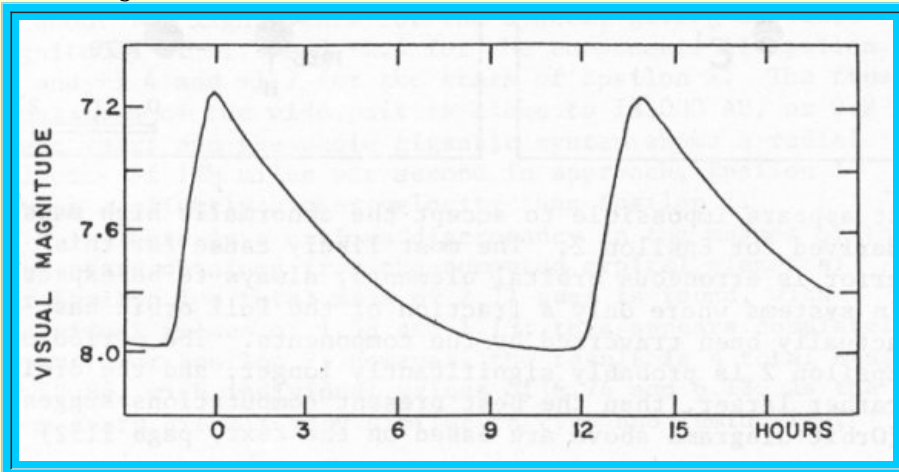
RR LYR (RR Lyrae). When we concentrate on naked-eye stars, we obviously miss many that are faint but great, prime examples being the ninth magnitude black- hole binary Cygnus X-1 and fast-moving 10th magnitude Barnard's Star, which holds the record for motion across the sky. RR Lyrae, a seventh-eighth magnitude star in northeastern Lyra 10 degrees to the northeast of Vega, falls well into this family. It's not just a famed variable star, but the prototype of an enormous and deeply important set of them, the "RR Lyrae" stars, which abound within a good fraction of globular clusters, hence the alternative term of "cluster variables." RR Lyrae and the rest of the gang are short-period, low-metal versions of the giant/supergiant Cepheid variables epitomized by Delta Cephei, Zeta Geminorum, and Eta Aquilae. RR itself, a helium-fusing "giant," varies between magnitudes 7.06 at maximum brightness to 8.12 and back over a period of a mere 13.604 hours. The pulsations are driven by regions of partially ionized gas below the stellar surface that valve outflowing heat.



RR Lyrae is the prototype of the RR Lyrae stars, which pulsate in radius and brightness over very short periods. RR itself changes by about a magnitude over a mere 13.6 hours, the brightness rising quickly to maximum that is followed by a slow decline. The star is brightest during maximum expansion velocity. The maxima and minima do not quite match those stated in the main text because of additional, and not-understood, variations. (From *Burnham's Celestial Handbook*, R. Burnham, Jr., Dover Publications, NY, 1978.)

Most such giants fall into class K or the cool end of class G. A very low iron (really, metal) content of only 7 percent that of the Sun makes RR smaller and hotter than an ordinary giant, rendering it a nominal mid-class-F (F5) star. But as a pulsating variable, the surface temperature varies as well, so the class goes from A8 to F7 (typical of the full range of RR Lyrae stars). The temperature itself is not well known but seems to average somewhere between 6200 and 7000 Kelvin. The Hipparcos parallax satellite gives a distance of 940 light years, but a better measure of 850 light years comes from a Hubble parallax. Using that one, and factoring in five percent dimming by interstellar dust, the luminosity comes in between 30 and 85 times that of the Sun, the radius -- as noted above, small for a giant -- somewhere between 4 and 8 times solar depending on the temperature used.

RR Lyrae and its ilk are denizens not of the Galaxy's thin disk (which hosts the Sun and most of the stars around us), but like the globular clusters are members of the vast surrounding Galactic "Population II" halo (the stars of the disk "Population I"). As such they are the evolved progeny of lower mass solar (really subsolar) type stars that have lost a good fraction of their masses. The disk stars like the Sun have somewhat circular orbits about the center of the Galaxy and have low speeds relative to one another. Halo orbits, though, are highly elliptical, the stars and clusters screaming through the disk at high speeds. RR Lyrae is no exception. It's speeding past us at 285 kilometers per second, close to 20 times what is normal for the surrounding stars of the disk. Though RR Lyrae stars are reliable variables, their periods and amplitudes (ranges of brightness) can change over weeks and years. RR Lyrae is particularly vulnerable to it, its variations having superimposed further variations on them of 41 days and 4 years, whose origins (after nearly a century of study) remain mysterious.

No matter what their temperatures or pulsation periods, which range between 0.2 to 0.8 days, RR Lyrae stars all have roughly the same average absolute visual brightnesses (absolute visual magnitudes of -0.7), which makes them excellent distance indicators when seen in clusters or in other galaxies (the absolute magnitude the apparent magnitudes they would have if 32.6 light years away).

Written by Jim Kaler 11/13/09. Return to STARS.