Quantitative Morphological Classifications from z = 0 to z = 3 with SDSS, ACS, and WFC3

Arjen van der Wel
Johns Hopkins University, Baltimore, USA

Brad Holden; Marijn Franx; Garth Illingworth; Holland Ford;
John Blakeslee; Marc Postman; Dan Kelson;
Andrew Zirm; Ivo Labbé
and the ACS team

Outline

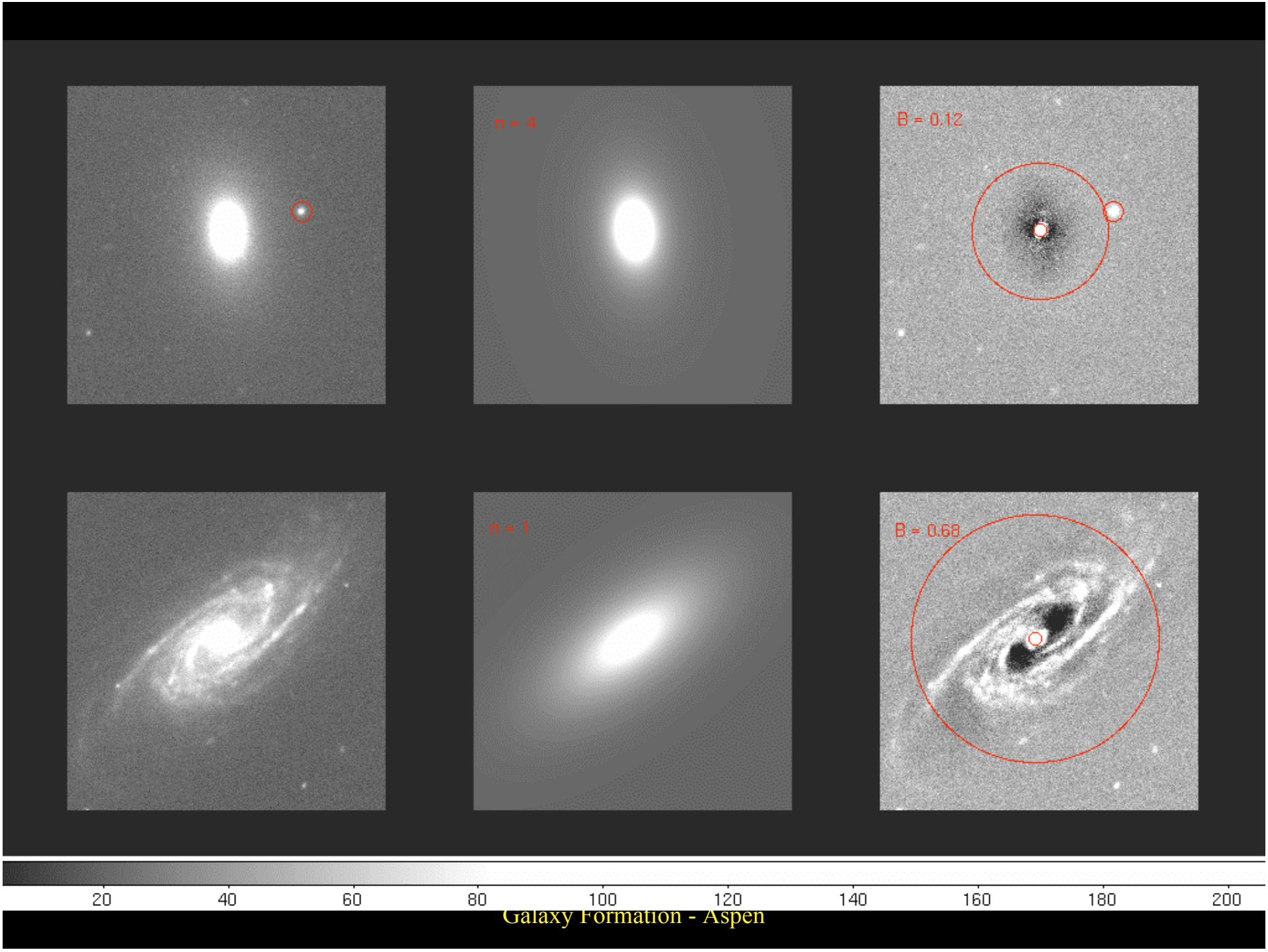
- Morphologies in the SDSS

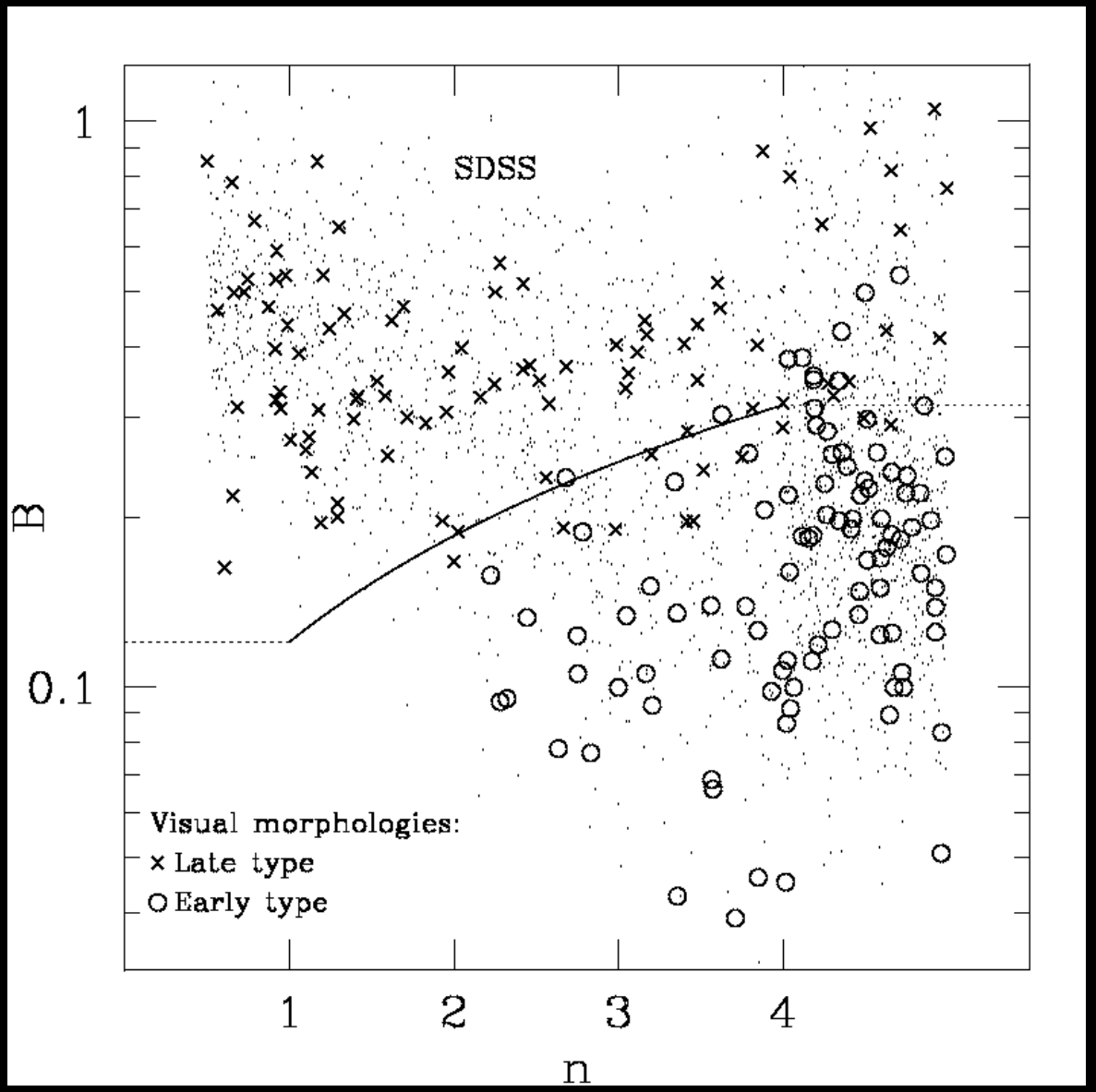
- Evolution of the morphology - density relation

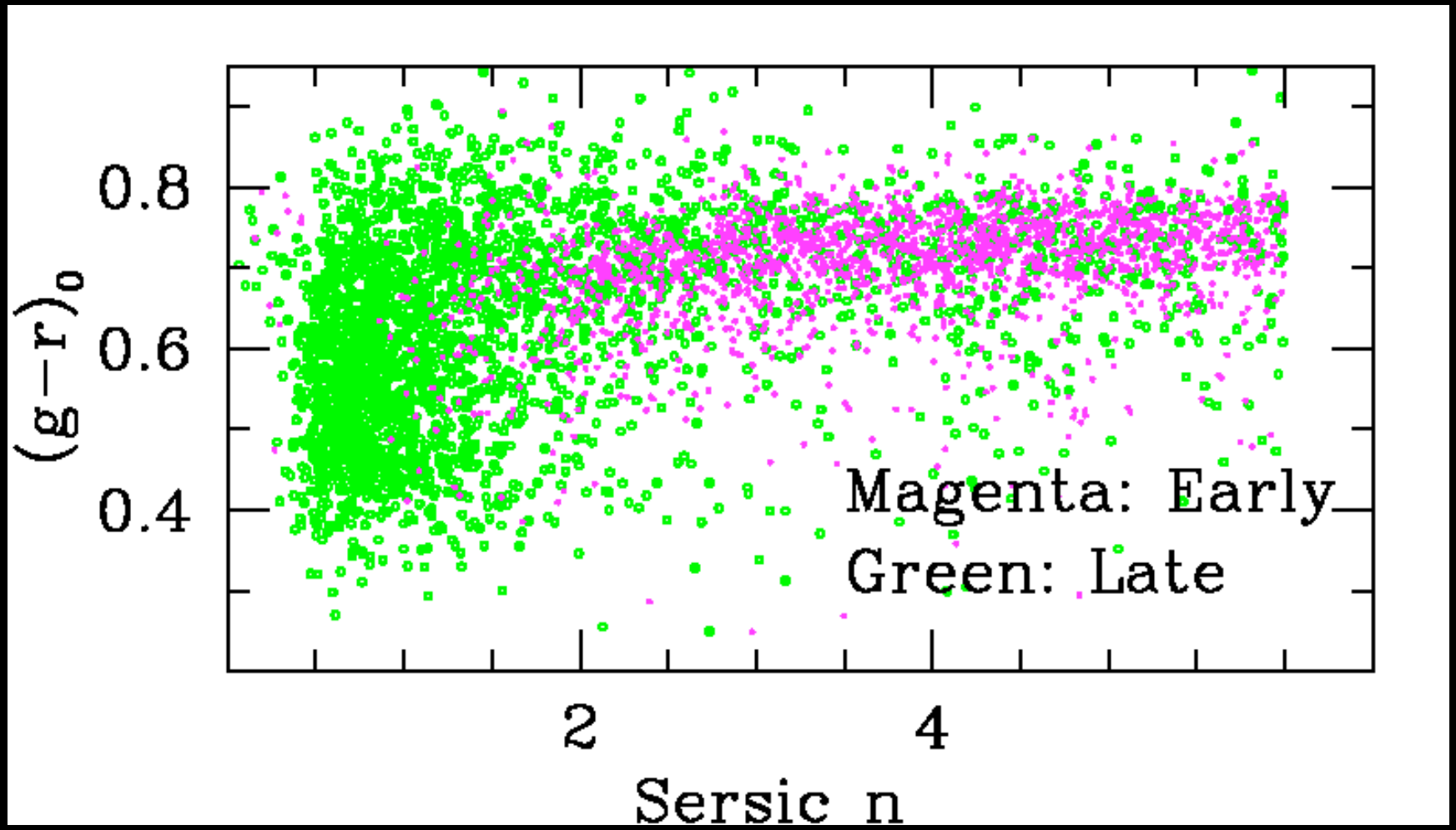
- What WFC3 will bring

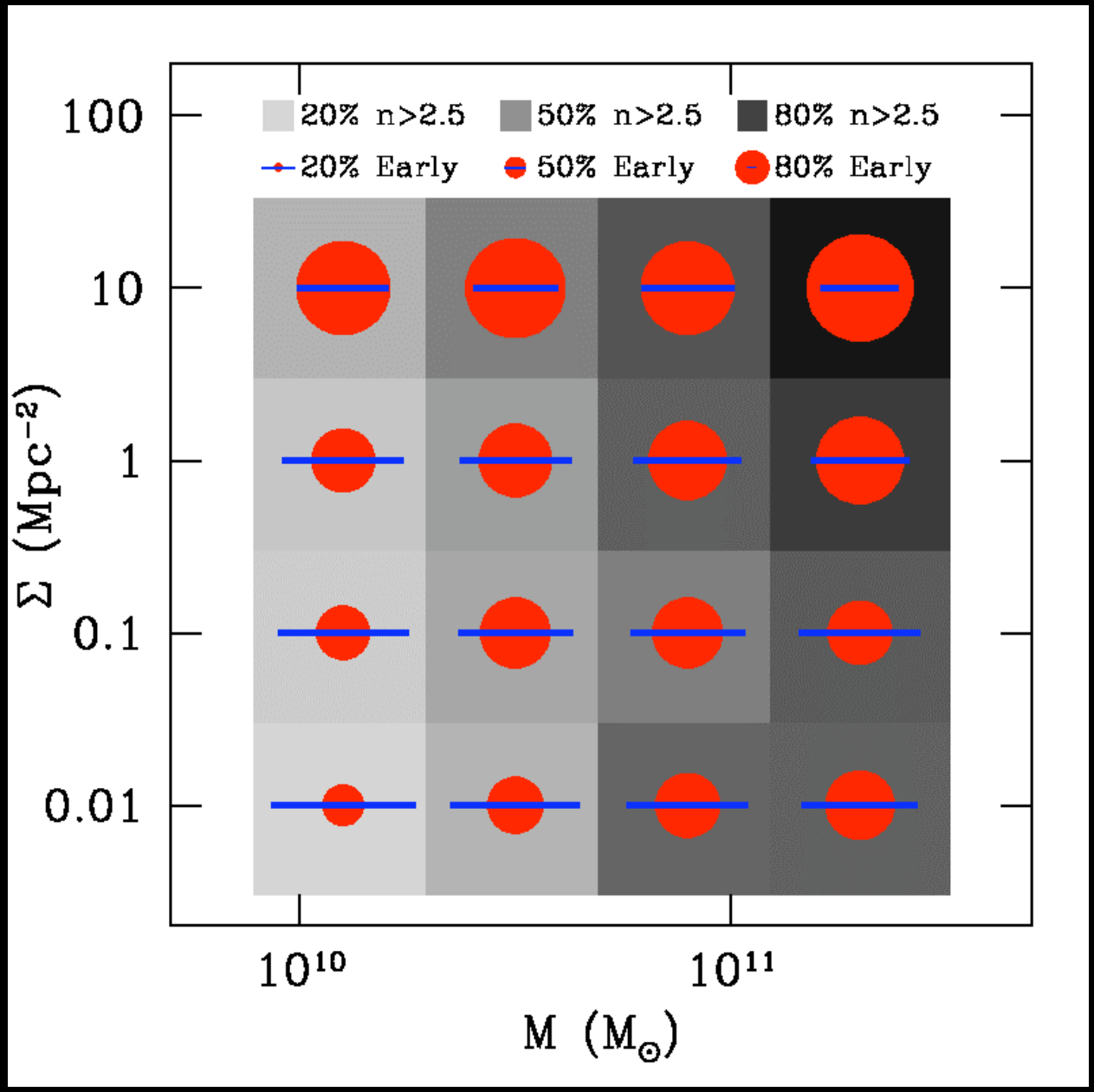
Sample extracted from SDSS (DR5)

- $0.02 < z < 0.03$
- $M_* > 10^{10}$ Msol (Bell et al. 2003)
- Environment (7th nearest neighbor)
- Morphology
  - Sersic profile fits to g-band images (GALFIT; Peng 2002)
  - 'Bumpiness' (Blakeslee et al. 2006)


n = 4
B = 0.12
n = 1
B = 0.68
20
40
60
80
100
120
140
160
180
200


SDSS
1
0.1
B
1
2
3
4
n
Visual morphologies:
× Late type
○ Early type


0.8
0.6
0.4
$(g-r)_0$
2
4
Sersic n
Magenta: Early
Green: Late


20% n>2.5
50% n>2.5
80% n>2.5
20% Early
50% Early
80% Early
100
10
1
0.1
0.01
Σ (Mpc⁻²)
10¹⁰
10¹¹
M (M⊙)

Conclusion

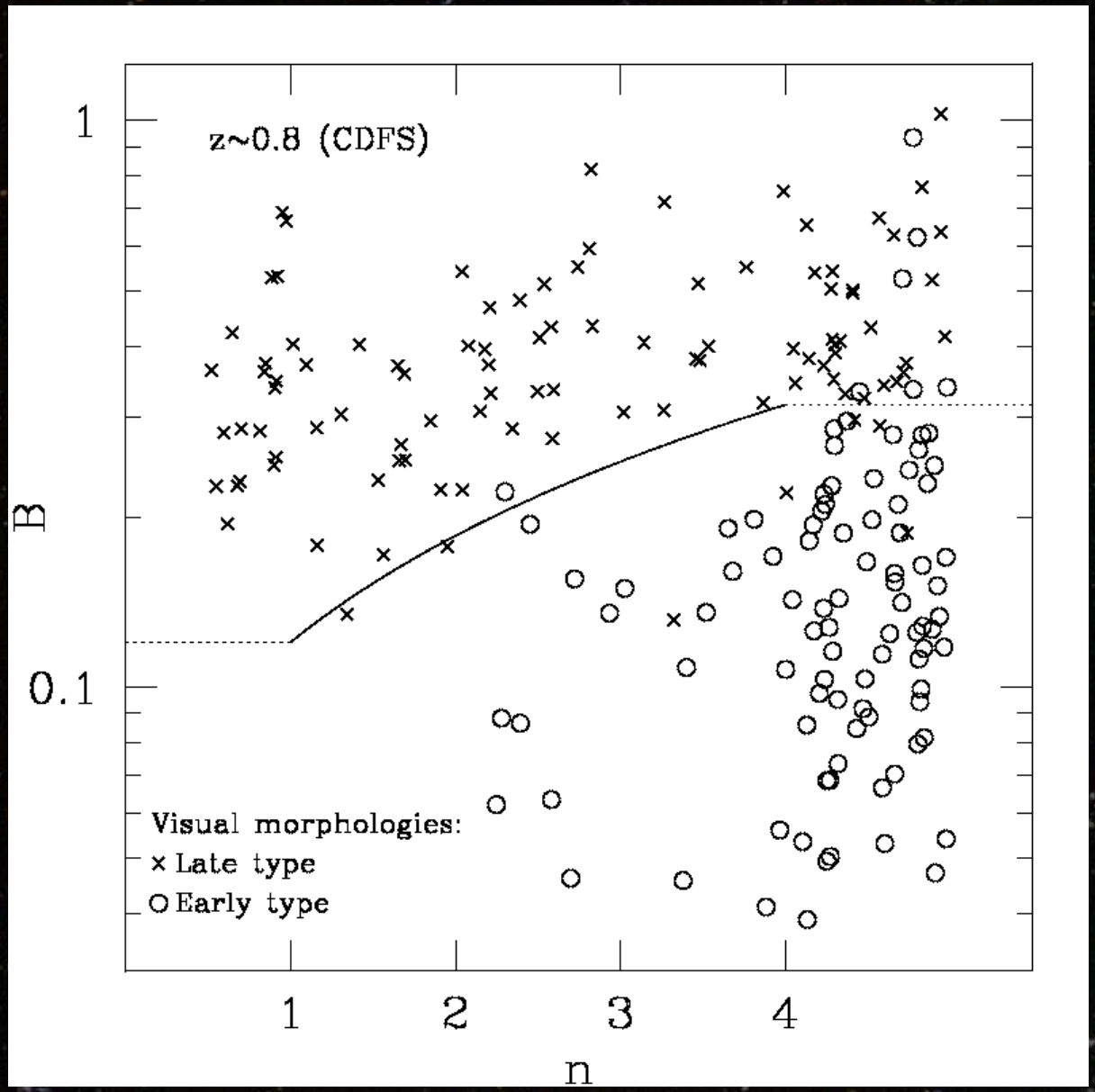
van der Wel 2008 (ApJL, in press, arXiv:0801.1995)

‘Structure’ and ‘morphology’ are intrinsically different quantities that behave differently as a function of mass and environment.

Field sample

- SDSS at $0.020 < z < 0.045$:
  2003 galaxies with $M > 4 \times 10^{10}$ Msol

- GOODS-South (CDFS) at $0.6 < z < 1.0$:
  207 galaxies with $M > 4 \times 10^{10}$ Msol

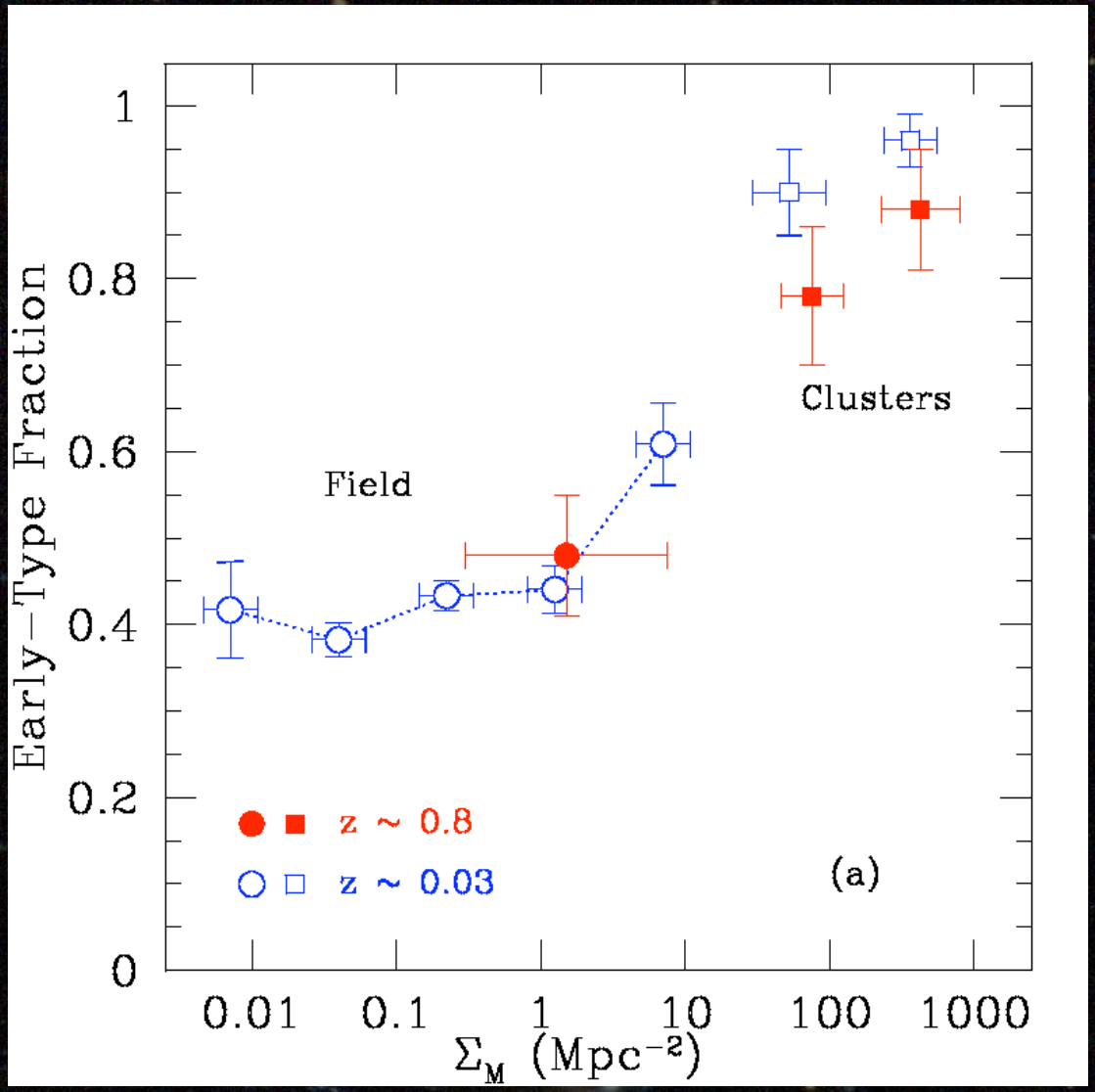

z~0.8 (CDFS)
1
0.1
B
1
2
3
4
n
Visual morphologies:
× Late type
○ Early type

Cluster sample

- Coma cluster at z = 0.023:
  95 galaxies with $M > 4 \times 10^{10}$ Msol

- MS1054 & CL0152 at z = 0.83:
  191 galaxies with $M > 4 \times 10^{10}$ Msol

The MDR at z = 0 and z = 0.8

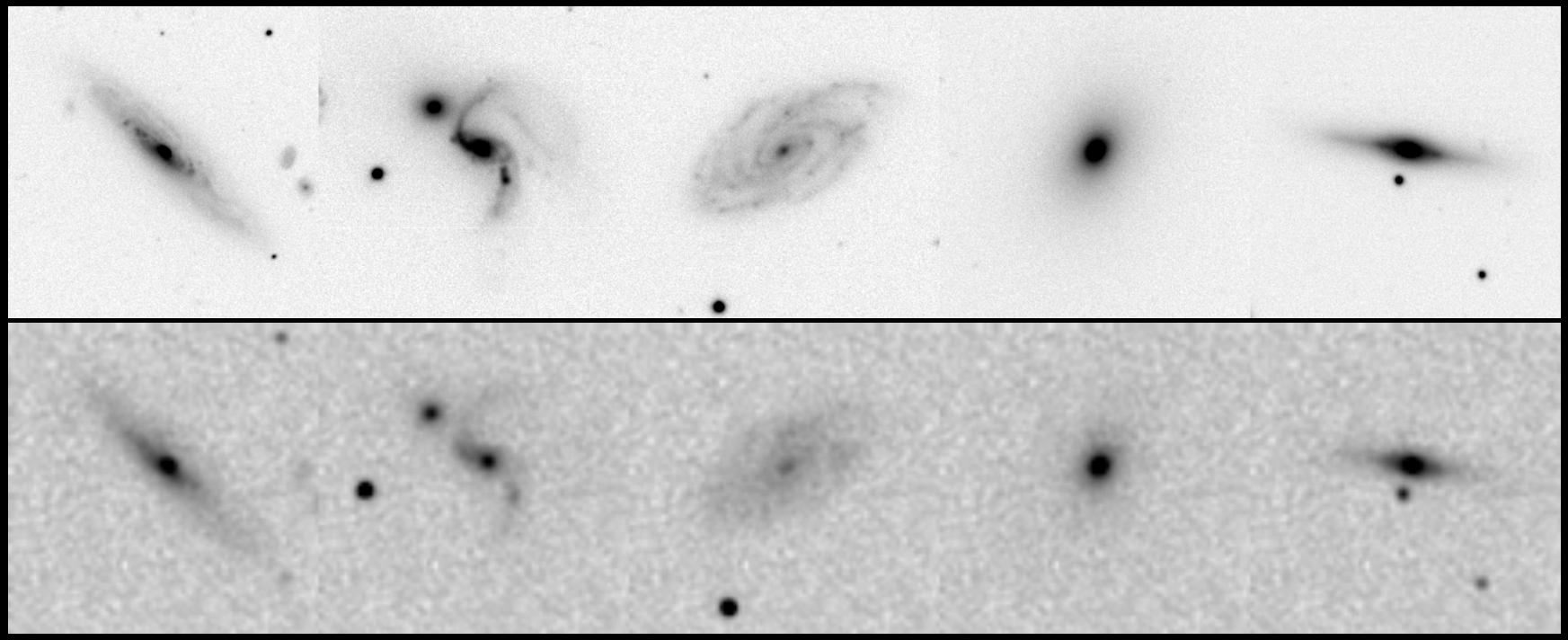


Conclusion

Holden et al. 2007 (ApJ 670, 190)
van der Wel et al. 2007 (ApJ 670, 206)

The early-type galaxy fraction does not significantly evolve in any environment between $z = 0.8$ and the present for galaxies with $M > 4 \times 10^{10}$ Msol

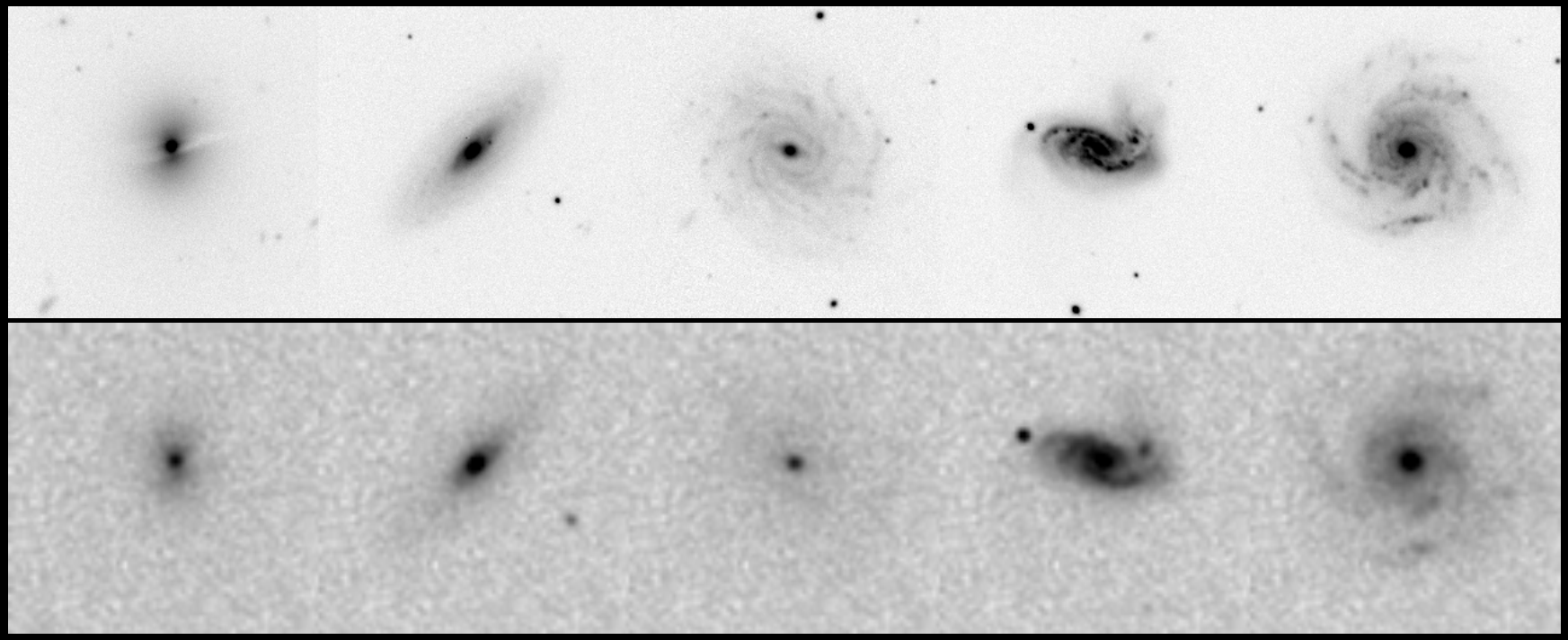
What WFC3 will bring…



L* - 2 L* ; H(AB) = 23 … 24 at z = 2.2

4 orbits with F160W

What WFC3 will bring…



L* - 2 L* ; H(AB) = 23 … 24 at z = 2.2

4 orbits with F160W