
THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS
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E Y E P I E C E V I E W S #318

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1. INTRODUCTION

Greetings All,

A new year, new beginnings... Tthe new official address of the AAVSO HQ became 49 Bay Street Road, Cambridge, MA 02138, USA. Remember to check our homepage articles to learn more about this exciting transition.

Our articles are as fascinating and fun to read as always. Kate Hutton generously contributed two wonderful pieces and we have a fascinating article by David Turner.

We hope you will enjoy our first issue of 2007, as much as we enjoyed working on it.

Best wishes for a wonderful New Year!

Thanks and good observing!
Gamze Menali, AAVSO Technical Assistant (MGQ)

2. TYPE C SEMIREGULARS: WAITING FOR THE SPECTACULAR

The Type C semiregular variables, or SRCs, are, like many fascinating objects in astronomy, relatively unstudied. But not unobserved, given that many AAVSO members, and especially the more experienced observers, have been observing them for years.

Their basic properties are easy enough to summarize, although the descriptions given for them in many textbooks are, quite simply, wrong. As defined in the General Catalogue of Variable Stars (GCVS), the SRC class consists of semiregular supergiant variables of late spectral type (M, C, S or Me, Ce, Se, i.e. class M or their chemically peculiar carbon star equivalents), with Mu Cephei cited as an example. Their light amplitudes are of order one magnitude or more, and they undergo cycles of anywhere from 30 days to several thousand days. Most of the Milky Way SRCs may be multi-periodic, with primary periods of order 300-900 days and light amplitudes tied to luminosity, according to AAVSO observations. Closely related are the LC variables, irregularly variable M supergiants with visual amplitudes also on the order of one magnitude. A cited example is TZ Cas.

The primary periods of SRC variables fall in the range 300-900 days, and are tied to radial pulsation according to Stothers (1969, ApJ, 156, 541), who also pointed out that they appear to obey a period-luminosity relation different from that of Cepheids . More recent numerical, linear, nonadiabatic, pulsation models by Guo and Li (2002, ApJ, 565, 559) confirm and extend the earlier work of Stothers. Their secondary periods tend to be longer and probably originate from spot cycles on their surfaces.

AAVSOers may recognize a more familiar prototype SRC variable in Betelgeuse, Alpha Orionis, literally the Shoulder of the Giant (bet el geuse), an object selected previously as the AAVSO star of the year but one that is probably not an ideal example of the class. Betelgeuse is not an easy star for which to make magnitude estimates because of its extreme visual brightness between 0 and 1.3. All of its reference stars lie well outside the standard field of view for observations without optical aid (i.e. "naked eye," no telescope, no binoculars, although with corrective lenses permitted), and calibrated photoelectric or CCD photometry is often difficult for such bright objects.

The SRC variables should not be confused with the more familiar types of long period variables (LPVs): Miras and Type A and B semiregulars. Those objects are all red giants, stars of spectral type M that are about as massive as the Sun and of varying chemical composition, typically with ages of order 1-10 billion years passing through the red giant or asymptotic giant branch (AGB) stage of evolution. They are found just about everywhere in our Galaxy, although more frequently in the disk.

The Type C semiregulars, on the other hand, are young, massive stars ~15-25 times more massive then the Sun with ages of only a few million years, and they are tightly constrained to the Galactic disk. Most such stars help delineate our Galaxy's spiral arms. All are M supergiants, typically the most poorly studied stars in our Galaxy. And, according to stellar evolutionary models for massive stars, they will end their lives as Type II supernovae after exhausting their various sources of nuclear fuel (Chevalier 1981, Fund. Cosmic Phys., 7, 1). Somewhat unexpectedly, perhaps, the most spectacular such events in recent years, SN 1987A in the Large Magellanic Cloud and SN 1993J in M81, originated from B3 I and G8-K5 I supergiants, respectively.

It is interesting to note that, while all SRCs are M supergiants or their chemically peculiar kin, e.g. supergiant carbon stars, is it also true that all M supergiants are Type C semiregular variables? The related class of LC variables does consist of M supergiants, for example, and conceivably they are simply variables like the SRCs where the variability is so poorly expressed that the main periodicity is difficult to detect. It is noted by Pierce, Jurcevic and Crabtree (2000, MNRAS, 313, 271) that M supergiant variables are more common than Cepheid variables in most galaxies, yet classical Cepheids outnumber the SRCs and LCs by a factor of 10 in the GCVS. Have we simply overlooked most of our Galaxy's nearby SRC variables because of their red colors and long pulsation periods?

Dedicated variable star observers are all familiar with the Purkinje effect, in which the sensitivity of the eyes at low light levels shifts to the blue end of the spectrum, so that staring at a red star over an extended period of time leads one to perceive it as being brighter than it actually is. Such difficulties make SRC variables challenging objects to observe, and yet it has not dissuaded the many observers who observe both them and the Miras and Type B and C semiregulars in routine fashion.

My interest in SRC variables began with the discovery that one of them, BC Cyg, was the brightest member of the heavily reddened young cluster Berkeley 87 and was listed in the GCVS with only the barest details regarding its light variability. Berkeley 87 is a relatively obscure open cluster in terms of literature attention, yet it happens to coincide with the strongest source of cosmic rays in the northern hemisphere. Other young clusters lie in the general direction of Berkeley 87, but its stars are the likely origin of the cosmic rays given their extreme peculiarity. Where else in the Galaxy can you find a M supergiant variable, a peculiar emission-line B supergiant, ST3 --- one of the Galaxy's few known Wolf-Rayet stars of the oxygen sequence, V439 Cyg --- an exotic variable that appears to be a Be star hidden from direct view spectroscopically by a surrounding nebular veil, and perhaps a few other exotic stars (?), all collected together in a sparsely populated open cluster? I know of no others myself, and I have been studying our Galaxy's obscure star clusters for more than thirty years.

I managed to complete a study of the long term variability of BC Cyg using the plate collection of the Harvard College Observatory in conjunction with a smaller subset of plates in the collection of the Russian Sternberg Institute examined by my Russian colleagues. BC Cyg displays regular pulsational variations of duration ~700 days, but more interesting is how the pulsation changes over the course of a century. Between 1900 and 2000 BC Cyg brightened by about 60%, while its pulsation period dropped from ~700 days to ~690 days. The most likely origin of such changes is evolution during the red supergiant stage, given that most evolutionary models of stars of ~20 solar masses exhibit detectable changes on time scales as short as 35 years! If the picture deduced from the star's observed color variations is correct, the brightening of the star at blue/visual wavelengths actually corresponded to a <u>decrease</u> in its overall luminosity, which is highly temperature-dependent for such cool stars. In turn, the decrease in its luminosity and pulsation period resulted from an increase in surface temperature as a result of evolutionary pressures.

The recent picture is even more interesting, since it is here where AAVSO observations play an important role, especially the valuable observations of red variables supplied by long-time observer Paul Vedrenne. Visual observations of BC Cyg indicate that the star has recently faded in the blue/visual region. But decreased brightness at blue/visual wavelengths corresponds to an <u>increase</u> in overall luminosity, which means that the pulsation period of BC Cyg is probably increasing again as the star ascends the red supergiant branch in the H-R diagram and becomes more extended. The question is: how much further can the star evolve up the red supergiant branch before it turns into a Type II supernova? Will it occur within our lifetimes or some time in the distant future? Given the scanty state of information about such stars that is currently available, it is not a question that is easily answered.

Although the existing list of Galactic SRC variables in the GCVS numbers only 55, new photometric surveys will likely turn up many more in years to come. AAVSOers should not be dissuaded from observing them simply because of their red colors and long pulsation periods of 1-2 years, because it may turn out that we are observing the long time-delay fuse on a very promising fireworks display. The deduced mass of BC Cyg, ~19 solar masses, is remarkably close to the estimated masses for the progenitors of SN 1987A and SN 1993J! Perhaps in this instance we will have advance warning of the star's impending doom?

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3. LUMINOUS BLUE TINSELTOWN – Kate Hutton

A few weeks ago, I had the privilege of meeting an icon of amateur astronomy.
I've had it in my mind for awhile to visit one of the Sidewalk Astronomers' impromptu star parties, but for some reason I was busy, it was cloudy, or I was out with a few select buddies "doing variables". I'd added myself to their e-mail list, so I would know when and where they were going to be, but I had postponed actually going. The Sidewalk Astronomers are somewhat of an institution in California, maybe in the rest of the country as well. They set up their telescopes in parks, or literally on the sidewalk, and invite passers-by to view the Moon, any planet that may be up, or a double star or two. In my particular L.A. suburb, their site of choice is a busy, fashionable shopping area, where they get a lot of viewers, but are sometimes not very popular with the authorities. On this particular evening, however, the viewing was at another location, in a (well-lit) park adjoining a different shopping area.

The Sidewalk Astronomers tradition started in San Francisco in the 1960's with John Dobson. Dobson was apparently somewhat of the archetypal San Francisco hippie, who endeavored to bring astronomy directly to the people. Everyone knows the story already, about how he used surplus ships' portholes as mirror blanks, and invented the Dobsonian telescope out of whatever junk happened to be on hand. He taught classes in telescope making, and so forth. His philosophy was that the worth of a telescope was determined not by size or magnification, but by the number of people that looked through it. The universe belongs to the masses, to any shopper or passer-by who would take a look.

Anyway ... John Dobson is still around, at 91 years of age. The e-mail announced that he was going to be in Monrovia for a particular viewing, along with the regular local organizers Jane and Morris Jones, and a few others who it turns out I recognized from the Los Angeles Astronomical Society. Not being able to scrounge any observing partners for a trip to Ford Observatory, I went to meet John Dobson. Since I often use a Dobsonian scope, I thought it was a grand opportunity.

Imagine a 91-year old man who stands perfectly erect and alert. He's friendly, but modest, seemingly more ready to talk about his telescopes or his theories of cosmology than himself. The only vestige of the old days of San Francisco seems to be a snow-white pony tail. I did not get to talk to him much, because he was being interviewed by a BBC TV crew on that particular occasion, but I did get to listen to much of the informative interview.

Meanwhile, the local shoppers were indeed amazed at the "close up" views of the Moon. "This is what you would see about 3 hours before you landed," the Sidewalk Astronomers told everyone. We saw young children learning for the first time how to look through a telescope.

It was great fun. It was also in stark contrast to the billboards we have been seeing recently around the general L.A. area: "The Universe. By reservation only."

After four plus years of closure for renovation, the City of Los Angeles Griffith Observatory was just then opening its doors to the public again. In the 1930's, Colonel Griffith J. Griffith managed to get a peek through the 60-inch on Mt. Wilson and was so impressed that he donated the land for Griffith Park and funded the Observatory that carries his name. By condition of the original grant, admission is free (except for the actual planetarium show, which I believe has always charged admission). Now, however, there is no longer any parking at the Observatory or along the approach road. Visitors reserve and pay for a seat on a shuttle bus from the Zoo parking lot, hence the "by reservation only" ads. Traditional picnics on the spacious lawn have been replaced by Wolfgang Puck concessions. Veteran planetarium lecturers had to "audition" for their old jobs!

Admittedly, the Griffith Observatory still has monthly star parties, with genuine Dobsonian telescopes courtesy of the Los Angeles Astronomical Society. The shuttle bus and the reservations are still in effect, however, and the only concessions available are the Wolfgang Puck variety.

The contrast does make me stop and philosophize a little bit.

Maybe in this town, where the public Observatory overlooks Hollywood, there are people who would never bother to take a look at the sky if there were no hype and hooplah, people for whom the big screen is more real than the actual universe. Or it could be a manifestation of the perennial culture war between Los Angeles and San Francisco, each claiming their own version of the stars, only a few of which can be seen from either location.

My personal preference is for a telescope over the big screen, but of course that is why I belong to the AAVSO, where folks not only get to gaze at the stars for themselves, they get to make real, live measurements and participate in the actual doing of astronomy. Considering Dobson's views about how many people look through a particular telescope, he might not approve. But to me, participation is the point. Variable stars for the people!

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4. LIFE IN THE LIGHTBULB – Kate Hutton

A number of years ago, Los Angeles experienced a damaging earthquake, centered near the suburb of Northridge in the San Fernando Valley. Along with the obvious physical effects, such as the collapse of parking structures, people became noticeably nuts due to stress and lack of sleep (every night having its aftershocks). The Caltech Seismological Laboratory received a number of somewhat bizarre public inquiries. One that comes to mind was: "The strangest thing that I remember about the earthquake was how bright the stars were! They were beautiful. How can an earthquake make the stars brighter?"

Somehow I think the L.A. Department of Water and Power was too busy to wonder about that one. Too busy trying to get the electricity back on.

Another version of this story may be apocryphal or may have been a joke, but I've been told that people actually called the Griffith Observatory after the quake and asked what the little lights were that were in sky!

It was a shock, I guess. We normally don't see such things.

I do actually remember when I could find the constellation of Hercules, or when delta Cephei was a naked eye star. But that was a long time ago, and far, far away.

The number of naked eye stars that I can see from my yard varies (some of the stars vary, too!), of course, but it's often below thirty. Still, it took me awhile to realize that my conditions might be a little atypical. Maybe the hint was a comment from Arne that I should be able to see GK Per with a 10-inch scope. I can't. Not quite. It was 12-something and while doing its minor outburst, and I could only see 11.5.

So, one method of coping with light pollution is more glass. A bigger scope pulls in the photons and cut down the sky brightness. With a 10-inch scope, I can do what people in the country can do with a 5-inch.

One coping mechanism is running … to whatever dark sky opportunity presents itself. I've gotten myself connected with the regular Ford Observatory crew and also with the Los Angeles Astronomical Society, which has a dark sky site in the mountains (which we came within a couple of hundred yards of losing to one of the big wildfires this fall).

Still, I don't always have the opportunity to get out of town. The bulk of my estimates are made in my yard, the "Dog Yard (open air) Observatory".

Another coping mechanism is hiding … the dog yard, although small, can be quite dark. The neighbor's garage blocks the Save-On Drugs parking lot; the house blocks the nearest street light, etc. I may have to move around the yard a bit to see different parts of the sky. Which means no time to spend on polar alignment. Which means a Dob.

My neighbor's back porch light burned out about six months ago, and dang I keep forgetting to mention it to him.

Initially, the Dob and the thirty naked-eye stars made finding anything smaller than an A chart pretty dicey. That got better as I re-familiarized myself with the sky. I do not honestly know how anyone found anything at all before the Telrad was invented. Kudos to Steven Kuffeld, after whom the LAAS dark sky site is named. I have been told that even the 100-inch at Mt. Wilson has a Telrad on it (two actually). I don't know about Palomar …

My first step is a little seat-of-the-pants geometry with the Telrad, to get into the right general area. Then I compare what I see in my reversing finder scope with a good sky atlas, a maneuver which took more than a little practice, and eventually I march myself over to where the variable is penciled in on the atlas. If it's a B chart, I'm then likely to be on it somewhere. I nudge the scope in the general direction of north and note where the stars are coming into the field, to orient the chart. If there is only a D chart, hopefully it has a distinctive asterism on it, or I'll pass right over it searching. Charts like that go into the Ford file.

If I can't figure out where I am in the finder scope, then I will have to hop from the nearest third-magnitude star, which takes time.

Another coping mechanism is specialization … some parts of my sky, particularly the north, since there are no shopping malls between here and Mt. Wilson, are darker than others. I rarely look at any star farther south than RS Oph (which is easy to find). I have to bid adieu to my seasonal friends sooner than most observers do, because the west positively glows.

Basically, most everyone else's easy stars are my deep sky objects. Most people's binocular stars are pretty easy for me in my 10-inch scope. Other people's naked eye stars, I do in my finder, sometimes traveling a good bit to get to the comp stars. And, I actually have a few naked eye stars on my own list: Betelgeuse, alpha Her, gamma Cas. Can't think of any more off hand.

Interestingly, I can see some cultural and historical aspects to our local light pollution. The city street lights on the older streets are often sodium lamps, and properly directed downward to where they are needed. Mt. Wilson friendly, you might say. The newer ones are not. Nor is any of the parking lot lighting, or advertising of any sort. Exactly when, I wonder, did we give up on the stars and embark on our free-for-all light fest? Probably there was some turn-over on the City Council, or some such. The big-name observatories moved to the Andes. Who knows? Who would think that common people might want to look at the stars?

So how many variable star observers does it take to change a light bulb? I don't see any volunteers stepping forward ...

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Good observing!

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