HOMEWORK #3 (due start of class Jan. 24)
(copyright D. McCarthy)

LEARNING GOALS for this assignment:

1. To understand the concept of parallax.
2. To understand the concepts of astronomical coordinate systems.
3. To apply the above ideas via practical situations in modern astronomy.

TO RECEIVE FULL CREDIT:

1. Staple multiple pages and identify yourself by Star Name (worth 5 points!).
2. You must **show how** you derived your answer by writing all the logical steps that led you to it. Follow the format of the "Homework Example" on our Web site.
3. All sentence responses must be typewritten and in complete sentences. You may handwrite any arithmetic. Use good English grammar.
4. **If you work more than three hours on this assignment, you should stop, record your work here, and contact Dr. McCarthy or Mr. Hammer (our Teaching Assistant) for help.**

Part I: Read sections 2.1 through 2.2 (Ryden and Peterson's book) to review this week's concepts and to prepare for next week's classes.

Part II. Equatorial Coordinates

1. Could the famous navigational star "Canopus" be observed from Tucson (latitude +32.25 degrees)? In other words, could Canopus be seen above our southern horizon? Canopus has a Declination (DEC; δ) of -52:41:44.

Part III: Parallax

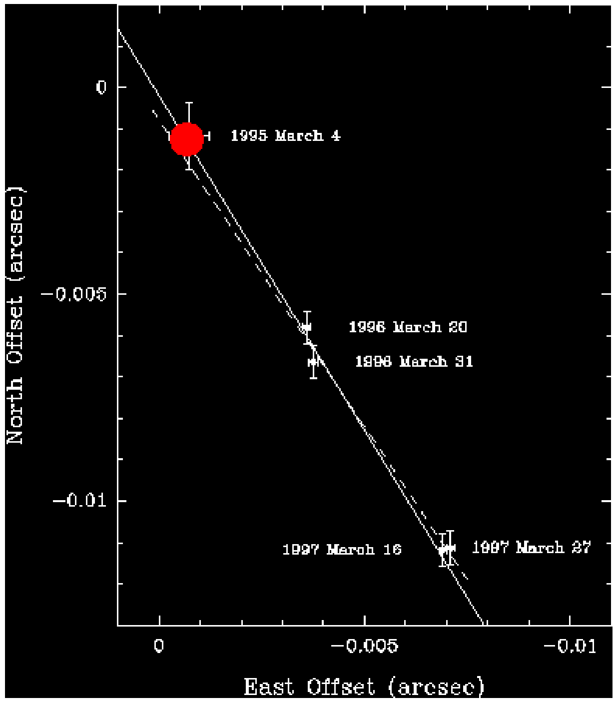
Solve either problem #2 or #3.

2. Parallax of stars in our galaxy. Europe's Gaia spacecraft is measuring the positions of about one billion stars in our Milky Way galaxy. Gaia can measure parallax angles as small as 7 microarcsec (7 μas). The spacecraft is located at Earth's Lagrange point (L2), i.e., a distance of ~1.5 million km from Earth in a direction opposite the Sun.

a. What distance (in kpc and light-years) corresponds to this parallax angle?

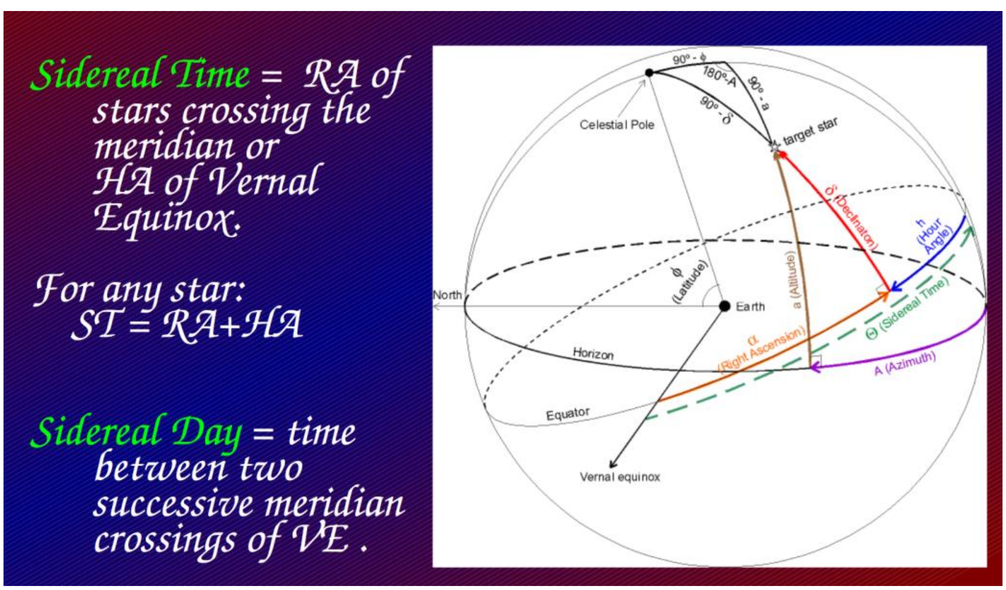
b. Express this distance as a percentage of our galaxy's diameter (~10^5 light-years).

3. Parallax to our Galactic Center. The center of our Milky Way galaxy contains a "supermassive black hole" (aka, Sagittarius A*, abbreviated Sgr A*). The region around Sgr A* emits light at radio wavelengths which, in contrast to visible light, can penetrate the intervening "interstellar dust" and be detected by telescopes on Earth. The data shown below shows how the apparent direction to Sgr A* changes (EW and NS components) over two years as our Solar System revolves inside our galaxy. Our Solar System moves 230 km/sec or equivalently ~45 AU/year (i.e, the Sun-Pluto distance). Use the concept of "parallax" to calculate the distance from Earth to the center of our galaxy.



Part IV: Local Sidereal Time (LST)
Do not submit an answer but come to class prepared to share your thoughts, diagrams, algebra, etc.

"Local Sidereal Time" is the Right Ascension of an object that is transiting the meridian. Read the following information about "Local Sidereal Time" and Hour Angle" and study the following illustration in that context: https://lco.global/spacebook/sidereal-time/



http://www.physics.hmc.edu/faculty/esin/a101/lectures/lecture2.pdf

On 17 August 2017, 12:41:04 UT (i.e., Universal Time), the gravitational-wave observatory, LIGO, detected an event (aka, GW170817) from a pair of merging neutron stars. The estimated location had coordinates of (RA: 13:09:48.08; DEC: -23:22:53.3). Quickly, an electronic alert message was sent around the world, encouraging astronomers at observatories around the world to record the event across the spectrum of light. This event provided an opportunity for “multi-messenger” astrophysics.

In Greenwich, the Local Sidereal Time (LST) was 10.35 hours. The 1-meter Swope Telescope in Chile (longitude: 70:42:05.9 W; latitude: -29:00:35.85) was the first facility to observe the object. At the time of the event, what was the object’s Hour Angle at the Swope Observatory; in other words, could Swope astronomers have observed the event immediately or did they need to wait some amount of time for the object to rise in their sky? [NOTE that right ascension increases towards the east.]