Galaxy Colors In The NDWFS

National Optical Astronomy Observatory Deep Wide-Field Survey

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Galaxy found using SE-xtractor © Robert Mutel 2018

Objectives

- Find the 10 brightest objects in the K-band
- Find the 10 brightest objects in the R-band
- Find the magnitudes and R-K colors for each
- Determine what the objects are (galaxy, star, etc..)
- Produce a histogram of the # of galaxies VS. magnitude and determine any patterns that exist
- Produce a plot of R-K colors VS. K-band magnitude and determine any patterns that exist

K-band

- K-Band is a part of the optical and infrared spectrum which is near infrared, and lies between 2.0 - 2.4 micrometers in wavelength.
- K-Band is detected in major optical telescopes as well as most dedicated infrared telescopes.
- The magnitudes of the K-Bands which we detected ranged from -13 to -8.

K-Band Image results after -CHECKIMAGE_TYPE OBJECTS

R-Band

- The R-Band is in the near infrared spectrum.
- The wavelength in R-Band range from 0.65 micrometers to 1.0 micrometers and can be seen with all major optical telescopes.
- The magnitudes of the R-Band which we detected ranged from -19 to -16.

R-Band Image results after -CHECKIMAGE_TYPE OBJECTS

Methodology

- Initially removed artifacts from the image by increasing the detection threshold enough to remove unnecessary objects in the images (Both K-Band & R-Band).
- Created three catalogs, each of which served their own purpose in locating the 10 brightest K-Band sources and then locating each of those objects in the R-Band image.
- Upon locating the respective R-Band source, we took down its x and y coordinates, and then manually found its magnitude in the testr.cat catalog.
- This same methodology was used in finding the 10 brightest R-Band sources.

Methodology (Expanded)

- In terminal, ran the following commands...
  - $ sex NDWFSJ1428p3346_K_01_sci.fits -CHECKIMAGE_TYPE OBJECTS
  - $ sex NDWFSJ1428p3346_R_03_sci.fits -CHECKIMAGE_TYPE OBJECTS
- Then created three catalogs to work from...
  - 1. test.cat = catalog containing x-coordinate, y-coordinate, and magnitude value as parameters of K-band img.
  - 2. test2.cat = catalog containing only the magnitude of the K-band img.
  - 3. testr.cat = catalog containing x-coordinate, y-coordinate, and magnitude value as parameters of R-band img.
- Opened ds9 and then loaded both images (K-band & R-band) in separate frames.
- Upon selecting the frame that the K-Band image is in...
  - Manually went into the test2.cat catalog and used Search>Find... to locate the largest magnitude (negative).
  - Upon finding that magnitude, then went into the test.cat catalog and located that specific magnitudes x and y coordinates using its line number from the test2.cat catalog.
  - Located the coordinates in the K-Band image and then using Frame>Match>Frame>WCS located that specific location in the R-Band image.
  - Took down its x and y coordinates, and then using the testr.cat catalog, searched for those coordinates and took down the respective magnitude.

But is it a star?

Stellarity is a measure of how stellar or “star-like” an object is.

Objects are given a value (between 0.00 and 1.00), where objects which possess a higher value are almost certainly a star (above 0.50), where as objects that possess a lower value (below 0.50) are less stellar and more likely to be galaxies.

In practice, this does not mean lower value objects are actually galaxies so much as they are “not stars”.

K-Band			R-Band			Object Type
x-coordinate	y-coordinate	Magnitude	x-coordinate	y-coordinate	Magnitude	
3129.798	390.958	-12.9811	3916.765	5426.082	-14.1294	Star
4149.423	378.786	-10.8993	5254.92	5333.074	-19.6282	Star
3407.079	2639.193	-10.8437	4273.932	8311.532	-18.5568	Star
2956.991	2848.46	-10.3446	3689.943	8587.383	-19.1196	Galaxy
5565.623	1679.603	-10.2535	7122.403	7047.085	-16.7699	Galaxy
3203.631	1872.212	-10.2409	4014.046	7299.346	-19.0682	Star
1918.298	2951.67	-10.0394	2320.493	8723.539	-17.7972	Star
2846.143	240.499	-9.318	3544.301	5150.127	-18.0405	Galaxy
5967.734	2196.899	-9.1303	7653.768	7729.822	-16.9	Galaxy
1370.838	2381.243	-8.9935	1580.648	7971.779	-16.6355	Galaxy
1348.542	432.542	-8.8892	1569.372	5404.519	-17.7362	Galaxy
2500.895	571.746	-8.5793	3087.292	5587.145	-14.6266	Galaxy
474.028	760.592	-8.4716	415.564	5836.397	-17.21	Galaxy
2188.752	352.892	-8.3733	2677.885	5298.922	-16.9635	Star
480.516	558.12	-8.1548	423.545	5569.561	-16.9321	Star

R-K Values

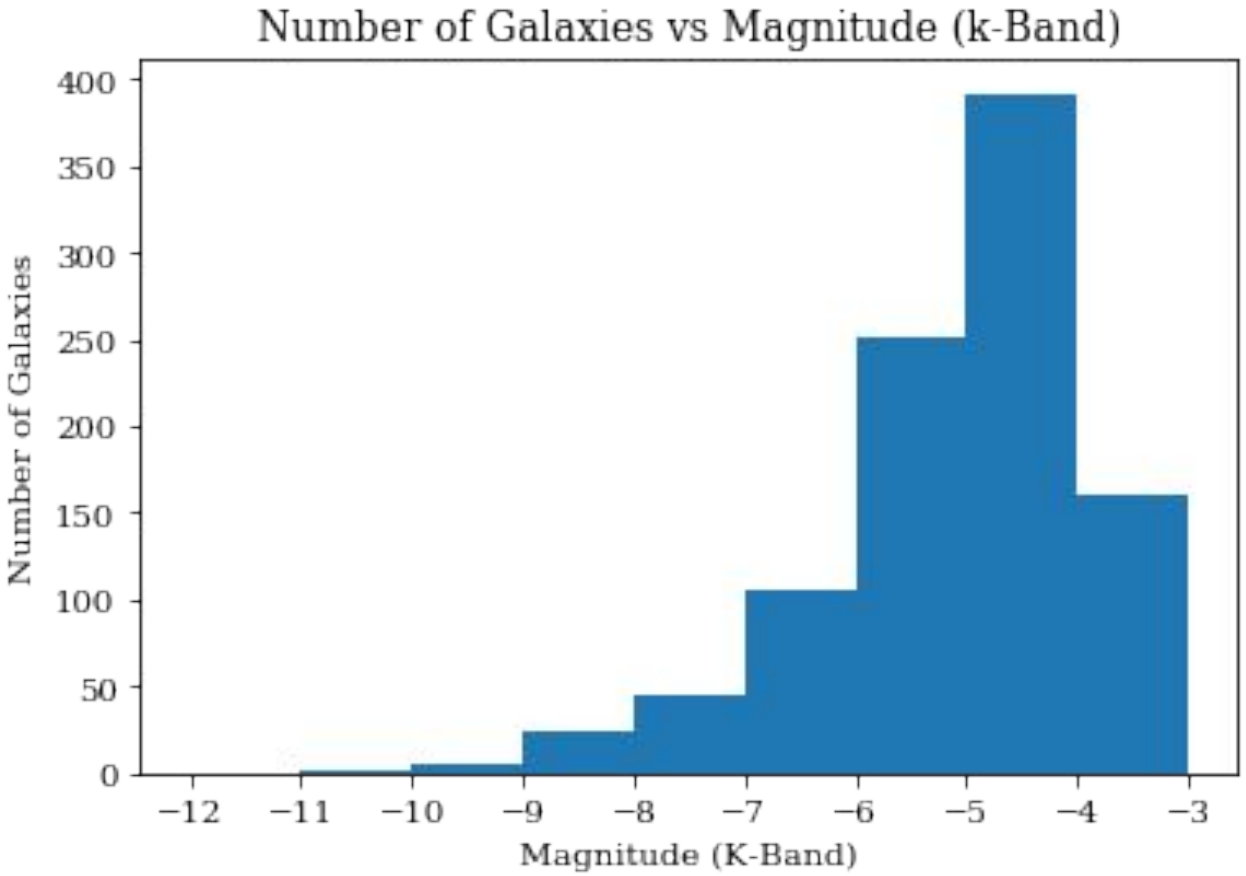
If source of R-band is brighter than K-band, the source tends to be bluer.

If source of K-band is brighter than R-band, the source tends to be redder.

ex) Star A has magnitude of R=10 & Star B has a magnitude of R=12.

Star A is brighter and Star B is fainter.

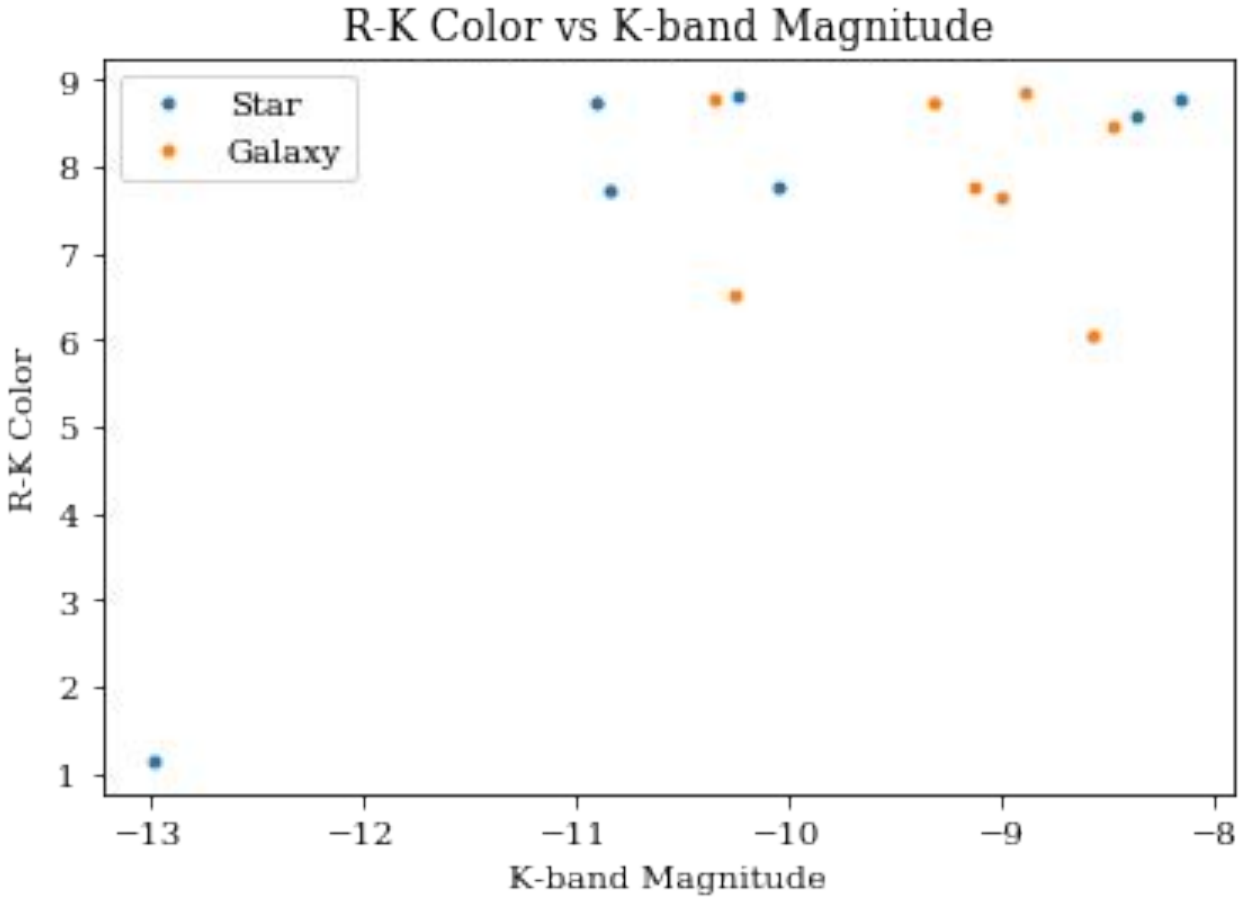
K-Band Magnitude	R-Band Magnitude	R-K	Color
-12.9811	-14.1294	1.1483	Bluer
-10.8993	-19.6282	8.7289	Redder
-10.8437	-18.5568	7.7131	Redder
-10.3446	-19.1196	8.775	Redder
-10.2535	-16.7699	6.5164	Redder
-10.2409	-19.0682	8.8273	Redder
-10.0394	-17.7972	7.7578	Redder
-9.318	-18.0405	8.7225	Redder
-9.1303	-16.9	7.7697	Redder
-8.9935	-16.6355	7.642	Redder
-8.8892	-17.7362	8.847	Redder
-8.5793	-14.6266	6.0473	Redder
-8.4716	-17.21	8.7384	Redder
-8.3733	-16.9635	8.5902	Redder
-8.1548	-16.9321	8.7773	Redder



Patterns

We have a clear trend where the majority of the identified galaxies, tend to be contained between magnitudes -7 to -4.

This would seem to imply that (regarding the region of space we have observed) are relatively more dim than bright though there are a few exceptions.



Patterns

Our brightest 15 objects with the exception of one outlier tend to be more red than blue. Though aside from that there is not a clear pattern, only that it would seem that in general the k and r band brightness seem to scale with one another as the object gets generally brighter.

The brighter objects tend to be less common in comparison to the k-band magnitudes of the galaxies in the previous histogram.

Thanks to..

Anna Wright

For assisting us in the arduous task of learning SE-xtractor as well as providing us with a neural network to use for the purpose of determining stellarity.

http://www.physics.rutgers.edu/~awright/