1. FINDING AND MEASURING THE PROPER MOTION OF AN ASTEROID

IN THIS TELESCOPE EXPERIMENT, YOU WILL LOCATE AN ASTEROID BY ITS EPHEMERIS POSITION AND IDENTIFYING THE "MOVING" OBJECT. THEN YOU WILL MEASURE ITS PROPER MOTION AND, GIVEN ITS DISTANCE DETERMINE ITS SPACE MOTION RELATIVE TO EARTH.

1. Before observing, choose the asteroid you wish to find as follows:

a. Using the world wide web, go to the minor planet website at:

`http://cfa-www.harvard.edu/iau/mpc.html`

b. Click on : Minor Planet & Comet Ephemeris Service

c. Enter the following asteroid names in the large box:

Ceres, Juno, Vesta, Hygiea, Proserpina, Eunomia, Dione, Sappho, Luisa, Dembowska, Nausikaa, Nemesis, Angelina, Pales, Victoria, and Zappafrank (actually too faint to be observed at SBO)

d. enter the start date for the ephemeris (the date of your planned observation in format: YYYY/MM/DD) and enter 30 days duration, just to be cautious. An ephemeris interval of one day should suffice.

e. obtain SBO's longitude, latitude and altitude from the SBO website under " SBO-INFO". You will also find the Observatory Code for SBO on this same page, so you can use that instead.

f. Click on: Get Ephemeris

2. Based upon the RA and DEC of the target asteroids ON YOUR NIGHT OF OBSERVATION, select two asteroids (you might not know yet which part of the sky will have clouds) and prepare a "finding chart" for those parts of sky as follows:

***CAREFUL: (1). Some of these asteroids cannot be easily observed in the early evening at this time of year !!!! Choose wisely! I have thrown in some "ringers", which, if you decide to observe them, you could point the telescope at the ground!!! You are warned ***

(2). The minor planet ephemerides are for UT = 0 for the day given. If you are observing on the evening of Feb 6, for example, you will wish to use the coordinate for Feb 7th since when you start observing it will already be a bit past UT = 0. ***

3. Go to the Space Telescope's Digitized Sky Survey service and obtain and print a "finding chart" for your asteroid. You will find a link to this service on our class web page: (`http://casa.colorado.edu/~keeney/classes/astr3510/`)

Enter the RA and DEC of the asteroid, select "POSS2/UKSTU Red", select "GIF" and click on "Retrieve Image". You can then print the image down at Cosmos (I am presuming that is where you are working from, in fact).

*** Why do you need a "finding chart". First, to make sure that the telescope is pointing in the correct place in the sky, since screwups do happen and they are not always your fault (i.e., telescope didn't set correctly, etc). Second, the asteroid will be a bright object NOT on your finding chart. ***

4. Take an image through the Hα filter of two of these asteroids. Do NOT saturate the brightest objects in your image. Record the EXACT start and stop time (use Universal time for this, but Mountain time would suffice) of your images.

5. Return to this same fields 0.5 - 2 hours later and take a second image, also recording the exact start and stop times.

6. We will help you discover how to use XIMTOOL in IRAF to load two images and "blink" them to see which object moves. Eventually you will want to measure the motion of the moving asteroid relative to the "fixed stars" in the same images. This determines the proper motion from our viewpoint.

7. Once you have obtained a proper motion in some units, say arcsec per minute of time, it will now be possible to compute the velocity of your asteroid across the sky. On the minor planet ephemeris printout, you will find a column labeled "Delta", which is the distance from Earth in Astronomical Units (AU). The column labeled "r" is the distance this asteroid is from the Sun in AUs. Recalling that 1 AU = 1.5 x 10^6 kilometers, solve the "skinny triangle" to obtain the velocity on the sky of your asteroid in kilometers per second (careful to follow the units). Is most of this velocity due to the Earth's motion or the asteroid's motion about the Sun. Is the number you have calculated the full "space velocity" of the asteroid relative to the Earth? If not, is it nearly the entire amount or only a small part? Why or why not?