Possibly Useful Information

RR Lyrae stars have M_v=0.6

The period-luminosity relationship for Classical Cepheid is given by

$$M_v = -2.81log(P) - (1.43 \pm 0.1)$$

Where P is given in days

Data for the Sun

- Mass ≅ 2 x 10^{30} kg
- Radius ≅ 7 x 10^{5} km
- Luminosity ≅ 3.8 x 10^{26} W
- Temperature = 5778 K
- Spectral Type G2V
- Absolute visual magnitude M_V = 4.83

1 Astronomical Unit ≅ 1.5 x 10^{8} km

DSO's for this year

Circinus X-1
RU Virginis
Epsilon Aurigae
RX Andromedae
Z Andromedae
SN 1006
RX J0822-4300
G292.0+1.8
NGC 2440
Betelgeuse
RS Ophiuchi
Mira
T Tauri
RS Puppis
Hinds Variable Nebula

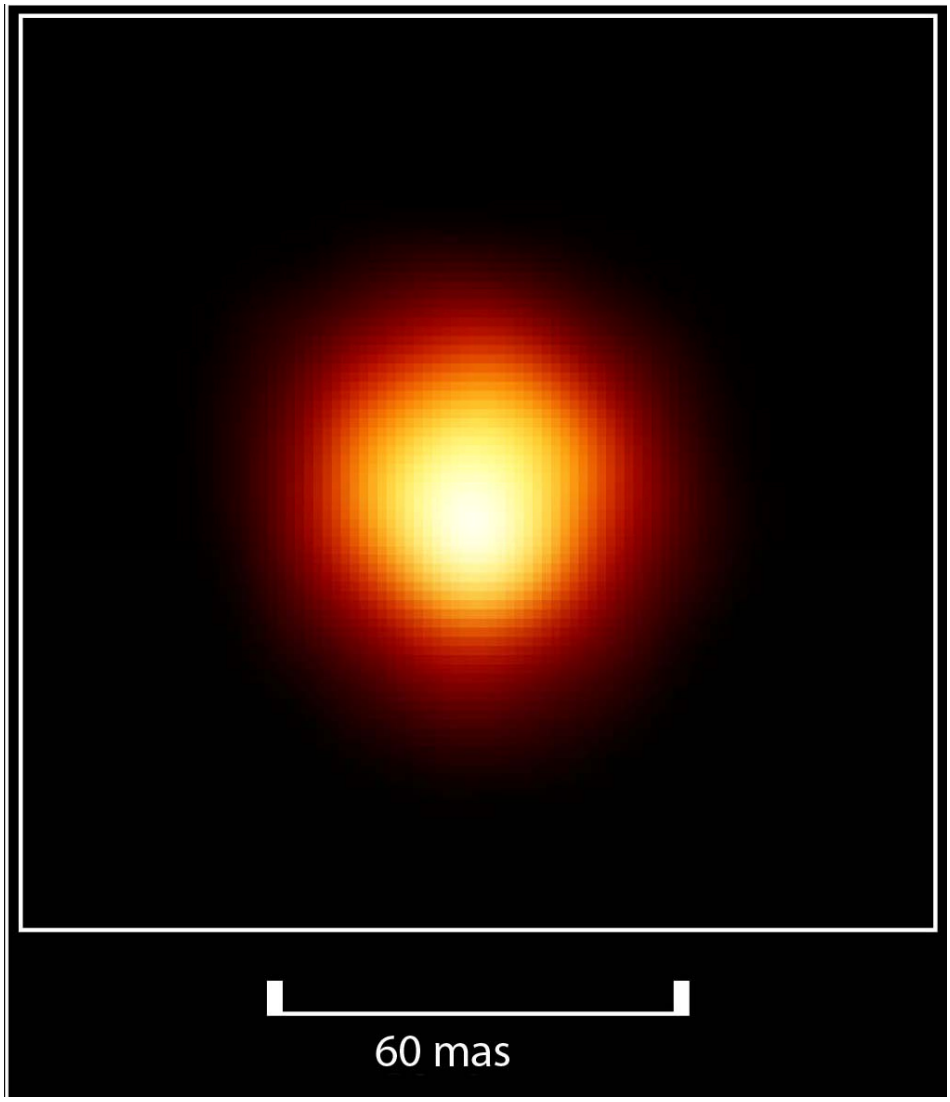
 Team Name_____ Team Number_____

Point values for the problems

1a 6	3b 2
1b 4	3c 4
1c 6	3d 10
1d 6	4a 2
1e 6	4b 2
1f 6	4c 6
1g 2	5a 2
1h 2	5b 2
1i 15	5c 4
2a 2	5d 5
2b 4	5e 2
2c 2	6a 2
2d 2	6b 2
2e 4	6c 4
2f 8	6d 4
3a 2	Total Points 130

3 Team Name_____ Team Number_____

1 This is a picture of one of this year's DSOs, α Orionis or Betelgeuse.



For the purpose of this exercise we will assume:

This picture is taken in the V band, in spite of the color.

The scale bar gives the measured diameter of the object as 60 milli arc seconds (mas).

The apparent V magnitude of the object was measured on the day the picture was obtained m_V=0.58.

The temperature of the star is 3100 K.

The parallax of the star is **7.63 mas**

4 Team Name_____ Team Number_____

a Given the temperature of the object, what would be the wavelength of the peak of the object's spectrum. _____

b Would this peak be included in the band that the image was made in? _____

And why?_____

_____

_____

c What is the absolute magnitude of the object? _____

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d What is the star's radius in km? _____

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 Team Name_____ Team Number_____

e Find the ratio of the luminosities of Betelgeuse and the Sun by comparing their absolute magnitudes. _____

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f Now find the ratio of the luminosities of Betelgeuse and the Sun by comparing their radii and measured temperatures. _____

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 Team Name_____ Team Number_____

g Look at your answers for parts e and f. Are the same? _____

Are they close (in an astronomers sense)? _____

h We now have two derived (calculated from experimental measurements) for the value of the ratio of the luminosities of Betelgeuse and the Sun. Assume that we have the values for the Sun measured correctly. Given that any measurement will have some error associated with it, which of the following measured quantities for Betelgeuse would make the largest contribution to the overall error in our determination absolute magnitude assuming that the error in each measurement was 5%.

1 Angular Diameter _____

2 Distance _____

3 Temperature _____

4 Apparent Magnitude _____

i Support your answer for part h (i.e show some work) _____

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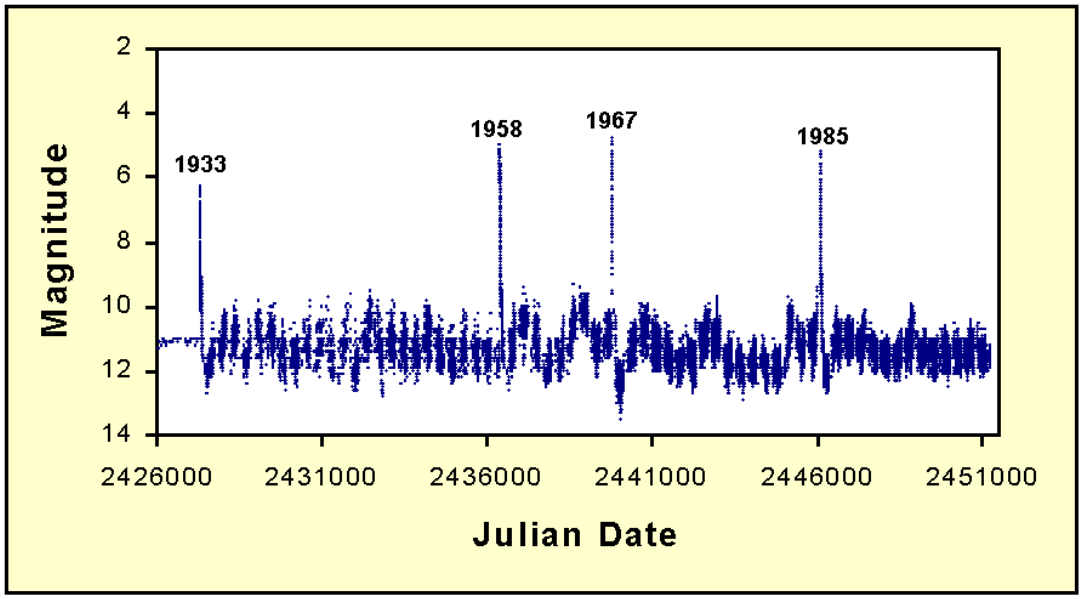
7 Team Name_____ Team Number_____

2 This is a spectrum of one of the DSO's for this year.



a Which of our DSOs is shown here? _____

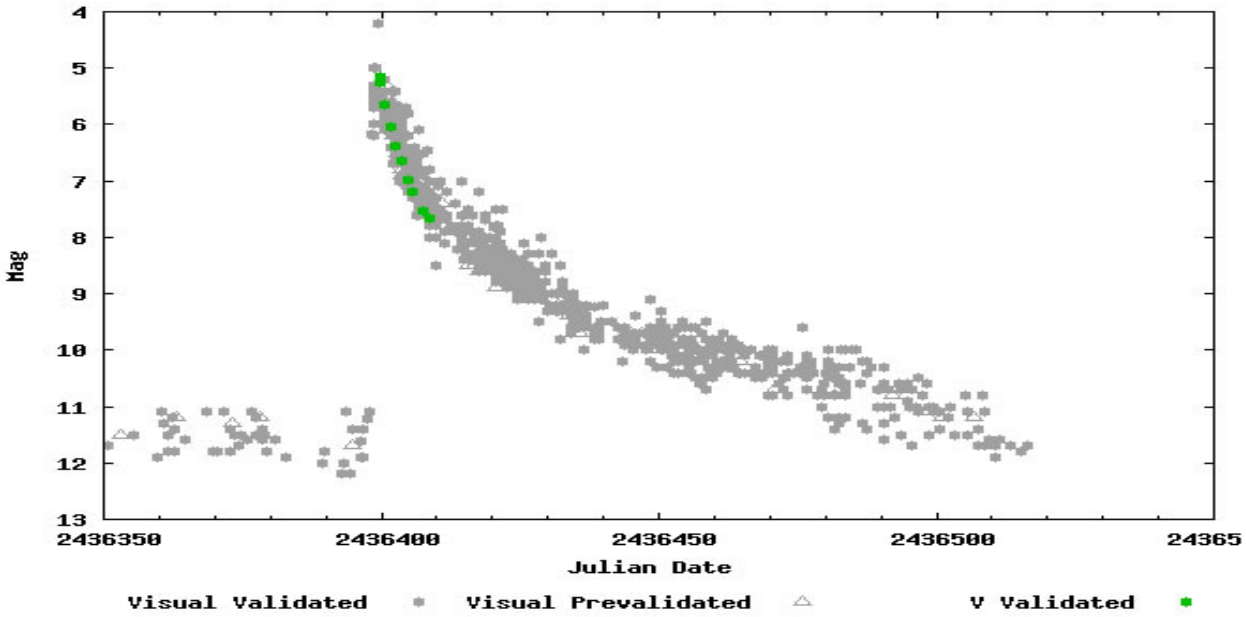
b What sort of variable star is this DSO? _____

c At a maximum, could an observer see this object with the naked eye?_____

d Would this object be observable from Mentor High School (assuming a power outage took out all of those nasty city lights and some thoughtful lumberjack had cleared all of the trees from the southern horizon)?_____

 Team Name_____ Team Number_____

Here is a closer look at the 1958 outburst



e Looking at the rapid rate of the increase (less than 1 day) do you think a change of temperature or a change of size caused most of the observed change? _____

f Why. _____

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9 Team Name_____ Team Number_____

3 This is a false color image of the field of one of this years DSOs.

a Which object is in this field?_____

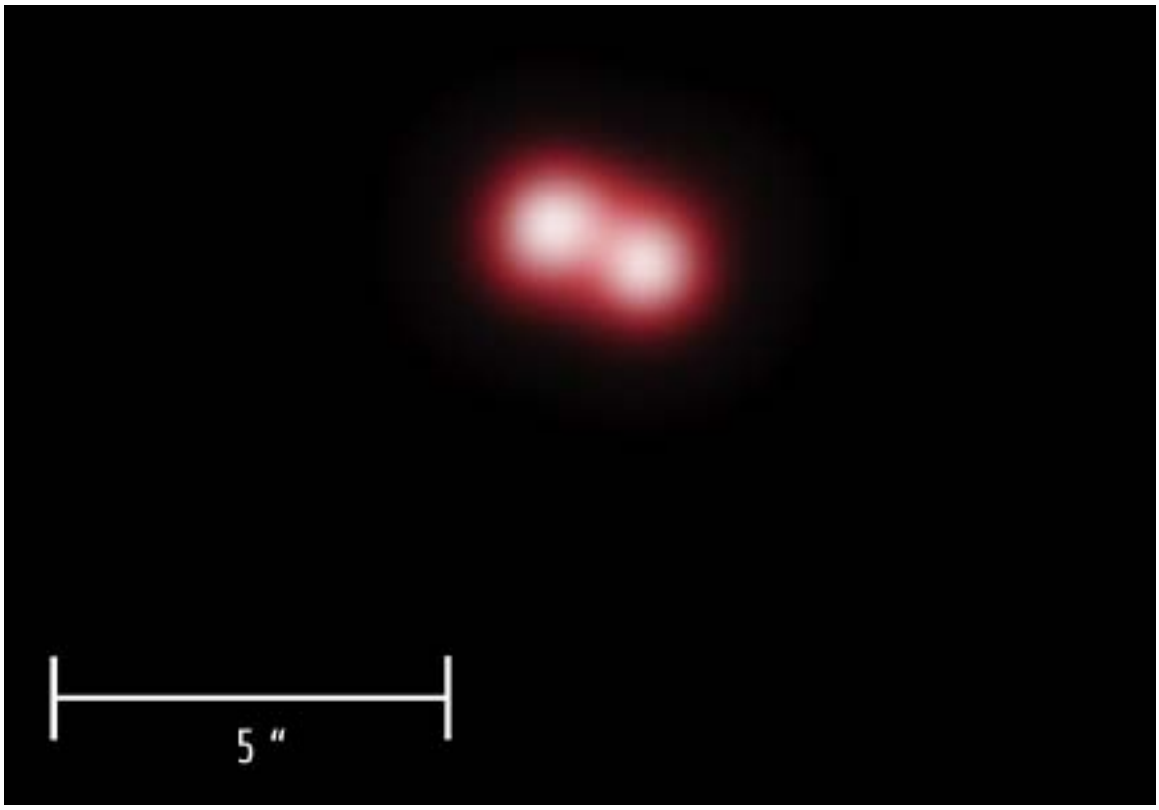
b What sort of object is this?_____

c What part or parts of the electromagnetic spectrum are represented in this false color image?

_____

This is a close-up of an overlay of two images of the DSO, taken 12/21/1999 and 04/25/2005, with a scale bar.

A radial velocity measurement of the object give a value of +1350 km/sec.



d Estimate the distance to the object, assuming that the motion of the object is along a line at 45^{o} to the line of sight. _____

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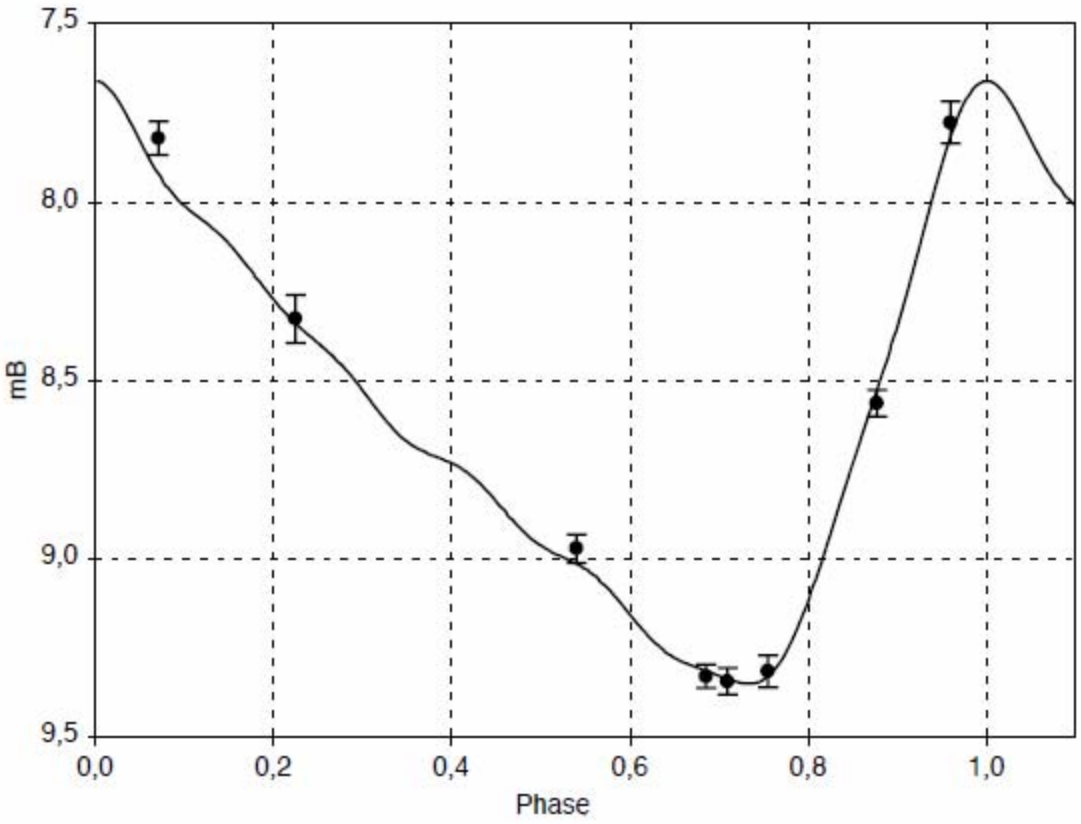
 Team Name_____ Team Number_____

4 This is a light curve for one of the DSOs



The period of the variable is 41.5 days. The ligh curve given is in the B band. A visual magnitude for this object is $m_V = 7.0$.

a Which of our DSOs is this? _____

b What type of variable star is this? _____

c Calculate the distance to this object from the data given. _____

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 Team Name_____ Team Number_____

5 This is a picture of two of our DSOs.

Which two DSO's are represented in this picture?

a _____

b _____

c Label two objects in the picture. An arrow with an a or b at the end will do.

d Describe what we are seeing here in terms of the life of a star. _____

_____

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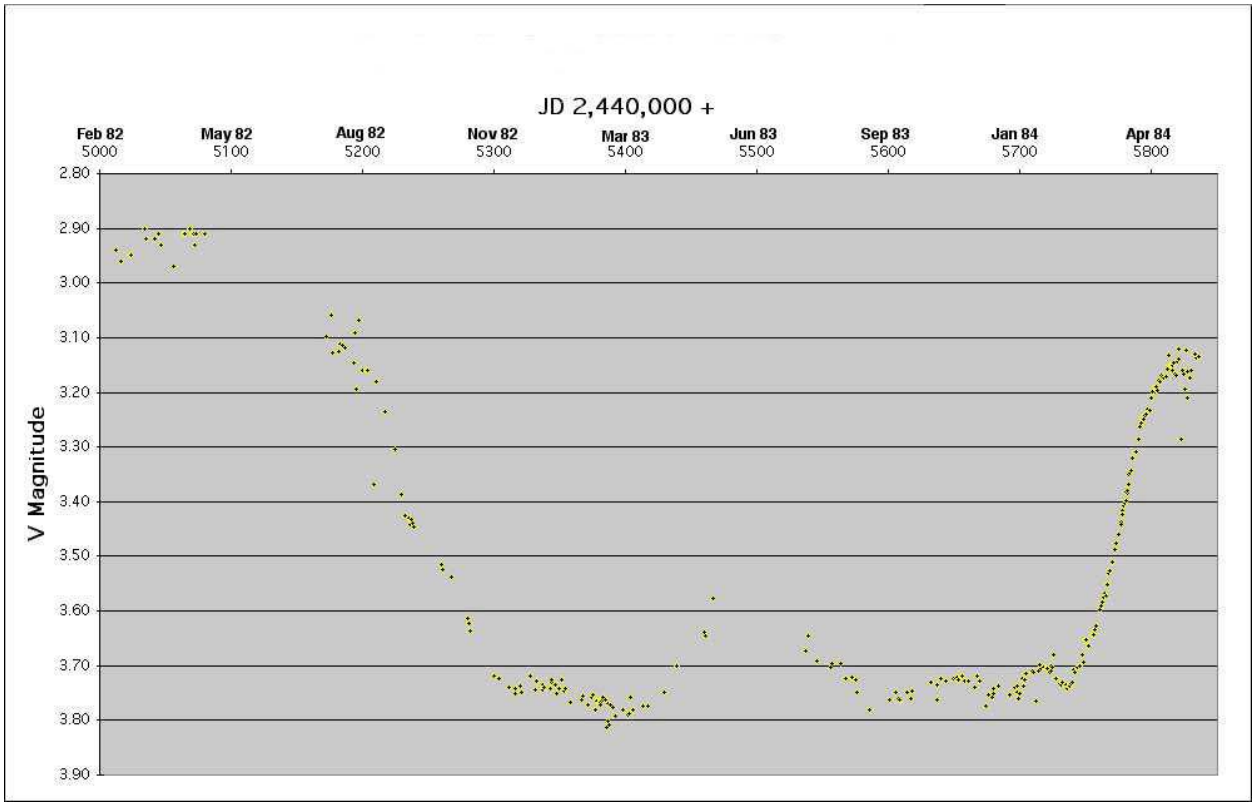
e Assuming clear weather (never a good assumption in February in Northeast Ohio), could we observe this object from Mentor after dark tonight? _____

13 Team Name_____ Team Number_____

6 This is a light curve for one of the DSOs.



a Which DSO is this?_____

b What sort of variable star is this? _____

c This plot only shows the "Interesting" part of the light curve. If you have answered part a and/or part b correctly, you should be able to tell me about the rest ("Boring" part) of the light curve. Do so. _____

_____

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d If you were paying attention to this year's event description, you should be able to tell me why this DSO is particularly topical. Do so. _____

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