Homework 2

Due **September 10 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.

1. A star is measured to have a parallax angle $\pi'' = 0.10''$.
   (a) How far away is the star (in parsecs)?
   (b) How does this distance compare with that of the brightest stars in the sky? (HINT: use Table A.8 in the back of the textbook)
   (c) The Gaia satellite is the most recent effort to measure the parallaxes of stars in our Galaxy, with over 1 billion parallaxes measured for stars out to distances of 4 kiloparsecs. How precise must Gaia's parallax measurements be to be able to estimate the distance to the most far away of these stars?

2. The differential gravitational attraction of the planets is sometimes used by astrologers to justify how the positions of planets could affect people on the Earth. Compare the magnitude of changes in the gravitational force (between maximum and minimum separation) of you and Jupiter, F_J, with similar changes between you and a big dog, F_d, when it jumps on you in greeting versus when you are miles away at school or elsewhere. Is this justification of astrology viable?

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3. Consider an exoplanetary system around a 2 $M_\odot$ star with 2 planets on circular orbits, both with intelligent civilizations. The two planets are 2 AU and 3 AU from their star, and the civilizations conduct regular trade using energy-efficient Hohmann transfer orbits (although they call them Hwfffffluggen87tWWn Orbits, after the first traveller to successfully make the voyage, the space adventurer Dr. Orbits). Answer the following questions using Earth units (i.e., 1 AU is the Earth-Sun distance, which are the units given above, and years are Earth years).

   (a) What is the semimajor axis of the transfer orbit?

   (b) How long is a year on each planet?

   (c) How long does the journey take between planets?

   (d) Draw a picture of the orbit, indicating where both planets are when a ship leaves on a trip from the innermost planet, and also where both planets are when the ship arrives at the outermost planet.

4. Imagine the alien civilizations from Problem (3) orbit the star from Problem (1), with $\pi'' = 0.10''$, and they've detected our radio transmissions and want to pay us a visit. Assuming they can build a spaceship that can last a long time, but they are barely able to accelerate it to a speed that will allow it to leave their star system from the orbit of the outermost planet, how long will it take the ship to make the journey to Earth?