

Observing Lab 2: Astronomical Coordinates

1 Goals

The goals for this lab include understanding the use of two-angle coordinate systems to locate objects on the celestial sphere, specifically the "altitude-azimuth" local coordinate system and the "RA/Dec" celestial or equatorial coordinate system. This lab also covers the concepts of Ecliptic coordinates of planets and the best time to observe an object.

2 Preparation

- You will need to go to the "Stellarium" website (stellarium.org) on your computer.
- Open Stellarium and set the simulator to your current location and close the window.
- Open the date and time window. Set the date and time to April 1, 2025 at 9pm (for the current time zone). Stop time (or click on the pause button in the time controls).
- Go to the View Setting tab and check "Meridian" and "Equator (J2000)".
- Left-click on an object in the sky to select it and hit the spacebar to keep it centered. Right-click to deselect the object. You can open the search window to find and select named objects.

3 Questions

Use Stellarium to answer the following questions. For each stellarium situation, indicate the location and the time. You can (and probably should!) ask for help on these questions from the instructor and TAs, but otherwise you must complete the lab questions independently. The answers you submit must represent your understanding of how to answer the questions.

3.1 Movement of the Sky

- Look to the South, with the Meridian in the middle of the screen. Increase the time by a couple of mins. Note how the stars move relative to the Celestial Equator. Which way does the sky "turn" (up? down? left? right?)? Explain your answer.

- Look to the North, and again speed up time by three notches. Describe the motion that you see. Which way does the sky "turn"?
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3.2 Az-Alt vs Equatorial Coordinates

If needed, reset the date to 4/1/2025 at 9pm local time zone time, and answer these questions.

- What are the altitudes and azimuths of Polaris, Altair, Arcturus, Jupiter, and Saturn? Which of these objects are east of the Meridian and which are west of the Meridian? What do you notice about the Altitude values of the objects under the ground?
- Let time run forward one hour and measure these altitudes and azimuths again. Have they changed? Do the directions and magnitudes of the changes make sense?
- Go back to 9pm on this same date, and look up the RA and Dec (J2000) of these same objects.
- Step forward by one hour again and look up the RA and Dec of the objects again. Have they changed? Do the directions and magnitudes of the changes make sense?
- Of all of these 5 celestial objects, which is the furthest "east" on the celestial sphere? Which is furthest "west"? Which is furthest "south"? Which is furthest "north"? Explain your answers.
- At what time (local time) do these objects transit (on the date of Apr. 1, 2025)? (Passes the Meridian / Az = 0 deg) What are the altitudes of these objects at the time of transit?
- Explain in your own words why astronomers almost always specify the coordinates of a target (like a galaxy, star, or whatever) using equatorial coordinates rather than Alt-az coordinates. Also explain why astronomers always have to specify the date of the RA/Dec coordinates (such as "J2000").

3.3 When can we observe sources?

Using Stellarium, determine the best time (Eastern Daylight Time) to observe the following objects on the night of Apr. 1, 2025 / Apr. 2, 2025 using a telescope here at Pupin Hall, New York (latitude = 40.80° N, longitude = 73.96° W, in the Eastern Time Zone), and what will be the altitude of the object at this time? Ensure the sun is completely set, and the source is not under the ground. (Pretend light pollution is non-existent for now.)

- NGC 3587, the "Owl Nebula"
- NGC 3242, the "Ghost of Jupiter Nebula"
- M51, the "Whirlpool Galaxy"
- M82, the "Cigar Galaxy"
- M101, the "Pinwheel Galaxy"
- M104, the "Sombrero Galaxy"

Look up images of these sources. Which source do you like the most? Why?

3.4 Observing (If Time)

As a group, you will get to pick an object to try to find outside. We will be observing in Pupin Plaza, but directions in the North are blocked by the building. Change the location to Morningside heights and the time to 9 pm. Then, look towards the southeast to the southwest region and find an object. Ensure this object is bright, with a Magnitude < 10 and above the ground.

Write the name of the source here and its:

- Azimuth and Altitude Coordinate
- RA and Dec Coordinate
- Magnitude Now we will try to find this object!

4 Conclusions

1. If the lab was perfectly clear to you, what did you like or dislike? If not, what confused you? Any other feedback?