Coronado PST
40mm f/10
15mm - 26x
10mm - 40x
6mm - 67x

Hydrogen Alpha Solar Observing Program

Hydrogen Alpha Solar Observing Program Coordinator:

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8/4 - 9/1 - 9/28 - 10/25
2140 2141 2142
↑ Solar Rotation

Introduction:

The Sun is one of the most exciting objects in the sky to observe. Solar observing in Hydrogen Alpha light is the only branch of amateur astronomy where you can see changes by the minute, rather than hours or days, unlike most astronomical objects. All events happening on the Sun are unique and never will be repeated exactly. Whether you follow the growth and decay of a sunspot group, the rapid emergence of a solar flare or the spray of an erupting prominence on the Sun's limb, one thing is certain: the Sun will always present a uniquely different face, each and every day.

Welcome to the world of Hydrogen Alpha Solar Observing!

Warning:

Only use H-alpha filters and telescopes from reputable sources and always check your filter for damage before each use. As Richard Hill states in *Observe and Understand the Sun*: *"Observing the sun is the only inherently dangerous observing an amateur astronomer can do. Be aware of this at all times and take all necessary precautions. If you do not know a filter or procedure is safe then do not use it! Always err on the side of safety. An eye once damaged is forever damaged. Filters that let too much INFRARED light through can burn an eye if used visually. There is NO PAIN when this happens. Burned retinas can not be repaired. Excessive ULTRAVIOLET light has been shown to cause cataracts. So be very careful."* Remember to cap or remove your finder scope before observing and never use a "solar filter" that screws into an eyepiece.

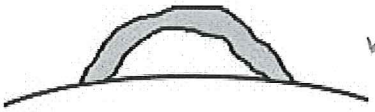
Rules and Regulations:

You must be a member of the Astronomical League, either through membership in an affiliated astronomical society or as a Member-at-Large.

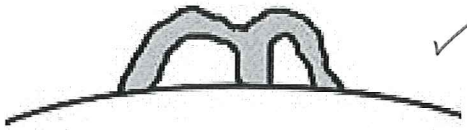
The program can be completed visually or by imaging. To accomplish the program, an observer will be required to make three sets of drawings or images.

The first set is 20 or more sketches or images of the whole solar disk during two solar rotations (one rotation is about 30 days). Only the main features need to be drawn: filaments, plages, flares, and sunspot umbra. The penumbra may be omitted since it has lower contrast in H-alpha than in white light.

The second set is detailed sketches or images of the different forms that solar prominences take on the limb of the Sun. These MUST include:

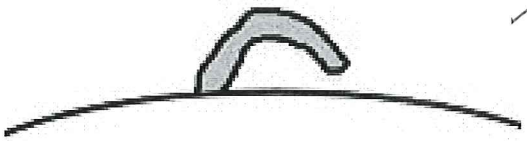


Single Arch—This is one of the most common shapes of a prominence, representing charged solar material flowing up from the solar atmosphere and down again following local magnetic field lines.

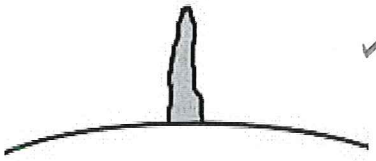


Double Arch—Much rarer than a single arch, this has two arches that are connected to each other via a center stream of material.

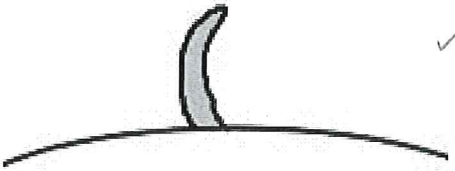
Broken Arch—Likely to be an evolutionary stage of a single arch, a broken arch features gaps in the stream of material where the plasma density is either too low to be detected, or the material has been blown away or disrupted by solar wind streams.



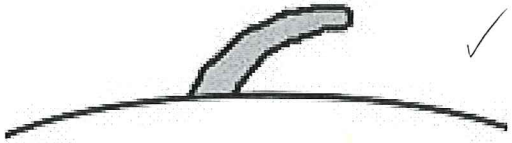
Unconnected Arch—This is where one end of the arch has not reconnected to the solar surface. This is also likely to be an evolutionary stage of the single arch, where the material is still travelling down the magnetic field lines to the surface.



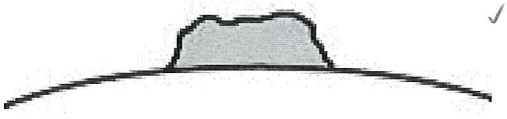
Straight Pillar—This appears as an eruption vertically up from the solar surface, and is quite common. It could also be an arch seen edge-on.



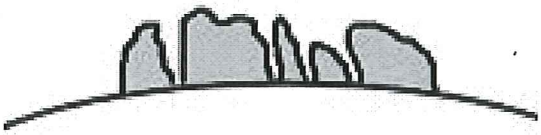
Curved Pillar—This is simply a pillar that is bent out of shape by magnetic or other forces, and could also be the early stages of an arch seen at an angle.



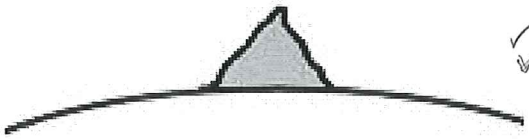
Inclined Pillar—This is where the material at the base of the eruption and throughout the prominence is at a significant angle to the surface.



Mound—This is also a fairly common type of prominence, and is seen as a relatively but fairly low eruption. It has a width equal to or greater than its height.

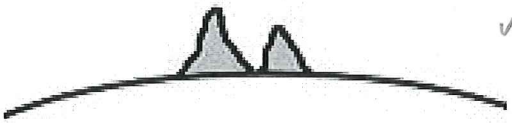


Hedgerow—This is a grouping of many smaller prominences that are likely to have come from the same source of activity.



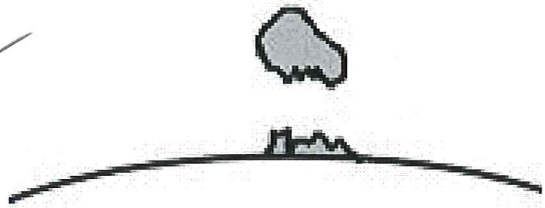
Pyramid—This common type is like a combination of a pillar and a mound, typically featuring a wide base that converges to a fairly sharp point.

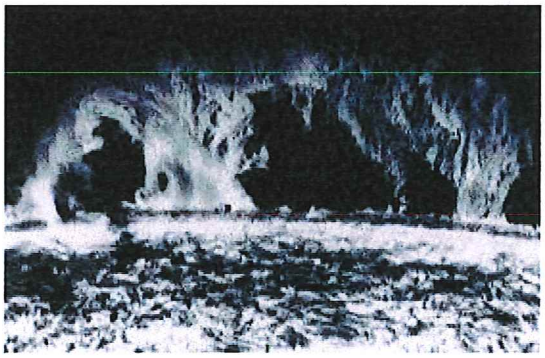
Broken Pyramid—This is a pyramid that has some damage in the form of holes in the plasma stream, or whole sections of plasma that have broken off. It is also likely to be an evolutionary stage of a regular pyramid.



Fork—This is two prominences, typically of pyramid or pillar form, that are very close together. The width between them is usually less than the base width of the thinnest prominence.

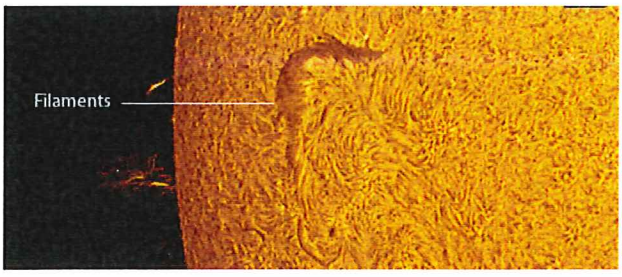
Detached—Here the material has lifted off the surface entirely, and appears to be completely disconnected from the surface. It is possible that some low density interconnecting material is there, but is not detectable with the observer's equipment.



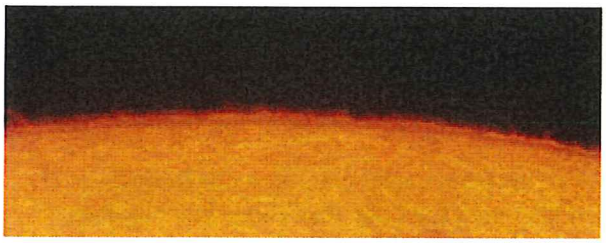


Anomalous—As is to be expected with any classification system, there are prominences that have no discernable shape or features than can place them in a distinct category. Due to the random and very complicated nature of solar surface eruptions and magnetic fields, these kinds of prominences are relatively common.

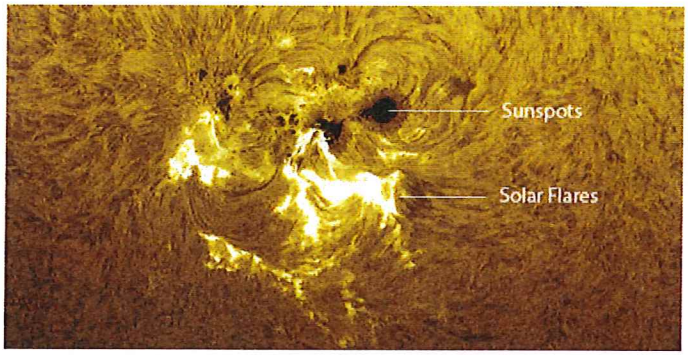
In the third set, you will make detailed sketches or images of individual features on the disk of the Chromospheric Sun, which MUST include six of the following nine features:



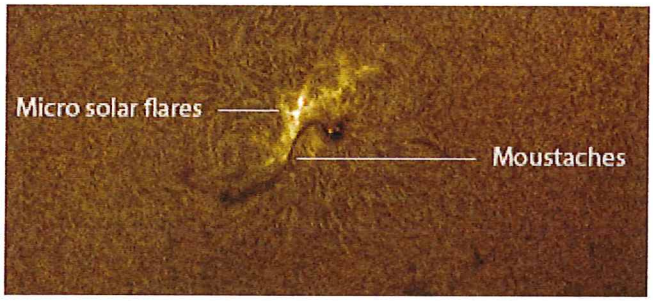
Filaments—Prominences seen against the face of the sun, appearing as long, narrow dark streamers or diffuse complex dark areas. Filaments often mark areas of magnetic shearing.



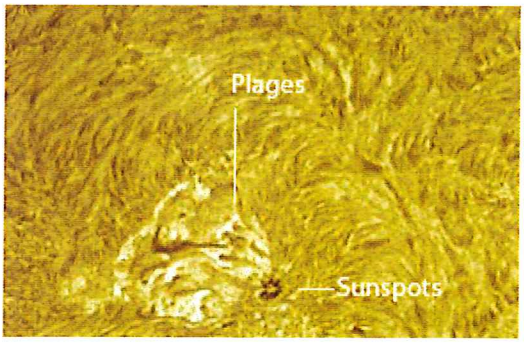
Spicules—Small jets of gas under 10,000 km high, usually seen as a mass of tiny brighter spike-like features on the limb or as tiny darker spikes coming out of network elements.



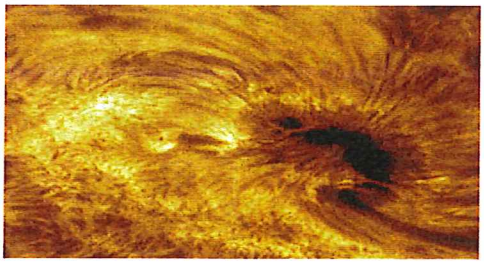
Flares—Intense, abrupt releases of energy which occur in areas where the local magnetic field is rapidly realigning or changing because of magnetic field stress.



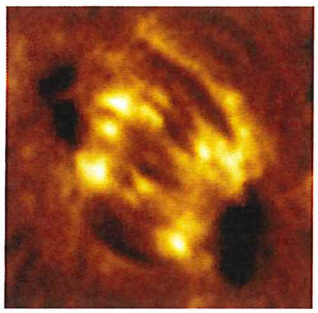
Elerman Bombs—Micro solar flares that appear as tiny fairly bright transient points of light (usually less than 5 arc minutes), most often found in Emerging Flux Regions or on edges of sunspots where the magnetic field is breaking the surface. Also known as a Severny moustache.



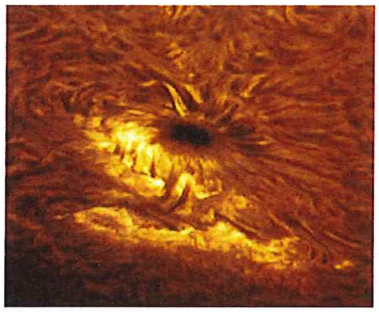
Plage—Patchy H-alpha brightenings on the solar disk, usually found in or near active regions, which can last for several days. Plage is irregular in shape and variable in brightness, marking areas of nearly vertical emerging or reconnecting magnetic field lines.



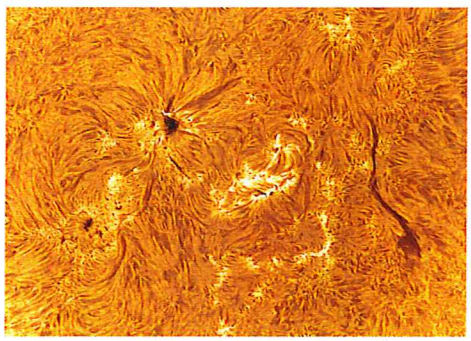
Field Transition Arches—Filament-like fibrils which cross the polarity inversion line of a bipolar magnetic region. A polarity inversion line is a line marking the halfway point between two opposite polarity areas.



Emerging Flux Region—An area on the Sun where a magnetic dipole, or flux tube is surfacing on the disk, eventually producing a bipolar sunspot group. Each pole of an EFR is often marked by pores or small developing sunspots. Growth is rapid, forming in just a few hours.



Sunspots—Temporary phenomena that appear visibly as dark spots compared to surrounding regions. They are caused by intense magnetic activity, which inhibits convection, forming areas of reduced surface temperature. Although normally a white light phenomena, they do appear in H-alpha, but their penumbrae are lower in contrast than in white light.



Active Region—A localized, transient volume of the solar atmosphere in which plages, sunspots, filaments, flares, etc., may be observed. Active regions are the result of enhanced magnetic fields; they are bipolar and may be complex if the region contains two or more bipolar groups.

(Solar images courtesy of Jack Newton)

Please note that artistic talent is not required to complete the program. Just diagram what you see as well as your ability allows. Use a number 2A lead pencil for best results. Work quickly as you can since changes can occur within minutes. On the whole disk recording form mark sunspots as small or large round black dots. Filaments should be drawn using short or long, narrow or wide black lines shaped as they appear to the eye. Plages and flares may be drawn with closed lines without shading. Limb prominences may be drawn with a shaded black outline. See sample drawings for examples. The focus of your drawings should be on the position, shape and size of the features. Remember to label each feature in your drawings/images.

The program should be achievable with modest Ha equipment, such as the Coronado Personal Telescope (PST) and the like. Double stacking of filters is desirable to bring out greater detail in the surface of the Chromosphere.

Seeing conditions for Ha observing can be carried out by looking at the sharpness of the chromospheric network, spicules (chromospheric edge) and filaments using the following scale:

5—*Near-perfect image. The details in the chromospheric network are well visible over the entire solar disk. There are no vibrations at the solar edge. Even the finest spicules are visible at the solar edge. The fine structure in filments is well observable.*

4—*Very small details in the filaments and chromospheric facule are visible over the entire solar disk. The chromospheric network is well visible. The solar limb is moving slightly.*

3—*Chromospheric network is visible over the entire solar disk. Spicules, just as the smaller filaments are visible. The shape of the chromospheric facuale is well visible. The solar limb is vibrating a bit, but this vibration is hardly noticeable in the umbrae.*

2—*Only the big filaments are observable. There are hints of the chromospheric network. The chromospheric faculae melt into the chromospheric background. The solar limb is moving strongly and this movement is also visible in the umbrae of the sunspots.*

1—*Only the biggest and darkest filaments can be observed. Umbrae of the sunspots are not or hardly visible. The entire image is wavering.*

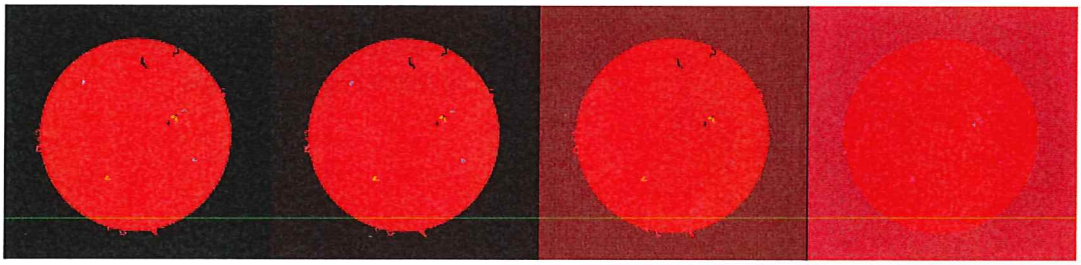
Transparency also should be evaluated using the following scale:

1—*Celestial background is very dark, prominences are very distinct.*

2—*Celestial background is dark, the prominences are distinct.*

3—*Celestial background is slightly bright, but the prominences are still distinct.*

4—*Celestial background is bright, the prominences can only be seen with difficulty.*



1 2 3 4

The observer must provide a log for each observation on the drawing sheets with information that includes:

1. Location of observer's site.
2. Date and time of observation (either UT or local time).
3. Seeing and transparency using the rating scale for Ha viewing.
4. Telescope used including aperture and focal length.
5. Eyepiece and magnification.
6. Filter used and whether double stacked or not.
7. Rotation number (can be obtained online or in astronomial almanacs).

The record of observation for imaging is the same as for visual certification, except specifics of how the image was obtained should be provided. This includes camera type, exposure times, imaging software, number of stacked images and the like.

Before setting up your equipment, you may want to see how the sun looks in hydrogen alpha light by checking out the GONG Network at http://gong.nso.edu where a global system of telescopes keeps constant vigil on the Sun with images and movie loops that are updated every minute.

Submitting for Certification

Observers should submit their drawings and images along with the completed submission form to their society's award coordinator or other member who is qualified and experienced in Ha viewing. This person shall exam the sketches or images and report completion of the program to the League's Hydrogen Alpha Solar Observing Program Coordinator either by mail or e-mail using the submission form.

Members-at-Large or members of societies that do not have awards coordinators should submit logs and drawings/images along with the submission form directly to the Hydrogen Alpha Solar Observing Program Award Coordinator. It is recommended that only copies of your log and drawings/images be sent; since the originals can be lost in the mail. We will not return originals unless the observer provides for postage.

Images in electronic format may be forwarded by any convenient means that accomplishes transfer or makes the images available for review. This may include mailing of a storage device such as a CD or posting the images on the web. Please avoid sending prints or slides unless you do not want them back.

A certificate and pin will be mailed to the address provided, either to the observer or to a society officer for presentation at a society event.

Enjoy daytime observing!

Vincent S. Foster
Hydrogen Alpha Solar Observing Program Coordinator

Recommended Reading:

Jenkins, J.L., **The Sun and How to Observe It,** Springer-Verlag, NY 2009

Jenkins, J.L., **Guidelines for the Observation of Monochromatic Solar Phenomena,** A Handbook of the Association of Lunar & Planetary Observers (A.L.P.O.), Solar Section, January 2010 (Downloadable from A.L.P.O. Website http://www.alpo-astronomy.org/)

Handy, R., et al, **Astronomical Sketching, A Step-by-Step Introduction,** Springer-Verlag, NY 2007

Pugh, P., **Observing the Sun with Coronado Telescopes,** Springer-Verlag, NY 2007

MacDonald, L., **How to Observe the Sun Safely**, Springer-Verlag, NY 2003

Glossary of Major Hydrogen Alpha Terms

ACTIVE FILAMENT SYSTEM (AFS): A system of small, arched linear-absorption H-alpha features connecting bright, compact plage of opposite polarity. An AFS is a sign of emerging bipolar magnetic flux and possibly rapid or continued growth in an active region.

ACTIVE PROMINENCE: A prominence above the solar limb moving and changing in appearance over a few minutes of time.

ACTIVE REGION: A localized, transient volume of the solar atmosphere in which plages, sunspots, faculae, flares, etc., may be observed. Active regions are the result of enhanced magnetic fields; they are bipolar and may be complex if the region contains two or more bipolar groups.

CHROMOSPHERE: The layer of the solar atmosphere above the photosphere and beneath the transition region and the corona. The chromosphere is the source of the strongest lines in the solar spectrum, including the Balmer alpha line of hydrogen and the H and K lines of calcium, and is the source of the red color often seen around the rim of the moon at total solar eclipses.

CHOMOSPHERIC NETWORK: An ever-present patchy network of long thin sinuous chains of tiny low contrast brighter points called Filigree (also found in plages) extending over much of the solar disk in H-alpha. These points, or network elements, often have darker spicules or short fibrils sticking out of, or running over them (part of the fine disk detail known as the Dark Mottles), making the actual network harder to see.

CORONAL MASS EJECTION (CME): Huge bubbles of gas threaded with magnetic field lines that are ejected from the Sun over the course of several hours. They disrupt the flow of the solar wind and produce disturbances that strike the Earth with sometimes catastrophic results. CME's are often associated with solar flares and prominence eruptions but they can also occur in the absence of either of these processes.

DISAPPEARING SOLAR FILAMENT (DFS): A solar filament that disappears suddenly on a timescale of minutes to hours. The prominence material is often seen to ascend but can fall into the Sun or just fade. DSFs are probable indicators of coronal mass ejections.

ELLERMAN BOMBS: Tiny fairly bright transient points of light (usually last less than 5 minutes), most often found in Emerging Flux Regions or on the edges of sunspots where the magnetic field is breaking the surface. They are best seen it the wings of H-alpha (nearly 5 Angstroms wide).

EMERGING FLUX REGION (EFR's): An area of the sun where a magnetic dipole, or "flux tube" is surfacing on the disk, eventually producing a bipolar sunspot group. In H-alpha, EFRs usually appear as a small oval area of bright plage (typically about 7000 km across) often containing a series of short-lived narrow fibrils (Arch Filament System(AFS)) running roughly from one end of the dipole to the other. Each pole of an

EFR is often marked by pores or small developing sunspots. Surges or even small solar flares can sometimes occur in EFRs.

FIBRILS: Small fine filament-like darker features which tend to run along magnetic field lines. Often, they are connected to or part of the structure of larger filaments, curving into or running along the filament's main axis.

FIELD TRANSITION ARCHES (FTA): Filament-like fibrils which cross the polarity inversion line (a line marking the halfway point between two opposite polarity areas) of a bipolar magnetic region. Unlike AFS fibrils, they show little or no Doppler shifts and tend to be rather thin and not very dark. FTA tend to arch directly between localized areas of opposite magnetic polarity, and often mark magnetically stable regions.

FILAMENTS: Prominences seen against the face of the sun, appearing as long narrow dark streamers or diffuse complex dark areas in H-alpha light. Filaments often mark areas of magnetic shearing (see Prominences).

HYDER FLARE: A filament-associated two-ribbon flare, often occurring in spotless regions. The flare is generally slow (30-60 minutes rise time in Ha and x-ray) and follows the disappearance of a previously quiescent filament.

MORETON WAVE: A chromospheric shock wave that is sometimes seen expanding outward from large impulsive solar flares, moving over the surface at about 1000 km/sec. It usually appears as a slowly moving diffuse arc of brightening in the centerline of H-alpha, or as a faint diffuse slightly darker arc in the blue wing.

PLAGE: Patchy H-alpha brightenings on the solar disk, usually found in or near active regions, which can last for several days. Plage is irregular in shape and variable in brightness, marking areas of nearly vertical emerging or reconnecting magnetic field lines (from French word for "beach" with the "a" being a short one).

POLAR CROWN: A nearly continuous ring of filaments occasionally encircling either polar region of the Sun (latitudes higher than 50').

PORES: Tiny darker spots under 2500 km in size, often having fairly short lifetimes. Pores occasionally form where several granulation channels meet and can sometimes precede the development of sunspots.

PROMINENCES: H-alpha emission features projecting beyond the limb of the sun, consisting of complex clouds or streamers of gas above or in the chromosphere. They generally come in two broad classes: Active (limb flares, surges, sprays, loops), and Quiescent (Quiet Region Filaments, Active Region Filaments).

QUIESCENT PROMINENCE: A long, sheet-like prominence nearly vertical to the solar surface. Except in an occasional activated phase, shows little large-scale motion, develops very slowly, and has a lifetime of several solar rotations. Quiescent prominences form within the remnants of decayed active regions, in quiet areas of the Sun between active regions, or at high solar latitudes where active regions seldom form.

RECONNECTION: A realignment of magnetic fields, where an area of one magnetic polarity breaks earlier links, and connects with the nearest region of opposite polarity. On the sun, this often happens when a new magnetic dipole emerges near another pre-existing one. For example, if the north pole of the new dipole emerges close to the south pole of the old dipole, the lines of force may reconnect these two nearby poles configuring them as a new lower energy dipole and releasing energy, often in the form of plage brightening or a solar flare.

ROTATION: This is the Carrington Rotation Number for the date of the observation. This can be found in any good astronomical almanac or in the ALPOSS ephemeris at: http//www.lpl.arizona.edu/~rhill/alpo/solstuff/ephems/solephem.html

SOLAR FLARE: Extremely bright moderate to large transient emission feature lasting from a few minutes to over four hours. Flares are a rapid and violent release of energy in the chromosphere due to extreme magnetic field stress and can occasionally result in material leaving the sun in the form of a Coronal Mass Ejection(CME).

SPICULES: Small jets of gas under 10,000 km long, usually seen as a mass of tiny brighter spike-like features at the limb or as tiny darker spikes coming out of network elements, but are not usually seen over bright plage.

SPRAY: A transient prominence formed by the explosion of pre-flare elevated material which sends debris flying off in many directions. Usually produced only by the most violent flares, as overlying filaments are blown away.

SUNSPOT: Dark long-lived photospheric feature, typically from 2500 to 50,000 km in size. Moderate to large spots usually consist of a darker central region (umbra) and a lighter halo consisting of many short fine fibrils (penumbra). Sunspots have strong concentrated magnetic fields which tend to inhibit energy transfer from below, making them at the center about 2500 degrees K cooler than the photosphere. In the Umbra, the fields tend to be nearly vertical in orientation while in the penumbra, the magnetic fields become more horizontal. Sunspots are visible in H-alpha, but their penumbrae are lower in contrast than in white light.

SURGE: A transient prominence produced by flares or very active regions, appearing as a moderate to large collimated jet of gas rising up from the surface. Surge ejected gas will often fall or draw back onto the sun tending to follow magnetic field lines, while at other times it will rise and disperse, fading from view.

"WINGS" OF H-ALPHA: Wavelengths slightly off of 6562.8 Angstroms (up to +/-2 Angstroms), used for viewing Doppler-shifted features. The "blue" wing is a shorter wavelength and the "red" is on the longer side.

**Glossary compiled by David Knisely*

Solar Disk Feature Drawing

Observer: John Doe

Location: Anytown, NJ

Date/Time: 11/22/11 10 am EST

Seeing: 4/5

Rotation: 2108

Transparency: 1/4

Telescope: SolarMax 60

Aperture/FL: 60mm f/6.6

Eyepiece: 9mm

Magnification: 44x

Double Stacked? Yes

Imaging Specifications

Camera_____

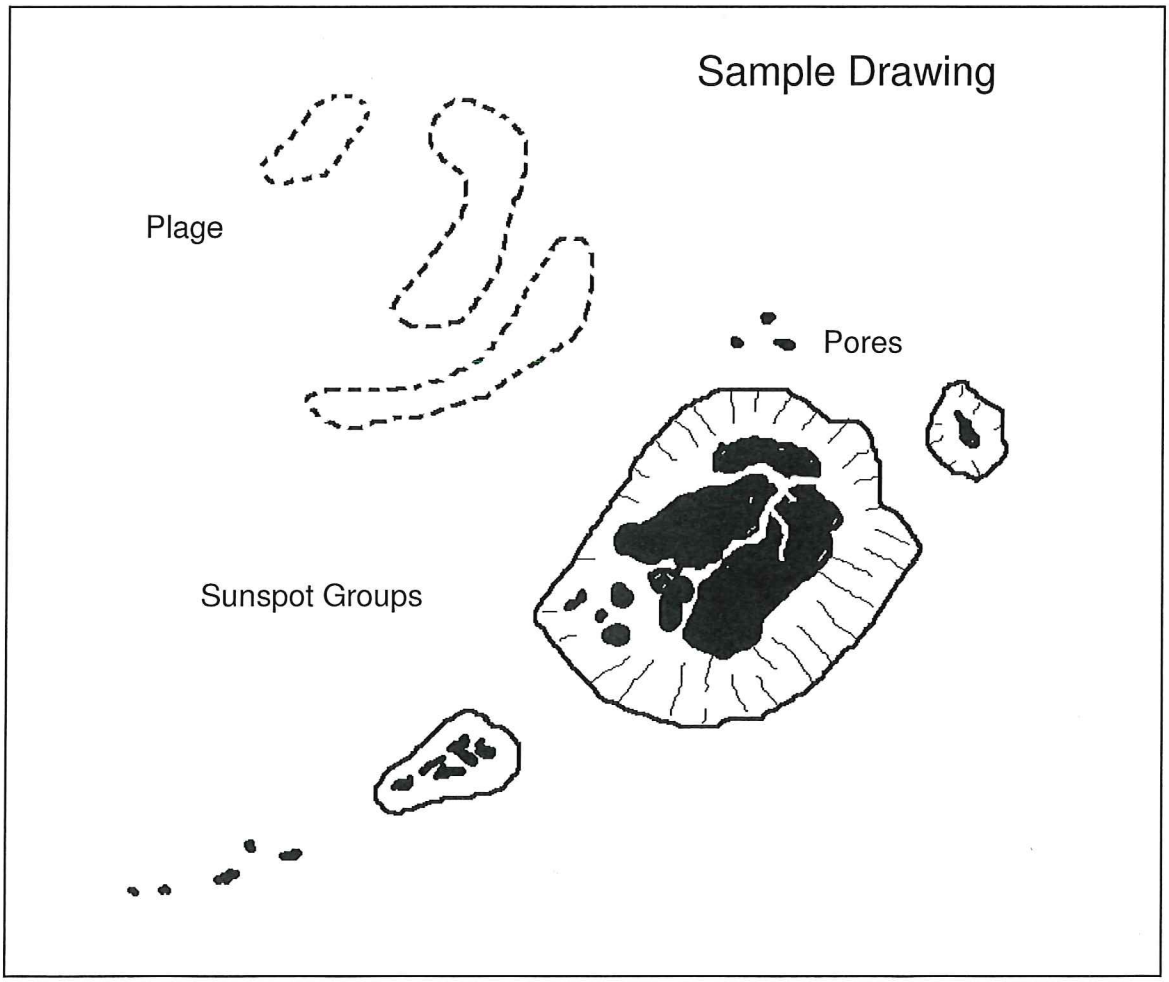
Imaging Software_____

Exposure Time_____

No. Stacked Images_____

N

E



Solar Prominence Drawing Form Sample

Observer: John Doe

Date/Time: 11/22/11 10am EST

Telescope: SolarMax 60

Aperture/FL: 60mm f/6.6

Eyepiece: 12mm

Double Stacked? Yes

Location: Any Town, NJ

Seeing: 4/5

Transparency: 1/4

Filter: .5 Angstroms

Magnification: 33x

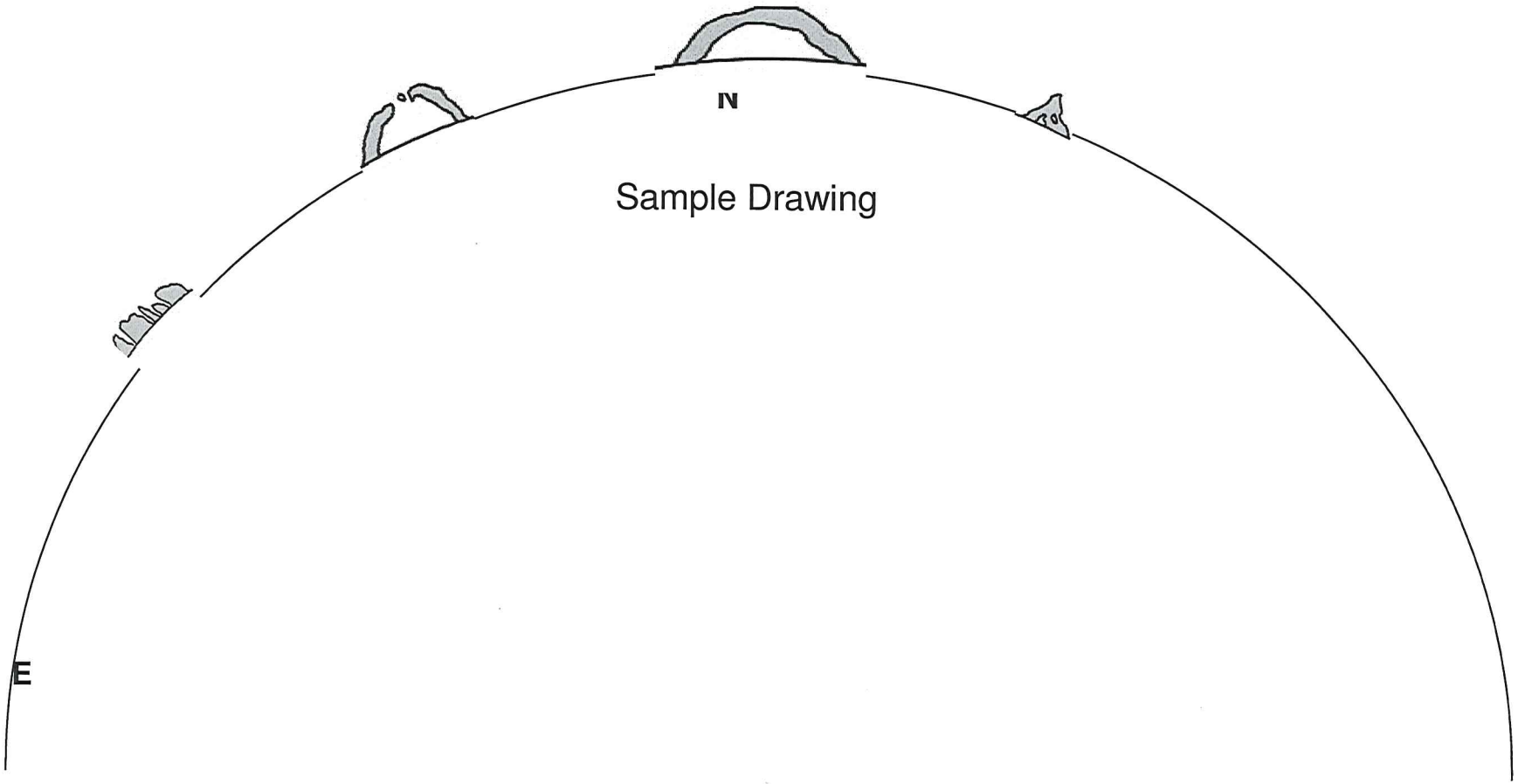
Imaging Specifications

Camera_____

Exposure Time_____

Imaging Software_____

No. Stacked Images_____



Sample Whole Solar Disk

Observer: John Doe

Location: Any Town, NJ

Date/Time: 11-22-11 10 am EST

Seeing: 4/5

Transparency: 1/4

Telescope: SolarMax 60

Aperture/FL: 60mm f/6.6

Eyepiece: 12mm

Magnification: 33x

Filter: .5Angstroms

Double Stacked? Yes

Rotation: 2108

Imaging Specifications

Camera_____

Exposure time_____

Imaging software_____

No. Stacked Images_____