P2_5 The Apparent Magnitude of α Orionis Supernova

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Abstract

The star α Orionis (Betelgeuse) is to become a type II supernova at the end of its life. Some have postulated that this supernova will be bright enough that it will be visible during the day. Betelgeuse will have an apparent magnitude of around -8.7, brighter than Venus, which can be seen when the sun is low in the sky. The star α Orionis will be most probably be visible throughout the day when it reaches the final stages of its evolution.

Introduction

Betelgeuse (α Orionis) is a red supergiant in the constellation Orion and is expected to become a type II supernova [1,5]. When this star becomes a supernova, it will radiate far more light and will become brighter in the night sky. This paper contains an investigation into the prospect of being able to see the supernova during the daytime.

Analysis

To see if the supernova is visible during the day, its apparent magnitude must be compared to that of the sun. Apparent magnitude is a measure of the brightness as seen by an observer on Earth normalised to the value it would have in the absence of the atmosphere; the brighter the object, the lower the magnitude. To find apparent magnitude, the flux on Earth must be found from both bodies using equation 1.

$$F = \frac{L}{4\pi D^2} \qquad (1)$$

The luminosity distance equation [2] calculates the flux (*F*) reaching an observer as a function of the luminosity (L) and the distance (D). To find the apparent magnitude of Betelgeuse equation 2 was used [3]:

$$m_{Be} = 2.5 \log\left(\frac{F_{Sun}}{F_{Be}}\right) + m_{sun} \qquad (2)$$

where m is the apparent magnitude and F is the flux of the object denoted in the subscripts respectively. The apparent magnitude of the sun is a known value and so is the distance between Earth and the Sun (1AU).

Expressing the distance to Betelgeuse [4] in AU, gives a distance of $40.6 \times 10^6\ D_{Sun}$. The luminosity of a Type II supernova is $10^8\ L_{Sun}$[5], so $\frac{F_{Sun}}{F_{Be}}$ can be expressed as a ratio:

$$\frac{F_{Sun}}{F_{Be}} = \frac{1.65 \times 10^{15}}{10^8} \qquad (3)$$

The apparent magnitude of the sun (m_{sun}) is -26.74[6]. From equation 3 and the aforementioned values the apparent magnitude of Betelgeuse is ≈ -8.7.

Conclusion

It has been found that when α Orionis becomes a supernova, it will be visible during the day. However, it will appear as a bright star rather than illuminating the Earth in the same way as the sun or moon. The moon has a mean apparent magnitude of -12.74 [6], and gives just enough light to help see in the dark. Venus has an apparent magnitude of -4.6 [6] and is visible when the sun is low in the sky. With an apparent magnitude of -8.7, Betelgeuse will definitely be visible during the day depending on the position of the sun in the sky.

References

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