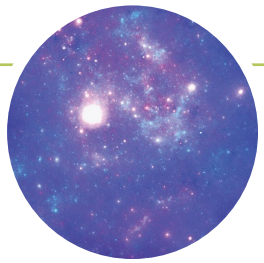
Determining the Age of a Star

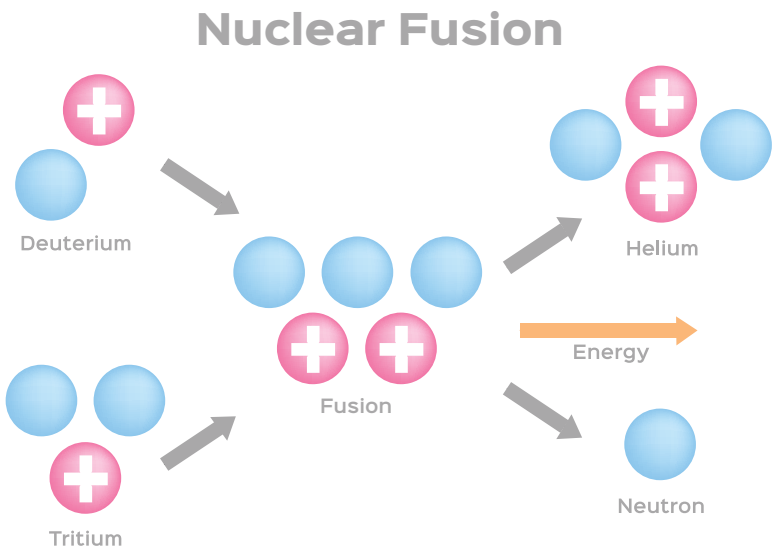
A Carolina Essentials™ Demonstration



Student Worksheet

Overview

Hydrogen is the initial fuel of stars like our sun that have lower temperatures. Through the process of nuclear fusion, hydrogen nuclei (protons) fuse to make helium as shown:



Astronomers use this process—the proton-proton cycle—to help determine the age of lower-temperature stars. The more helium that is present, the older the star. How do astronomers establish which elements are present in a star? They use spectroscopy: light from a star is broken up into its specific wavelengths. Remember that white light is a combination of all wavelengths.

Every element has its own unique spectrum, so once a star's spectrum is obtained, the elements producing the light can be identified. The intensity of the spectral lines also helps determine the amount of the element present. A CD simulates what a spectroscope does.

Phenomenon

Take a CD and rotate it around under a light. What do you notice?

What do you think is causing the spectrum to appear?

MATERIALS

- CDs or CD pieces for the phenomenon
- Colored pencil set (24 colors)
- Economy spectroscope
- Hydrogen spectrum tube
- Helium spectrum tube
- Hydrogen and helium spectrum tube
- Spectrum tube power supply

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Essential Question

How does the composition of a star like our sun change over time?

Activity Objectives

1. Use the spectra of hydrogen and helium to identify and communicate the composition of a star.
2. Use the spectrum of a hydrogen/helium mixture to approximate the age of a star and describe where the star is in its life cycle.

Activity Procedures

1. Observe the hydrogen spectrum tube using the spectroscope. (Do not shake or drop the spectroscope—the diffraction grating may come loose.)
2. Record the color bands you see, paying attention to the color, width, and brightness of each line.
3. Notice the numerical scale under the color bands. Estimate the wavelength for each color band and record the wavelength in nanometers.
4. Repeat the procedure with the helium spectrum tube.
5. Repeat the procedure with the hydrogen and helium tube.

Data and Observations

Hydrogen Spectrum

Helium Spectrum

Hydrogen and Helium Mix

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Analysis and Discussion

1. Explain how the 3 spectra compare.

2. If a star in the same class as our sun produced a spectrum similar to helium, what would you conclude about its age?

3. Explain what kind of spectrum you would expect our sun to produce in middle age.

4. Using the spectra, illustrate the life cycle of our sun.

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