Environmental and morphological-type segregation on the evolution of galaxies out of the blue sequence

Wednesday, November 20, 2013

MORPH2013

Deconstructing Galaxies - Structure and Morphology in the Era of Large Surveys
2013 ESO Workshop, Santiago, Chile

by Alexandre Bouquin, PhD student & DAGAL Early-Stage-Researcher

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with Armando Gil de Paz, Samuel Boissier, Juan-Carlos Muñoz-Mateos

Outline

1. DAGAL PR and motivation of the work
2. Sample and data products
3. Preliminary analysis of data products (color-mag. diagram, color-color diagram, application of models, inclination effects, environmental effects)

http://dagalnetwork.eu/

DAGAL PR

DAGAL

DETAILED
ANATOMY OF
GALAXIES

- Goal: complement the S4G and adding to it by using Ha, 21cm HI, UV data from other surveys + simulations

- Structure: 6 universities across Europe, 3 private companies, 8 ESRs (PhD) students, 2 ERs (postdocs)

university of groningen

UNIVERSITY of OULU

LAM

Springer

Fractal

Specim

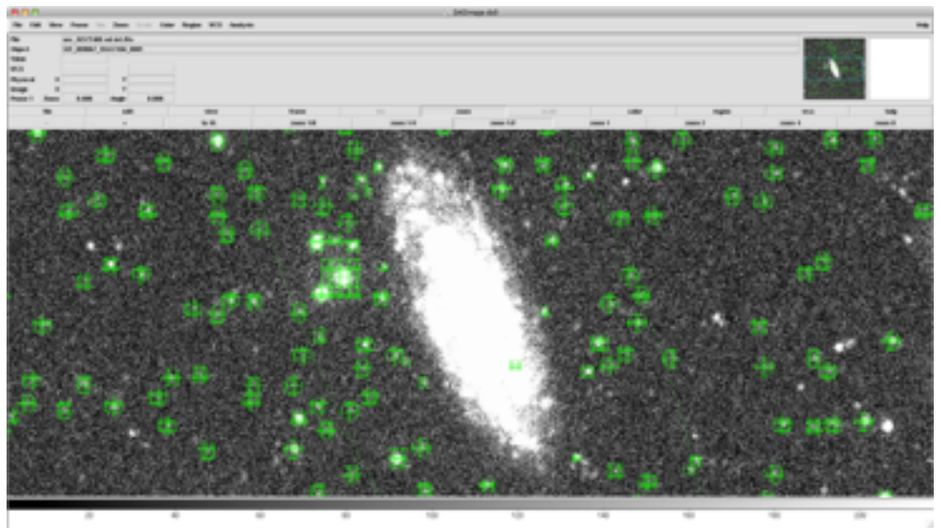
S4G

My Role in DAGAL

- Perform photometry on GALEX FUV and NUV images

- Compile and analyze the first, large catalogue of eXtended-UV (XUV)-disk galaxies ever

- Investigate disk growth



We have yet to classify the XUV-disk galaxies contained in our sample. But, we can already clearly see interesting trends.

Motivation of the work

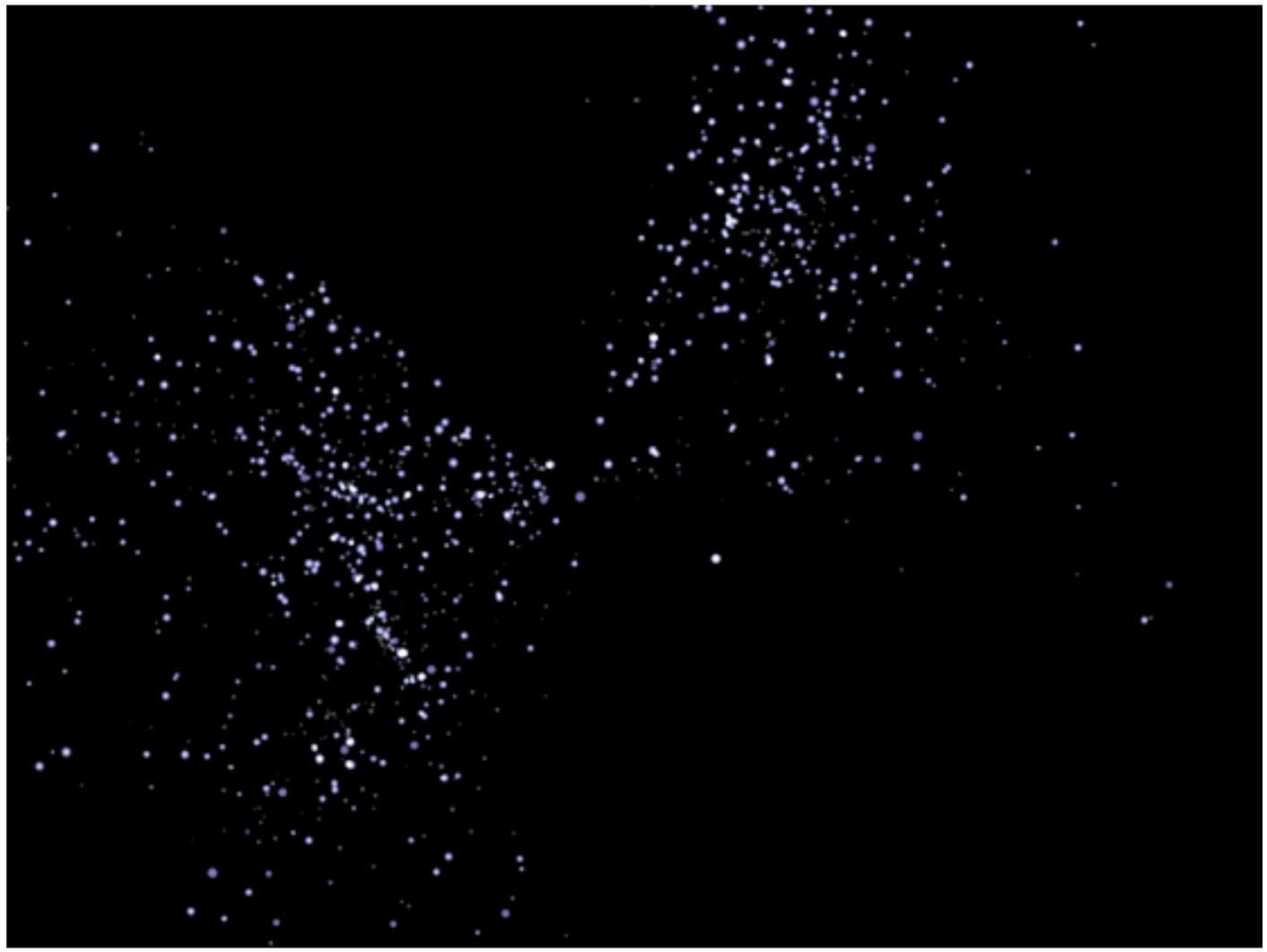
- understanding the evolution of the **outer parts of disks**
- understanding the unexpectedly high chemical abundances there
- understanding the mechanism(s) that activate the SF in these rarefied environments

HOWEVER, the integrated UV-IR properties of the sample have provided important clues to the evolution of early-type spiral galaxies as a whole in recent epoch. We will focus on this today.

SAMPLE

- Base-sample is S^4G:
  2,352 galaxies
  IRAC 3.6μm, 4.5μm
  d<40 Mpc, |b| >30°,
  m_{Bcorr}<15.5, D_{25}>1'

- GALEX (GR6/7)
  counterparts:
  1,512 (for the work in this presentation)
  (now 2,141 galaxies with GR7),
  FUV (1516Å), NUV (2267Å)



With Partiview and the Digital Universe package
(Download it for free!)
Credit: AMNH

SAMPLE

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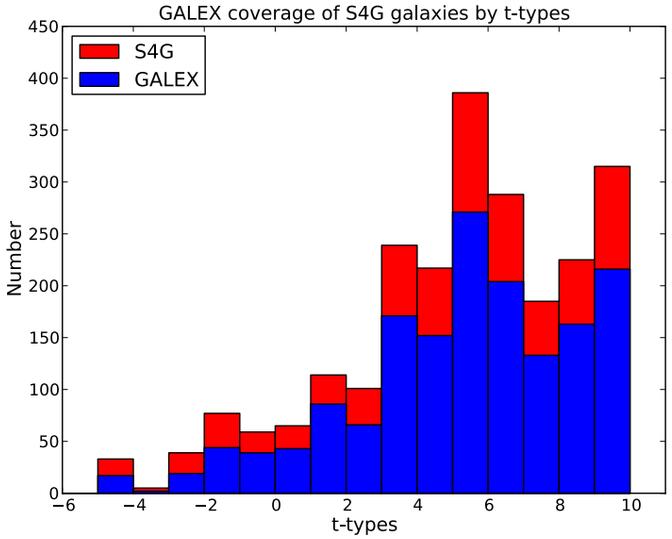
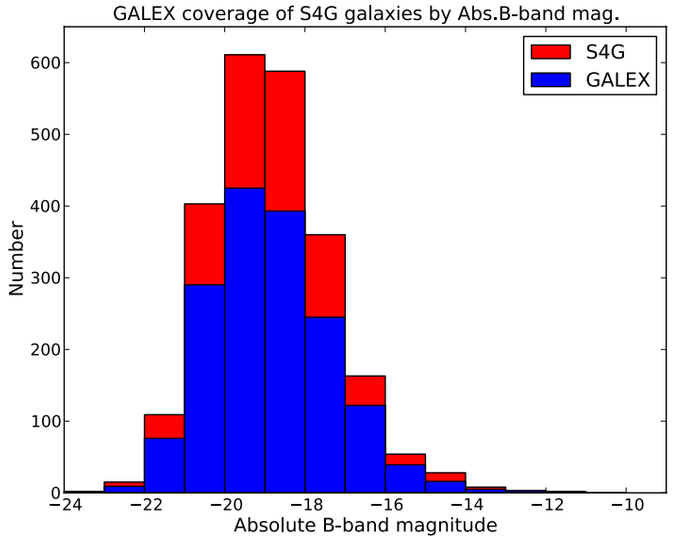
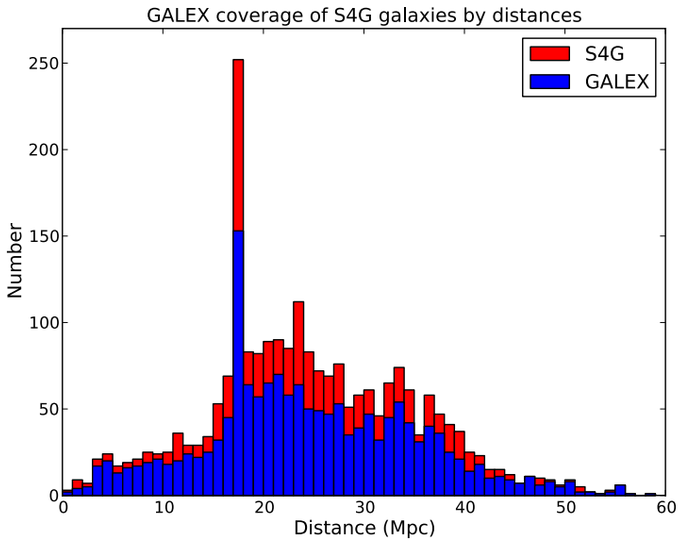




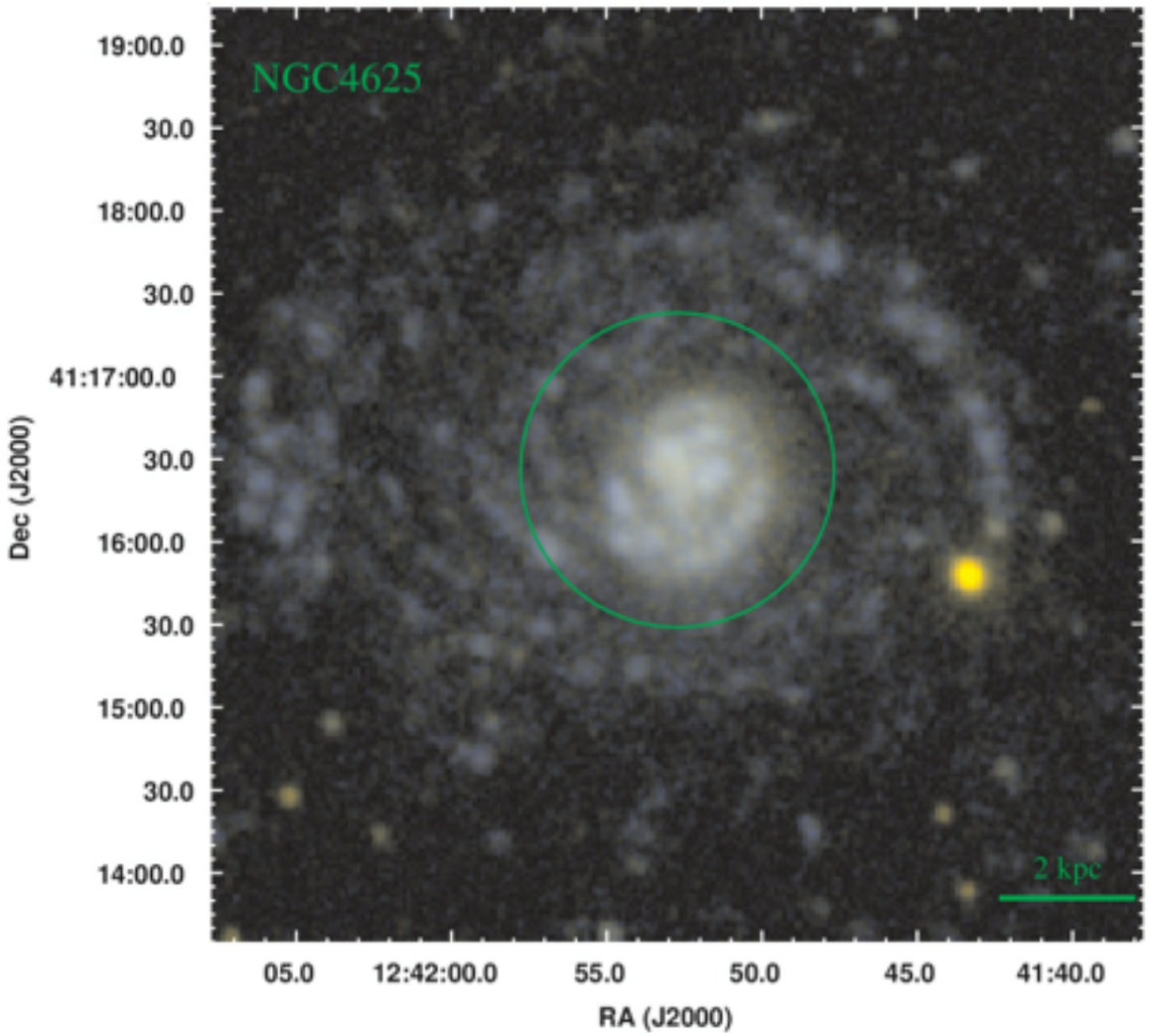


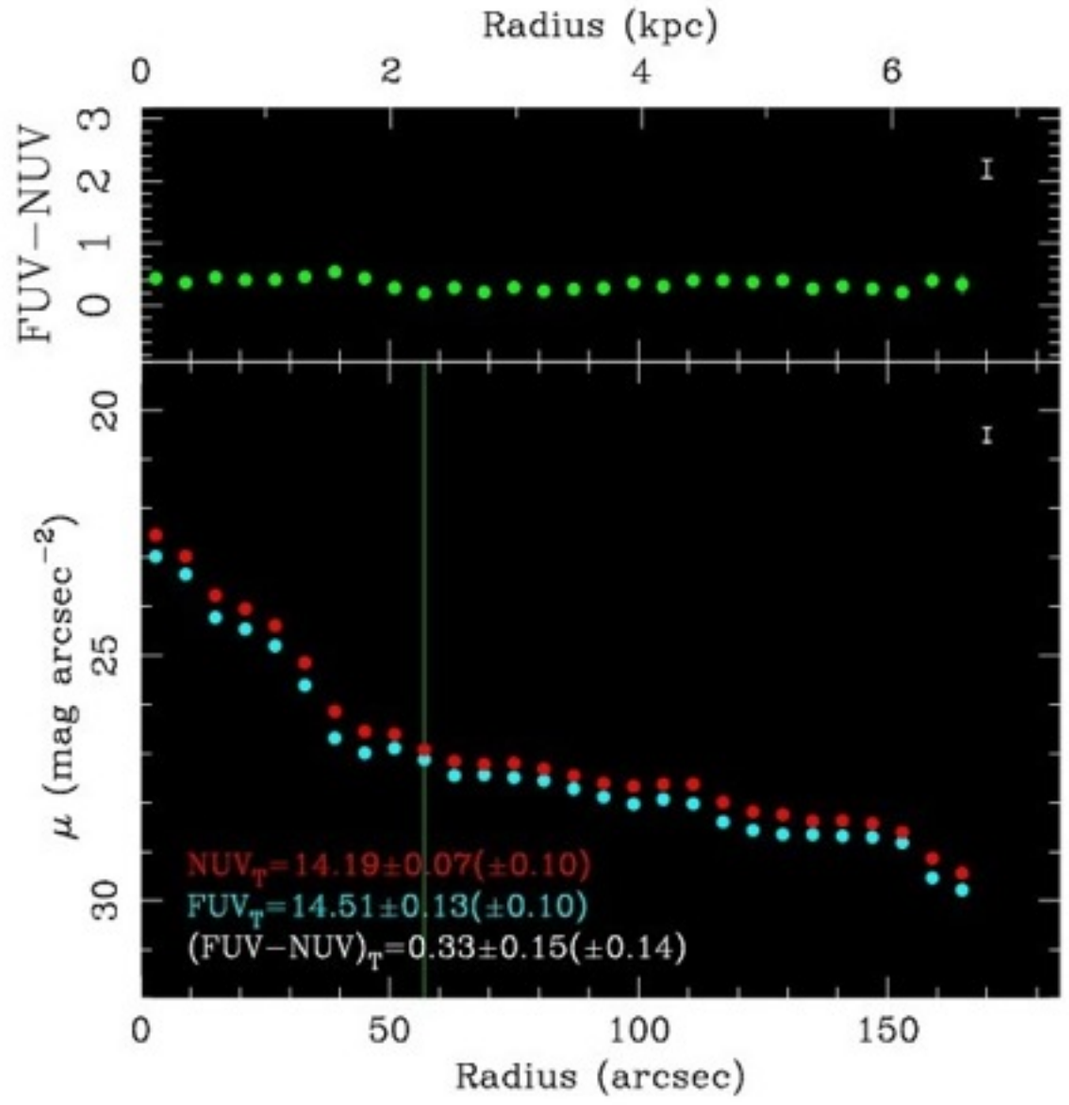
~70% of S4G covered (this work)

(~91% of S4G covered with GR7)

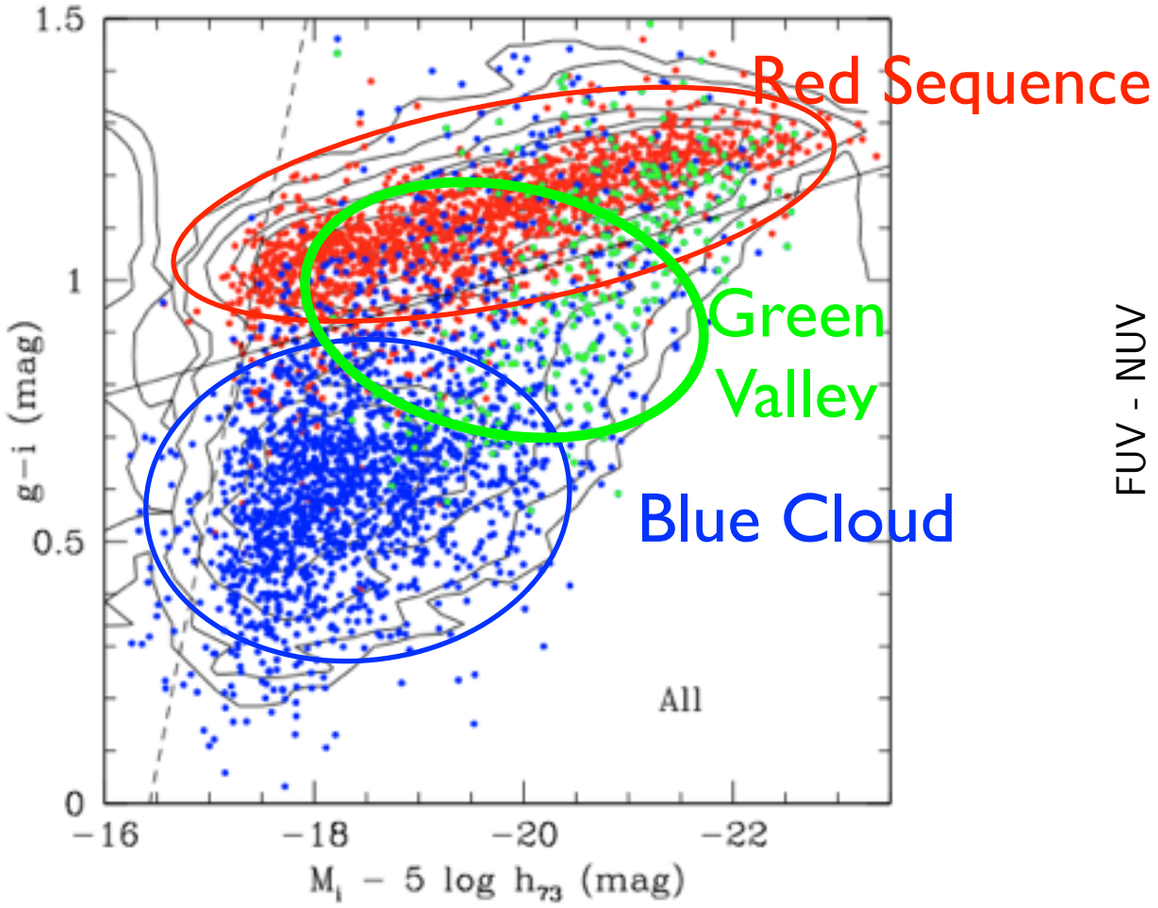
Data Products

- We obtained asymptotic magnitudes, surface brightness profiles, color profiles, FUV+NUV RGB images from GALEX images.

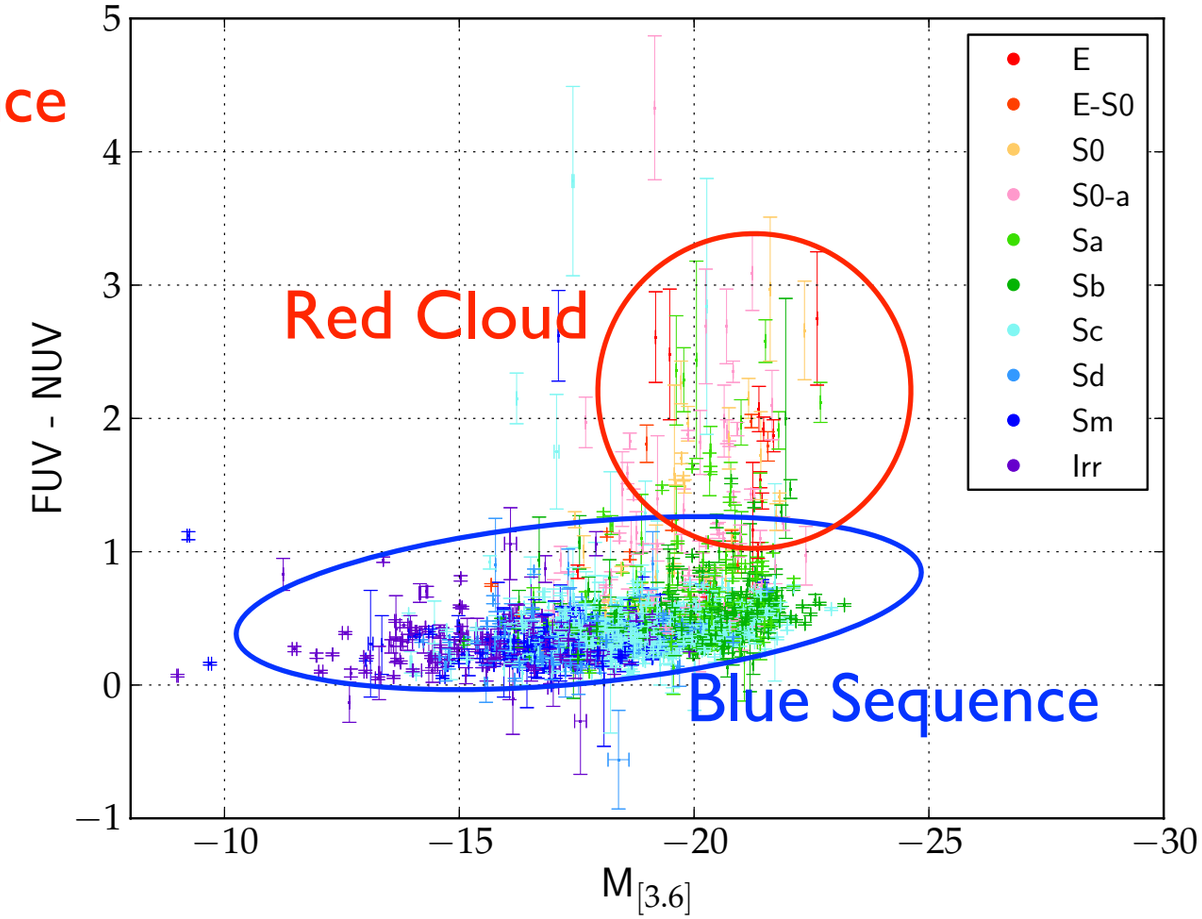




Color-Magnitude Diagram

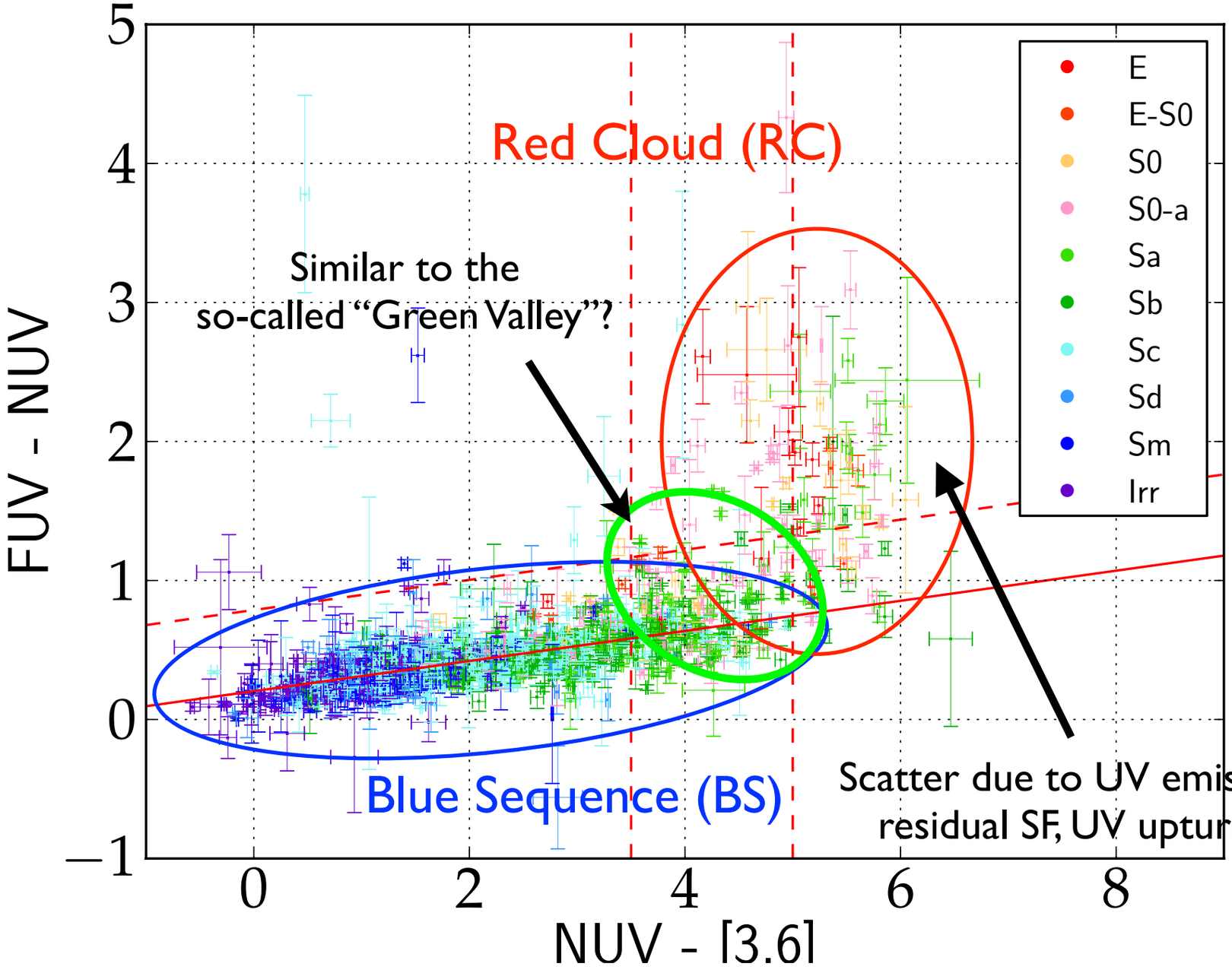


Gavazzi et al., 2010, A&A, 517, 73



OPPOSITE OF "CLASSICAL" OPTICAL/IR CMD

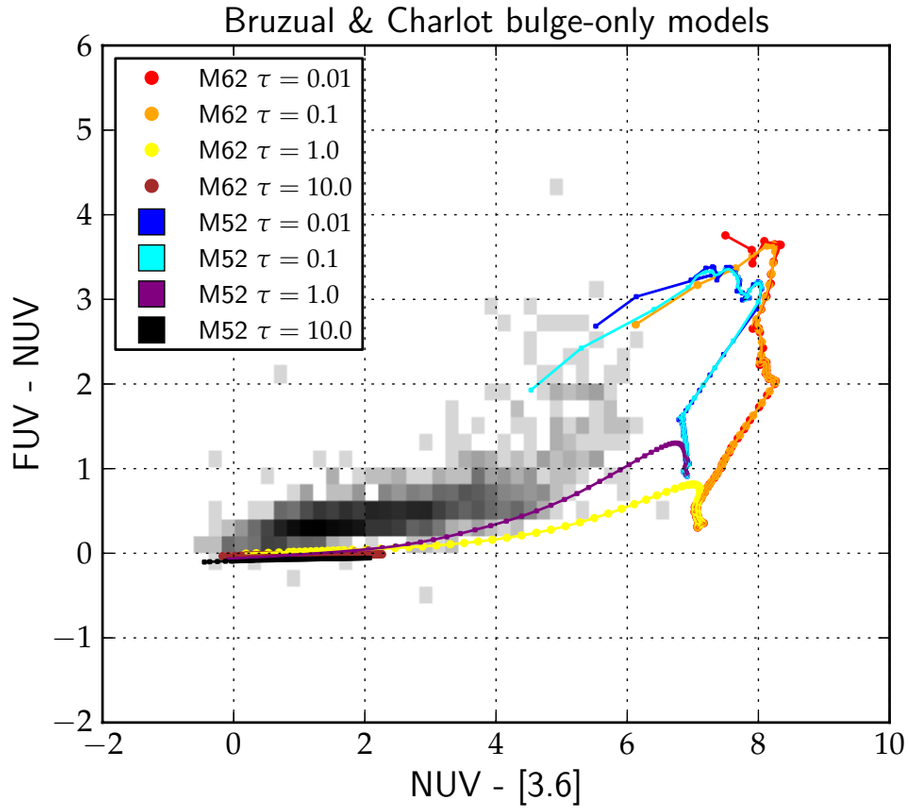
A tight color-color diagram of star-forming galaxies: a.k.a. the Blue Sequence

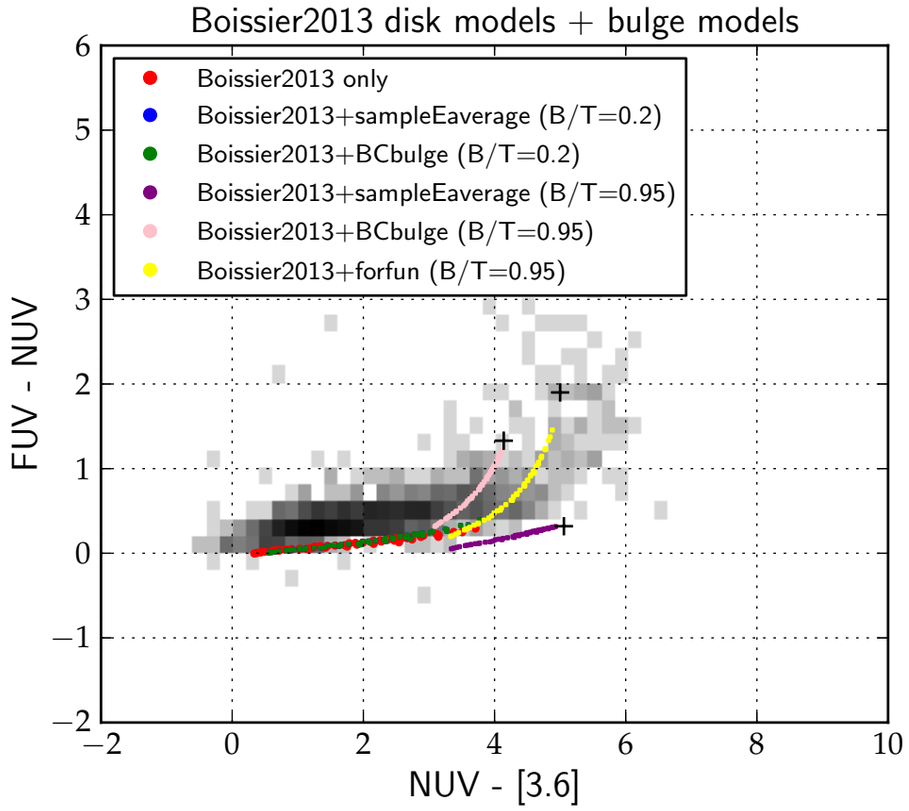


- (FUV-NUV) vs (NUV-[3.6]) plotted by morphological type.
- Obvious trend by type, with late-type galaxies aligned in a blue sequence, and early-type galaxies populating the red part of the diagram.

Applications of models

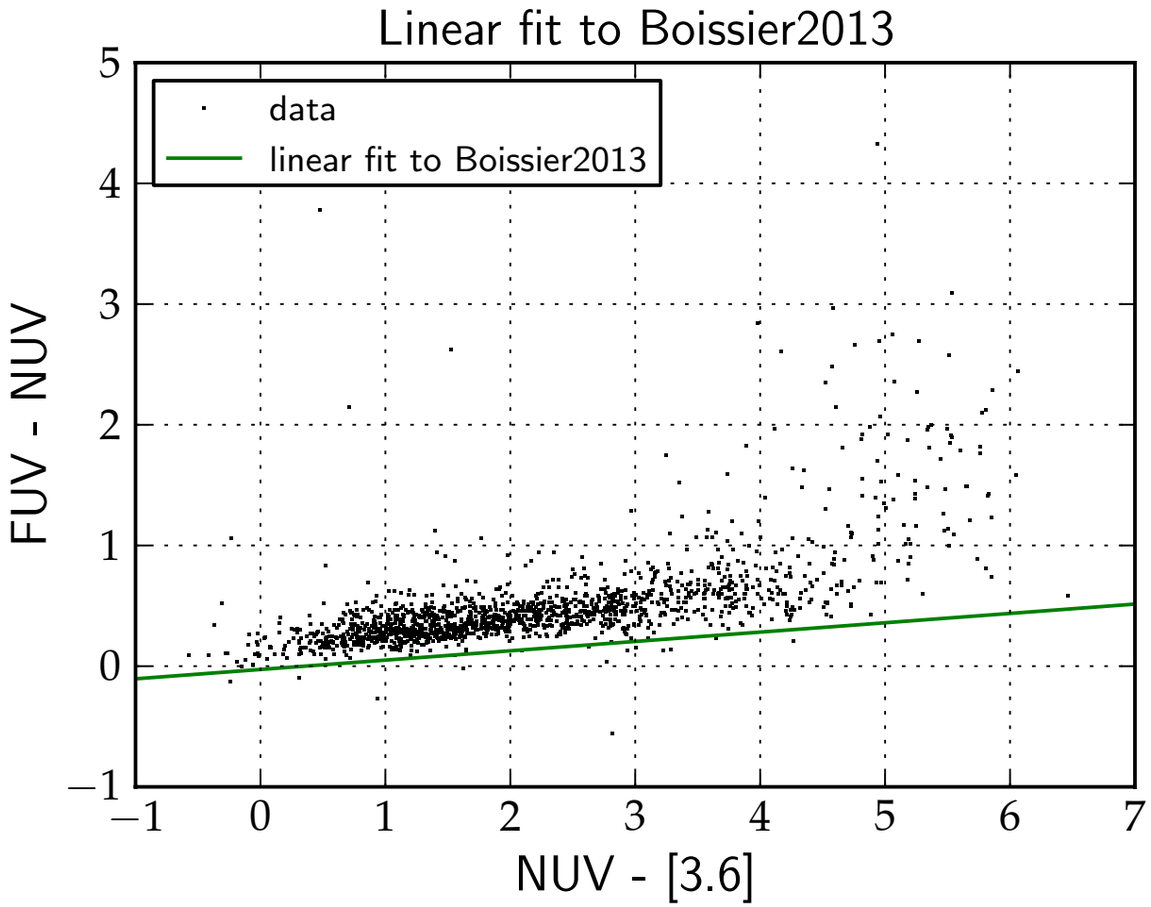
- We use Samuel Boissier's galaxies model to predict the disk UV and FIR colors and BC03 models for the bulge colors. (Boissier, L. & Prantzos, N., 2000, ASPC, 215, 53. 2000, MNRAS, 312, 398)

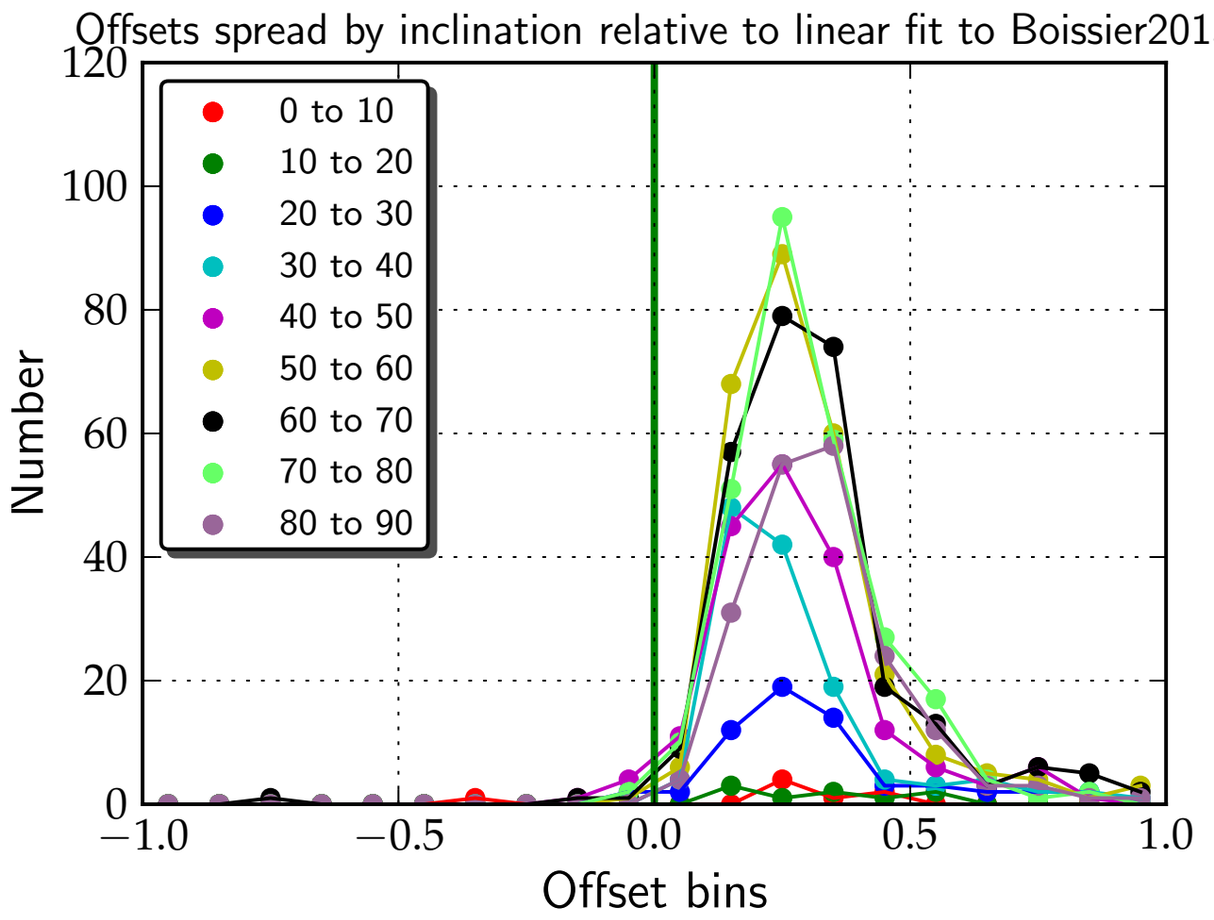




unrealistic B/T=0.95 needed to reproduce the color distribution we see

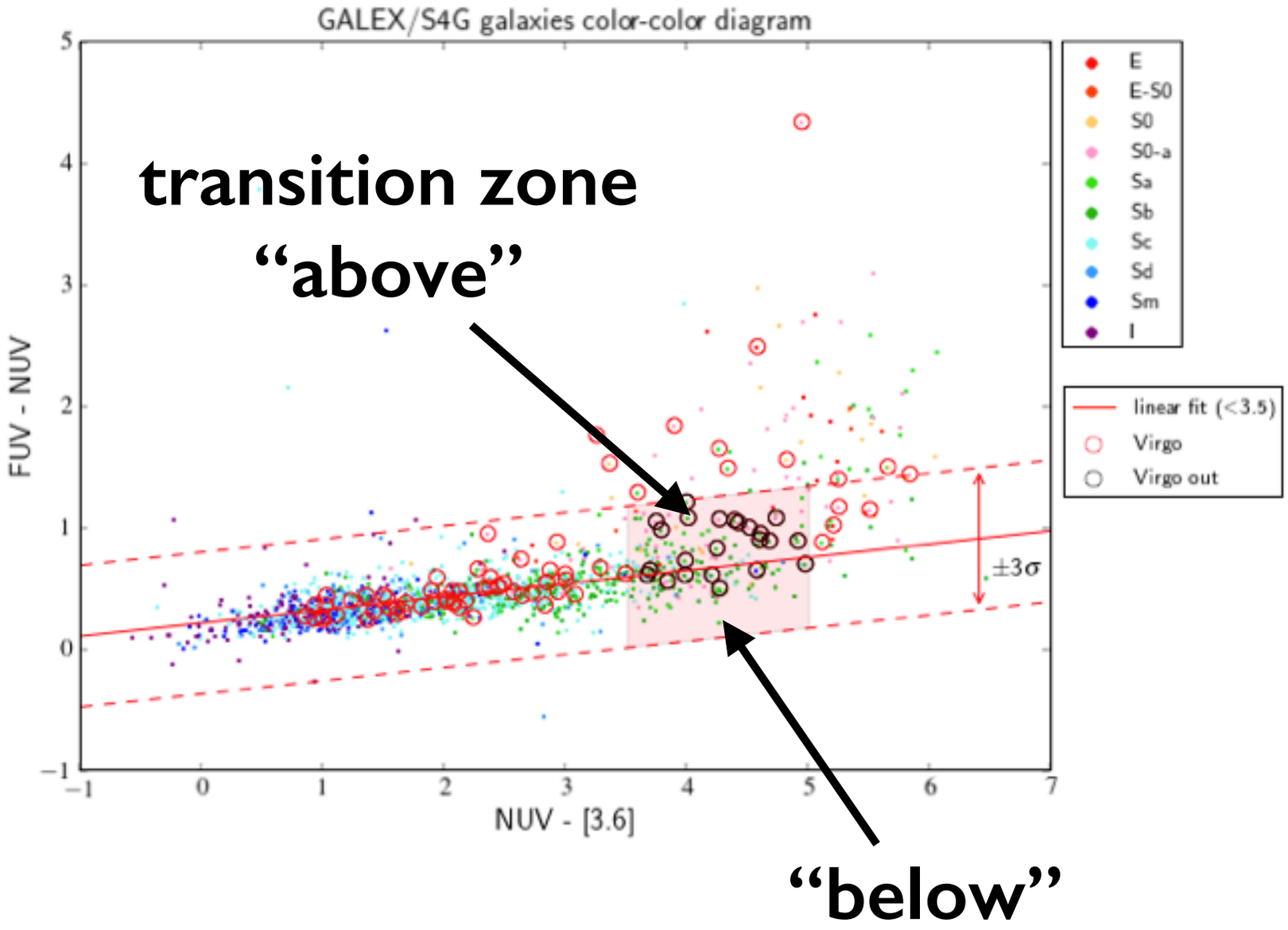
Inclination effects





Width of the Blue-Sequence not due to inclination.

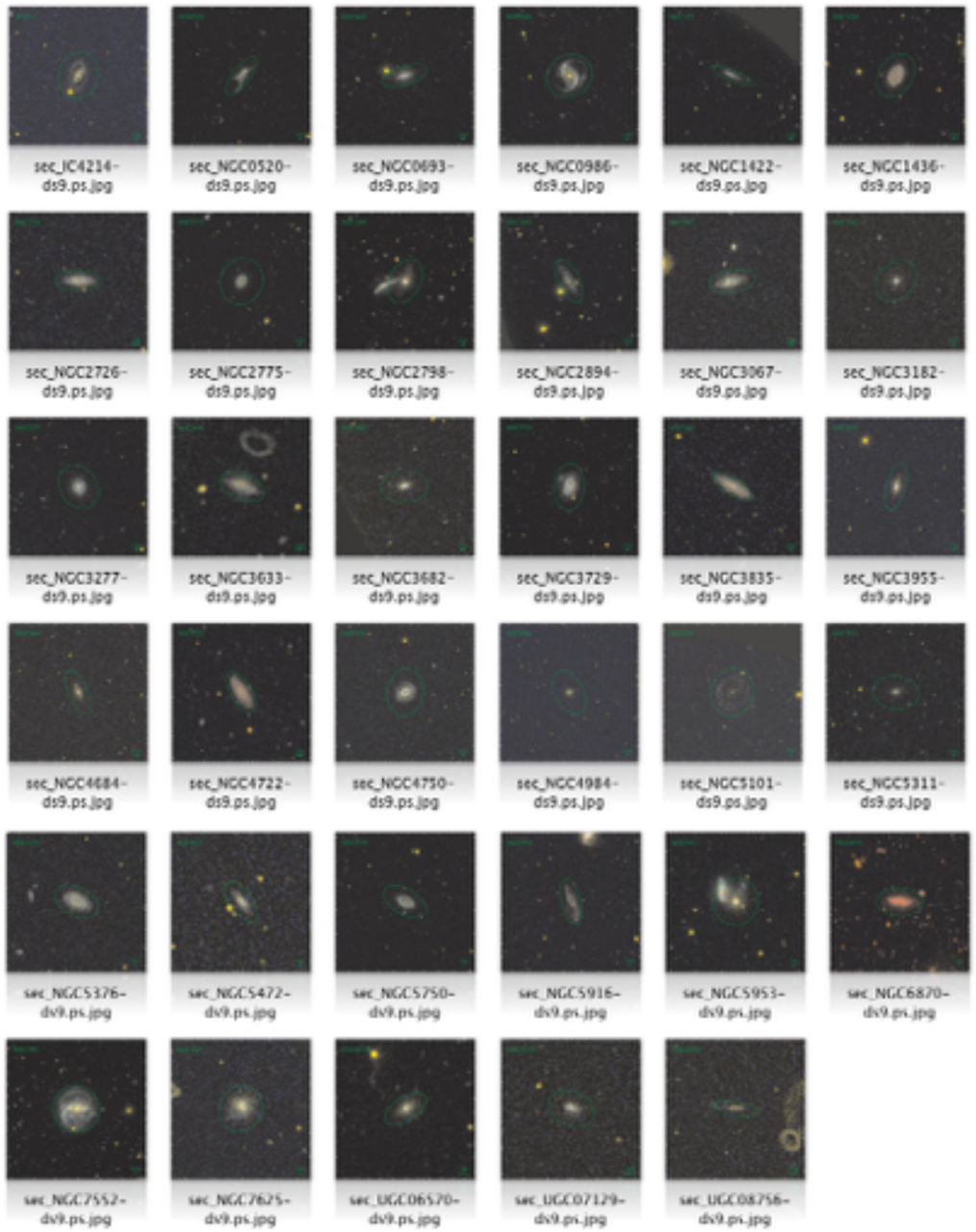
Environmental Effects



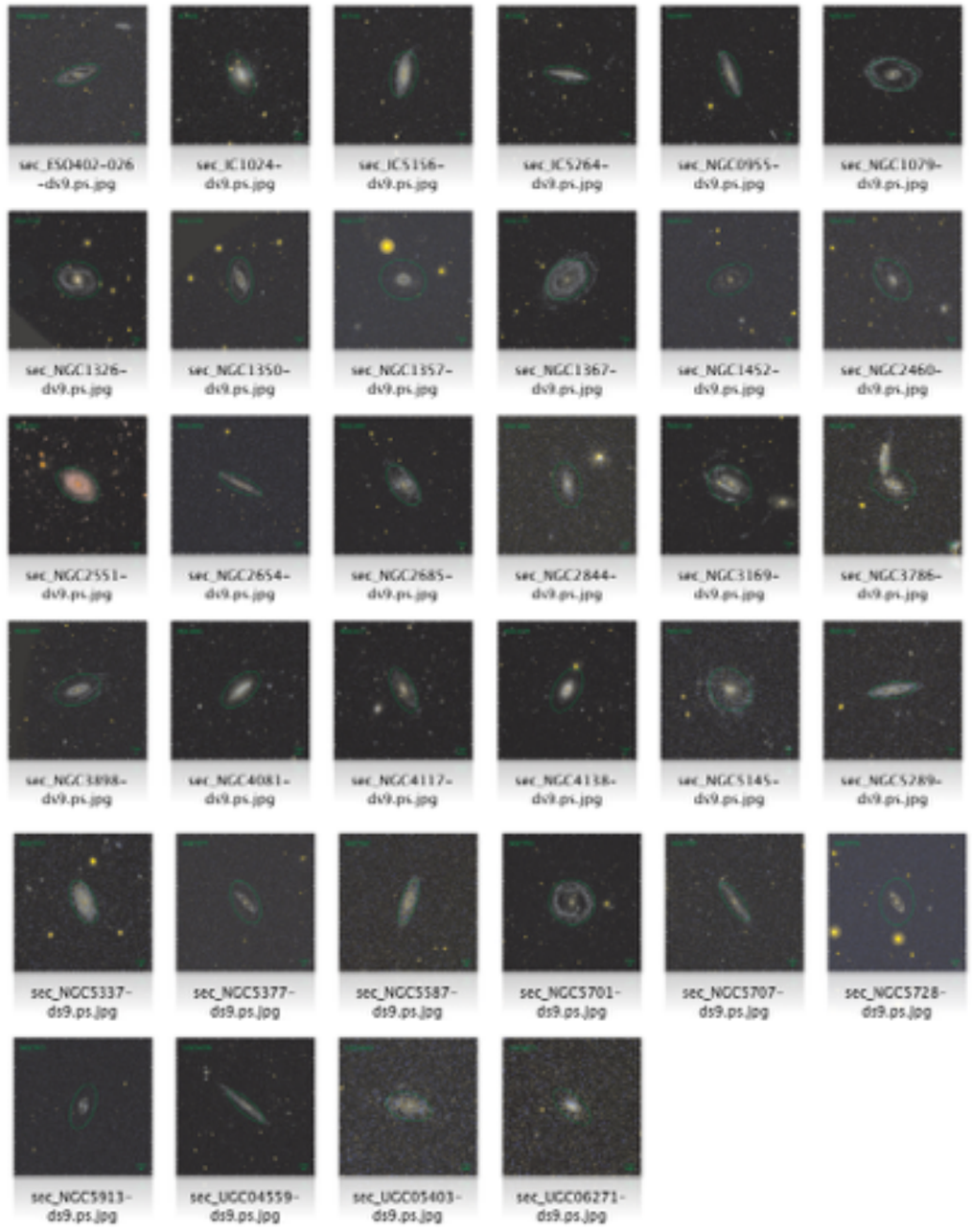
In addition to the long known correlation of galaxy morphology with local density (Dressler 1980), we find a higher fraction of Virgo S0-a and Sa "above" (i.e. redder) than the mean of the blue-sequence, compared to non-Virgo (field) S0-a and Sa.

FUV+NUV RGB images of **non-Virgo** S0-a and Sa in the transition zone

non-Virgo "above"

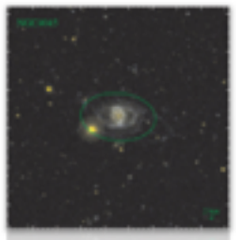


non-Virgo "below"



FUV+NUV RGB images of **Virgo** S0-a and Sa in the transition zone

Virgo "above"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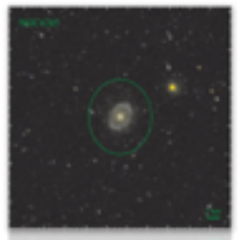
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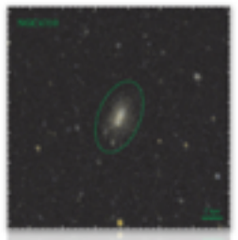
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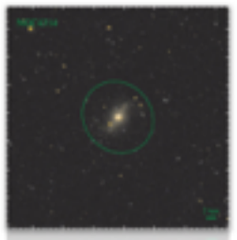
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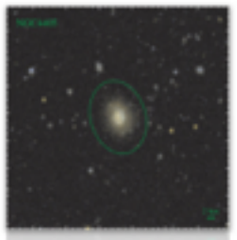
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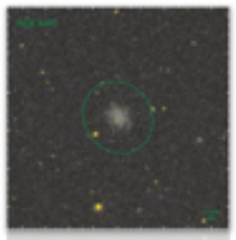
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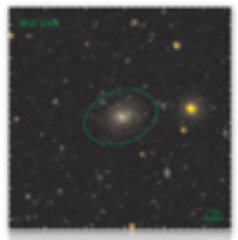
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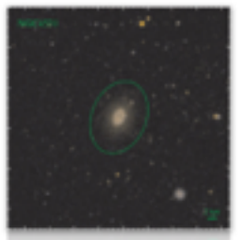
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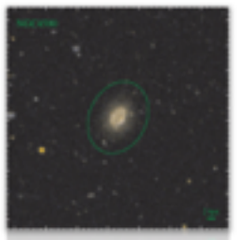
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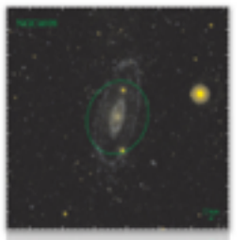
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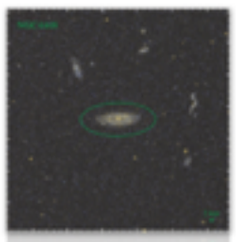
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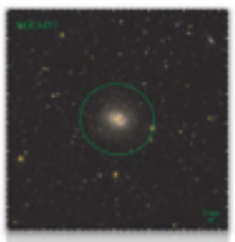
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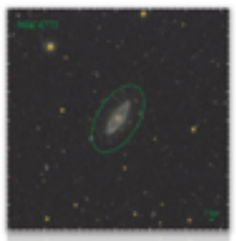
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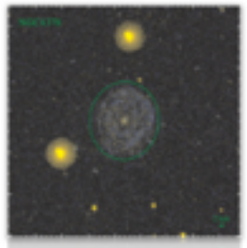
Virgo "below"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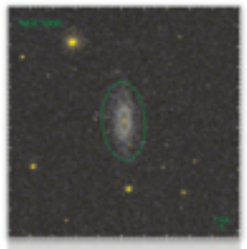

sec_NGC3900-ds9.ps.jpg

Coming soon

1. Analysis of the properties of galaxies in this "transition zone" (outer-disks, inner-disks, gas consumption, central region, ram-pressure?, etc...)

2. Completion of classification of XUV Catalogue (mid-December)

3. Observation of selected XUV galaxies with GTC (10.4 m) OSIRIS Tunable Filter scan (20hours, queue scheduled between Oct. 2013 ~ Mar. 2014) to get Hα and NII lines over an 8' radius FOV.

4. Observation of selected XUV galaxies with Subaru (8.2 m) Suprime-Cam (Dec. 1~3) with Jin Koda.

5. Get optical spectra of those regions that drive the BS --> RC (TBD)

Summary

- (FUV - NUV) vs (NUV - [3.6]) color-color diagram: the smooth SFH and dust attenuation places the bulk of our galaxies in a tight sequence (the blue sequence) and a scattered red cloud. This is the opposite of the "classical" Red Sequence and Blue Cloud in optical-IR data, or more recent Red and Blue Sequences with NUV-IR.

- early-type spirals that are offset from that blue sequence (i.e. the red cloud) may be galaxies where the SF has been recently quenched, which suggest some kind of strangulation effect.

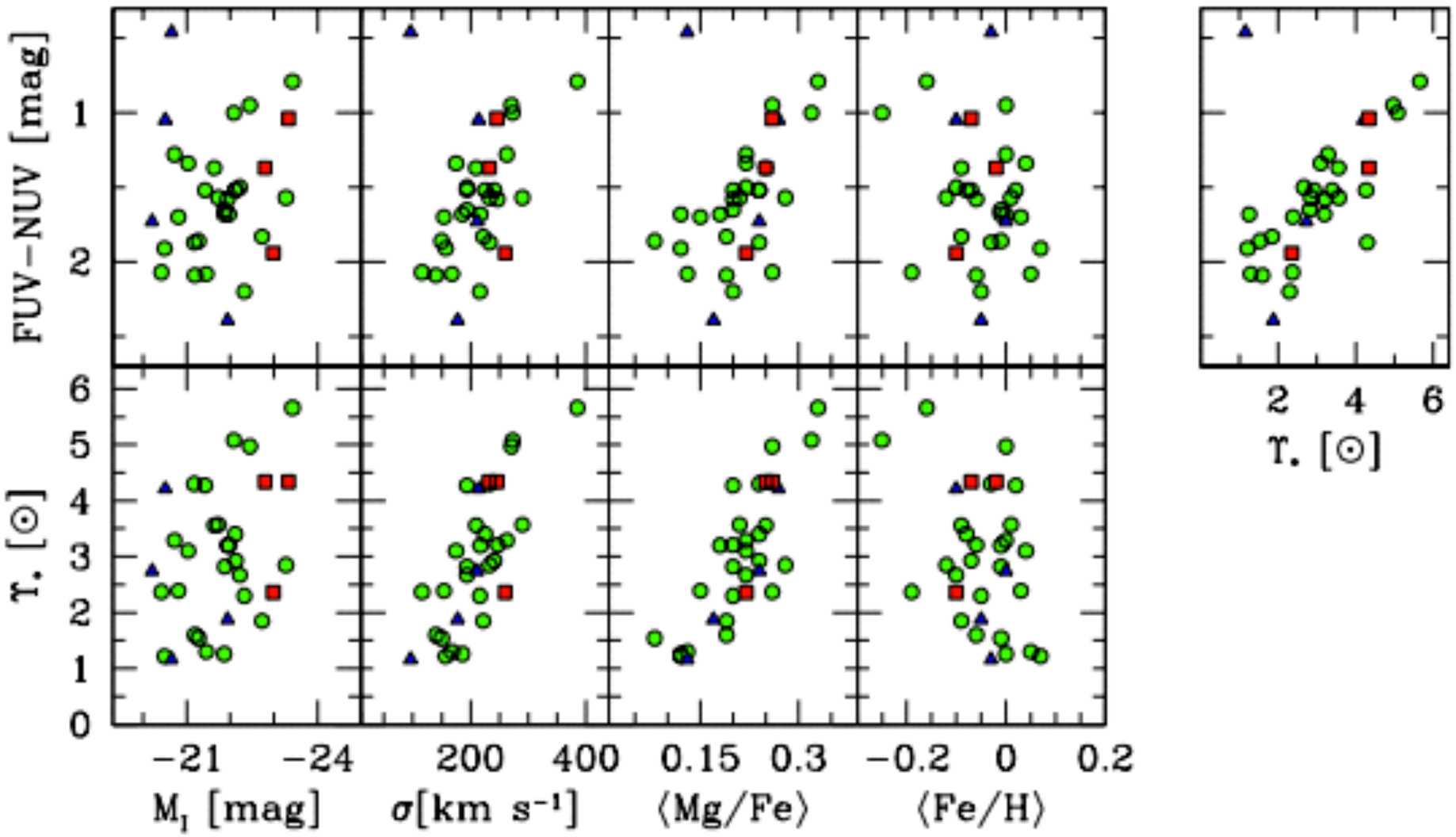
- We do not exclude the possibility of disk re-growth, which would move galaxies from the RC to the BS in our UV-IR color-color diagram.

- The analysis of the regions and structural components that are responsible for the evolution of these early-type spirals is underway along with the connection between these transitional systems and the overall population of XUV disks.

Thank you!

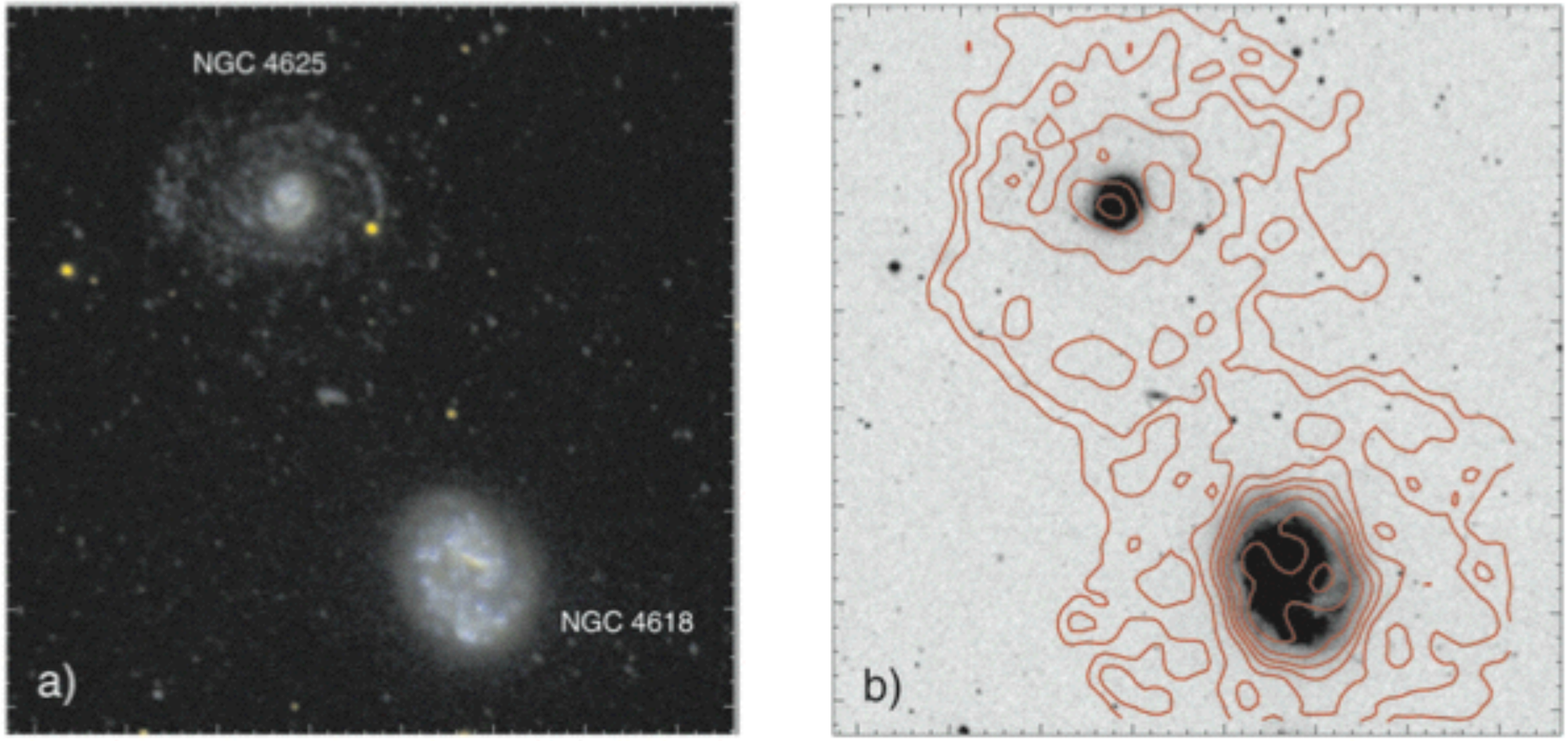

SAMSUNG
SAMSUNG

Very tight relation between UV color and stellar mass-to-light ratio of ETGs



Zaritsky et al. 2013
(accepted for publication in ApJL)

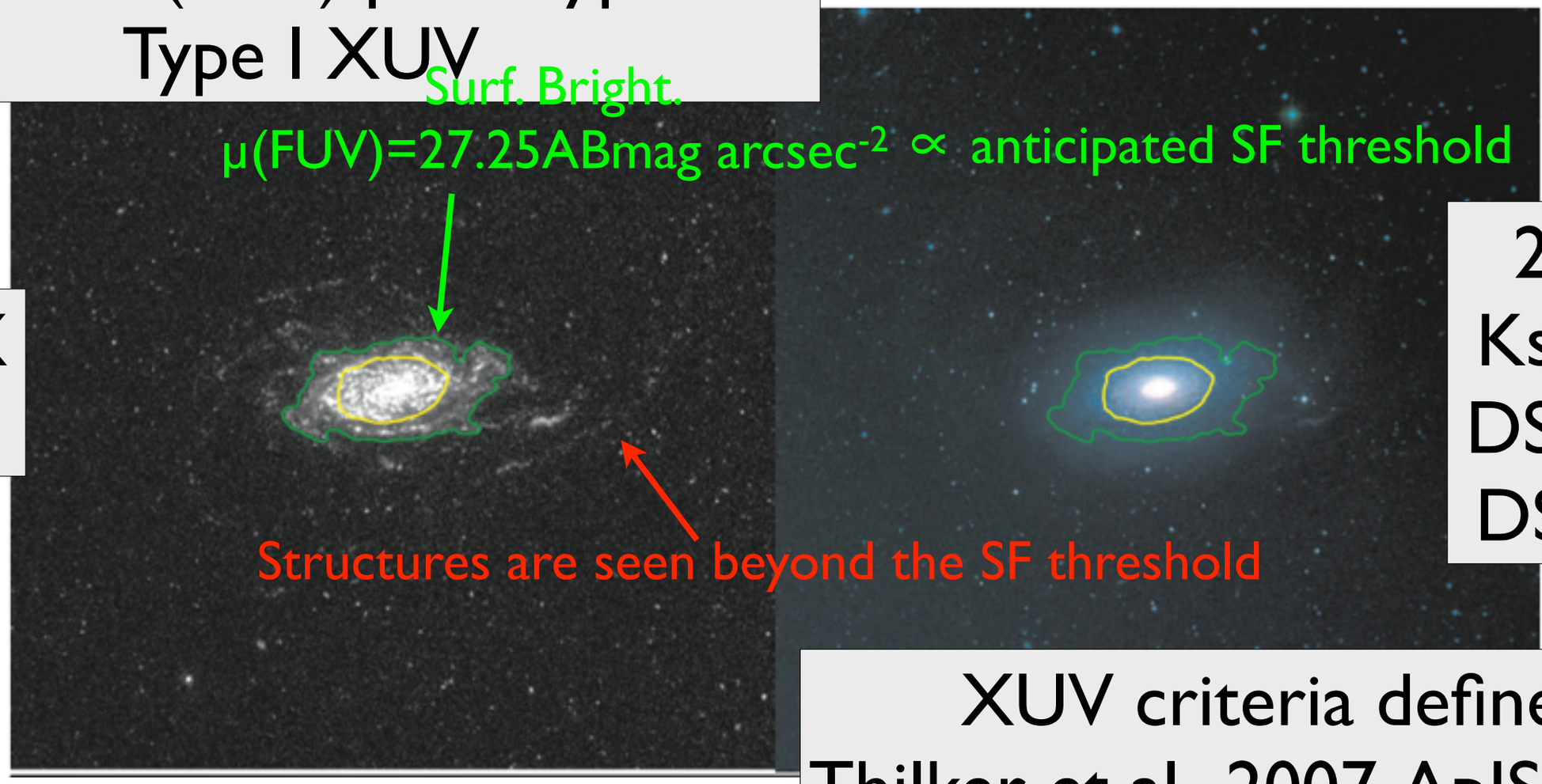
XUV stands for "eXtended UV"



- The first XUV discovered:
  M83 (Thilker et al., 2005, ApJ, 619, 79) and NGC4625 (Gil de Paz et al., 2005, ApJ, 627, 29)

XUV stands for "eXtended UV"

NGC5055 (M63) prototype for Type I XUV



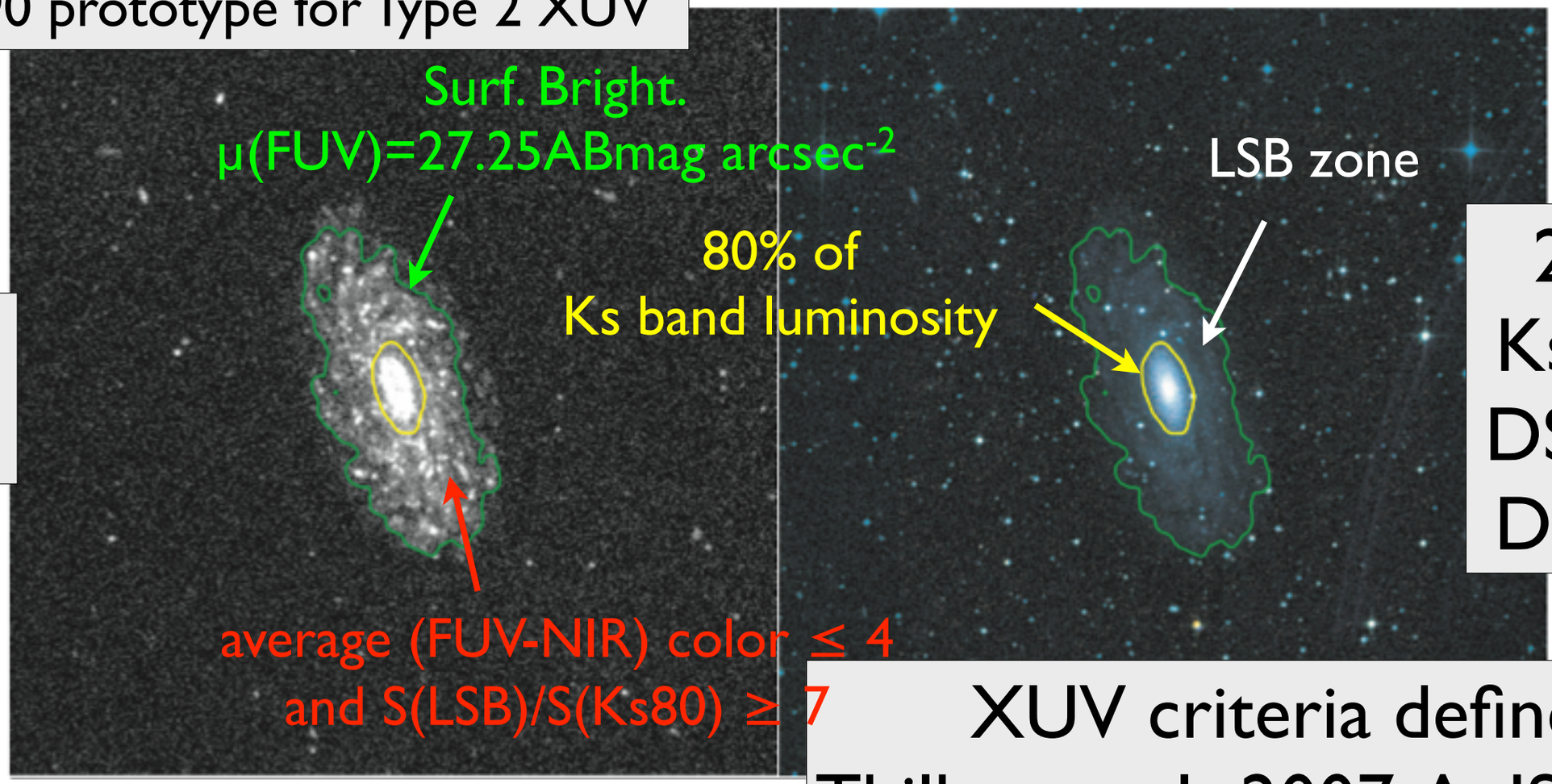
GALEX FUV

2MASS Ks band+ DSS2red+ DSS2blue

XUV criteria defined in Thilker, et al., 2007, ApJS, 173, 53

XUV stands for "eXtended UV"

NGC 2090 prototype for Type 2 XUV



GALEX FUV

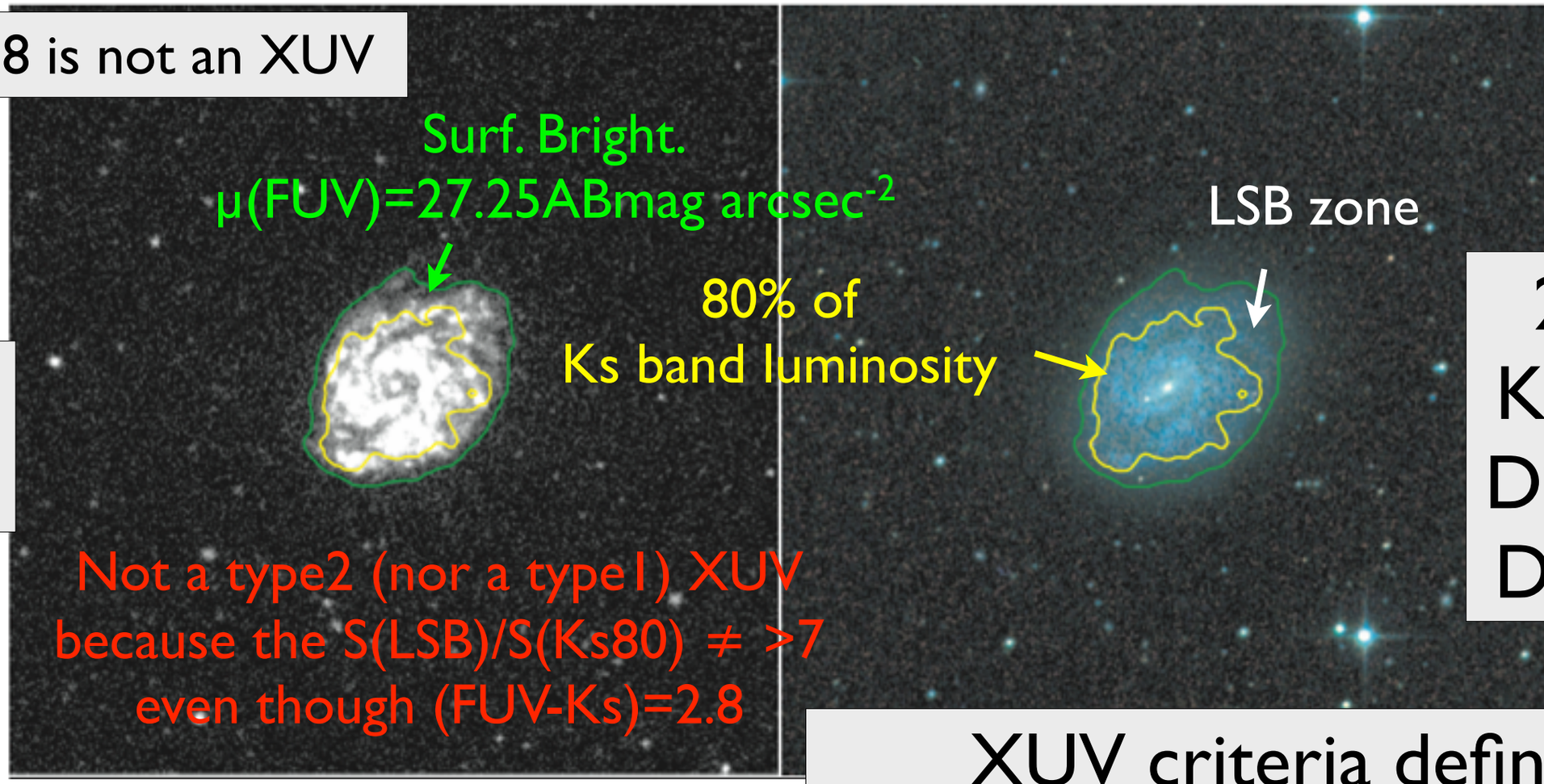
2MASS Ks band+ DSS2red+ DSS2blue

XUV criteria defined in Thilker, et al., 2007, ApJS, 173, 53

XUV stands for "eXtended UV"

NGC 7418 is not an XUV

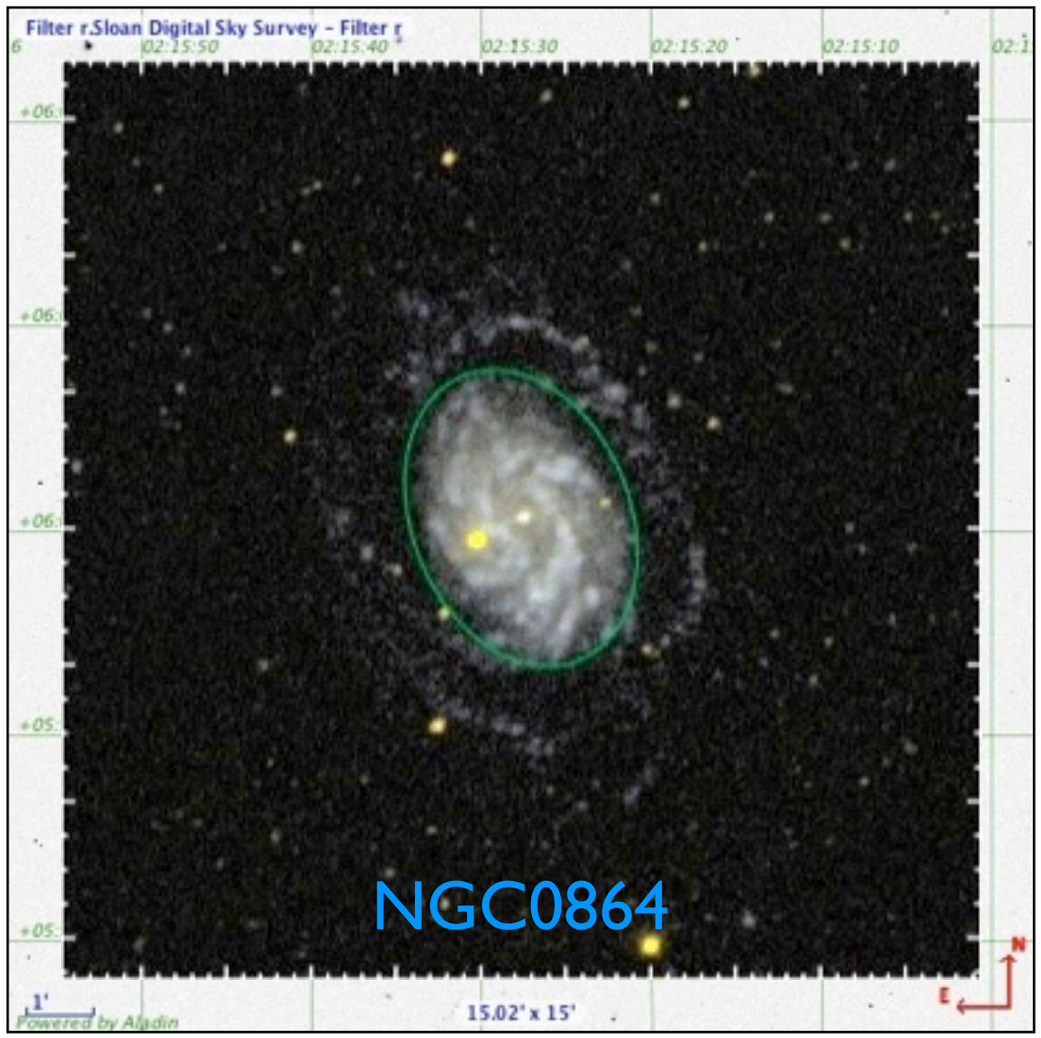
GALEX FUV



2MASS Ks band+ DSS2red+ DSS2blue

XUV criteria defined in Thilker, et al., 2007, ApJS, 173, 53

XUV galaxies are... extended



SDSS
Filter r

FOV
15' x 15'

GALEX
FUV+NUV