Central Enhanced Star Formation:
the role of bar and environment

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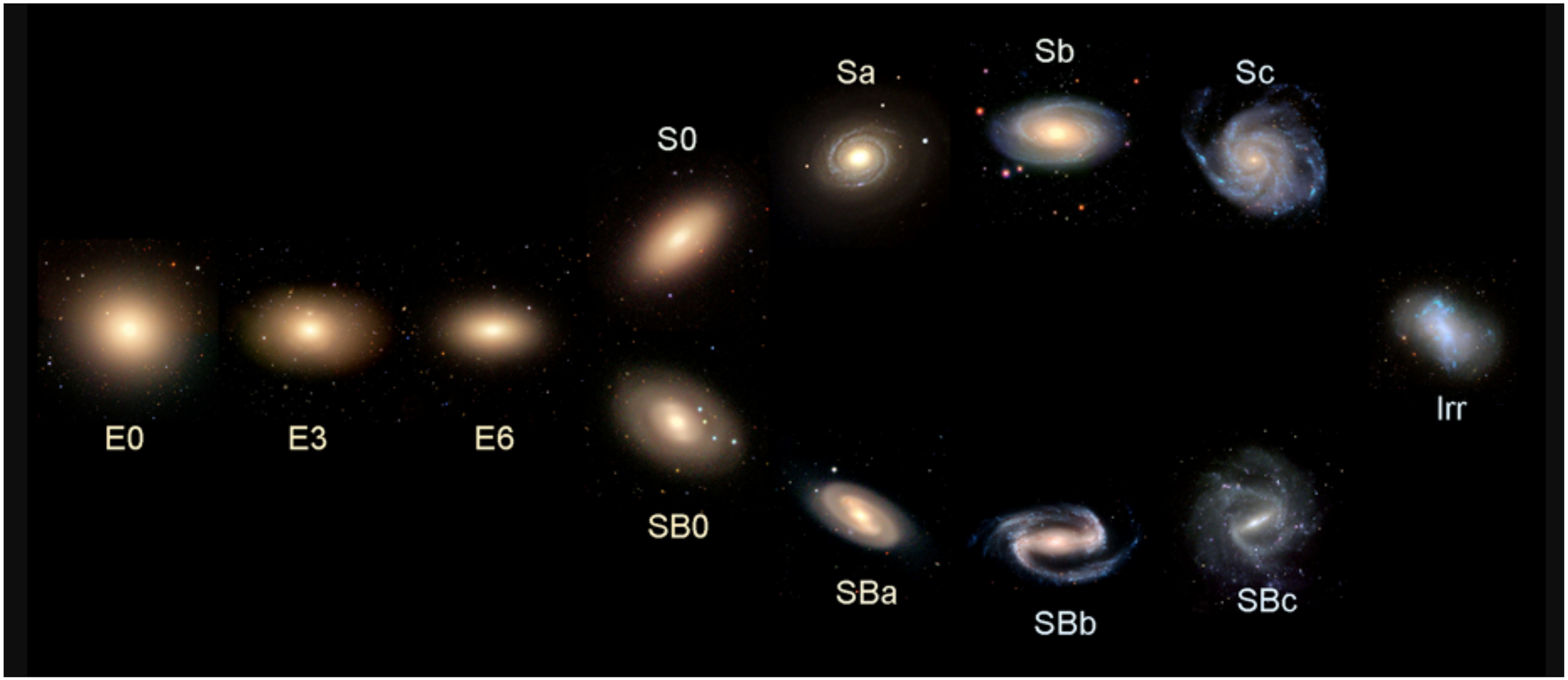
Galaxy Evolution Workshop, Dali, 2018

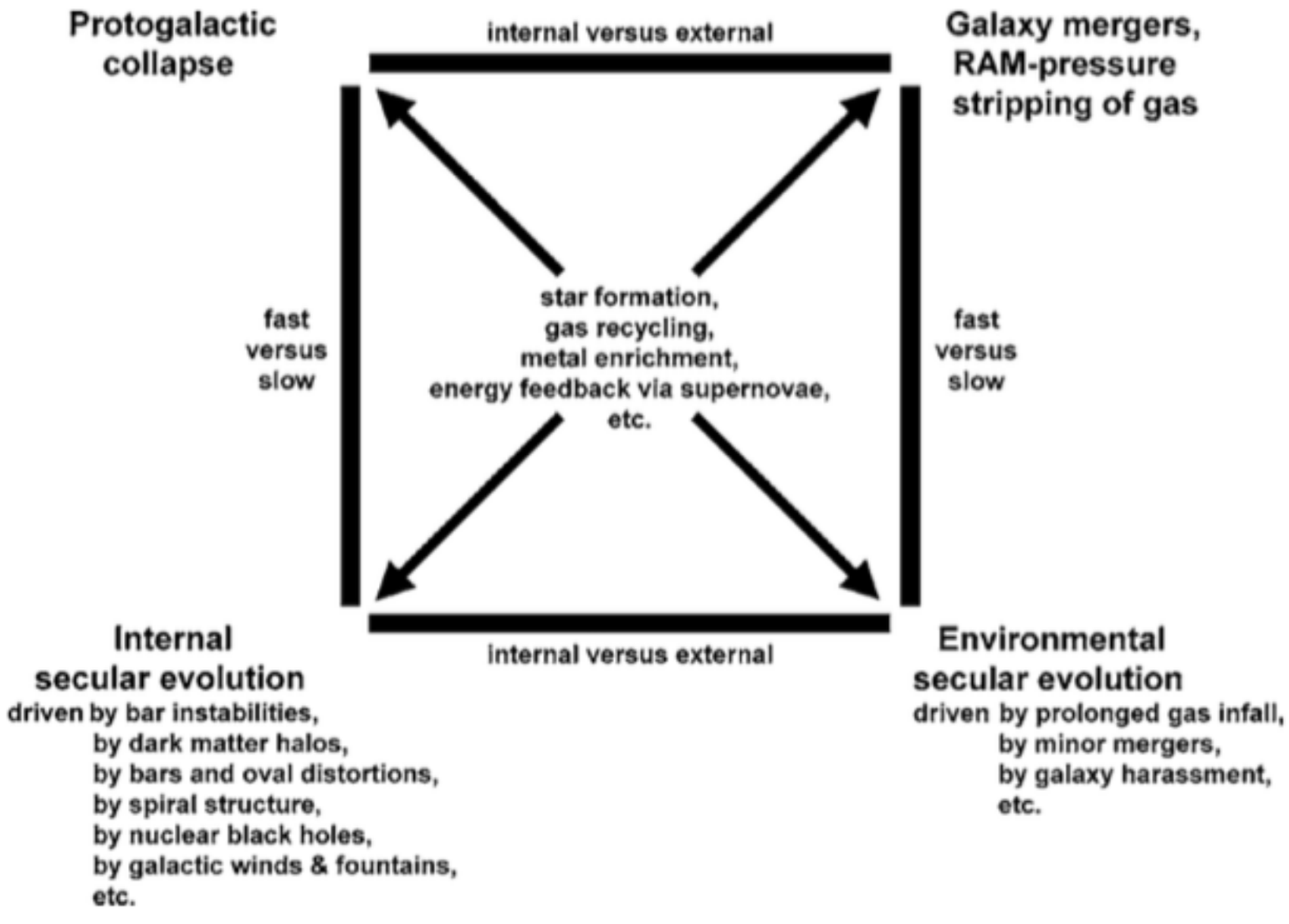
central SF -> bulge mass build-up



- Hubble type morphology
- global stellar mass and color
- BH mass, etc

Bulge plays an important role in galaxy evolution

How do bulges build-up?



Kormendy+04

CALIFA:

600 galaxies

D25 selected

spatial FWHM: 1 kpc

λ range: 3750-7500A

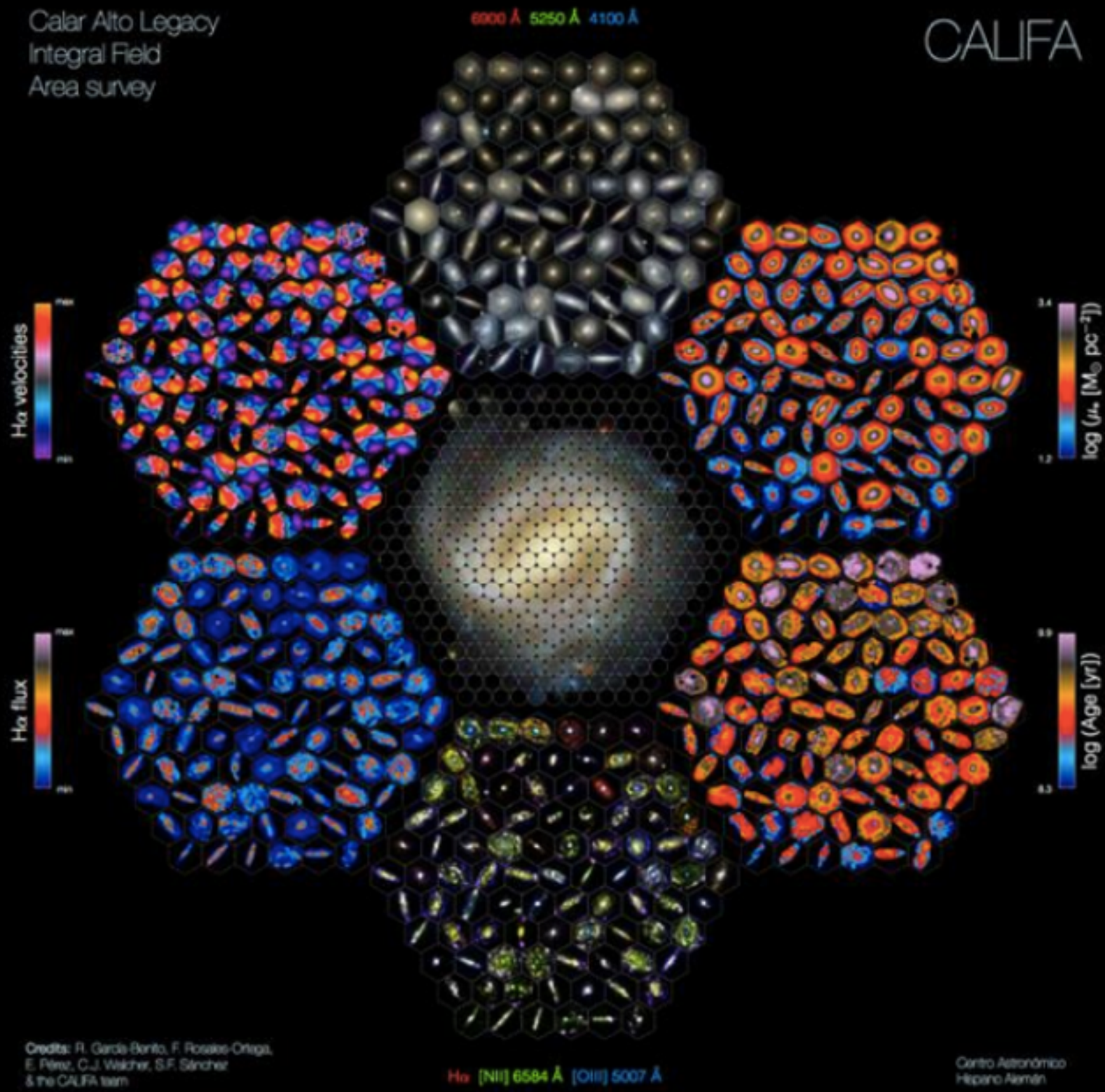
MaNGA:

10000 galaxies

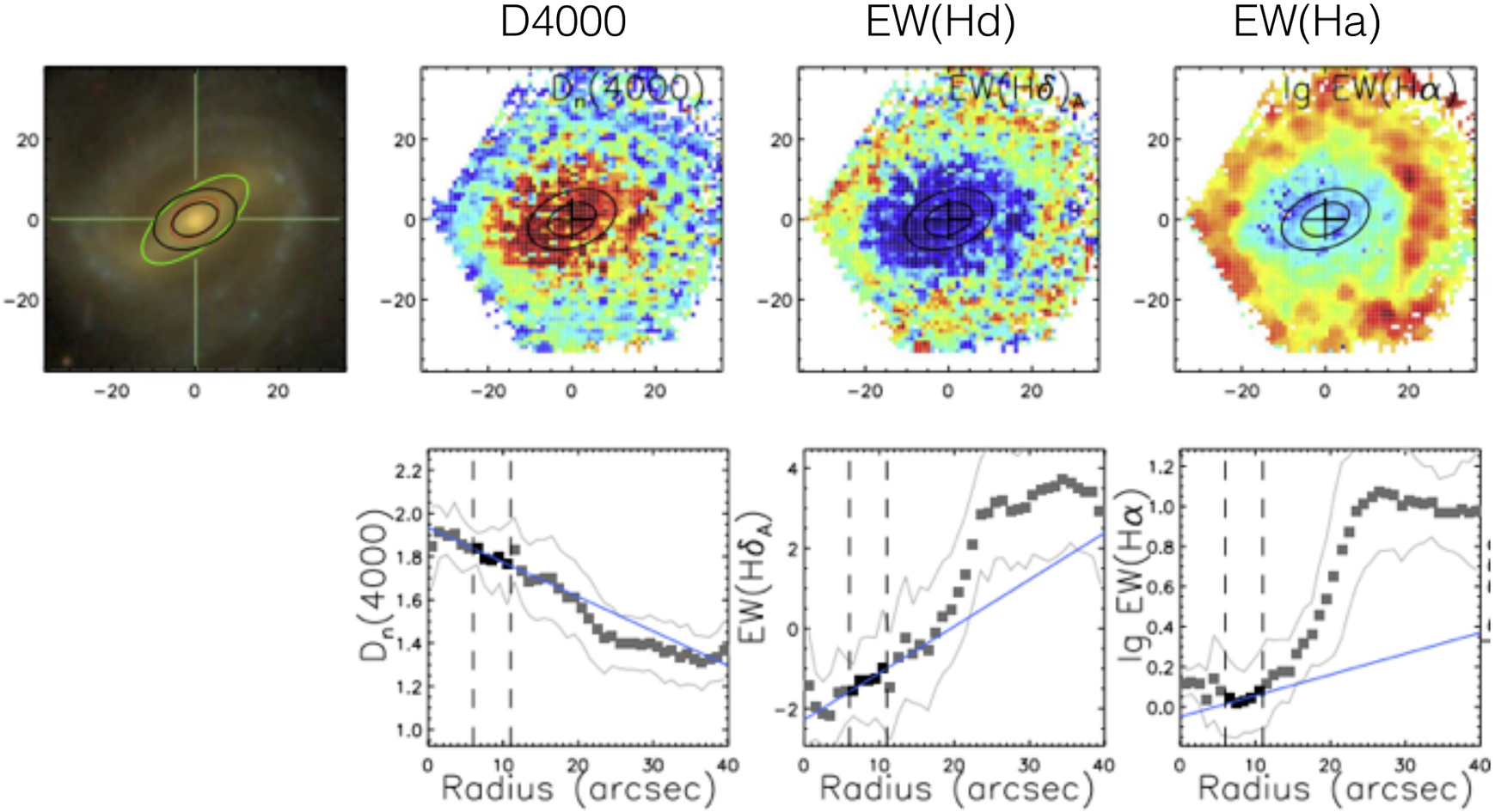
M* > 10^9 Msun

spatial FWHM: 1.5-4.5 kpc

λ range: 3600-10300A



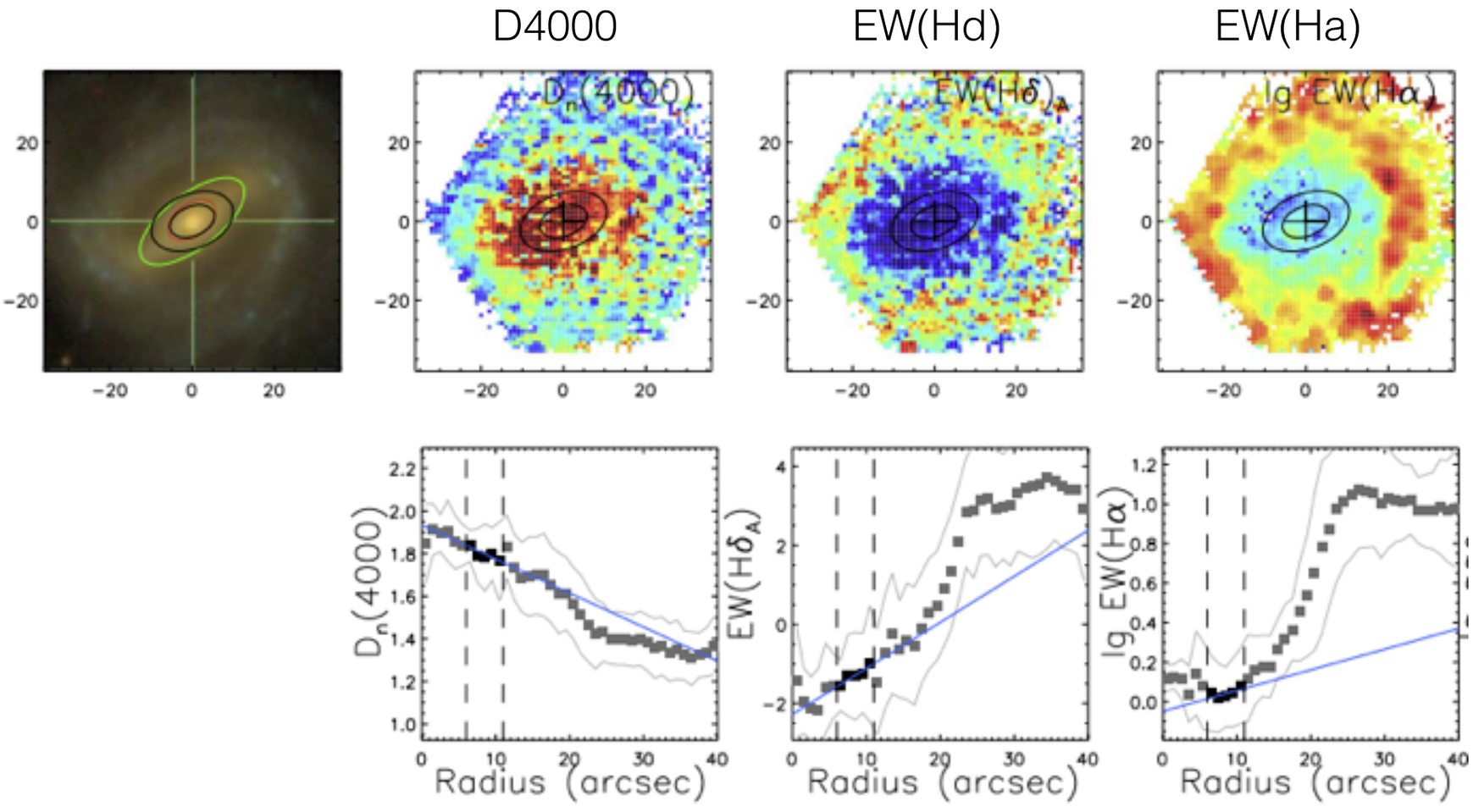
D4000, EW(Hd), EW(Ha) maps & profiles

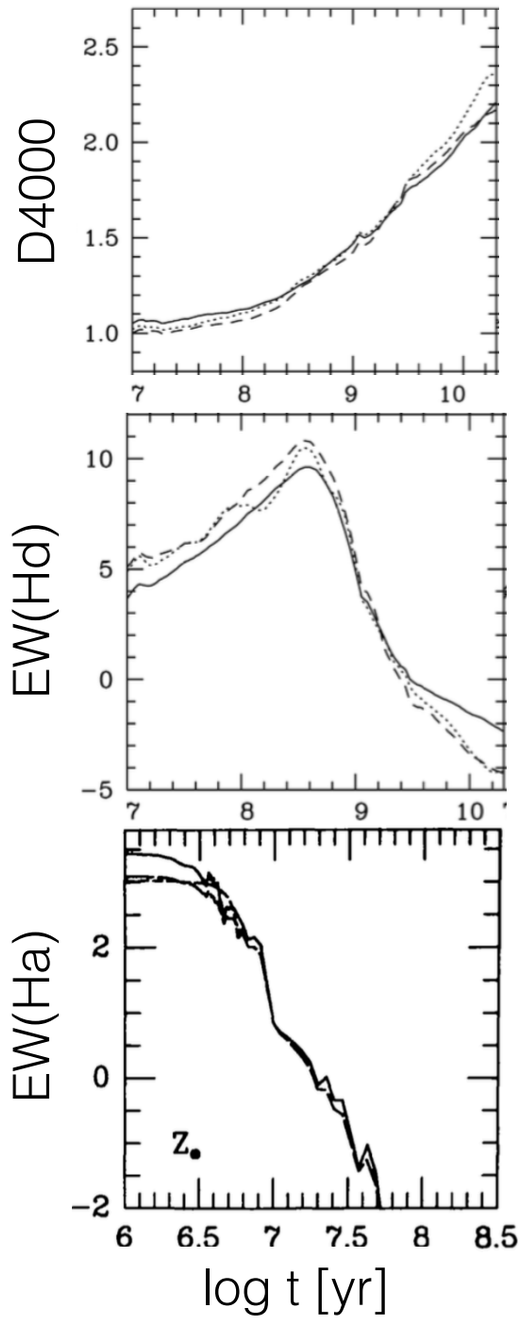


typical spiral galaxy

Lin et al. (2017)

D4000, EW(Hd), EW(Ha) maps & profiles





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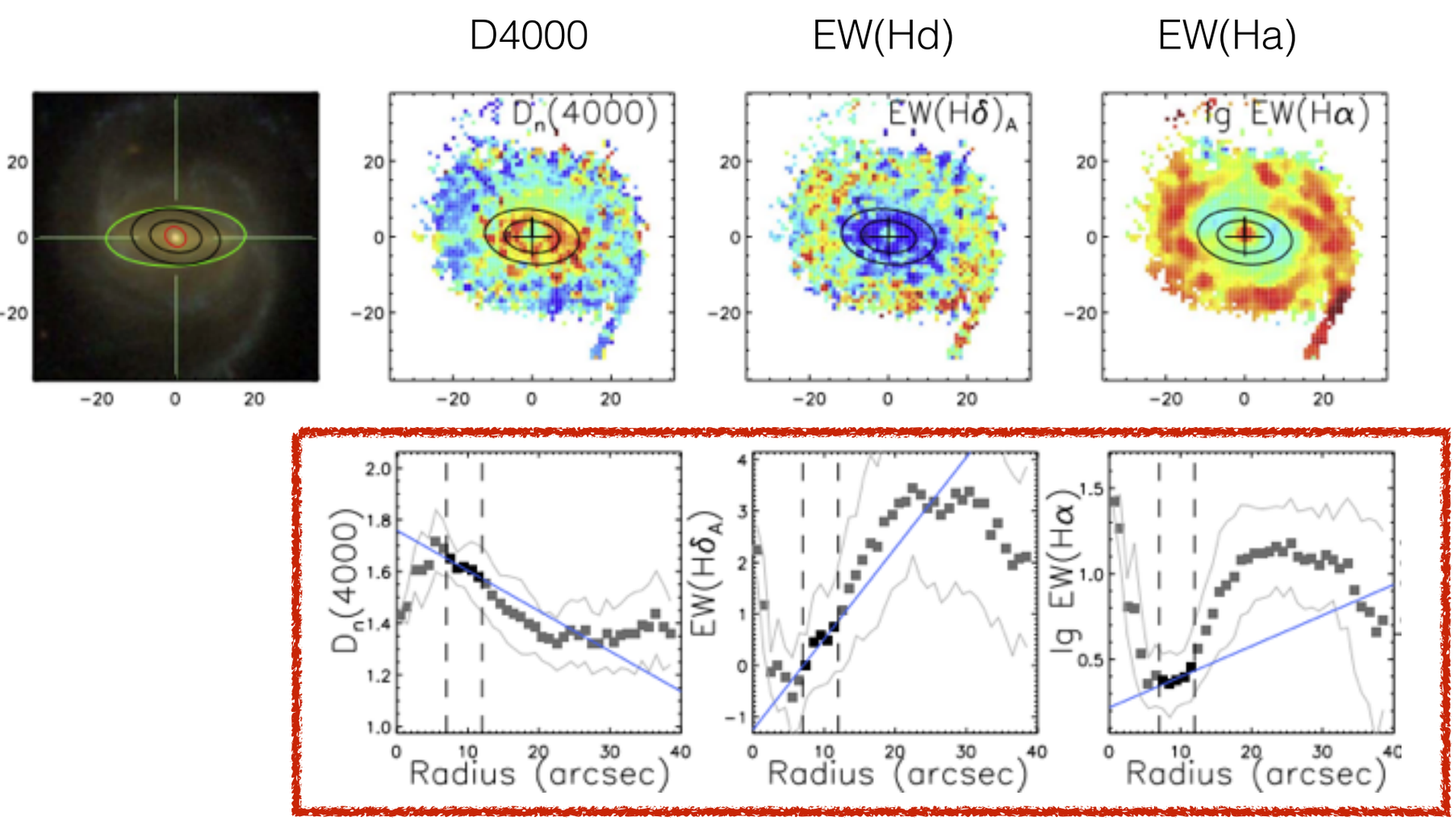
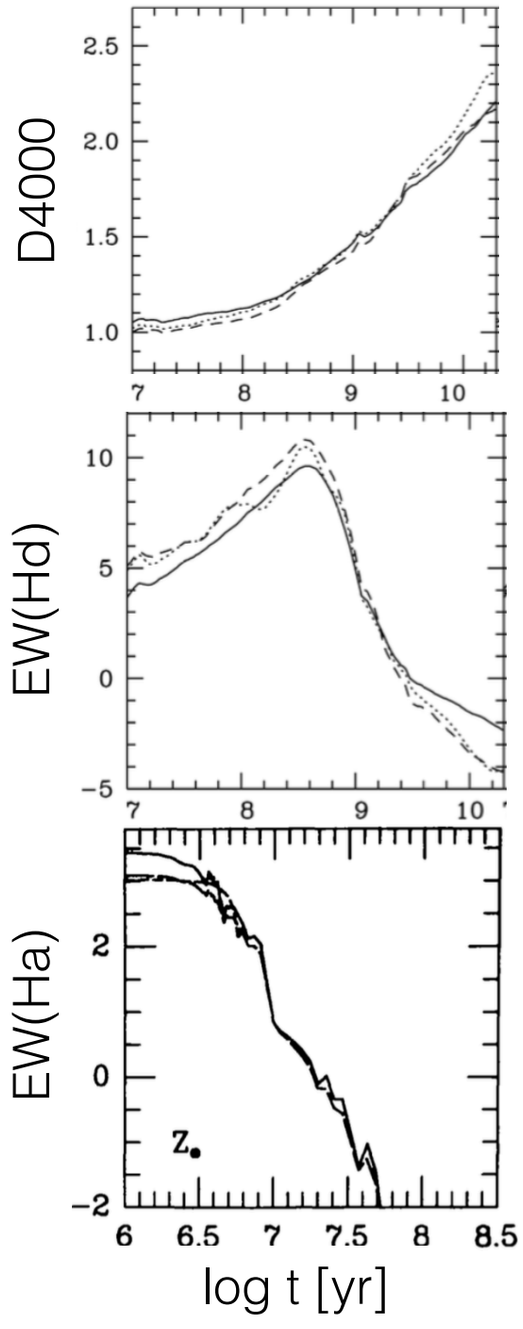


‘turnover’ galaxy



Lin et al. (2017)

Select turnover galaxies by fitting their profiles

Barred galaxies:

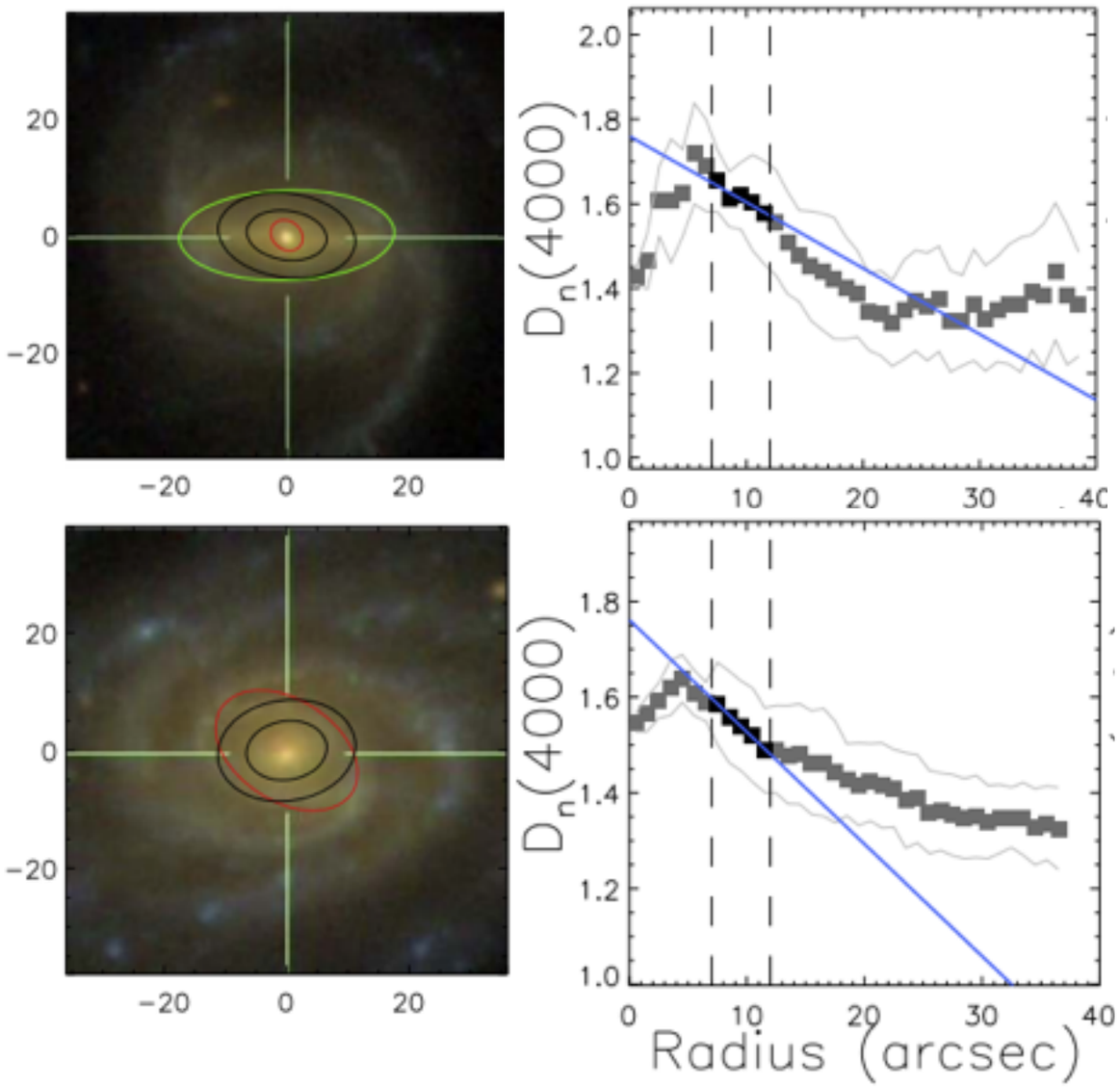
R_{in}: R_{bulge}

R_{out}: R_{bar}

un-Barred galaxies:

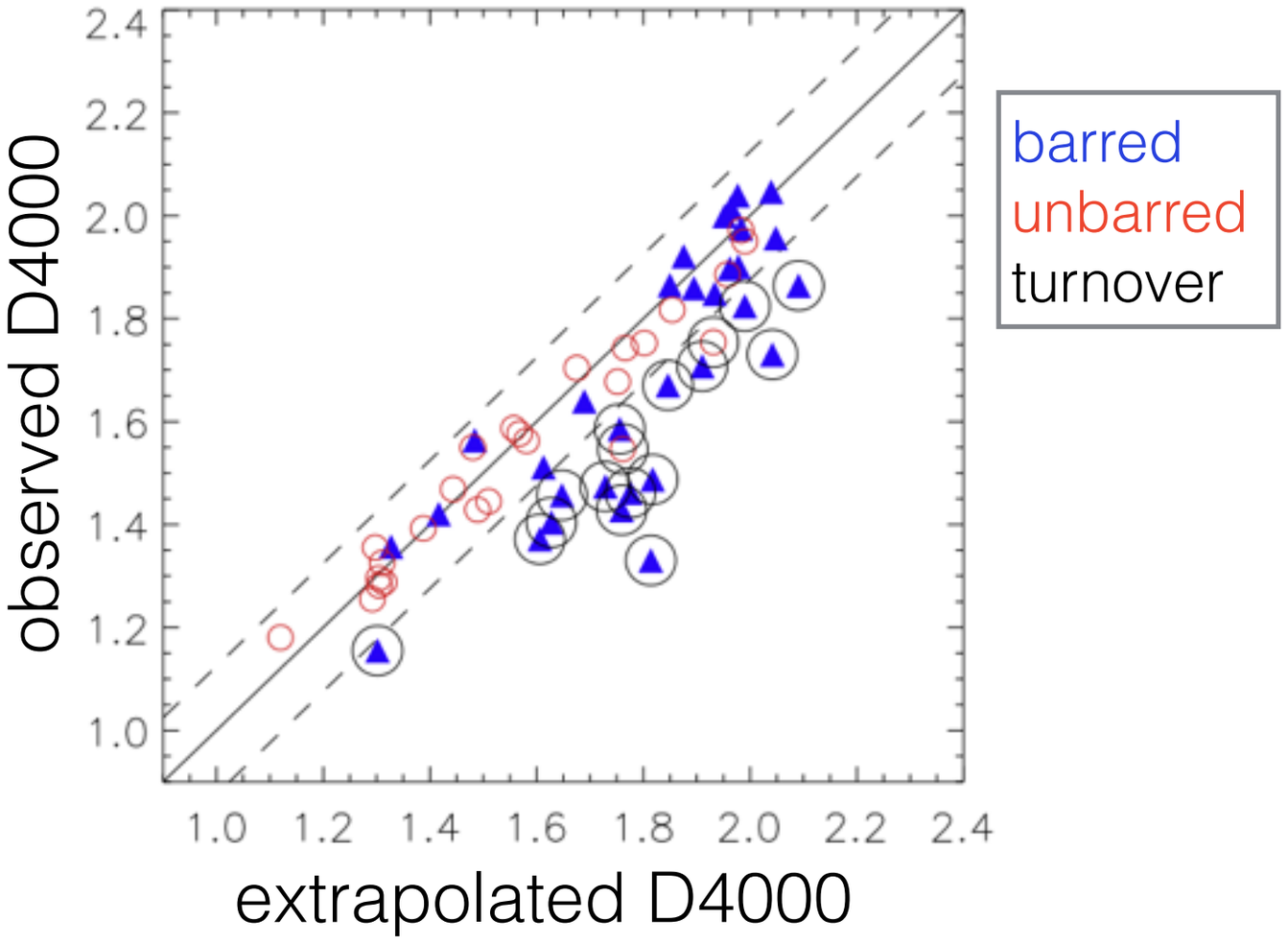
R_{in}: 3” (PSF size)

R_{out}: R_{bulge}



Lin et al. (2017)

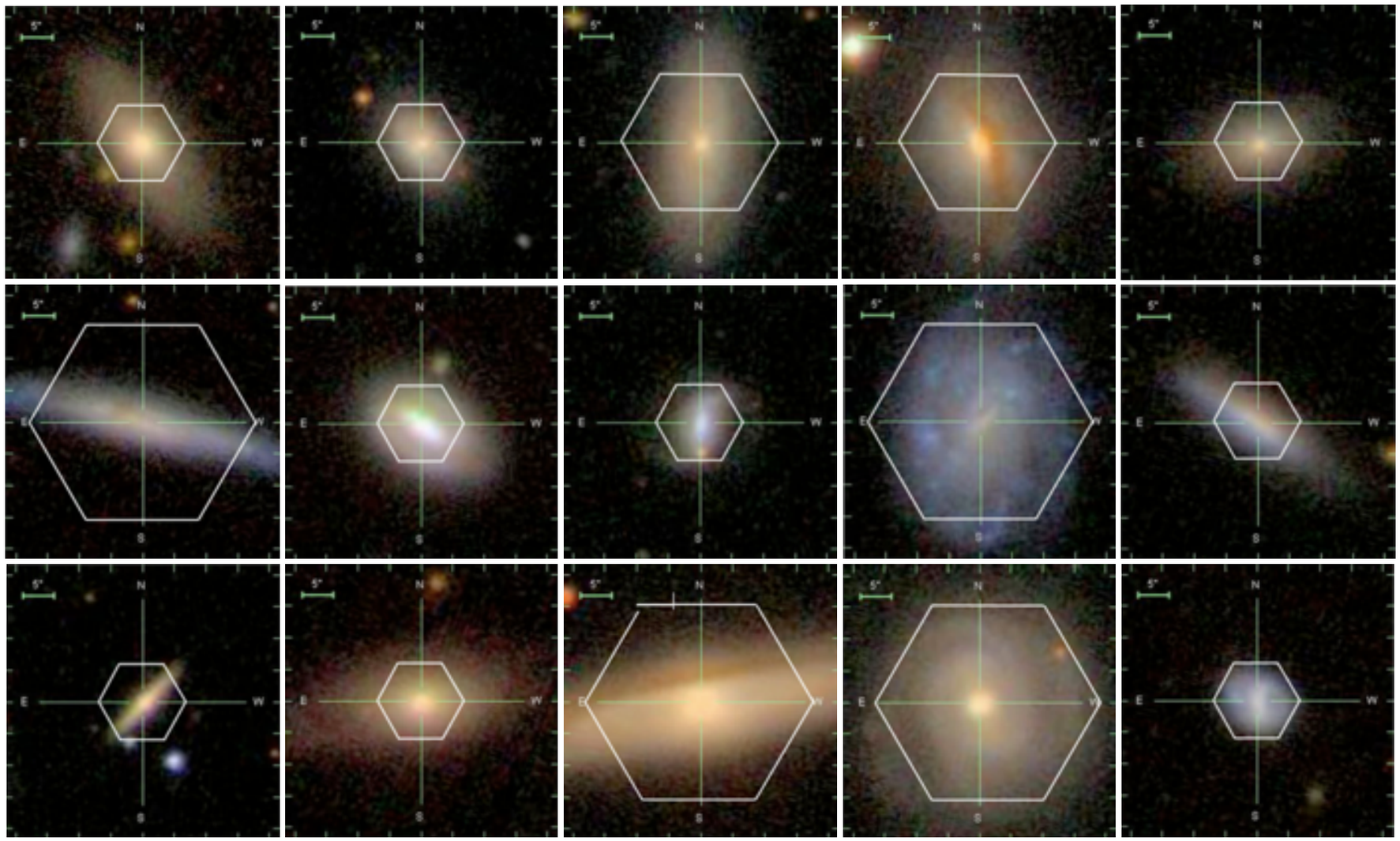
Most turnover galaxies are barred galaxies, BUT only a fraction of barred galaxies show turnover



- Discover 17 turnover galaxies from CALIFA DR2. ~88% (15/17) of them are barred galaxies. While only ~50% (15/31) barred galaxies show turnover profiles.

Lin et al. (2017)

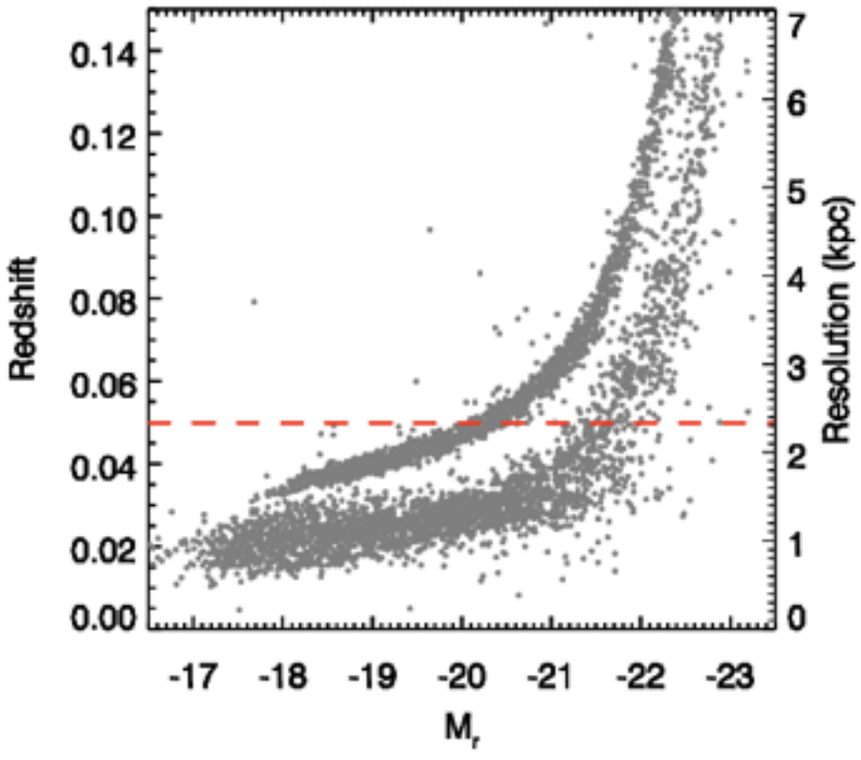
Improvements based on MaNGA survey



- More general with a wide M* coverage
- larger sample size
  - statistical analysis
  - design control sample

Turnover Selection in MaNGA

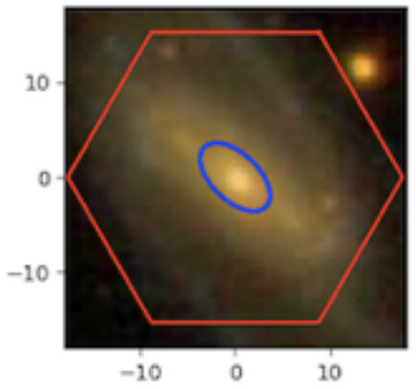
- high-resolution galaxies in MPL-7 (2460 / 4672)
  - redshift < 0.05 (resolution ~1-2 kpc)
  - b/a > 0.5



- Bar identification by visual inspection

- Turnover detection
  - $FWHM_{PSF(1.5")}$ < break < R_{50} or R_{bar}
  - date-driven automatically detect breaks along the profile
  - find out 134 turnovers (barred: 119, unbarred: 15)

Turnover galaxies from MaNGA



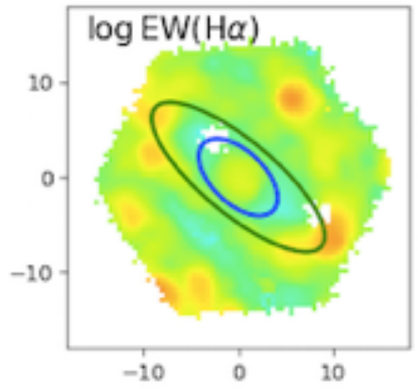
7962-12703

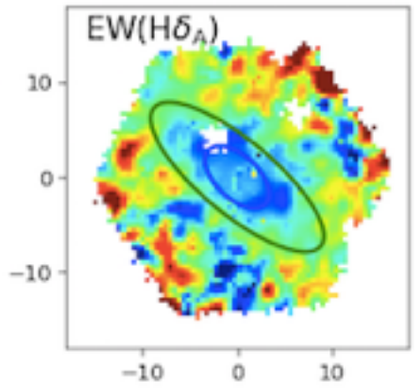
R_{50}: 10.28"

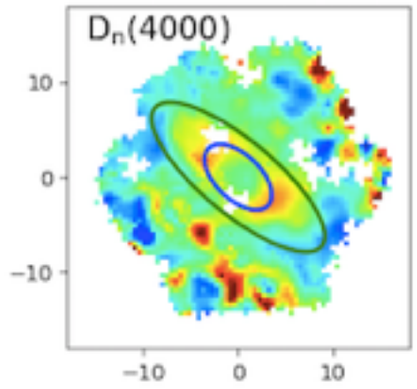
R_{bar}: 11.34"

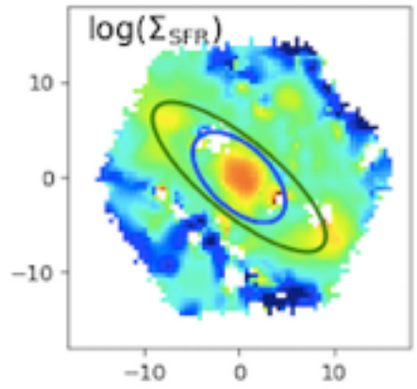
R_t : 4.52"

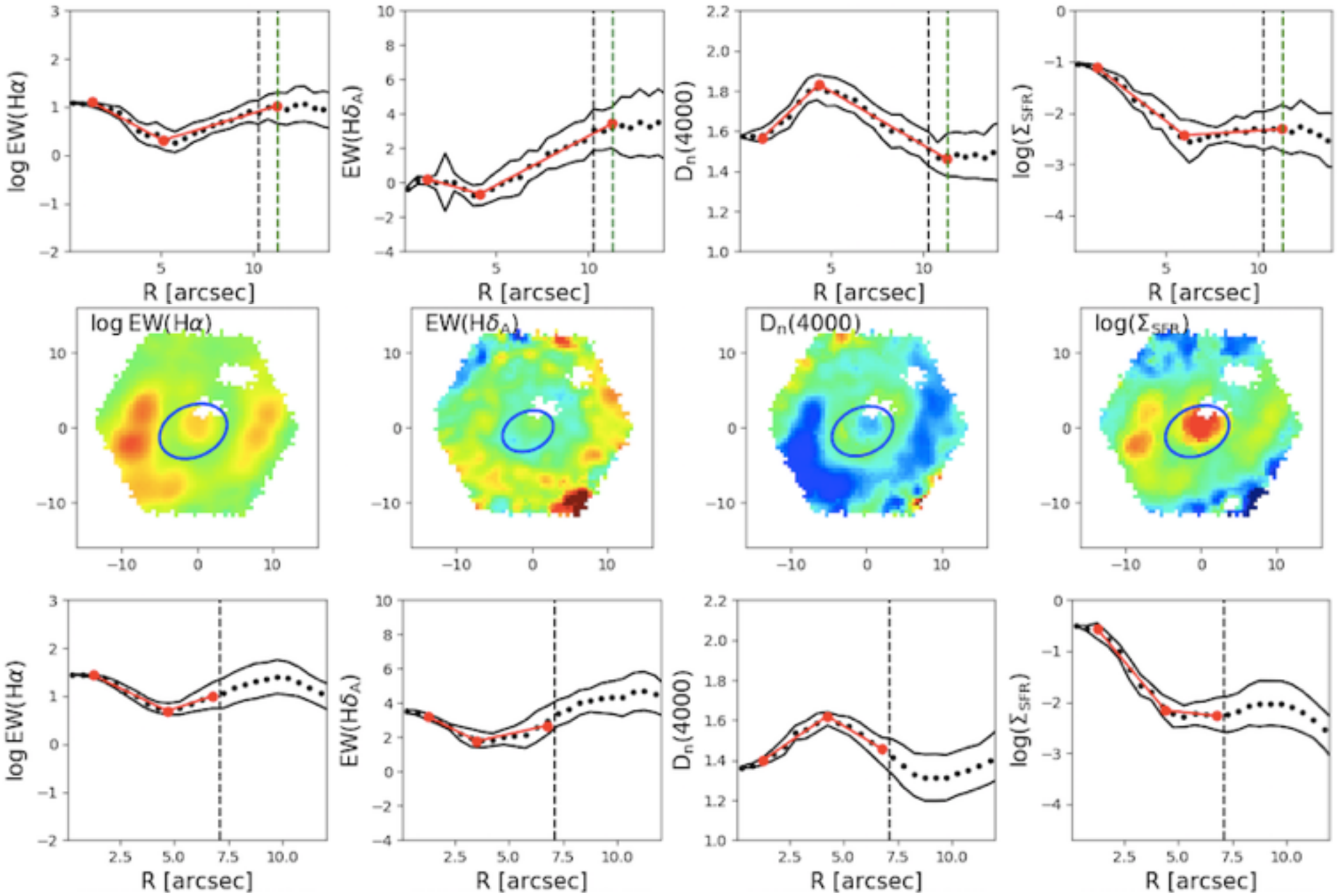
Pair_stage: --

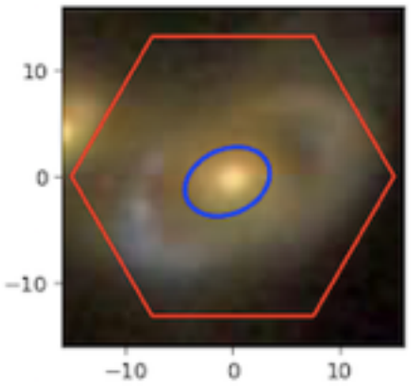












8258-9101

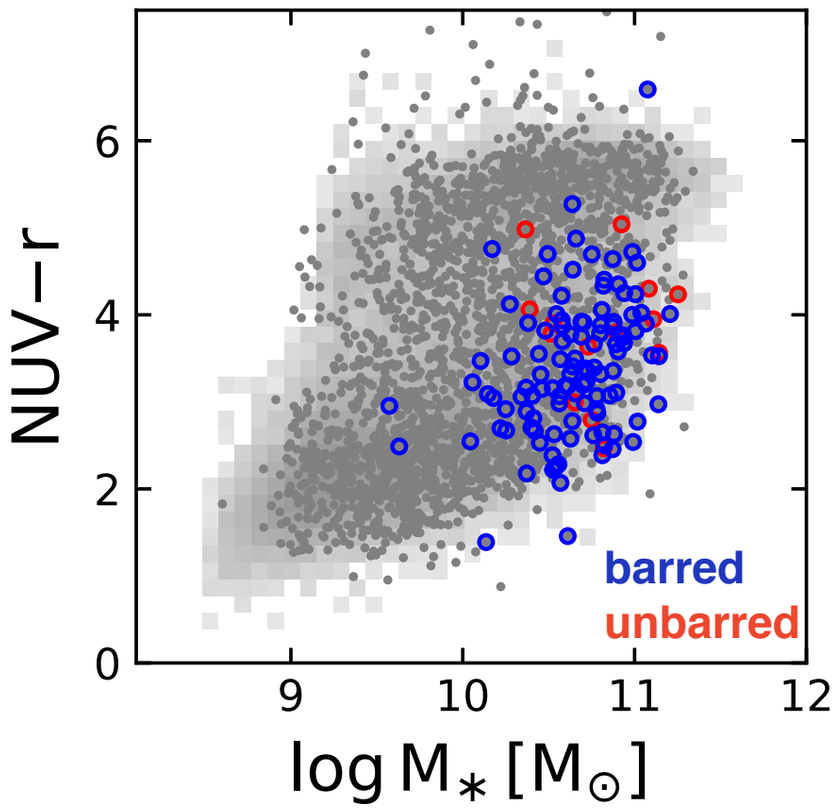
R_{50}: 7.14"

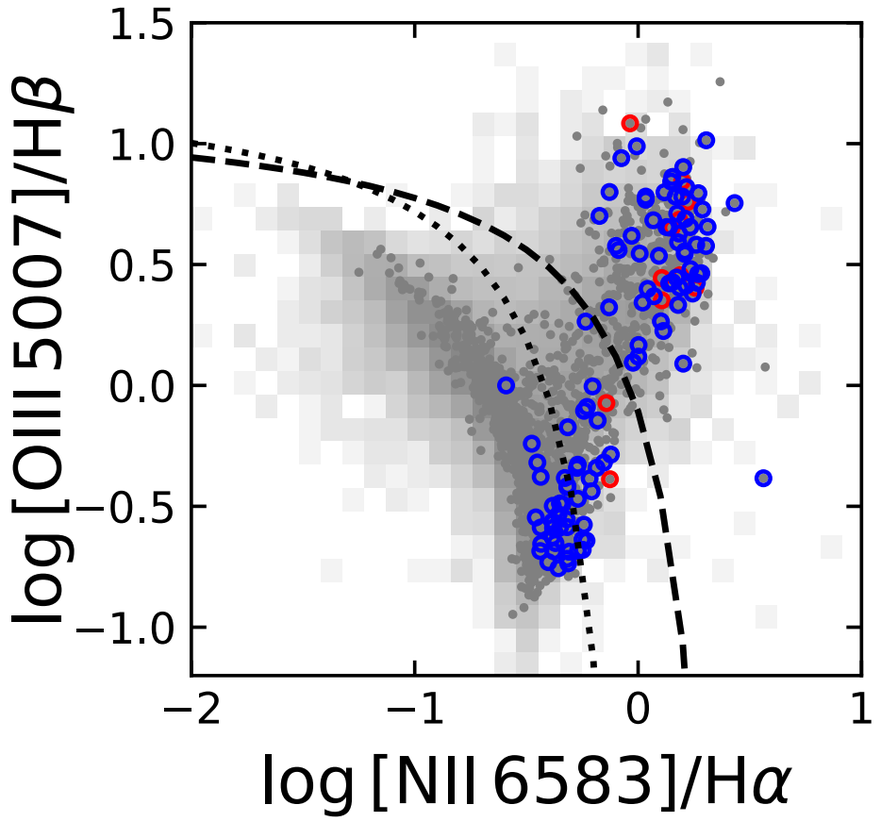
R_{bar}: --

R_t : 4.15"

Pair_stage: 2

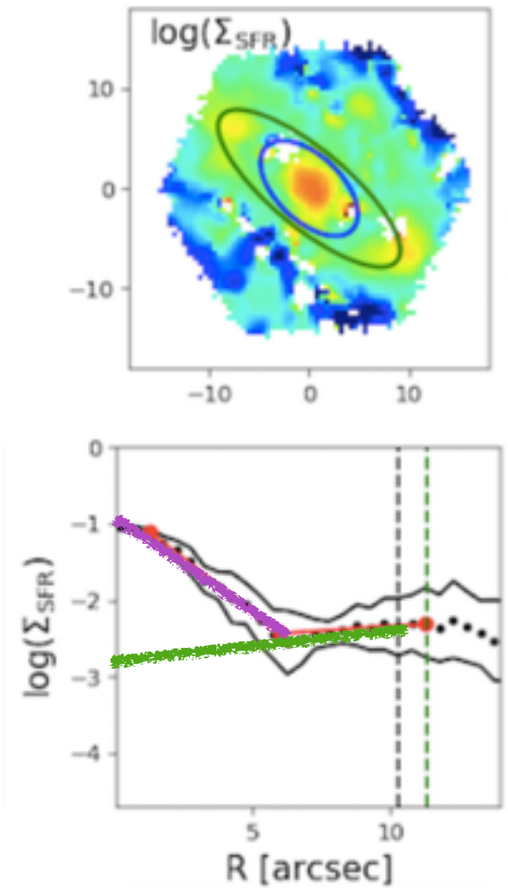
Global properties of turnover galaxies

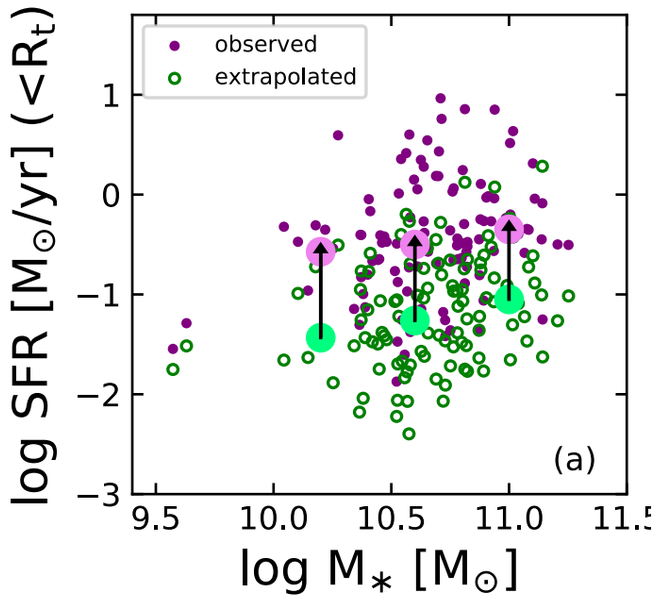


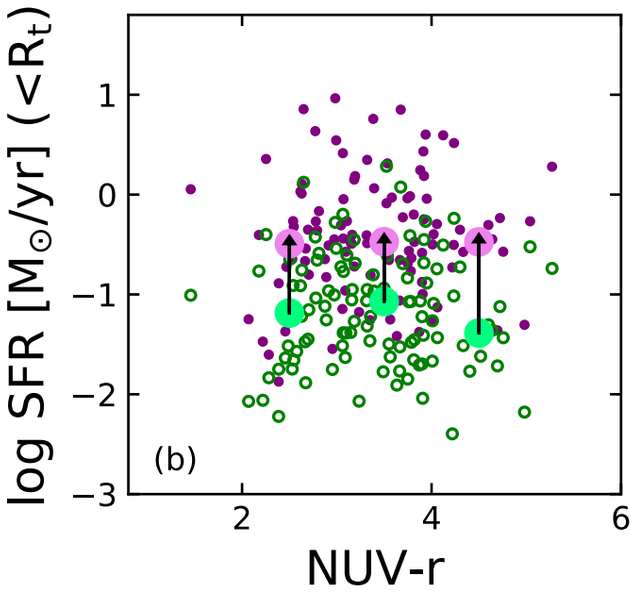


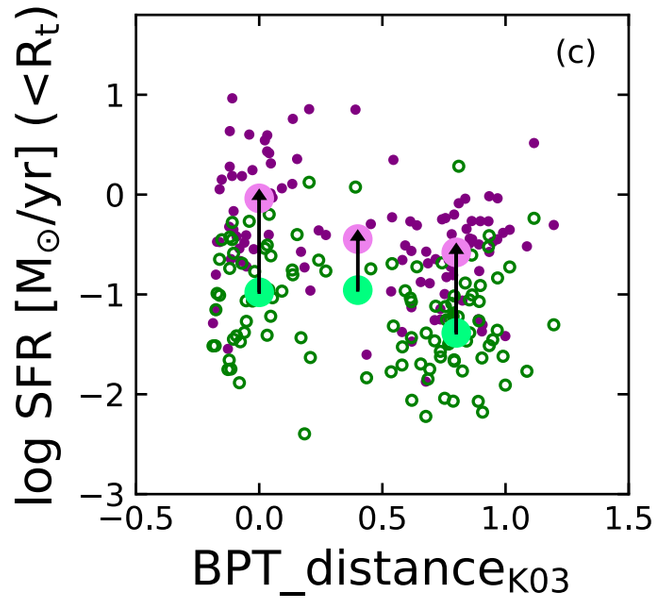
- Most of them are massive spiral galaxies, with log M*~10-11, NUV-r ~ 2-4.5, with large fraction of barred.
- Few of them have log M* less than 10, or global red color.
- The central emission can be SF or LINER-like galaxies.

Enhanced SFR within $R_{turnover}$









- Calculate SFR from dust-corrected Ha flux, then integrate the Σ_{SFR} within R_t
- The Δ log SFR have large spread. No obvious trend with stellar mass, color, or distance to SF sequence.
- The mean Δ log SFR is about 1 dex (0.3 Msun/yr), could be up to 10 Msun/yr as the extreme case.

turnover vs. bar properties

- Most (119/134~88%) turnover galaxies have bars, but only (119/325~36%) bar galaxies show turnovers.

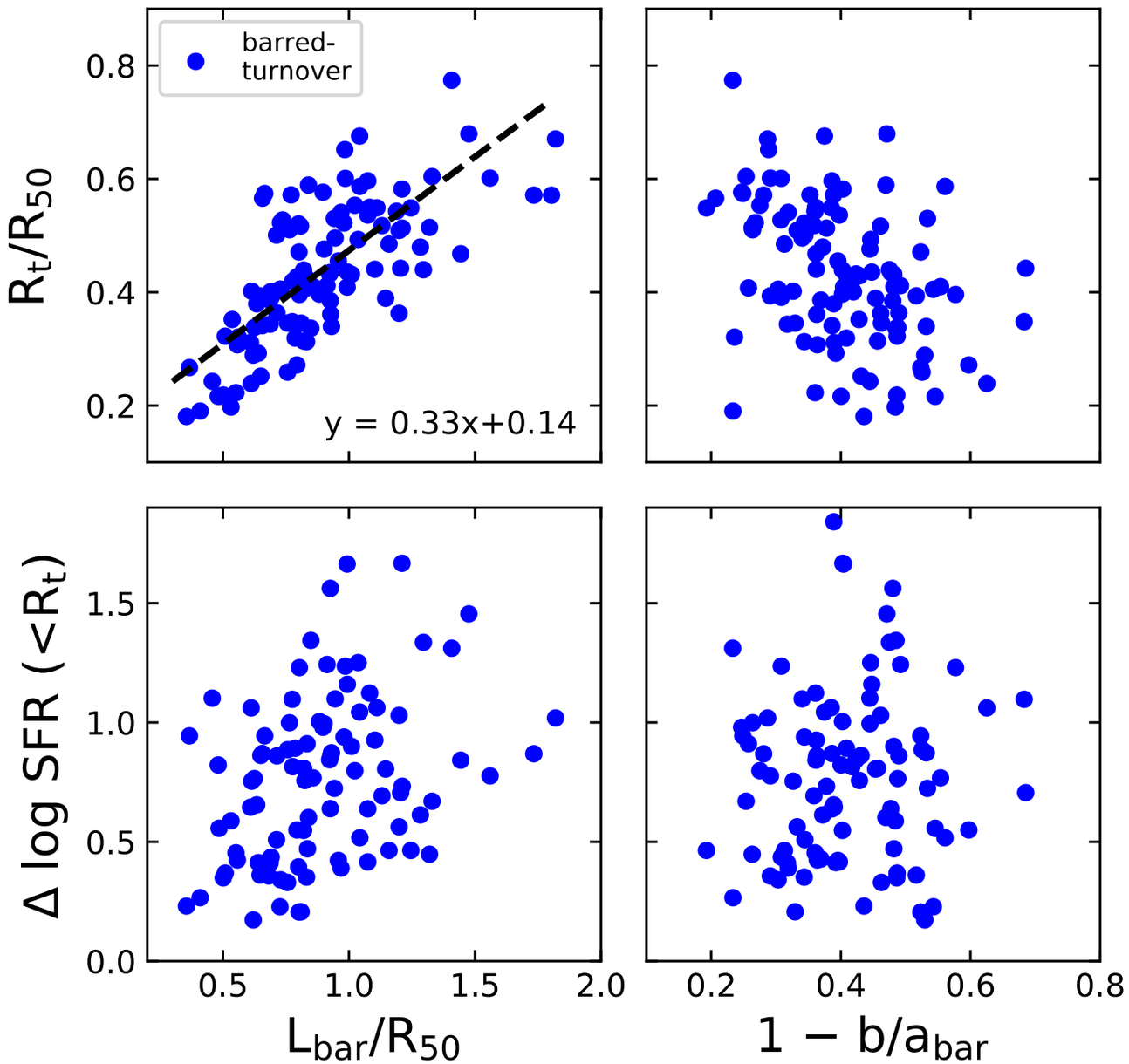
- If turnovers are caused by bar-induced gas inflow, can we see larger SFR enhancement in stronger bars?

turnover vs. environment

- No obvious correlation between bar and environment in the literature

- Any environmental effects to trigger turnover feature?

Bar effects: I.

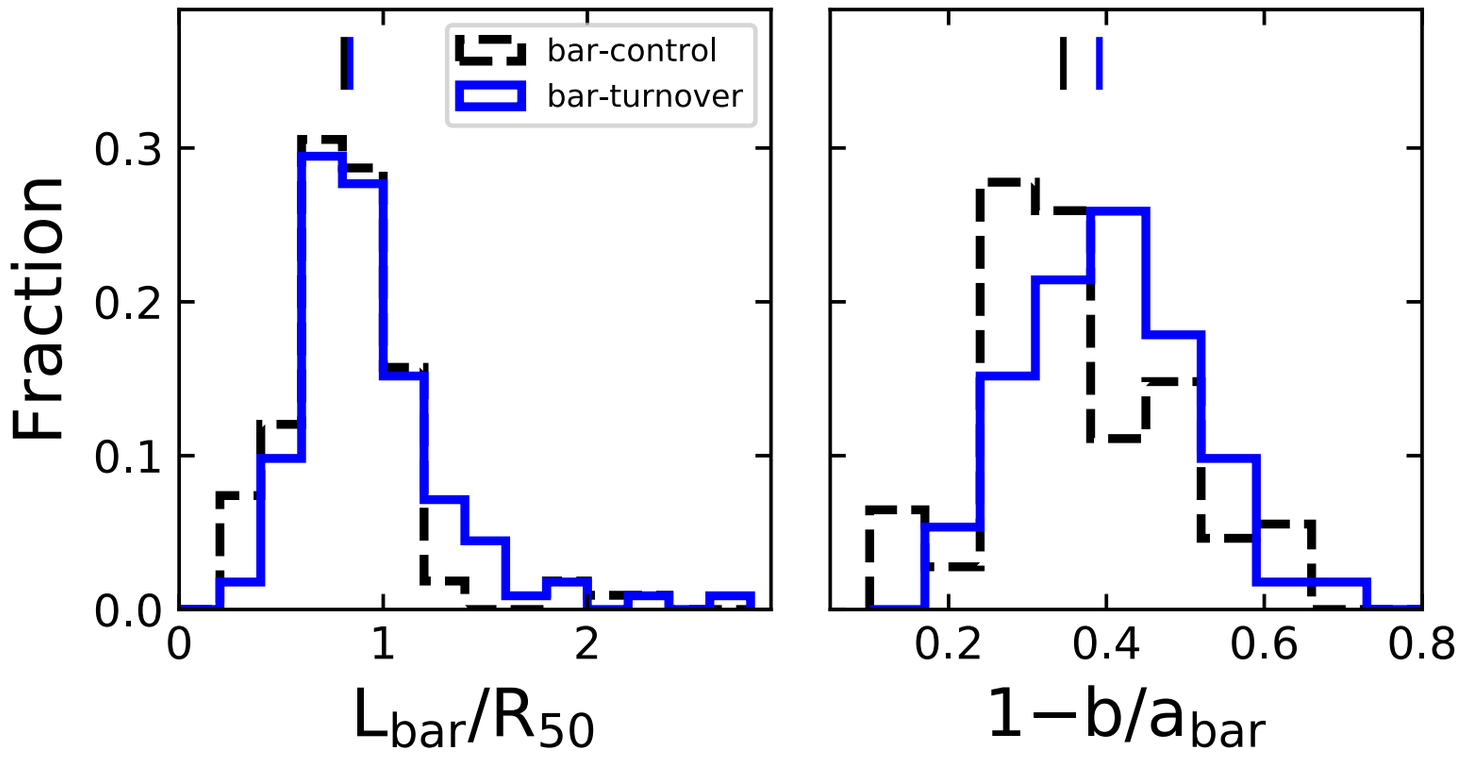


- Both turnover radius and SFR enhancement have good correlation with bar length
- turnover radius show a weak correlation with bar ellipticities
- do not find obvious trend between SFR enhancement vs. bar ellipticities

— measure L_{bar} and b/a_{bar} using ellipse@IRAF

Bar effects: II.

Comparison with control sample (M*, NUV-r, T_{bar} matched):



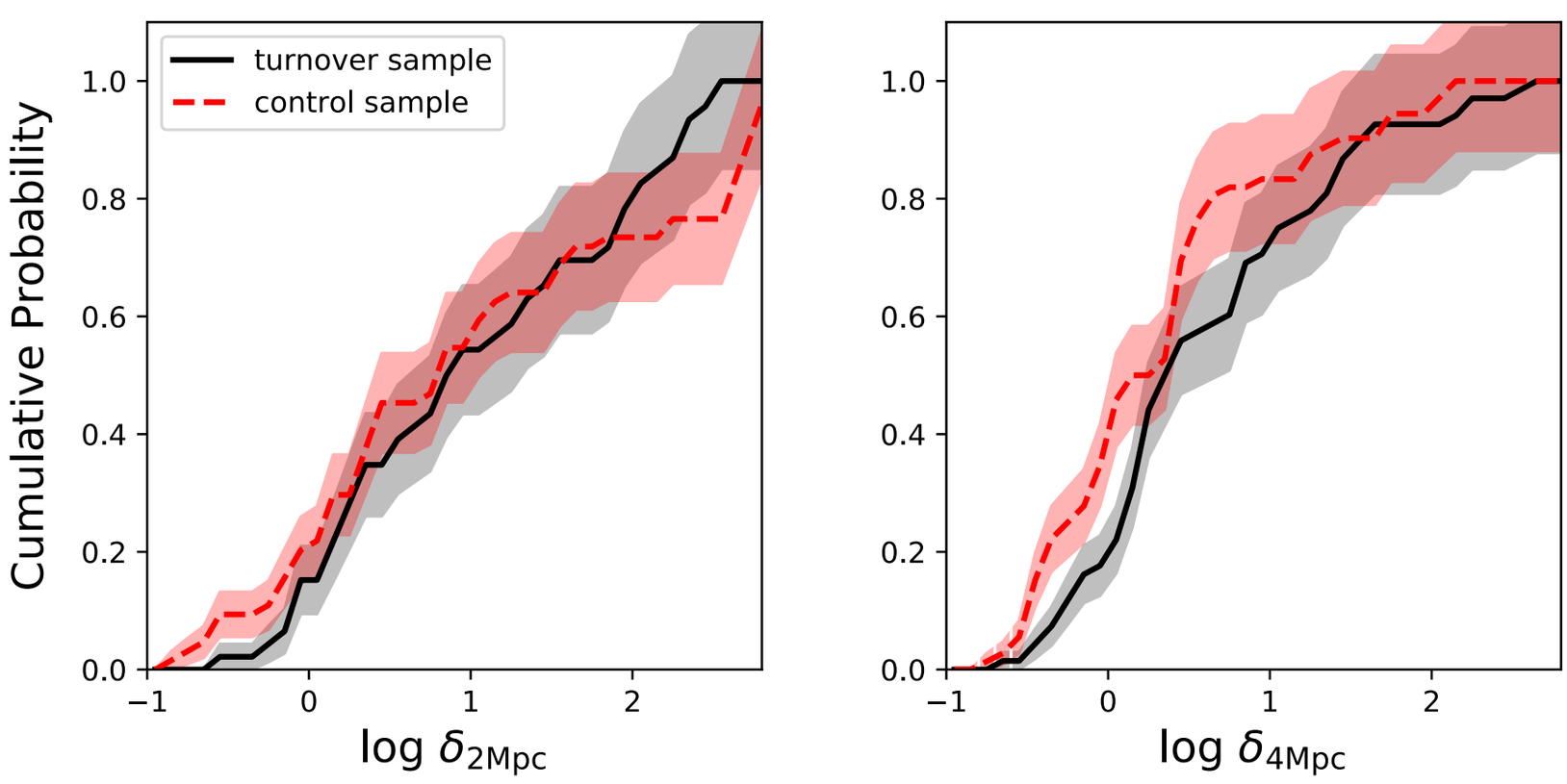
- No obvious differences in bar length and bar ellipticity

-> Bar-induced gas inflow happens periodically ?

Environmental effects

Comparison with control sample (M*, NUV-r, T_{bar} matched):

- In 2 Mpc scale, no significant difference.
- In 4 Mpc scale, turnover galaxies tend to locate in higher density than control sample (KS test p<0.05)



local density catalog from H. Wang+16

Summary

- We look for turnover feature in EW(Ha), EW(Hd) and D4000 profiles, which indicates recent star formation.

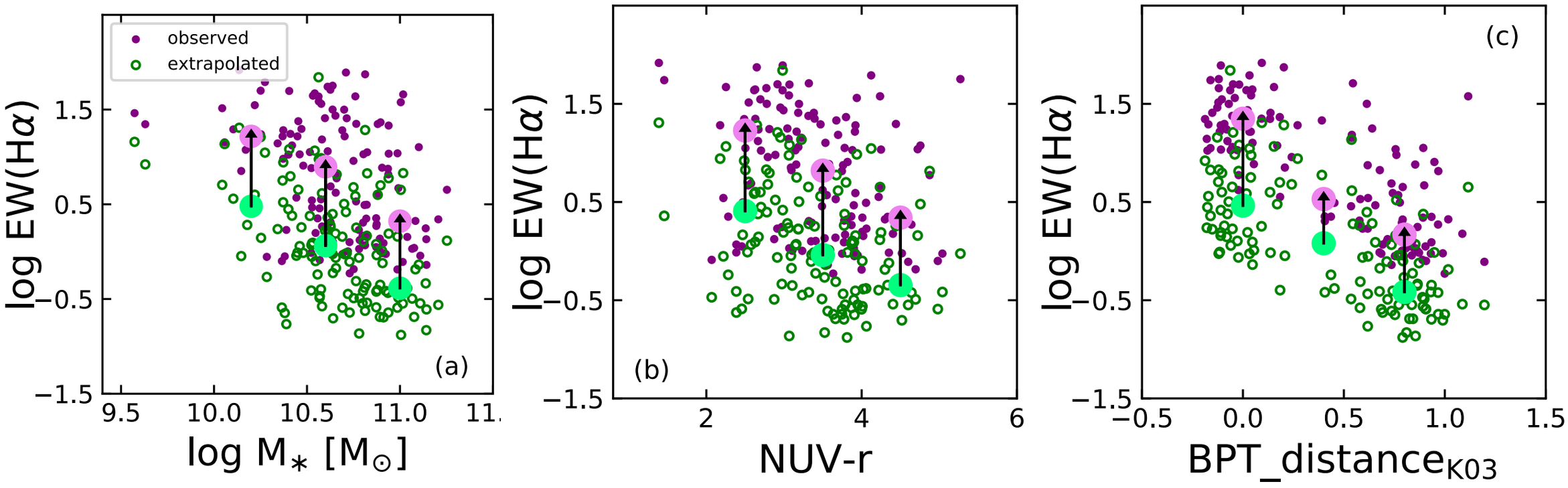
- We confirm that turnover galaxies are massive spirals, with a large fraction of barred galaxies, BUT only a fraction of barred galaxies will show central turnover.

- The enhanced SFRs have a large variety. The typical Δ log SFR is ~1 dex, could be up to 10 Msun/yr.

- Both turnover radius and SFR enhancement have clear correlation with bar length. Turnover radius have a typical value of 1/3 bar length.

- Turnover galaxies tend to locate in higher density environment than control sample.

Central enhanced EW(Ha)



- The central observed and extrapolated log EW(Ha) have large spread.
- The mean Δ log EW(Ha) do not have obvious trend with stellar mass, color, or distance to SF sequence.