

Mapping Molecular Clouds Near Messier 17

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Introduction

M17 is a huge cloud of gas mostly made up of Hydrogen and Helium. M17 has molecular clouds, which are dark and opaque nebulas that block out light. M17 is a stellar nursery. The radiation from the stars is very strong, which ionizes the hydrogen gas around them, and eventually, radio waves are emitted.



Figure 1. Infrared image of M17.

Methods

Mapping Intensity

- Performed a continuum scan at 100 different points
- IF GAIN → 12

Mapping Velocity

- Performed a spectrum scan
- Used the change in frequency to find velocity
- Used a formula to assign each velocity a number on the luminosity scale (color wheel)

(Both used the 12 meter radio telescope)

Velocity

Figure 2 is an example of a spectrum graph. It includes three different lines to show the variety of data.

1. Found the maximum point on the graph
2. Determined the change in frequency
3. Used the change in frequency to calculate the velocity.

$$\text{Equation: } v = (c) \left(\frac{\Delta f}{f} \right)$$

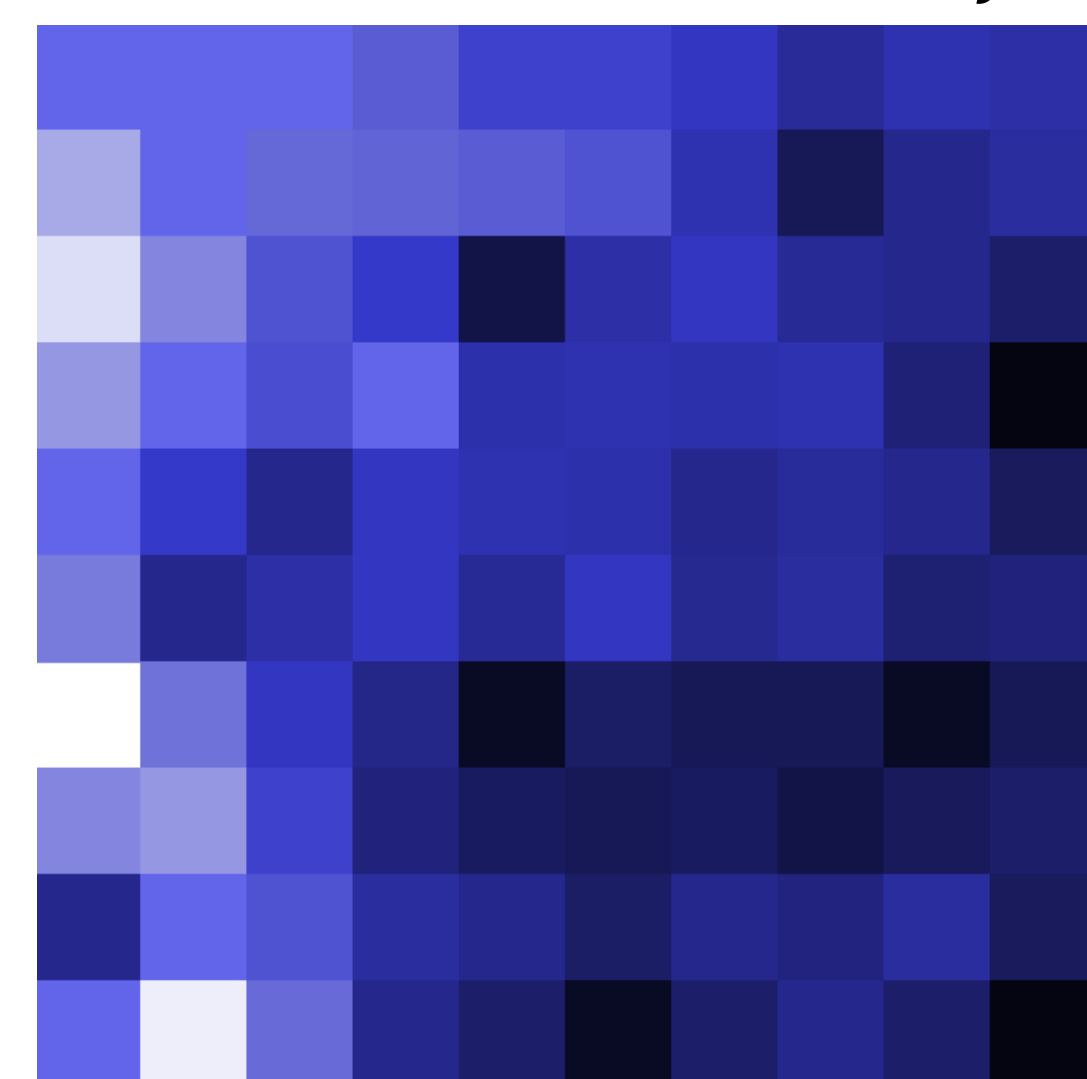
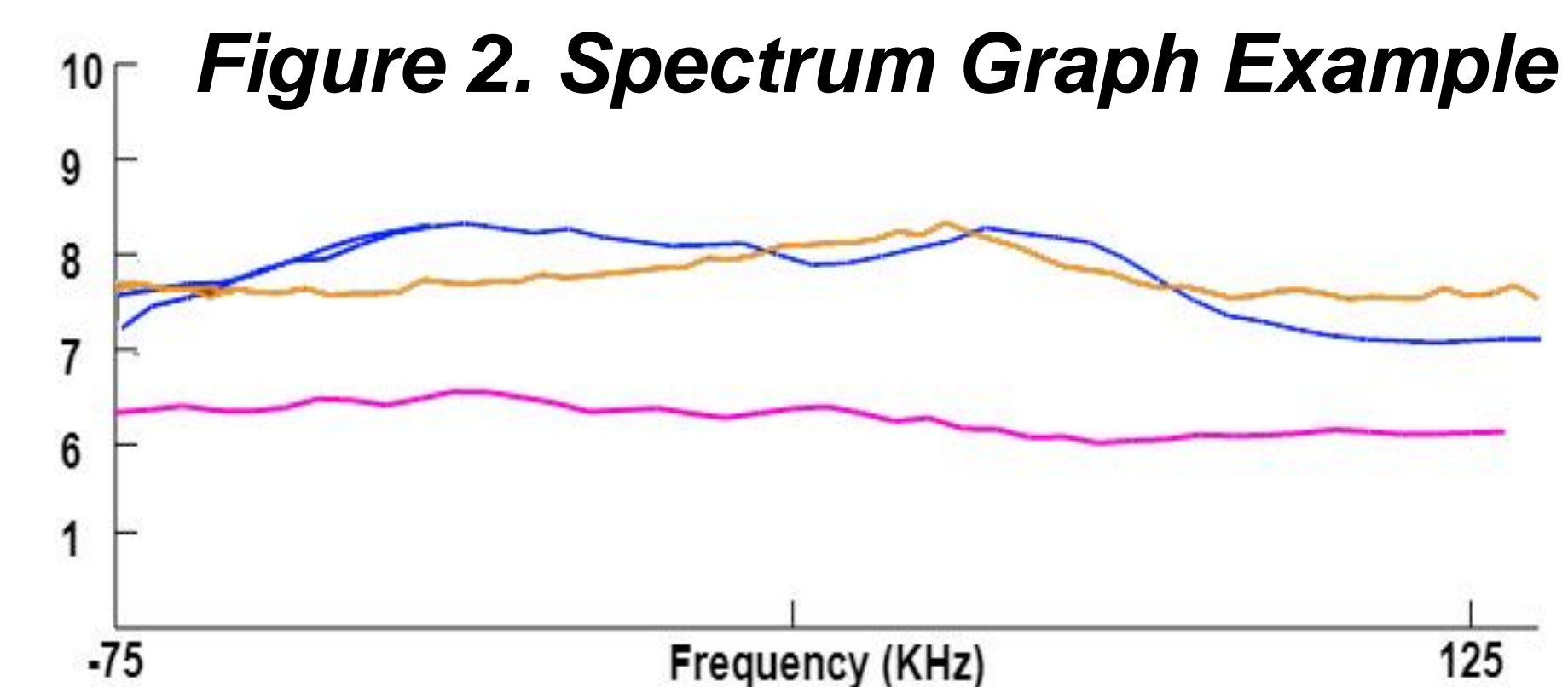


Figure 3. Velocity Map.



$$x = \frac{\text{Max Luminosity} \times \text{Velocity}}{\text{Luminosity} \times \text{Max Velocity}} = \frac{255y}{24.295}$$

Determines the shade of blue represented in the map. Paler colors demonstrate a faster velocity, and darker colors demonstrate a slower velocity.

Intensity

In the intensity graph, mass and intensity are directly proportional. Areas with more mass, have more Hydrogen, which is where the molecular clouds are located. Red → higher mass/intensity
Purple → lower mass/intensity
The graph has a huge dip in the middle, which could possibly be another gas cloud that does not contain Hydrogen blocking our data.

Intensities at Each Coordinate

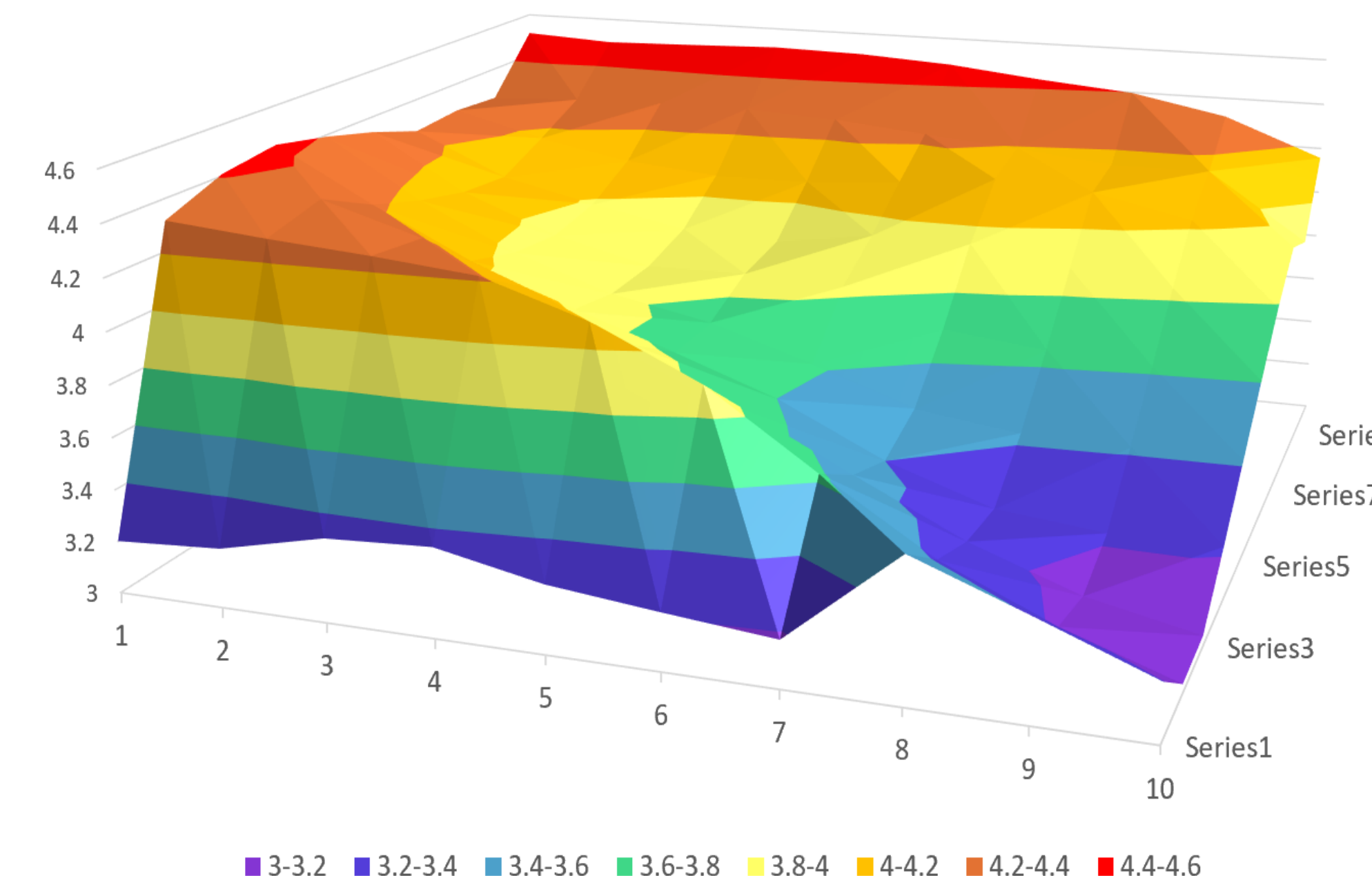


Figure 4. Intensity Graph

Conclusion

- The places with higher velocities may have newborn stars.
- The heat from the stars excites the gas particles around them, making them emit red light.
- Optical images confirm M17 emits radio waves. The visible image only showed a portion of the nebula; infrared image showed that M17 emits light that is not visible to the naked eye.
- Can tell that M17 is spinning because one part is more blue-shifted than the other
 - moving towards Earth

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Omega Nebula. (2017, January 14). In *Sun.org*. Retrieved July 9, 2018, from <http://www.sun.org/images/omega-nebula>
Garner, R. (2017, October 6). Messier 17 (The Omega Nebula or Swan Nebula). In NASA. Retrieved from <https://www.nasa.gov/feature/goddard/2017/messier-17-the-omega-nebula-or-swan-nebula>