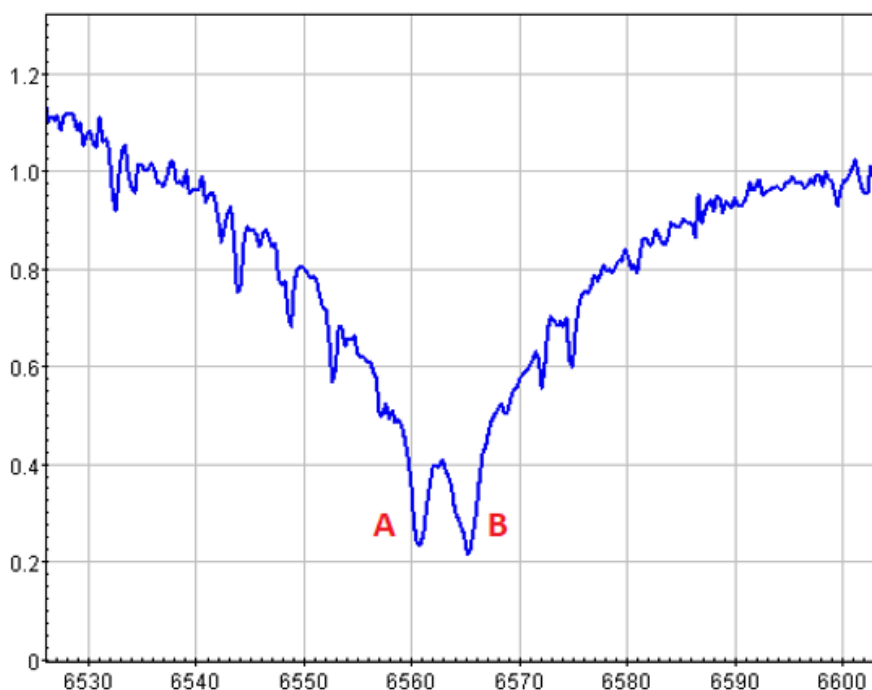


Menkalinan (β Aurigae) (13 points).

Almost half of the stars that we see are either binary or multiple star systems. A well-known example of this is Menkalinan (Beta Aurigae), which was initially thought to be a single star, but today recognised as a binary system comprising two stars that we will refer to as Menkalinan A and B. In the following figure, a spectrum of the system (obtained by the observatory of the Universidad de los Andes, in Bogotá) is shown:



Spectrum of Menkalinan binary system in the region of $H\alpha$. Y-axis is for the relative flux, and X-axis measures wavelengths. Menkalinan A is marked as A in the graph, and Menkalinan B is marked as B.

Answer the following questions using the plot and noting that the wavelength of $H\alpha$ line in the laboratory frame is 656.28 nm . Assume circular orbits, and assume that the binary system as a whole is at rest with respect to the observer.

7.1 In the spectrum, we can see the $H\alpha$ line for each star in the system. Calculate the line-of-sight velocity of each star (km/s) and determine, at the time of this observation, which of the two stars is moving towards us. 5.0pt

7.2 The binary system is located 81.1 light years from Earth and has an orbital period of 3.96 days. The semi-major axis for Menkalinan B (smaller star) was measured to be $3.35 \text{ milliarcseconds}$. If the mass ratio of the two components is 1.026, find the total mass of the system (in solar masses). 4.0pt

Theory



Q7-2

English (Official)

7.3	Calculate the individual masses of Menkalinan A and B in solar masses.	2.0pt
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7.4	Since Menkalinan A and B are main sequence stars, use the relation:	2.0pt
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$$\frac{L}{L_{\odot}} = \left(\frac{M}{M_{\odot}}\right)^{3.5}$$

to estimate the luminosity of each star (in solar luminosity).