

Homework 8

Due **November 5 by 11:59pm via Canvas upload**

Please show all work, writing solutions/explanations clearly, or no credit will be given. You are encouraged to work together, but everyone must turn in independent solutions; do not copy from others or from any other sources.

Don't forget to turn in HW 7, Problem 3 by Friday as well!

1. You have taken the spectrum of a star with apparent mag $m_V = 14.3$ and color $(B - V) = 1.9$. Using this spectrum, you have calculated the star's temperature to be 4000 K and its surface gravity to be 380 m s^{-2} . (HINT: Tables A.5-A.6 in your textbook contain useful stellar info. Do not trust the $\log(g/g_\odot)$ values column).
 - (a) What is the spectral type and luminosity class of this star?
 - (b) What is the color excess $E(B - V)$ of this star (in magnitudes)?
 - (c) What is the extinction A_V of this star (in magnitudes)? Assume the interstellar dust follows an $R_V = 3.1$ extinction law.
 - (d) What is the distance to this star (in parsecs, pc)?
 - (e) If you had ignored the presence of dust, what distance would you have calculated?

2. Of the five methods for detecting interstellar gas described in the textbook, which one is best-suited to mapping the vast amounts of neutral hydrogen gas spread throughout the Milky Way? Justify your answer thoroughly.

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3. You observe an interstellar cloud made of nearly pure molecular hydrogen (assume pure H_2 , so the mean molecular mass $\mu = 2$), with a temperature of $T = 10$ K, an adiabatic index of $\gamma = 7/5$, and a mean mass density of $\rho_0 = 5 \times 10^{-12} \text{ M}_\odot \text{ AU}^{-3}$.
- (a) What is the speed of sound within this cloud?
 - (b) What is the Jeans length of this cloud (in AU)?
 - (c) What physical limit does the answer in part b) represent?
 - (d) You observe your cloud to have a flattened, disk-like shape, with a disk radius of twice the Jeans length and a rotational speed of 42.7 m/s at the edges. Ignoring rotational pressure support, and assuming conservation of angular momentum, how fast will the disk edges be rotating if the cloud collapses to a radius of 30.1 AU (the semimajor axis of Neptune's orbit)?
 - (e) How does this rotation speed compare to the speed of Neptune along its orbit?