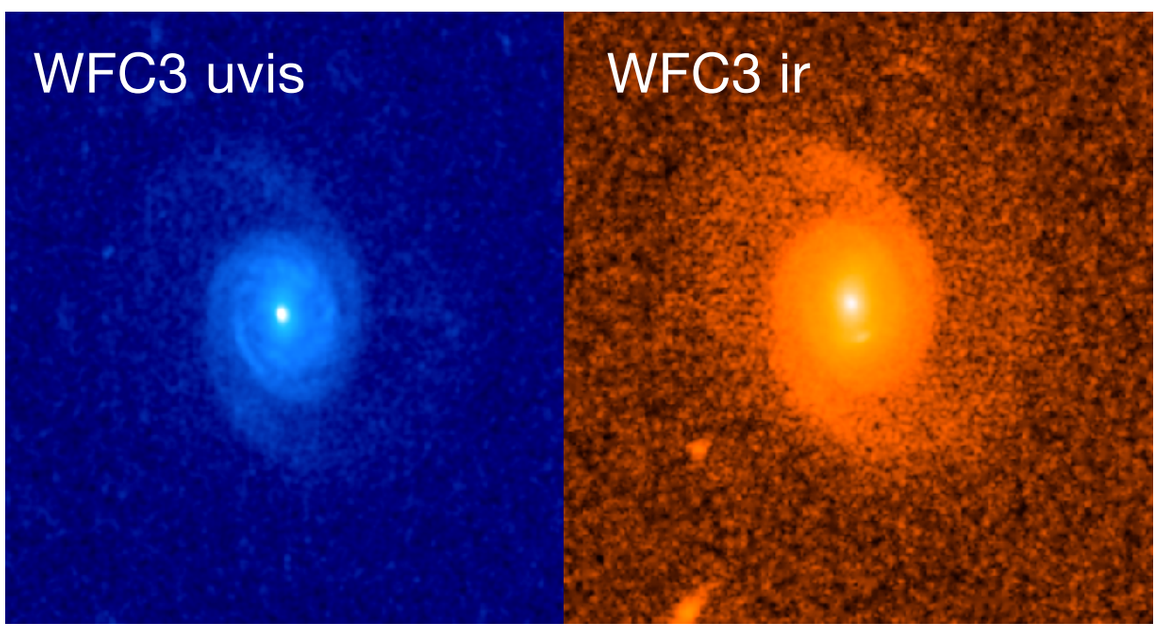


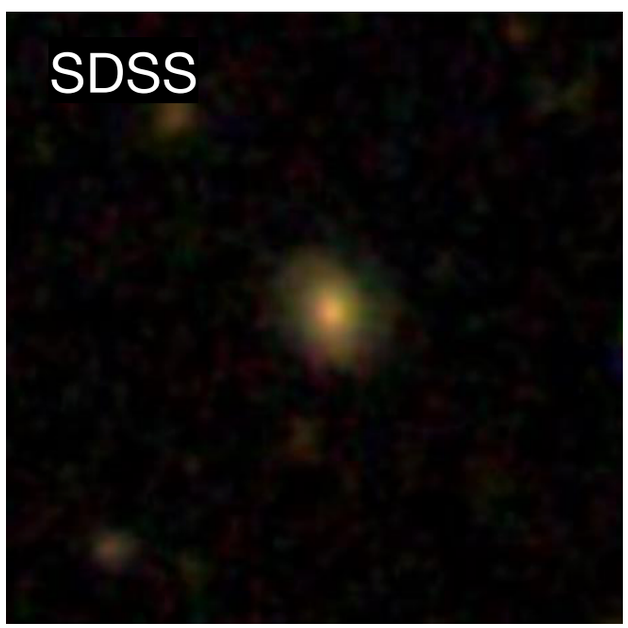
Kormendy & Ho (2003)

SAMPLE AND DATA

- 887 QSO2s identified from optical SDSS sample by Reyes et al. (2008), $L_{[OIII]} \geq 10^{41.6}$ erg s^{-1}, z<0.83.
- **29** local QSO2s (z~0.1, $L_{[OIII]} \sim 10^{42.1}$ erg s^{-1}) are selected from sample of Reyes et al. (2008).
- High-quality images taken with HST using WFC3 UVIS and NIR bands (PI: Luis Ho, snapshot mode).
- WFC3 images allow us to study morphologies and structures of QSO2 host galaxies in great detail.
- Data of HST two bands allow us to measure colors and stellar masses of QSO2 host galaxies.

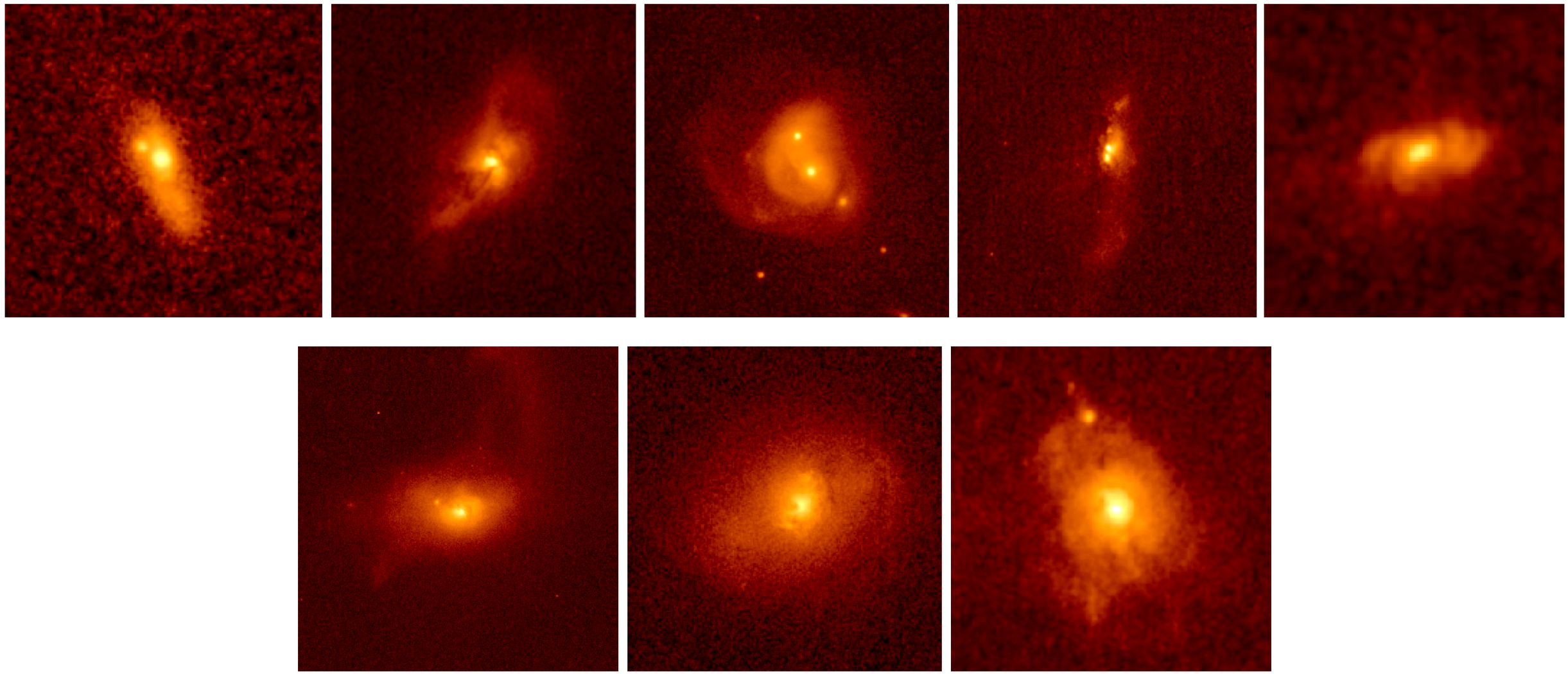






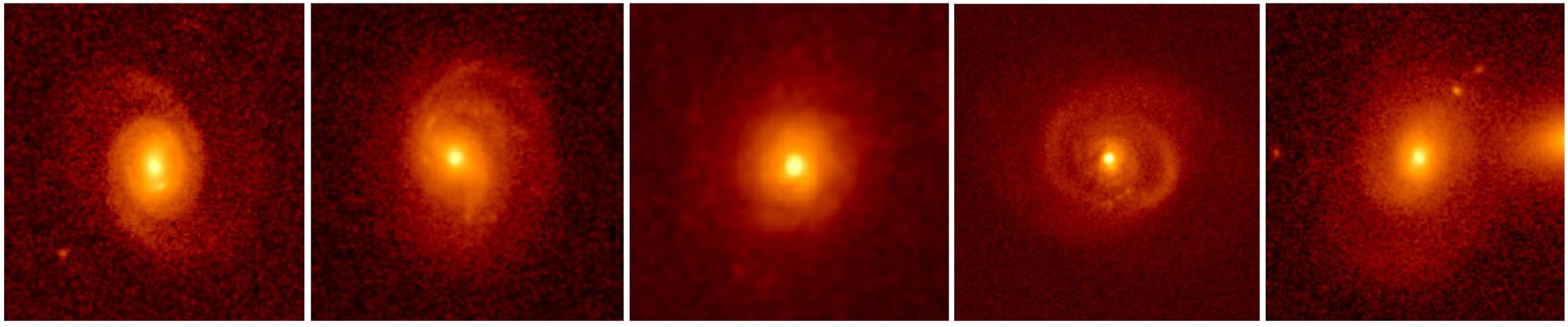
MORPHOLOGY CLASSIFICATION

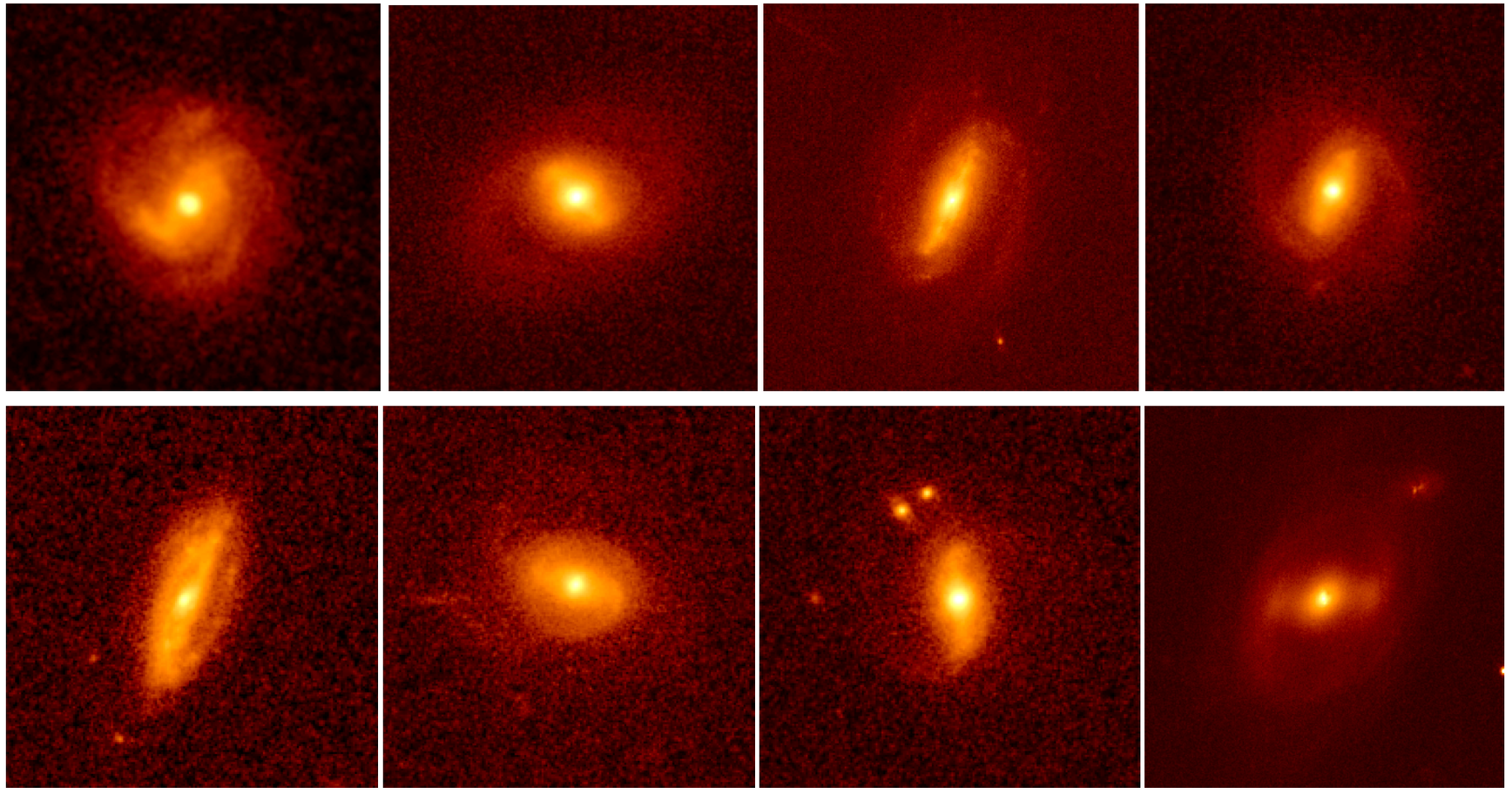
- Only 8/29 (27%) have merging or disturbed morphologies



MORPHOLOGY CLASSIFICATION

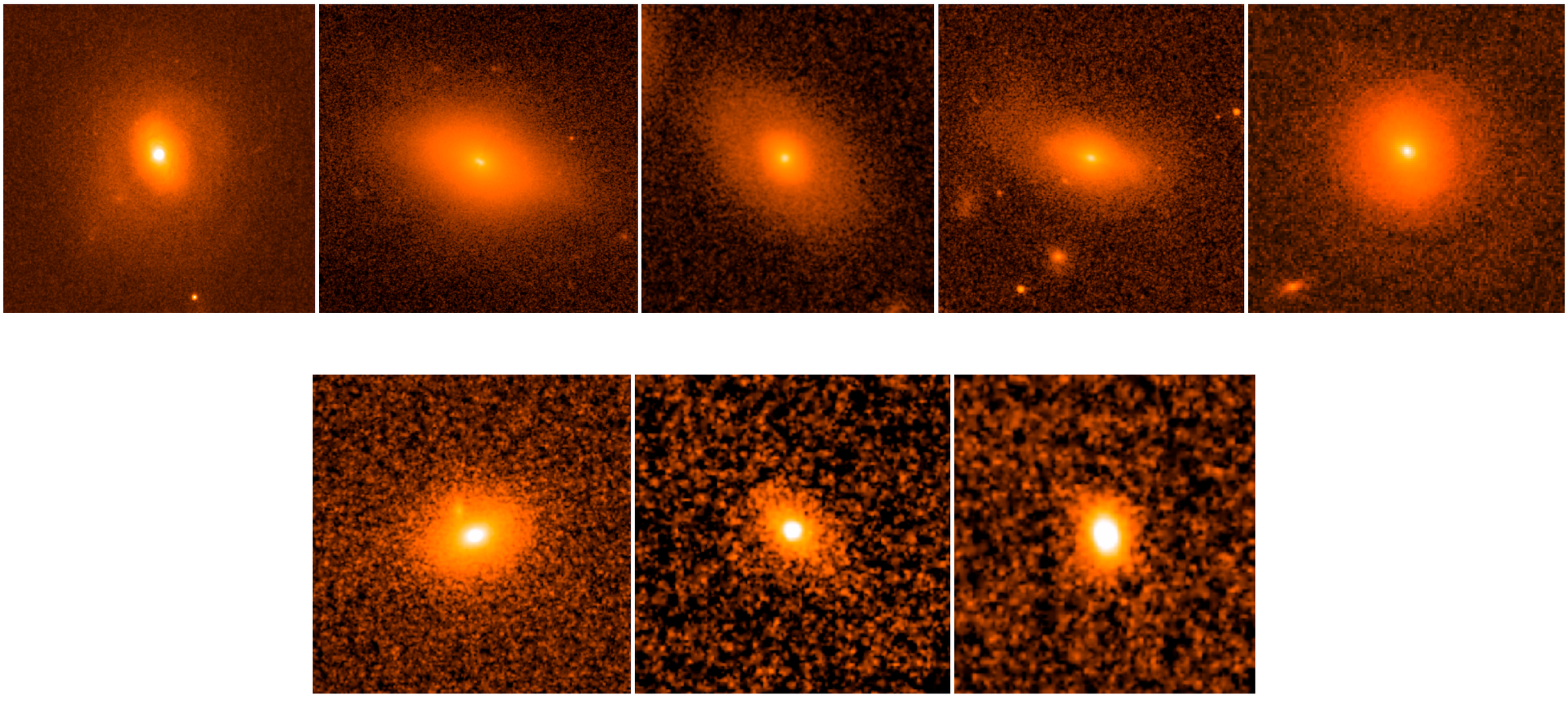
- 13/29 (45%) are spiral or bar spiral galaxies





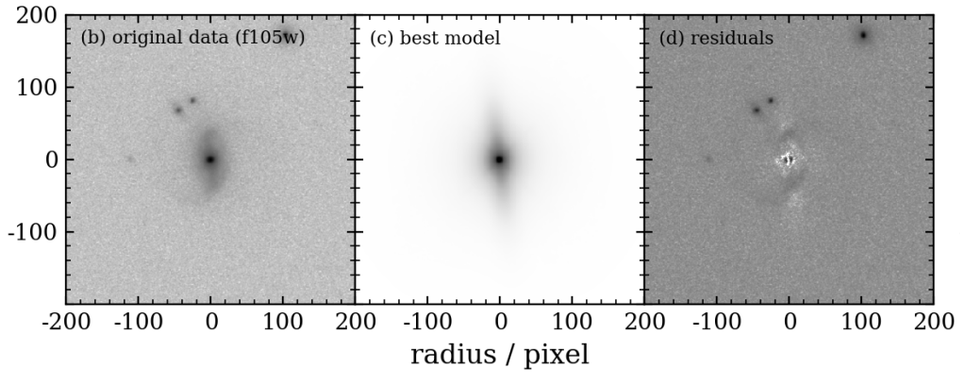
MORPHOLOGY CLASSIFICATION

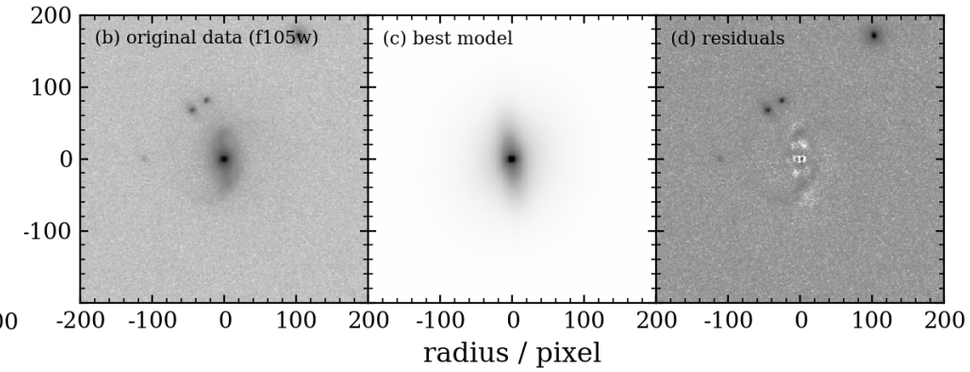
- 8/29 (28%) are lenticular or elliptical galaxies

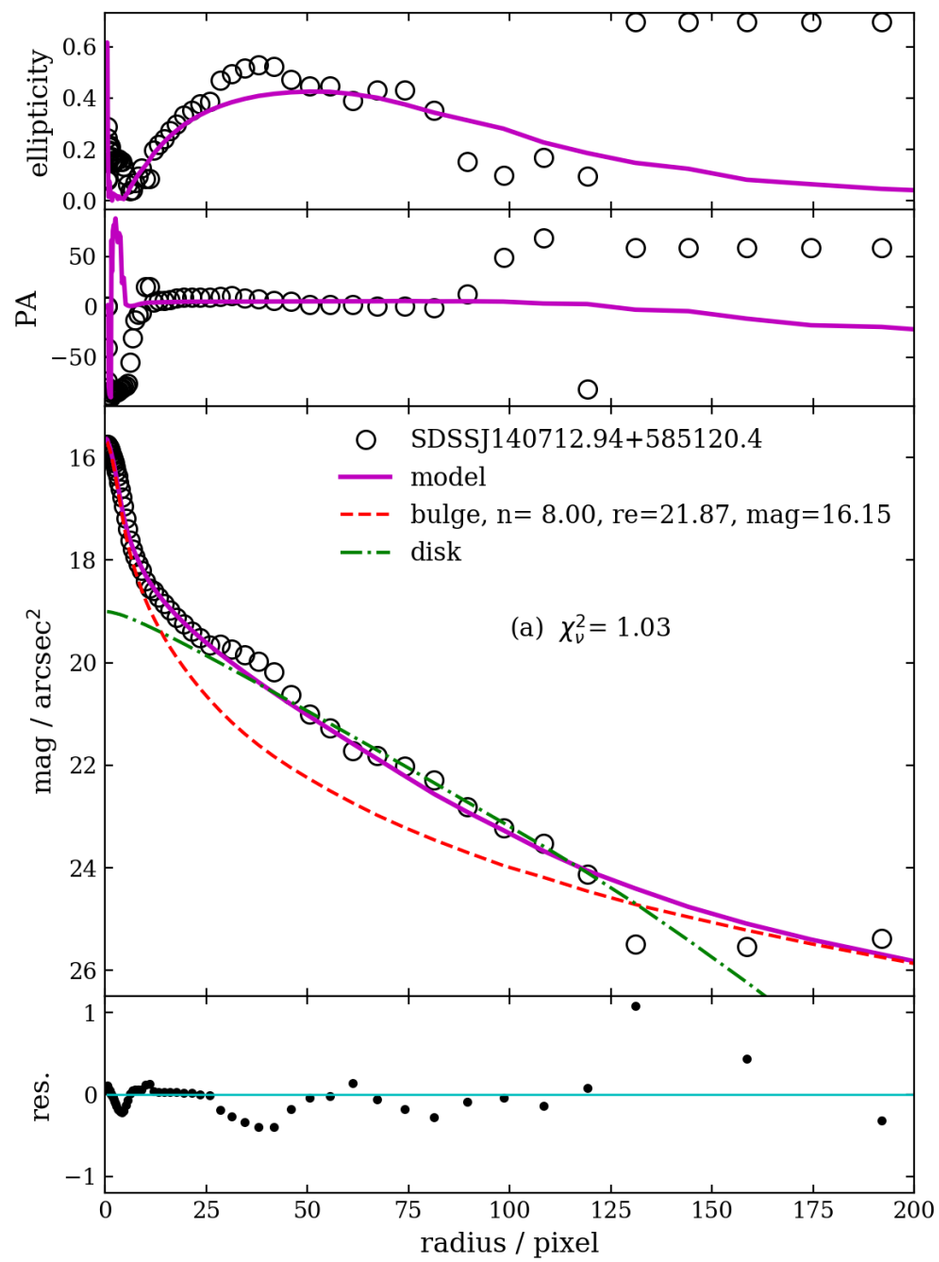


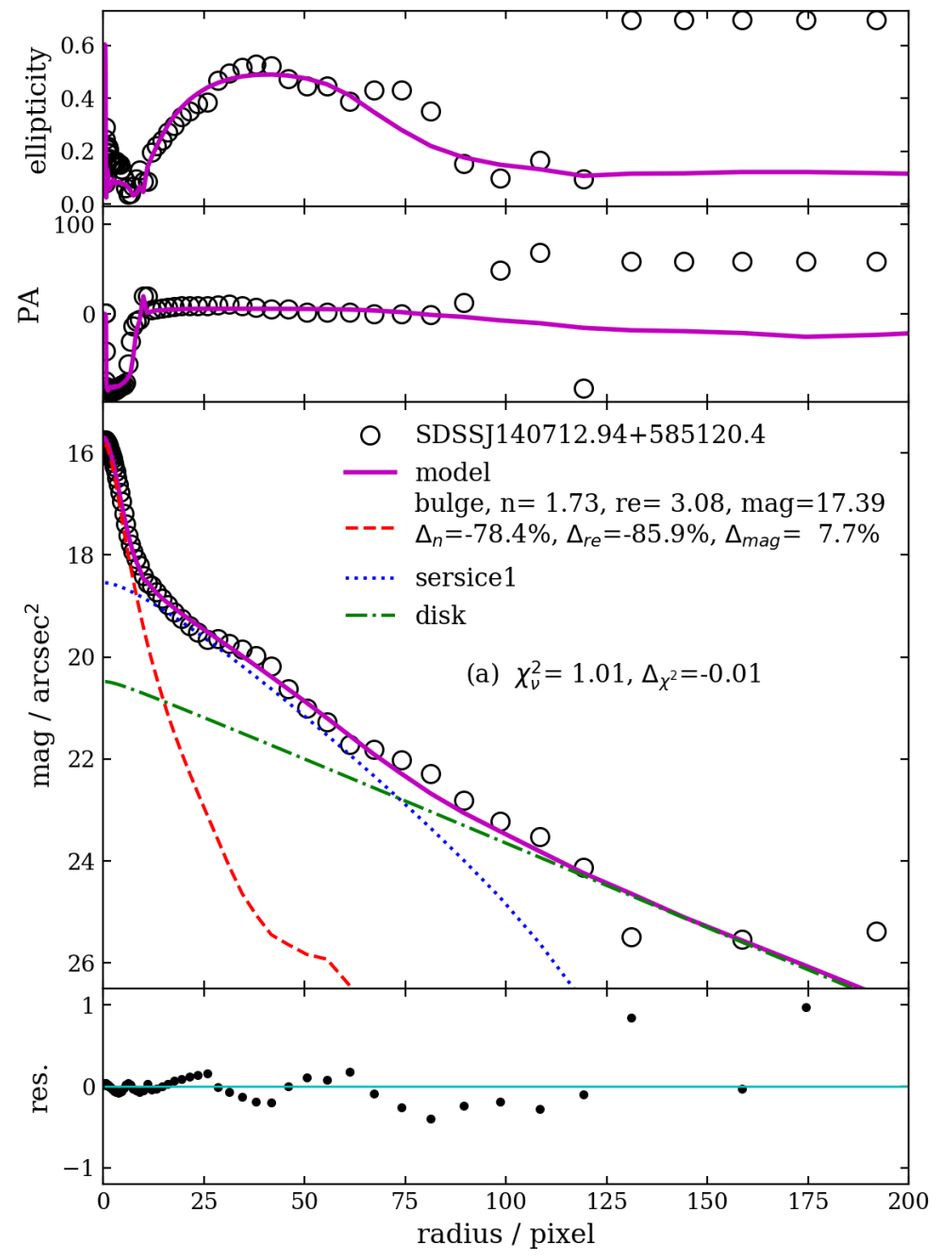
STRUCTURE MEASUREMENT

- Structures are measured by GALFIT using WFC3 NIR images
- Careful structure decomposition: bulge, bar, disk, psf
- B/T ratio from IR image
- Magnitude of WFC3 UVIS band is measured by the best-fit model of IR band









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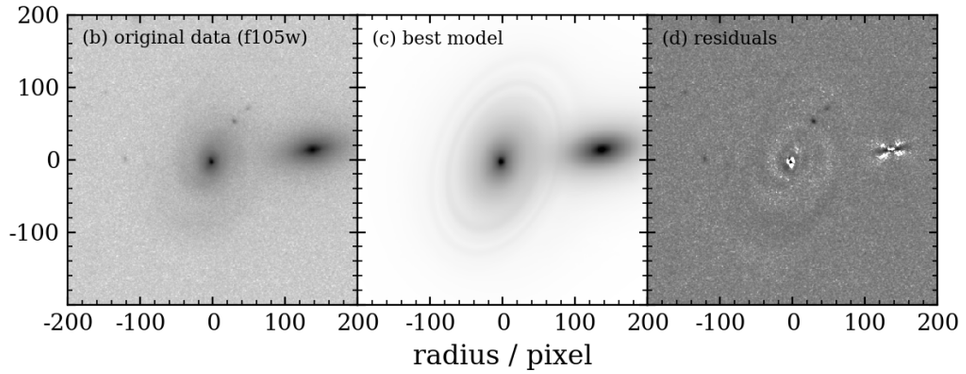
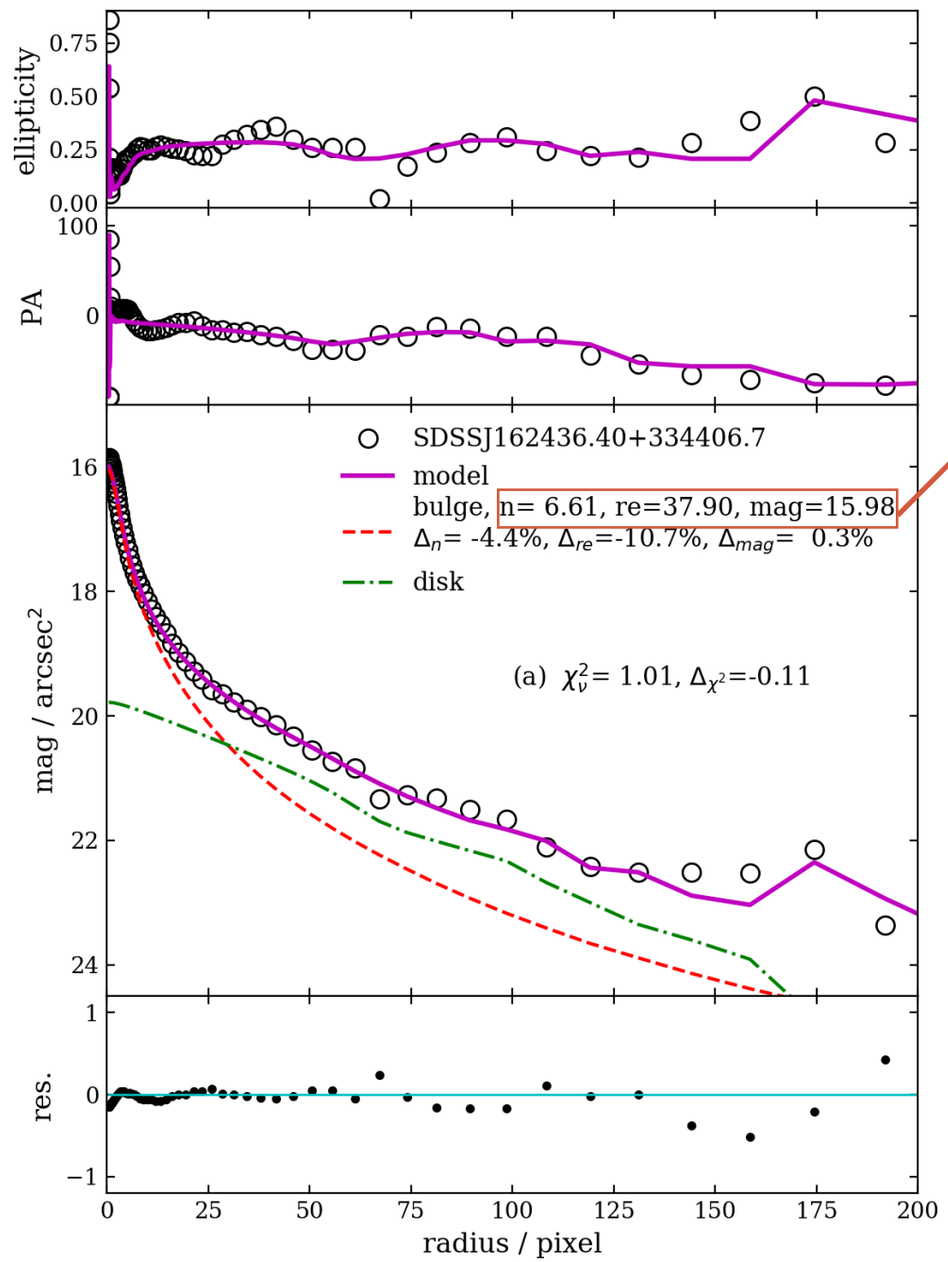
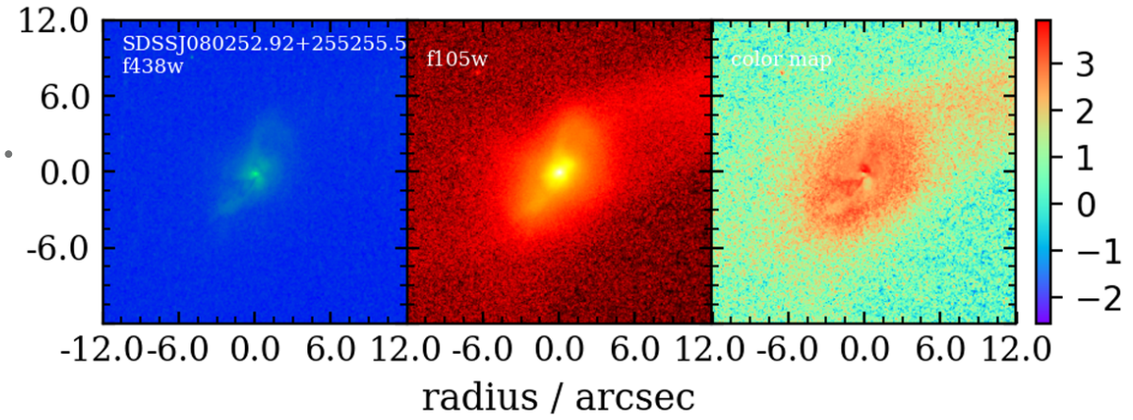


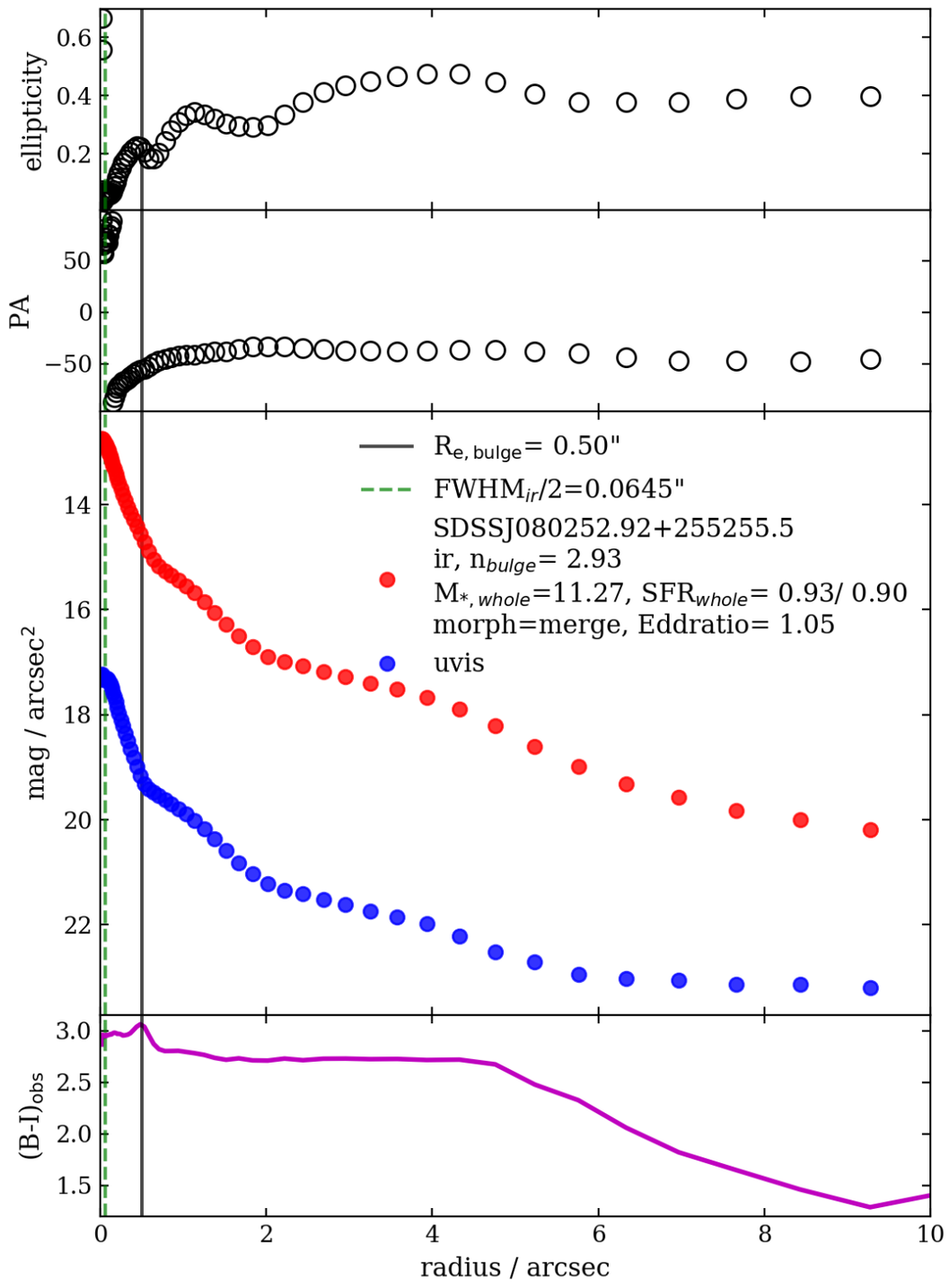


adding PSF component:
n=1.93, re=13.14, mag=16.84

COLOR MAP CREATION

- B-I color map is created by using WFC3 UVIS and IR images
- Color vs. radius shows the color information of different region of QSO2 host galaxies



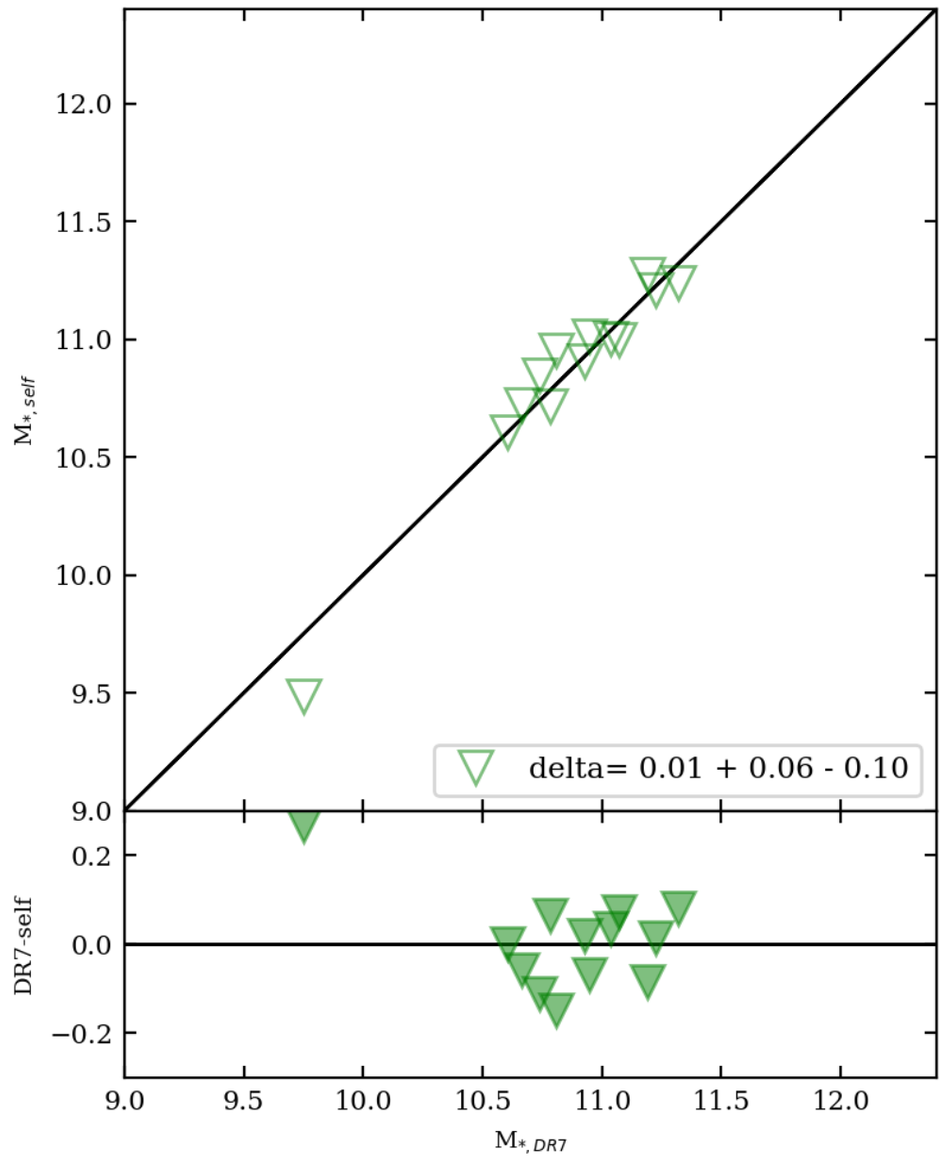


STELLAR MASS ESTIMATION

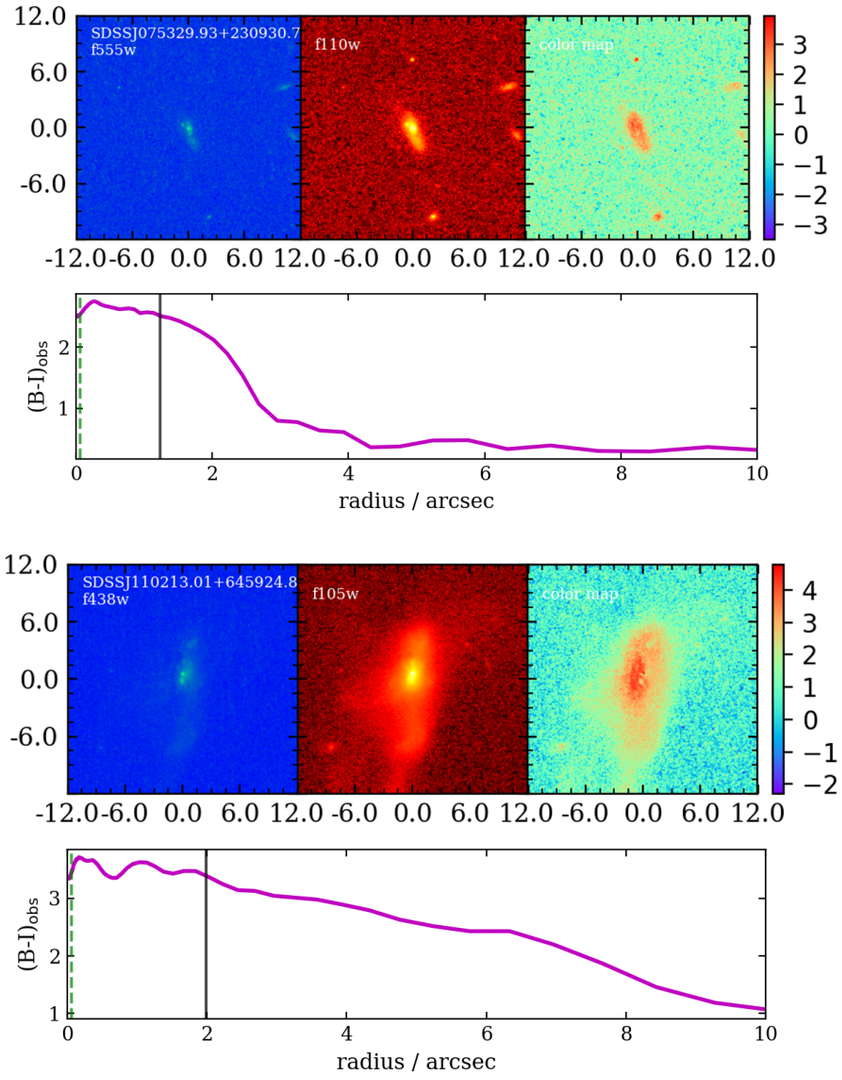
- Stellar mass is estimated by M/L ratio of Bell et al. (2001):

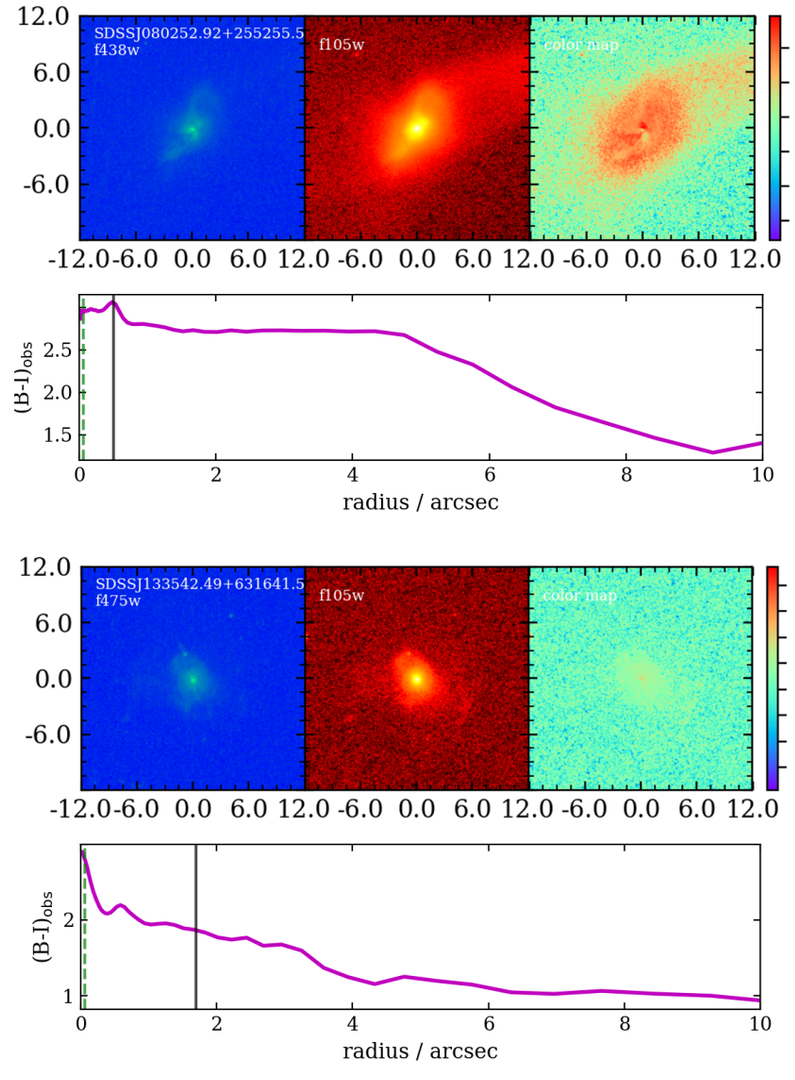
$$\log_{10}\left(\frac{\mathrm{M}_{*,\mathrm{Salpeter}}}{\mathrm{M}_{\odot}}\right) = -0.4(M_{\mathrm{I}}-M_{\mathrm{I},\odot})-0.394+0.439(B-I)$$

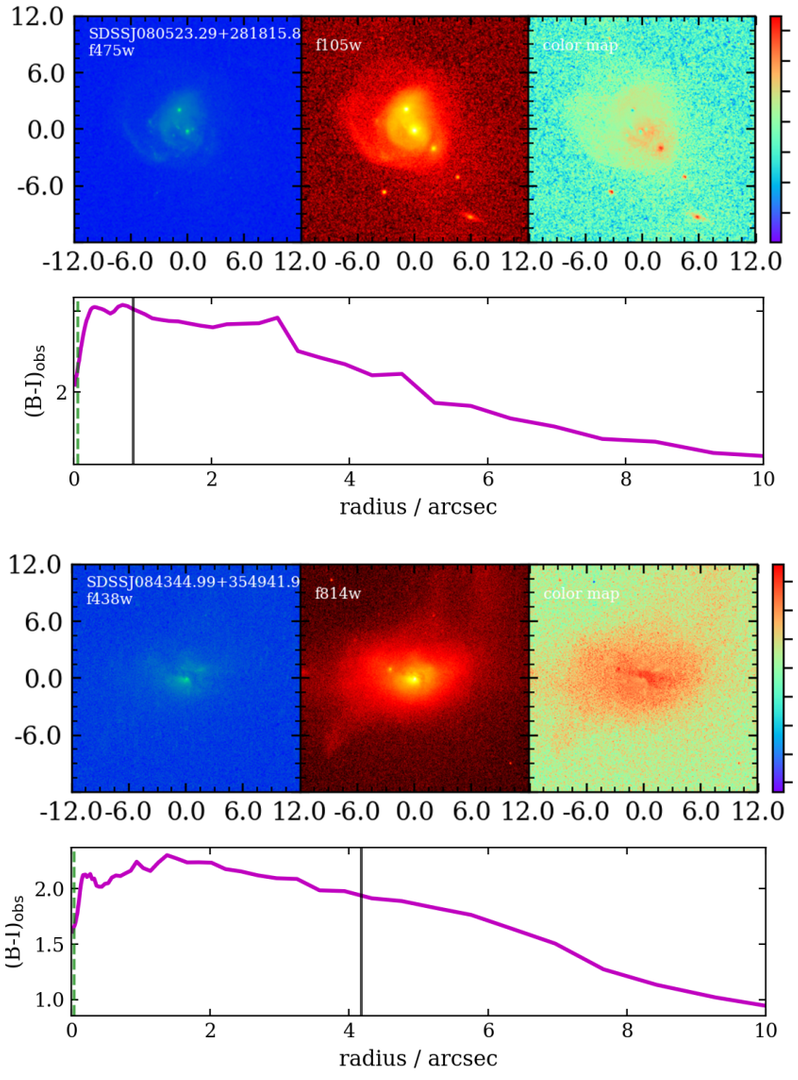
- However, measured magnitudes are contaminated by AGNs:
  - Emission lines effect: ~0.1 dex on stellar mass
  - AGN scatter light effect: ~0.01 dex on stellar mass
  - Balmer continuum effect: <0.01 dex
- Stellar mass of bulge is derived from B/T ratio

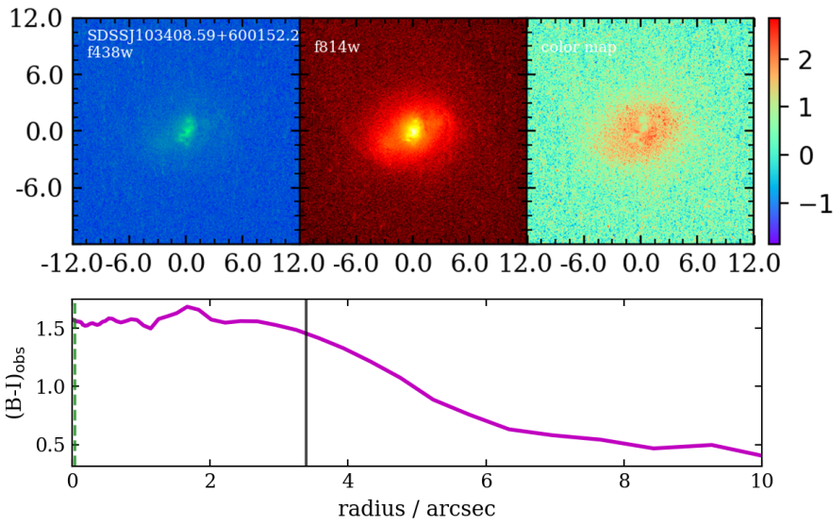


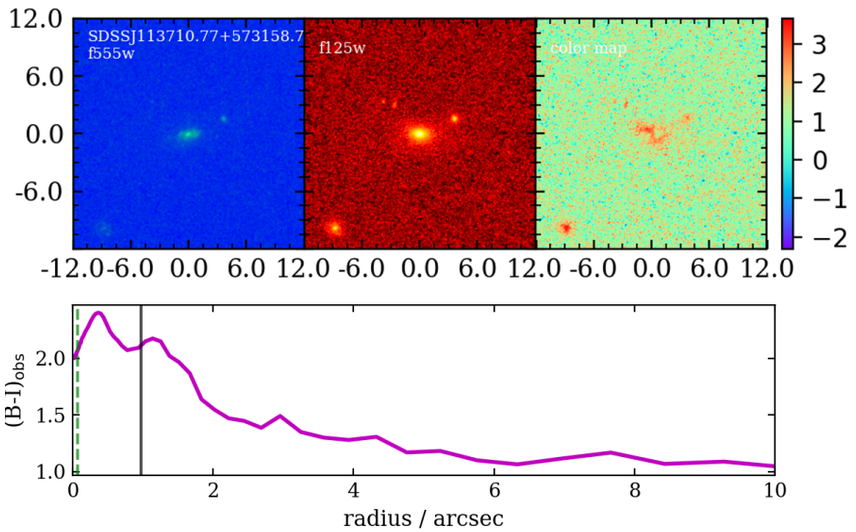
RESULTS AND DISCUSSIONS: COLOR MAP





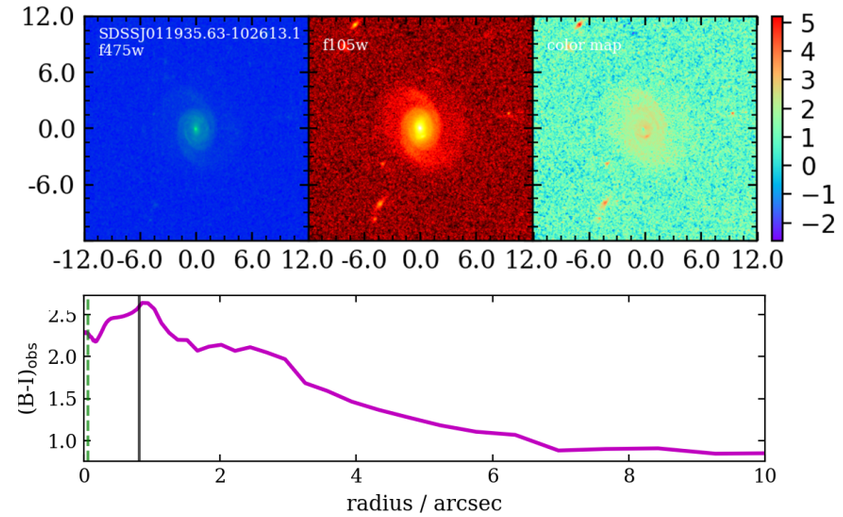


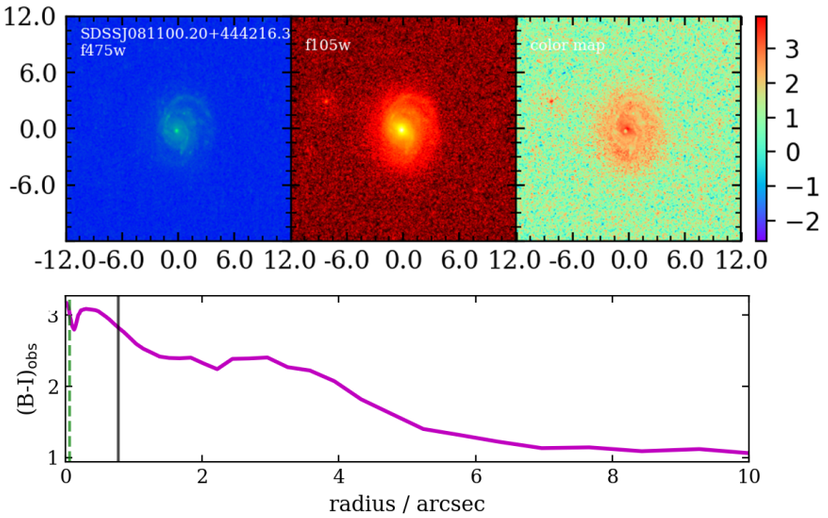


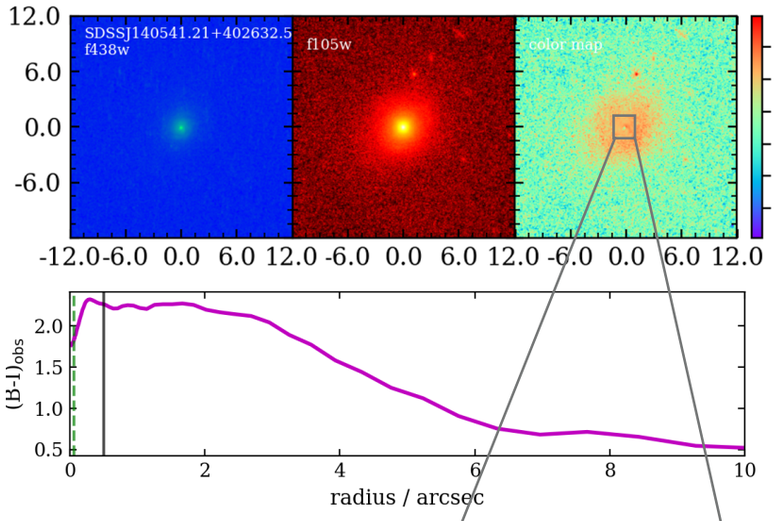


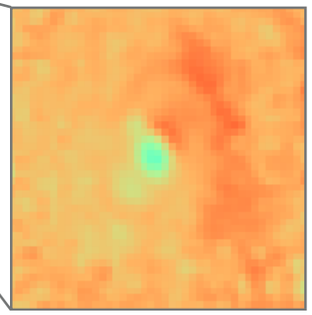
- host galaxies in merging or disturbing

RESULTS AND DISCUSSIONS: COLOR MAP



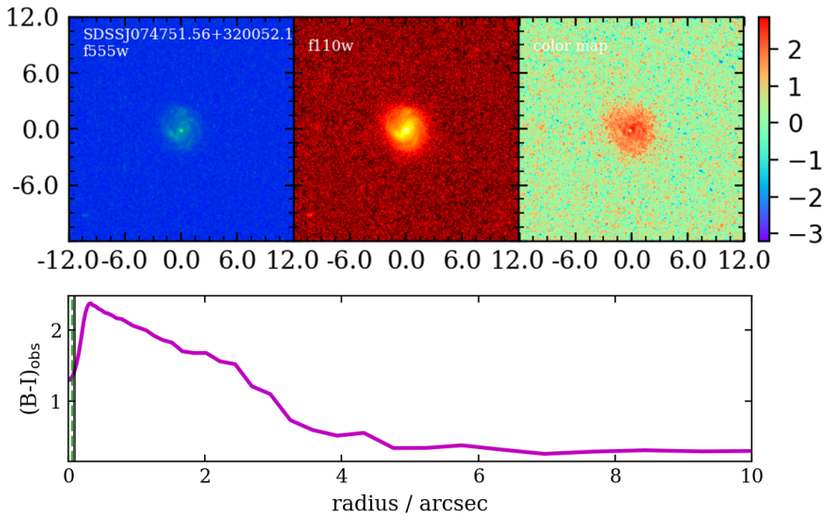


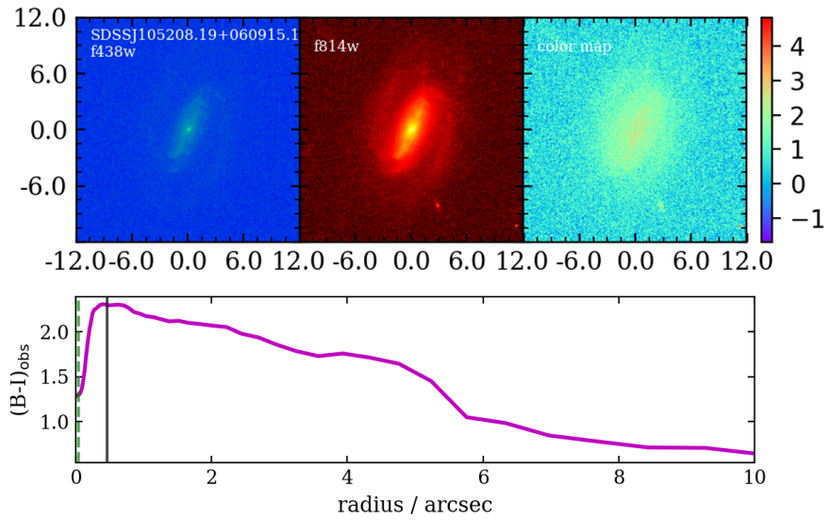


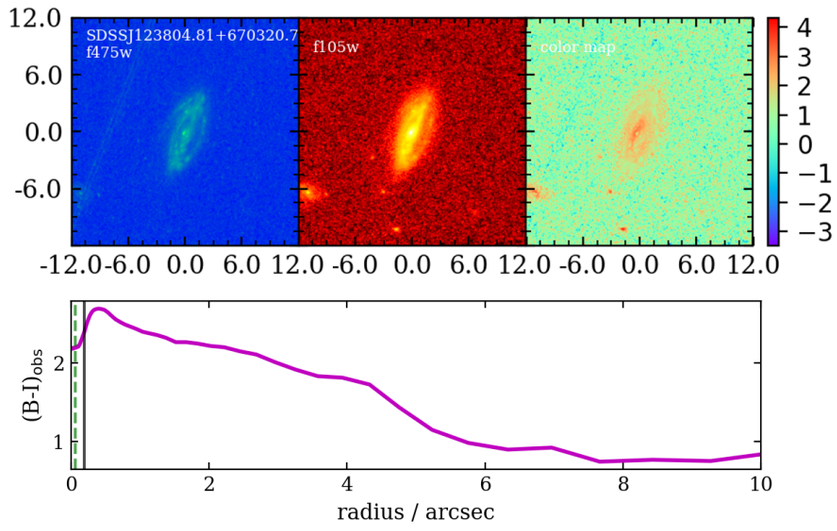


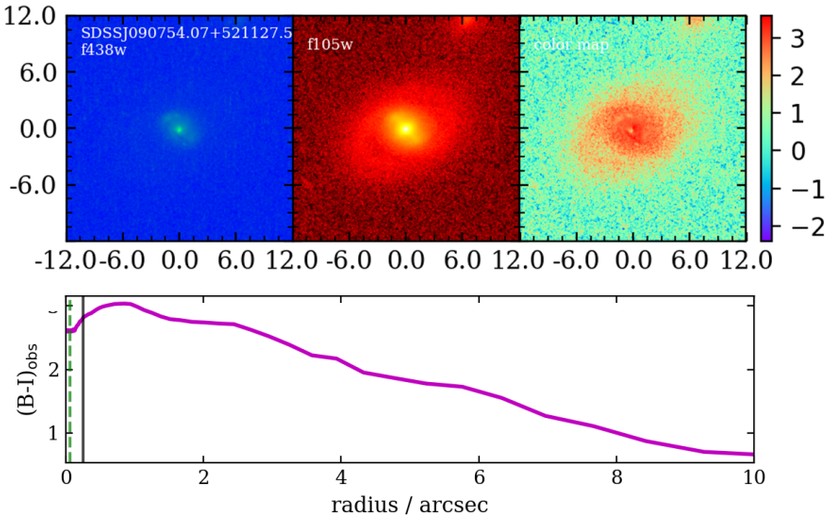
- spiral host galaxies

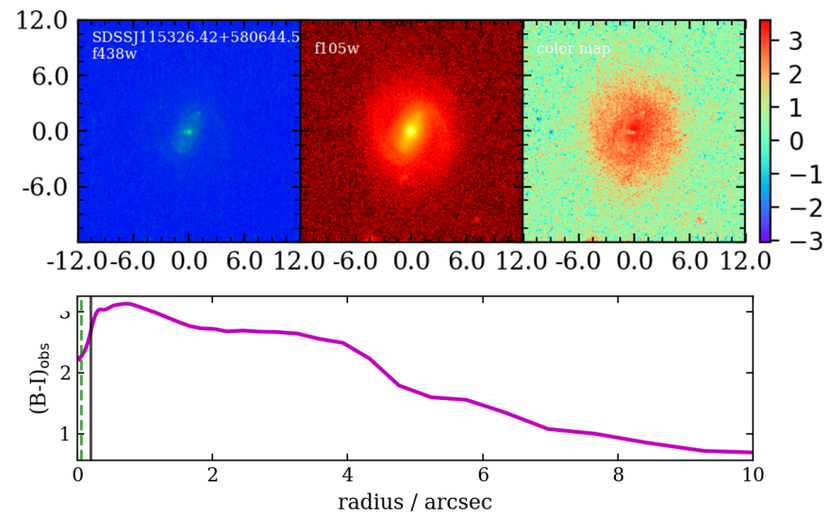
RESULTS AND DISCUSSIONS: COLOR MAP

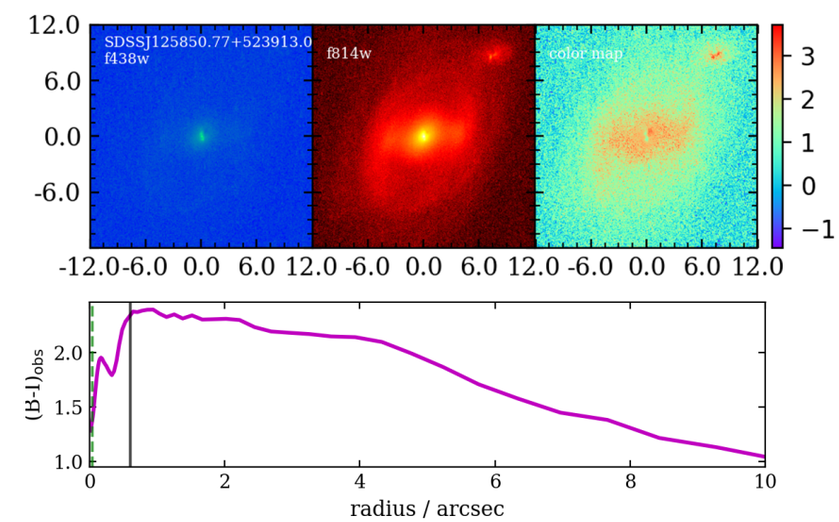


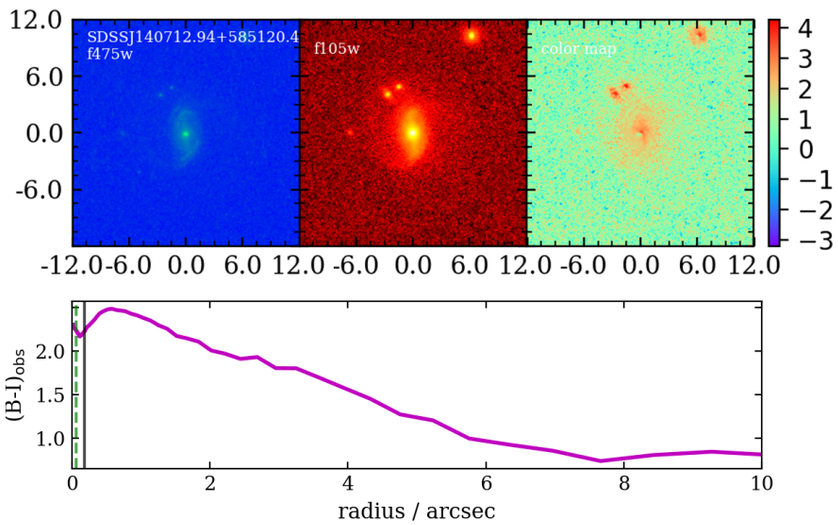


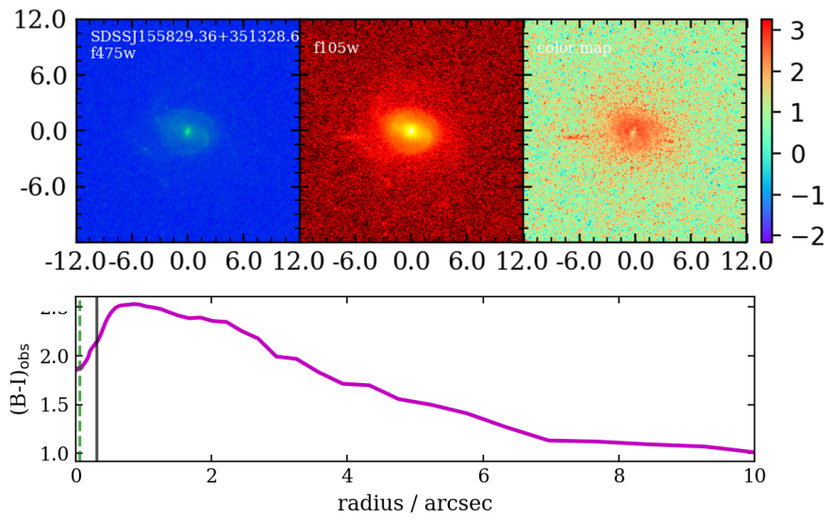






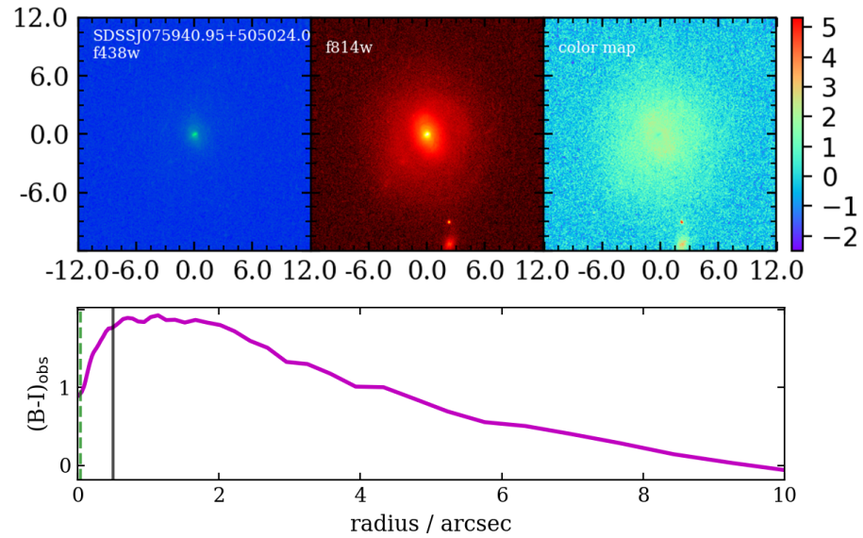


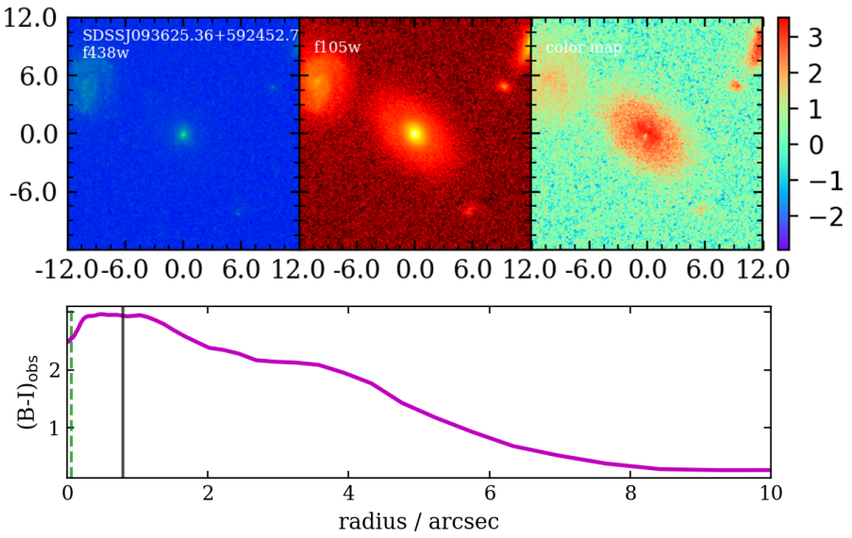


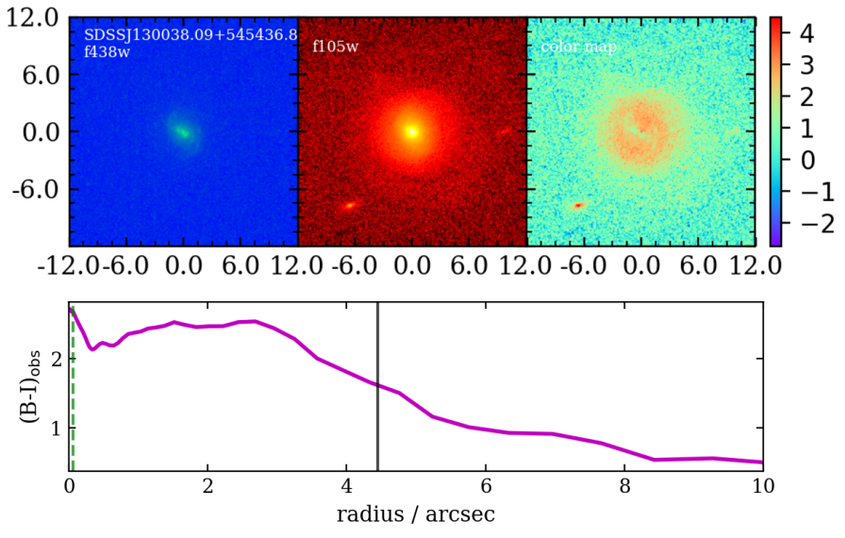


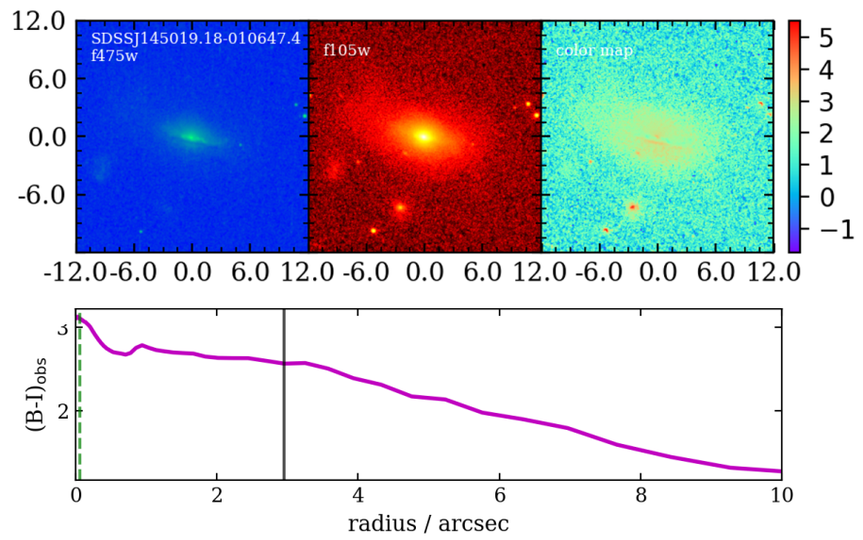
- bar spiral host galaxies

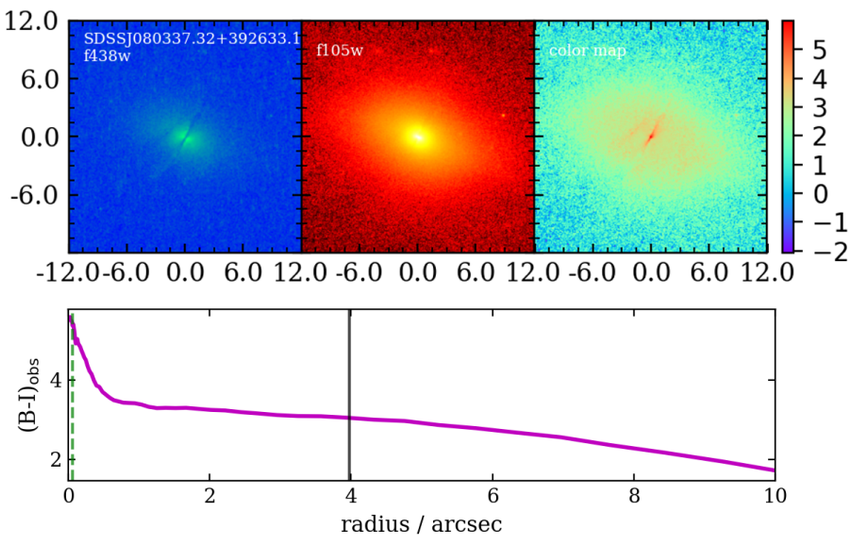
RESULTS AND DISCUSSIONS: COLOR MAP







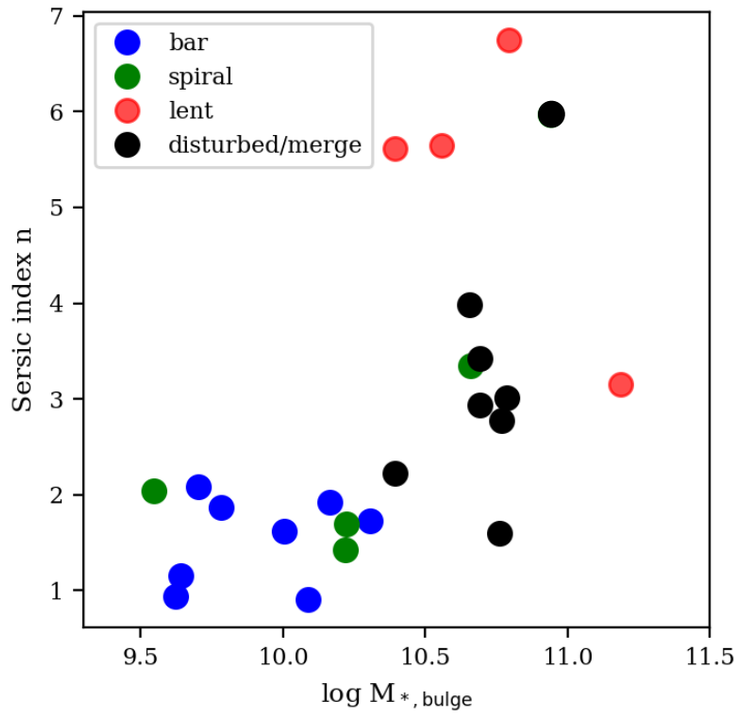


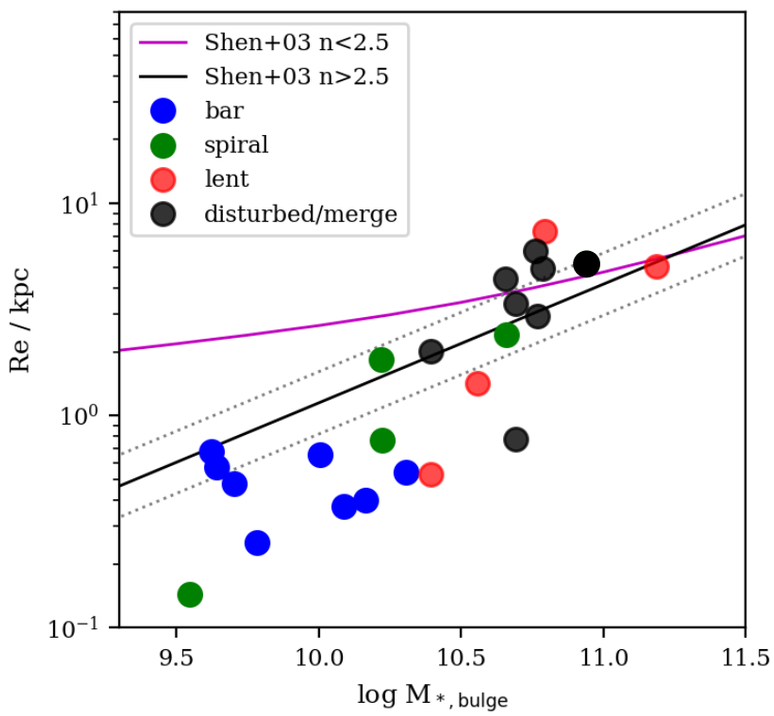


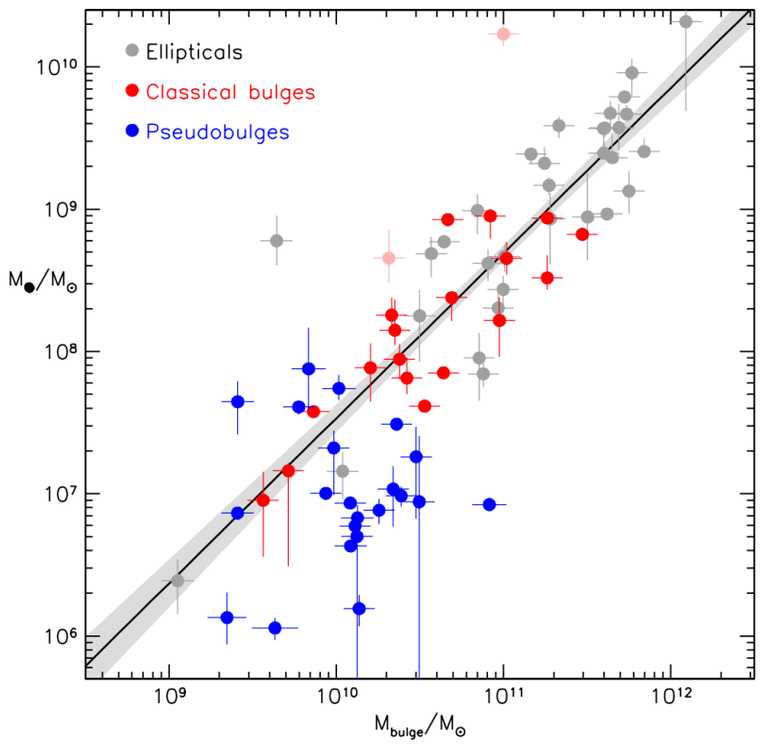
- lenticular host galaxies

RESULTS AND DISCUSSIONS: BULGE

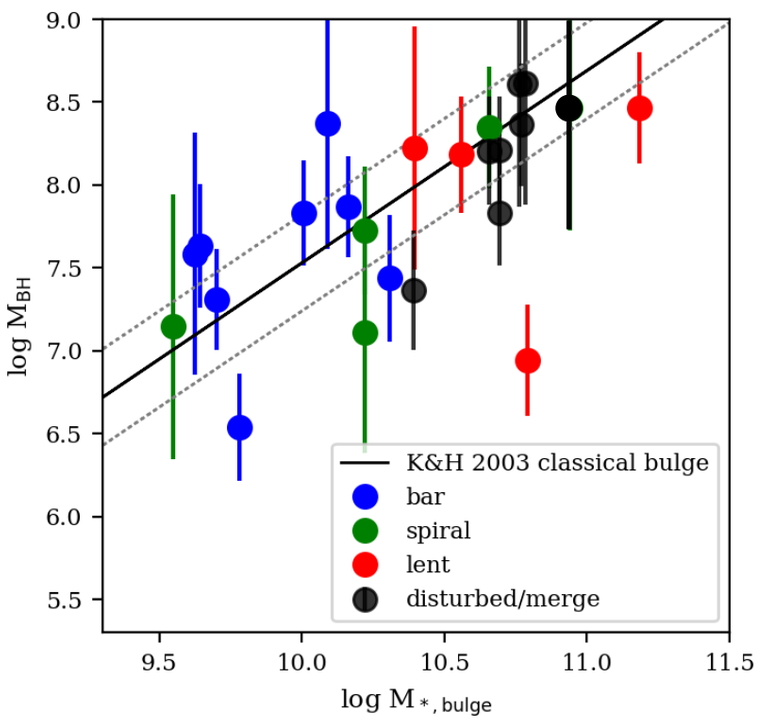
- Bulge properties:
  - host galaxies in merging/ disturbing do not possess bulges with special properties
  - host galaxies in late-type profiles (i.e., bar spiral or spiral) possess pseudobulges
- BH masses are measured by Minzhi Kong (HNU)

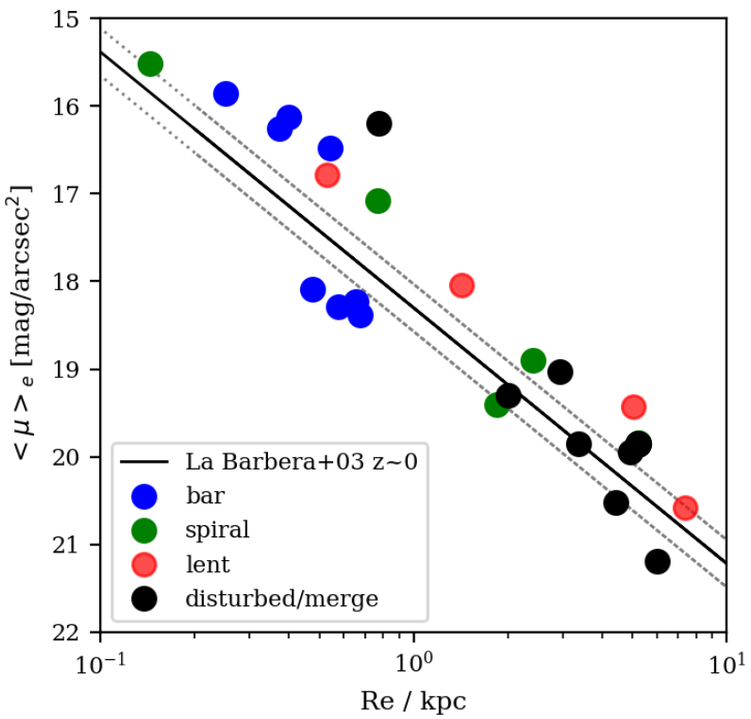






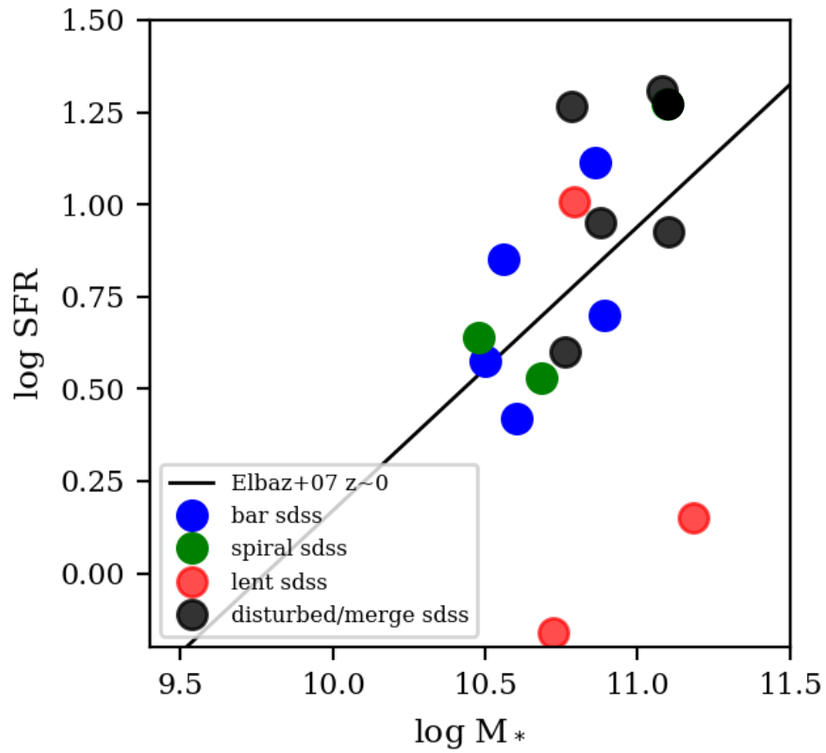
Kormendy & Ho (2003)

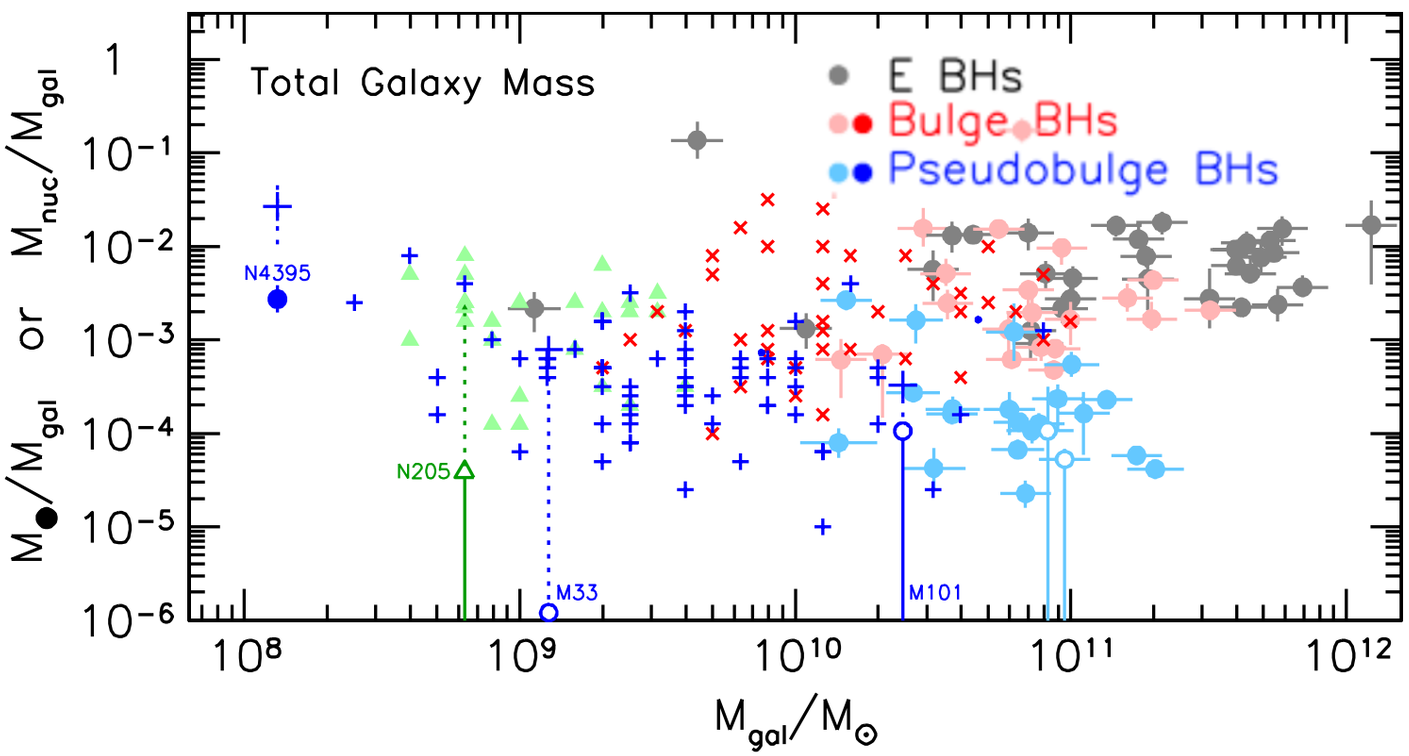




RESULTS AND DISCUSSIONS: WHOLE

- Properties of whole host galaxy:
  - host galaxies in merging/disturbing do not have special properties





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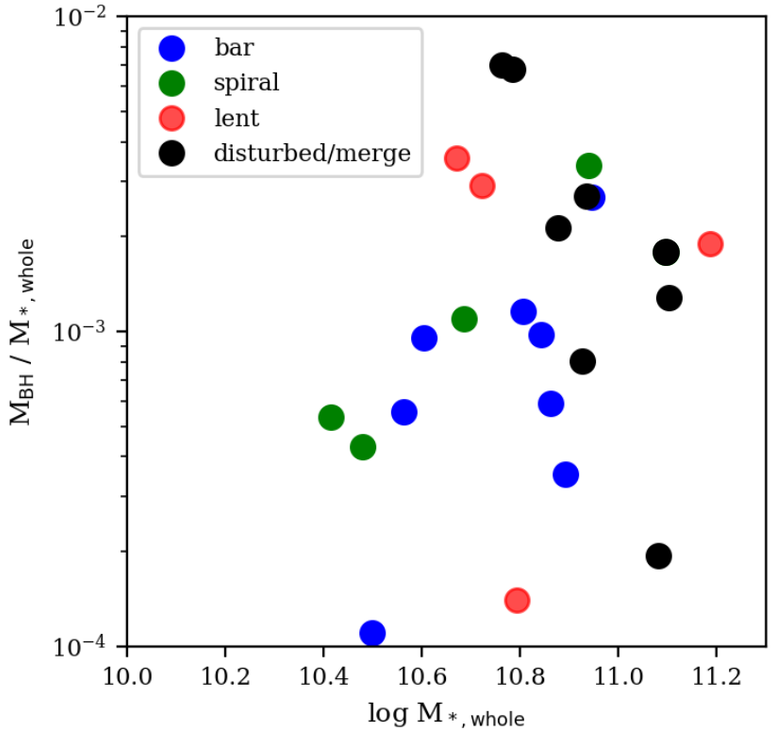
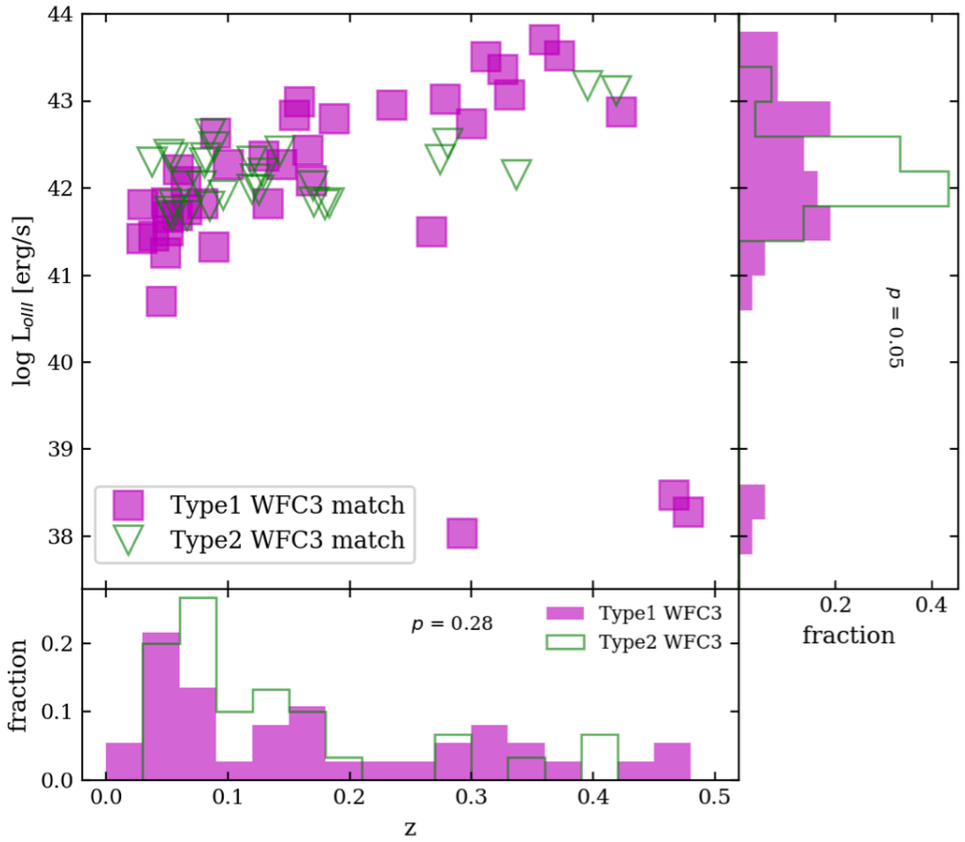
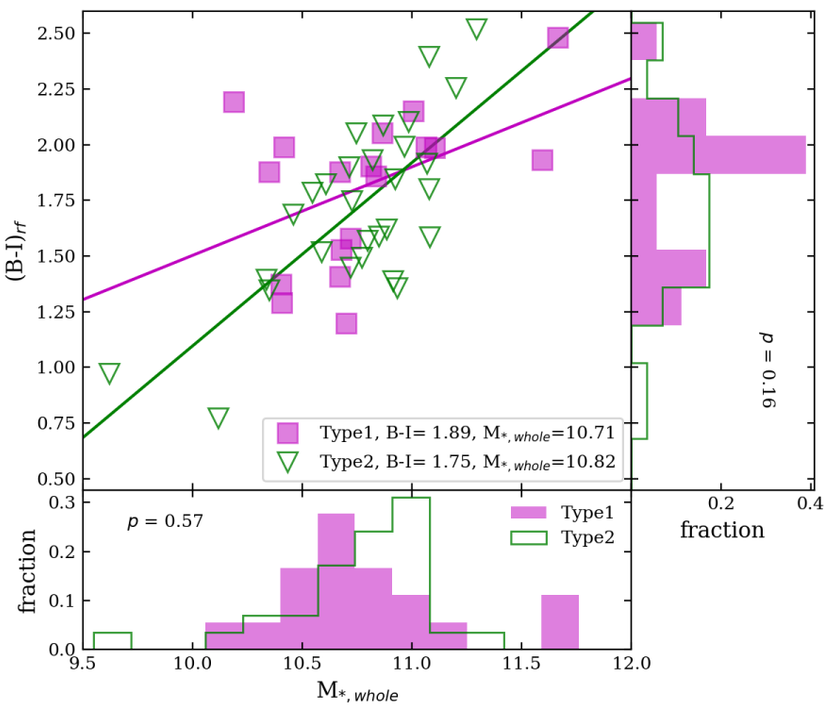
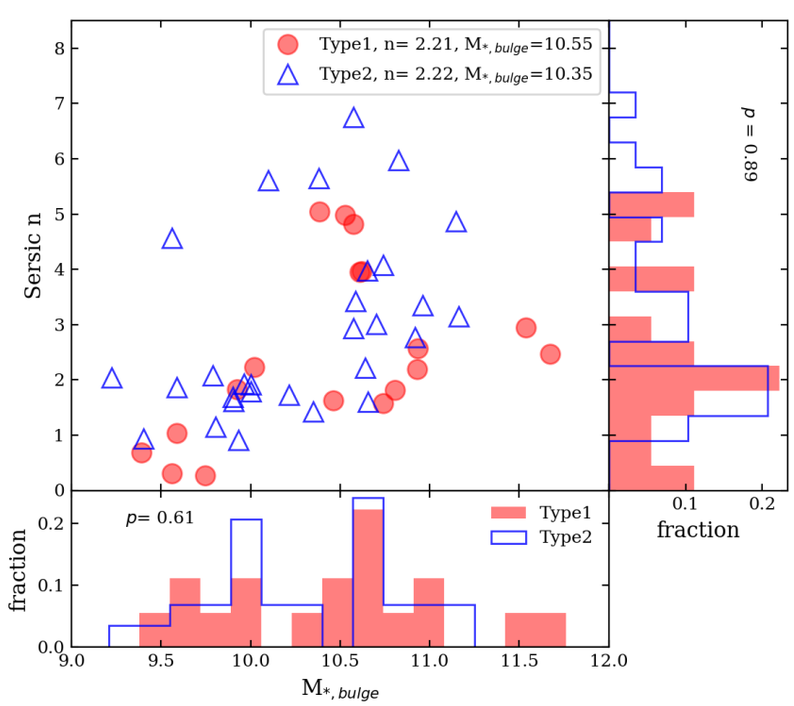


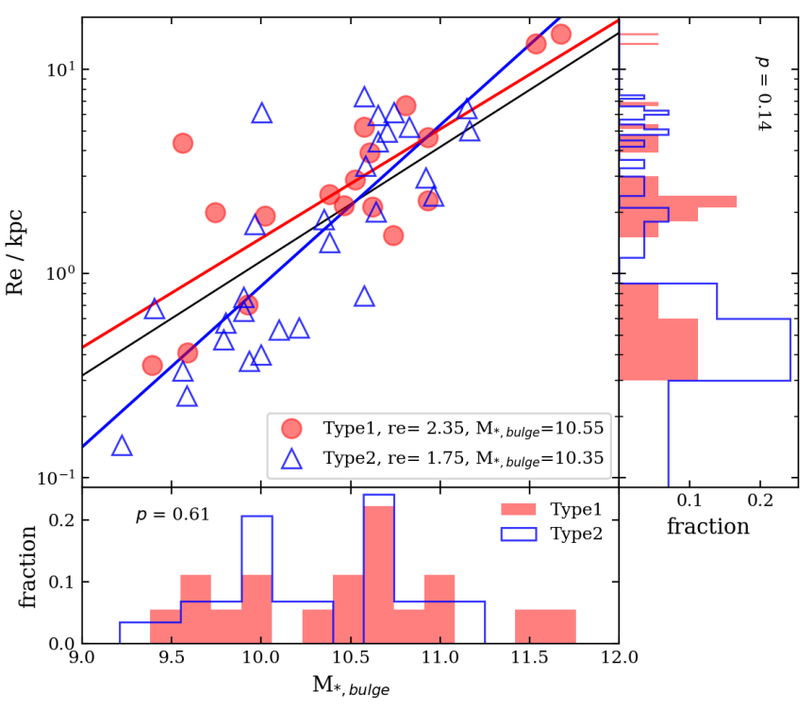
RESULTS AND DISCUSSIONS: COMPARE WITH QSO1S

- 30 QSO1s with similar z and $L_{[OIII]}$ distribution
- Properties of QSO1 host galaxies are measured with the same method as QSO2s by Yulin Zhao (KIAA)
- QSO2s are not distinguished from QSO1s









TAKE HOME MESSAGES

- Only 27% of our local QSO2s are in merging or disturbed phase, but 45% have late-type host galaxies, and 28% have early-type host galaxies.
- Host galaxies of QSO2s in merging/disturbing do not have special properties.
- Host galaxies of QSO2s and QSO1s have similar properties.
- Merger may not be an important mechanism to trigger AGNs.

THANK YOU