


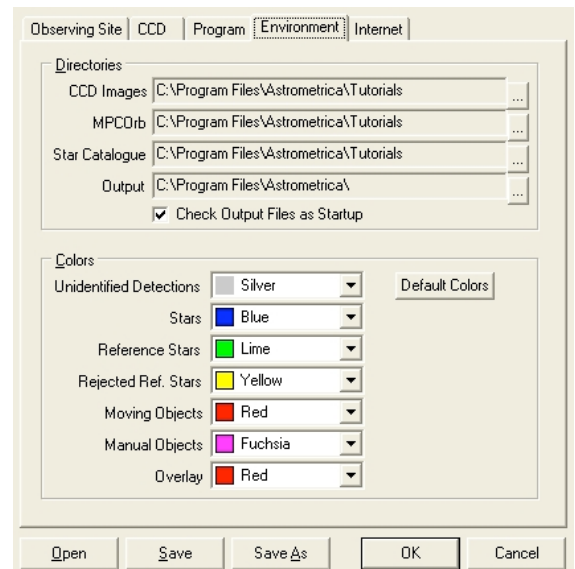
Astronomy 150

Asteroid Lab

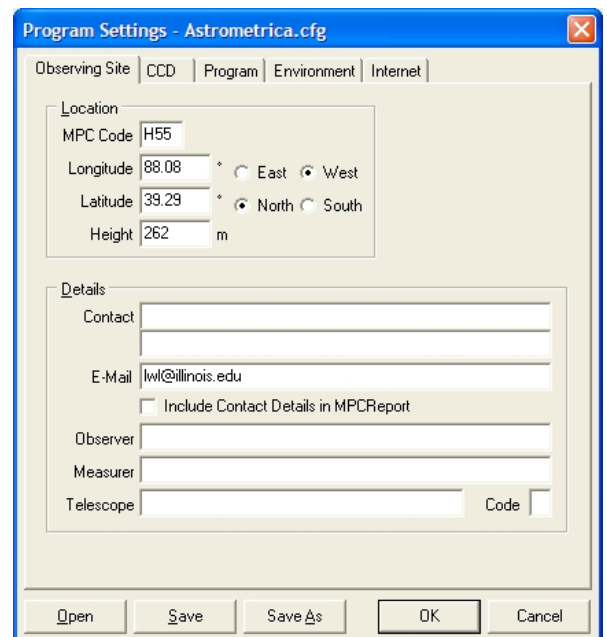
Due in Class: Monday, Oct. 26

Section 1: First setup computer. (If this step is not correctly setup, nothing will work properly.)

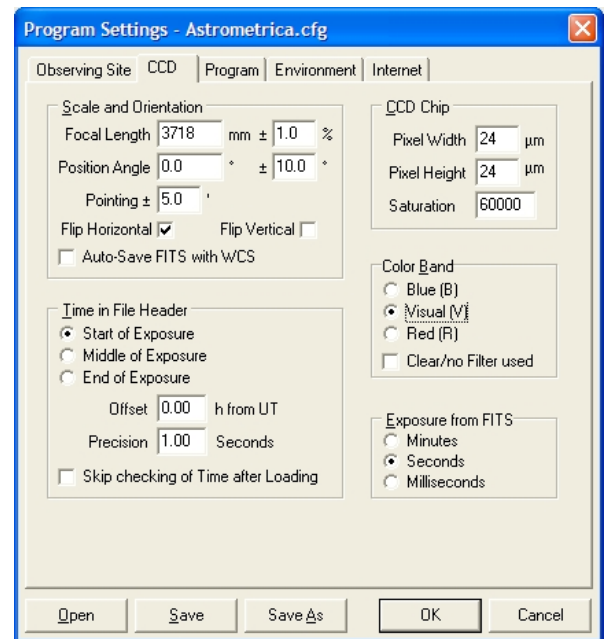
1. Verify that lab computer is booted in windows (for Macs)
2. Create Folder on desktop, called Astro150
3. Create a linked P: folder or directory by going to the start menu, under class programs, Astro 150, and clicking on Telescope Data (to access data and catalogs). This makes a P: drive, popping up the folder.
4. Copy the Cats directory in P: to your Astro150 folder.
5. In the start menu, under class programs, Astro 150, start Astrometrica
6. Click on the  for program settings (or click File, and Settings)
7. On the Environment tab of the Program settings, we need to change the Directories to:
 - a. CCD images -> Astr 150 on 'Ics-midas\Class' (P:) (the whole directory)
 - b. MPCOrb -> Your desktop folder Astr 150/Cats
 - c. Star Catalog -> the same as (b)
 - d. Output -> your desktop Astro150
8. To reset the catalogs, we have to close and restart the Astrometrica program.



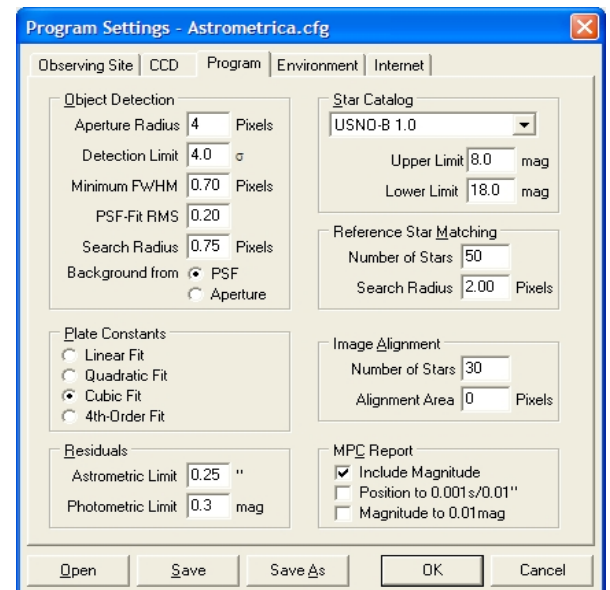
9. Open back up the program settings. Click on the Observing Site tab:
 - a. Set the MPC Code to H55
 - b. Set the Longitude to 88.08 West
 - c. Set the Latitude to 39.29 North
 - d. Set the Height to 262 meters
 - e. Set email to your email.



10. Then, go to the CCD tab in the Program Settings
 - a. Set the focal length to 3718
 - b. Set the pixel width and height to 24 microns
 - c. Set the color band to Visual



11. Then, go to the Program Tab
 - a. Set the Plate Constants to Cubic Fit
 - b. Set the Residuals to
 - i. Astrometric Limit to 0.25"
 - ii. Photometric Limit to 0.30 mag



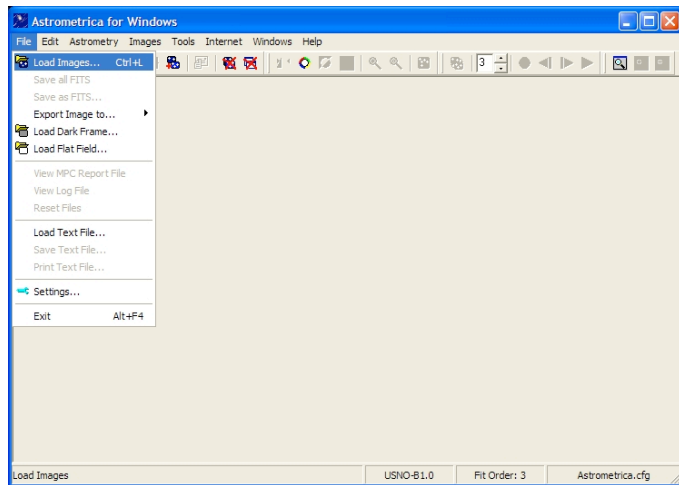
12. Click Okay, saving your changes

13. Now, we are ready to play with some data.

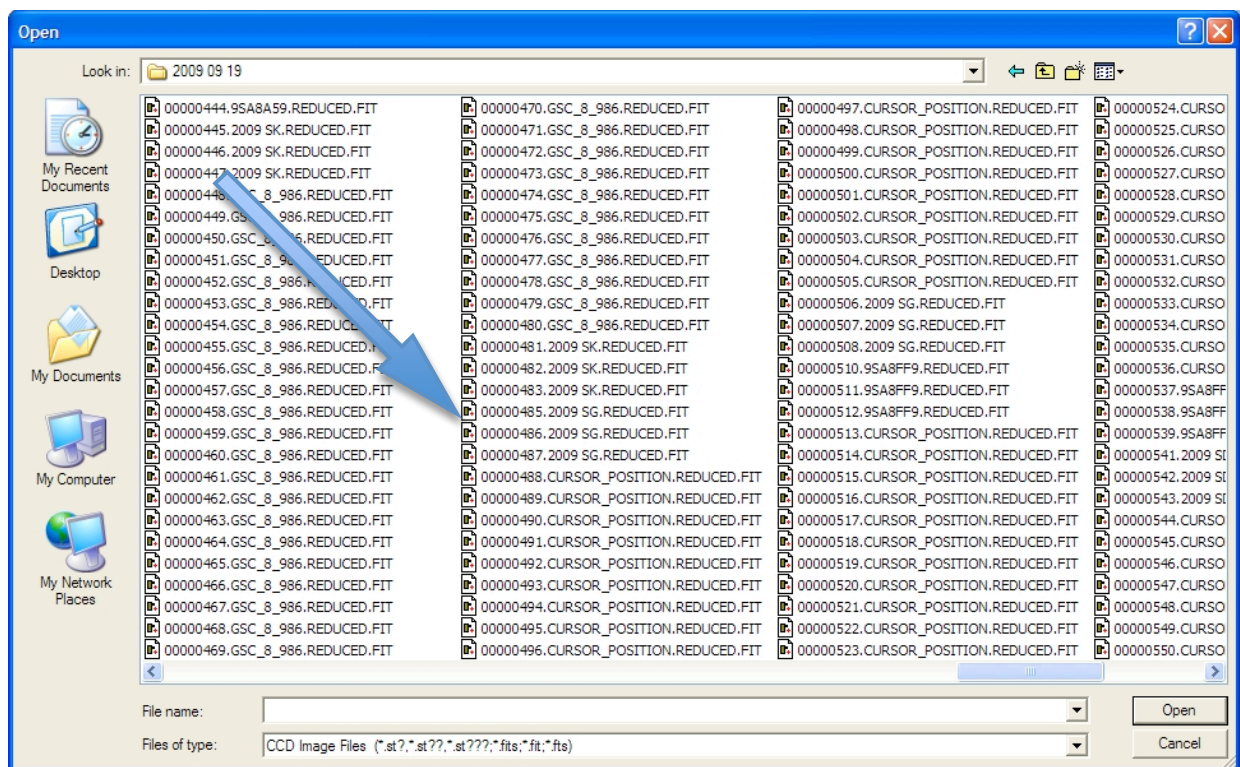
Section 2: Let's Look at the NEA 2009 SG:

<http://ssd.jpl.nasa.gov/sbdb.cgi?sstr=2009+SG&orb=1>

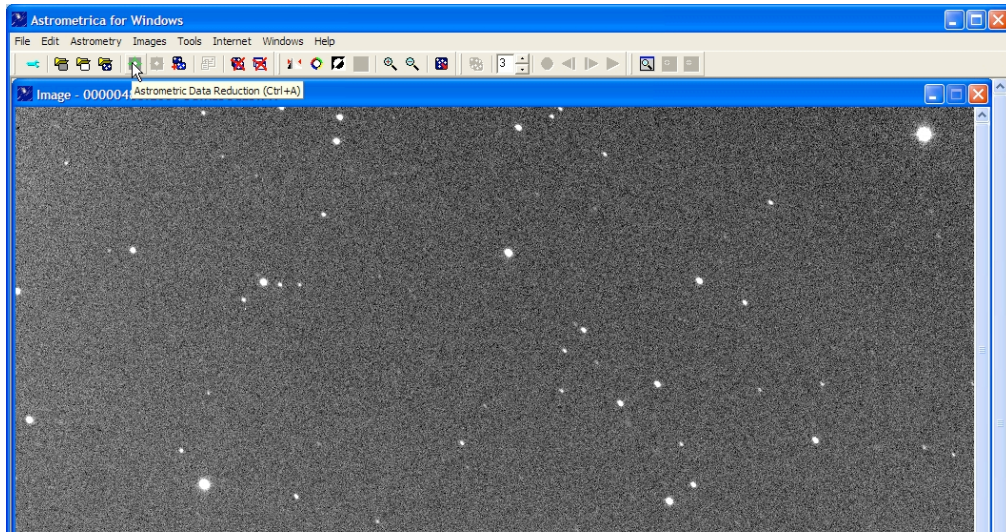
1. Go to File, Load Images, and open the folder or directory 2009 09 19



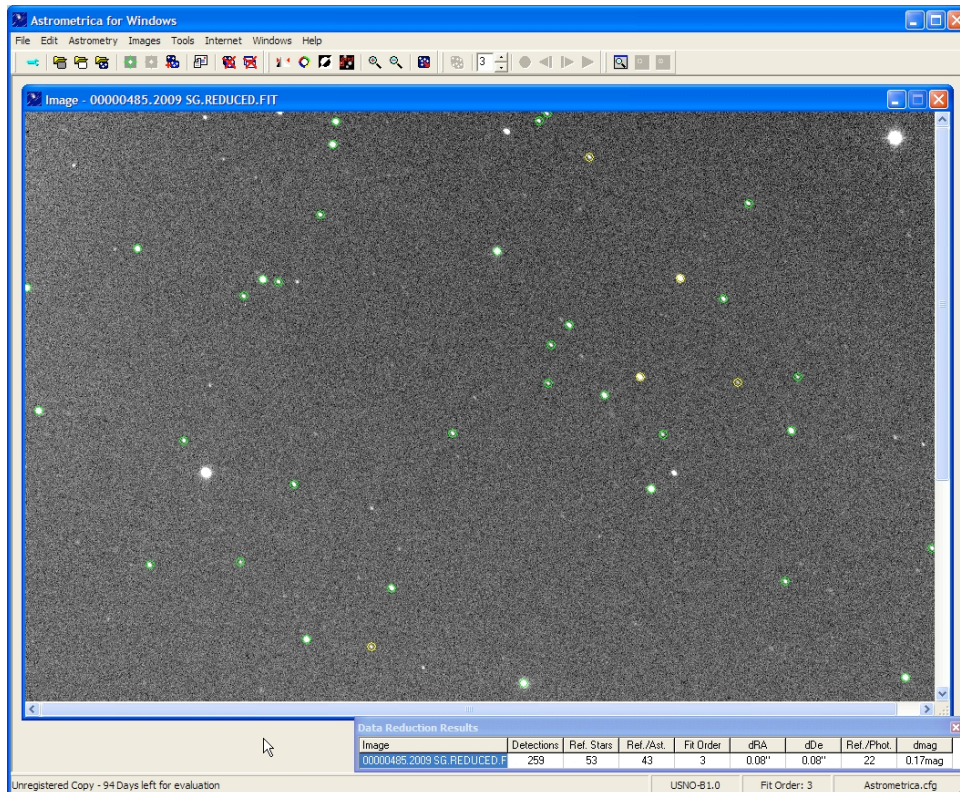
2. In the directory, scroll to find the File 00000485.2009 SG.REDUCED.FIT. This is where the dataset for the NEA 2009 SG begins. Open it.



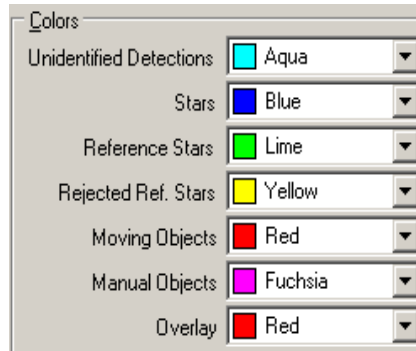
3. If you did all the Settings right, you can now use the stars on the image to find the exact location of the telescope pointing. Press the data reduction button.



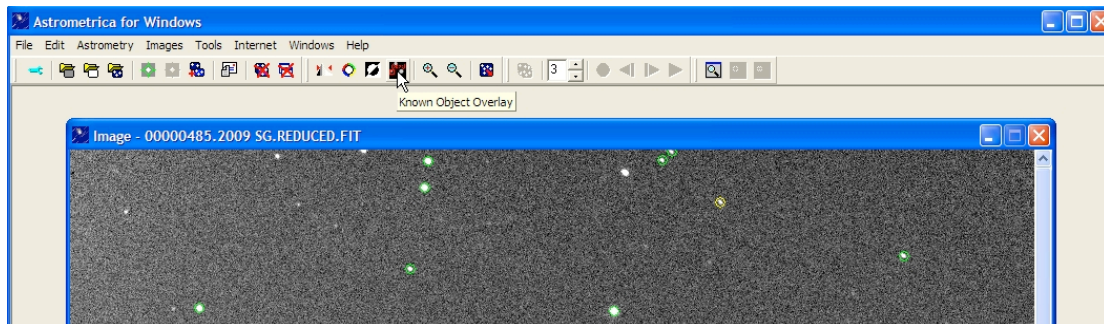
4. Click okay when the window pops up asking about the object name and coordinates.
5. If everything was setup properly, it should find the solution and show the following with circles around the standard stars. If it did not find a solution, try closing ALL windows in the program and try again. If it still doesn't work, verify all of you settings from above, and try again. If that doesn't work, restart program.



6. The colors used represent different objects. The default settings are:

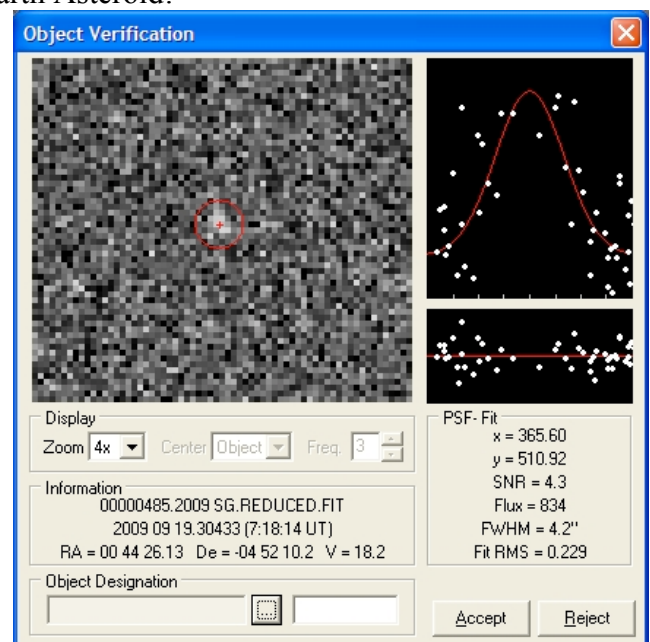


7. Now, since we know the true coordinates, we can check out where the known Solar System objects are in this image. Click on the Known Overlay Button.

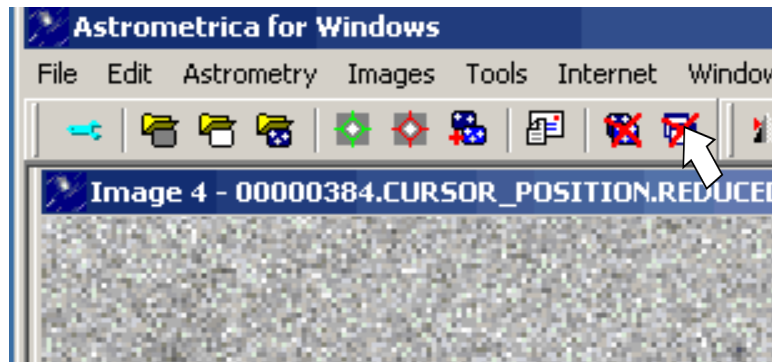


8. This will show two objects inside of squares (maximize the window). The one toward the North is labeled K09S00G, which is the NEA 2009 SG. Click the magnification button to see the small blob. That is an Near Earth Asteroid!

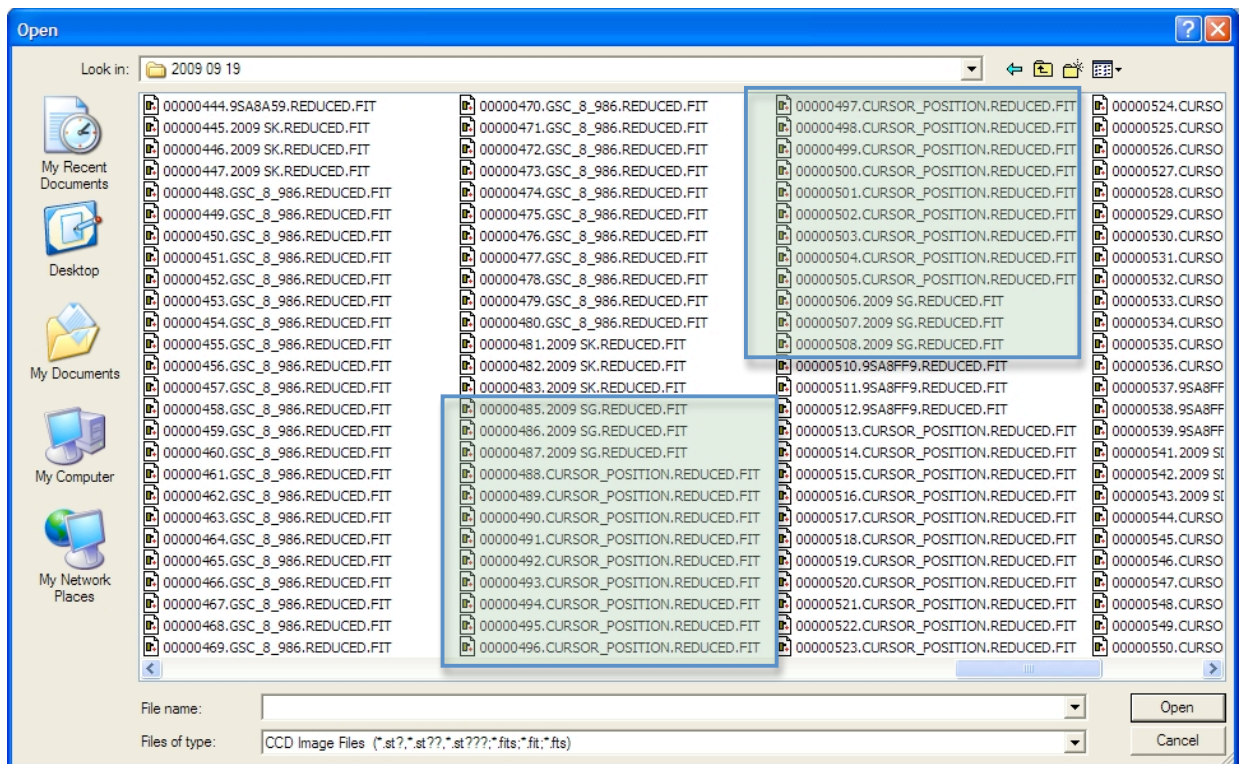
9. Put your cursor on the object and right click.
10. This brings up a window with the object and a fit. The data of this one observation is noisy (This is a dim object). If you click on the button next to the Object Designation section, the program looks for nearby objects (in this case we know what it is). The object is 2009 SG, and the Program gives its brightness in magnitudes, how fast it moves, and in which direction. Go ahead and write down the speed and PA (direction of movement); we'll need these later. Then, click okay, and close the Object Verification window.



11. Finding asteroids in one image is very hard. So, we take many images over a few hours. Close all image windows, so we can look at more data. Click the close all windows button.

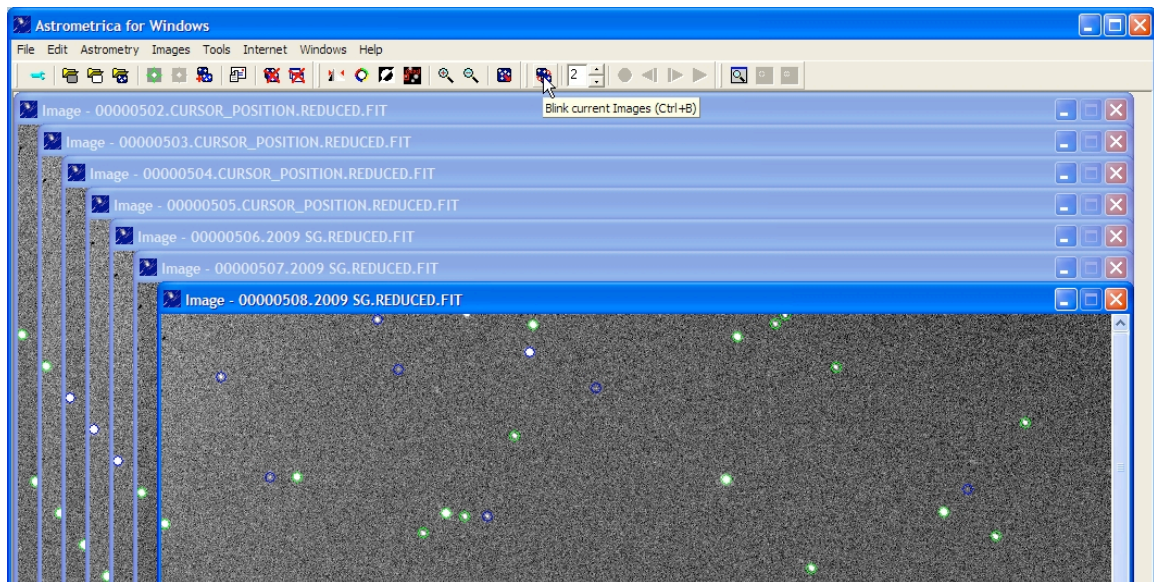


12. Go back to File, Load Images, and open the directory 2009 09 19. Find the same file as before, 00000485.2009 SG.REDUCED.FIT. This is the first data for this object and 00000508.2009 SG.REDUCED.FIT is the last file. The data have this format for all sources. The object name is in the filename for the first and last three files, with other names in between. Using the control button and right mouse clicks, choose five files over this night to view. The farther apart the more chance of seeing the asteroid move, so try to well sample the interval.

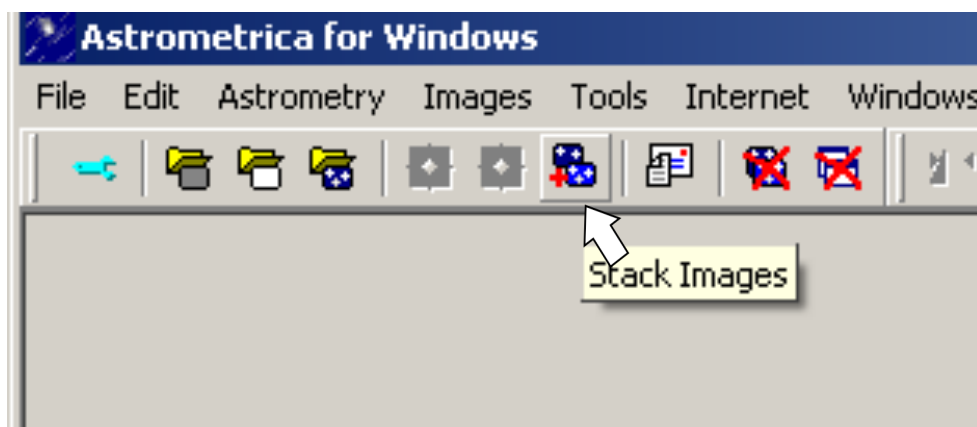


Note: Only the first and last few files in an image set will be labeled with the NEO's name.

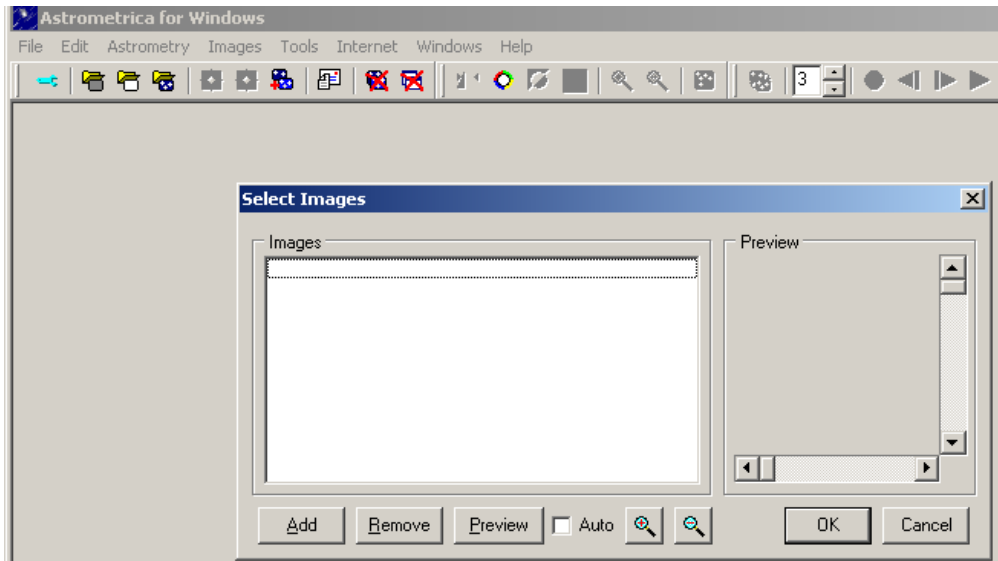
13. After loading them, press the reduction button. (You will have to click Ok for each file). For this dataset, if the program is set up correctly, all frames should reduce without a problem.
14. Now, click the blink button. This will make a movie of all the frames together.



15. Now find 2009 SG. It moves, while the stars stay still. This is one way to find new NEAs!
16. Stop the blinking by pressing the stop sign button. Then, click on the Known Overlay Button, and see if you were right. Start the blinking again by pressing the Play button and watch it move. (This blinking method is probably the best way to find new bright asteroids.)
17. After you find an asteroid, you want to measure its parameters using all the data. To do that, we need to stack the images on the asteroids. Let's stack the windows around this source and see how much signal to noise we can get. So, close all images by pressing the Close All Windows Button again.
18. Click on the stack button.

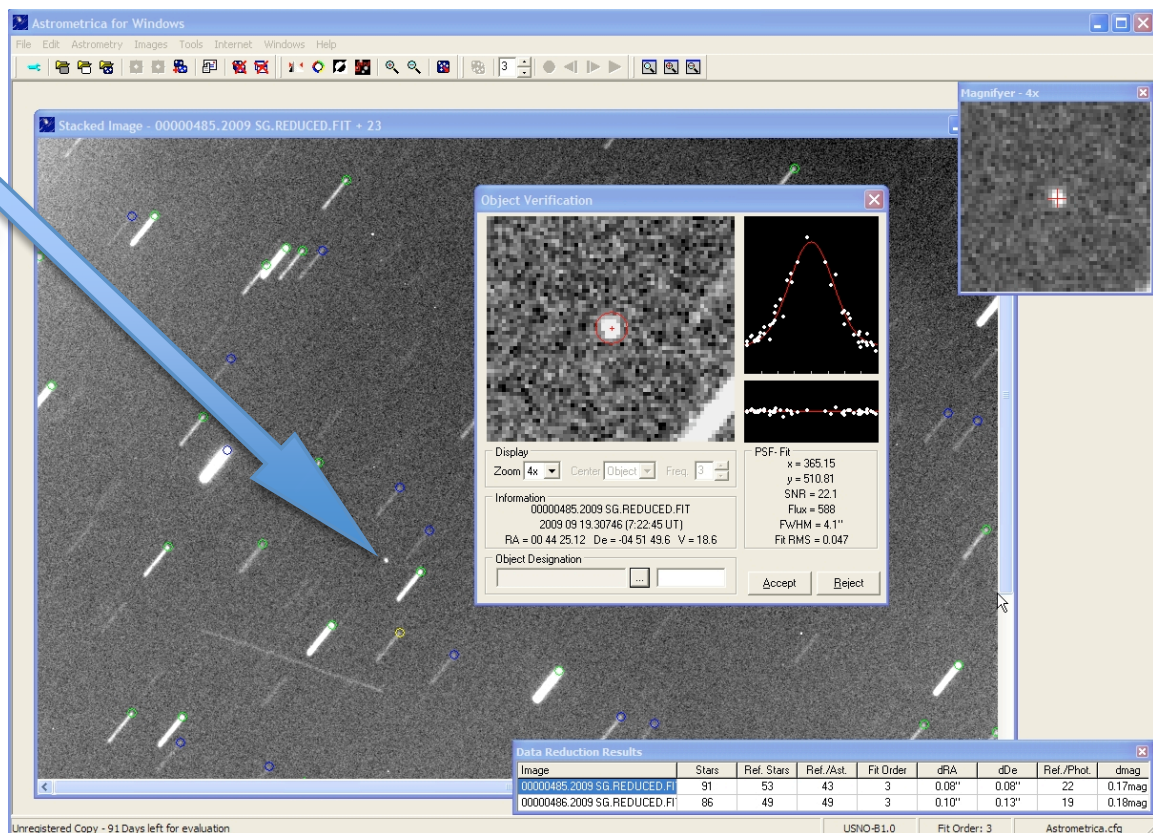


19. We have ~24 datasets, so go ahead and add all of them, then click Ok.



20. You will have to hit Ok to verify positions for all datasets, so 24 times. But stop before you accidentally hit the 25 okay for the Coordinates, Tracking, and Stacking window.
21. The Coordinates, Tracking, and Stacking window, requires the operator to specify how the asteroid moves in Speed and PA. You can hit the ... button next to the Speed, typing in the asteroid name should bring up the speed and PA, but VERIFY using your values from #10 above (5.74 "/min and 322.4 degrees), then click ok.
22. Note that the stars become streaks, but the asteroid is a point source and much brighter.
23. Measure the position and brightness using the same technique as in #10.

The Asteroid



Section 3: Now that we are experts, let's do the lab!

The previous sections were for learning how to run the software; this section describes the assignment. Note that this can be done during lab session or you can do it at your leisure. If you do it later, you may have to redo the program settings and download the catalogs again.

The main point of this is to either find 3-5 new asteroids or measure properties of known ones. To get full credit for the lab, each student needs to examine three to five observing datasets (i.e. 3-5 different asteroid fields). We did 2009 SG in the practice computer lab, which is a single asteroid field. In some cases, you may not detect anything (just say so and skip the other parts), but in some cases there may be 4+ objects in one field. For each set of data, you **must** address the following issues. (Make sure the results are typed, i.e. no handwritten notes.)

1. What was the date of the observation? This is the folder's name.
2. What is the name of the source from the file name? For example, 2009 SG.
3. First, we want to look for asteroids using the blink function. Load ~5 of the dataset files from that group, and do the data reduction. Any issues? If so, refer to the data reduction document on the class website for more info.
(<http://eeyore.astro.uiuc.edu/~lwl/classes/astro150/fall09/Docs/HardDataReduction.pdf>)
Describe how you fixed any data reduction issues.
4. Describe the images. Many stars or few? Anything interesting in the images?
5. Using the blinking option, find moving objects. Describe them. Describe their motion. This is the only way to find new asteroids.
6. Using the Known Object Overlay, find all of the known asteroids in your field. Did you find all/any of them in the blink mode?
7. Did you find any yet unknown asteroids? Why?
8. Pick one of the above asteroids to better measure its parameters. Write down the name.
9. To get the best signal to noise, we want to stack all the data for this source. As in Section 2 step 10, click near the asteroid and load the parameters of the nearest known asteroid. Write down the asteroid's speed and PA. We need this to stack.
10. Using the procedure for 2009 SG (Section 2, steps 18-23), stack the data using the above speed and PA. Find your asteroid now (it should be a point source). Click on it to fit it with the best signal to noise. Write down its x and y position, FWHM, and V magnitude.