Spiral Galaxies

Milky Way

- radial scale length 3-4 kpc
- blue (B) luminosity ~1.5×10^{10} $L_\odot$
- absolute blue magnitude -20.7
- mass ~10^{12} $M_\odot$

All Spirals

- radial scale length 1–50 kpc
- blue (B) luminosity ~10^{8} —10^{11} $L_\odot$
- absolute blue magnitude -16 — -23
- mass ~10^{9}–10^{12} $M_\odot$

Spirals are ~75% of all “field” galaxies
= galaxies not in clusters

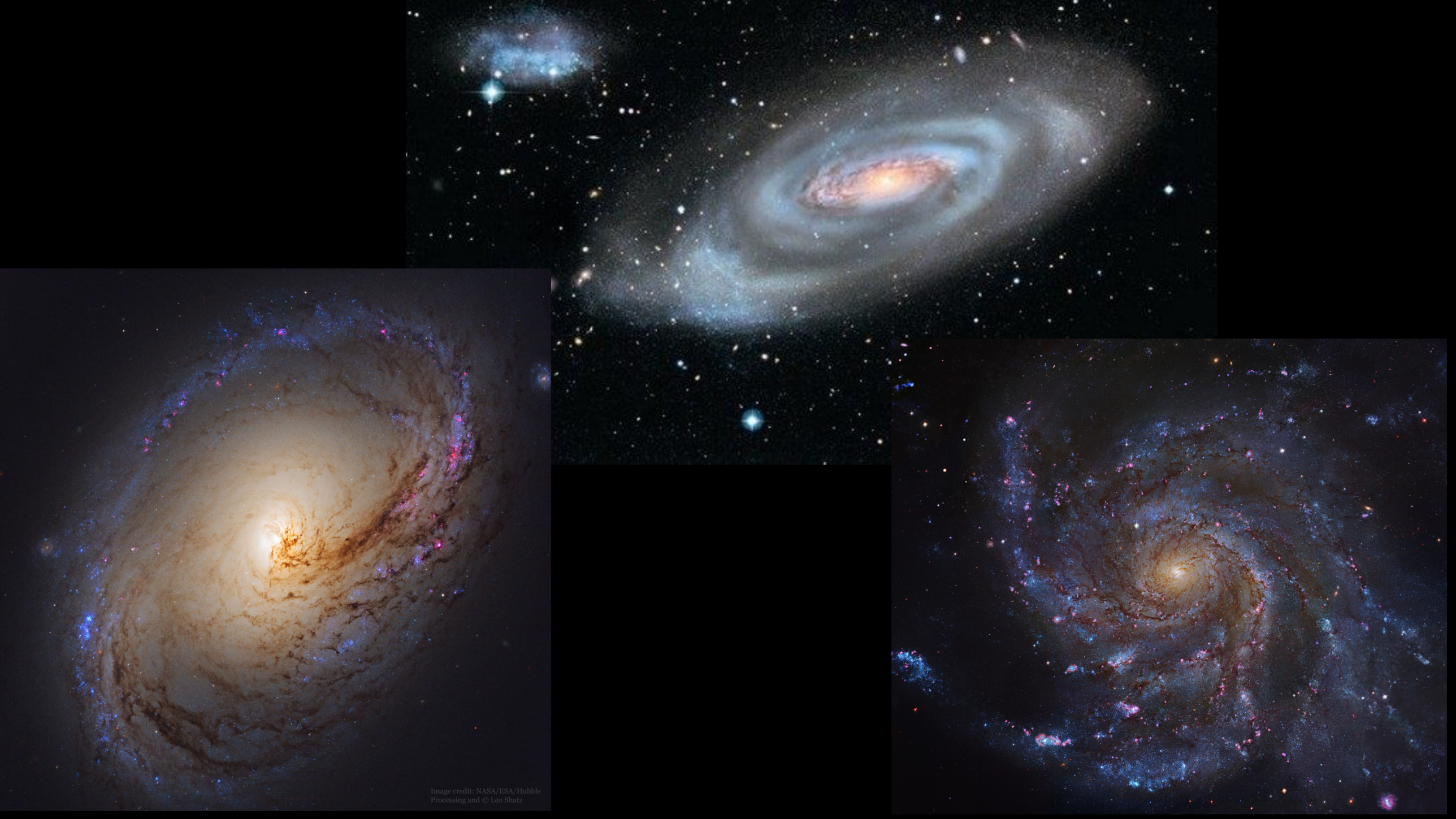
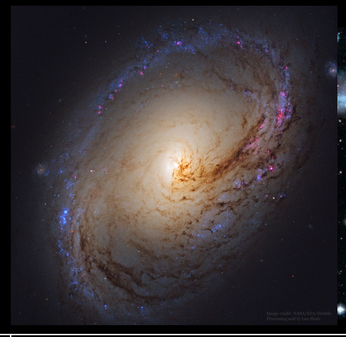
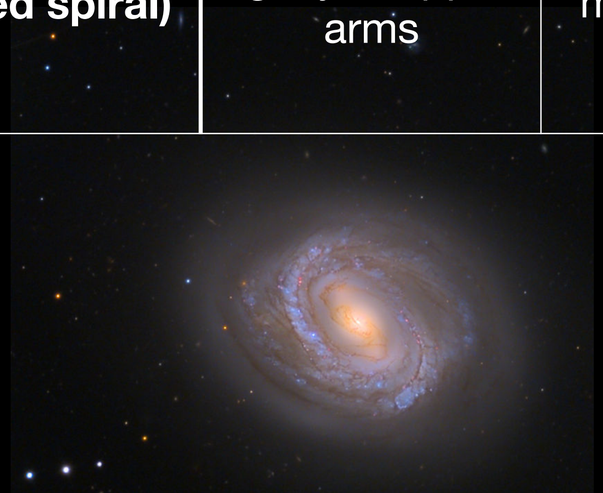


Image credit: NASA/ESA/Hubble
Processing and © Leo Shatz



	a	b	c	d
S (regular spiral)	prominent bulge, tightly wrapped arms	medium bulge, medium wrap	weak bulge, loose wrap	no bulge, very loose wrap
SB (barred spiral)	prominent bar, tightly wrapped arms	medium bar, medium wrap	weak bar, loose wrap	—

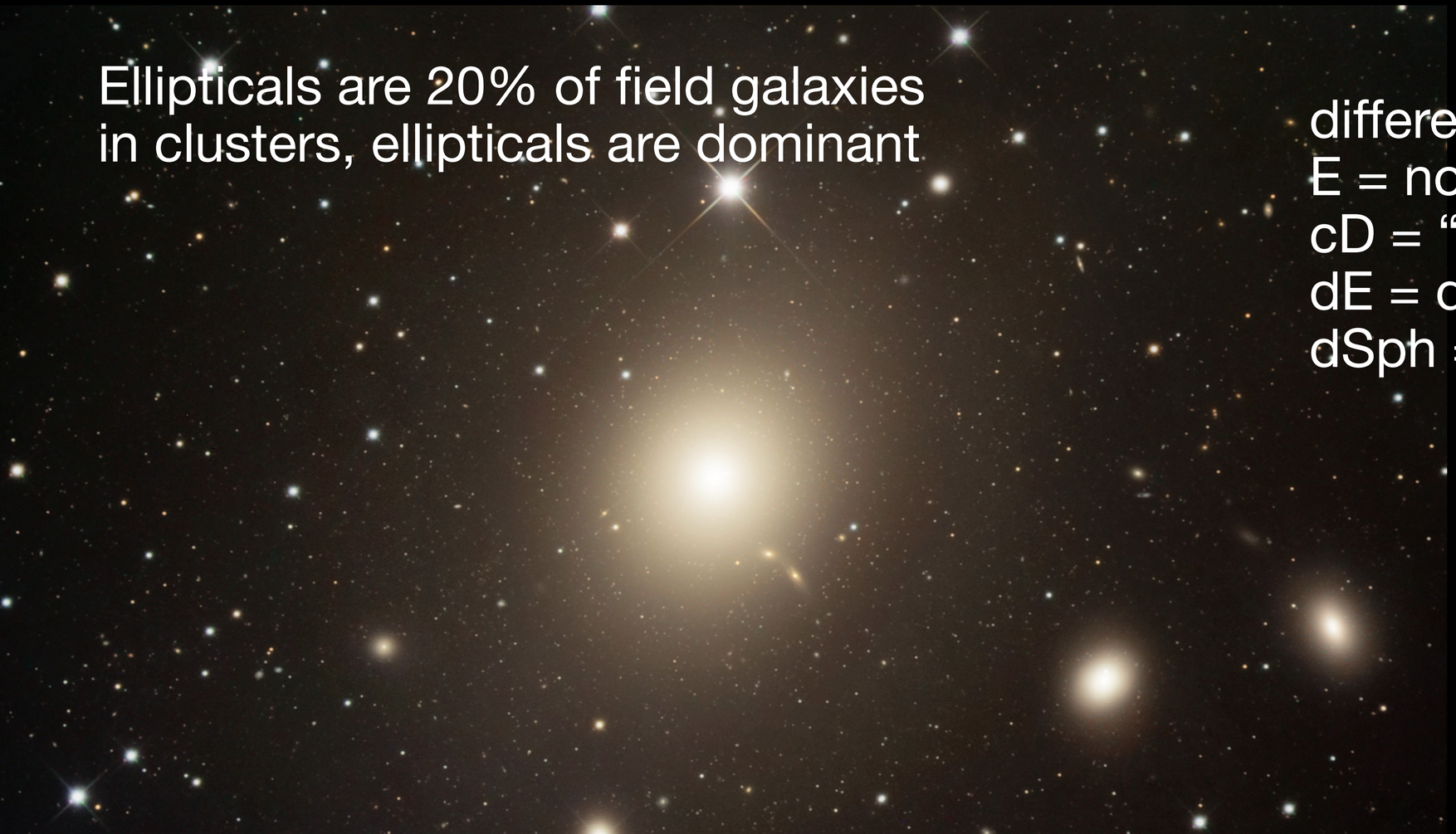



Milky Way = SBbc

Elliptical Galaxies

- effective radius — 0.1–10 kpc
- absolute magnitude — -10 — -25
- mass — ~10^7–10^{14} $M_\odot$

effective radius = radius that contains 50% of the overall light that the galaxy emits; for a disk $r_e = 1.7h$

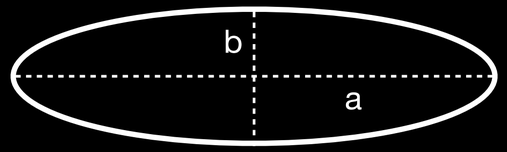


Ellipticals are 20% of field galaxies in clusters, ellipticals are dominant

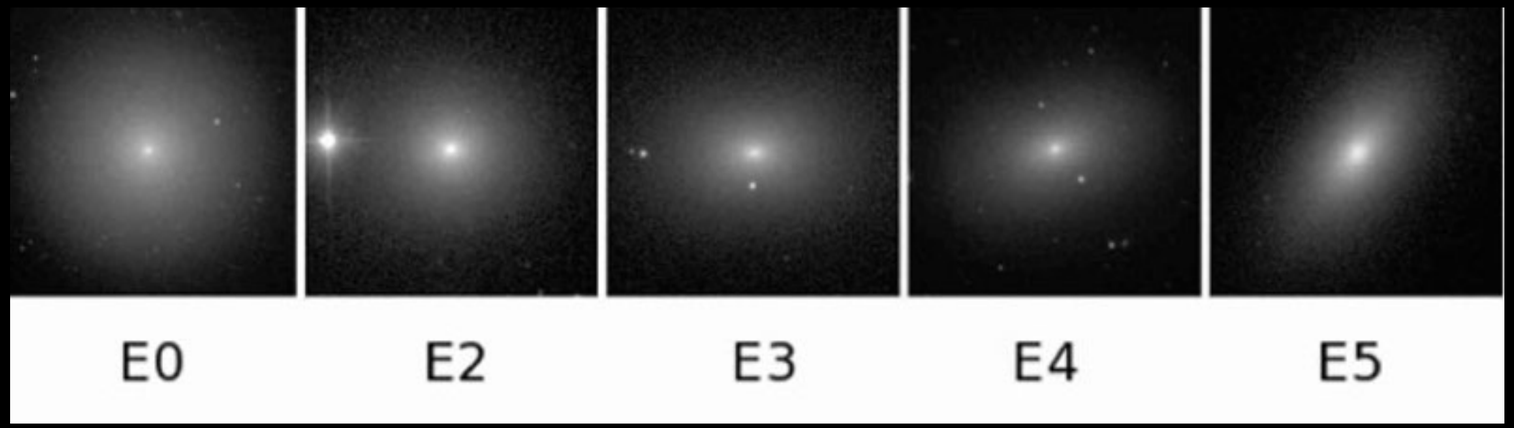
different types of ellipticals:
E = normal
cD = “cluster dominant”
dE = dwarf ellipticals
dSph = dwarf spheroidals

ellipticals are classified by how flat they are:

$$1 - \frac{b}{a}$$



c = line of sight axis



a = b = c spherical

a > b = c prolate

a = b > c oblate

a > b > c triaxial

circular **stretched**

E0 1 2 3 4 5 6 7 8

Lenticular Galaxies

A disk with no spiral arms* or star formation

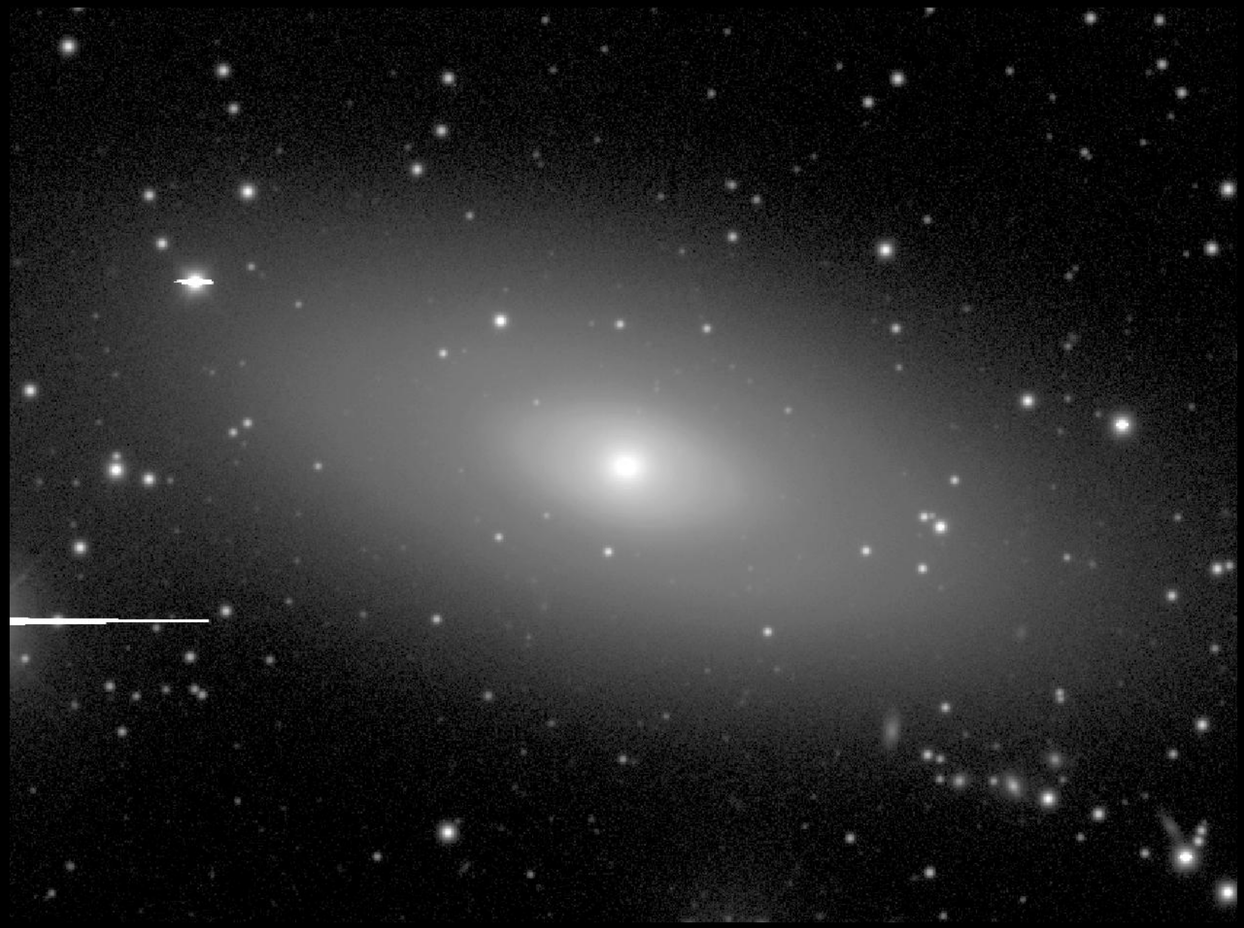
*except sometimes in dust

“transitional” between S&E

usually have bulges/bars

redder in color but otherwise similar to spirals in luminosity mass and size

S0 / SB0



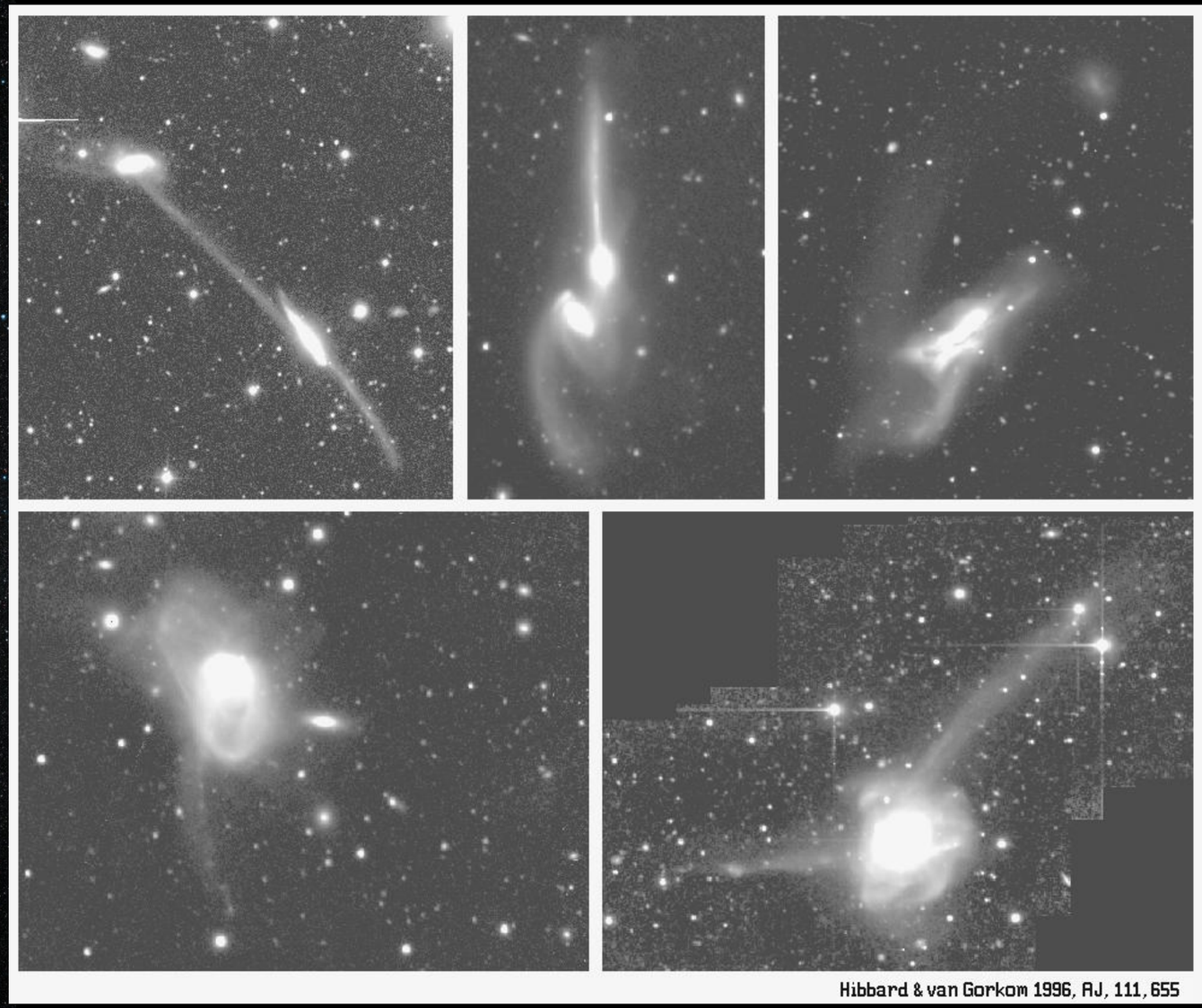
Irregular Galaxies

Usually heavy star formation,
but no discernible regular shape
—“blobs”

few % of field galaxies
few kpc in diameter
abs mag = -13 — -20
mass 10^8–10^{10} $M_\odot$

Peculiar Galaxies

“wack, yo”



Hibbard & van Gorkom 1996, AJ, 111, 655

Hubble Tuning Fork Diagram

“early”

“late”

E0 E1 E2 E3 E4 E5 E6 E7 E8

S0
SB0

Sa

Sb

Sc

Sd

SBa

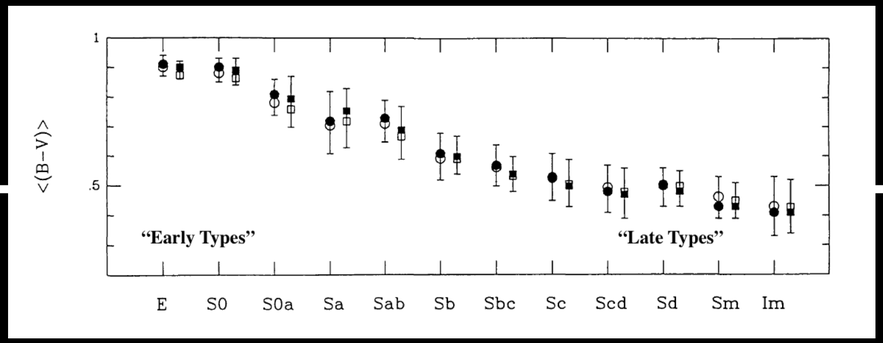
SBb

SBc

SBd

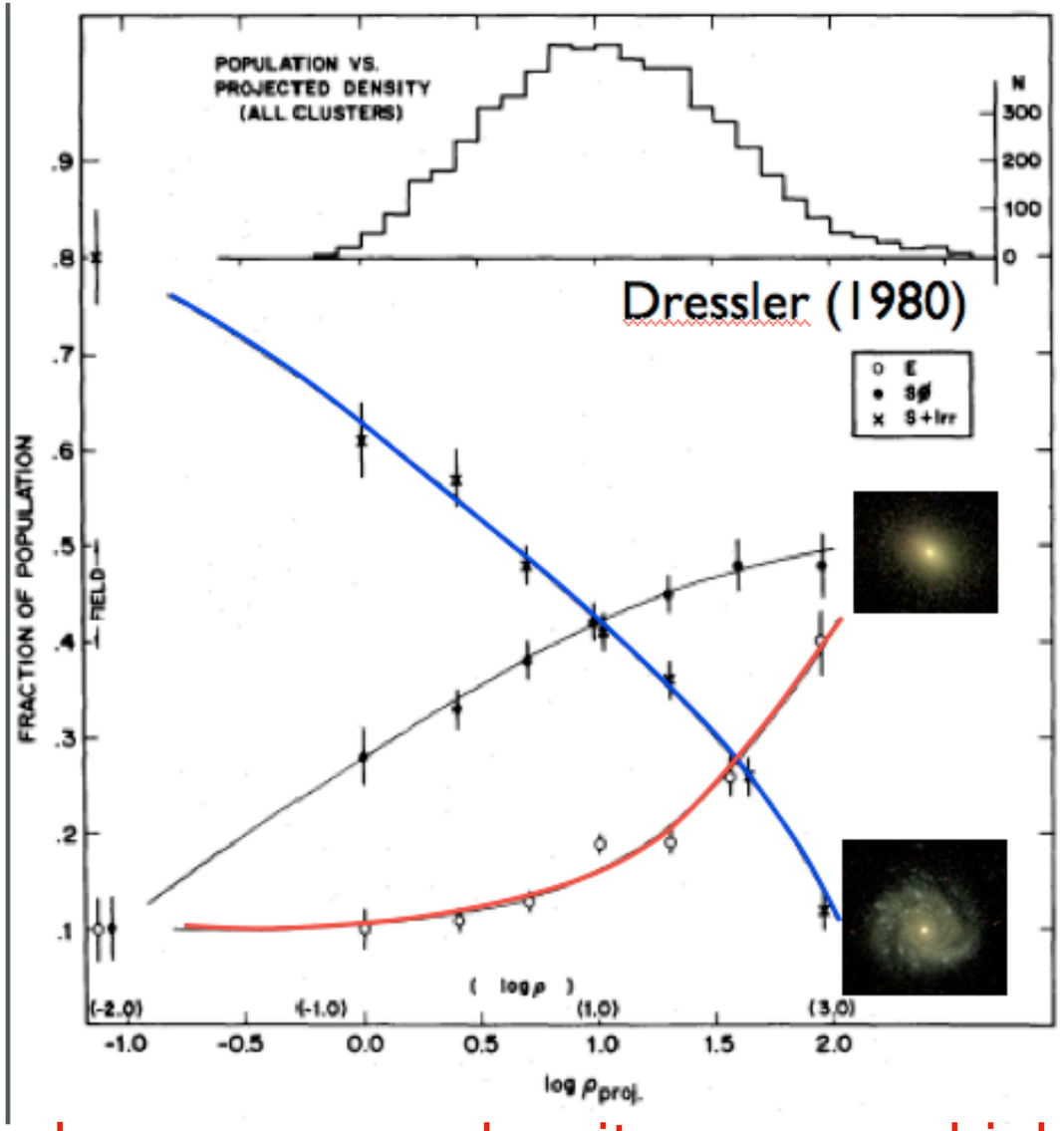
Irr
Pec

reddest



bluest

Morphology-Density Relationship



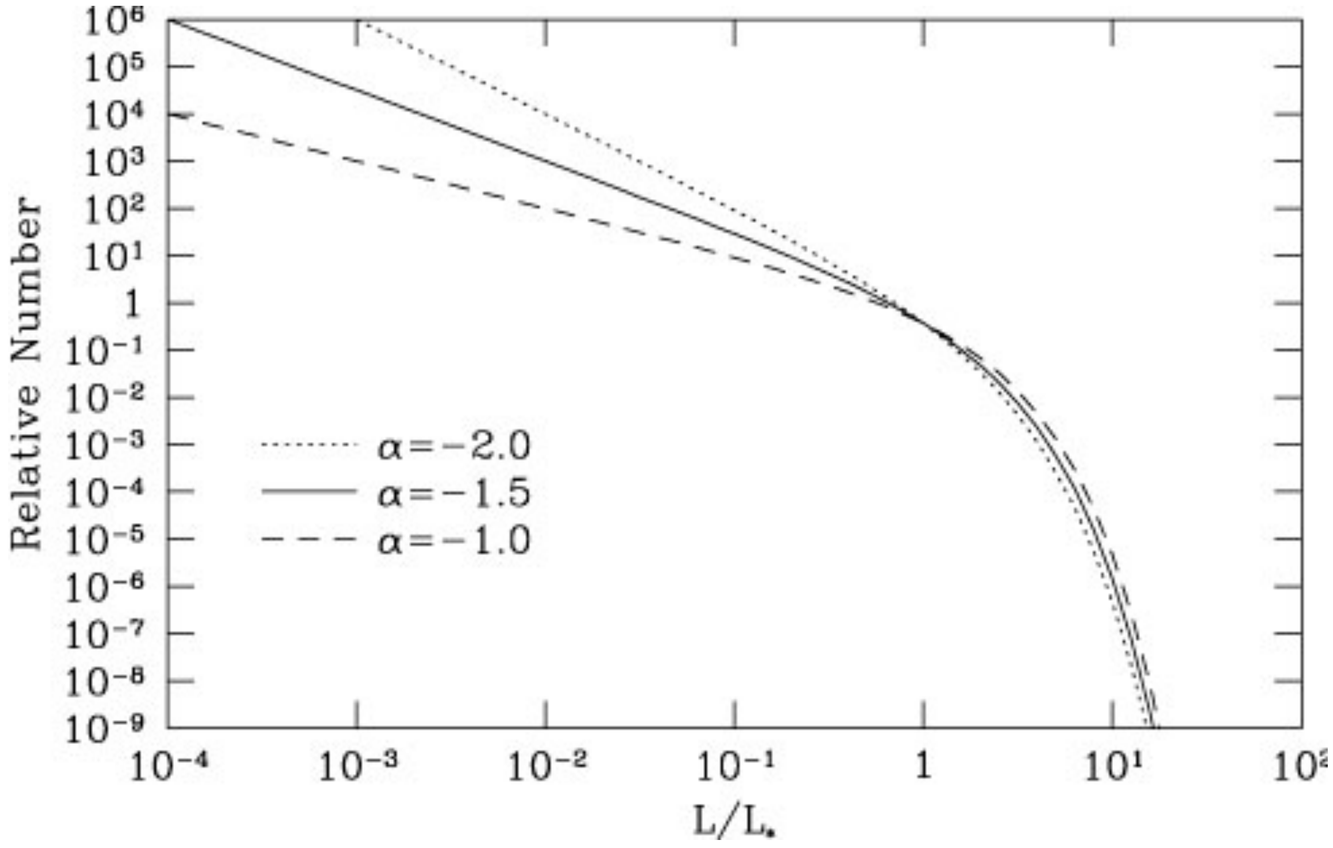
low density high

spirals prefer low density environments

lenticulars prefer high density environments

ellipticals prefer really high density environments

Galaxy Luminosity Function



# of galaxies per unit luminosity or magnitude

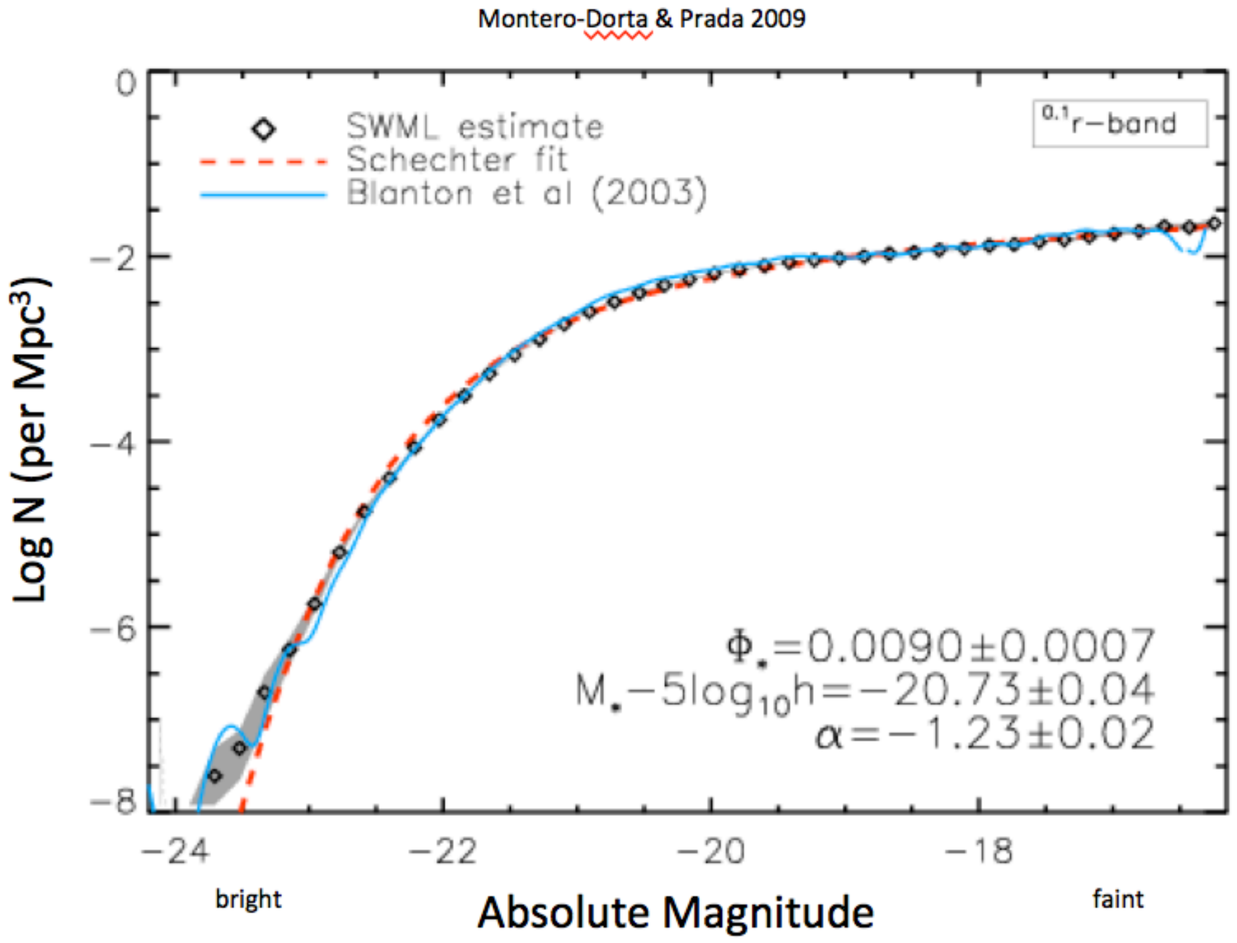
are brighter galaxies more common? or fainter more common?

Schechter function

$$\phi(L)dL \sim L^{\alpha} e^{-L/L^*} dL$$

$$\phi(M)dM \sim 10^{-0.4(\alpha+1)M} e^{-10^{0.4(M^*-M)}} dM$$

Galaxy Luminosity Function



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$L^* = 2\times10^{10}\ L_\odot \sim$ MW

α = -1 — -1.5

M* ~ -21

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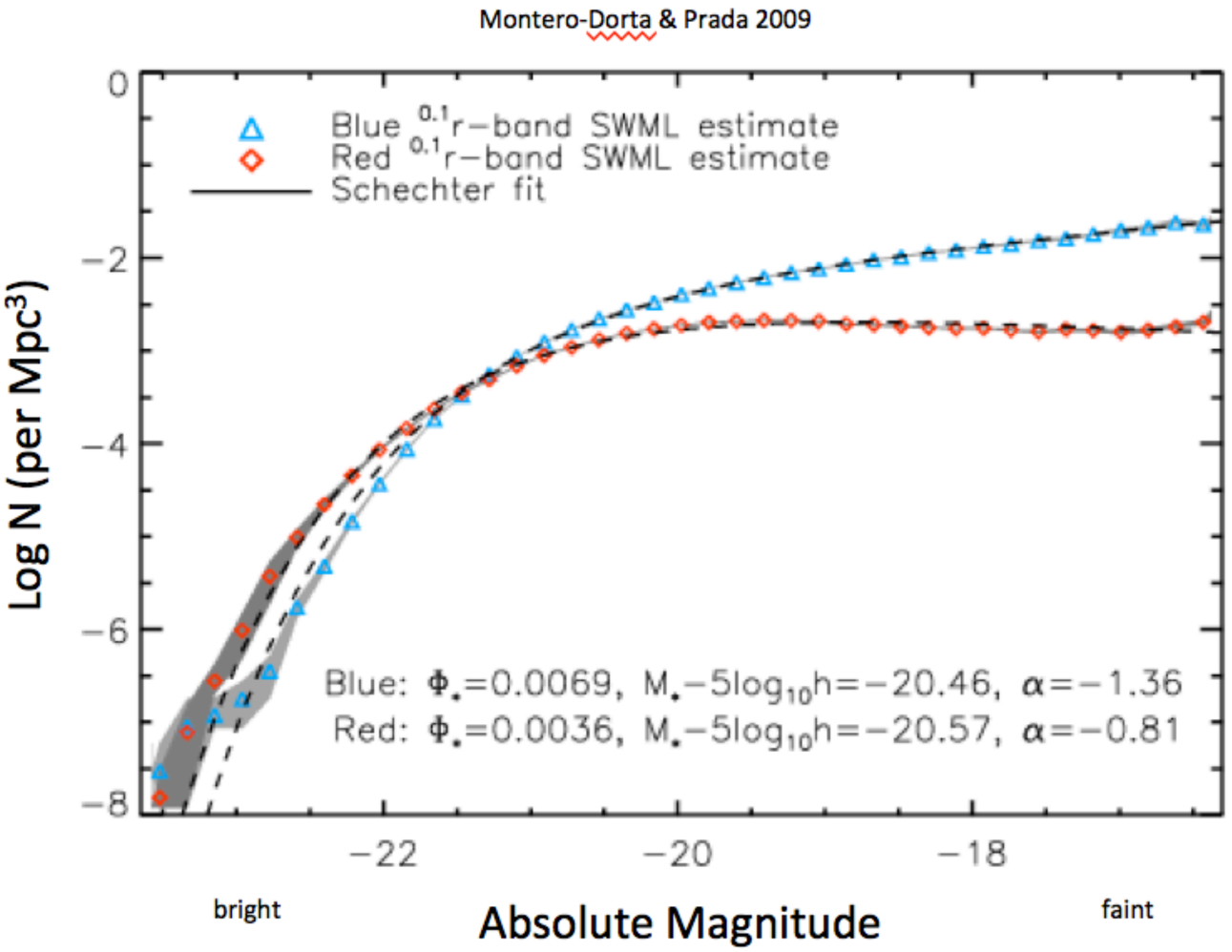

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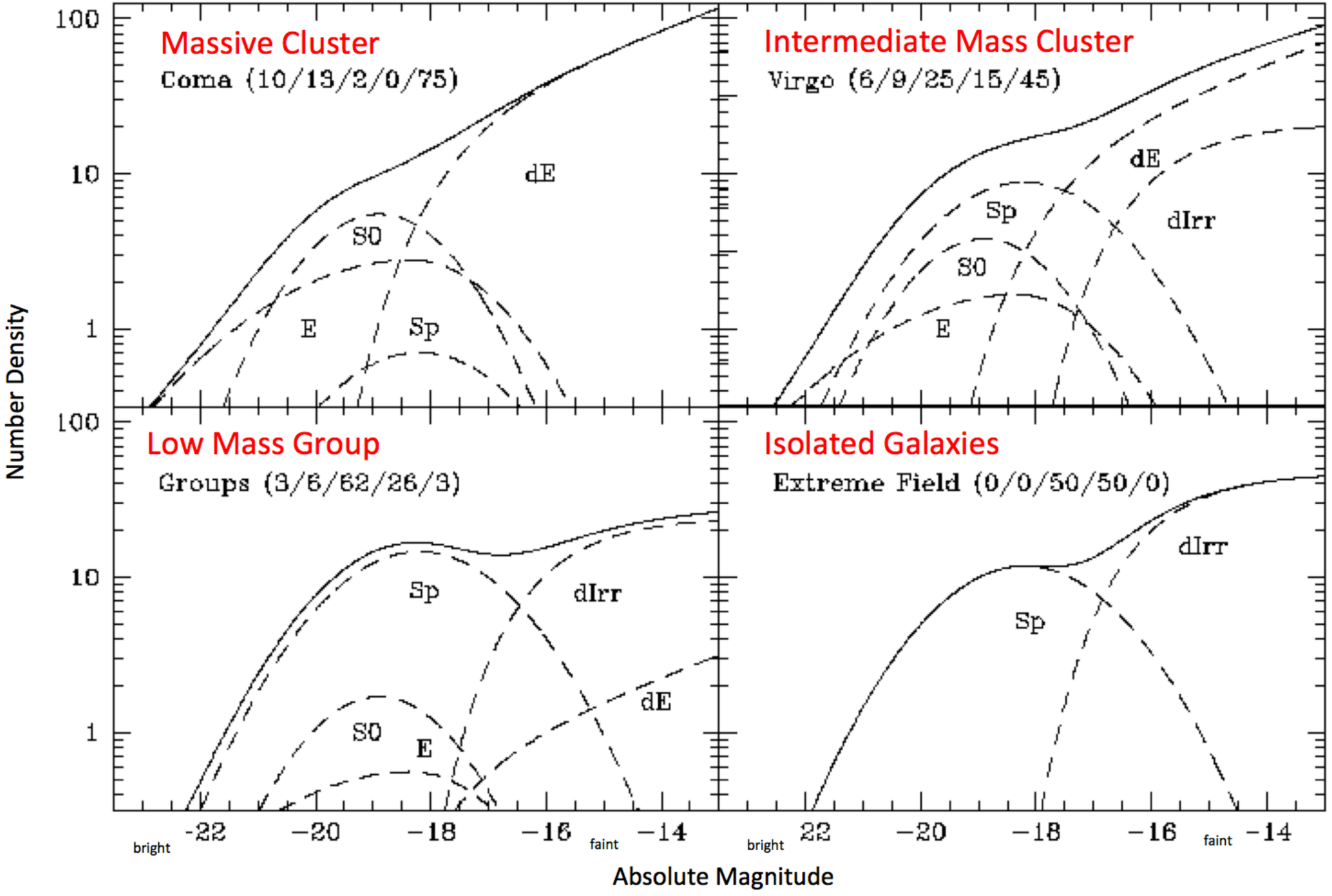
Massive Cluster
Coma (10/13/2/0/75)
dE
S0
E
Sp
Intermediate Mass Cluster
Virgo (6/9/25/15/45)
dE
Sp
dIrr
S0
E
Low Mass Group
Groups (3/6/62/26/3)
Sp
dIrr
dE
S0
E
Isolated Galaxies
Extreme Field (0/0/50/50/0)
dIrr
Sp
100
10
1
Number Density
bright
-22
-20
-18
-16
faint
-14
bright
22
-20
-18
-16
faint
-14
Absolute Magnitude