GALAXY MORPHOLOGY AND TRANSFORMATION ANALYSIS

PAP301 Seminar in Particle Physics and Astrophysical Sciences

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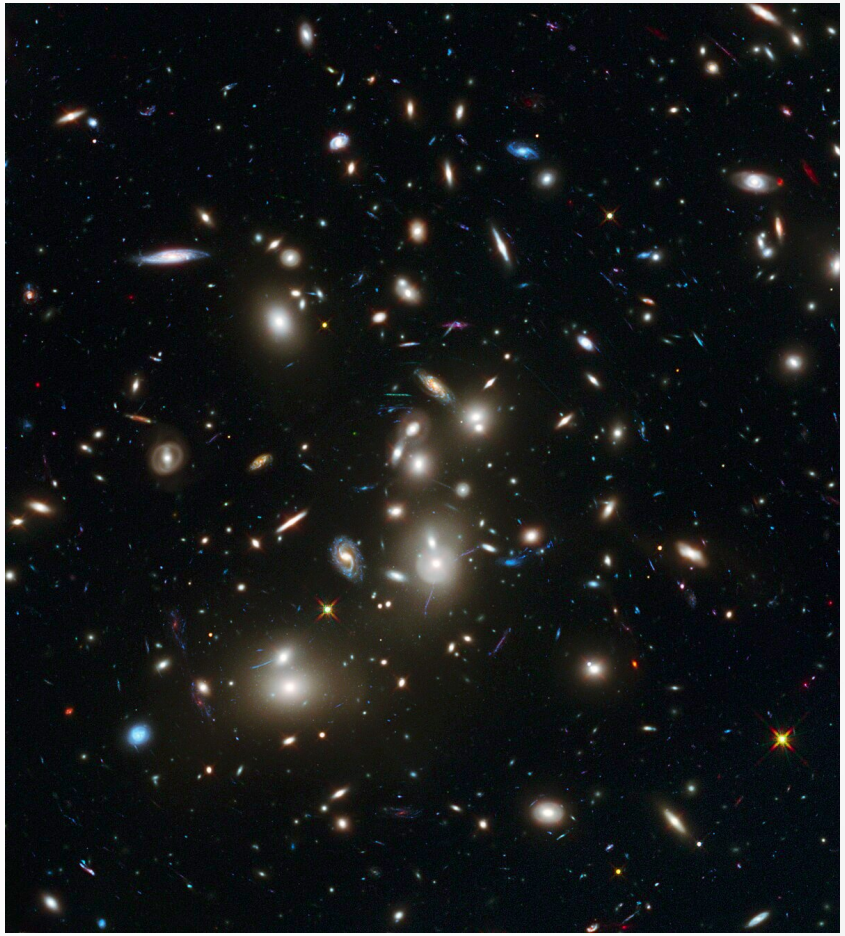
CONTENTS

- Introduction
- Structural measurements methods
  - Visual morphology, parametric and non-parametric measurements
- 2D light curve fitting
- James Webb Space Telescope (JWST) data
- Results from Hubble Space Telescope (HST) data
- Summary

INTRODUCTION 1/3
GALAXY GROUPS

- Galaxy group and clusters
  - Central, satellite galaxies
  - Field galaxies
- Galaxy interactions
  - Mergers, tidal
  - Effect on star formation (SF)



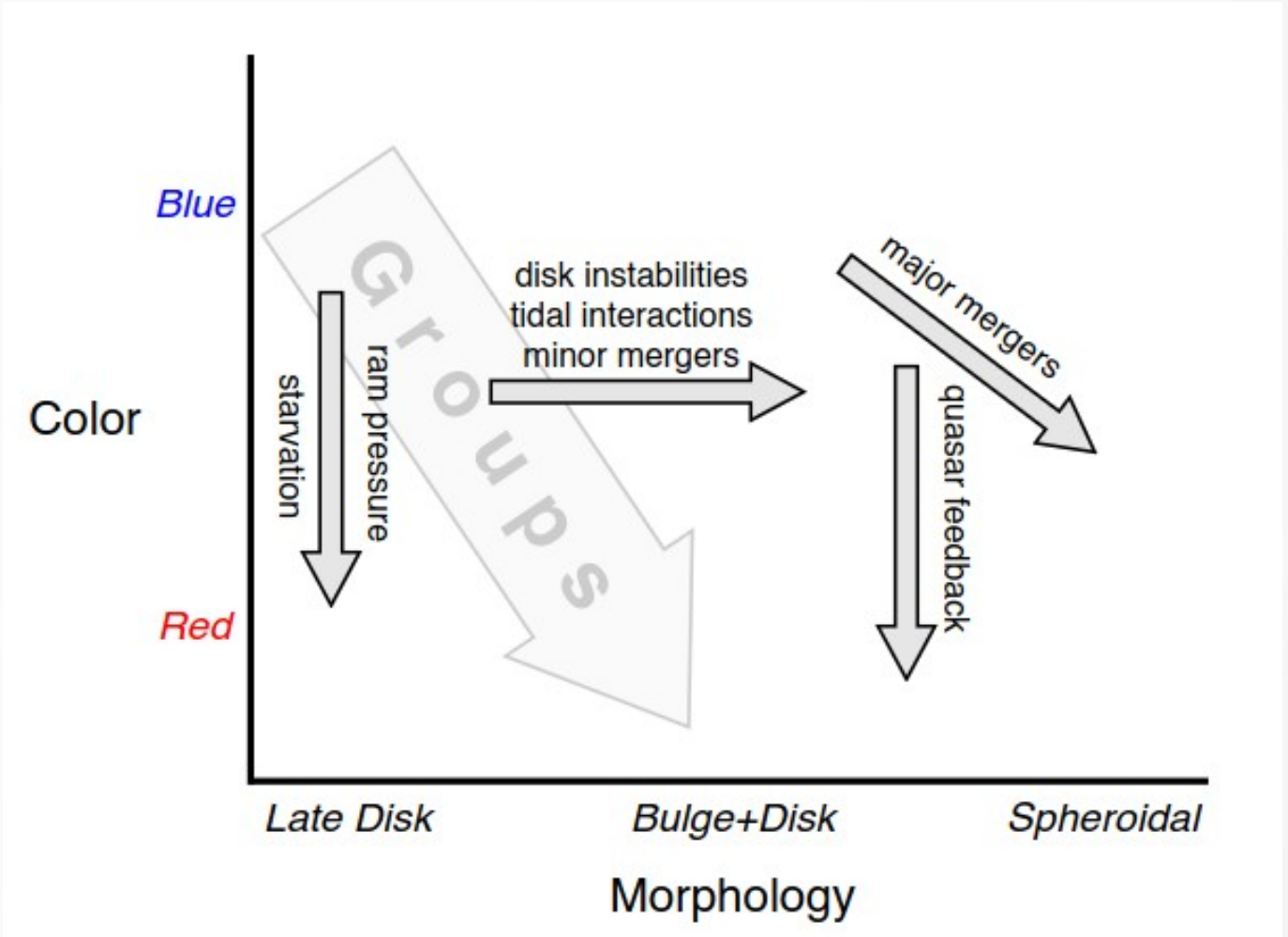
Galaxy cluster (NASA/Hubble Space Telescope)

INTRODUCTION 2/3
MOTIVATION

- Galaxy properties and environment correlation
  - Transformation of morphology and colour
  - SF and colour related
- Effect of groups and clusters
  - Location within group

INTRODUCTION 3/3
MOTIVATION

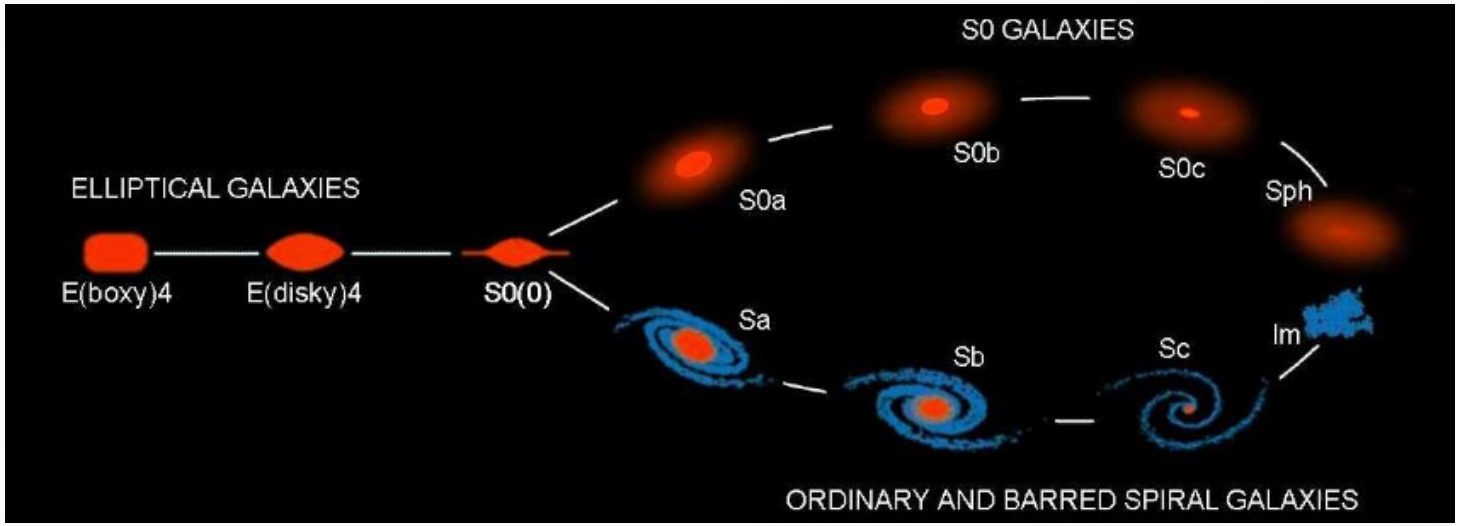
- Dominant mechanism unknown



Effects of physical mechanisms on colour and morphology (George et al. 2013)

STRUCTURAL MEASUREMENT METHODS 1/3
VISUAL MORPHOLOGY

- Most classical way
- For distant galaxies the classification limited
- Issue with ’elliptical’ or ’disky’ galaxies
  - Do not match the nearby systems with same morphologies



Hubble sequence (Kormendy & Bender, 2012)

STRUCTURAL MEASUREMENT METHODS 2/3
PARAMETRIC MEASUREMENTS

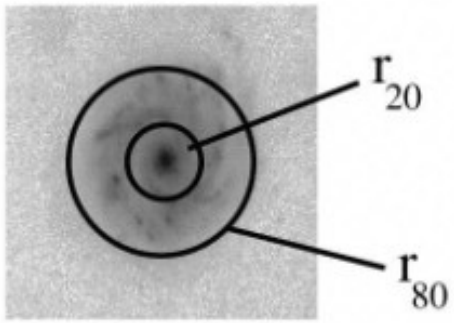
- Quantified values
- Measurements by light curve fitting
  - 2D light profile fitting
- Most common profile by Sérsic (1963)
  - Sérsic index n

$$I(R) = I_0 \times \exp[-b(n) \times ((\frac{R}{R_{eff}})^{1/n} - 1)]$$

Sérsic profile

STRUCTURAL MEASUREMENT METHODS 3/3
NON-PARAMETRIC MEASUREMENTS

- No assumptions of underlying form
- Most common system is CAS
  - Light concentration C

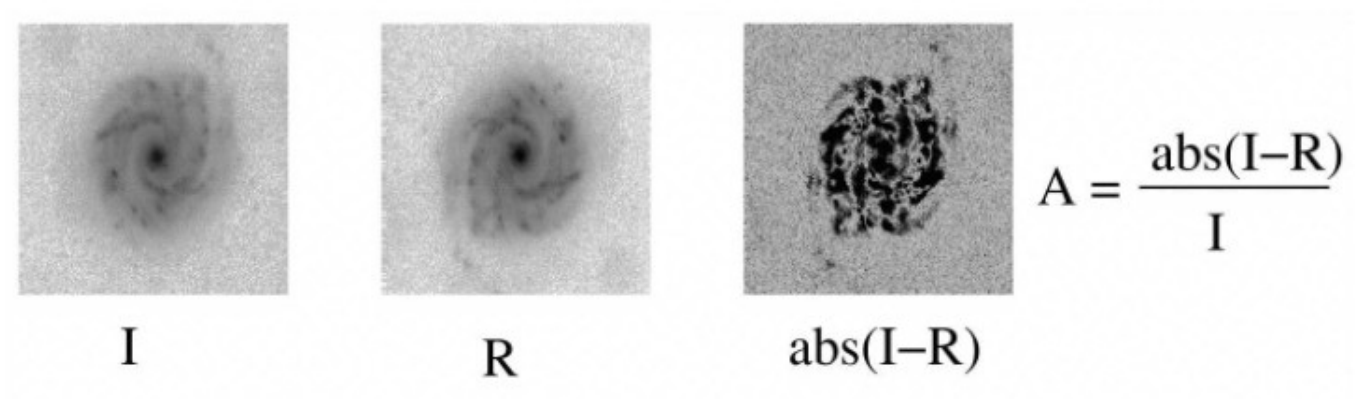


$$C = 5 \log\left(\frac{r_{80}}{r_{20}}\right)$$

(Conselice 2014)

STRUCTURAL MEASUREMENT METHODS 3/3
NON-PARAMETRIC MEASUREMENTS

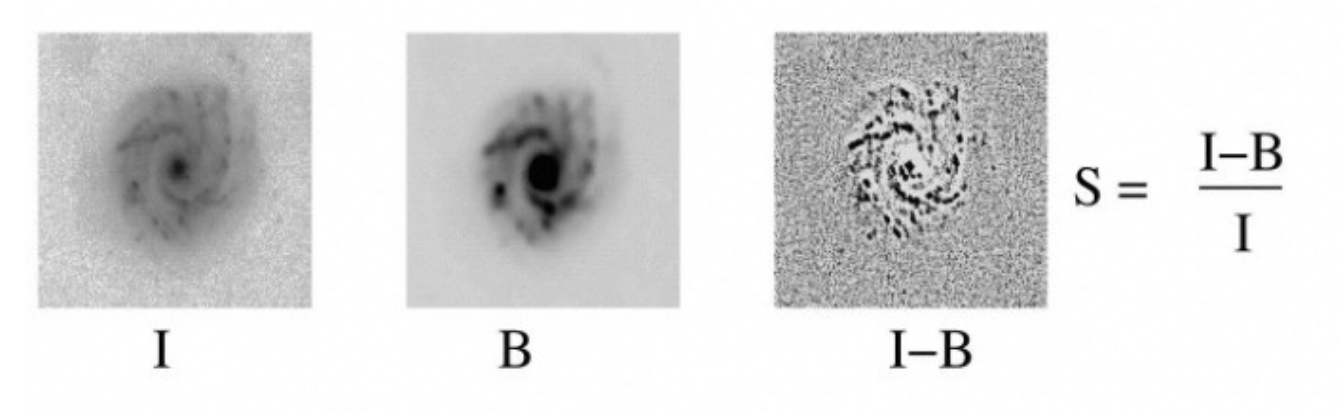
- No assumptions of underlying form
- Most common system is CAS
  - Light concentration C
  - Asymmetry index A



(Conselice 2014)

STRUCTURAL MEASUREMENT METHODS 3/3
NON-PARAMETRIC MEASUREMENTS

- No assumptions of underlying form
- Most common system is CAS
  - Light concentration C
  - Asymmetry index A
  - Clumpiness S



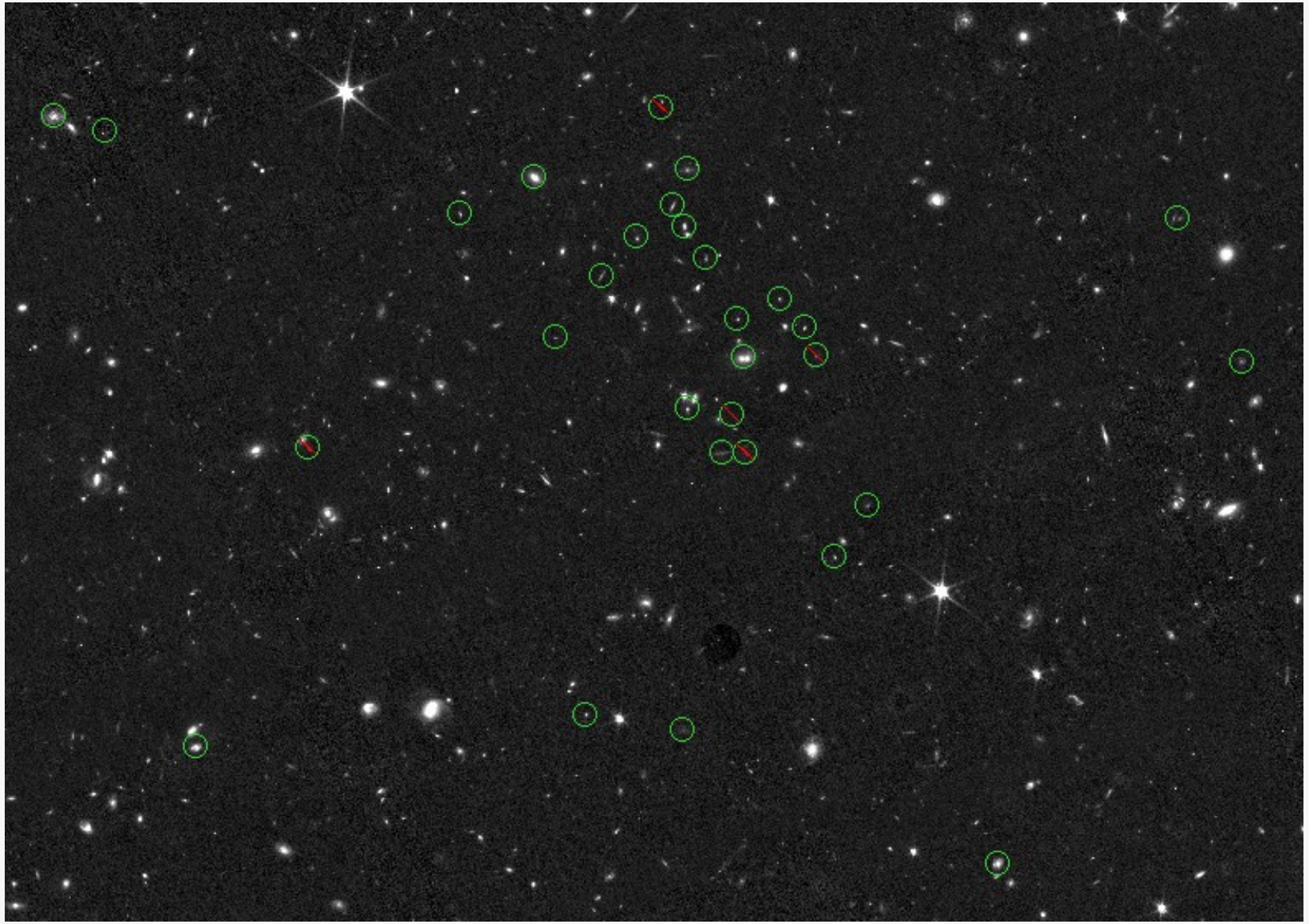
(Conselice 2014)

2D LIGHT CURVE FITTING

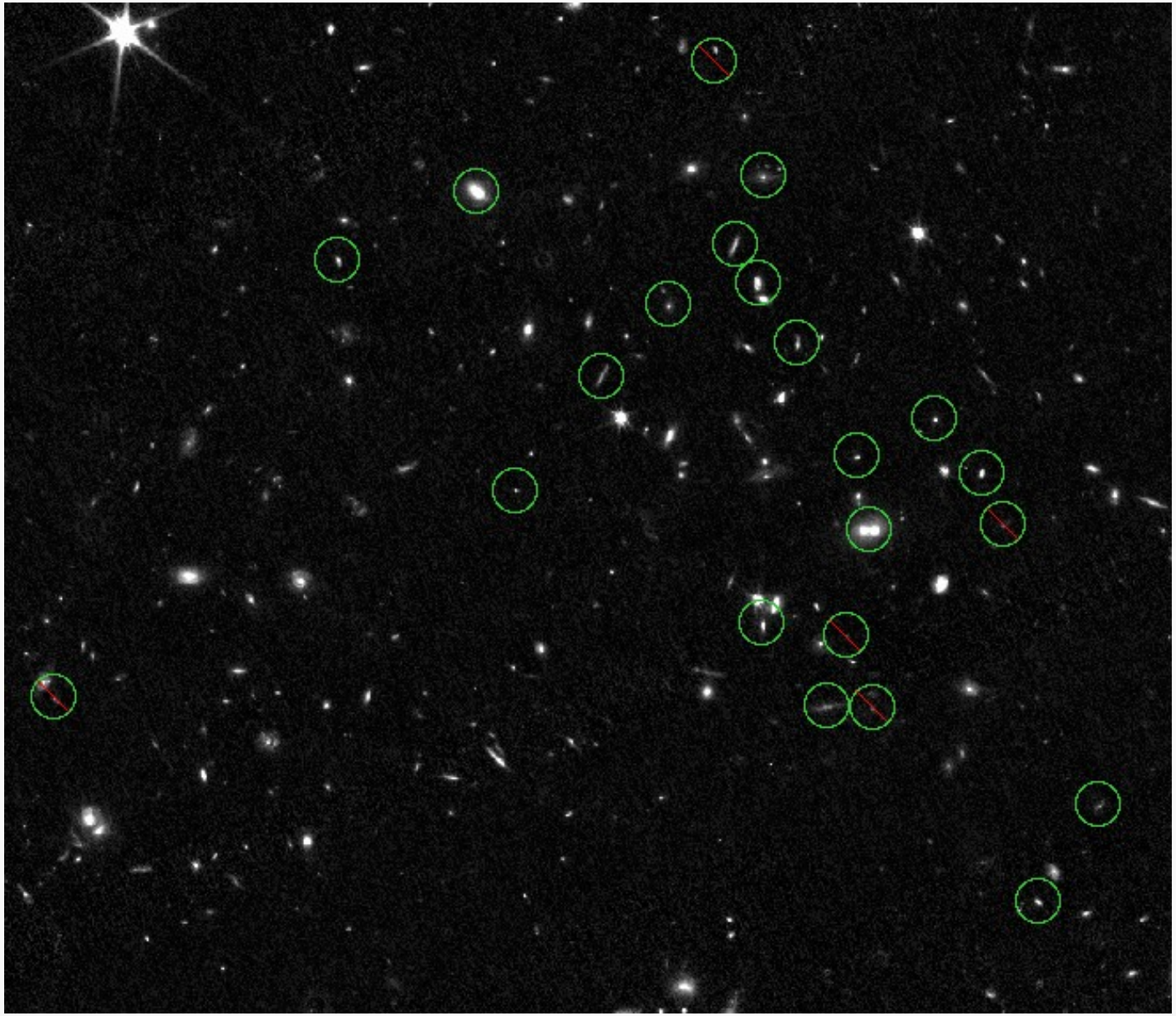
- Fairly new way of measuring galaxy structure
- Python based GaLight
  - Parametric measurements
  - Non-parametric measurements
- Programs have limitations → constant upgrades

JWST DATA

- Analysing galaxy group members and comparing to results of George et al. 2013
- James Webb Space Telescope (JWST) data
- 30 group members
  - Four NirCam (Near Infrared Camera) filters
  - Redshift z=1.07
  - Excluding magnitudes m≥24



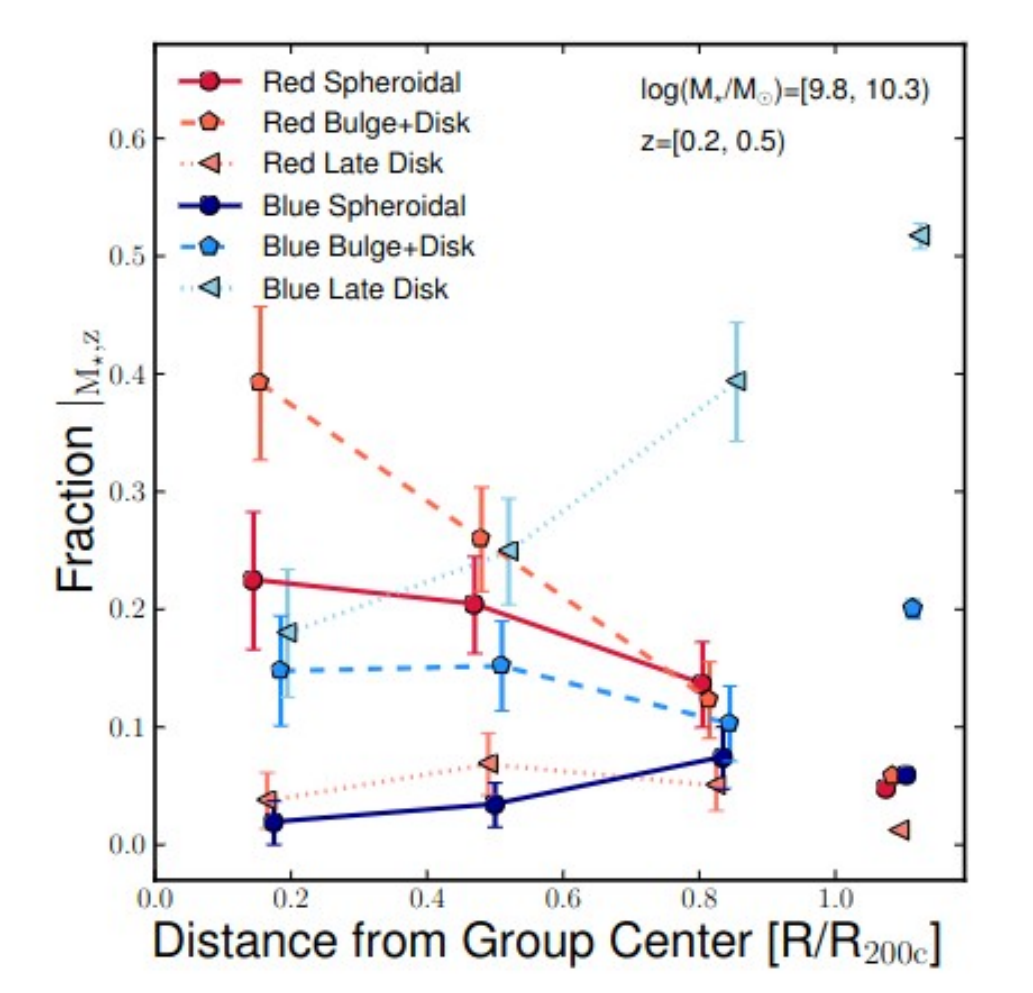
Target galaxies



HST DATA RESULTS 1/3

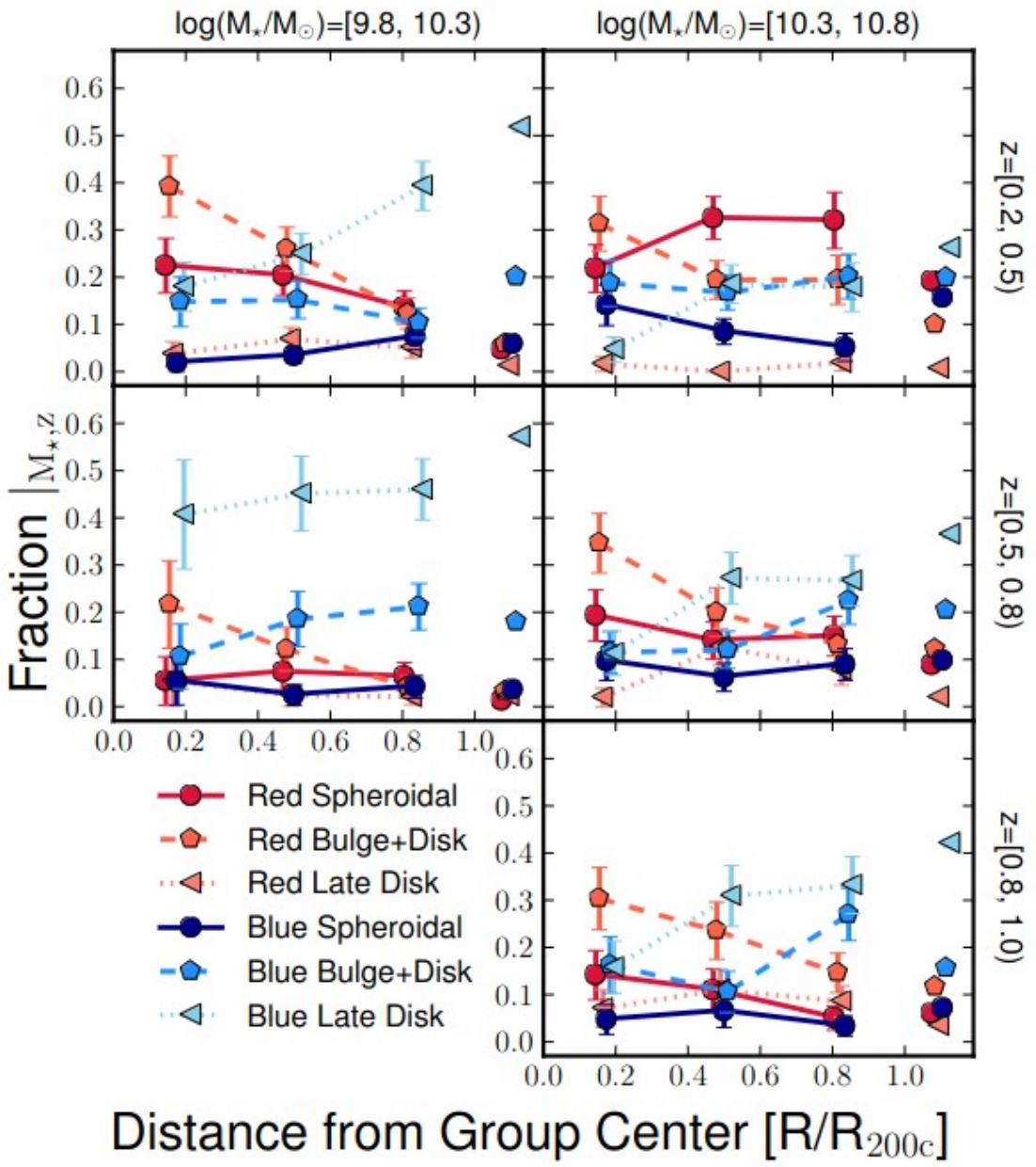
- George et al. 2013, arXiv:1302.6620
- HST and JWST data from the same catalog
  - Redshift z=0.2-1
  - Galaxies into central, satellite, and field populations
- Among satellites blue late disk galaxies → red bulge+disk galaxies

HST DATA RESULTS 2/3



Colour and morphological fraction as a function of group-centric distance with low stellar mass and low redshift (George et al. 2013)

HST DATA RESULTS 3/3



Colour and morphological fraction as a function of group-centric distance (George et al. 2013)

SUMMARY

- A correlation between galaxy properties and environment
- Morphology and colour transformations caused by physical mechanisms, dominant mechanism unknown
- Structural measurements methods used to study this
  - Including 2D light curve fitting programs
- JWST will likely give answers to some questions

THANK YOU!