# THE ESTIMATED DISTANCES OF NOVAE N OPHIUCHI 2008

**by Michael A. Earl**

Since June 3, 2008, I have been measuring the apparent brightness of two novae in southern Ophiuchus.

As of September 24, 2008, the first nova, N Ophiuchi 2008 #1, has been measured at (unfiltered CCD) magnitude 12.6. It is continuing to dim, but much more slowly than its cousin, nova N Ophiuchi 2008 #2, which disappeared from my detection in early August. According to current trends based on my photometric measurements, the first nova will disappear from my view sometime in mid 2009, over one year after its discovery!

The two novae can be considered as textbook cases of a “fast nova” and a “slow nova”. Nova N Ophiuchi 2008 #1 is the slow nova, taking months to dim, while its cousin, #2, is the fast nova, having required only 3 months to fade from magnitude 12 to magnitude 19.

After doing some research, I have found that there is a direct correlation between the time a nova takes to dim 2 magnitudes from maximum and its maximum absolute magnitude. The faster a nova dims, the brighter its maximum absolute magnitude. Once the absolute magnitude is found, its approximate distance can be determined, but only if the galactic absorption is taken into account.

Whatever my distance results were, they would have to be less than 76,000 light years. The Milky Way is approximately 100,000 light years across. Since both novae are (angularly) located near our galaxy’s center, the distance of the two from us cannot be more than the distance from us to the furthest edge of the galaxy. Only supernovae can be detected in external galaxies, so these novae cannot be extra-galactic.

I had to be ready for some strange conclusions. Nova #1 was $10^{th}$ magnitude at its brightest. Nova #2 was $12^{th}$ magnitude at its brightest. Naturally you would think that Nova #1 is closer than Nova #2, but we have to prove this scientifically to make sure!

I will not torture you with equations. I might save those for a paper later on. Graphs are not necessary either, as all this article will do is give the final results and try to explain why they are physically possible. The equations that I used came from Massimo Delle Valle and Mario Livio (1995). I found them within the American Association of Variable Star Observers (AAVSO) web site http://www.aavso.org/publications/ejaavso/v34n1/36.pdf.

For Nova #1, I calculated an absolute magnitude of -6.9. This is approximately 2100 times brighter than Sirius! This certainly qualifies as a nova! For Nova #2, the absolute magnitude was determined to be -7.5! This is approximately 3600 times brighter than Sirius and 1.7 times brighter than Nova #1.

This was my first surprise! Although Nova #2 appeared dimmer than Nova #1 at their brightest, Nova #2 had a brighter absolute magnitude than Nova #1! As I determined the novae's distances, I was shocked again.

**I arrived at 6400 light years for Nova #1 and 5900 light years for Nova #2.** So, it appears that Nova #2 is also closer to us than Nova #1. Nova #1 is 5 degrees from the galactic center. Nova #2 is only 3 degrees from the galactic center. This is actually a big difference. Physics often seems to find ways to totally contradict initial assumptions. These two objects are no exception.

For Nova #1, the galactic absorption was estimated to be about 0.86 magnitudes per 1000 light years of distance. This means that at 6400 light years, Nova #1 is dimmed by about 5.5 magnitudes from its true apparent brightness! For Nova #2, the galactic absorption was estimated to be about 1.38 magnitudes per 1000 light years. At 5900 light years, Nova #2 is dimmed by about 8 magnitudes from its true apparent brightness!

If the Milky Way did not absorb light, Nova #1 and Nova #2 would have been discovered at magnitudes 4.5 and 4.0, respectively. We would have suddenly seen two new naked eye stars in Ophiuchus.

Of course, all of the above can be taken with a grain of salt. You might get much different answers than I did, with just as sound rationale. I had to estimate some of the values and treat my unfiltered CCD photometric data as being in the visual wavelength (V). I did attempt to access other photometric measurements, but the data I found was all over the map, and I thought that using my own data was at least more consistent if not more accurate. It is also very true that the distance error would be proportional to the true distance itself. Finally, the galactic absorption is very uncertain near the galactic equator.

There is so much more to tell, but if I wanted to tell the whole story here, this month's AstroNotes would be the size of a telephone book. The story's not over either! I will continue to measure the brightness of Nova #1 until it disappears into the twilight sky. I will then try to pick it up again after it re-emerges from the dawn glow sometime in February until it fades to black.

You can view the further adventures of novae N Ophiuchi 2008 #1 and #2 on my web site at www.castor2.ca/14_Images/Novae.