Remote-Individual Lab 1

Tracking the Apparition of Venus

Overview

Venus will be prominent for the rest of the semester as the Evening Star. We will observe it to see how it moves and how its appearance changes.

1. Introduction

Venus comes and goes. Sometimes it is the Morning Star, and sometimes it is the Evening Star. It changes brightness too. Galileo discovered that it changes shape, with phases like the Moon has. This pretty well finished off the Ptolemaic model. In the Copernican model, the phases are easy to understand.

2. Starting and Submitting a Report

You need some kind of observing log. A serious experimenter uses a special experimenters' notebook, but a couple of sheets of paper on a clipboard will do fine. There are observing log templates at the back of this lab. Each entry in the log will begin with the date and the time. Then a sentence or two, like:

2020-03-26, 8:30pm, clear skies. No Moon visible. Easily found and plotted Venus on the star chart. Three finger widths below Aldebaran. Extremely bright and steady.

A star chart is in Section 4 and a full page version of the chart is at the end of this writeup. Ideally you will be able to print out the last few pages of the lab writeup. If there is no printer where you are staying, we can mail you a copy! Email your lab professor if you need that.

The log, the observations, and the answers to a few questions will be your lab report. When you are done, PDF your report using GeniusScan (or any other app that turns your phone's camera into a good-quality PDF scanner),

https://thegrizzlylabs.com/genius-scan

On Wednesday, May 20th, you will email the PDF to your lab professor. *The lab professors are creating other labs that can go on in parallel with this lab.* So this will be your first remote-individual lab, and your last remote-individual lab, but there will be others in between. Among the three we are considering are the elevation of the Sun, the brightness of Betelgeuse, and the height of mountains on the Moon.

3. Observing Location and Times

The first thing to do is find a place that you can observe Venus whenever it is clear. You need a good view to the west, in the direction that the Sun goes down. If you have bad obstructions to the west where you live, search for a place that is convenient with a better view.

On any night that it is clear and you are going out to observe, go out just before 8:30pm. The stars will be out, and your main job is to accurately locate Venus among them. *If you set a daily alarm for yourself around 8:15pm, that will help you remember to go out and see if it is clear.* We are hoping you will get two clear nights a week on which you can make observations. Even though your observation time is fixed at 8:30pm, it will get closer and closer to sunset, because sunset will get later and later.

Day	Twilight start	Sunrise	Sunset	Twilight end
Wed, Mar 25	6:35:31 am	**7:01:45 am**	**7:26:15 pm**	7:52:28 pm
Thu, Mar 26	6:33:58 am	**7:00:13 am**	**7:27:10 pm**	7:53:25 pm
Fri, Mar 27	6:32:25 am	**6:58:42 am**	**7:28:05 pm**	7:54:21 pm
Sat, Mar 28	6:30:53 am	**6:57:11 am**	**7:29:00 pm**	7:55:18 pm
Sun, Mar 29	6:29:20 am	**6:55:40 am**	**7:29:55 pm**	7:56:15 pm
Mon, Mar 30	6:27:47 am	**6:54:09 am**	**7:30:50 pm**	7:57:12 pm
Tue, Mar 31	6:26:14 am	**6:52:39 am**	**7:31:45 pm**	7:58:09 pm
Wed, Apr 1	6:24:42 am	**6:51:09 am**	**7:32:40 pm**	7:59:06 pm
Thu, Apr 2	6:23:10 am	**6:49:39 am**	**7:33:34 pm**	8:00:03 pm
Fri, Apr 3	6:21:38 am	**6:48:09 am**	**7:34:29 pm**	8:01:01 pm
Sat, Apr 4	6:20:06 am	**6:46:40 am**	**7:35:24 pm**	8:01:58 pm
Sun, Apr 5	6:18:35 am	**6:45:11 am**	**7:36:19 pm**	8:02:56 pm
Mon, Apr 6	6:17:03 am	**6:43:43 am**	**7:37:14 pm**	8:03:53 pm
Tue, Apr 7	6:15:33 am	**6:42:15 am**	**7:38:09 pm**	8:04:51 pm
Wed, Apr 8	6:14:02 am	**6:40:47 am**	**7:39:04 pm**	8:05:49 pm
Thu, Apr 9	6:12:32 am	**6:39:20 am**	**7:39:59 pm**	8:06:47 pm
Fri, Apr 10	6:11:02 am	**6:37:54 am**	**7:40:54 pm**	8:07:45 pm
Sat, Apr 11	6:09:33 am	**6:36:28 am**	**7:41:49 pm**	8:08:44 pm
Sun, Apr 12	6:08:05 am	**6:35:03 am**	**7:42:44 pm**	8:09:42 pm
Mon, Apr 13	6:06:36 am	**6:33:38 am**	**7:43:39 pm**	8:10:41 pm
Tue, Apr 14	6:05:09 am	**6:32:14 am**	**7:44:34 pm**	8:11:40 pm
Wed, Apr 15	6:03:42 am	**6:30:51 am**	**7:45:29 pm**	8:12:39 pm

FIGURE 1. Sunrise and Sunset, Moraga

4. Star Chart

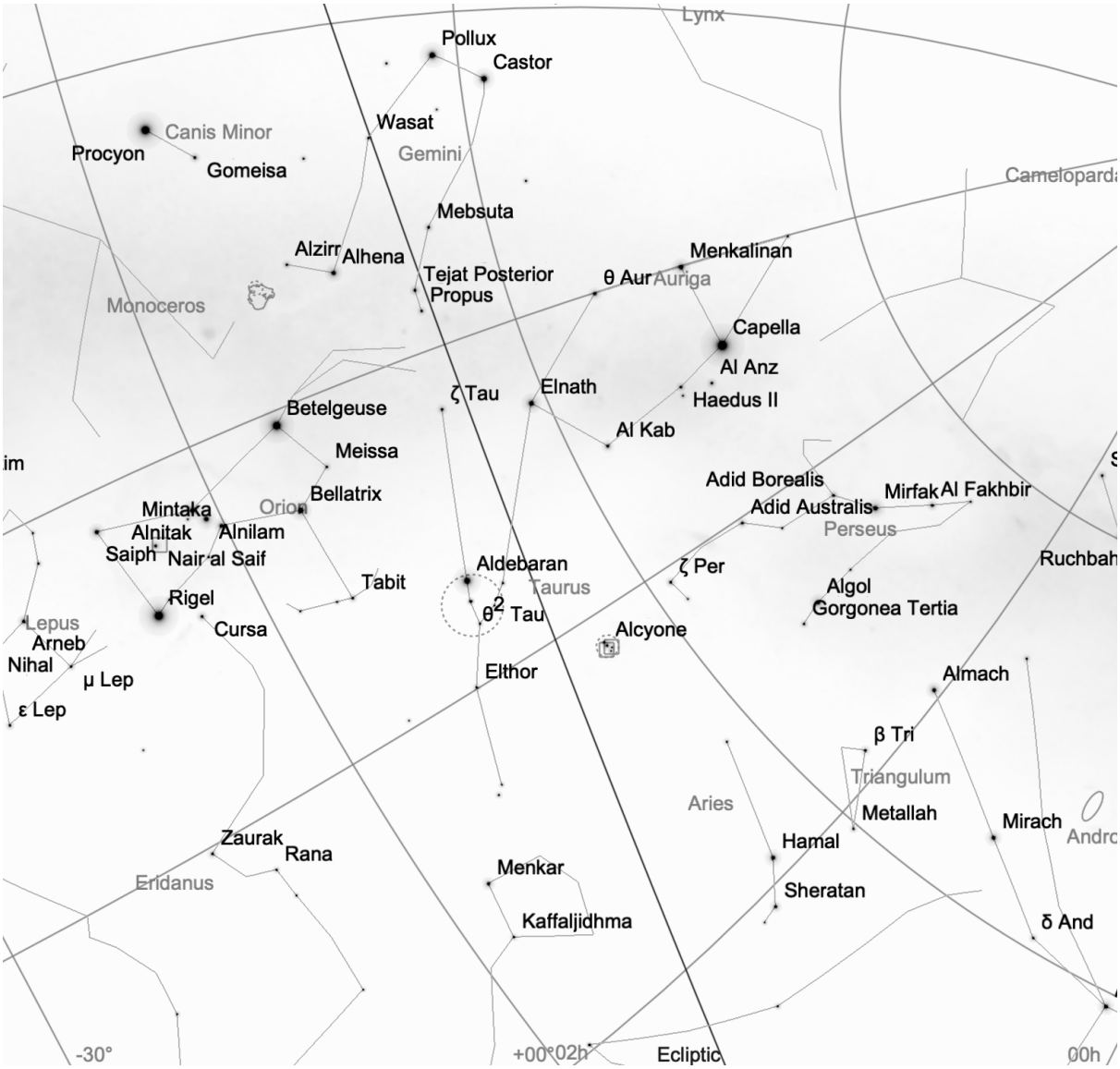

FIGURE 2. Looking Due West, 8:30pm, April 1, 2020, Stars to Magnitude 4

The star chart above is optimized for 8:30pm on April 1st. The stars shift a small amount each evening if you go out at exactly the same time. Print out and use the large version of this chart on the last page of this writeup to locate Venus. There aren't a lot of bright stars close to Venus. On some nights, the Moon might be among the stars in the chart. Whenever the Moon is visible, also record its location and phase in your log.

1. A question to answer in your report: by how much *earlier* would you have to go out each night (about how many minutes) if you wanted to see the stars in the same place each time?

5. Totally Optional, Requires Binoculars

It would be a blast if you can get your hands on some good binoculars. Then, like Galileo, you could observe the changing phase of Venus. If you are so fortunate as to own good binoculars, or have a friend or family member who will loan some, add whatever you observe about the phase of Venus to your observing log. If your eyes are excellent, you may get a hint of what is going on toward the end of the semester even without binoculars.

6. Discussion, Explanation, Retrograde Motion

In class, you constructed the retrograde motion of Mars. The orbit of Mars is larger than the orbit of Earth. You can also construct the retrograde motion of Venus. It has a smaller orbit than the Earth. It has the inside track and it is passing us up. As Venus passes us up, it will get ahead of the Sun, and after it does this, it will be the Morning Star. It passes the Sun on June 3.

Please use a separate sheet to answer all of the questions.

2. Give two good reasons why it is impossible to see Venus passing up the Sun. HINT: the reasons are the same as the reasons it is impossible to see the New Moon.

3. Why isn't Venus always along the Ecliptic? HINT: why doesn't Venus cross the face of the Sun every time it goes from being the Evening Star to the Morning Star?

4. By the end of this lab, you will have been tracking Venus for almost two months. That's one-sixth of a year. Based on your observations, what has happened to Orion the Hunter in this time?

5. Do the retrograde motion construction for Venus. Directions will be emailed and will be similar to the directions for the retrograde motion construction for Mars.

To summarize, the complete Venus observing lab report will consist of a PDF containing:

(1) Observing log
(2) Star chart with positions of Venus (and of the phases and positions of the Moon on days when the Moon is in the chart)
(3) A sheet with answers to questions 1-4
(4) Venus retrograde motion construction

Your lab professor may ask for intermediate progress reports to make sure you are off to a good start and so that people can share experience and learn from what is and isn't working.

We hope everyone enjoys doing this lab.

Date and Time	Conditions	Moon Phase (Draw)	Moon Position (Approximate)	Venus Position (as Accurate as Possible, place on Chart)	Venus Description (Brightness, Shape)

Observing Log — 2/2

Date and Time	Conditions	Moon Phase (Draw)	Moon Position (Approximate)	Venus Position (as Accurate as Possible, place on Chart)	Venus Description (Brightness, Shape)

Western Sky from Horizon to Zenith, on April 1 at 8:30pm