

Solar Observation

•Materials

Telescope operating instructions
Sun chart
Telescope
Filters

•Introduction

In this lab, you will use the department's 8 inch telescopes and two types of solar filters. **NEVER LOOK DIRECTLY AT THE SUN!** The sun can burn your eyes in a very short period of time, resulting in permanent damage. Astronomers use special filters to filter out the powerful radiation of the sun so we can safely observe it. The filters are placed on the telescopes before pointing them at the sun, because the sun can also damage the optics inside the telescope. Your lab instructor will set up the telescopes for you, so you don't need to worry about placing the filters correctly. You should, however, know the difference between the filters and how to operate the telescope while you're observing. Refer to the telescope operating instructions at the front of this manual for information on the latter.

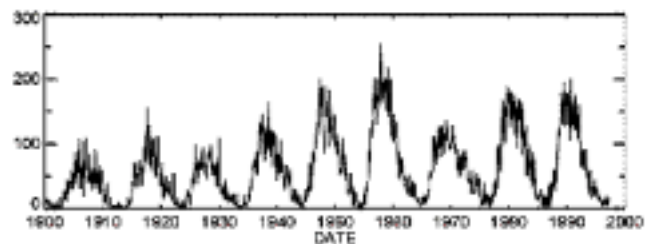
The first of two types of solar filters you'll be using in this lab is a neutral density or white light filter. A white light filter blocks out all types of light equally. Usually, they are made of mylar. When you look at the sun through this type of filter, you will see the surface of the sun. The surface is the layer where the visible light, produced in the center of the star, is released. It is no mistake that we see in "visible"; this is the range of light that is emitted more than any other from the sun. Solar physicists call the surface layer the **photosphere**. Often, the photosphere has large dark patches, **sunspots**, that rotate with the sun. Sunspots are regions of concentrated magnetic field. They appear dark because they are about 1500 K cooler than the surrounding "quiet" photosphere, at 5800 K. Cooler temperatures in sunspots are a result of the strong magnetic field suppressing the convection that continually brings up hotter material from under the surface. In the quiet photosphere, the convection results in granulation

cells. You won't be able to observe the granulation cells with the telescopes we have, but take a look at the following web site to see some amazing images of granulation and sunspots.

<http://www.solarview.com/eng/sunspot.htm>

You will be able to see sunspots well. That is, if there are any to be seen! The sun has an eleven year activity cycle, and sun spot number is a good indicator of activity. At solar maximum, there will likely be as many as 100 sunspots visible from Earth. During minimum, chances are there will be only a couple or even none. The last solar max was around 2000-2002. Solar minimum is expected to last from about 2004-2009. People have been charting sunspots for hundreds of years, since Galileo. Look at the diagram below and make a guess yourself as to when the next solar max will take place.

Monthly Average Sunspot Number



The second type of filter you will observe with is an H α (said "H alpha") filter. H α refers to the Balmer alpha transition for the Hydrogen atom. (See the section of your textbook on spectral lines for more information.) The wavelength of H α is 656 nanometers, corresponding to a red color. Through a telescope with an H α filter on it, you will see the area of the sun's atmosphere that emits in H α , the **chromosphere**. The chromosphere lies just above the photosphere, and is about 10,000 K. You will still see sunspots, but you should also be able to see **prominences**. A prominence is a region of dense, relatively cool plasma suspended in the hot **corona** (the outermost part of the solar atmosphere). These mysterious phenomena are at chromospheric temperatures even though they reside in the million degree corona. Again, for more information, see your text. Look for prominences just off the limb (edge) of the sun. They will appear as reddish blurs against the dark background.

•Procedure

1) Read telescope operating instructions located in the front of the manual.

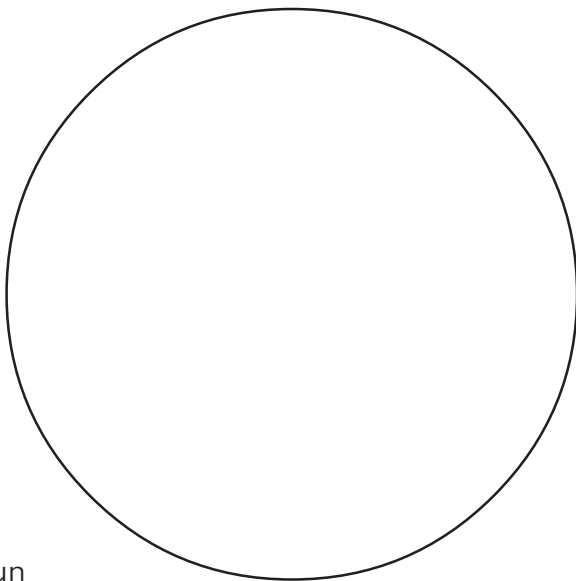
2) Look at the following two websites for information on what the sun currently looks like. Make some notes about how many sunspots are on the solar disk and where they're located. Do you see any prominences in the Big Bear Solar Observatory's Ha image? If so, where are they in respect to the sunspots?

<http://www.spaceweather.com>

<http://www.bbso.njit.edu/cgi-bin/LatestImages>

3) After your lab instructor has set up a filtered telescope for you, position the telescope so it is pointing at the sun. **Important note:** make sure the viewfinder scope is covered. The easiest way to position the scope the correctly is to minimize the shadow cast by the scope. Then look through the main eyepiece. If the sun is not visible, try again. It is best to start with a wide angle eyepiece (40 mm). Once you have the sun in your field of view, you can zoom in by replacing the 40 mm eyepiece with a 20 or 25 mm one.

4) Make drawings of sunspots and prominences on the solar chart. Label the date, time, type of telescope, filter, and eyepiece type. Note that the telescope flips the image upside down and backwards. Which way is solar north? Think about this carefully!



Sun
Chart

Trace the chart onto a piece of paper or get a copy of the chart from your lab instructor.

For credit, turn in your notes from surfing the solar websites and your solar observations.

•Further investigation (for extra credit)

The rotation of the sun is easily observed by plotting sunspot location over a series of days. Your lab instructor can set up a time for you to do a quick solar observation several days in a row. Carefully draw what you see each day. What do you guess the rotation period of the sun to be?