The Evolution of Galaxy Dust Properties for $1 < z < 2.5$

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Motivation (1)

Dependence of dust properties on environment:

Sequence: Milky Way average – LMC average – LMC2 supershell – SMC bar

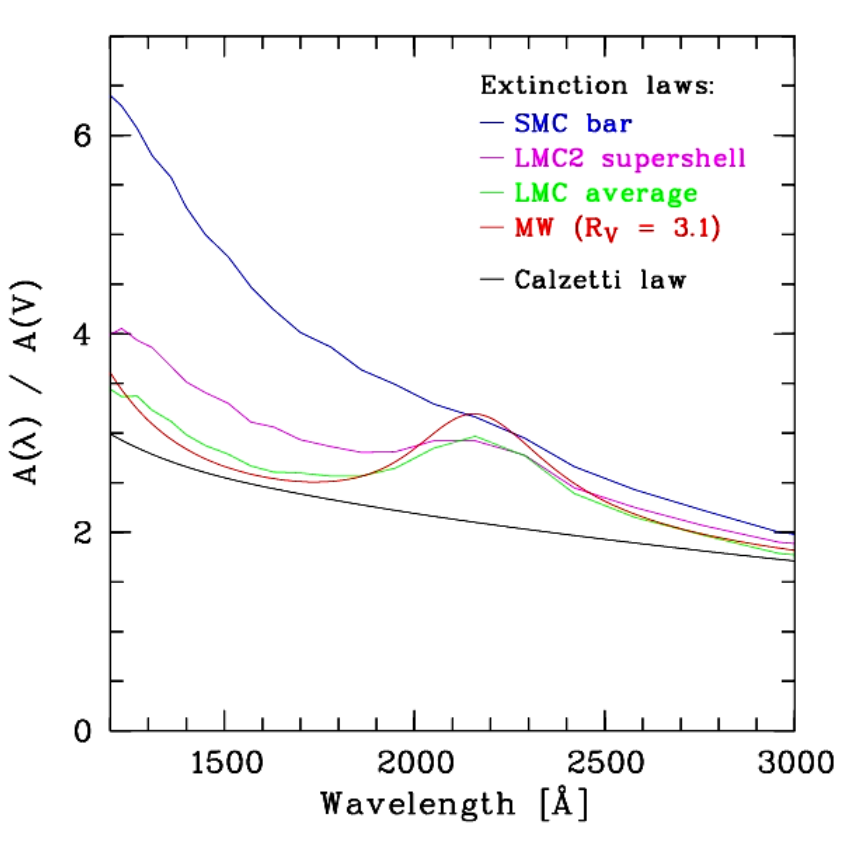
Explanations:

– Lower metallicity (?)

– Stronger radiation fields and shocks ($\rightarrow$ destruction of carriers of 2175 Å feature)

Local starburst galaxies:

– No significant UV bump (Calzetti et al. 1994, 2000)



Cardelli et al. (1989); Gordon et al. (2003)

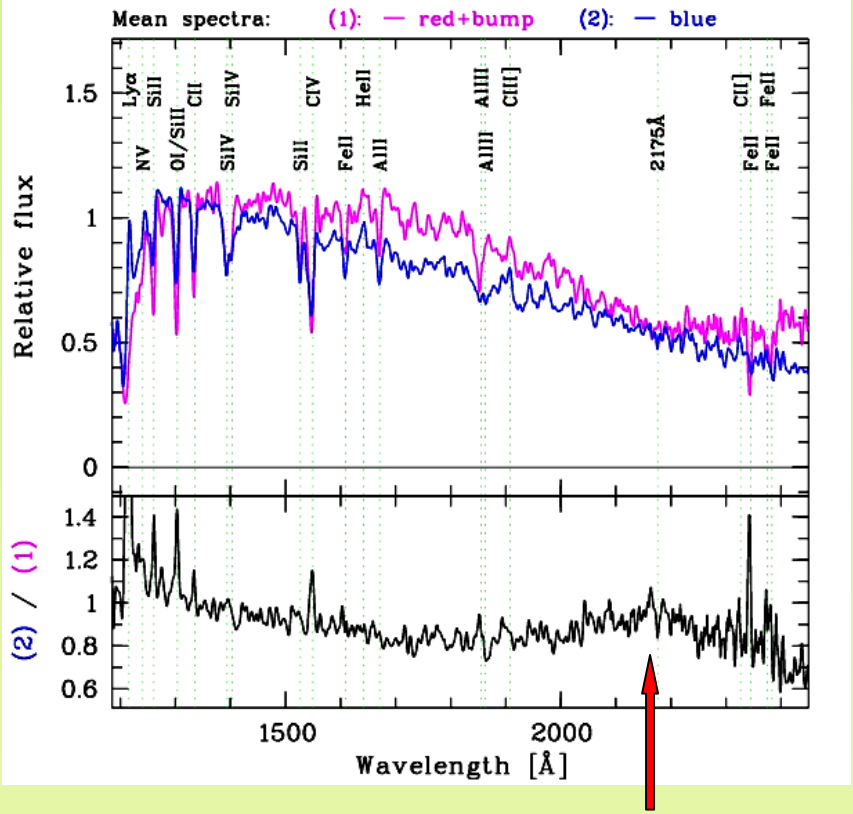
Motivation (2)

Noll & Pierini (2005):

UV-bright galaxies at 2 < z < 2.5 (selected from the FDF) show dust properties ranging from those typical of the **SMC** to those typical of the **LMC** (→ **2175 Å bump!**).

→ **Extension of the study** to
- a wider redshift range
- other surveys

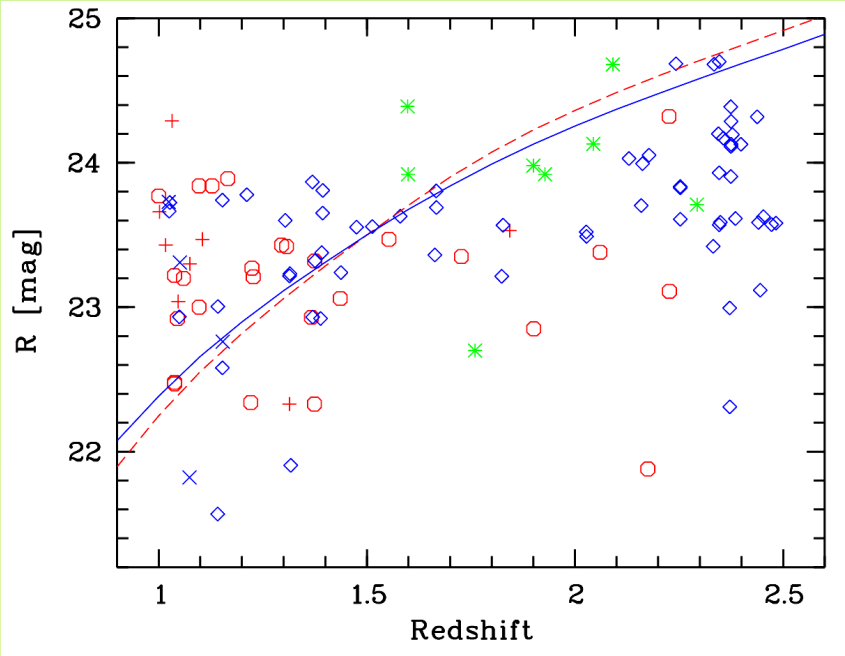
→ **What dust in what galaxies?**



(2166 ± 15) Å

The sample

- **FDF, 2 < z < 2.5:**
  - z_{phot} and I-band selected
  - 34 objects with R < 24.7
- **FDF, 1 < z < 2:**
  - z_{phot} and I/R-band selected
  - 32 objects with R < 24 (8 objects with K < 20)
- **K20, 1 < z < 2.3:**
  - K-band selected (K < 20)
  - 32 of 34 objects have R < 24
- **GDDS, 1.5 < z < 2.3:**
  - I- and K-band selected (K ≤ 21)
  - 8 objects with R < 24.7 (4" apertures)



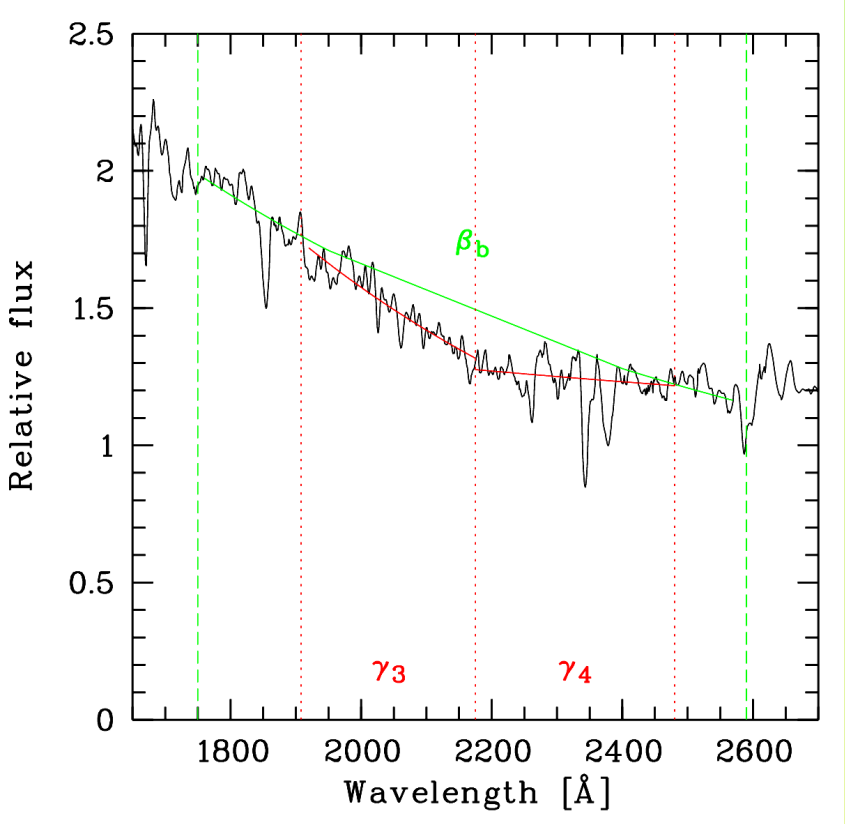
blue: FDF (Noll et al. 2004)
red: K20 (Mignoli et al. 2005)
green: GDDS (Abraham et al. 2004)

crosses: no β_b

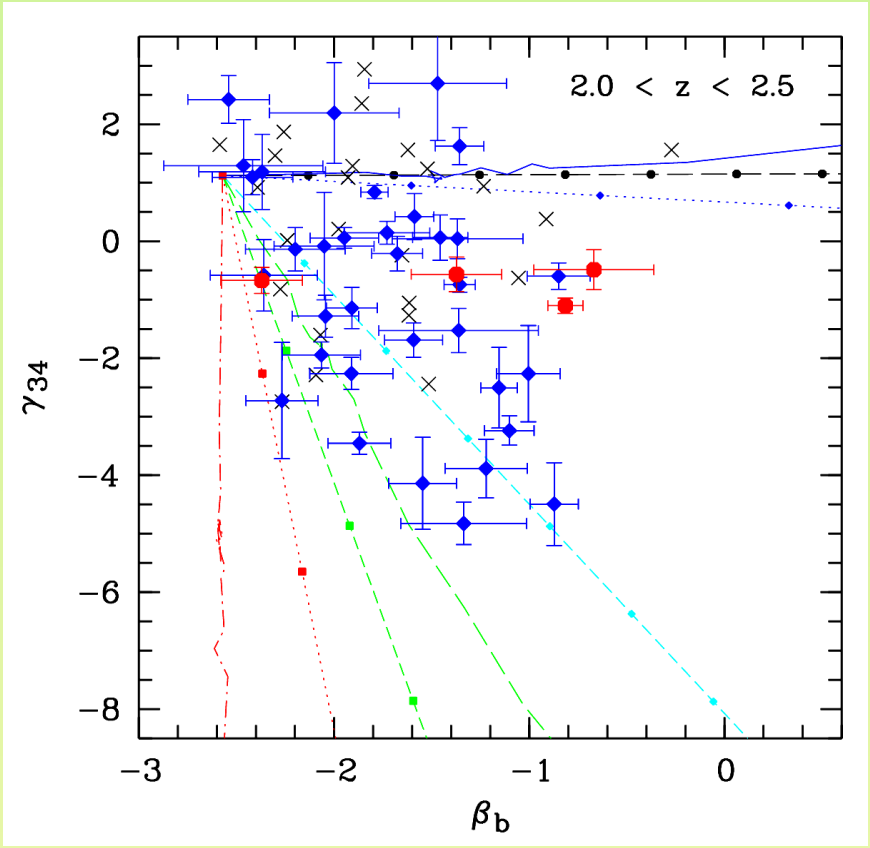
Analysis

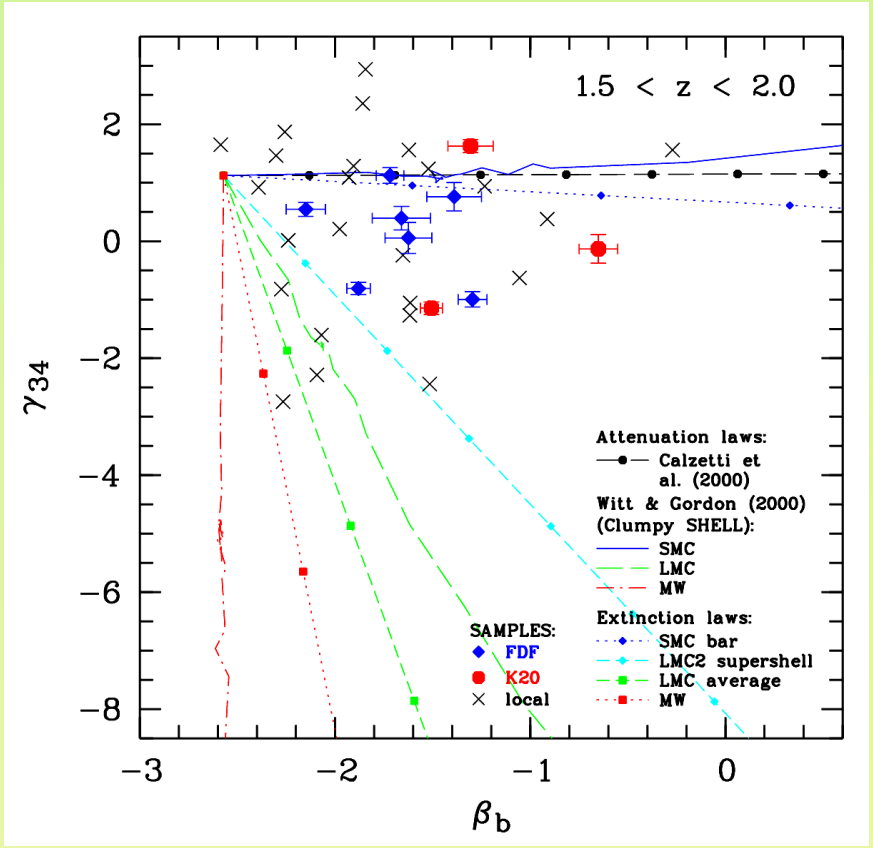
UV-continuum parameters to study dust properties:

- UV-bump index $\gamma_{34} = \gamma_3 - \gamma_4$ (1900 – 2500 Å)
  → 108 objects
- UV-continuum slope parameter β_b (1750 – 2600 Å, excluding 1950 – 2400 Å)
  → 88 objects



Results (1)

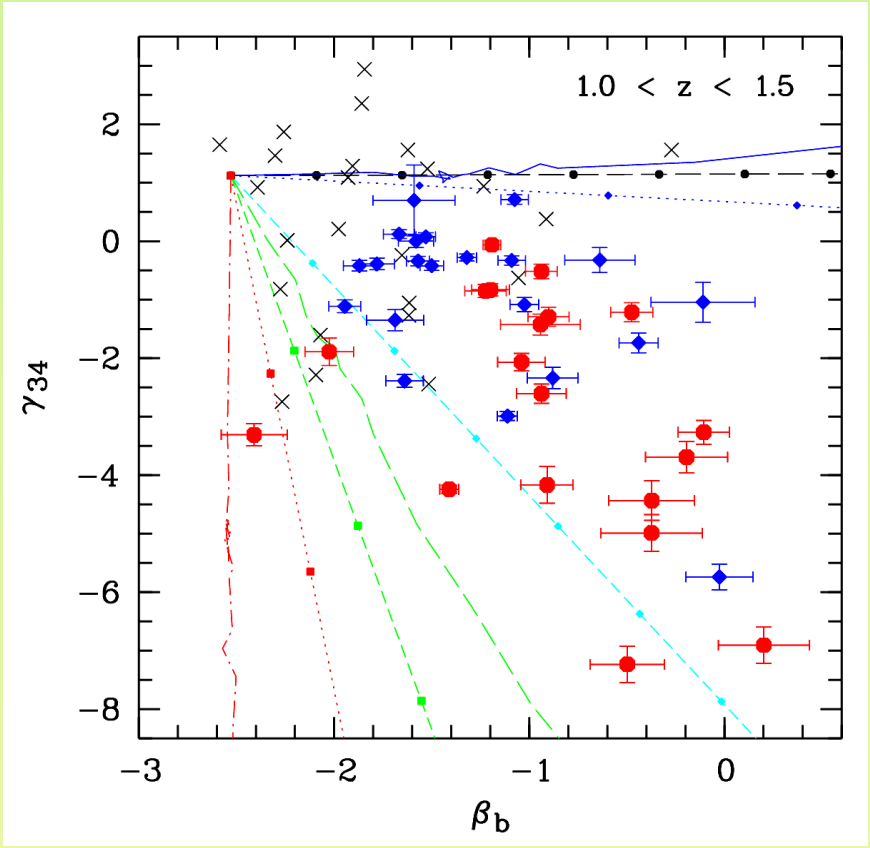


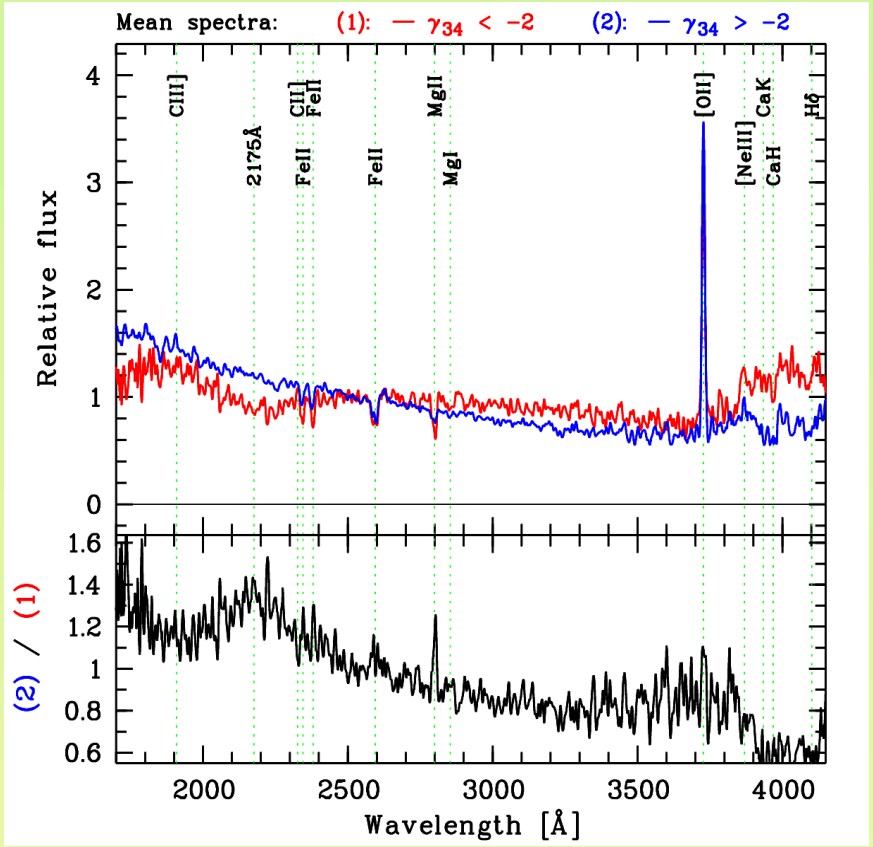


➔ Consistent with Noll & Pierini (2005), but large uncertainties

➔ Only few objects, no strong UV bumps

Results (2)





➔ ~ 52% (~ 13%) of the K < 20 (K > 20) galaxies at 1 < z < 1.5 shows strong 2175 Å features (γ_{34} < -2).

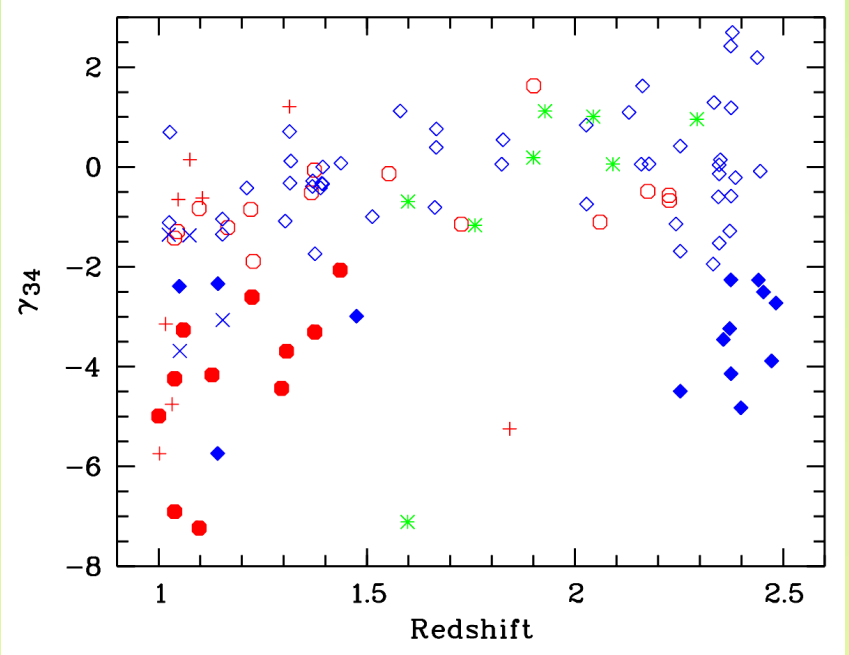
The strength of the 2175 Å feature vs. redshift

- **Two populations of galaxies with strong 2175 Å features (γ_{34} < -2):**
  - UV-bright FDF galaxies at z ~ 2.4
  - NIR-bright actively star-forming K20/FDF galaxies at 1 < z < 1.5

➔ Similarities and differences?

- **For UV-bright 1.6 < z < 2.2 galaxies: no secure detection of a object with γ_{34} < -2**

➔ Selection bias?

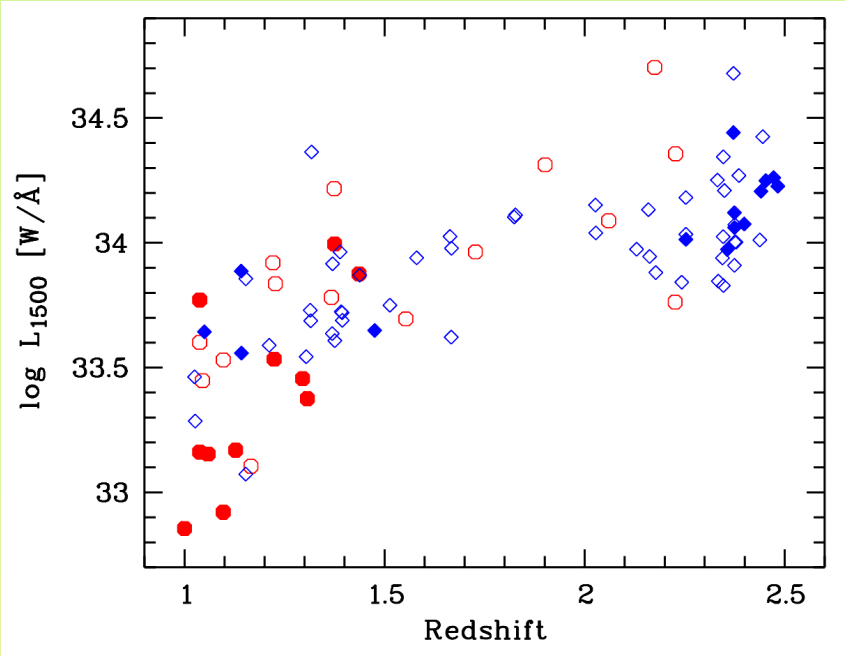


blue: FDF
red: K20
green: GDDS
crosses: no β_b

Luminosity at 1500 Å vs. redshift

Luminosity at 1500 Å:

- Almost no overlap of the galaxy populations at z ~ 2.4 and z ~ 1.2 showing strong 2175 Å features (γ_{34} < -2, filled symbols)



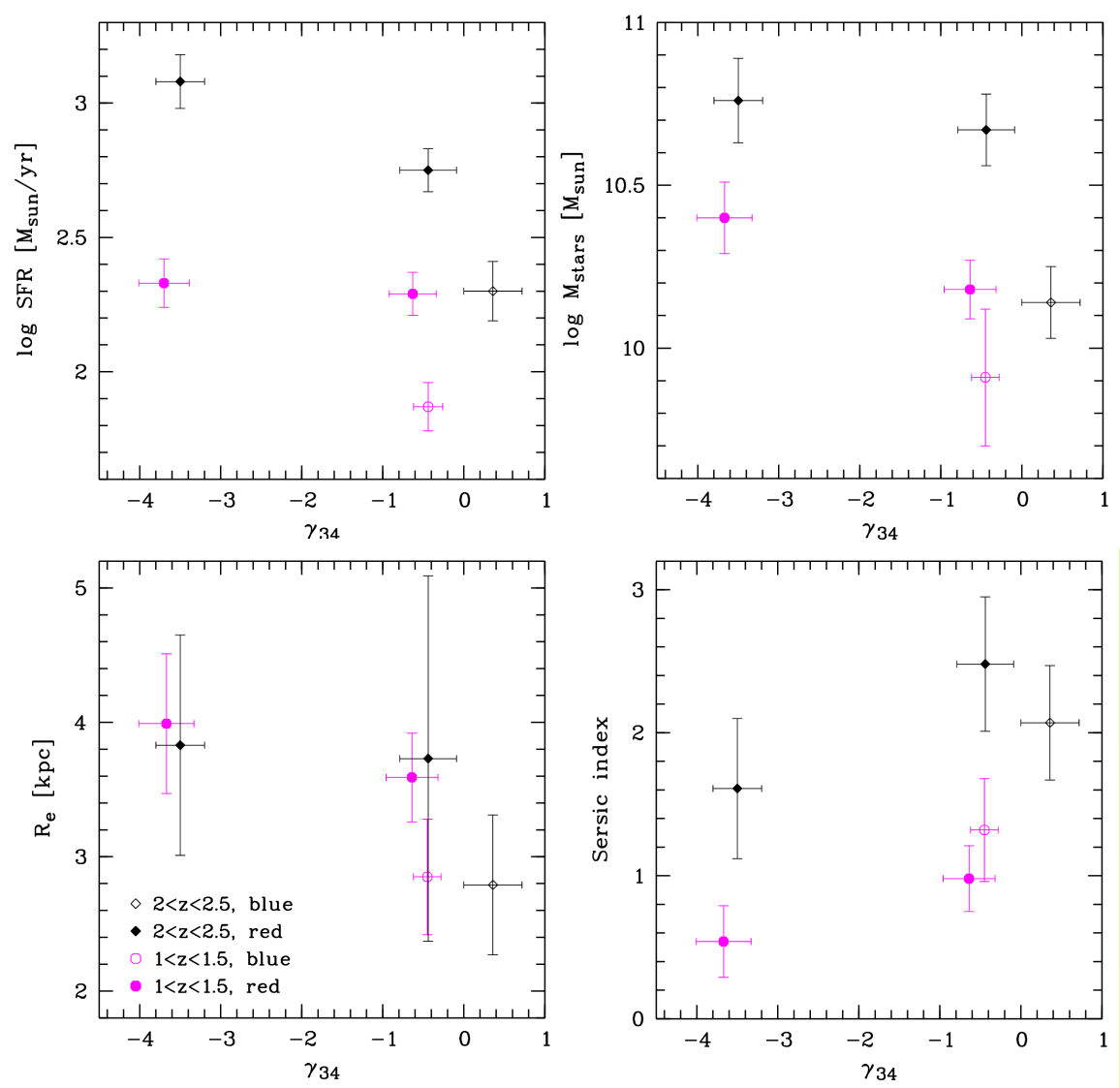
blue: FDF
red: K20

SFR, mass, morphology vs. γ_{34}

Red galaxies (β > -0.4, β_b > -1.5) have higher SFRs, higher masses, and larger sizes in relation to blue galaxies.

2 < z < 2.5 galaxies have higher SFRs and masses than 1 < z < 1.5 galaxies.

1 < z < 1.5 galaxies with strong UV bumps are predominantly disc galaxies (60 – 80%).



Conclusions

Two populations of UV-bright galaxies showing strong 2175 Å features (similar to those found in the LMC) in their spectra:

- Dusty, ultraluminous, massive, metal-rich galaxies at z ~ 2.4 (mainly major mergers). Strength of the UV bump depends on ISM topology (→ dust self-shielding, Noll & Pierini 2005).
- Dusty, luminous, aged, metal-rich galaxies at z ~ 1.2 of intermediate mass (mainly disc galaxies). More quiescent SF than at high redshift?