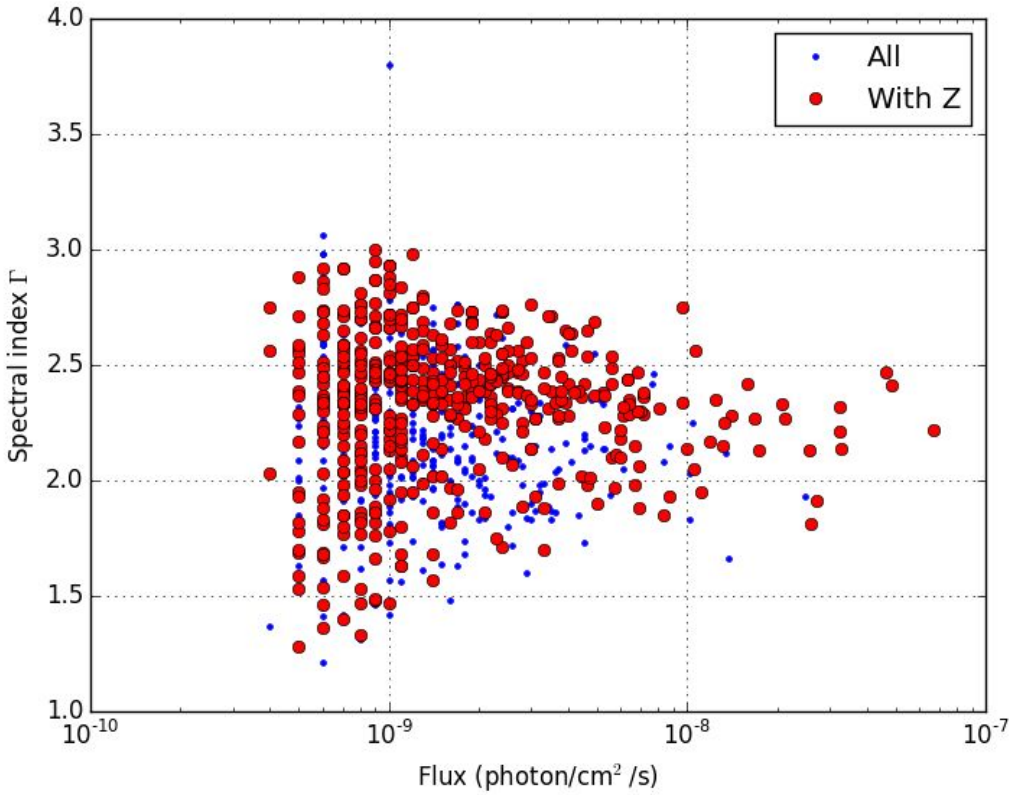
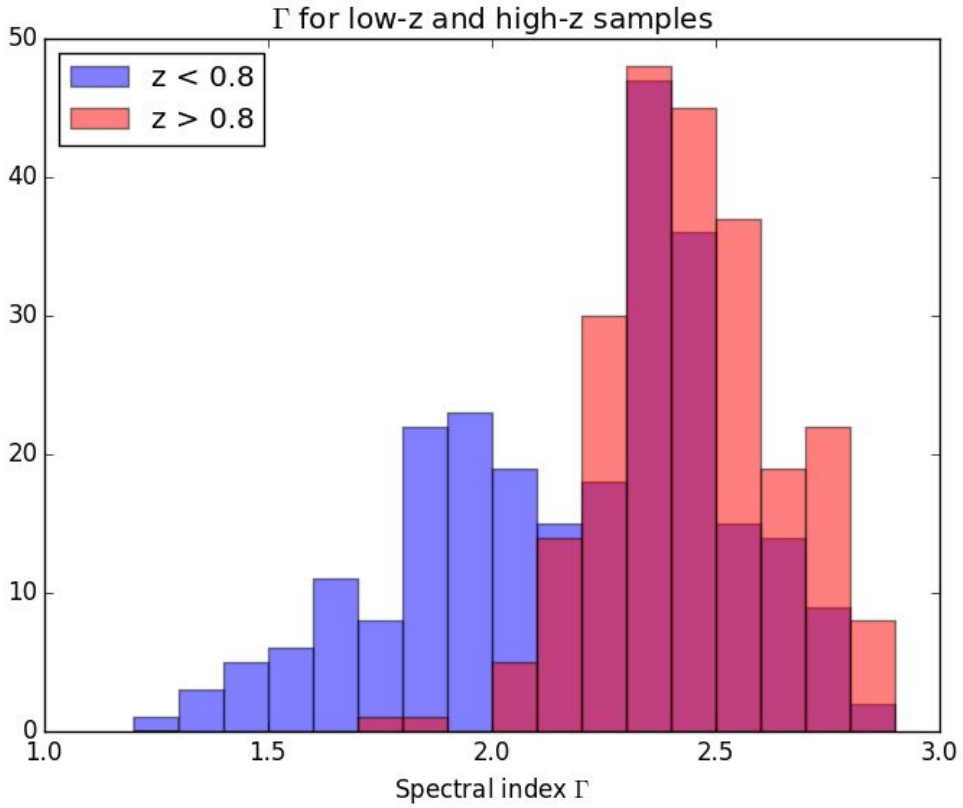
Galactic Astronomy Assignment Week1
陈平 Chen Ping 1501110226

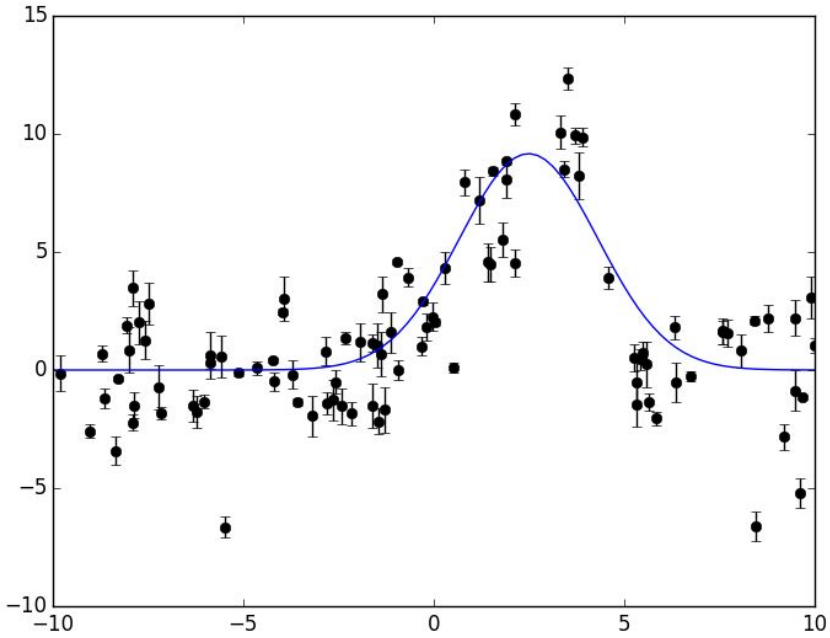
0. Download and read the Week 1 Notes. Done.
1. Install scientific Python. I have python 2.7 on my computer
2. Become familiar with scientific Python.

a) Read a Table and Plotting

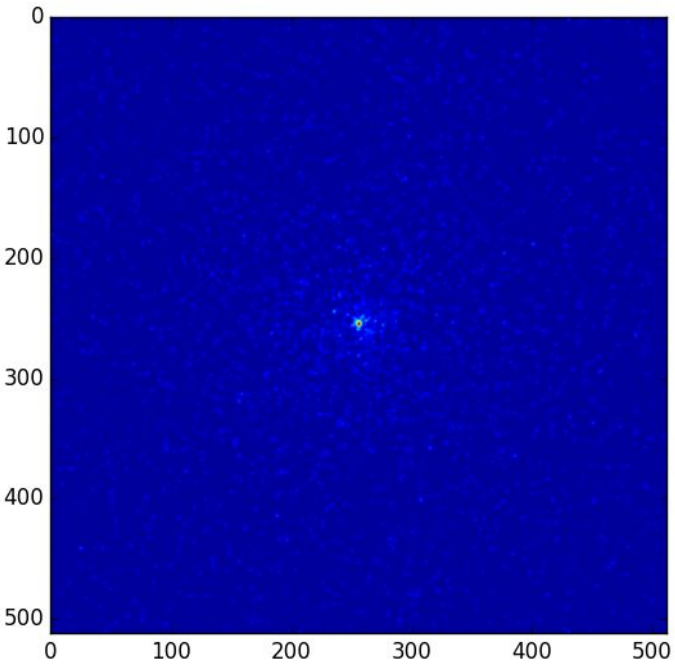




b) Curve Fitting with Scipy



c) Synthetic Images

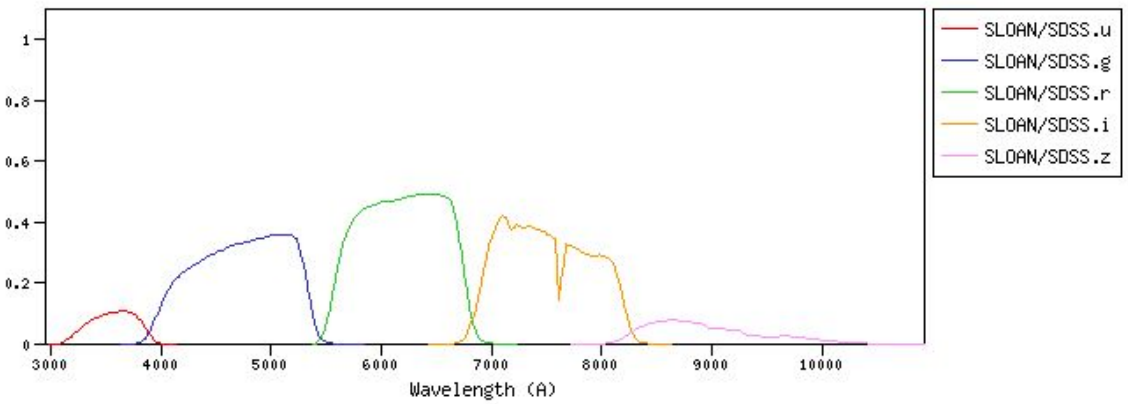


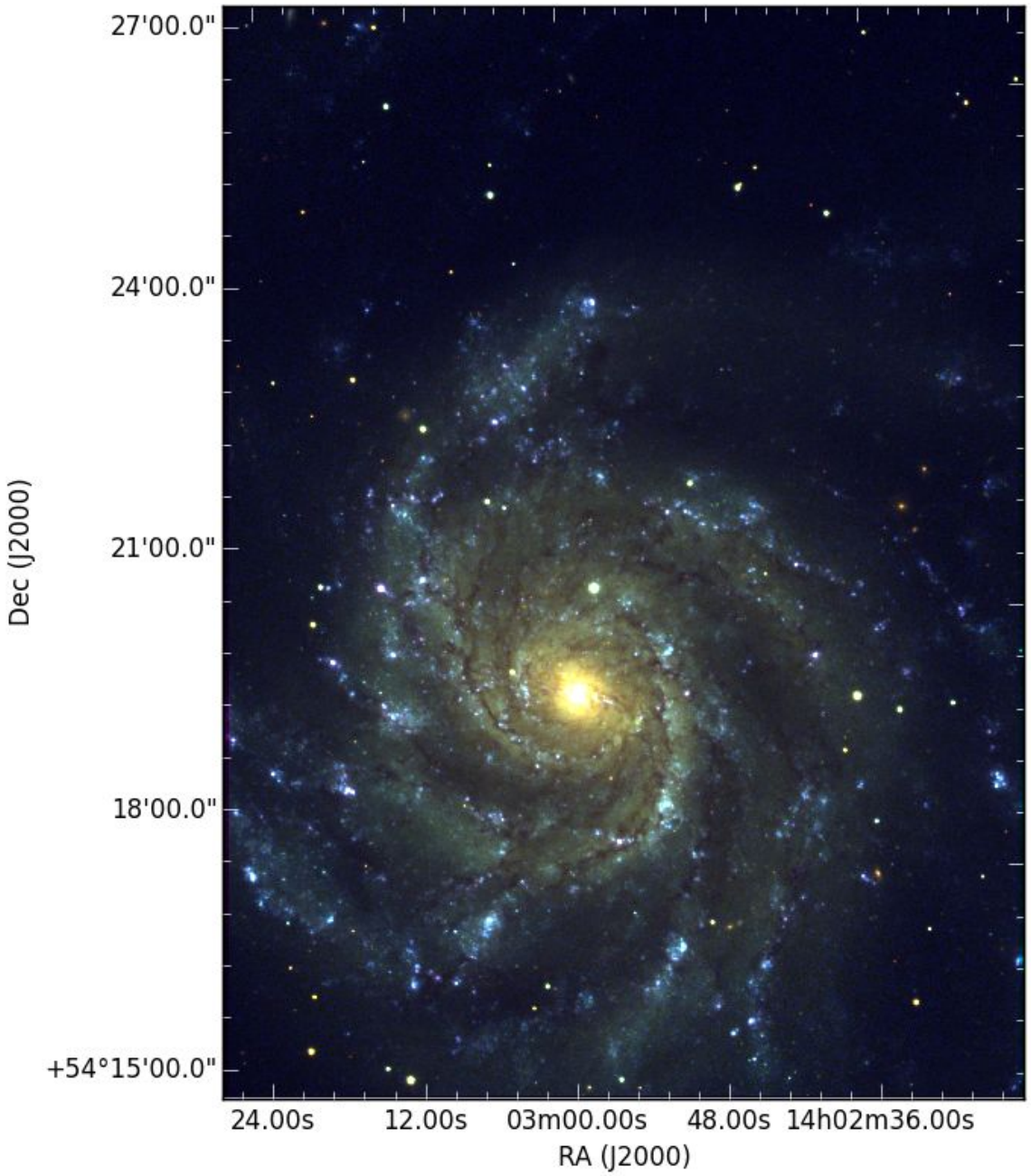
---

3. Manipulating galaxy images.

The following plot gives the wavelength range of u, g, r band as well as i, z.

Filter	λ mean	λ eff	λ min	λ max	Weff
u	3561.8	3594.9	3048	4028	558.4
g	4718.9	4640.4	3783	5549	1158.4
r	6185.2	6122.3	5415	6989	1111.2

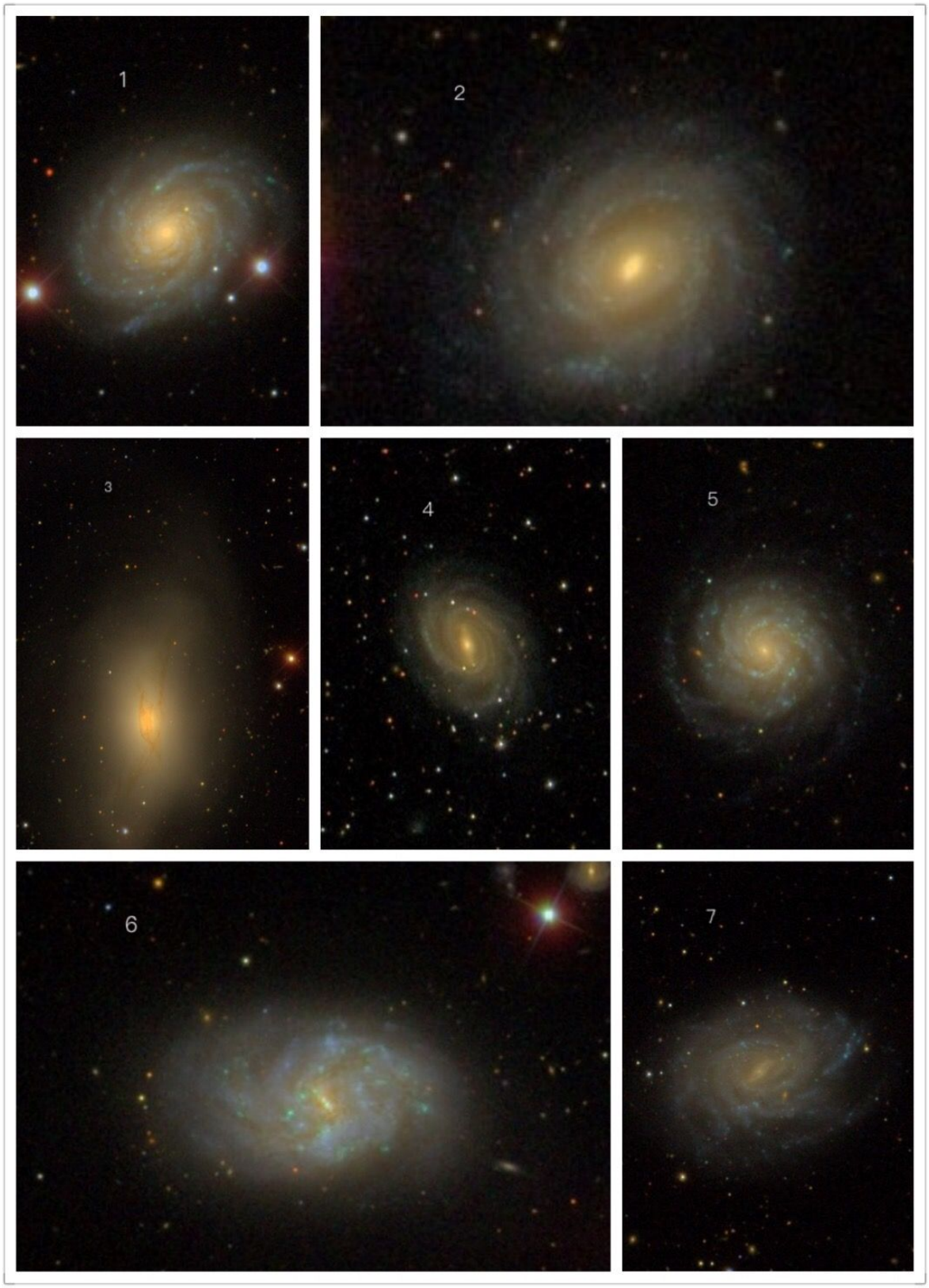


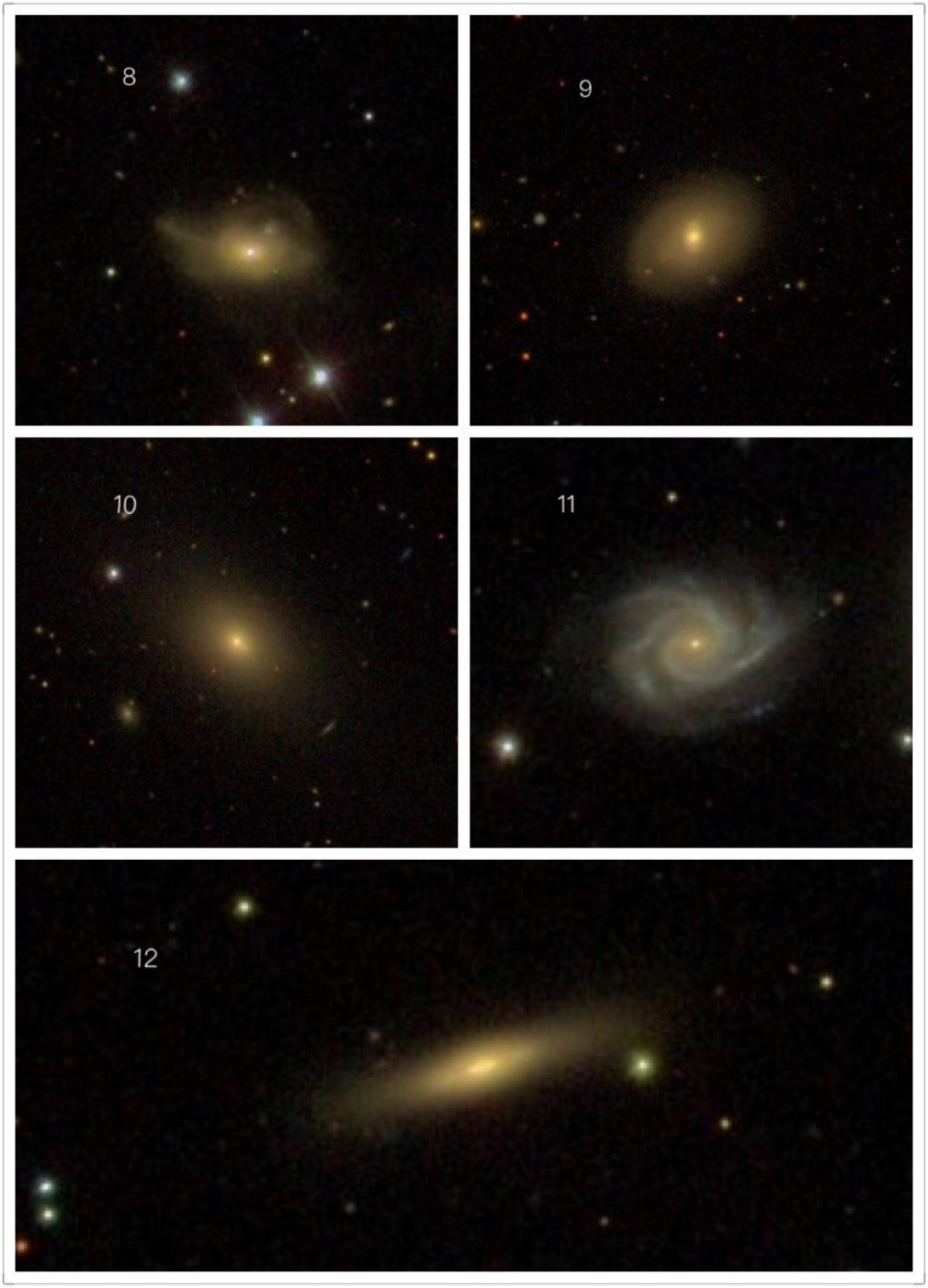


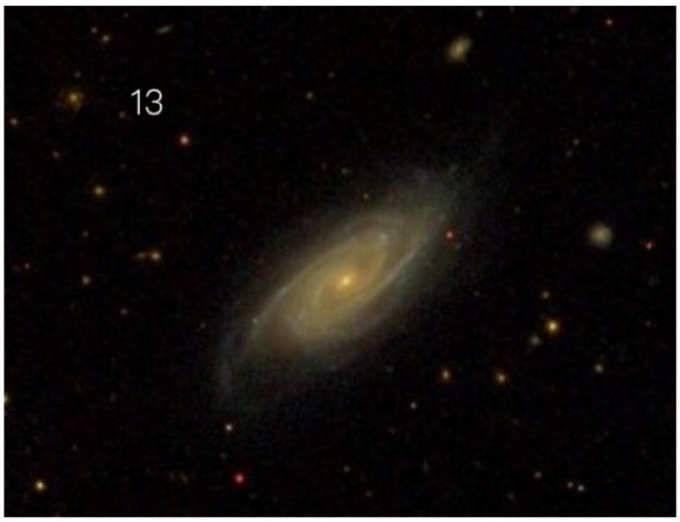
A typical human eye will respond to wavelengths from about 3900-7000 angstrom and we know the light can be decomposed into three colors red, green and blue. So we can create the pseudo-RGB color image with three different energy images respectively correspond to red, green and blue colors.

4. Exploring galaxies in the SDSS

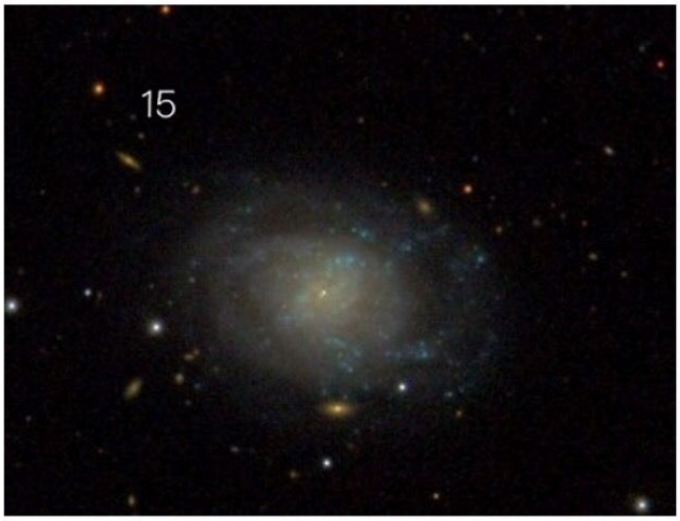
Exercise 1: Look at the following galaxies. Divide them into groups based on features they have in common. There is no set number of groups.

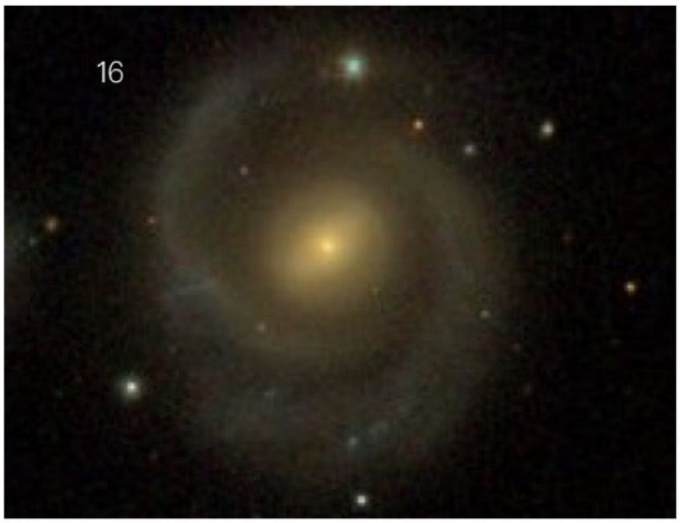

1
2
3
4
5
6
7


8
9
10
11
12


13


14


15


16


17

(For discussion convenience, I cut the images, put them together, gave them symbol numbers and distributed them to my group partners.)

Classification:
Type1 with spiral structure: 1,2,4,5,6,7,11,13,15,16
Type2 elliptical with central bright spot: 9,10,17
Type3 flat:12,14
Type4 others 3,8

Exercise 2: Go back to the galaxies you looked at in Exercise 1, shown again in the table below. Classify them on the Hubble Tuning Fork.

Spirals: 1,2,4,5,6,7,11,13,15,16
Ellipticals: 9,10,12,14(S0?),17
Irregular: 3,8

Exercise 3.

The galaxy I selected are as follow(the .csv file):

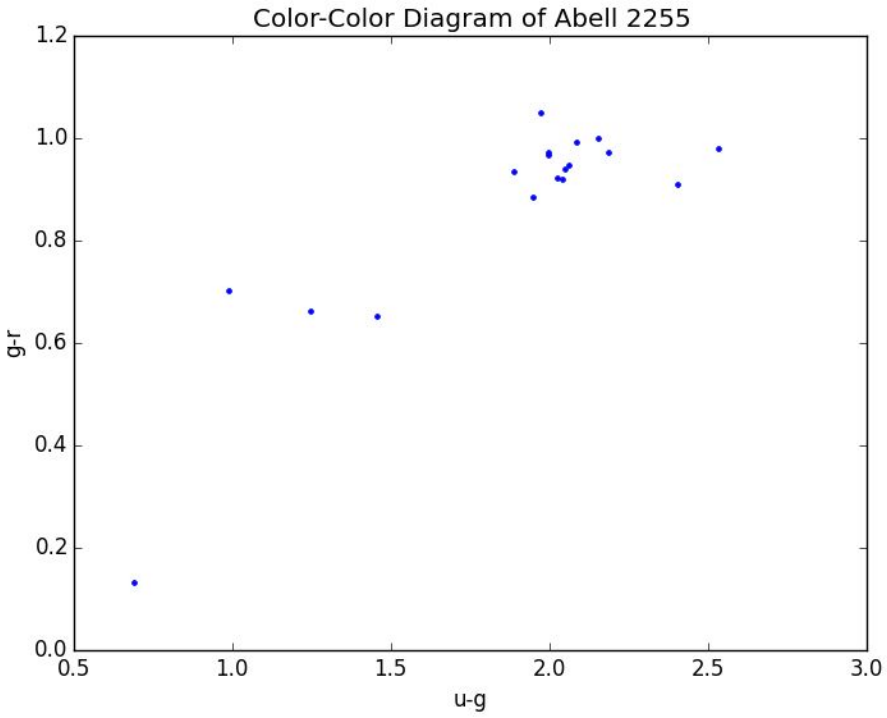
objid,type,ra,dec,u,g,r,i,z,redshift
1237671939804561466,GALAXY,258.14536146992,64.0707039556691,17.96586,15.43528,14.45425,13.74995,13.69962,Null
1237671939804561474,GALAXY,258.067495327645,64.0367718751392,19.88776,17.80275,16.81038,16.36799,16.01531,Null
1237671939804561475,GALAXY,258.213356620306,64.0731695837472,19.24982,17.20155,16.26258,15.75252,15.49401,0.07390616
1237671939804561476,GALAXY,258.119946070518,64.0607482946166,17.35083,14.94665,14.0375,13.56921,13.33719,0.0734653
1237671939804561477,GALAXY,258.10598183411,64.0221140024903,19.61755,17.57909,16.65882,16.26594,15.9918,Null
1237671939804561484,GALAXY,258.181636220846,64.0535395506805,19.60752,17.72213,16.78737,16.35058,16.07873,0.08562605
1237671939804561487,GALAXY,258.080537265349,64.0356334104144,18.81614,16.63012,15.65813,15.25769,15.02383,0.08261043
1237671939804561640,GALAXY,258.258457871243,64.0522970986782,17.98511,15.83024,14.83095,14.39797,14.0908,Null
1237671939804561642,GALAXY,258.24026130708,64.0510324043104,19.98869,18.03933,17.15539,16.76332,16.51385,0.07399645
1237671939804561830,GALAXY,257.991871547624,64.0891510021973,18.8715,16.84598,15.92457,15.48088,15.13799,0.07971801
1237671939804561927,GALAXY,258.135151517819,64.0028043403084,18.50986,16.514,15.54687,15.11602,14.77579,0.08500046
1237671939804561999,GALAXY,258.230950983658,64.032409038412,19.74761,18.29159,17.63881,17.27,17.15743,0.08127932
1237671939804627298,GALAXY,258.335387493843,64.0094516824416,18.47042,17.77927,17.64785,17.43055,17.42111,0.0798867
1237671939804627306,GALAXY,258.340516630173,64.0690707331199,18.71745,16.65773,15.71131,15.28201,14.95813,0.0761909
1237671939804627378,GALAXY,258.391298041976,64.0133828559746,18.49996,16.50575,15.53279,15.13875,14.79913,0.08209191
1237671939804627468,GALAXY,258.463305483247,64.0035185573993,18.23261,16.988,16.32518,15.93572,15.71291,0.08765244
1237671939804627594,GALAXY,258.296719025447,64.015460149115,20.7821,18.80833,17.75825,17.26745,16.84523,Null
1237671939804627716,GALAXY,258.363268143888,64.0035581135116,20.73138,19.74269,19.03925,18.6573,18.42551,Null

I think we need the information of redshift of the galaxy to determine to get the distance and tell whether one galaxy belong to the cluster or not.
D = z*c/H where z redshift, c light speed, H universe constant
If we adopt H = 70 km/s/Mpc then we have D(z=0.08) = 343 Mpc
The nearest galaxy I have in my sample has D(z=0.0734) = 315 Mpc
The farthest galaxy I have in my sample has D(z=0.0876) = 375 Mpc

The distance range(60Mpc) is larger than normal galaxy cluster diameter, which means some of the galaxies may not belong to this cluster.

From the morphology aspect, most the galaxies have a elliptical shape and their apparent size differ a lot.

Exercise 4: Make a color-color diagram for the galaxies you saved in Exercise 3. You can make the diagram in Excel. Put u-g on the x-axis and g-r on the y-axis. Do you notice any patterns?



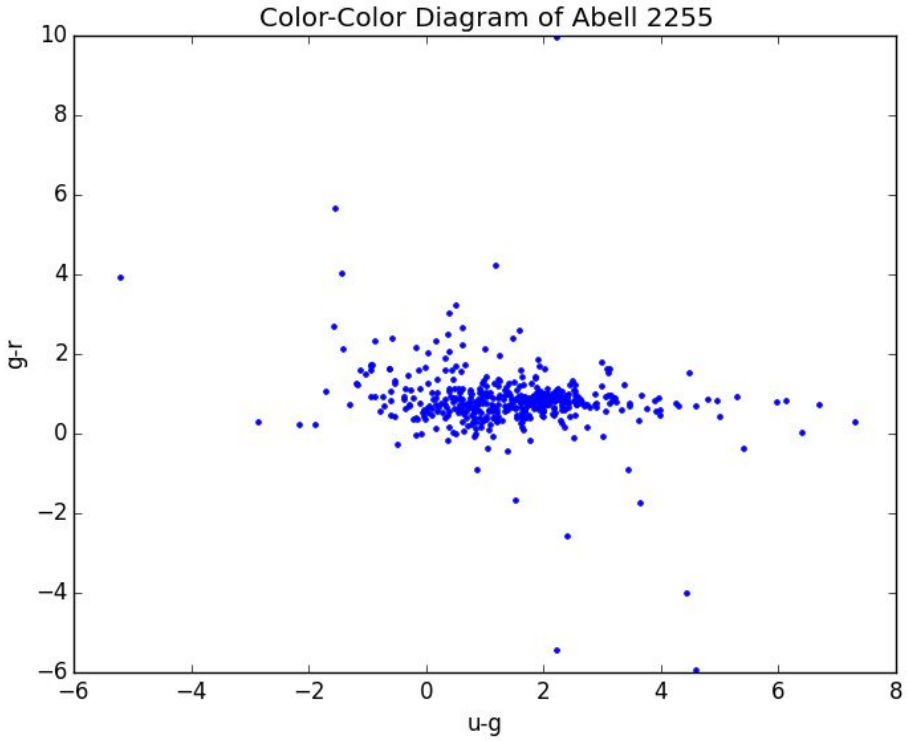
A possible pattern is noticed. There may be two preferred zones that galaxies tend to locate, up right and low left. But the galaxy number is far away small to draw any conclusion.

Exercise 5: Use the data you collected to make a color-color diagram of Abell 2255 with u-g on the x-axis and g-r on the y-axis.

Question 4

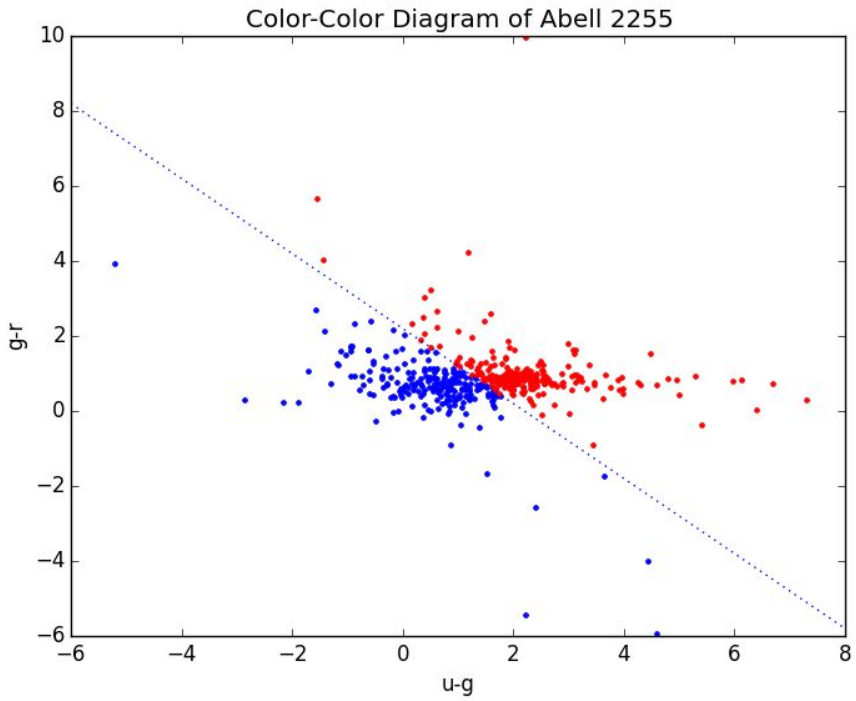
blue galaxies have smaller u-g and g-r, correspond to the low left part

Red galaxies have bigger u-g and g-r value, correspond to the up right part.



Question 5

Early galaxies have redder color, so the up right part corresponds to early galaxies. Late galaxies have bluer color, so the low left part corresponds to late galaxies.



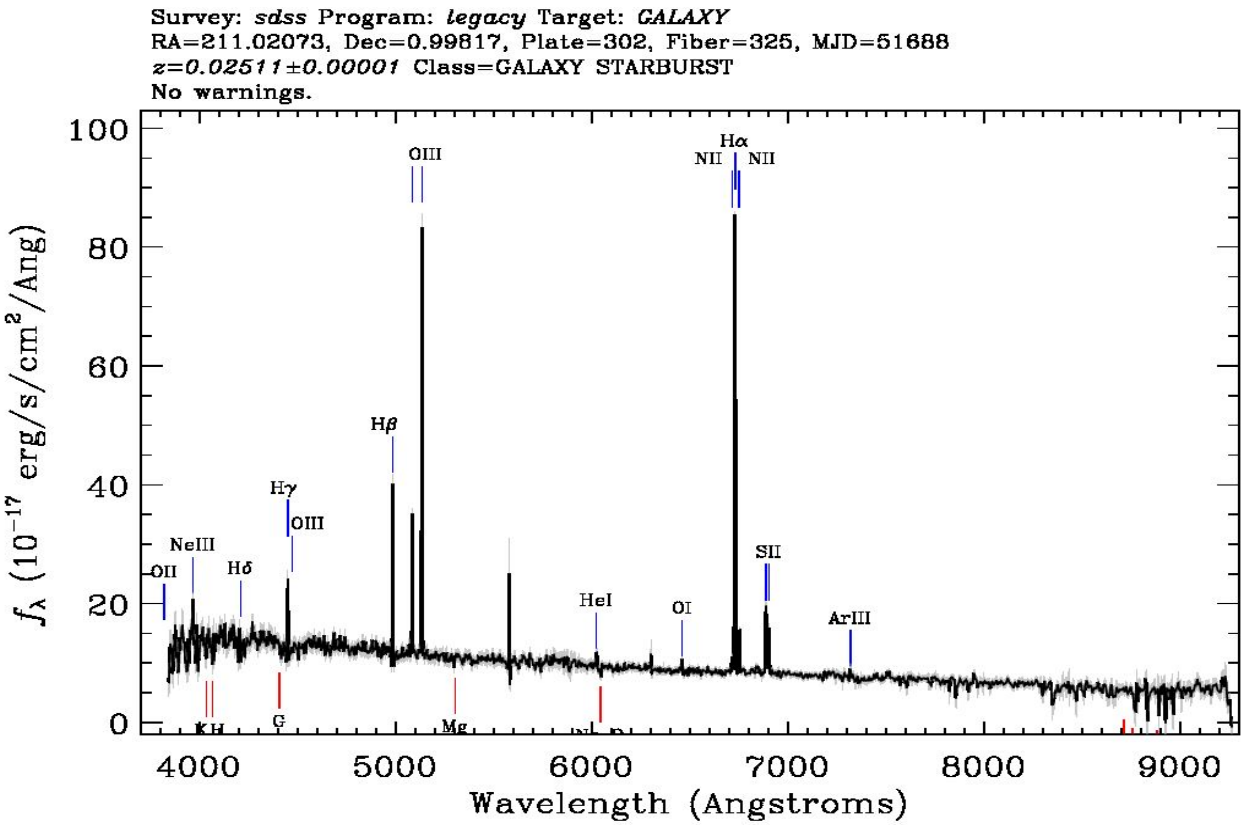
Question 6

In my sample of Abell 2255, the number of all galaxies is 480, in which contain 216 late galaxies and 264 early galaxies. There are much more early galaxies in Abell 2255 galaxy cluster. Galaxy cluster Abell 2255 is not a good representative of the universe as a whole.

Exercise 7: Below is a table of galaxies. Look up each galaxy using the Object Explorer. When you click on a galaxy's Object ID, the Object Explorer for this galaxy will open in a new window.

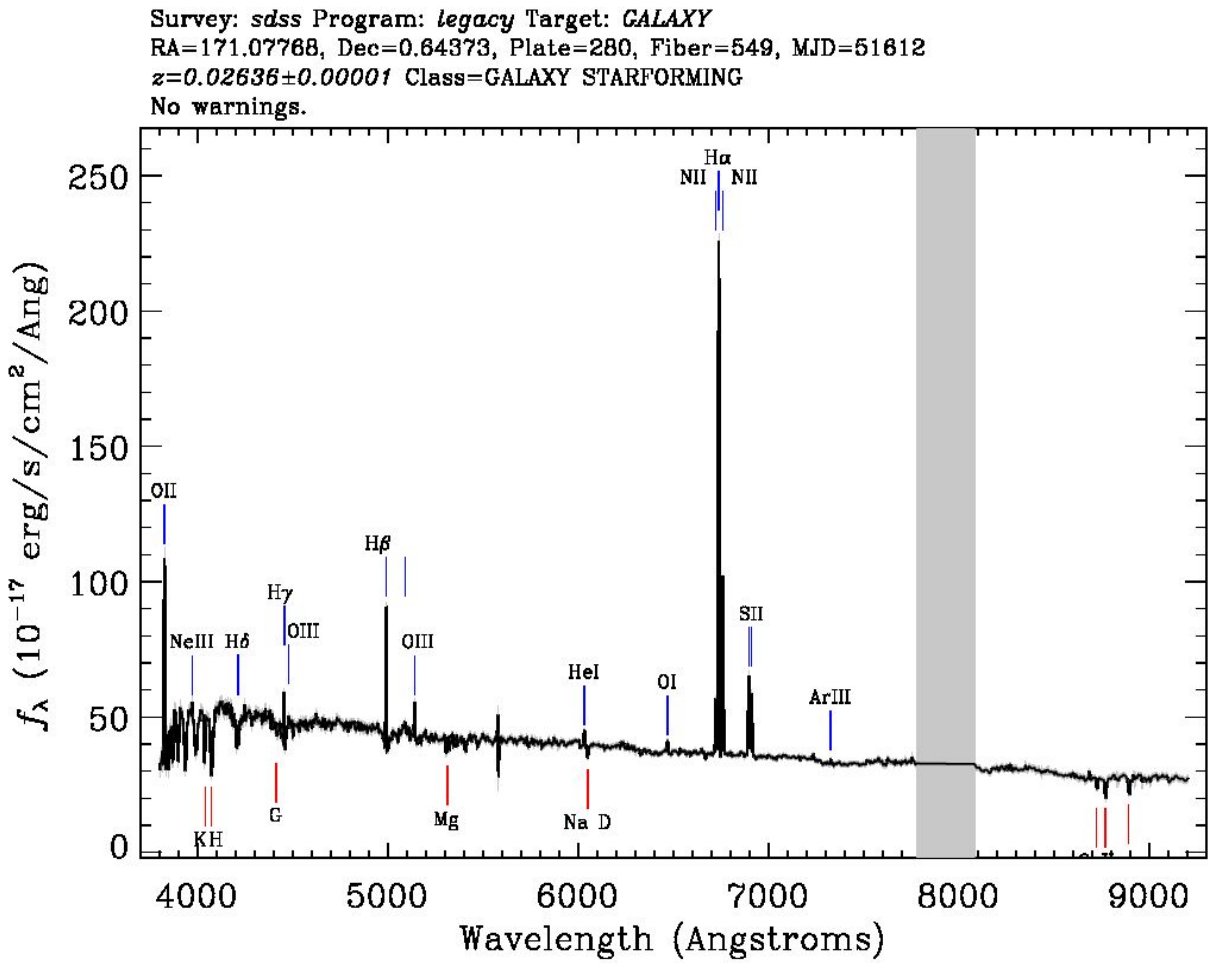
Examine the picture of the galaxy and classify it on the Hubble Tuning fork. Then scroll down and click on the galaxy's spectrum. Study its spectrum - pay close attention to its pattern of spectral lines. As you examine the galaxies, think about how to answer questions 7 through 10.

(Each spectrum is followed by the questions 7-9 corresponds to the galaxy)



Spec1 [1237674603215257765]

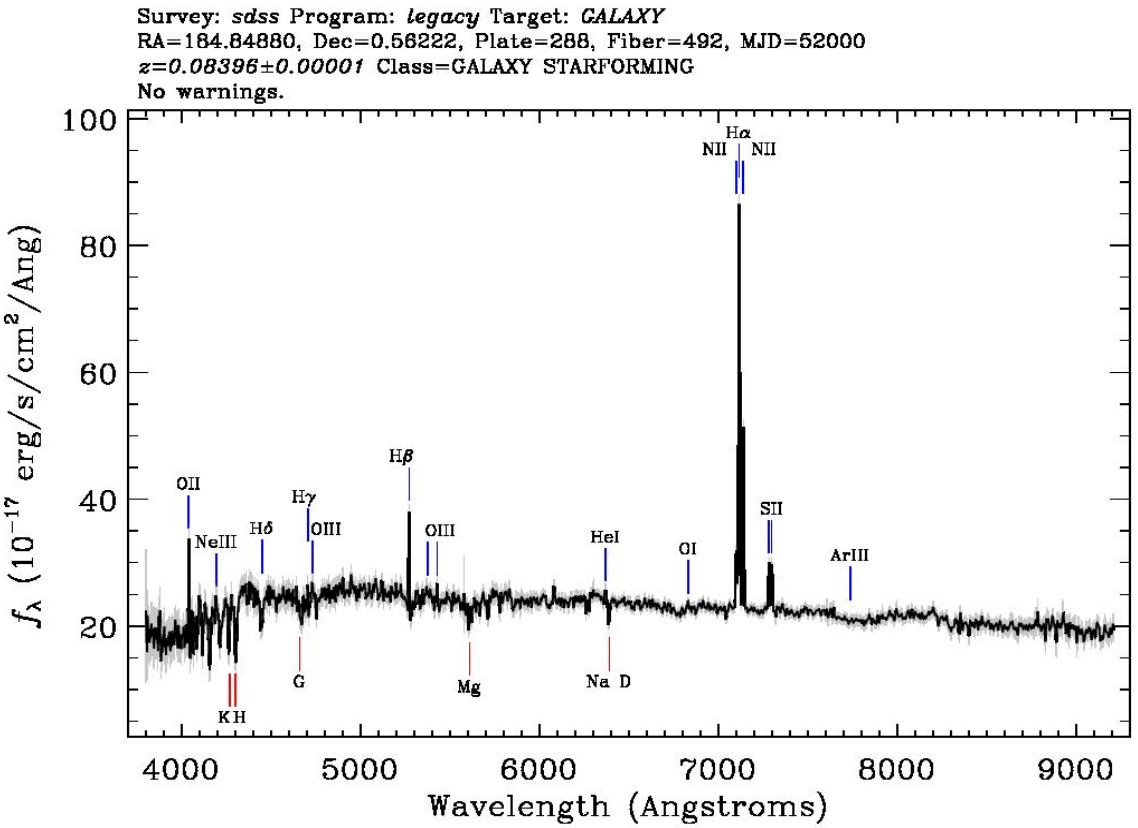
u-r = 17.34 - 15.95 = 1.39 blue starburst galaxy late type galaxy
Strong lines: emission line, Hydrogen balmer series, [OIII], [NII], [SII]



Spec2_1237648722300567644

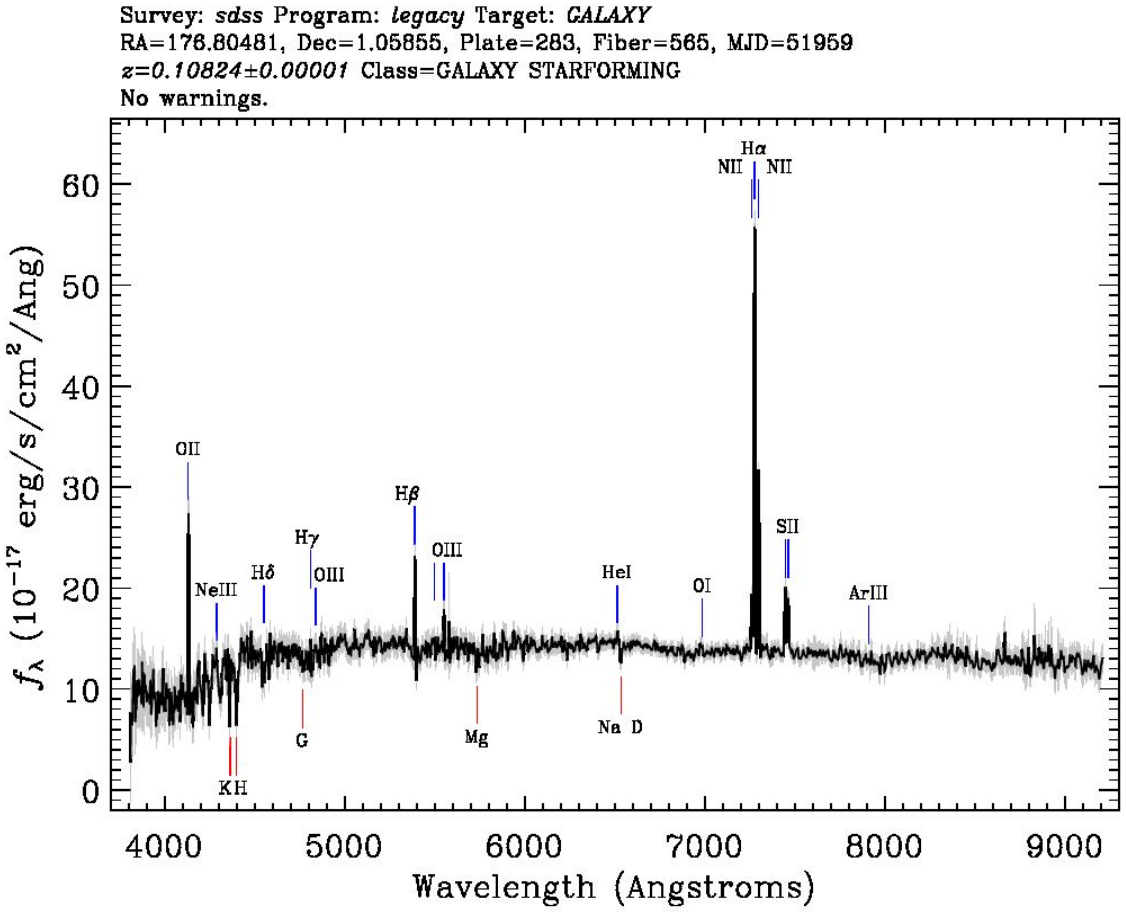
u-r = 15.96-14.40 = 1.56 blue, starforming galaxy, late type galaxy
Strong lines: emission line, Hydrogen balmer series, [OIII], [NII],

[SII],[OII]



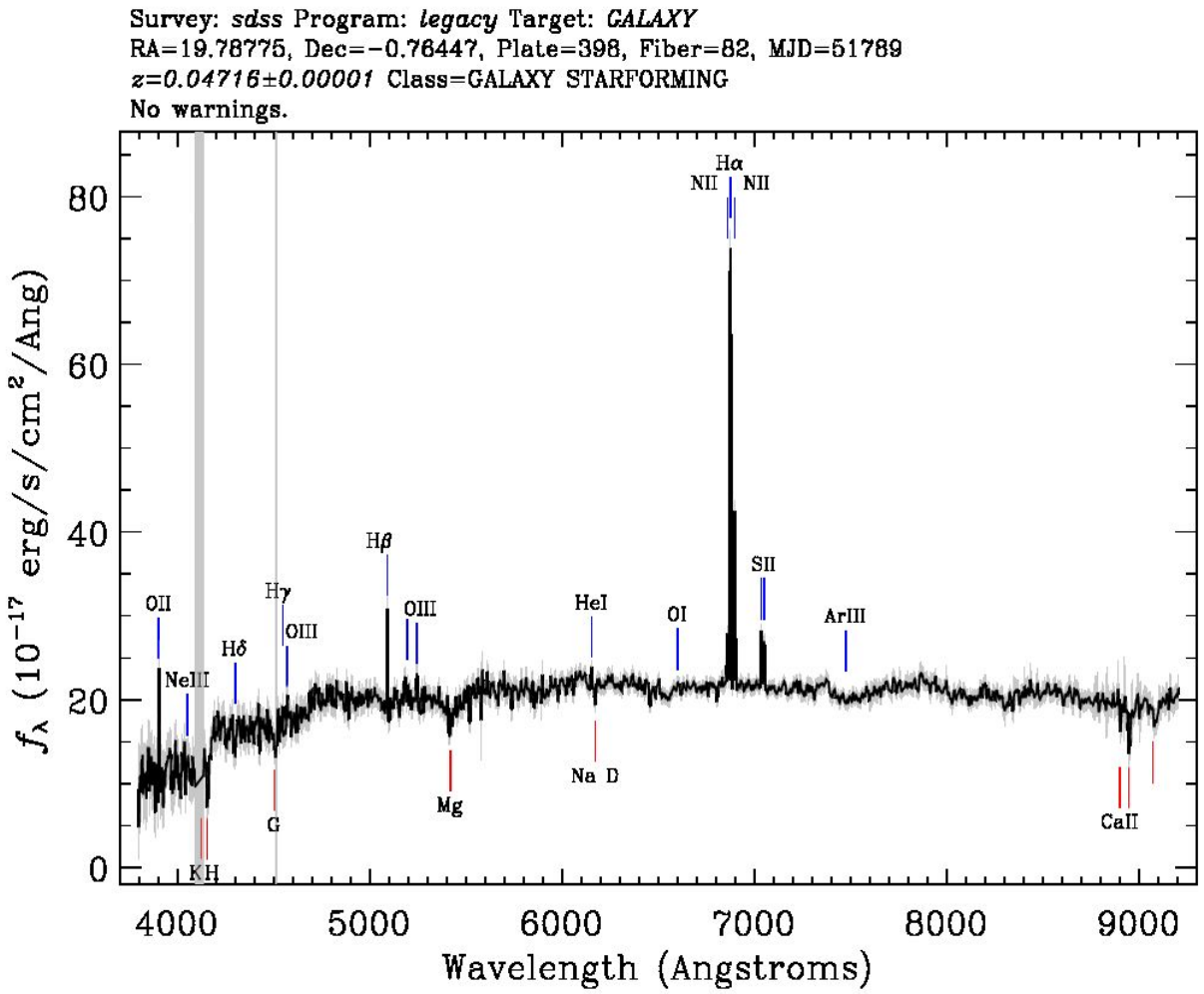
Spec [1237648705114603547]

u-r = 18.15-16.48 =1.67 blue, but not so blue, starforming galaxy, late type
Strong lines: emission line, Hydrogen balmer series,[NII], [SII],[OII]



Spec4 1237671128589336718

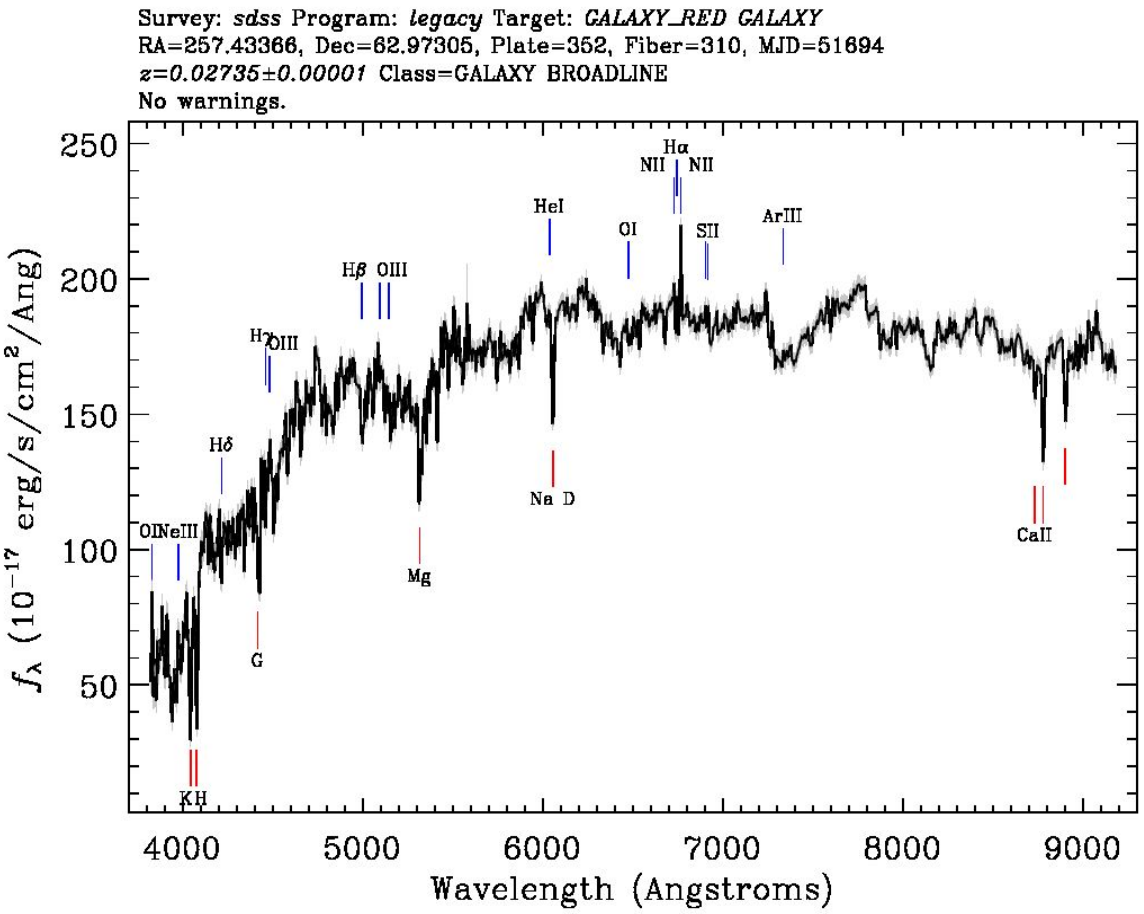
u-r = 19.11-17.38 =1.73 blue, but not so blue, starforming galaxy, late type
Strong lines: emission line, Hydrogen balmer series, [NII], [OII], [SII]



1237663783132332199

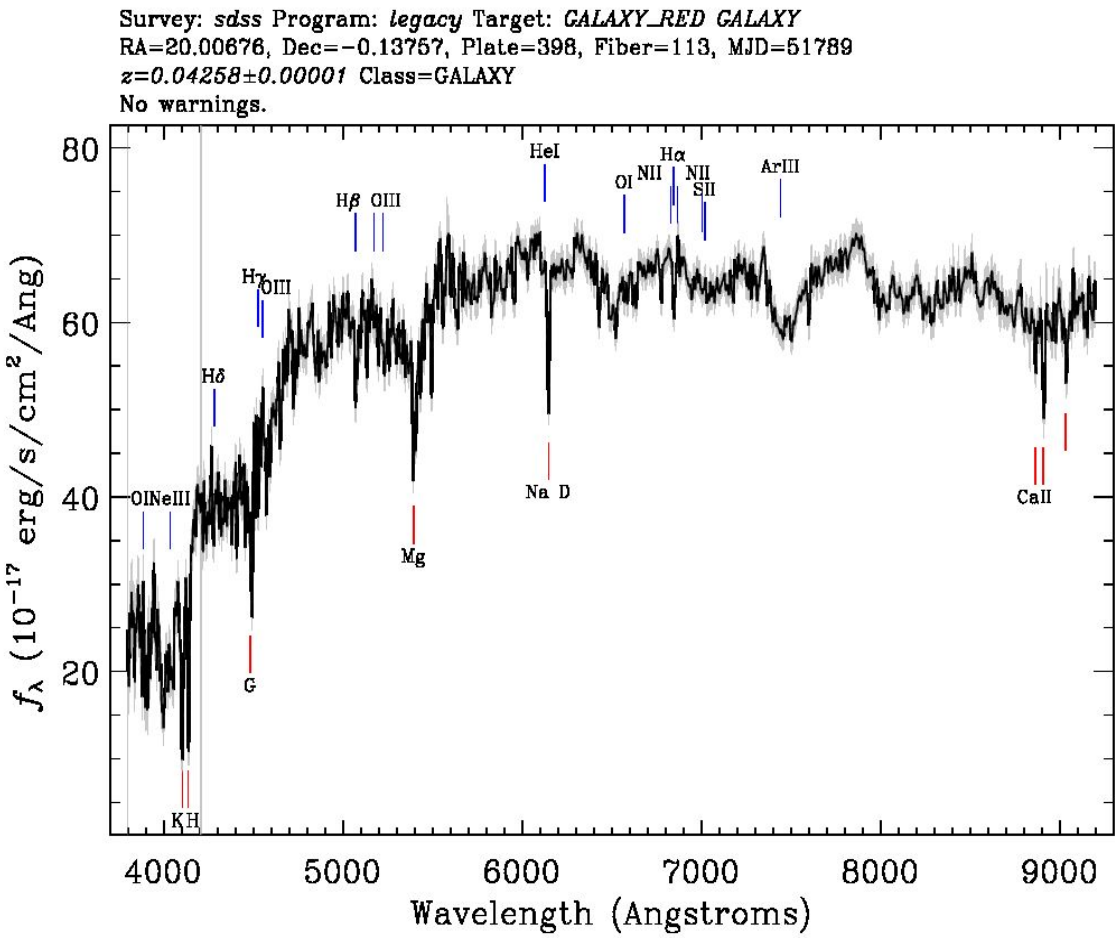
u-r = 18.47-16.28 = 2.19 blue/red, starforming galaxy, late type

Strong lines: emission line, Hydrogen balmer series,[NII],[OII],[SII]



1237671766931734590

u-r = 15.62-13.12 = 2.5 red, broad line galaxy, early type
Strong line: absorption line, Ca H K, Mag, Na D, Ca II triplet

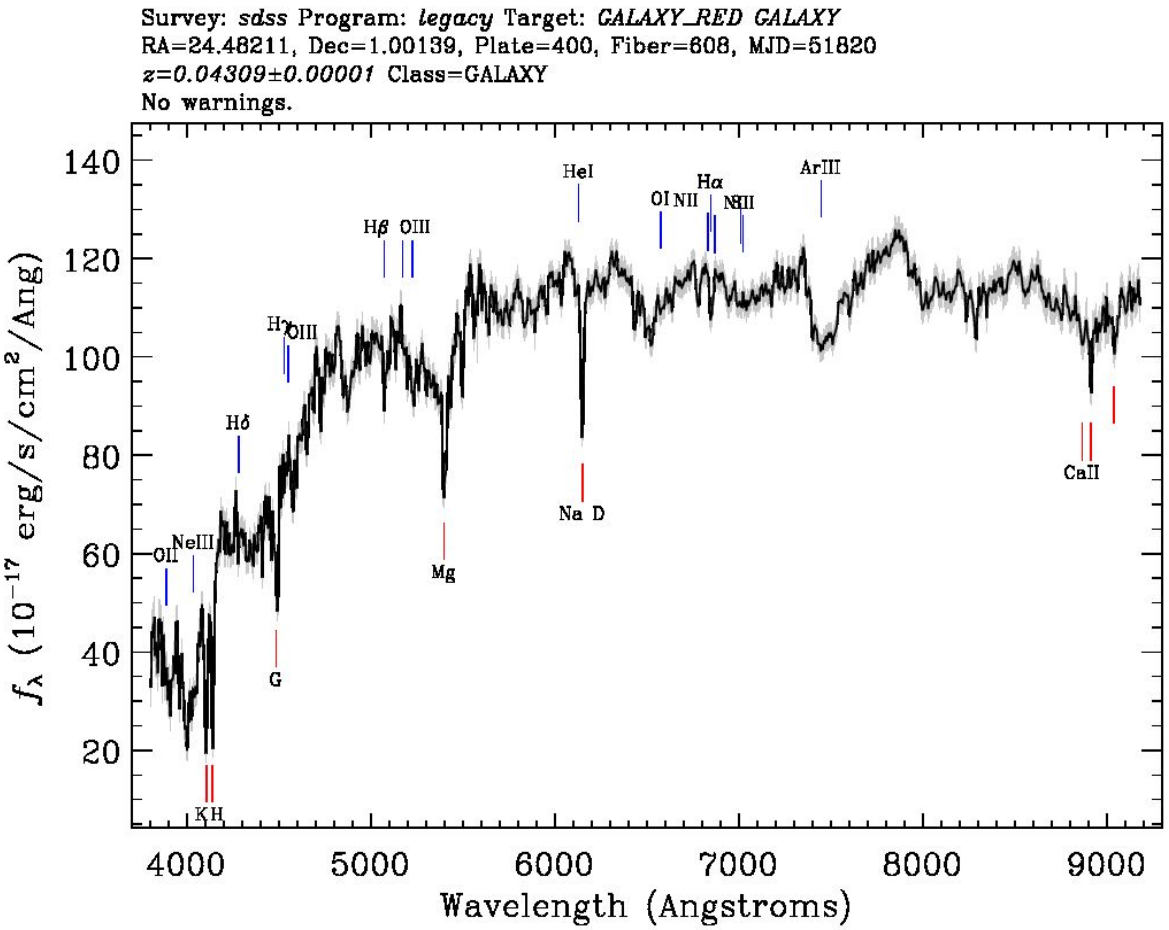


1237666339190472822

u-r = 18.23-15.38 = 2.85 red, late type galaxy

Strong line: absorption line, Ca H K, Mag, Na D, Ca II triplet, Ar III.

(strong but not very strong H_alpha, H_beta)

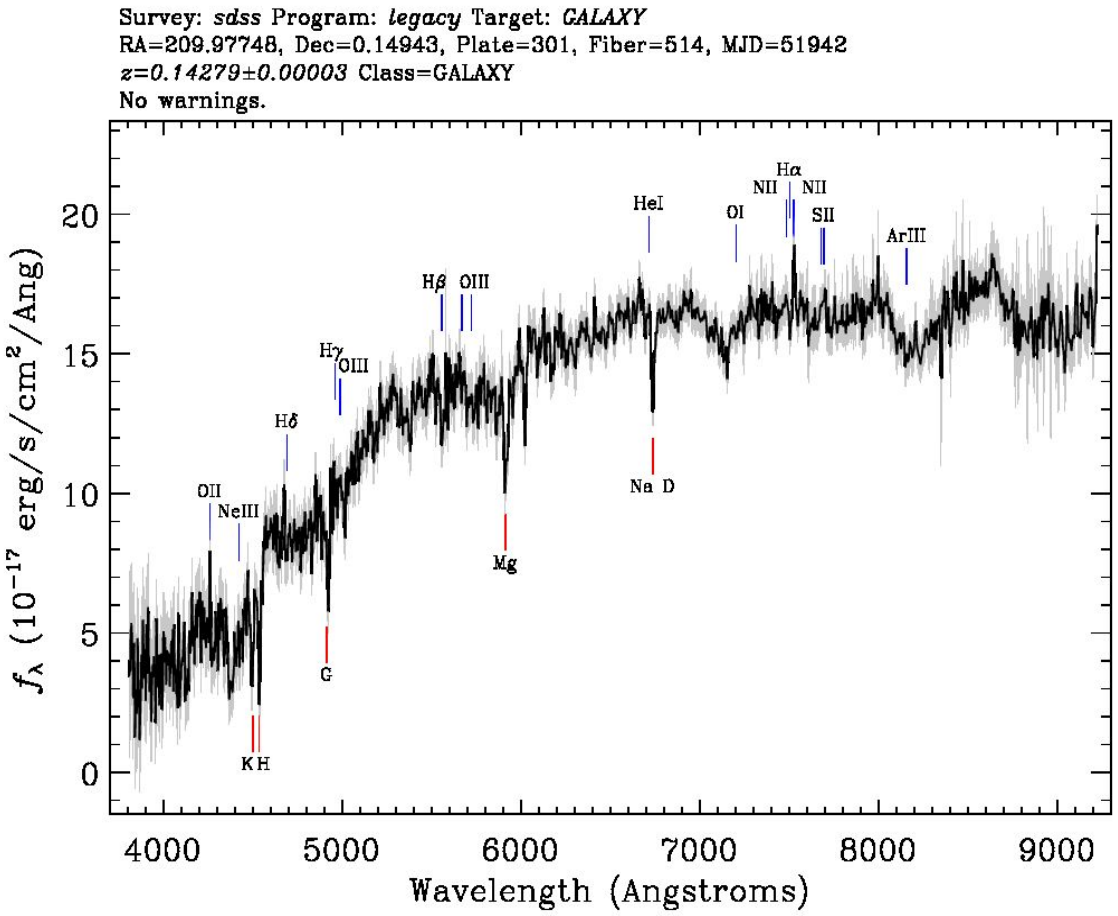


[1237663785281847338]

u-r = 16.92-14.07 = 2.85 red, early type

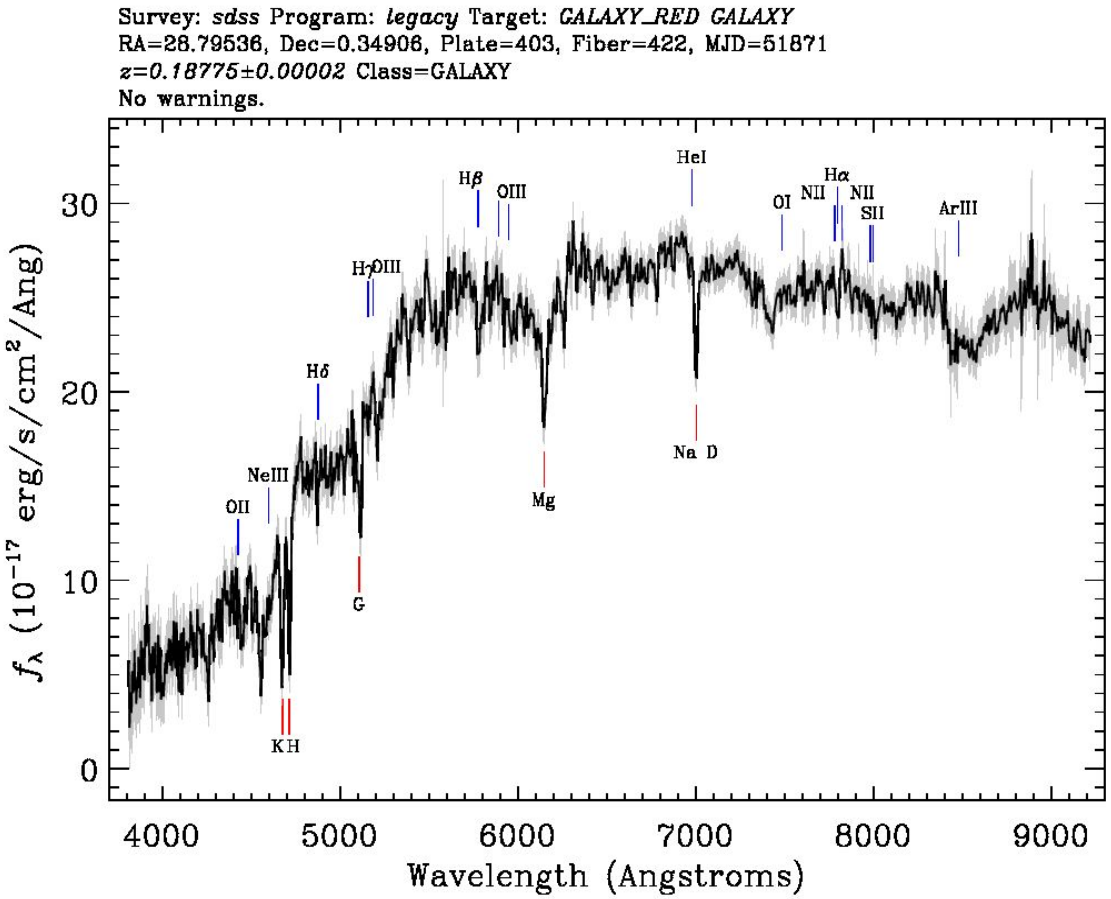
Strong line: absorption line, OII, Ne III, Ca H K, G, Mag, Na D, Ar III, Ca II triplet.

(strong but not very strong H_alpha, H_beta)



1237648704588742865

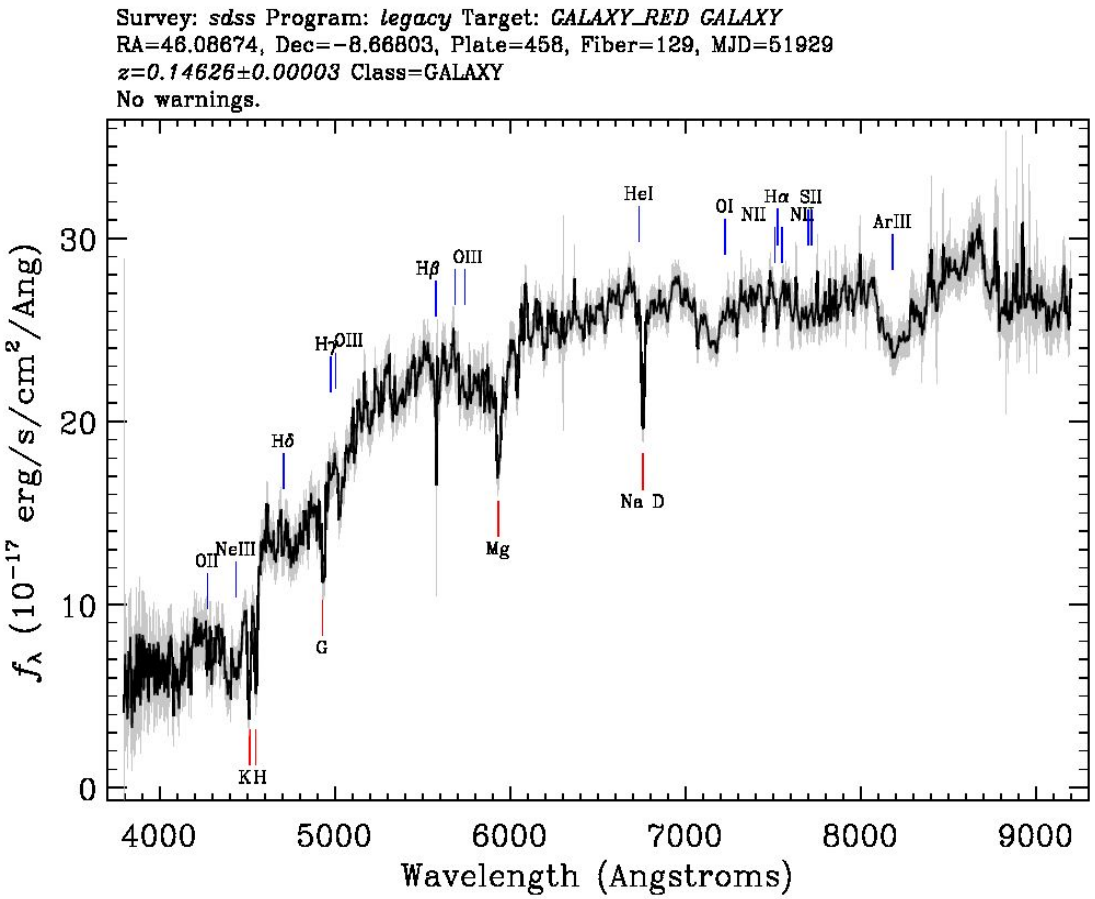
u-r = 20.25 -17.14 = 3.11 red, early type
Strong line: absorption line,Ne III, Ca H K, G, Mag, Na D, Ar III.



1237657071159738538

u-r = 20.15-16.72= 3.43 red, early type

Strong line: absorption line,Ne III, Ca H K, G, Mag, Na D, Ar III.



1237652899157377141

u-r = 19.16-15.59 = 3.57 red, early type
Strong line: absorption line,Ne III, Ca H K, G, H_beta, Mag, Na D, Ar III.

Question 10
The relationship:
Bule - emission line - late type galaxy (starforming or starburst galaxies)

Red - absorption line - early type galaxy