

Elemental Distribution of Reflection and Emission Nebulae

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Abstract: Using prior data in the form of plates, we determined that there is a slight correlation in the emission and absorption of elements in emission nebulae and the emission and absorption of elements in reflection nebula. In the emission nebulae we analyzed, we found that there was a common emission of the elements hydrogen and helium. However, in the reflection nebulae we found a common absorption of the element helium. When comparing the number of emission and absorption lines from the emission and reflection nebulae, we found that the emission nebulae had primarily emission lines, with few absorption lines. The reflection nebulae had relatively few emission lines and many absorption lines. We believe the reason for these results is due to the ionization of gas in emission nebulae and the lack of ionization in reflection nebulae. Because emission and reflection are formed in different ways, it is difficult to compare the elements within them.

Introduction: Nebulae have been studied by astronomers for many years. They offer a wealth of information about the creation of stars and heavier elements in the universe. This information can be used to determine if new stars are being formed or are going to be created in the future. They also provide information about the creation of planetary systems around stars, since planets are made from left over materials from star birth.

The purpose of our research is to determine the elements found in emission and reflection nebulae. In order to accomplish this we analyzed plates from the PARI

plate preservation project. Using these plates we can compare the spectrum of the nebula to the spectrum of many different elements to determine the composition of the nebula. This information can be used to study the materials left after a stars death and the materials needed for stellar formation.

Observations: To obtain the information necessary to complete our research, we collected data acquired at the CTIO (Cerro Tololo Inter-American Observatory). We used plates with the spectra of M20 (plate number 13475), IC4606 (plate number 13587), M8 (plate number 13475), and Eta Carinae (plate number 2101.)

To analyze this data many steps are involved. First, we would compare the plate to a star chart (from The Sky 6) and determine the location of our targets on the plates. We would then open the photos and determine which spectrum was best to analyze. We made this decision based on the brightness of the spectral lines. After determining which spectra is best for analysis we would crop the spectra out of the larger picture, rotate 90 degrees and invert the picture (the original plate is a negative.) The next step is to determine what type of star is most similar to our spectra. We would then determine the range of the spectra we were analyzing. Finally we determined the elements in the spectra by comparing it to the spectra of many different elements.

Using this method we were able to determine the elements in four nebulae. The process we used was ideal, but we managed to find out the simple elements in some nebula. The first two nebulae we analyzed were reflection. The first of the pair was M20. We inspected the reflection area of M20 even though the object contains both an emission and reflection nebula. The spectra of this object contained the absorption

lines of Argon, Helium, and Krypton. We were not able to determine any elements from the emission lines because they were too faint or we were not confident about which elements were present. The second reflection nebula we analyzed was IC4606, The Witch Head Nebula. In IC4606 we were able to confidently determine that the nebula emits Oxygen and absorbs Hydrogen. Although more spectral lines were present we were not able to determine the elements present. The second pair of nebulae we inspected was emission nebula. The first emission nebula we analyzed was M8. We determined that the nebula emits Hydrogen and Nitrogen. While there were more spectral lines visible we were not able to identify the element they belong to. The second emission nebula we analyzed was the Eta Carinae Nebula. This nebula emits Oxygen, Hydrogen, Helium, Sodium, and Barium. This particular nebula contained only emission lines. These data help show any correlation in the elements in emission and reflection nebulae.

Results: Our analysis of our data has allowed us to make some conclusions about the elements in emission and reflection nebulae. In emission nebulae we found that there was a common emission of Hydrogen and Helium. We also found that in emission nebulae have few absorption lines. The reflection nebulae have a common absorption of Helium and very few emission lines. We believe that emission nebulae have more emission lines than absorption lines because the Hydrogen and Helium gasses are easily excited into ionization. The reflection nebulae do not have many emission nebulae because the gas is not ionized. Also, the reflection nebulae have more absorption lines because the gas is absorbing light from the star that is illuminating it.

Discussion: It must be understood that Emission and Reflection Nebulae are very different from each other. It is very difficult to obtain any kind of correlation between the two types of nebulae. This is why we were limited in what we can obtain from our data along with a lack of proper training and experience. Because of this we were unable to acquire a very thorough and complete analysis.

From what we were able to obtain, it appears that the elements in different nebulae vary. For example, M8 and the Eta Carinae Nebula have different elemental compositions. Eta Carinae contains Oxygen, Hydrogen, Helium, Sodium, and Barium whereas M8 contains only Hydrogen and Nitrogen. Even though both nebulae contain Hydrogen, the other elements within their respective nebula are different.

Future Work and Continued Exploration: There is an immense amount of plates being stored at Pisgah Astronomical Research Institute (PARI). Most of these plates have not been analyzed to their fullest extent. During our two weeks at this Institute we have only been able to observe four of these plates. This leaves room for much more that can be done in the field. There are certainly better alternatives in analyzing these plates. Our process was mediocre compared to professional work being done by experts in the field. New data can be taken to update what is already there on plates but even without new information, old materials are long-lasting and still efficient. More research can be done in this field to adequately describe elements inside emission and reflection nebulae.

Conclusion: Through our research we have determined that there are elements common to emission nebulae, Hydrogen and Helium. There is also an element common to reflection nebulae, Helium. We also determined that there is probably no connection between the elements in emission nebulae and reflection nebulae (according to our analysis of our data.) As anyone can observe, nebulae are a very extensive field that would take many more years to understand.

Citations:

Osterbrock, Donald E. *Astrophysics of Gaseous Nebulae*. San Francisco: WH Freeman and Company, 1974.

"Copare Spec." University of Washington. 26 June 200

<<http://www.astro.washington.edu/labs/clearinghouse/labs/Spectanalysis/images/compspec.ec.jpg>>.

Acknowledgments:

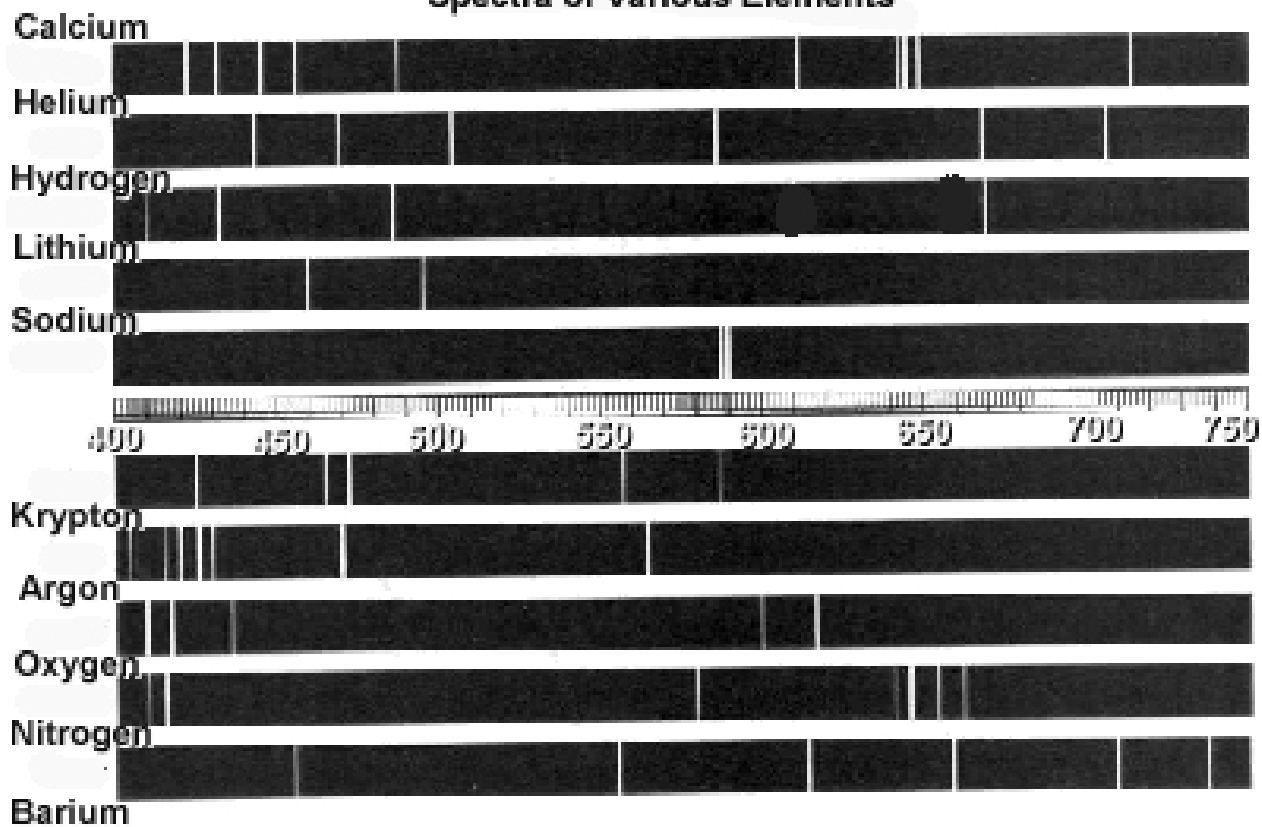
PARI Staff

Duke TIP Staff

CTIO

PARI Plate Center

Spectra of Various Elements



400 450 500 550 600 650 700 750



Spectrum of Unknown Composition

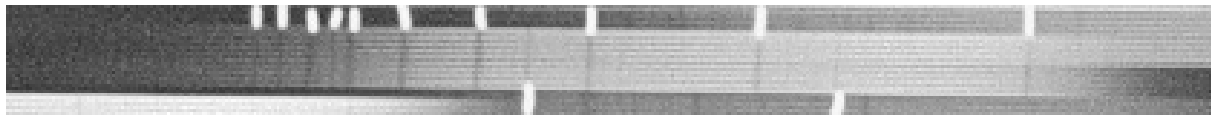
This is our reference for comparing nebulae spectrum to known elements



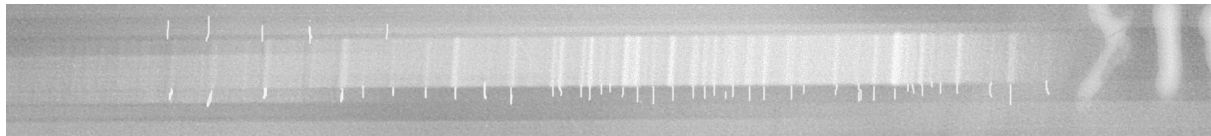
Spectrum from IC 4606 (Markings added for analytical purposes)



M 8 Spectrum (Markings and letters added for analytical purposes)



M 20 (reflection nebula) (markings added for analytical purposes)



Eta Carinae Spectrum (markings added for analytical purposes)

	H	He	N	O	Na	Ar	Ca	Kr	Ba
M8	X	X	X	X	X	X	X	X	X
Eta Carinae	X	X	X	X	X	X	X	X	X

Elements absorbed by emission nebulae (O = Absorbs, X = Does not absorb)

	H	He	N	O	Na	Ar	Ca	Kr	Ba
M8	O	O	O	X	X	X	X	X	X
Eta Carinae	O	O	X	O	O	X	X	X	O

Elements emitted by emission nebulae (O = Emits, X = Does not emit)

	H	He	N	O	Ar	Ca	Kr	Ba
M20	X	O	X	X	O	X	O	X
IC4606	O	O	X	X	X	X	X	X

Elements absorbed by reflection nebulae (O = Absorbed, X = Does not absorb)

	H	He	N	O	Ar	Ca	Kr	Ba
M20	X	X	X	X	X	X	X	X
IC4606	X	X	X	O	X	X	X	X

Elements emitted by reflection nebulae (O = Emitted, X = Does not emit)