Testing Galaxy model fits for the COSMOS data

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Abstract

1 Comparison

In this section, we will compare the relevant fields that are present in the GIM2D data file and the fits made by Claire. Since the galaxies that Claire worked with is a subset of the GIM2D dataset, we need to match the values using the IDENTIFIER of each galaxy.

Consistency check

To verify if we have got the matching right, we first plot the RA and DEC values of all the galaxies that are common to both. And as expected, we get a perfect straight line since these are independent of the fit.

B/T

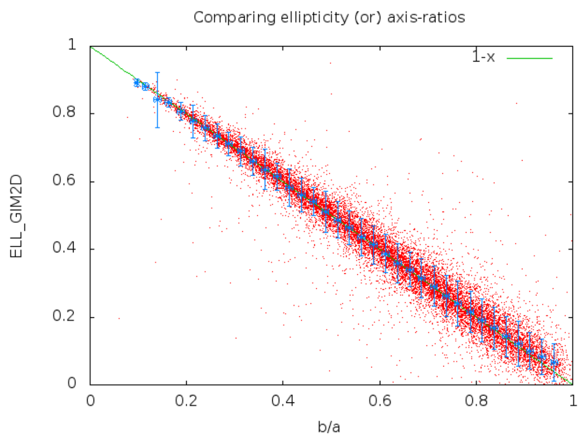
For the purposes of studying morphology, B/T ratio is important. The *Bulge-to-Total ratio* B/T is defined as the ratio of bulge flux to the total flux (bulge flux + disk flux).

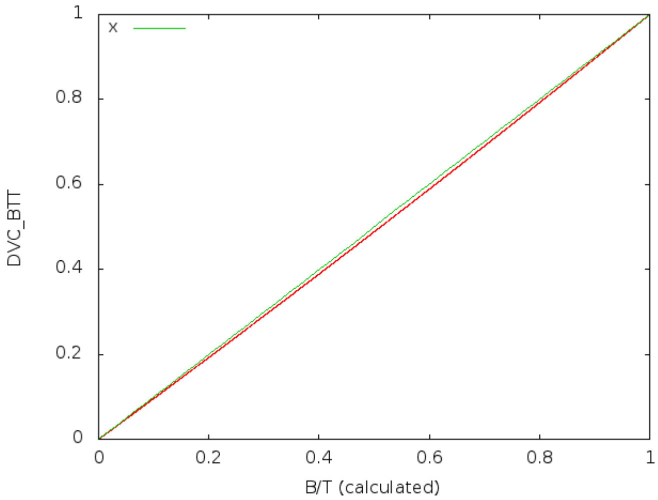
One can see that the values do not match exactly. The reason that Claire states is: *That's as good a match as I would expect. I used models cutoff at 8 (4) Reff for bulges (disks). So, the* DVC_BTT *values will be slightly different from what you compute, and smaller is certainly the right sense, since more bulge flux is missing than disk flux. If you want to be sure that's the problem, multiply the disk flux by 0.980 and the bulge flux by 0.937. These factors are corrections needed for the truncated profiles I used.*

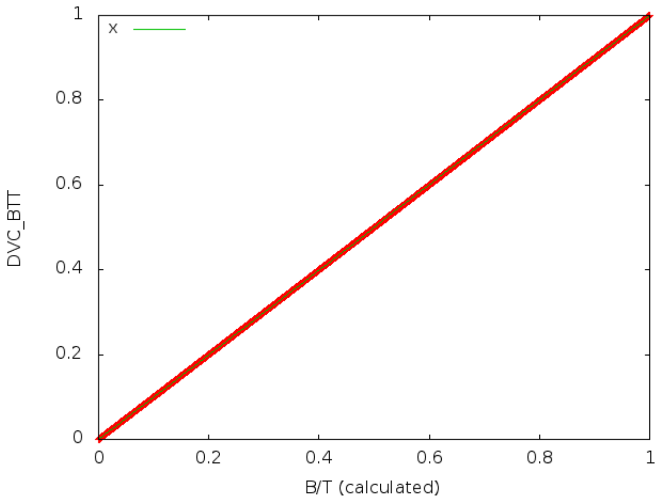
Making these changes, we see that we get a perfect straight line.

Another ratio that we plotted is b/a (semi minor to semi major axis) against ELL_GIM2D field.

$$ELL\_GIM2D = 1 - b/a$$

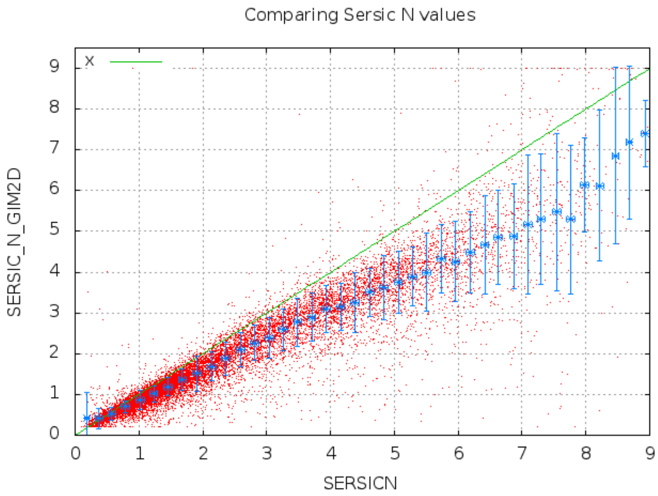






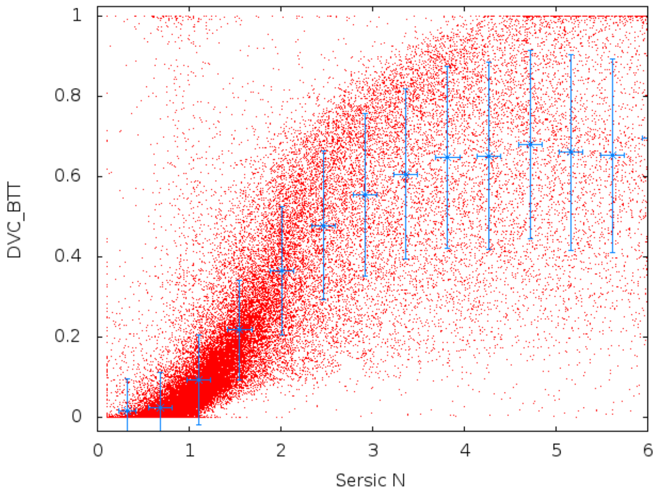
Sersic N

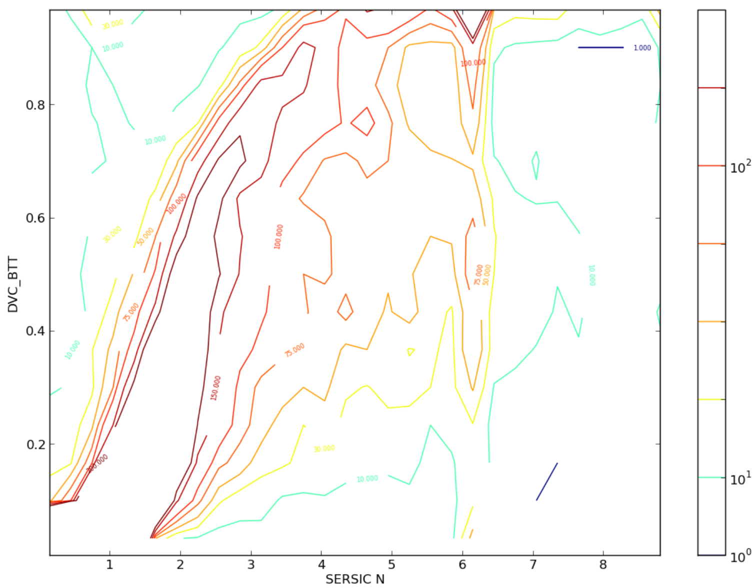
This is the first field in which Claire's fit values differ significantly from that of GIM2D. We observe that the scatter increases as the Sersic N values increase. The reason behind that is there are various ways to fit the bulge and the disk curves to the profile. This extra freedom causes ambiguity in the Sersic N values.



2 Relation between different quantities

Both B/T ratio and $SersicN$ quantify the profile of the galaxy and hence we expect these fields to exhibit a strong correlation. A scatter plot & a contour plot of these quantities are given below





We observe a strong correlation between the luminosity of a galaxy and its half-light radius (HLR).

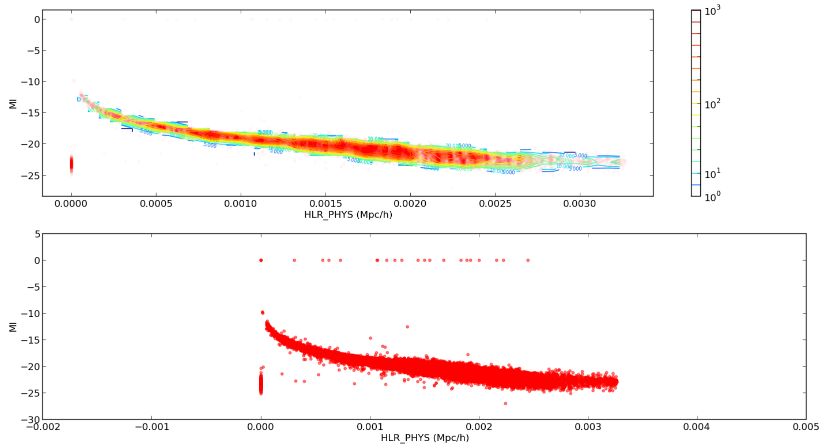
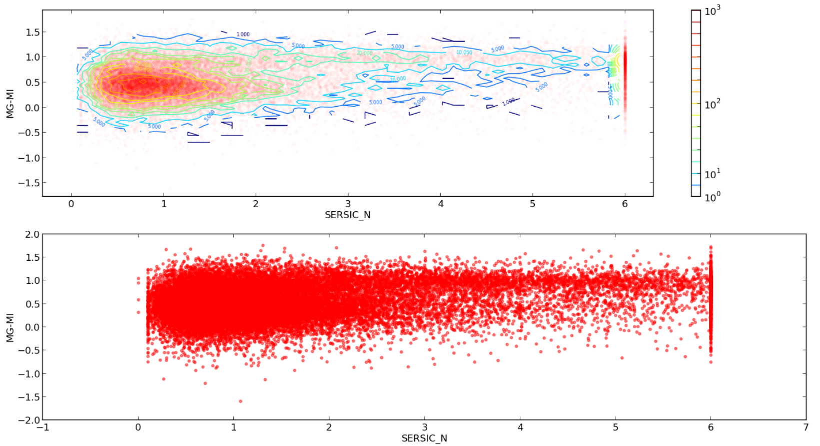
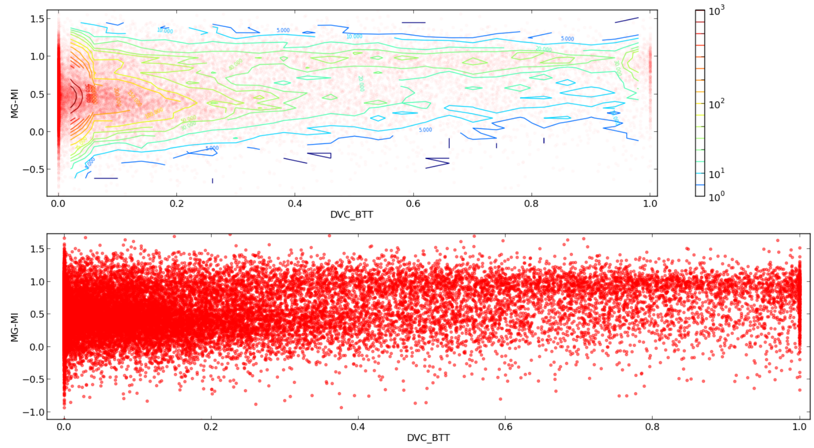


Figure 1: We see that the scatter is very minimal demonstrating that the correlation is strong. The colors are normalized in a logarithmic scale.

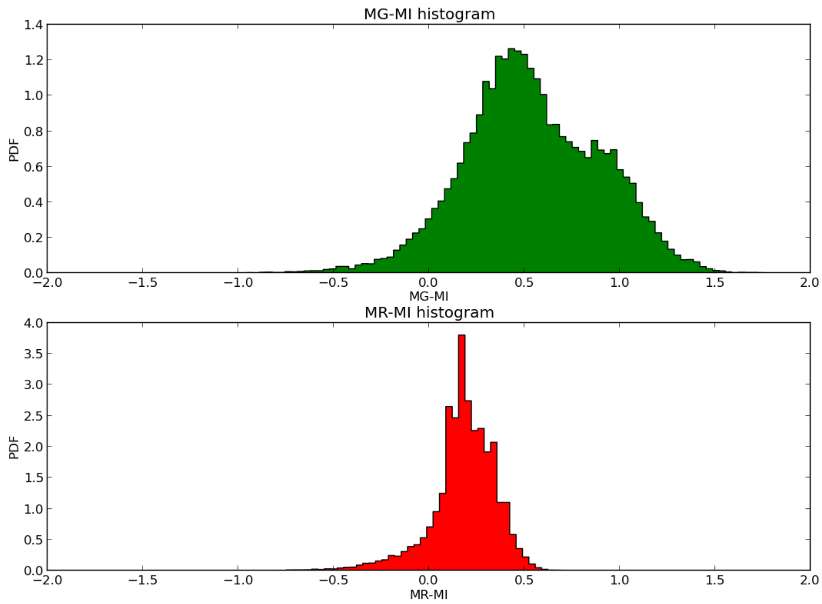
For our purposes, we are interested in seeing how colors of the galaxies depend on the shape. Thus, we make a plot of $MG - MI$ against Sersic N and the bulge-to-total ratio. One can observe that most of the galaxies are present in the lower range of Sersic N and DVC_BTT values and that there is a clustering around $MG - MI = 0.5$



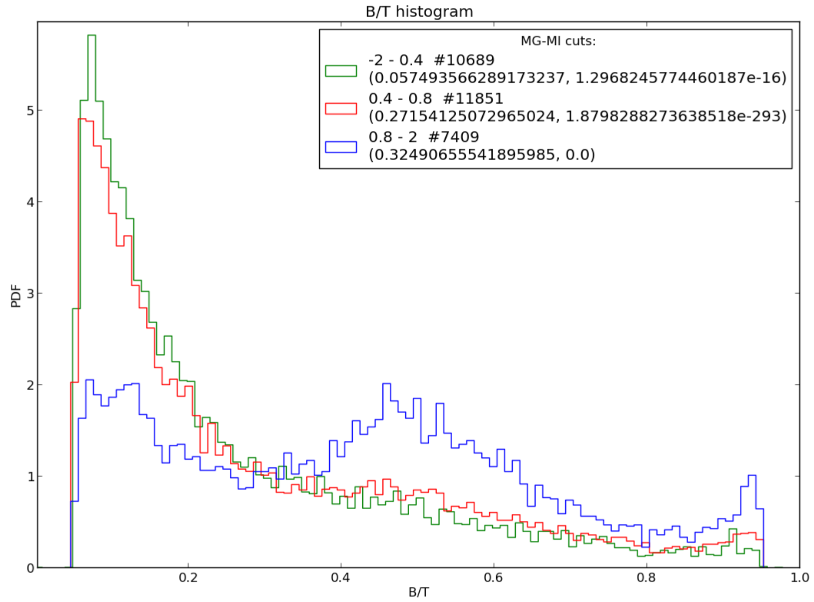


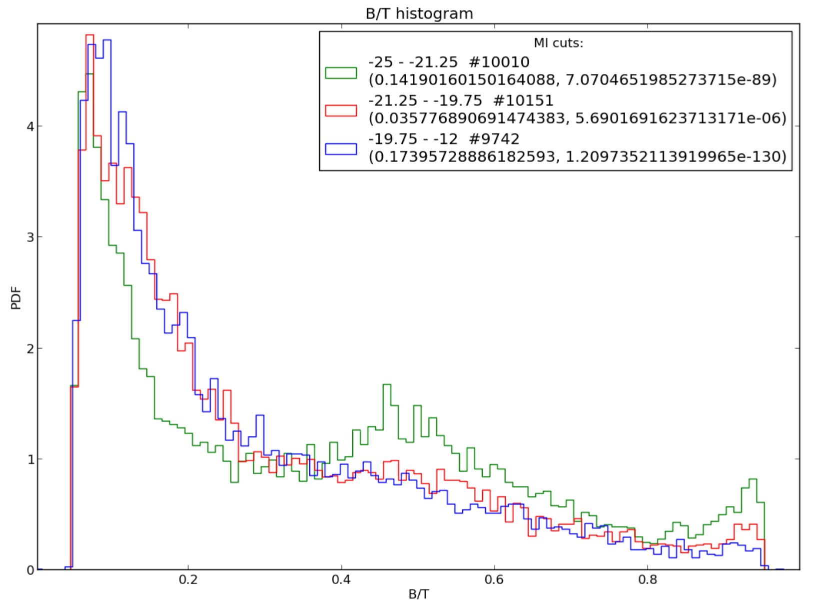
3 Distributions

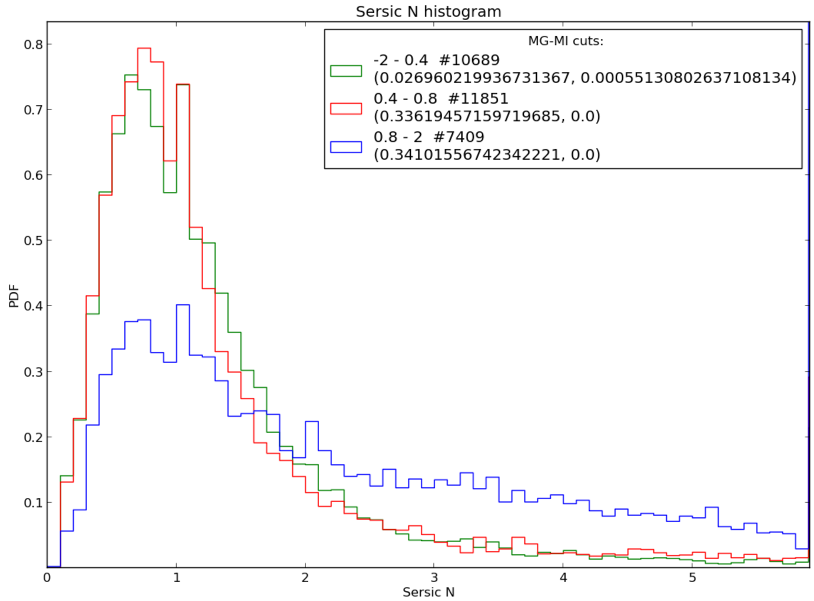
For the colors $(MG-MI)$ and $(MR-MI)$, we see that the former has more support than the later. This makes it easy to work with $MG-MI$ more than $MR-MI$.

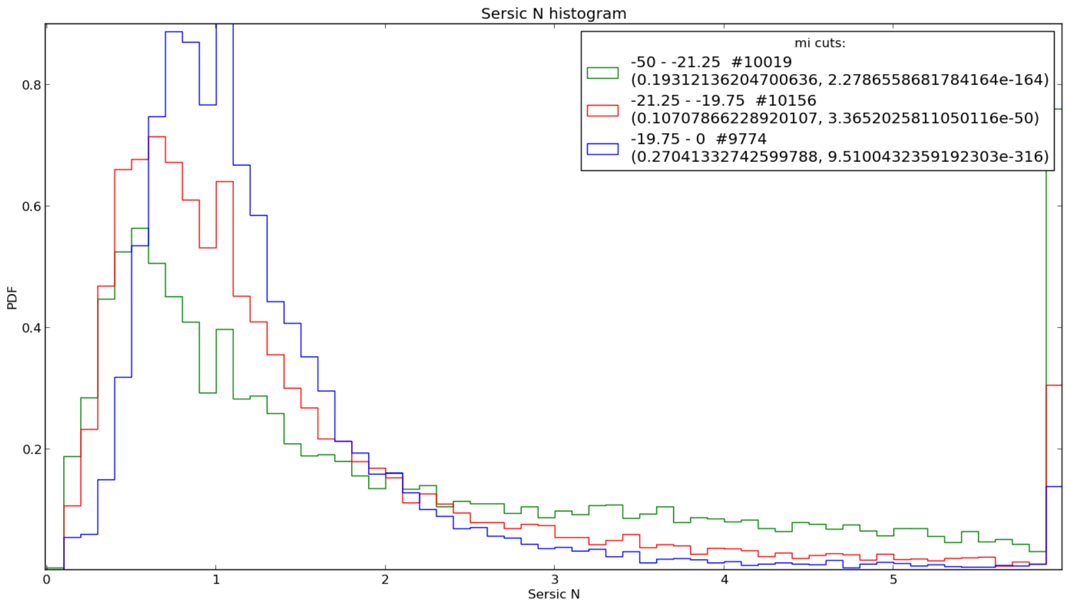


Based on the color and luminosity, we see how the distribution of the different quantities vary. Below, we plot the distributions of B/T ratios and $SersicN$ values. Note that all of these have the same apparent magnitude cut imposed.


B/T histogram
MG-MI cuts:
-2 - 0.4 #10689
(0.057493566289173237, 1.2968245774460187e-16)
0.4 - 0.8 #11851
(0.27154125072965024, 1.8798288273638518e-293)
0.8 - 2 #7409
(0.32490655541895985, 0.0)
PDF
B/T

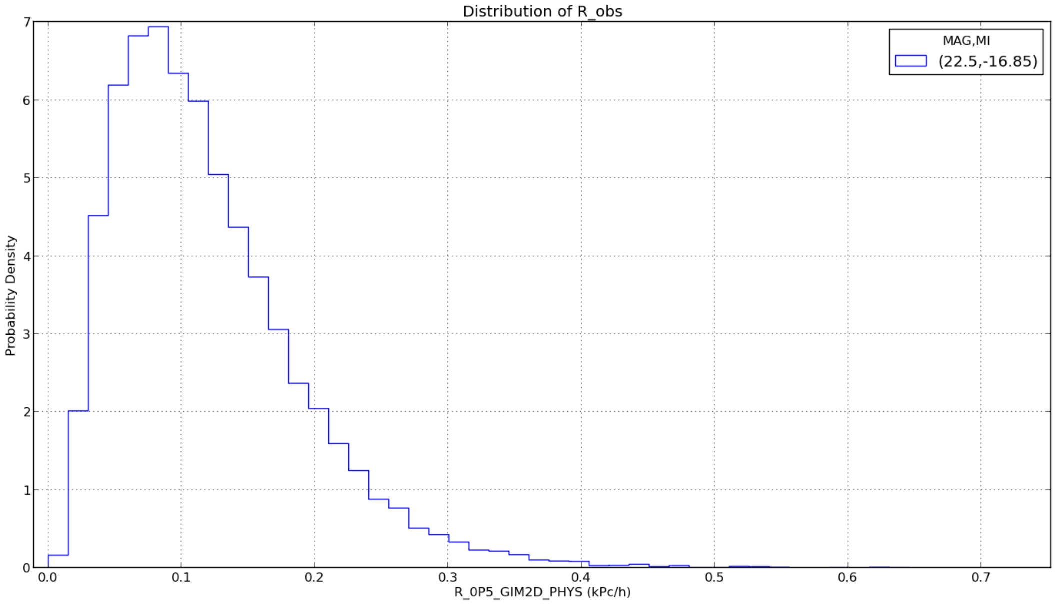

B/T histogram
MI cuts:
-25 - -21.25 #10010
(0.14190160150164088, 7.0704651985273715e-89)
-21.25 - -19.75 #10151
(0.035776890691474383, 5.6901691623713171e-06)
-19.75 - -12 #9742
(0.17395728886182593, 1.2097352113919965e-130)
PDF
B/T



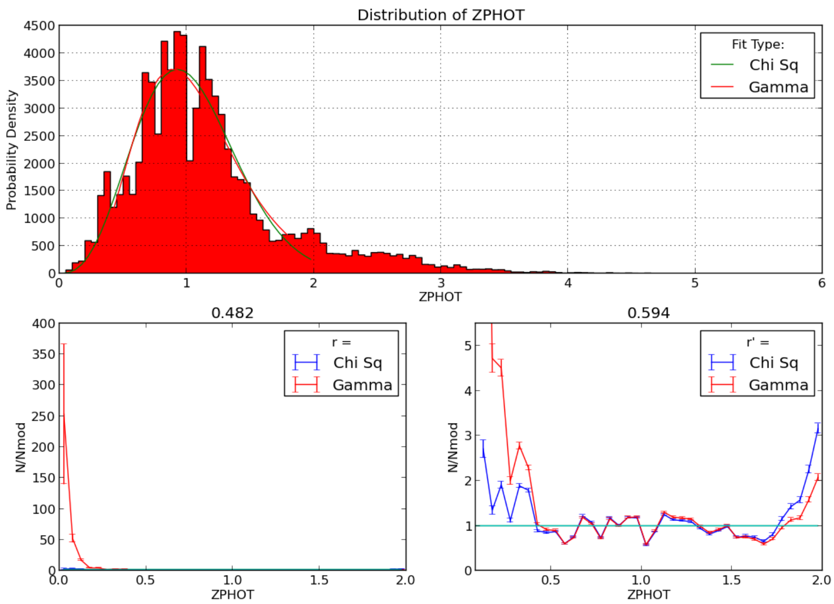


The numbers in paranthesis in the key are the outputs of KS tests. The comparison is made between the curve above it and the curve below it (in a cyclic combination).

The graph below is the distribution of the physical radius of galaxies in units of $kPch^{-1}$ with the magnitude and MI cut mentioned in the legend.

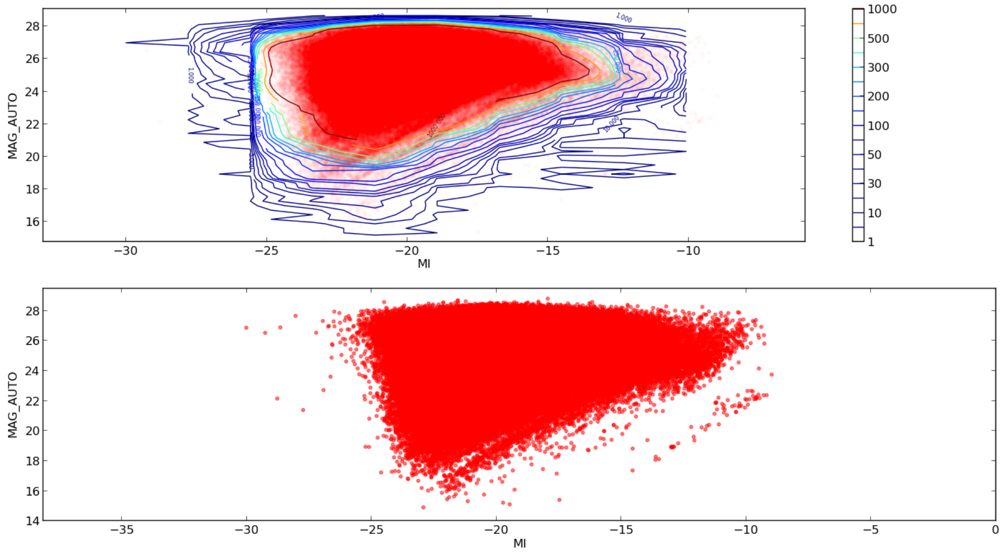


We plot a histogram of photometric redshifts ($ZPHOT$). For z values in the range 0 to 2, we fit Chi Square and Gamma curves. The ratio between the actual value and the value obtained from the curves is used to decide which regions are overdense and which are underdense.

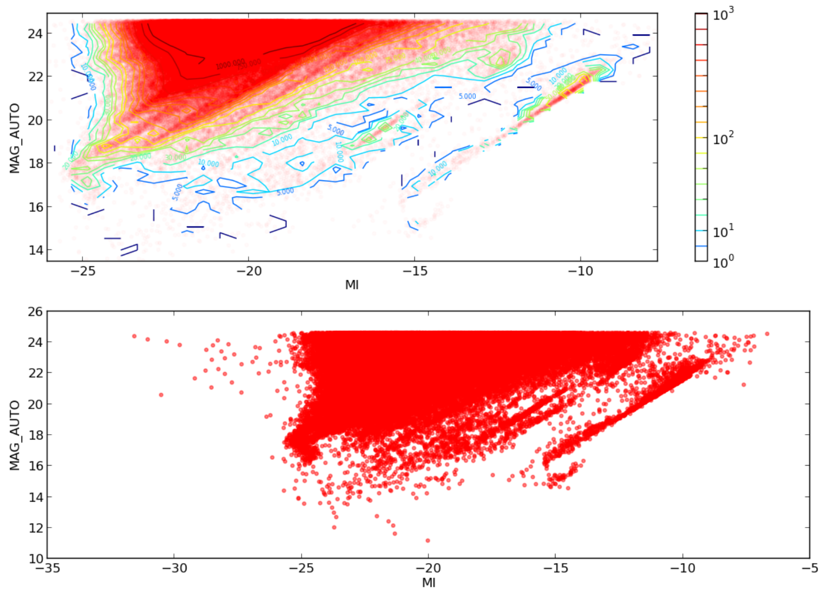


In the mid ranges of z, both the curves agree with each other and close to 0 and 2, the fits aren't good and disagree with each other.

Occasionally, we'd like to volume-limit our sample i.e. impose cuts on absolute magnitude and apparent magnitude to avoid any 'selection effects' in our analysis. This is done based on the following plot:



A zoomed in version of the same plot:

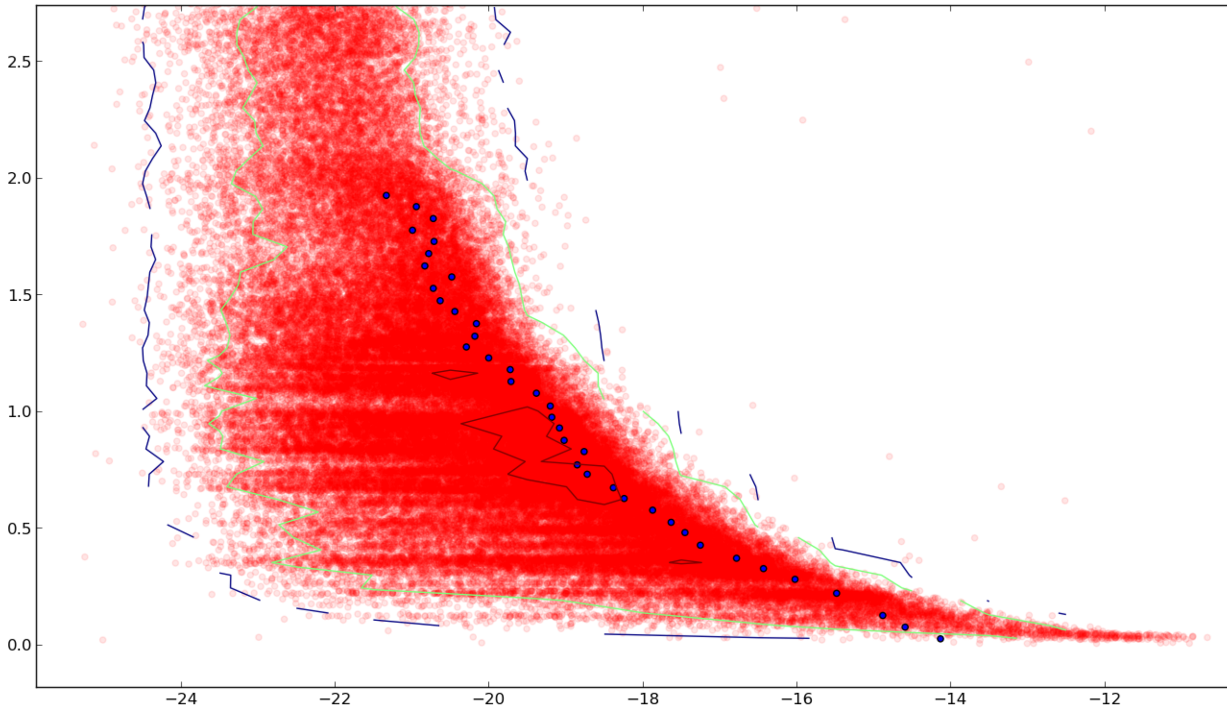


The MI-MAG_AUTO cut dependency is such that we do not include the triangular part of the scatter plot.

3.1 M_I cuts

z-bin	M_I cut	Galaxies
0.05 - 0.1	-14.13	651
0.1 - 0.15	-14.59	1132
0.15 - 0.2	-14.88	1310
0.2 - 0.25	-15.48	2214
0.25 - 0.3	-16.02	1716
0.3 - 0.35	-16.43	3040
0.35 - 0.4	-16.78	3599
0.4 - 0.45	-17.25	2366
0.45 - 0.5	-17.45	2641
0.5 - 0.55	-17.63	2336
0.55 - 0.6	-17.87	2231
0.6 - 0.65	-18.24	2887
0.65 - 0.7	-18.38	3527
0.7 - 0.75	-18.72	3386
0.75 - 0.8	-18.85	2952
0.8 - 0.85	-18.76	3692
0.85 - 0.9	-19.02	3196
0.9 - 0.95	-19.08	3184
0.95 - 1.0	-19.18	3518
1.0 - 1.05	-19.2	1746
1.05 - 1.1	-19.38	2174
1.1 - 1.15	-19.71	2877
1.15 - 1.2	-19.72	2488
1.2 - 1.25	-20.00	2055
1.25 - 1.3	-20.29	1888
1.3 - 1.35	-20.18	1643
1.35 - 1.4	-20.16	1378
1.4 - 1.45	-20.44	1360
1.45 - 1.5	-20.63	1306
1.5 - 1.55	-20.72	1080
1.55 - 1.6	-20.48	1078
1.6 - 1.65	-20.83	903
1.65 - 1.7	-20.78	774
1.7 - 1.75	-20.71	726
1.75 - 1.8	-20.99	800
1.8 - 1.85	-20.72	801
1.85 - 1.9	-20.94	722
1.9 - 1.95	-21.33	747

These points are shown are a $M_I - z$ plot **to be changed**



3.2 Fit failures

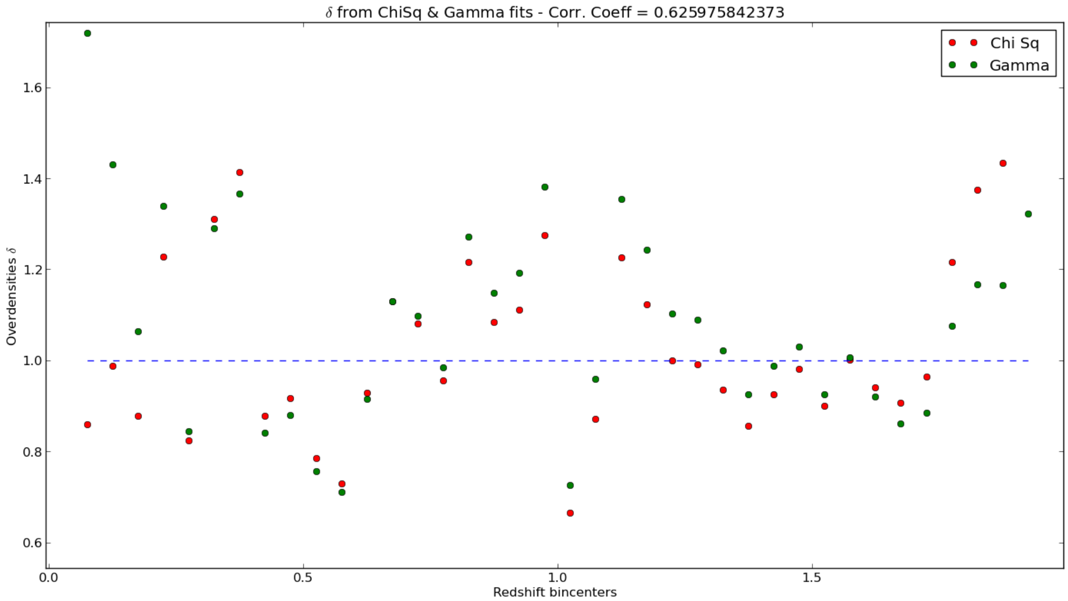
The field $MPFIT\_STATUS$ gives some idea about the fits. For each galaxy, there are 5 values in the $MPFIT\_STATUS$ array, one for each profile

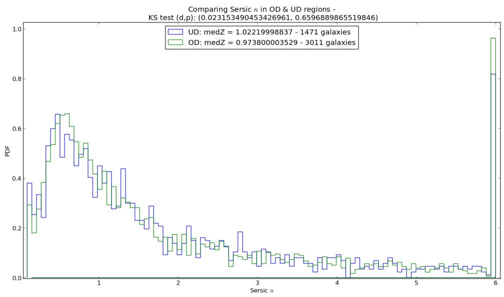
0. $BULGEFIT$
1. $DISKFIT$
2. $DVCFIT$
3. $EXPFIT$
4. $SERSICFIT$

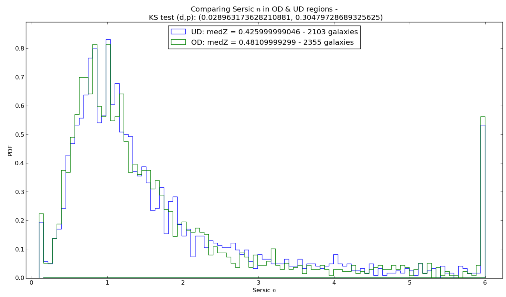
$MPFIT\_STATUS = 0, 5$ are failures. The other values tells us about which convergence criterion was matched, but they are all successes. If all the values of the fit are -1, that's also a failure. Claire Lackner knows more details.

3.3 Overdense & Underdense regions

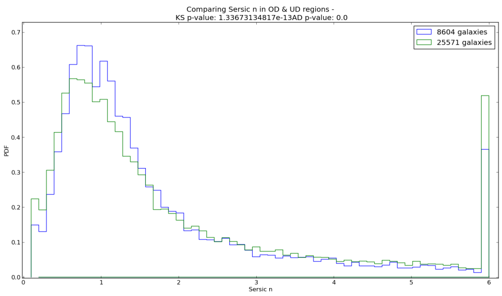
We categorize the galaxies into two - those that live in overdense regions and those that live in underdense regions. To make the distinction clear, we only categorize those regions where $\delta < 0.9$ as underdense and those with $\delta > 1.1$ as overdense.

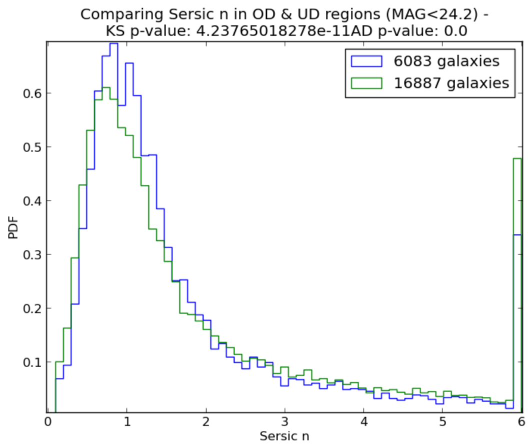






Taking particular overdense and underdense bins are not very illuminating. We compare in a plot all the overdense galaxies with all the underdense galaxies.


Comparing Sersic n in OD & UD regions -
KS p-value: 1.33673134817e-13AD p-value: 0.0
8604 galaxies
25571 galaxies
PDF
Sersic n


Comparing Sersic n in OD & UD regions (MAG<24.2) -
KS p-value: 4.23765018278e-11AD p-value: 0.0
6083 galaxies
16887 galaxies
PDF
Sersic n