Variable Stars

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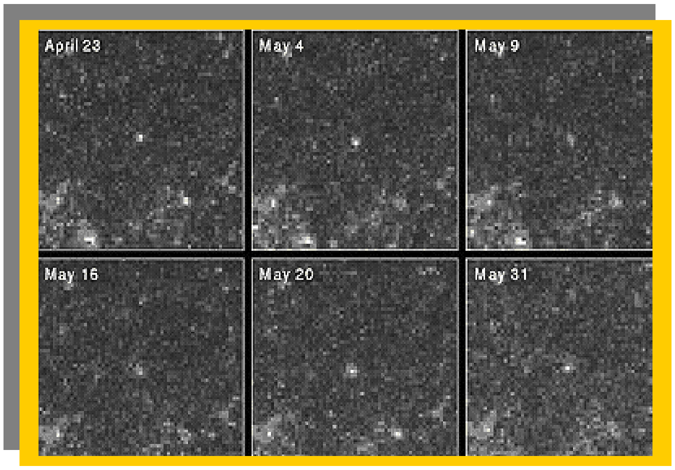
Although most stars in the sky, like our sun, appear to shine steadily, there are classes of stars whose **luminosity**, or brightness, noticeably changes over time. One important class of such **variable stars,** the **Cepheid variables**, pulsate and change their luminosity regularly. They grow larger and brighten and then shrink and dim at constant intervals ranging from 1- 50 days. The longer the pulsation period of a Cepheid, the brighter the star is. Cepheid variables with pulsation periods of one day are about 200 times brighter than the sun; those with periods 50 days long are 10,000 times brighter.



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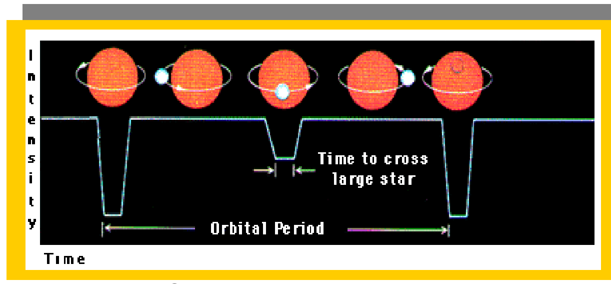
Cepheid Variable Star

Cepheid variables allow astronomers to measure distances to distant star clusters and galaxies. Here's how. Let's assume you are observing another galaxy and discover a Cepheid variable star in that galaxy. Measure its period by timing how long it takes to brighten and dim. You will then have a good idea of how bright the star really is. Brightness, however, also decreases with distance. Headlights from a car look much brighter up close than if the car was a mile down the road. A Cepheid in a distant galaxy will look much dimmer than it would if it was closer. By measuring the brightness of the Cepheid variable, and knowing how bright it actually should be (from knowing its period), then you should be able to figure out how far away that Cepheid must be. A distant galaxy containing the Cepheid must be at about the same distance.

A second class of variable stars are the **novae**. Stars that "go nova" increase in brightness many thousands of times, usually within a few days, then dim to their original luminosity. Novae are actually **binary star systems**, where one star is a **white dwarf**. A white dwarf is the end stage of a dwarf star after the hydrogen fuel runs out in its core. Since stars use up their fuel at different rates depending on their masses, and thus have different lifetimes, it is possible that one member star of the binary will turn into a white dwarf before the other does.

If the two stars orbit closely, the white dwarf can gravitationally pull gas from the other star. This gas piles up on the surface of the white dwarf, growing denser and hotter as more gas accumulates. Once it reaches 10 million °K, hydrogen fusion quickly begins. This results in a large explosion that clears the rest of the gas off the surface of the white dwarf. This explosion is seen as a nova by observers on Earth. Afterwards, the white dwarf can begin accumulating gas from its companion star once again for another nova anywhere from 100 years to 10,000 years later.



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Eclipsing Binary Star

One last type of variable star is the **eclipsing binary**. This is not a single star, but two stars orbiting so close together that they cannot be distinguished individually even through a telescope. If the two stars have different degrees of brightness, one star will be eclipsed or blocked from our view by the other as they orbit. As the positions of the two stars vary over the course of the orbit, the brightness of the binary system will also vary.

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