Internal Structure of Galaxies at z~3 with AO

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Morphology of galaxies in the nearby universe

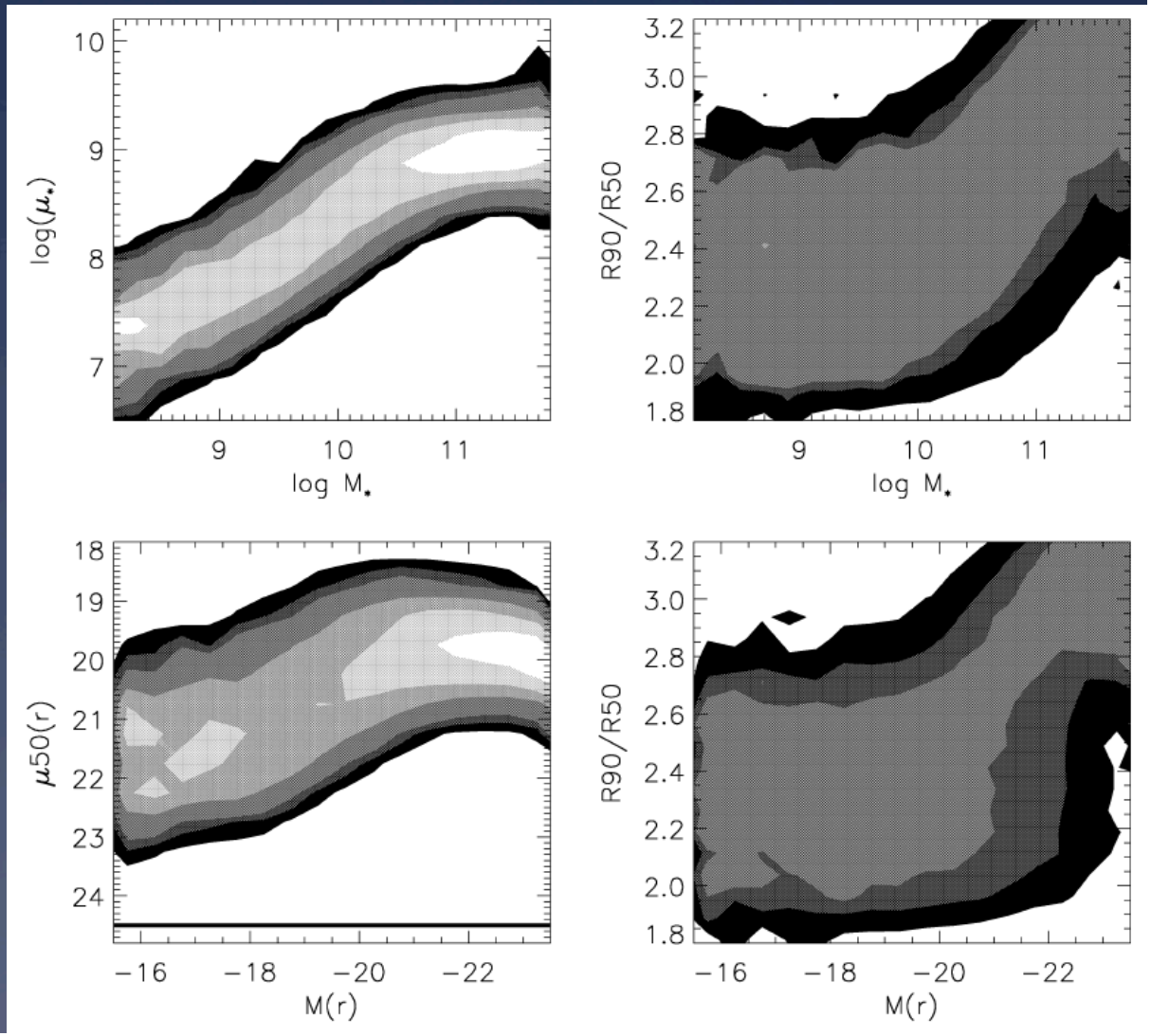
- At z~0:
  - Various types of morphologies → Hubble sequence
  - Many studies have been trying to understand the emergence of the Hubble sequence
    - → equivalent to the questions of how and when elliptical or disk galaxies in the nearby universe developed

Internal structure of galaxies at z~3

- Morphological studies:
  - Concentration
  - Asymmetry
  - Etc.
- Color distributions
- Stellar population distributions
- Statistical study of intrinsic structure

Dependence of internal structure on the stellar mass for low-z galaxies

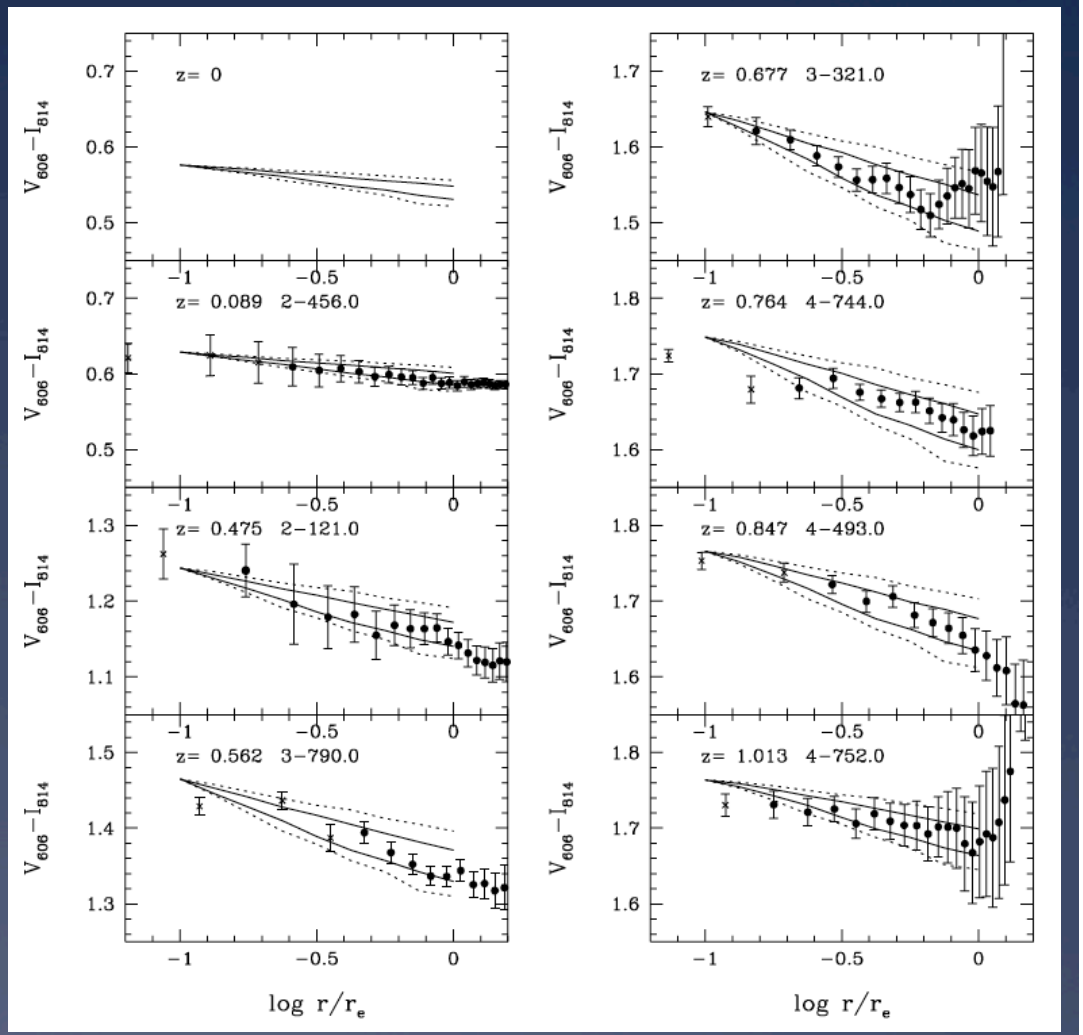
- High mass galaxies are more concentrated and show more stellar surface mass density than the low mass ones.



Kauffamnn+03, MNRAS, 341, 54

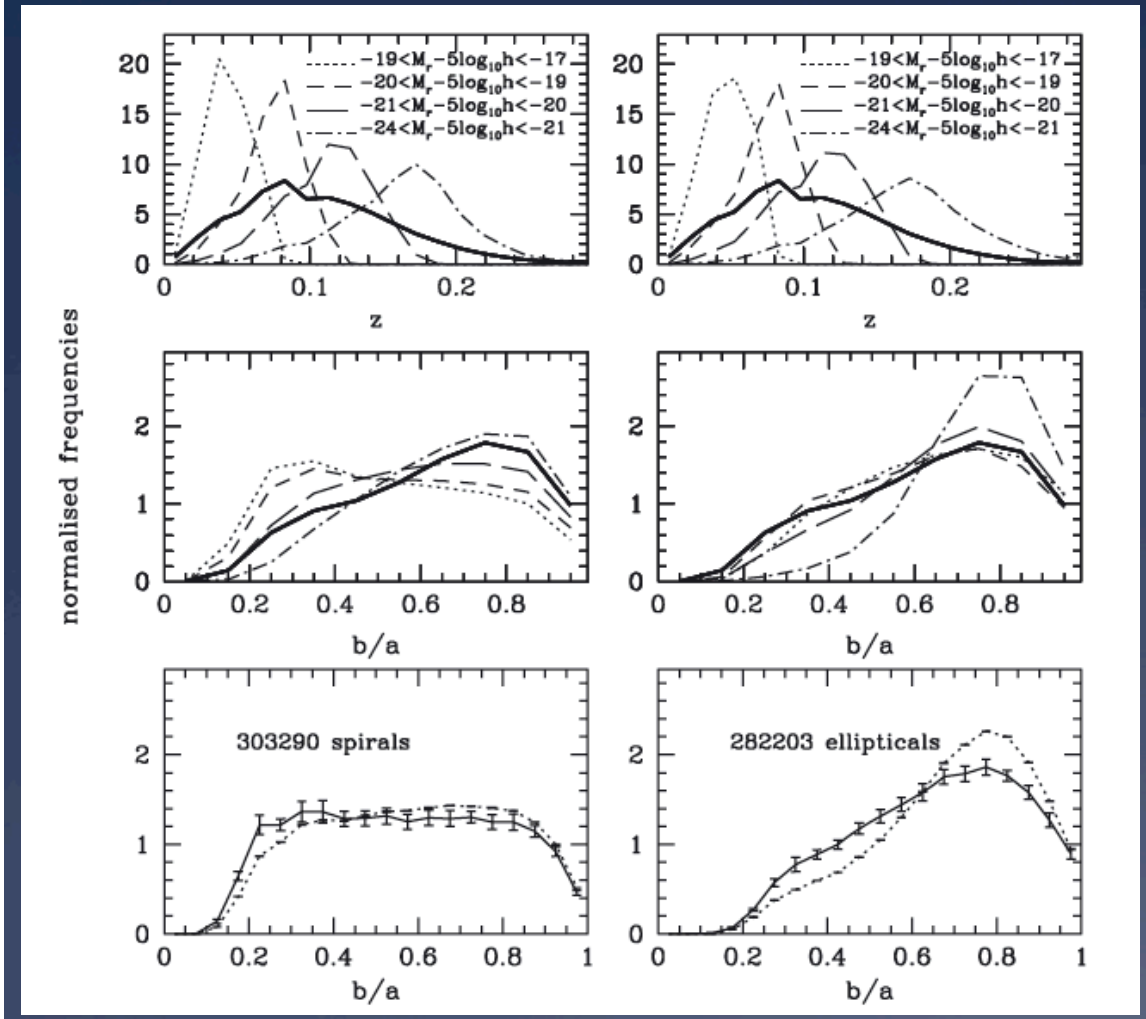
Color gradients of elliptical galaxies

- Color gradients of elliptical galaxies up to z~1
- Origin of the color gradient is likely to be stellar metallicity, not age



Tamura+00, AJ, 119, 2134

Shapes of galaxies in SDSS



- Assuming tri-axial model with axes A>B>C
- Spiral or disk galaxies intrinsically have a flat and round disk, while elliptical galaxies show a spheroid shape

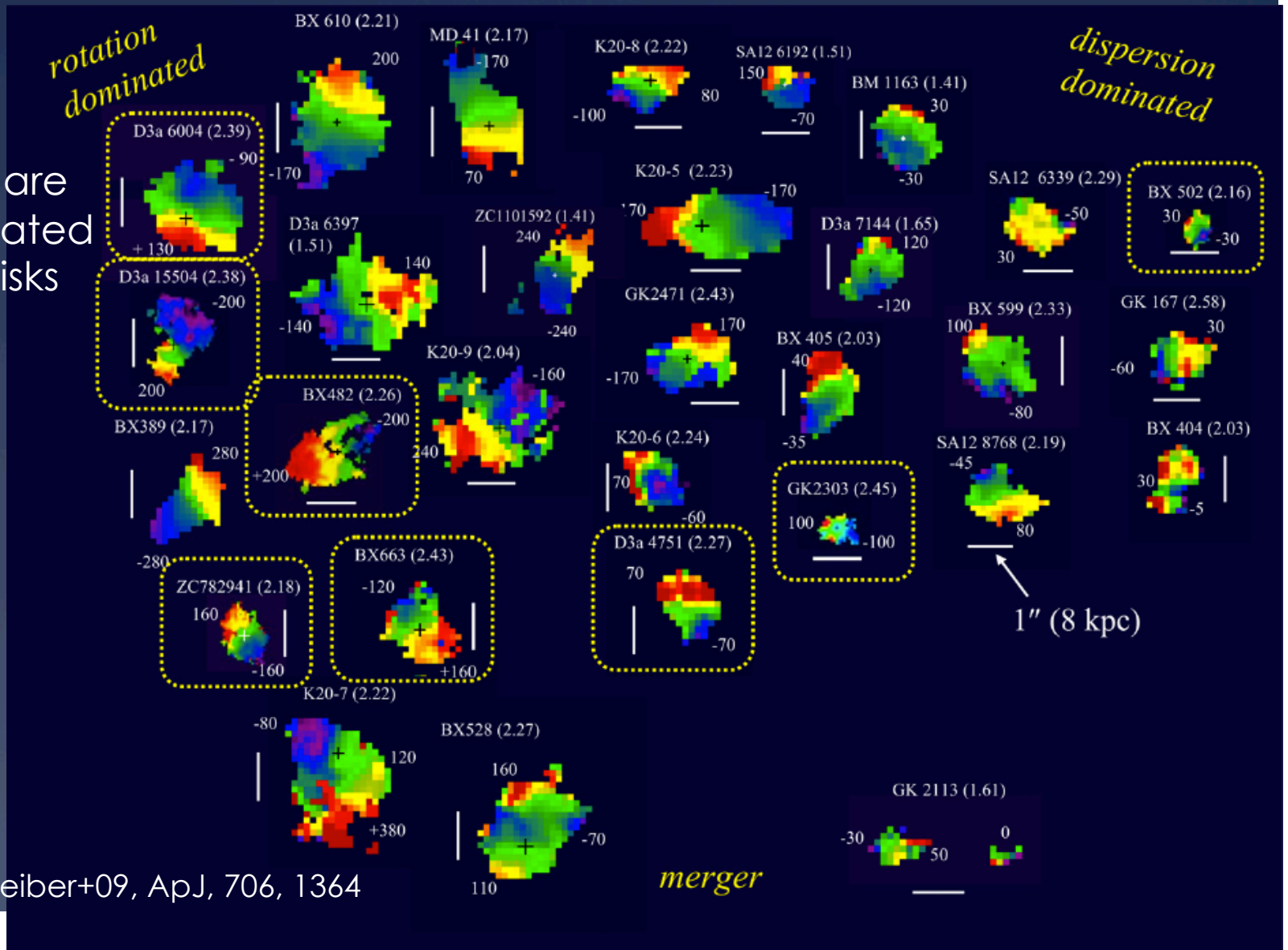
Padilla+08, MNRAS, 388, 1321

NIR spectroscopic imaging survey at z~2

VLT/SINFONI + AO

Kinematic varieties

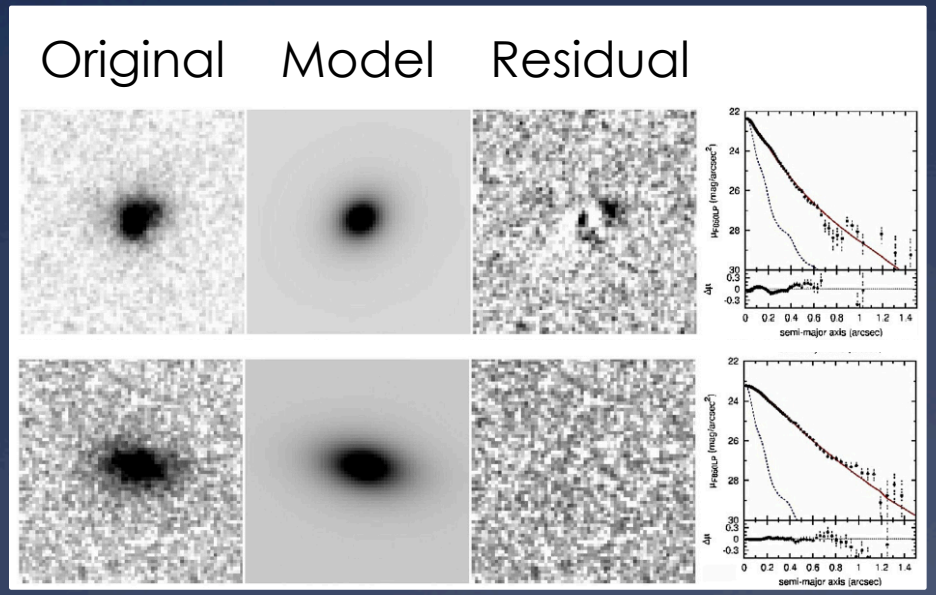
1/3 of samples are rotation-dominated but turbulent disks

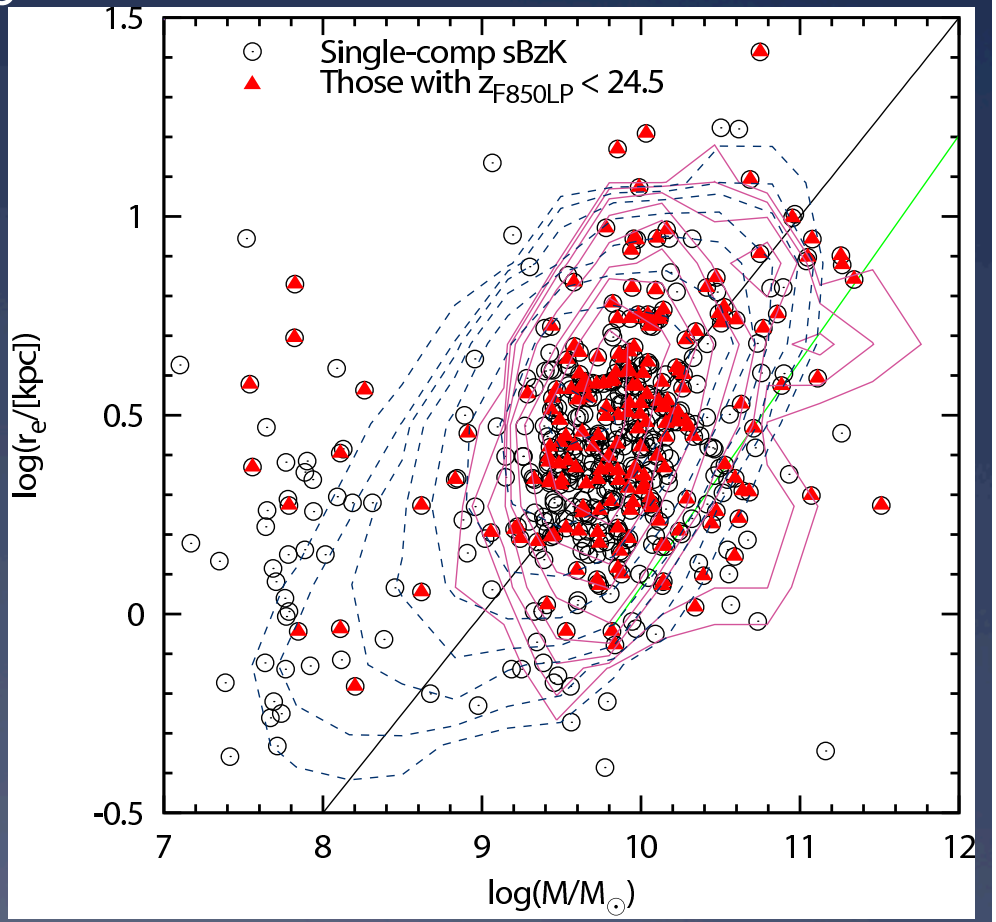


Förster Schreiber+09, ApJ, 706, 1364

Structure of galaxies at z~2

* Rest-frame UV Study of star-forming BzK galaxies in GOODS-N with HST/ACS

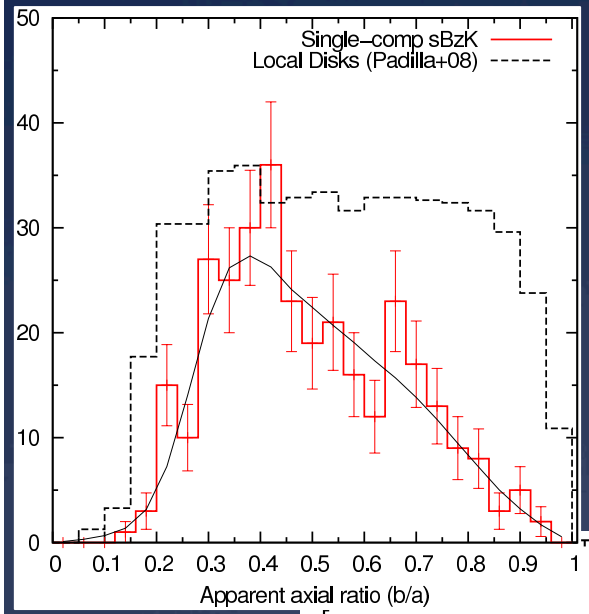


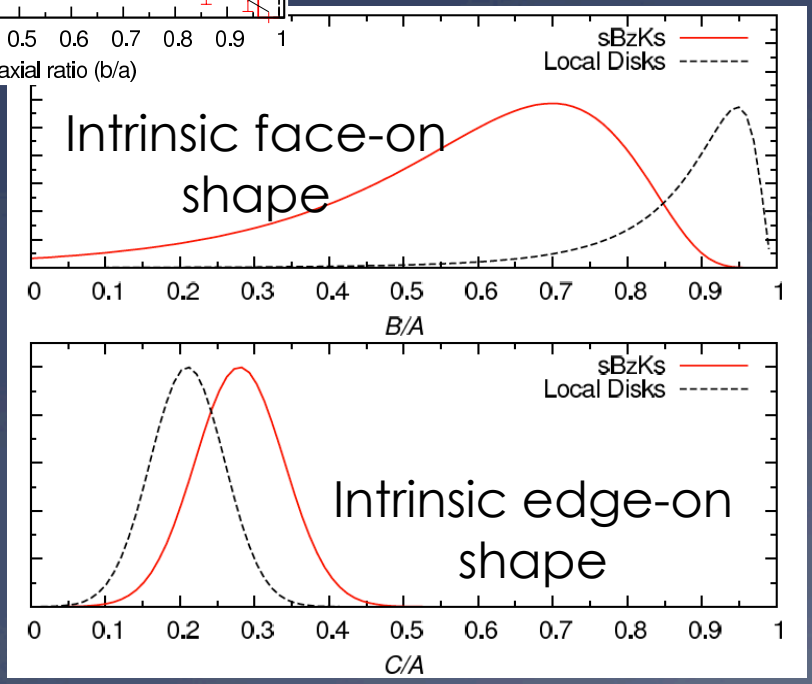


- Most of the sample show Sérsic index of n~1
- Comparable stellar surface mass density to the z~0-1 disk galaxies ➔ suggestive of disk structure?

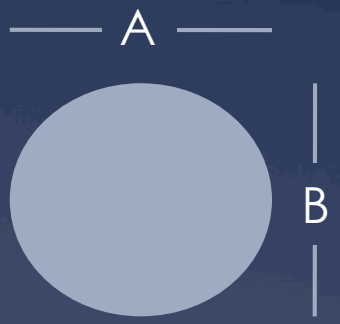
Yuma+11, ApJ, 736, 92

Intrinsic structure of sBzK

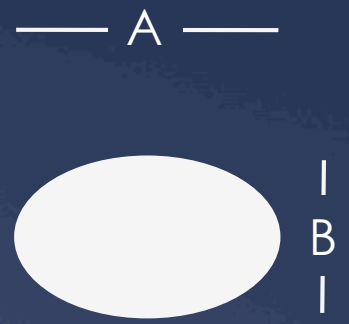




Local Disks



sBzK @ z~2



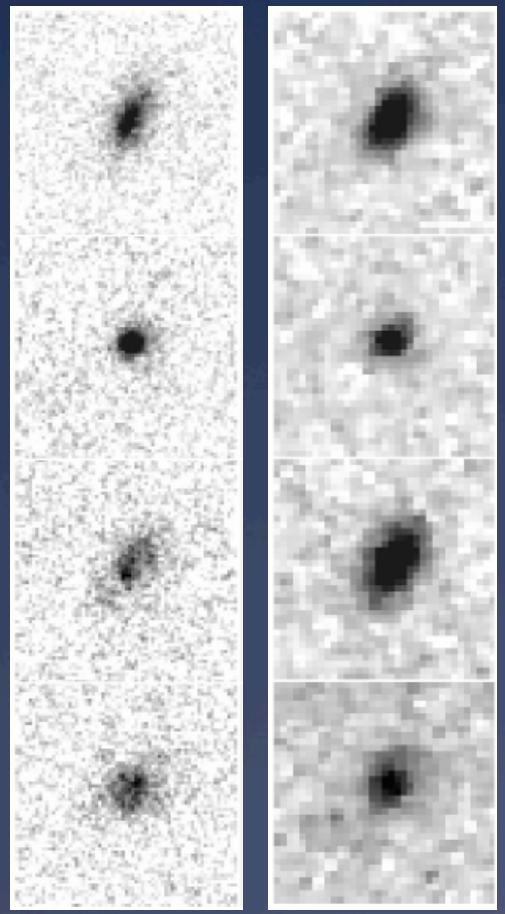
The sBzK galaxies rather show a bar-like or oval shape

Yuma+11, ApJ, 736, 92

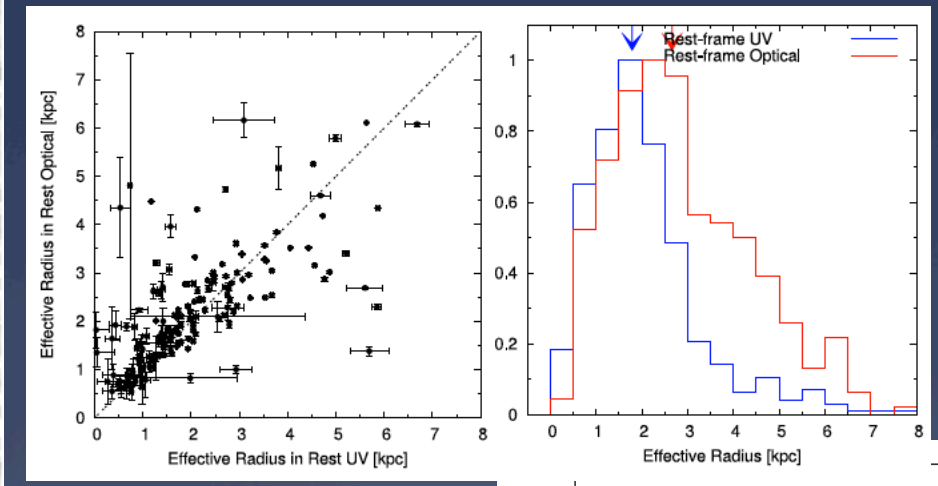
With the availability of HST/WFC3

(0."06/pix, 0."18 FWHM)

ACS/F850LP WFC3/F160W

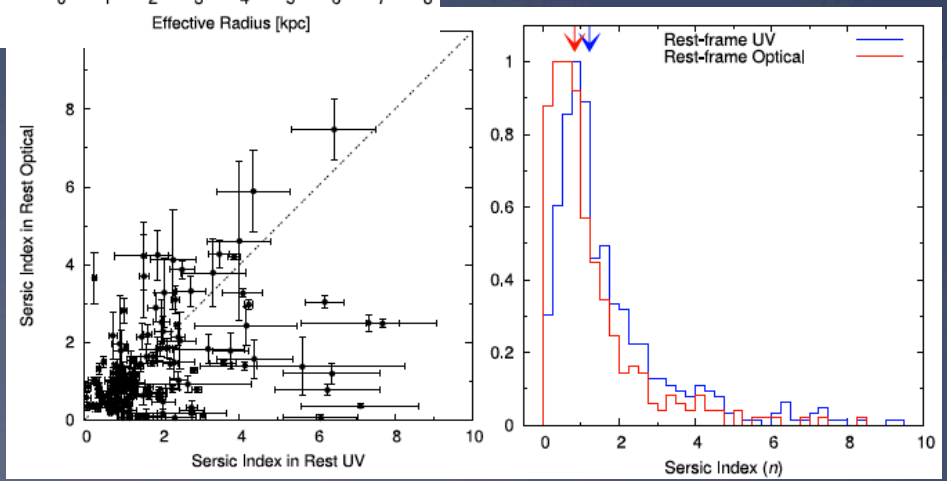


* We can study the structure of the galaxies at z~2 in the rest-frame optical wavelength



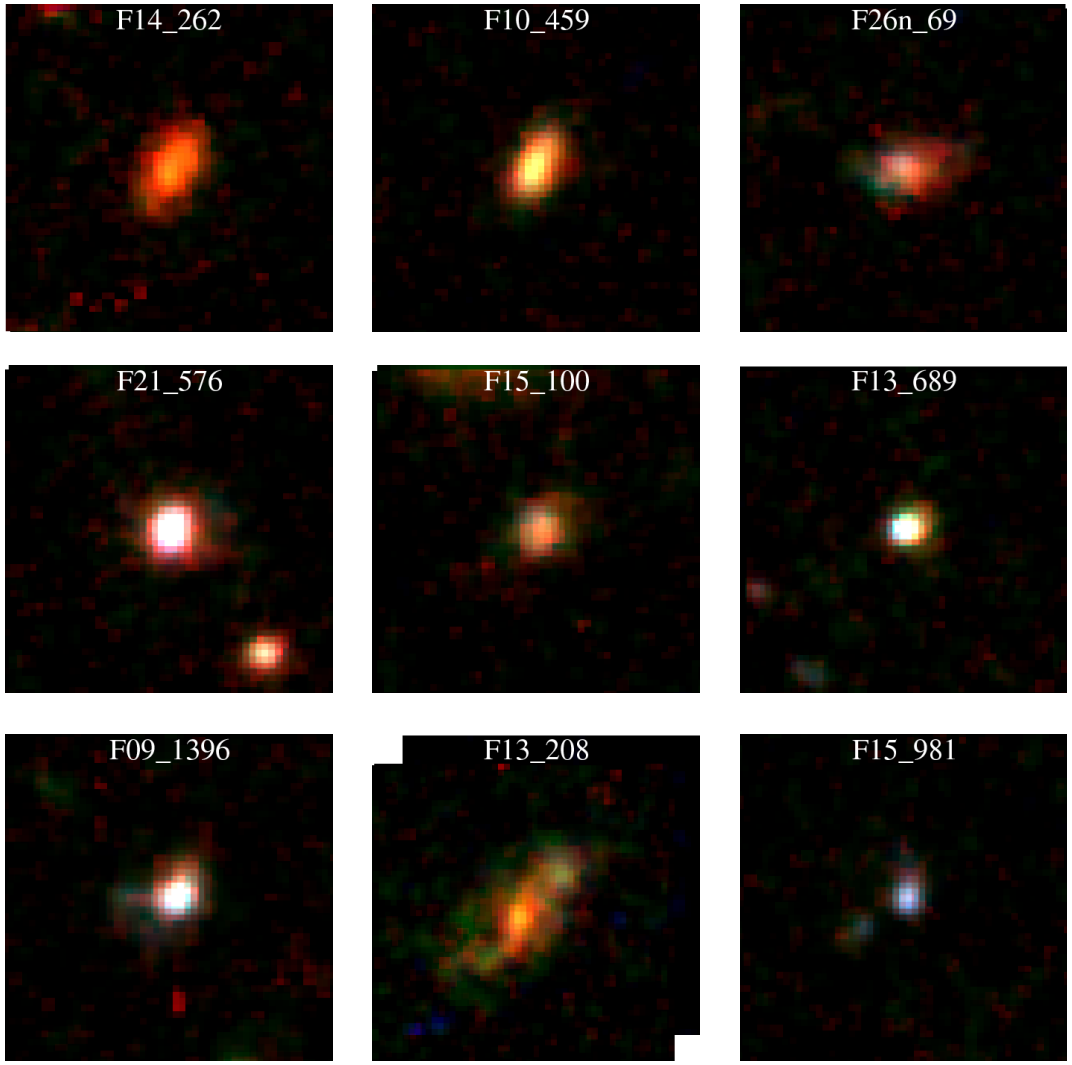
$R_{e,opt}/R_{e,UV}$ ~ 1.5

Comparable Sérsic index



Yuma et al. in prep.

Internal structure of galaxies at z~2



- Red → HST/WFC3 F160W
  - Rest-frame 5500 Å
- Green → HST/ACS F850LP
  - Rest-frame 3000 Å
- Blue → HST/ACS F435W
  - Rest-frame 1500 Å

- Color distributions
- Stellar population distributions

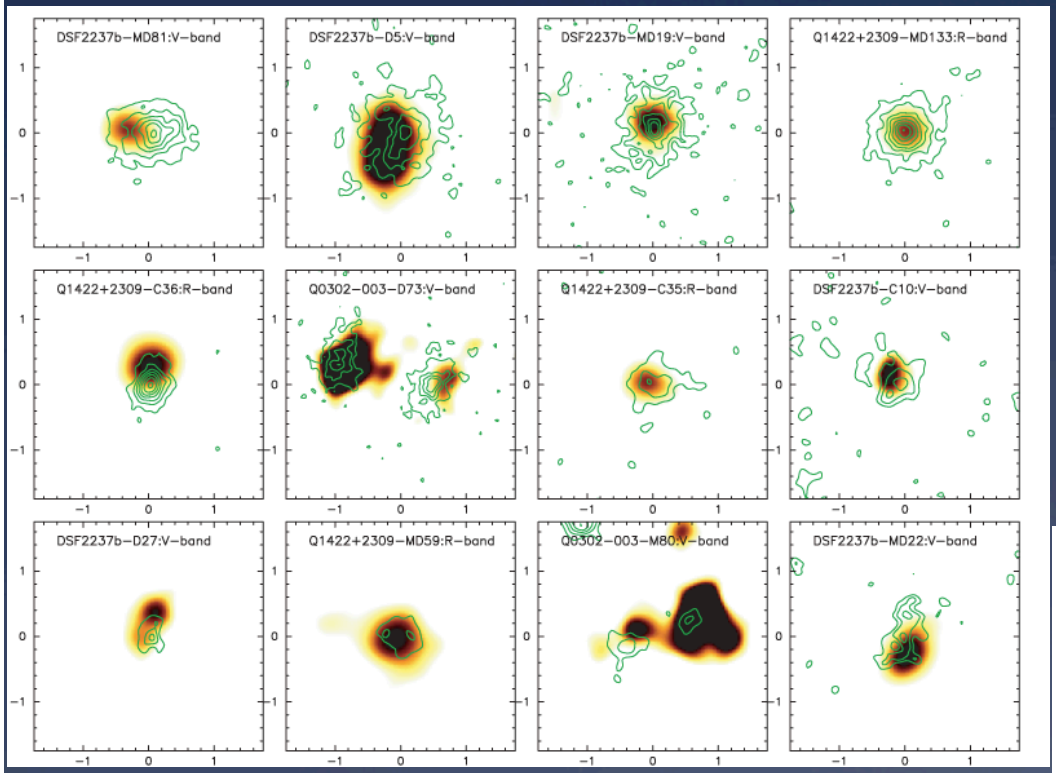
Yuma et al. in prep.

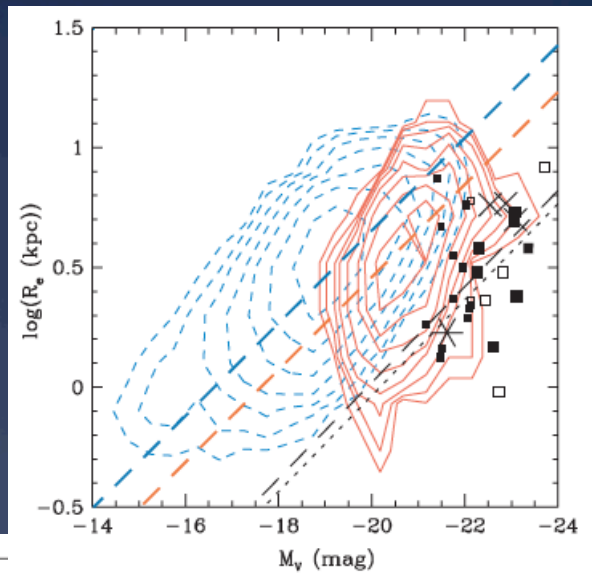
At z~3

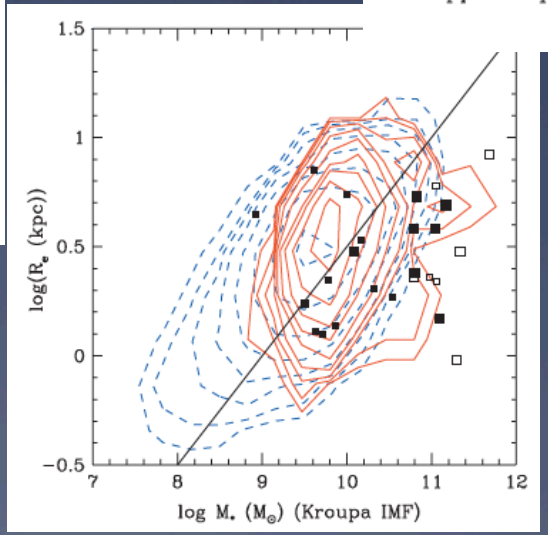
- The high-resolution image is desirable!
- Rest-frame optical wavelength ➔ ~2.2 μ m (K band)
- Unfortunately, no K band on HST/WFC3

- Ground-based observations with AO?

AO-assisted K-band imaging with Subaru of LBGs at z~3







- Most of the LBG samples show Sérsic index of n<2, though high stellar surface mass density
- Color distributions?
- Stellar population distributions?

Akiyama+08, ApJS, 175, 1

With Next-Gen AO

- GLAO + new imaging instrument
  - FoV ~ 10-20 arcmin
  - FWHM < 0."4
- Needed:
  - Hopefully < 0."06/pix ⇔ < 0.48 kpc @ z~3
  - FWHM < 0."2
- Wide field AO will provide possibility to study:
  - Statistical sample of galaxies at z~3
  - Internal structure: color distributions, stellar population distributions
  - Galaxy morphology (concentration, asymmetry, etc)
  - The intrinsic structure