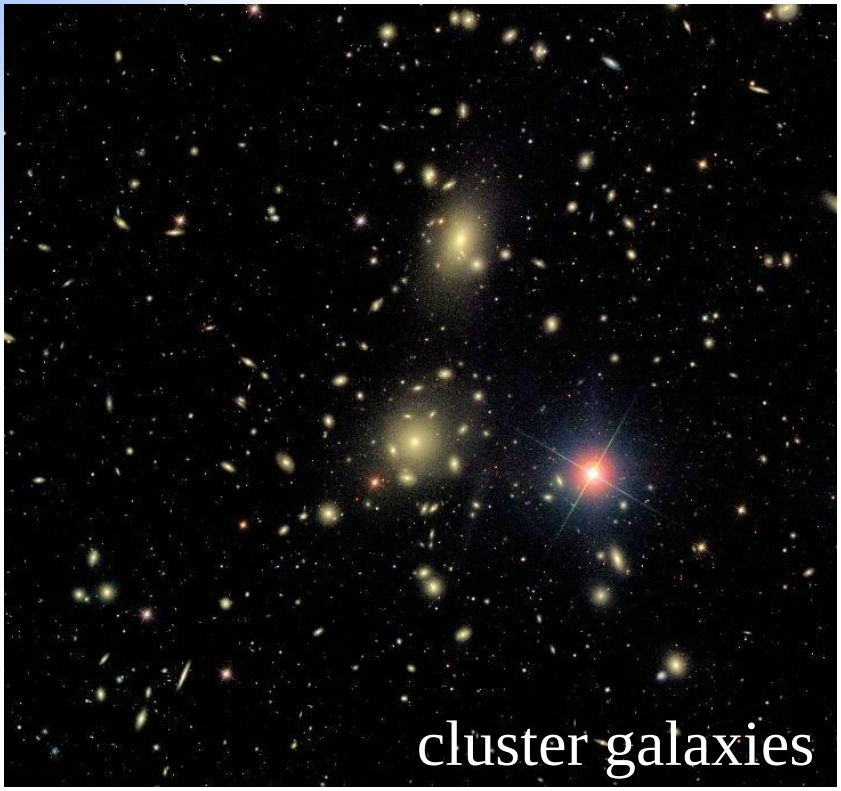
すばるが見た遠方銀河団
distant clusters of galaxies: take a closer look

Masayuki Tanaka (University of Tokyo)
Tadayuki Kodama (NAOJ) + PISCES team

picture credits: Sloan Digital Sky Survey, Robert Lupton (Princeton)

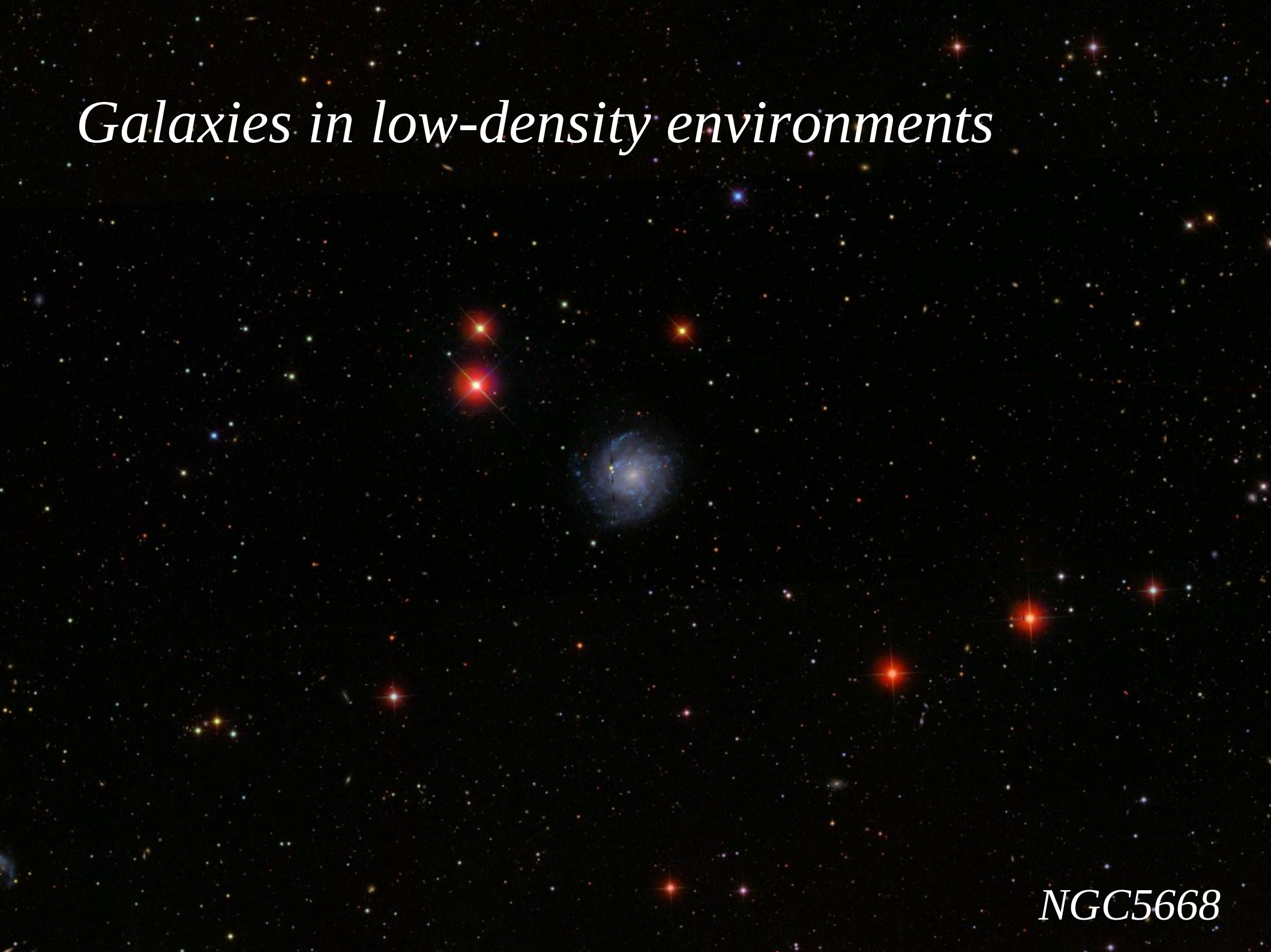
Outline



environment ⟷ *galaxy density*

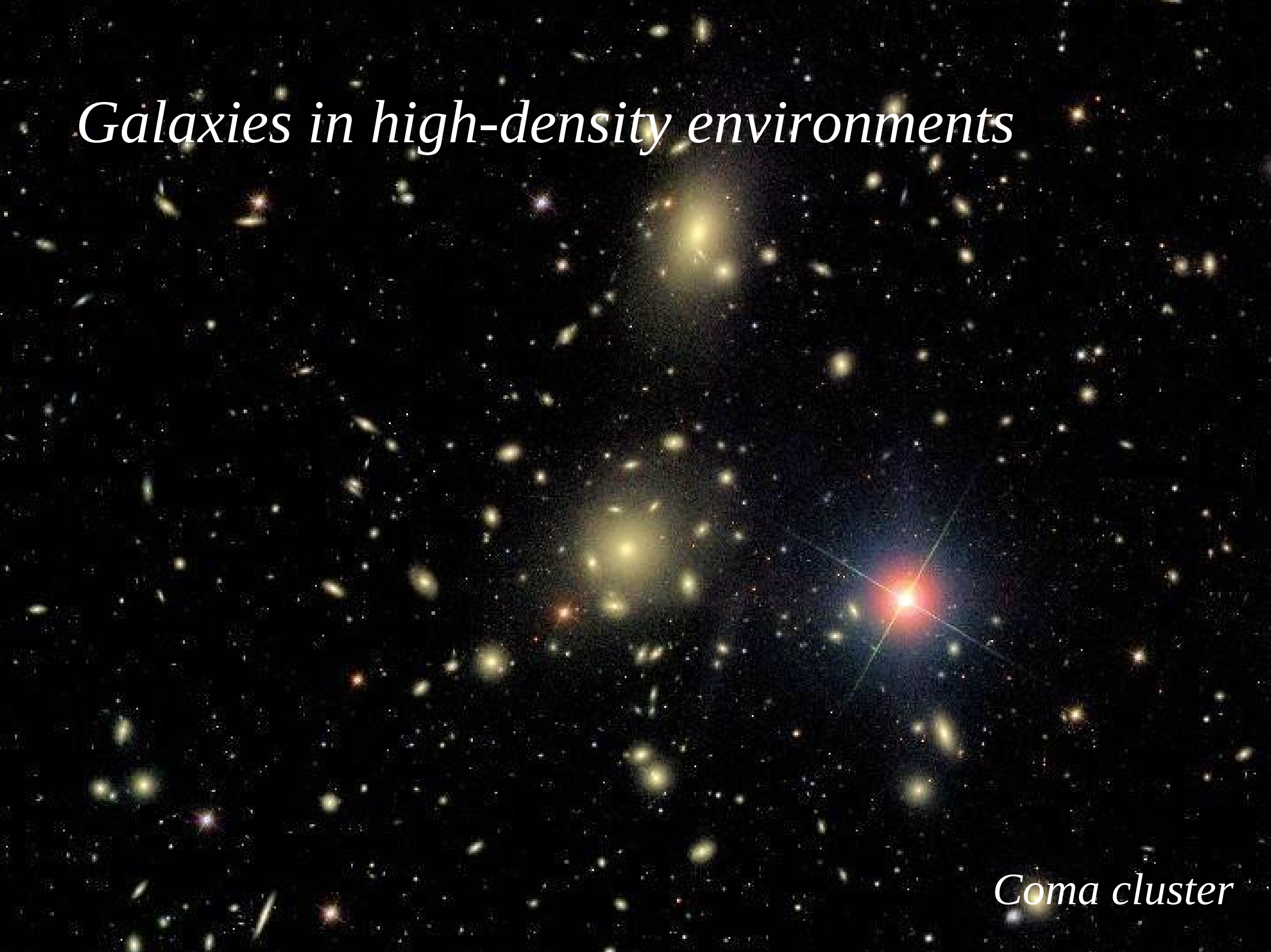
1-1 Environmental Dependence of Galaxy Properties

Galaxies in low-density environments



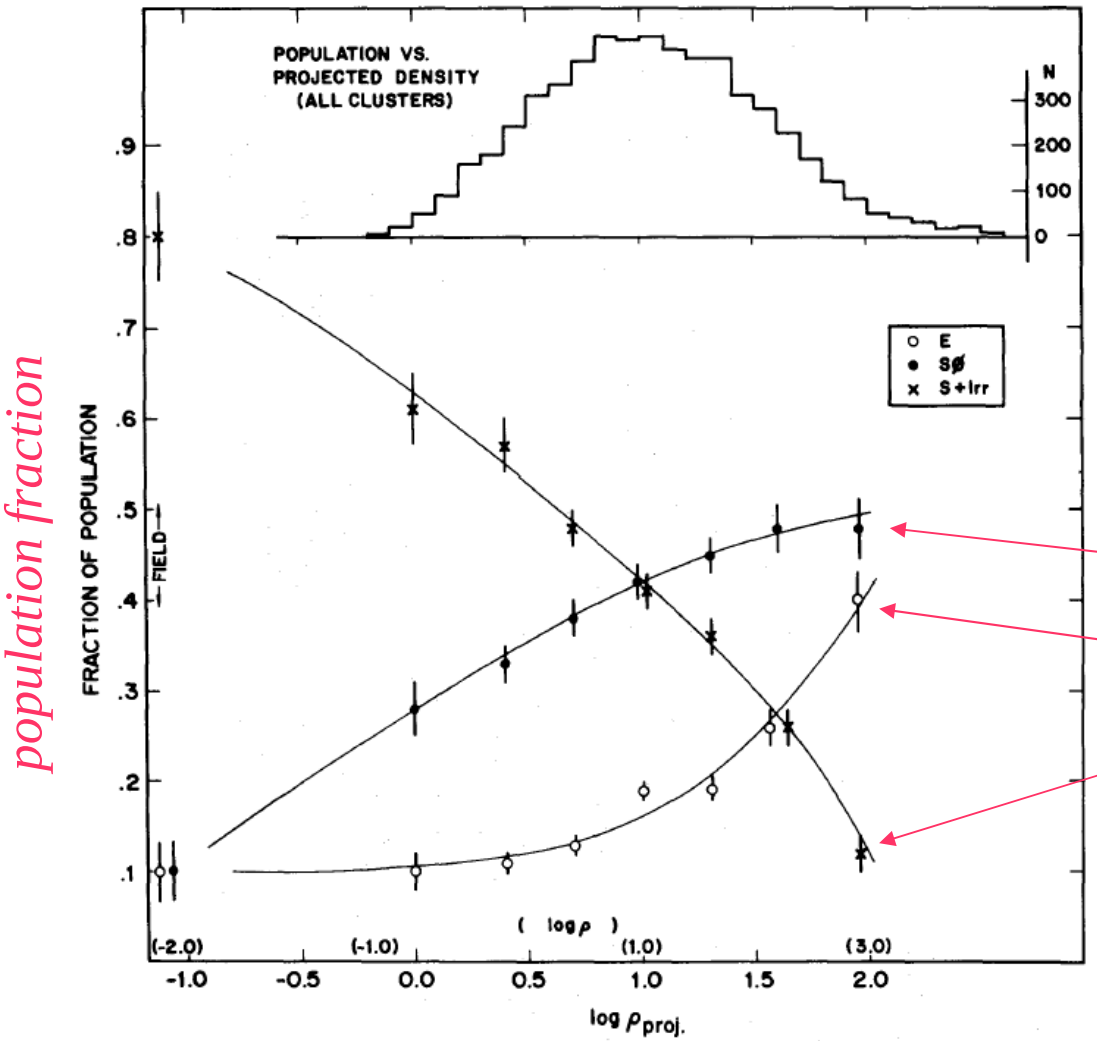
NGC5668

Galaxies in high-density environments



Coma cluster

Morphology-Density Relation



population fraction

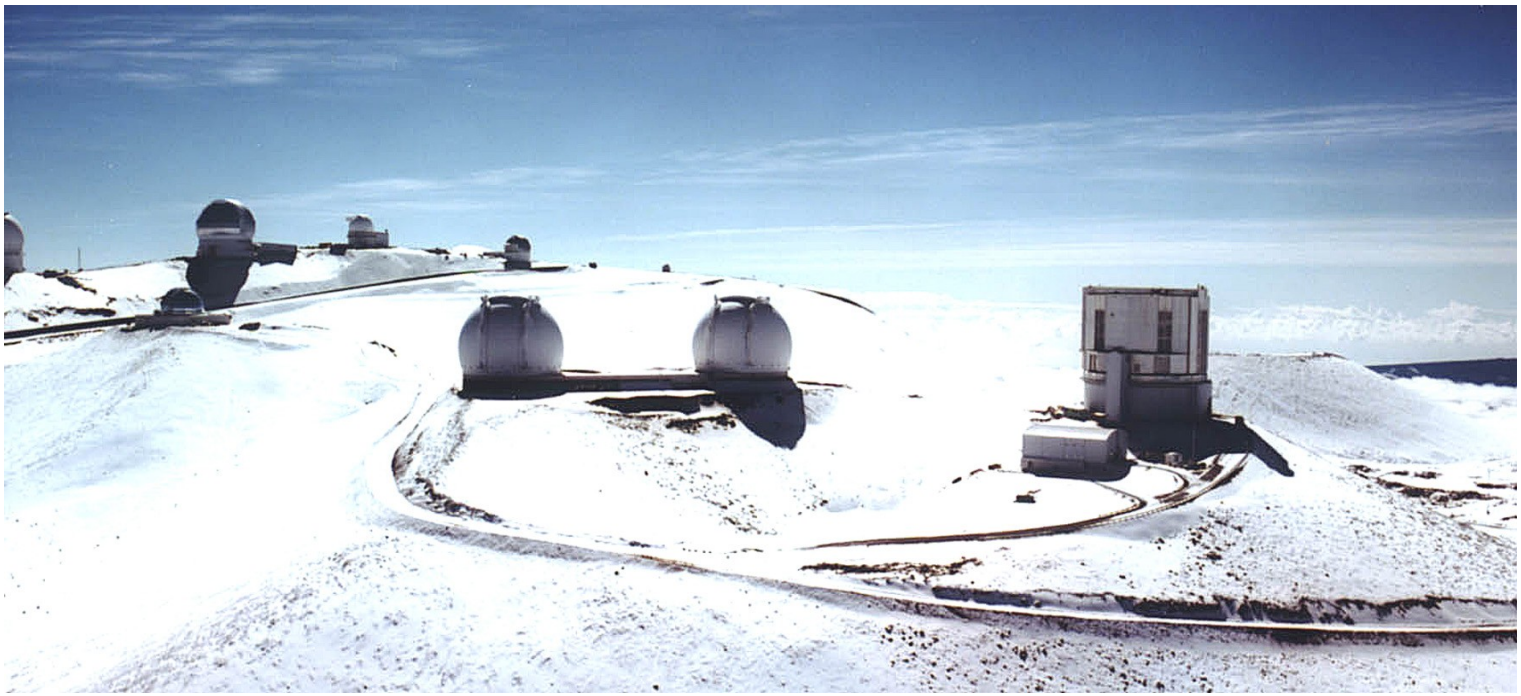
S0

E

Sp + Irr

low ← *galaxy density* → *high*

The environmental dependence of galay morphology was first quantified by Dressler 1980 (ApJ, 236, 351)



Mauna Kea Observatories

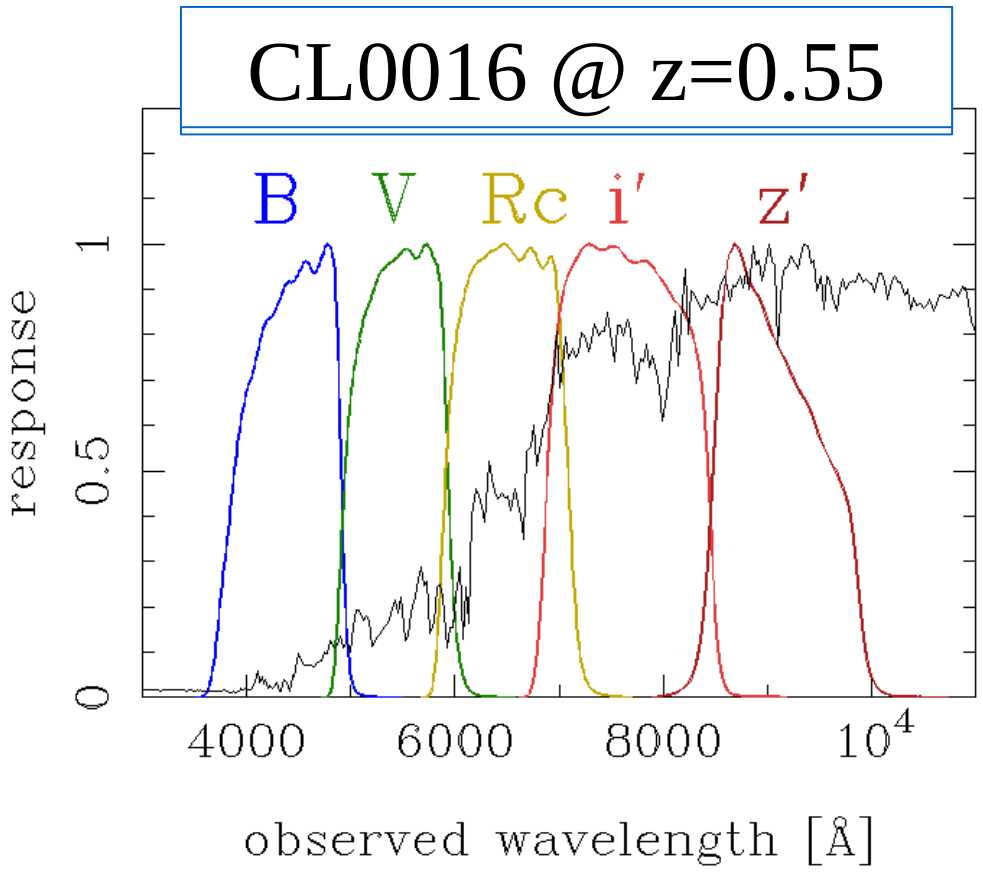
2-1 Observational Data

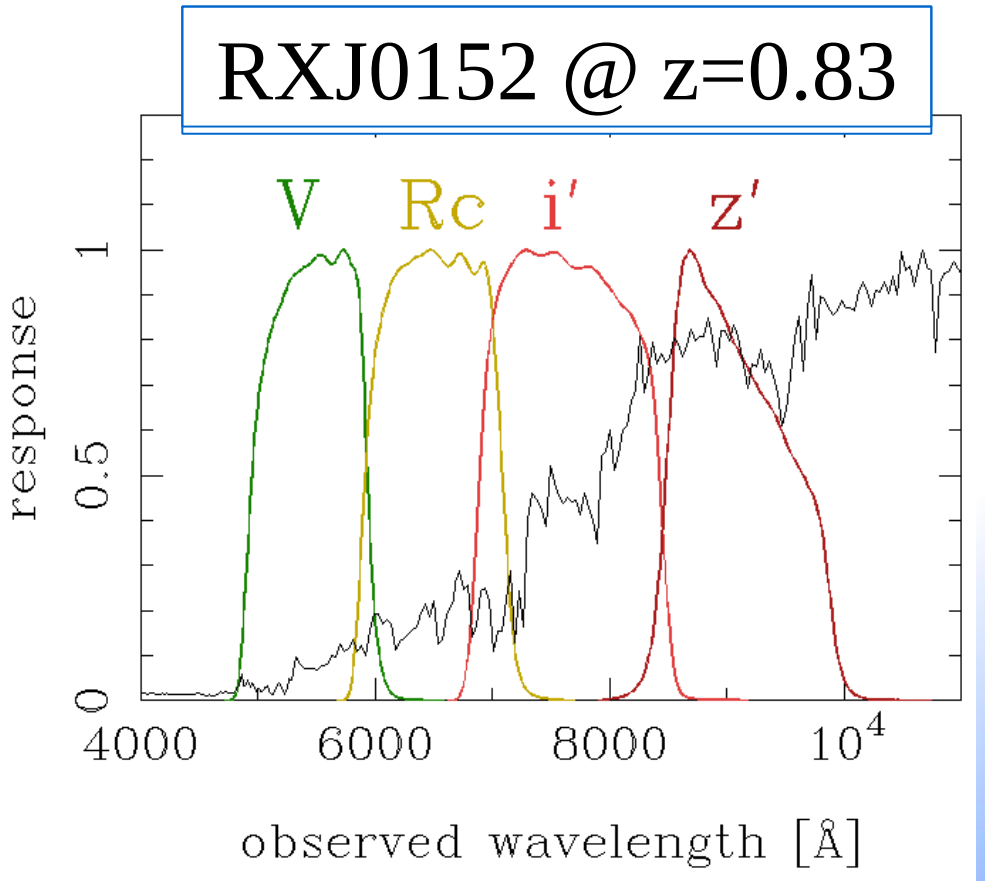
redshift	Source	Photometry	Spectroscopy
z=0	Sloan Digital Sky Survey (DR2)	u g r i z	~260,000 objects
z=0.55 (5.4Gyr)	**CL0016+16**		
	Suprime-Cam (Subaru)	B V R i z	
	FOCAS (Subaru)		~200 objects
z=0.83 (7.0Gyr)	**RXJ0152**		
	Suprime-Cam (Subaru)	V R i z	
	FOCAS (Subaru)		~300 objects
z=1.24 (8.6Gyr)	**RDCS1252**		
	Suprime-Cam (Subaru)	V R i z	
	WFCAM (UKIRT)	K	

Photometric Redshift

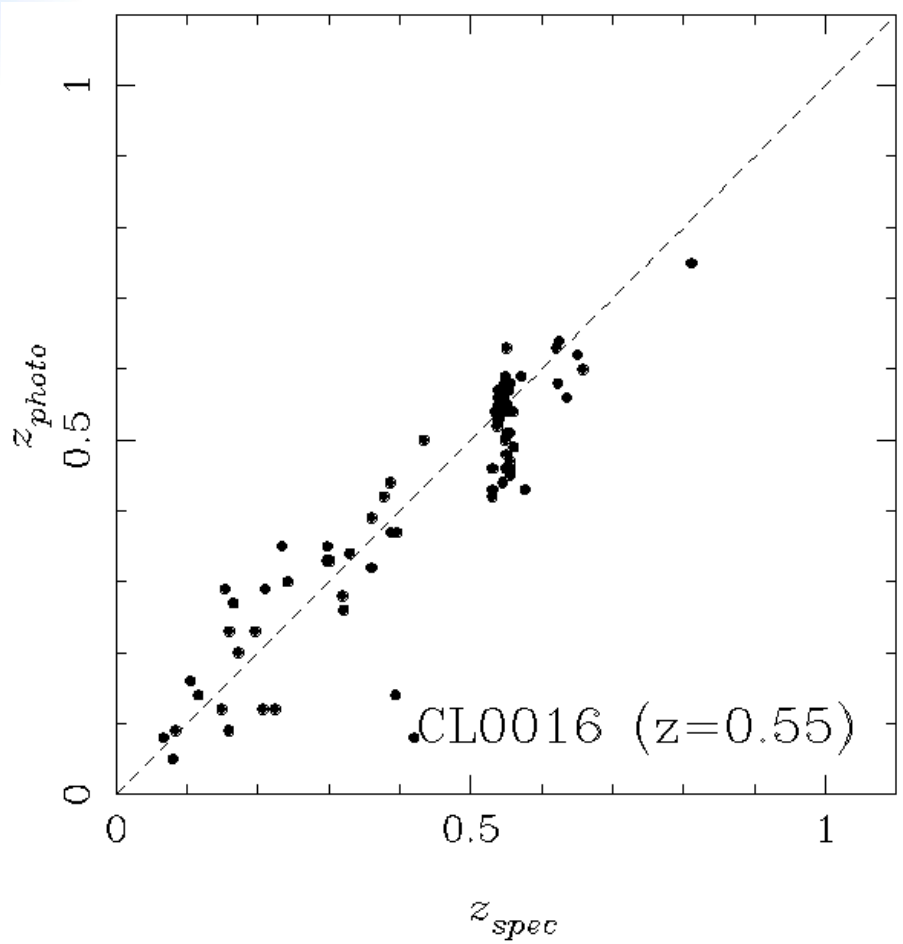
idea:

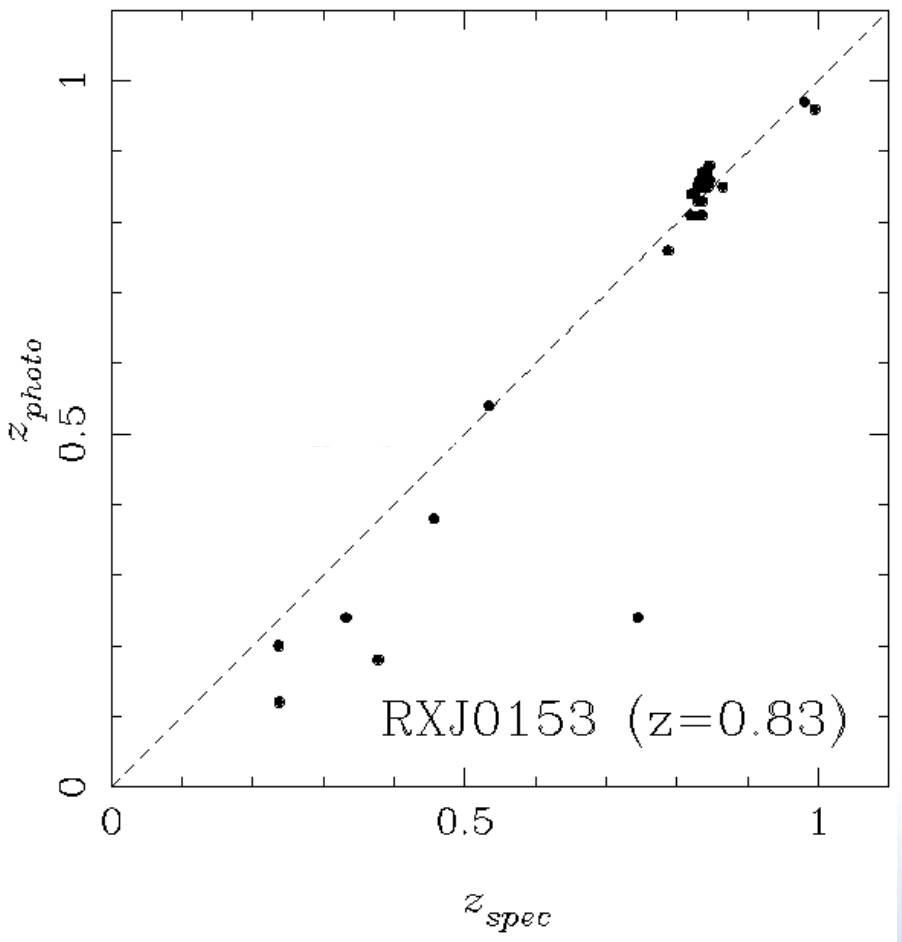
galaxies at different redshifts have different observed colors.

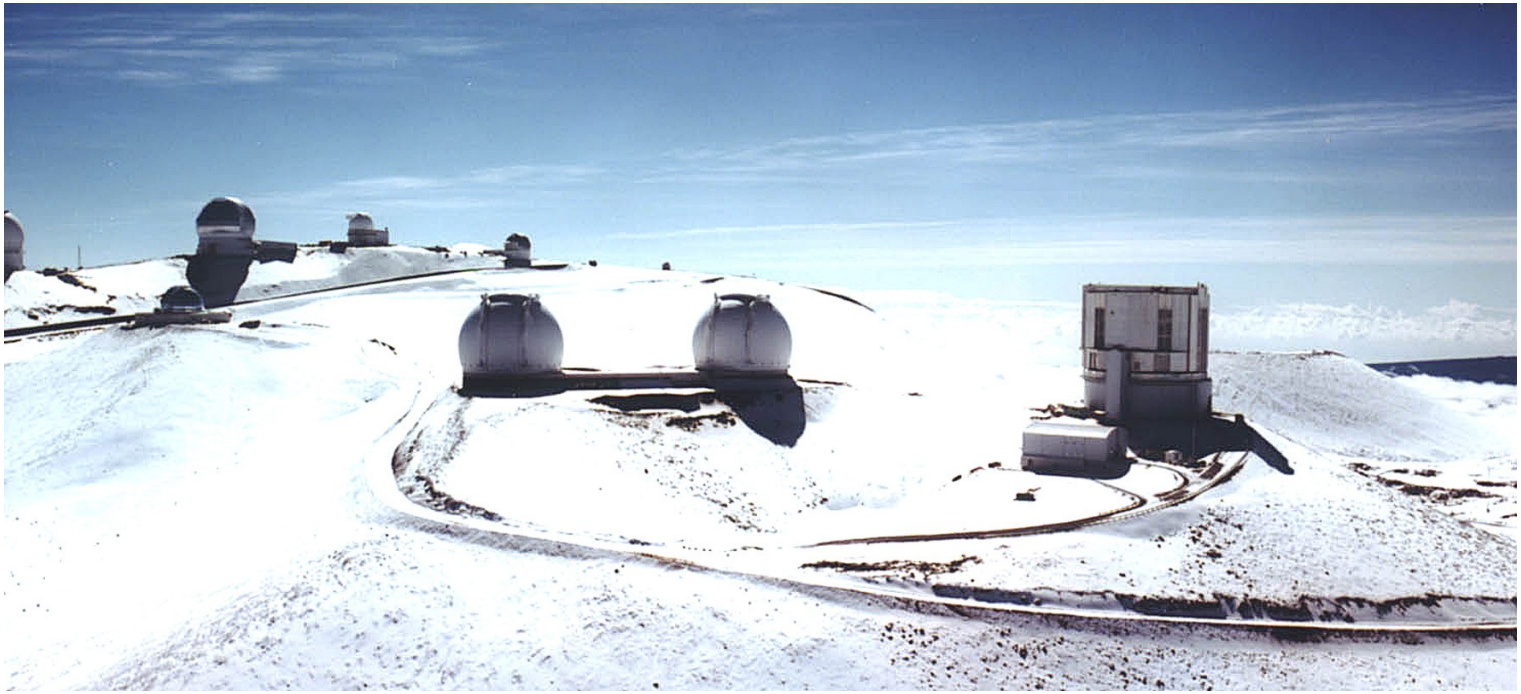




How accurate is it?

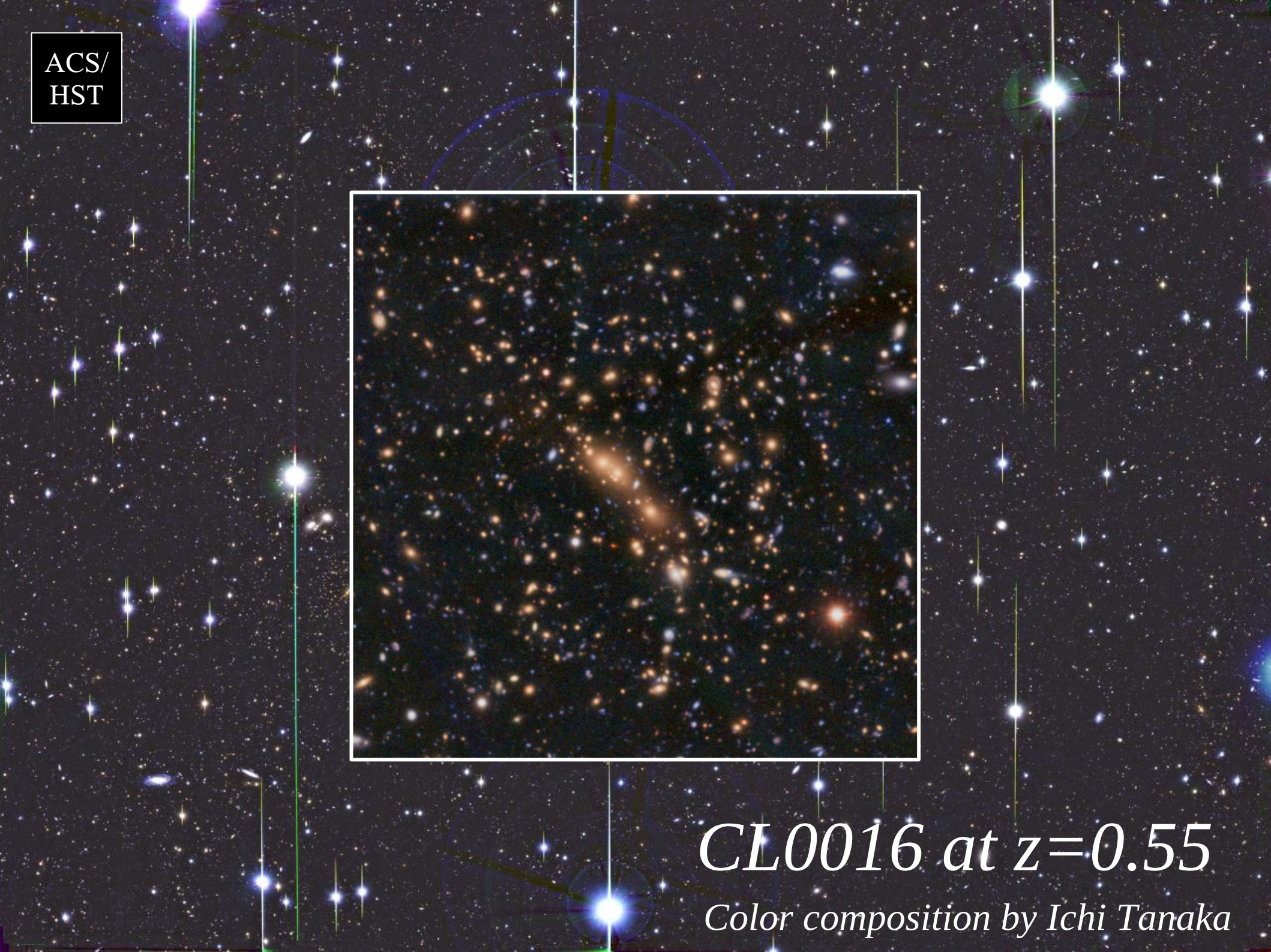




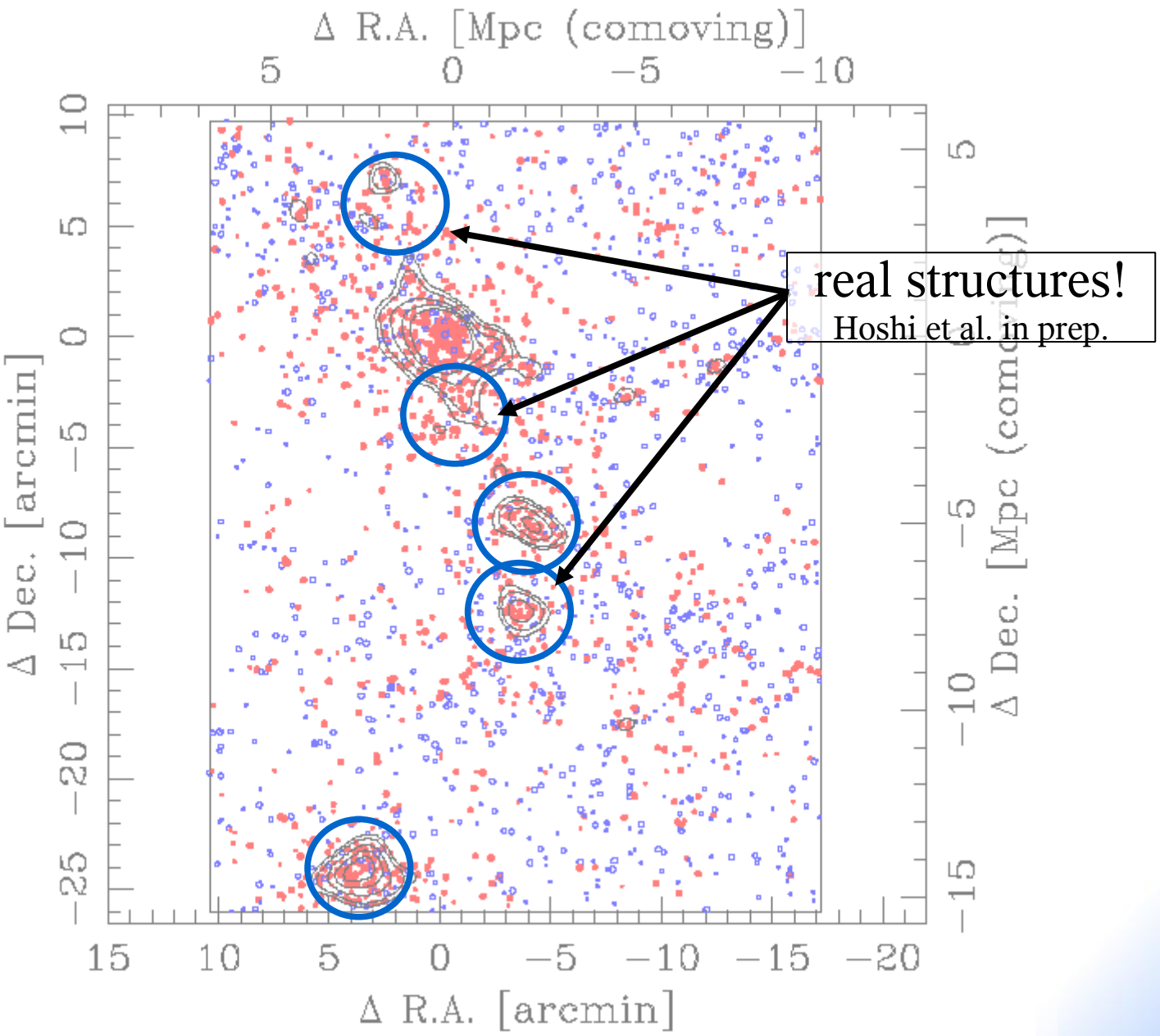


Mauna Kea Observatories

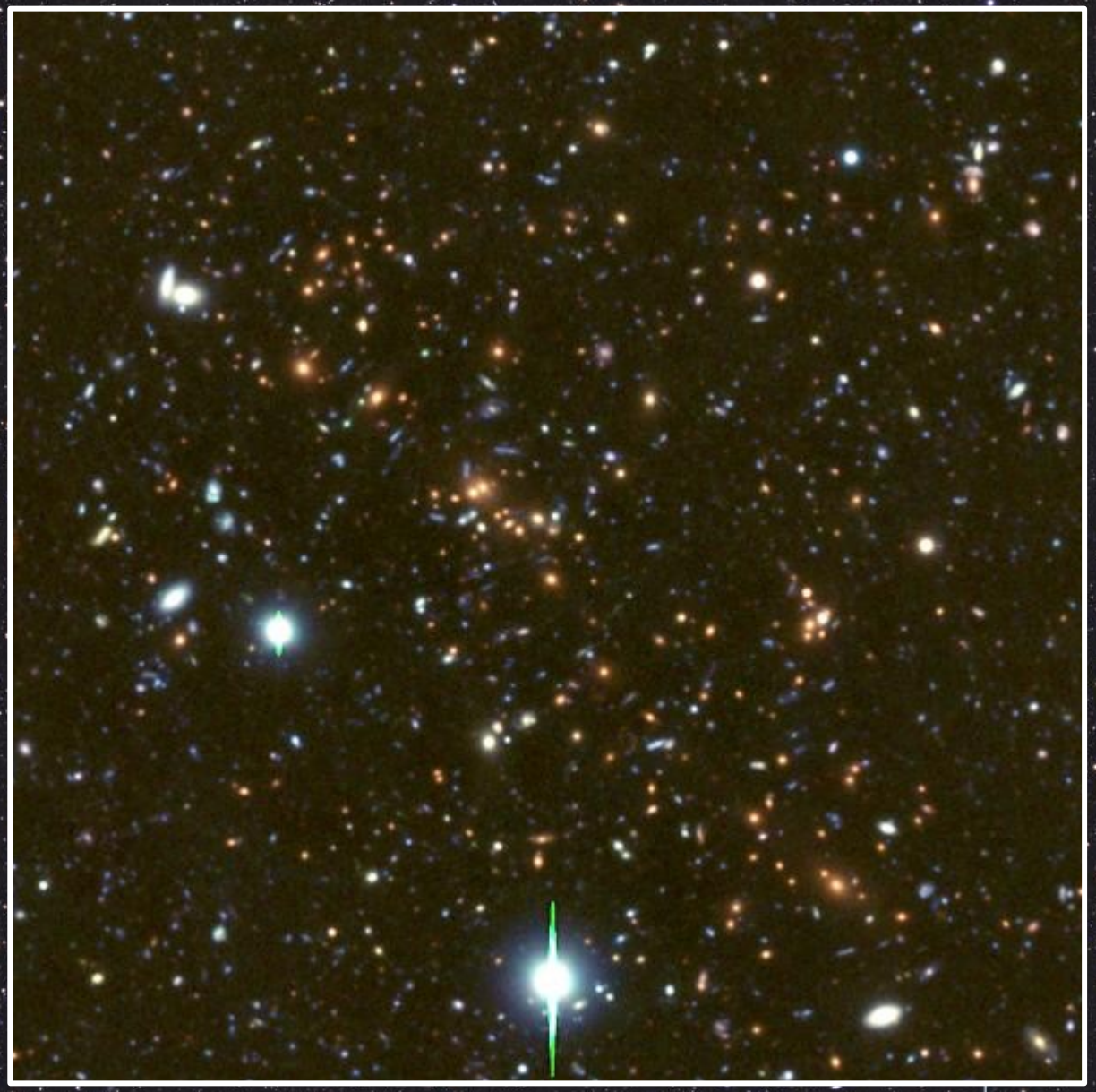
2-2 Large-Scale Structures


ACS/
HST
CL0016 at z=0.55
Color composition by Ichi Tanaka

Large-Scale Structures



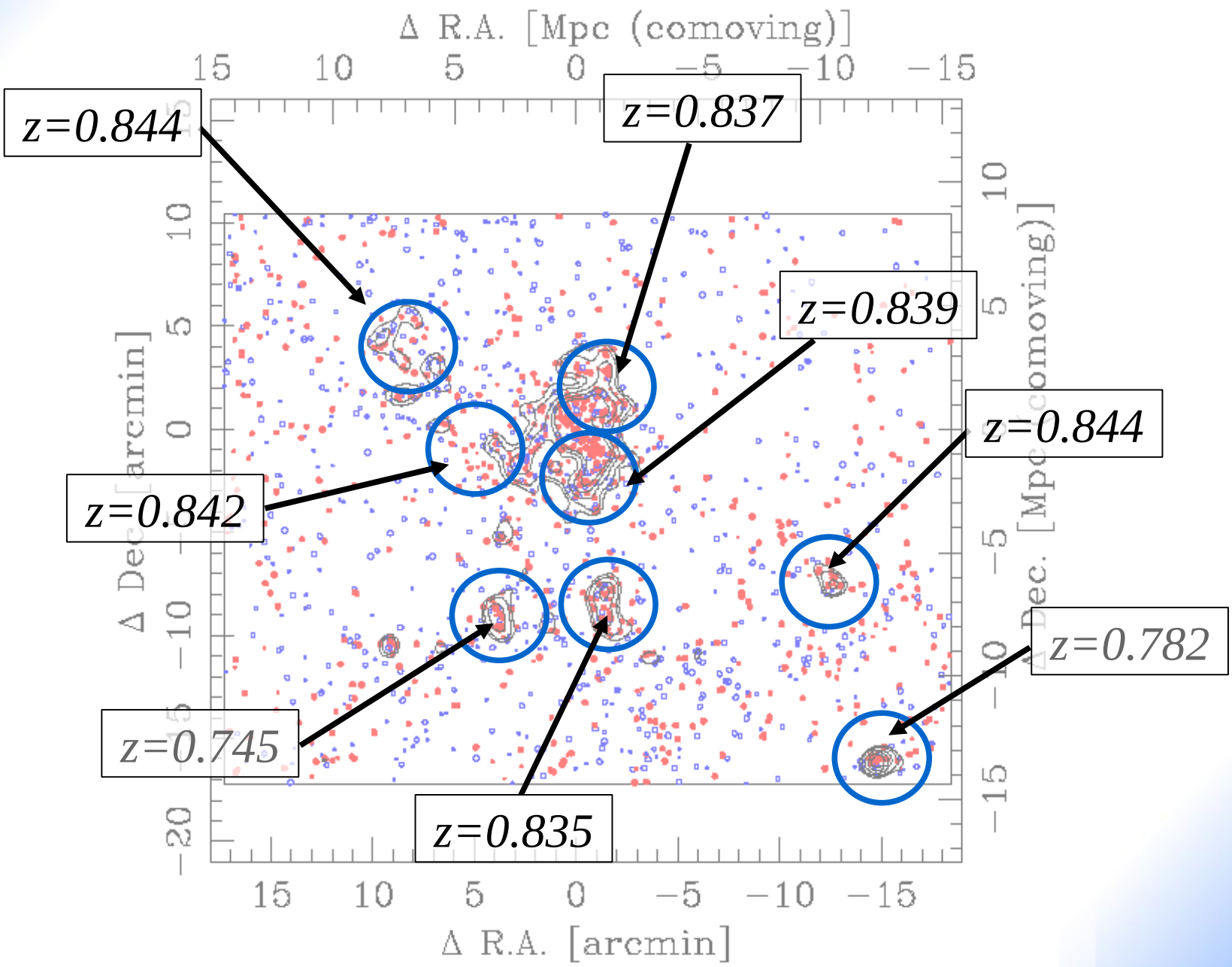
CL0016 at z=0.55



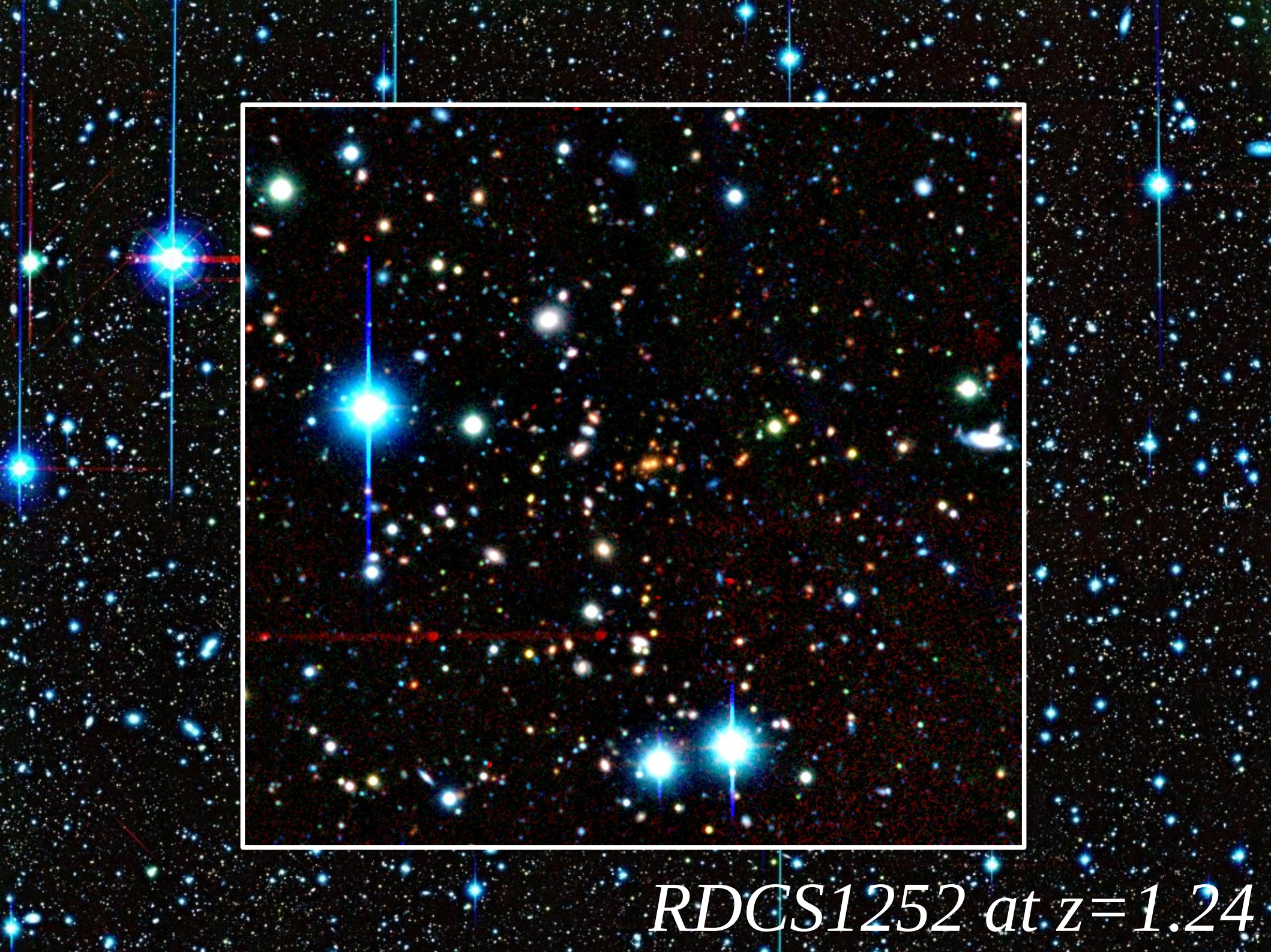
RXJ0153 at z=0.83

Color composition by Ichi Tanaka

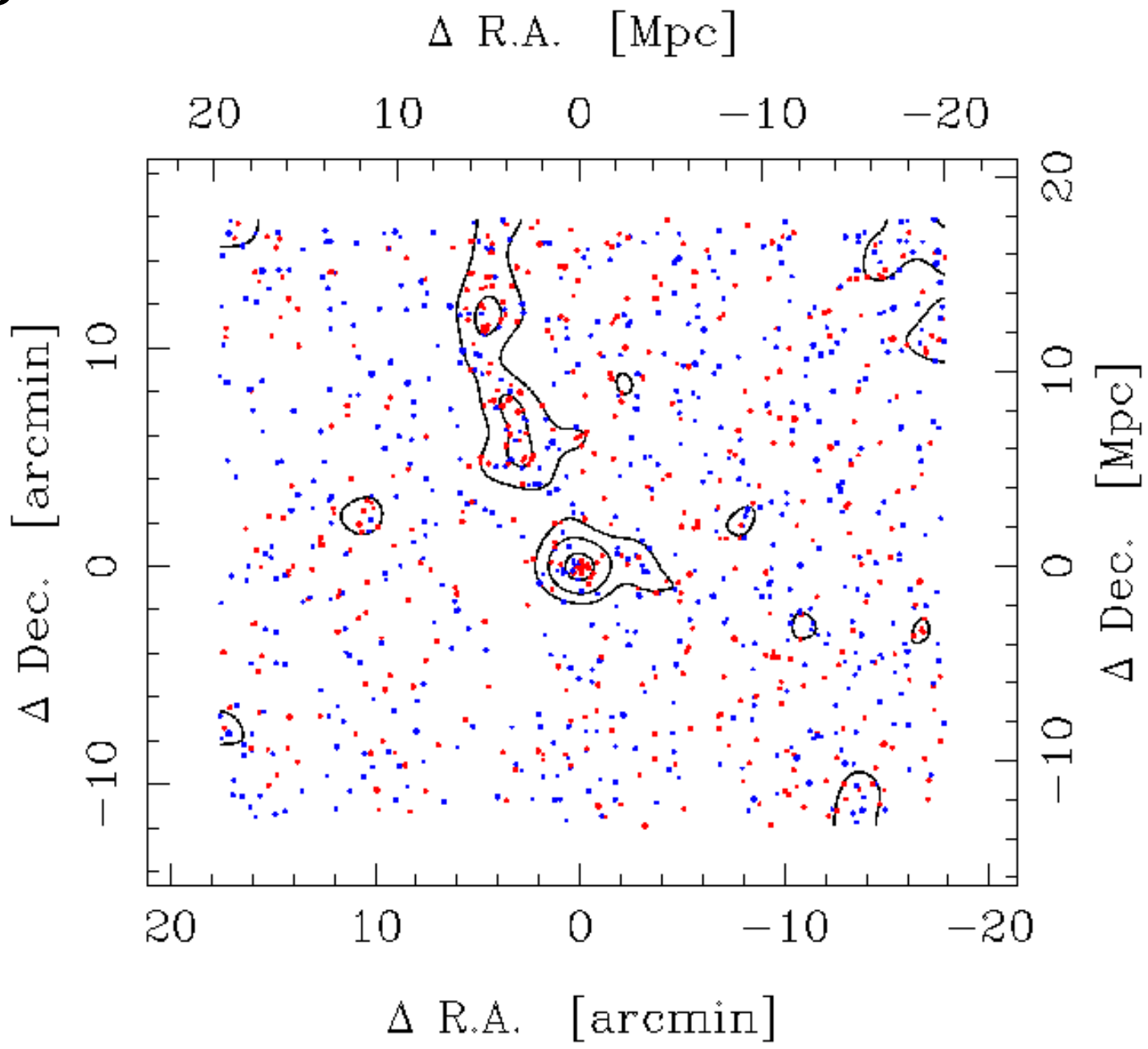
Large-Scale Structures



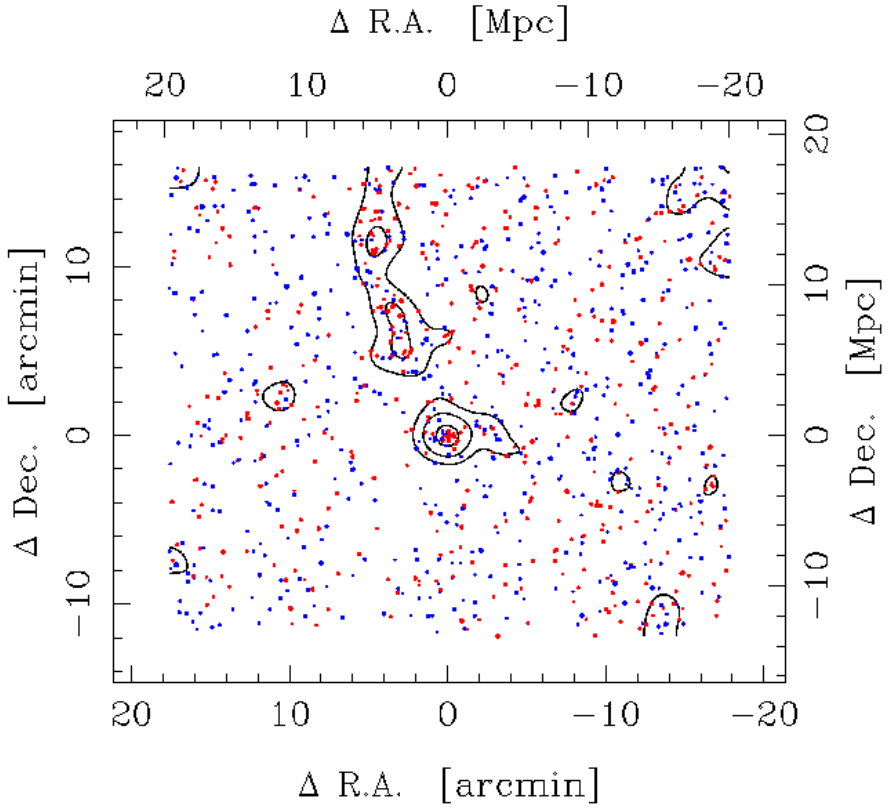
RXJ0152 at z=0.83


RDCS1252 at z=1.24

Large-Scale Structures



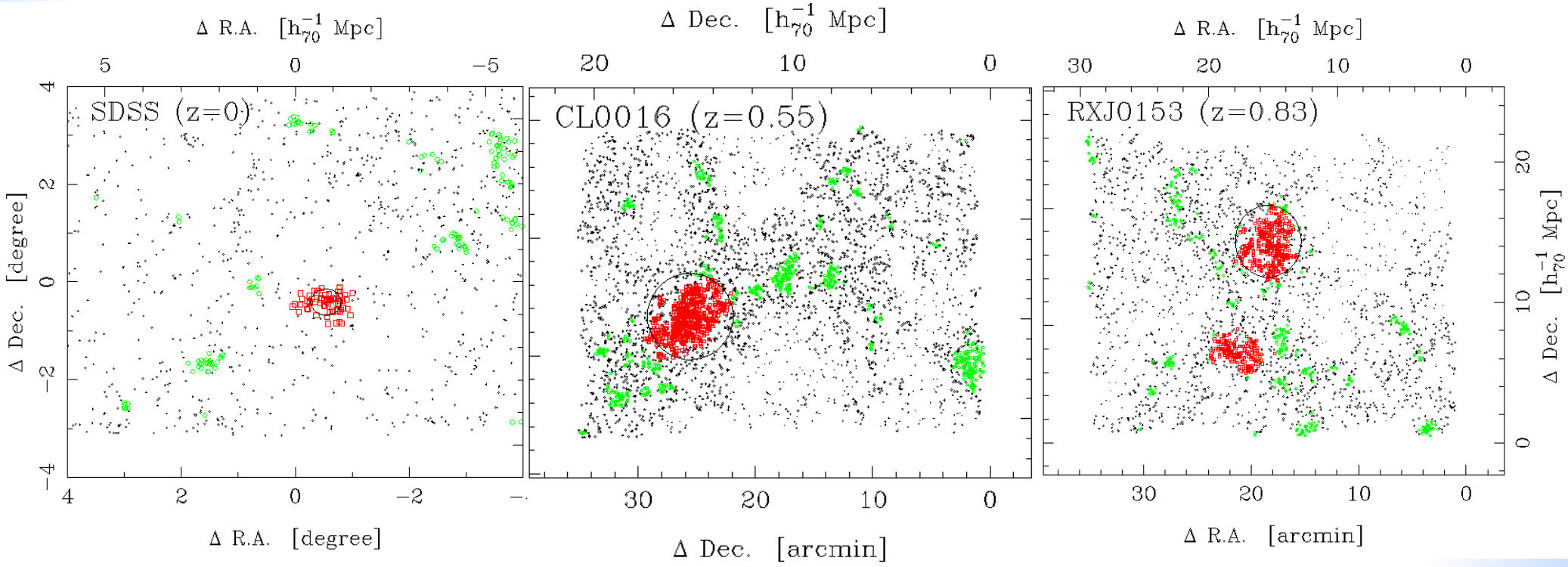
RDCS1252 at z=1.24



RDCS1252 (*z=1.24*) is <u>not</u> used from now on.

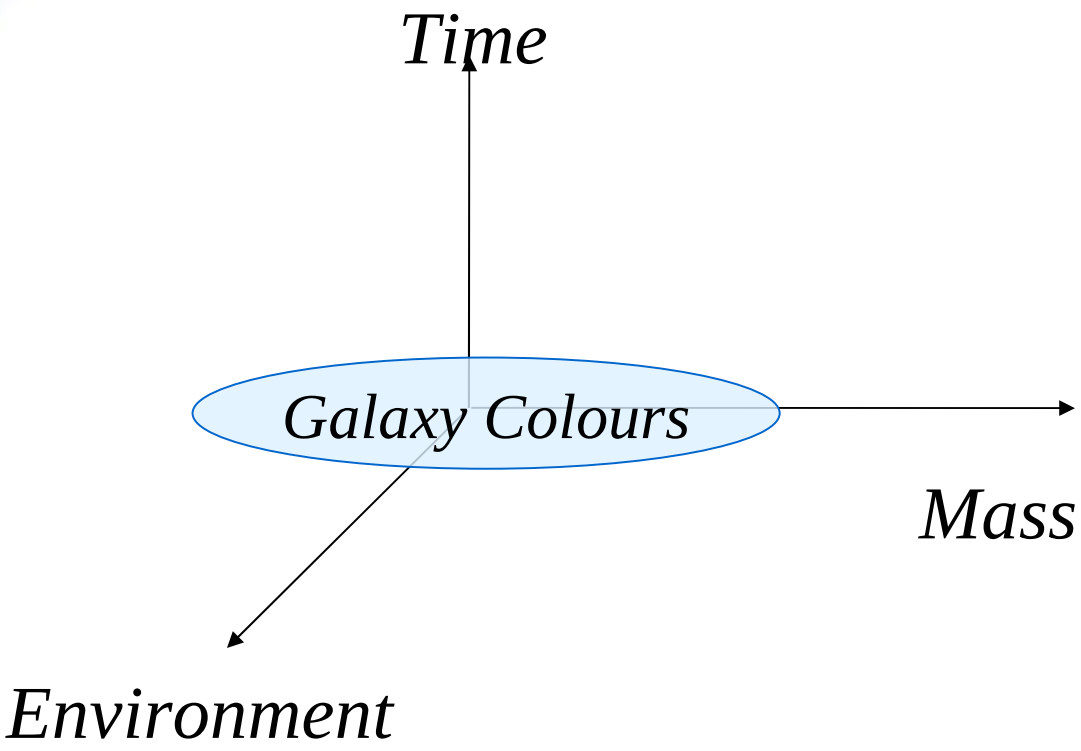
3-1 Definition of Environments

Cluster / Group / Field Environments



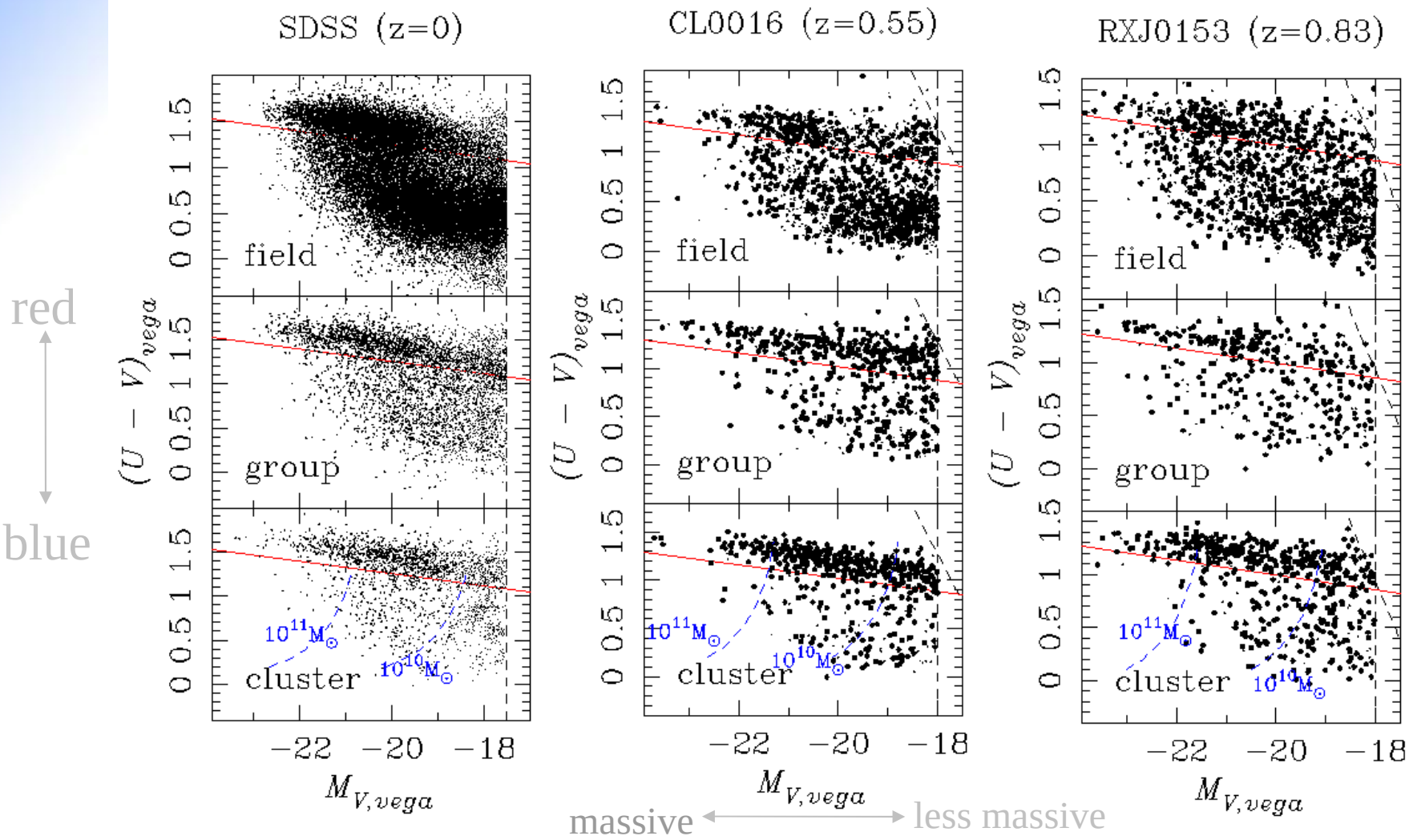
z=0 *z=0.55* *z=0.83*

redshift

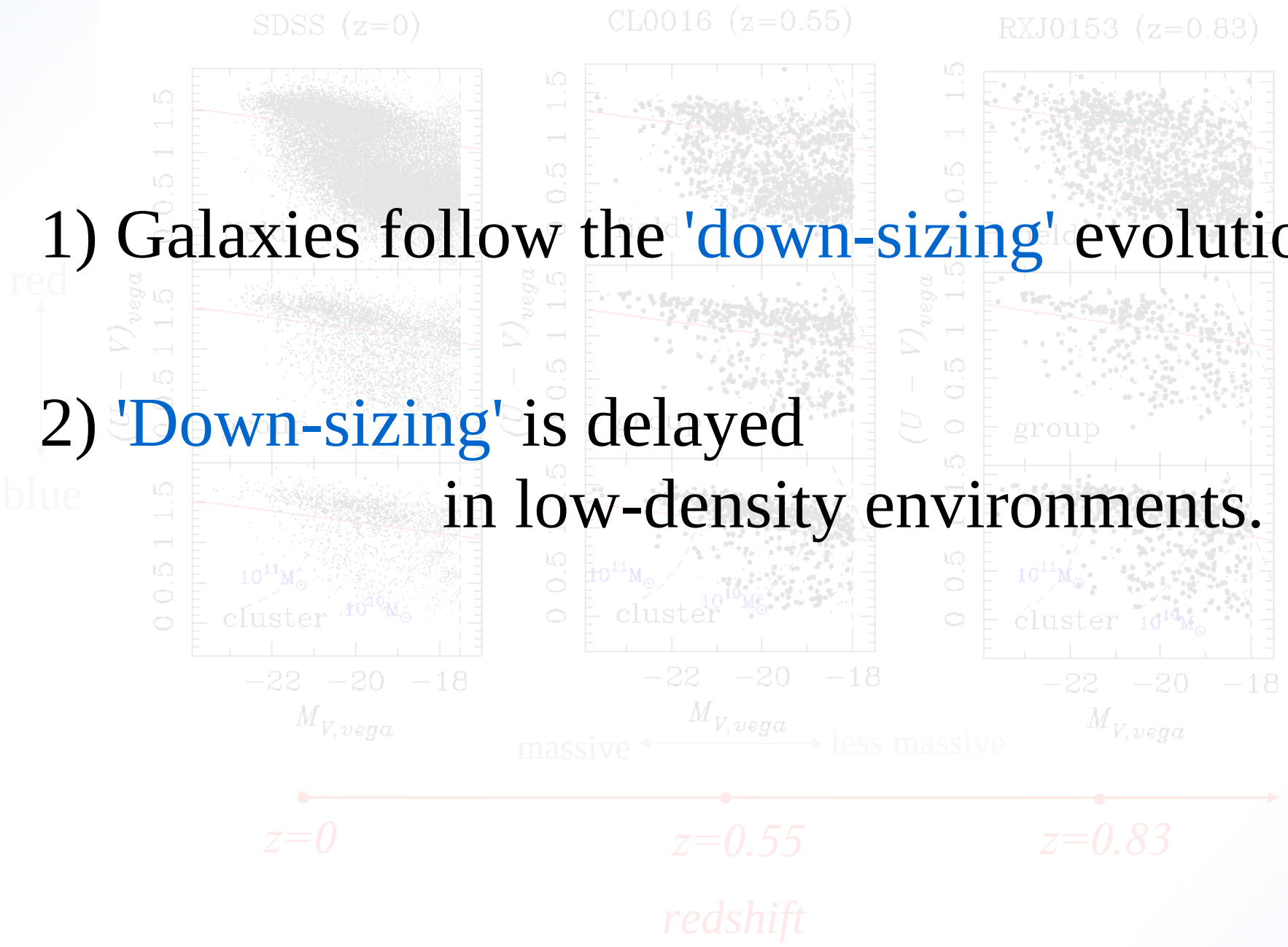


2-4 Colour-Magnitude Diagrams

Colour-Magnitude Diagrams



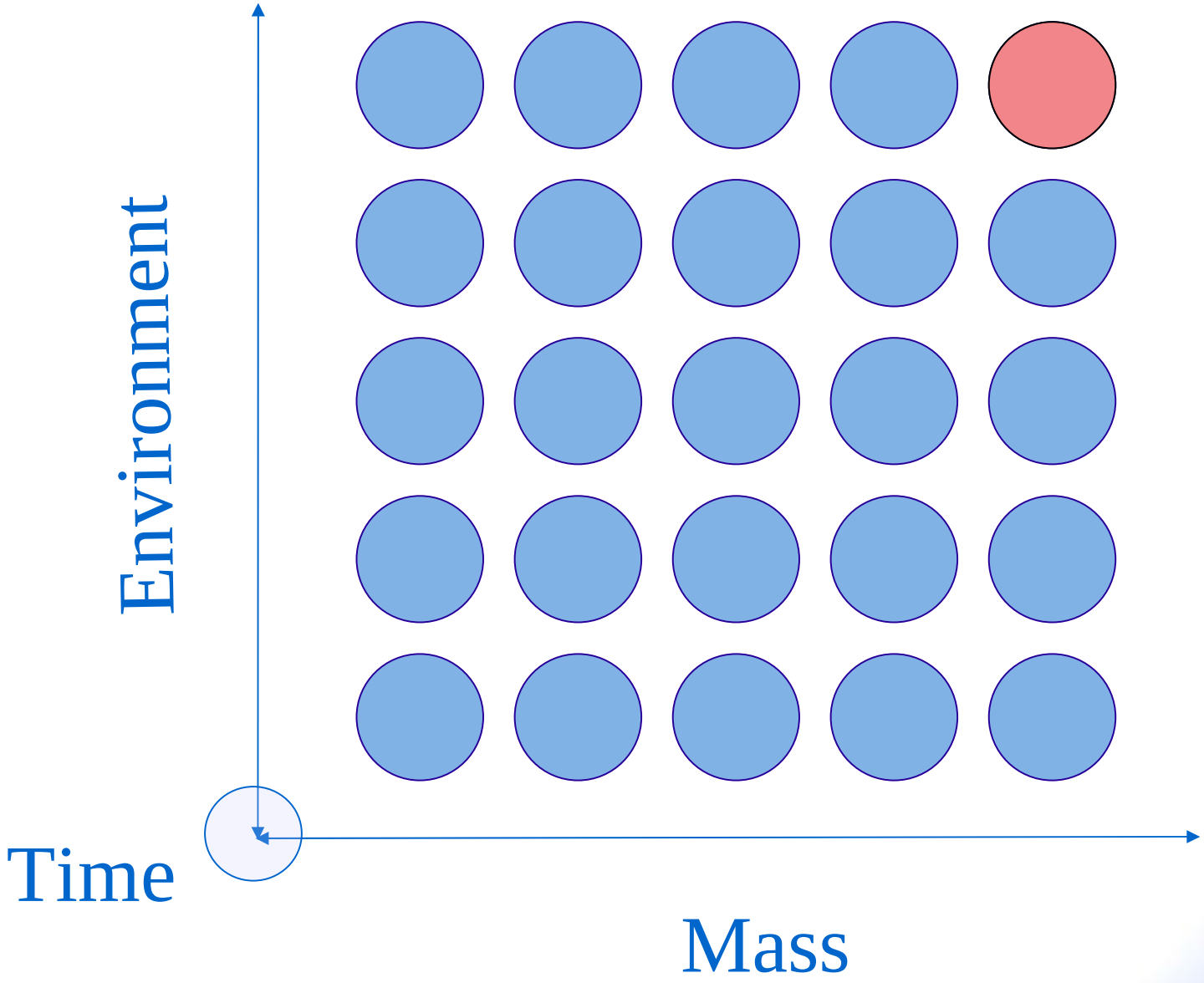
Colour-Magnitude Diagrams



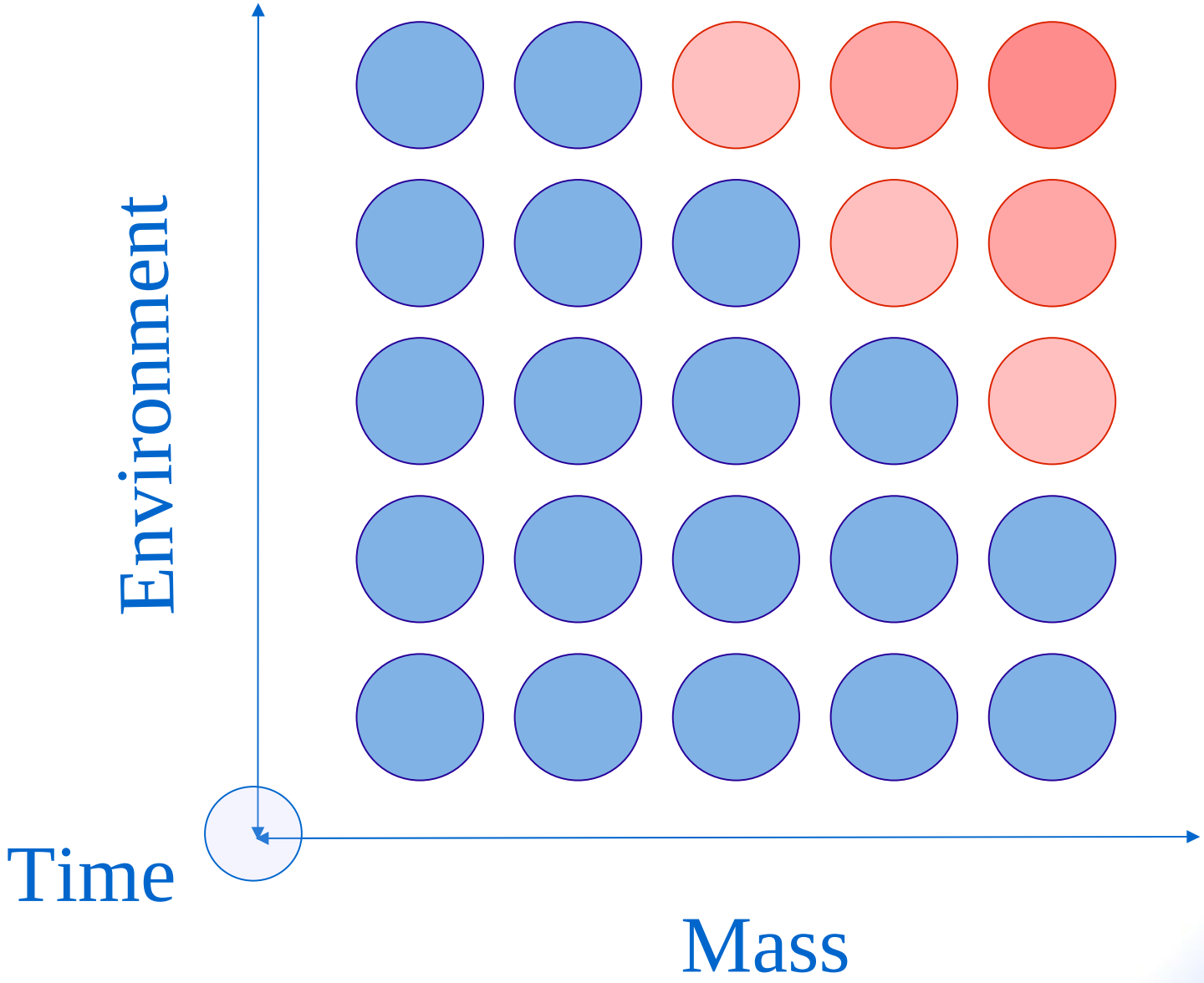
1) Galaxies follow the 'down-sizing' evolution.

2) 'Down-sizing' is delayed
in low-density environments.

Schematic View of Galaxy Evolution



Schematic View of Galaxy Evolution



Schematic View of Galaxy Evolution