ASTR 102
B08
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2: Stars, Clusters, Nebulae, and Galaxies

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Objective/Purpose

The objective of the “Stars, Clusters, Nebulae and Galaxies” lab is to further understand the types of supermassive entities that exist within the universe and how they are classified. The lab will be completed with the aid of Google-sky and some searching on wikipedia to determine specific answers about cosmic objects.

Introduction/Theory

What is out there in the universe and how is it made? I believe that this lab will be able to give us a taste of what kinds of wondrous formations of matter exist within the universe. The images that we will get to use in this lab will be what is available from Google-sky and associated observatories that have their data available through the application. There are not really any assumptions to be made or anything to take into consideration other than arrive with an open mind to learn what types of entities exist in the universe.

Equipment

The following is the equipment required to complete this lab:

- Computer (with peripherals) with an internet connection
- Google-sky & wikipedia access

Procedure

The following steps outline the steps that were taken to complete this lab. Google-sky was used for this lab, and prior to completing the following steps, it was opened on the computers available to us in the lab.

Stars

1. Initially we examined Vega by using the coordinates, the search box did not work.
2. Zoomed to approximately 1 degree and then picked a faint star at 38,46,45.16;38,46,35.25
3. After zooming out to a field of view of approximately 10 degrees, we found the ghost image of vega.
4. We went to 30 Cygni and examined the colours of the stars.
5. In the next step we used a subsection of an image located at the north galactic pole at 12,51,26;27,07,42 and counted the stars to get an approximation of visible stars.
6. Then we counted the number of stars near the center of the milky way at 17,58,59;-29,12,14 to determine another approximation of visible stars.
7. There was a resolution change between the two measurement locations as the images were taken using different means. We then measured the pixel size of each star in each image subsection.

Clusters

1. Initially went to M67 which is a type of Open Cluster
2. Set the field of view to approx. 4 degrees to see how the cluster stands out from the surrounding stars.
3. Went to M13 to see an example of a Globular cluster.
4. We then set to classify both M92 and the Pleiades and record some interesting information about them.

Nebulae

1. Move to the Pleiades with a field of view of approx. 3 degrees. This is an example of a Reflection Nebula.
2. Turned on the Spitzer showcase to get a different image displayed.
3. Afterwards looking at an Emission Nebula we went to the North American Nebula and the Pelican Nebula nearby.
4. The next step was to examine the dark nebula/globule and taking further information from the North American nebula and the Pelican nebula.

Galaxies

1. First examining Elliptical galaxies we took a look at M89 then moved to M87 to examine the jet-like protrusions.
2. We then examined the spiral galaxy the Whirlpool Galaxy, then moved onto M31.
3. Progressed to NGC4594 and took note of the nice edge-on spiral galaxy.
4. Next the barred spiral galaxy NGC 1300 was examined.
5. “The Mice” was then examined as it is a peculiar galaxy that does not fit typical classification categories.
6. We then classified 7 different systems.
7. Examining pictures from the Hubble Ultra-Deep Field, we were able to get an idea of how many galaxies the hubble telescope could picture if it could cover the whole sky.

Miscellaneous

1. Initially examining Planetary Nebula, we looked at M57.
2. Moving on to take a look at Asteroid Tracks, we looked at pictures from the Sloan Digital Survey.
3. Continuing to Supernova Remnants, we looked at the Crab Nebula and how it looks at different parts in the electromagnetic spectrum.
4. Next looking at Quasars that contain supermassive black holes at their centers. Specifically looking at APM 08279 +5255.
5. Black holes were next examined by finding the name of a star at a location.
6. Barnard’s Star is the second closest star system to the black hole and was looked at.
7. Lastly, an interesting nearby star was examined and Beetlegeuse was chosen.

Questions

The following questions are found throughout the procedure of the lab and are the core component of the progression through the lab’s material.

Stars

1. Which is the bluer star?
    - ➢ 30 Cygni
2. Which is the hotter of these stars?
    - ➢ 30 Cygni
3. What are the names and distances of the two stars?
    - ➢ 31 Cygni - 470 Light Years
    - ➢ 30 Cygni - 270 Light Years

4. How many stars can you count?
    - ➢ 50 stars
    - ➢ multiply by 6 million = 300 million stars
5. Count the number of stars.
    - ➢ 37 stars
    - ➢ multiply by 22 billion = 814 billion stars
6. How much bigger is the seeing disk of the DSS picture compared to the HST picture?
    - ➢ DSS:
        i. -29,12,15.53
        ii. -29,12,53.57
    - ➢ HST:
        i. -29,12,44.83
        ii. -29,12,45,17
    - ➢ So the differences would be 3.04” for the DSS compared to 0.34” for the HST

Clusters

1. How old the M67 cluster is.
    - ➢ 3.2 billion years
2. Are there more red stars or blue stars or about the same number?
    - ➢ More blue stars
3. How many stars in M13?
    - ➢ “Several hundred thousand stars”
4. How far away is M13?
    - ➢ 25,100 Light Years
5. Are there more red stars or blue stars in M13?
    - ➢ More blue stars
6. Is M92 globular or open cluster?
    - ➢ Globular cluster
7. M92 - record something interesting
    - ➢ It is brighter than most stars in the sky but often overlooked due to M13 being nearby.
8. The Pleiades, globular or open cluster?
    - ➢ Open cluster
9. The Pleiades - record something interesting
    - ➢ It is mostly blue and is also known as the “Seven Sisters”

Nebulae

1. How far is it to the Pleiades?
    - ➢ more than 400 Light Years
2. Who was chasing “them”?
    - ➢ Orion
3. Can you see “them” with your naked eye?
    - ➢ Yes, the stars are visible as a haze to the naked eye.
4. What colour will the globule appear on the images?
    - ➢ red
5. Record position of tiniest dust cloud in North American and Pelican Nebula.
    - ➢ 20,56,35.925;44,03,32.60
6. Compare the number of stars per square inch you see in the regions New Mexico/Texas, Gulf of Mexico and on the Pelican Nebula near 56 Cygni.
    - ➢ More stars in North American nebula compared to the Pelican
7. Which nebula is the furthest and which is the closest nebula?
    - ➢ Furthest is the Pelican nebula
    - ➢ Closest is the North American nebula

Galaxies

1. What colour is it? (M89)
    - ➢ Beige/red
2. What colour is the jet? (M87)
    - ➢ Blue
3. What colour are the arms of this galaxy? (Whirlpool galaxy)
    - ➢ Blue with red spots
4. What color is the bulge?
    - ➢ Pale yellow
5. Find the distance.
    - ➢ 37 million Light Years
6. Comment on the colours of M31
    - ➢ Green edge with bright pale yellow center
7. What is the distance to this galaxy? (NCG 1300)
    - ➢ 69 million Light Years
8. What is happening here? (“The Mice”)
    - ➢ Two spiral galaxies colliding and merging
9. Comment on the colours and dust in this/these galaxies.
    - ➢ bright yellow core with blue and white arms
    - ➢ long arms that extend a great distance

10. Classify the following:
    M101 - Spiral Face-on
    M89 - Elliptical
    NGC 4565 - Barred Spiral Edge-on
    M105 - Elliptical
    M95 - Barred Spiral
    M96 - Barred Spiral
    The Antennae - Pair of interacting galaxies mid-collision
11. Count the galaxies in a square from the Hubble Ultra Deep Field.
    - ➢ 53 galaxies
    - ➢ multiplied by 1 billion = 53 billion galaxies

Miscellaneous

1. What colour is it? (M57)
    - ➢ White
2. What colours is the asteroid track?
    - ➢ green, red and blue, but red at the location
3. At the next location what colour track can you find?
    - ➢ green, red and blue, but red at the location
4. When did astronomers observe the supernova that made the Crab Nebula?
    - ➢ 1054 by Chinese and arab astronomers.
5. How far away is the Crab Nebula?
    - ➢ 6300 Light Years
6. In the center of the nebula what is left of the star that exploded?
    - ➢ A pulsar
7. How far away is it? (3C273)
    - ➢ 2.4 billion Light Years
8. How long is the jet? (3C273)
    - ➢ 200,000 Light Years
9. What colour is APM 08279 +5255?
    - ➢ bright yellow?
10. How far away is it? (APM 08279 +5255)
    - ➢ 23.6 billion Light Years
11. What is the HD number of the star at this location?
    - ➢ HD226868
12. How massive is it?
    - ➢ 20 +- 5 solar masses
13. How far away is it?
    - ➢ 6100 +- 400 Light Years
14. Do we need to worry about falling into the black hole?
    - ➢ Certainly not within our lifetimes.
15. What is Barnard's Star's distance?
    - ➢ 5.96 Light Years

16. ** Bonus ** Interesting Object:
    - ➢ Beetlegeuse (very bright!)
    - ➢ RA 05:55:10, Dec 7deg 24’ 25”

Conclusion/Discussion

The objective of this lab was to further understand different classifications of cosmic objects and how they interact and it did a fine job of educating. By viewing the different types of cosmic objects, we were able to get a clearer picture of how space is examined and what things to look for. By examining different types of cosmic objects individually and understanding how they can fit certain patterns, it was able to help us understand that there is a typical way that things form and how rare anomalies can be. It can be concluded that this lab provided very pertinent information to understanding cosmic objects. There were no quantifiable results obtained from this lab other than the information that was provided to us by Google-sky. As there was no experimentation and this lab was purely information gathering, there are no sources of error, however it could be argued that the information received from Wikipedia pages could be inaccurate.

References

- The aid of Google-sky. http://www.google.ca/sky/
- Assistance from Wikipedia for certain object related information.

Evaluation

I think that there were some very interesting things to look at and definitely some important classification concepts to cover, however the material was very bland. The way that this lab was structured also didn’t fit with the typical lab structure and likely should be modified to be more of a “hunt” activity with a “fill-in-the-blank” type of questionnaire that can be submitted at the end of the “Lab”.