Preparing for Observing

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Summary

A star party can be a way to learn and have fun, especially if you do it with a friend or with a group of friends. You have to prepare for it, especially if you plan to use some instruments. But don't neglect the simple joy of watching the sky with the unaided eye or binoculars.

Goals

- Explain how to choose the correct place, time, and date, what equipment you will take and how to plan the event.
- Learn how to use the program Stellarium.

Choosing the place and date

Atmospheric light greatly affects our perception of the sky. In cities you can only see the sun, the moon, a few planets, and a few bright stars and satellites. It is far better to observe from a dark location, although you might have to give up the advantage of being able to do it at school or from home.

If you want to see more stars and nebulae, you must go to a site away from roads and towns, because cities send up a halo of light that prevents proper vision. This phenomenon is known as "light pollution". Also avoid the vicinity of isolated lamps or lights. Stay away from roads where cars can dazzle us with their headlights; look for a clear area where large trees don't interfere with your view of the sky.

In choosing a date, of course, you want clear weather without clouds. It's even better when the temperatures are comfortable. The phase of the Moon is very important. The worst days are when the moon is full, since it will produce a lot of ambient light and we will see only the brightest stars. When is waning, the moon will rise later, we will not see it unless we stay watching until dawn, but dark skies are assured in the early evening. Perhaps the most interesting are the days when the moon is just under first quarter, since the early hours of the night we can see the craters of the moon, and as the moon sets under the horizon, a few hours later, dark sky for our observing session.

If we have a telescope we should go to our chosen location before sunset while we have enough natural light to set up the equipment before darkness.

Equipment needed

Planning the observations. We need to remember that the sky changes as the observer's latitude. You can get the program Stellarium (www.stellarium.org, See the Annex to this unit for a quick guide), look in astronomy magazines, or examine books. On the web there are many places to obtain sky charts, for example www.heavens-above.com/skychart or in www.skyandtelescope.com. To obtain any of these sky maps you must indicate the location, (usually latitude and longitude), date, and time of day.

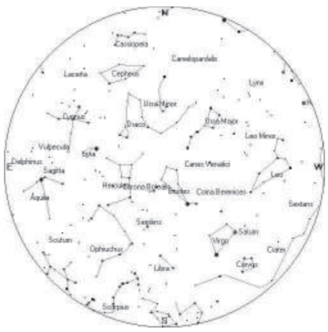

Fig 1: Example of plane of the sky (SkyChart). This is for a mid-latitude north, at the middle of July at 22 h.

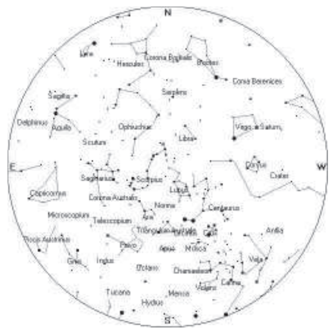

Fig. 2: Example of the plane of the sky (SkyChart). This is for a mid-latitude southern, at the middle of July at 22h.

Red flashlight. In the darkness, our eyes slowly open to let in more light, which ensures us to "see" at night; this ability is called "night vision". Night vision is related to one of the two types of photo sensitive cells in the retina: the rods. In the retina there are two types of cells: the cones, sensitive to color and that are activated in bright light, and rods, which are only active at low light levels. If suddenly the area where we are looking become illuminated, the pupil is closed immediately and the rods are disabled. If entering the dark again, the pupil will take a short time to open fully again, but the rods will take at least 10 minutes to allow night vision back. The rods are less sensitive to red light, so using a red light fools the eye into acting as if it was much darker. They will retain night vision better. To create a red flashlight we use a normal flashlight and we add a simple filter using a piece of transparent red paper.

Food. We have to consider the real time will be several hours, counting travel, material preparation, observation, collection and the return journey. The activity will be more pleasant if we share some food and drink (hot or cold depending on the seasonal temperature).

Green laser pointer to point out constellations, stars, etc. Be very careful with this type of pointer. Never point towards the eyes of the participants in the observation or to anyone; it can damage them. Never point at airplanes. This tool only can be manipulated by adults.

Clothes. Even in summer, in the evening, the temperature always goes down, the wind often blows, and we must keep in mind that we need to be there for a few hours and the weather could change. Plan for it to be much cooler than the daytime temperature.

Binoculars, telescopes, camera (see below) these materials change depending the observations that we plan.

If there are clouds. A cloudy sky can upset the whole plan. However we have provided an alternative plan: telling stories about mythology of constellations or talk about any astronomical topic. If we have Internet, we can enjoy the popular Google-Earth, but watching the sky or Mars, or any other simulation program of the sky, or can see a video about something astronomical in YouTube.

Unaided eye

It is essential to know the sky with the unaided eye. That means knowing the names of the major constellations and the bright stars, you only need a chart of the sky, and if it is possible, a green laser pointer. They are also very useful applications for the iPhone/iPad that can line up with the constellations and planets help you orient to the rest of the sky. The phone is not affected by clouds so can serve as an alternative if the sky is covered.

The stars that you see depend on where we are: near the North Pole would see only 50% of the stars across the sky, those in the northern celestial hemisphere. Near the equator will see all of the sky eventually, but which ones on a single night depends on the time of the year. Near the South Pole, we see only half again, in this case the ones which are in the southern hemisphere.

The constellations and stars that we recommend knowing are:

NORTHERN HEMISPHERE
Constellations: Ursa Major, Ursa Minor, Cassiopeia are usually circumpolar, so always visible. In summer also see Cygnus, Lyra, Hercules, Bootes, Corona Borealis, Leo, Sagittarius and Scorpio. The ones you see in winter are: Orion, Canis Major, Taurus, Auriga, Andromeda, Pegasus, Gemini, and the cluster, the Pleiades.

Stars: Polaris (near the North Celestial Pole), Sirius, Aldebaran, Betelgeuse, Rigel, Arcturus, Antares, etc..

SOUTHERN HEMISPHERE
Constellations: Southern Cross, Sagittarius, Scorpio, Leo, Carina, Puppis and Vela (the three constellations formed the ancient constellation of Argo, the ship of the Argonauts). It is also possible to see Orion and Canis Major from this hemisphere.

Star: Antares, Aldebaran, Sirius, Betelgeuse. In the southern hemisphere there is no star that marks the location of the South Celestial Pole.

The constellations that are in the region called the "Zodiac", can be seen from most of the northern and southern hemispheres although they change orientation on the celestial sphere.

It is interesting to follow the changing phases of the moon every day, and its changing position against the background of stars. This last can be done also with the planets, noting its slow movement on other planets near or on the stars. This is especially noticeable in the faster moving like Venus or Mercury, when you see at sunset. These planets also may be visible at sunrise and then you can continue recognizing them in the sky beyond the night of observation.

For a couple of hours after sunset, you can see shooting stars (meteors) at any time, with a frequency of about 5 to 10 per hour. At certain times of the year there are "falling stars", which are many more. For example around January 3 are the Quadrantids, with about 120 per hour, on August 12 Perseids, with 100/h, on 18 November is the peak of the Leonids, with about 20/h, and between 12 and 14 December are the Geminids, with 120/h. The Perseids are not visible from the southern hemisphere.

There are many satellites orbiting the Earth and when they are illuminated by the sun can be seen from Earth, slowly across the sky. As the altitude is usually not high, you just see them if it is not long after sunset, for example, the ISS is very bright and takes about 2-3 minutes to cover the visible sky. The times of these and many other satellites can be predicted over a given geographical location with a week in advance at www.heavens-above.com.

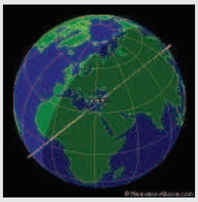

Fig. 3: Path of the ISS.

Fig. 4: xpansion and diameter of the objective.

Observations with binoculars

A useful and easily available astronomical instrument is binoculars. Although its ability to magnify is usually small, they collect much more light than our pupil, and help us see objects that at first glance are very faint such as star clusters, nebulae, and double stars. Also binoculars have the advantage of increasing the color differences of stars, especially if slightly out of focus.

They usually bear inscriptions such as 8x30 or 10x50. The first figure gives the magnification and the second the diameter of the front lens in mm. One highly recommended size for this activity is the 7x50. At higher magnifications, the image moves a lot, because it is difficult to keep steady, and larger apertures increase the price.

Interesting objects to see with binoculars are the Andromeda Galaxy (M31), the Hercules Cluster (M13), the double cluster in Perseus, the Praesepe (M44), the Orion Nebula (M42), the entire area of Sagittarius (nebulae such as the Lagoon M8, Trifid M20, Omega M17, several globular clusters M22, M55, etc..) and in general the Milky Way, seen with many more stars than the naked eye. In the southern hemisphere Omega Centauri and 47 Tucanae are spectacular globular clusters.

Observational telescope

Most people know that the mission of a telescope is to enlarge distant objects, but fewer people know that has another mission as important as this: to capture more light than the human eye. This will allow one to see faint objects that would remain faint even if we increased the magnification.

A telescope has two main parts: the objective and the eyepiece. The objective is a large diameter lens that bends light (refracting telescopes) or a mirror that reflects light (reflecting telescopes). Most objective mirrors are parabolic in shape. The eyepiece is a small lens to which, as its name suggests, we place the eye to see. It is usually removable, so that different sizes of eyepiece allow more or less magnification.

The larger the objective is, more light gets collected, and we can see fainter objects. High quality lenses are more expensive than mirrors of the same diameter, so larger telescope are more frequently reflecting telescopes. The most common type is the Newtonian, consisting of a concave mirror at the bottom of the tube, which returns the rays of the top of the tube, where there is a small secondary mirror at an angle of 45º, which deflects the rays to a point outside the tube, where the eyepiece is placed. The secondary mirror blocks some of the incoming light, but is not significant. Another design is the Cassegrain type, which sends the secondary light toward a central hole of the primary mirror. The eyepiece is placed behind that central hole. Finally, there are catadiópticos, typically like a Cassegrain but adding a thin lens at the entrance of the tube, there by greatly reduce the length of the tube and making more light weight and portable.

The magnification of a telescope is given by the ratio of the focal length of objective (either lens or mirror) and focal length of the eyepiece. For example, if we have a telescope with a lens focal length of 1,000 mm and we put an eyepiece of focal length 10 mm, we obtain a magnification of 100. If we want to double the magnification, we will need either a longer focal length objective or put shorter focal length eyepiece. This has a practical limit because eyepieces with small focal lengths are difficult to manufacture and give blurred images.
Manufacturers often describe telescopes in terms of focal ratio, for example f / 6 or f / 8. The focal ratio is the focal length of lens or the primary mirror divided

Fig. 5: Different optical telescopes.

by the opening and it works to meet one of these two quantities, if it know the other. For example, if we have a refractor f / 8 and the objective lens is 60 mm in diameter, the actual focal length of the telescope will be multiplied by aperture, namely 8x60 = 480 mm. At the same lens aperture, the larger focal ratio, the smaller field of view and magnification.

The larger the aperture of a telescope will capture more light, and therefore be brighter, and allow you to see fainter objects. Also, it offers a higher level of resolution, which is the ability to see details: when resolution is low you will see a blurred image, and when it is high it looks very clear, with many details. It also influences the darkness of the night: in the days of full moon or light around you can't see faint stars.

Another important limitation is the atmospheric stability. We've all seen how the warm atmosphere of a desert shakes the vision in movie scenes shot with telephoto lenses. When we look through a telescope, small air disturbances make the image move. Astronomers refer to this as the concept of "seeing". The atmosphere is what makes stars twinkle.

The image that you see with a telescope is reversed, but this does not matter much: in the Cosmos up and down positions are relative. There are accessories that flip the image and put it correctly, but at the cost of slightly lower brightness.

The mount is an important piece of a telescope. A poor quality mount allows the telescope tube to swing every time you touch. The result is a dance in the view, apart from feeling dizzy, you will be unable to see the details. It is important that mounts are rigid and stable.

There are two types of mounts: the azimuth and equatorial. The azimuth mount is the simplest but least useful. It can be rotated left and right about its vertical axis, and up and down around a horizontal axis. The Dobsonian mount is a azimuthal type that is easy to transport and use. In the equatorial mount there are two inclined axes situated at 90 degrees to each other. One, the polar, must be directed to rotational pole of the Earth. It turns in right ascension. The other axis, the equatorial axis, gives us the declinations. This is used by professional astronomers and by many amateur astronomers. They may include a motor in the equatorial axis that compensates for the rotation of the Earth. If not, especially with large magnification, the image leaves the field of vision in a surprisingly short time.

If you have an equatorial mount, you should orient it so that the polar axis is aligned with the North Pole (or South) of the sky. That takes time, but is necessary for the equatorial tracking motor, that serves to look at the object, does not move over time, something essential in photography. If we have no motor, exact alignment is less important, but will serve to keep the object in the field of view by moving a single wheel.

Finally, computerized telescopes, with a database of positions of celestial objects and two motors. Once you are set up correctly, these are easier to use. However, you must align it with three known stars in order to set it up, and beginners often are confused by this step.

Azimuth mount Equatorial mount Dobsonian mount

Fig. 6: Different mounts support telescopes.

Dark skies and light pollution

To observe the stars, we must have a dark sky. But this is only possible if we turn away from the cities. Humans have forgotten about the starry sky because we can not see it. This problem occurs because most of public lighting produces huge amounts of wasted energy lighting up the sky, which is unnecessary. Light pollution is one form of environmental pollution less known than most others. It affects the visibility of the night sky, but also alters the balance of the ecosystem and affects human health, since it breaches the biological clocks that are coordinated with periods of light and darkness. To be alert on this subject, learn to recognize the problem, warn others of the consequences, and find solutions.

There are three types of light pollution:

a) The glow is a phenomenon that occurs, in general, by the public lighting outside. It is evident when we have the opportunity to travel at night and approach a city. We see that a light wraps around the city. The light produced by the light glow is wasted, it is spent on lighting up the sky, which is not needed and, therefore, not only affects out seeing the stars but spends energy unnecessarily. This type of contamination is reduced by choosing careful light fixtures and bulbs.

b) The intrusion: the external light is projected in all directions and some of them entered, even unwittingly, to our homes. If the light is projected into the rooms, we will have to block the windows with curtains or shades at night.

c) The glare: This type of pollution is linked to the lights of cars and even outdoor lighting in cities and homes. It is evident in places with slopes, as the glare occurs when someone finds an unexpected lamp or a reflector.

It is possible from various programs on the Internet to compile a series of practical activities for working on this issue, we propose only one that is interactive and easy to perform in any setting.

Activity 1: Light pollution

The objectives of this workshop are to show the polluting effect of unshielded lighting, recognizing the beneficial effect from the astronomical point of view, the choice of a baffle designed to control light pollution and highlight the possibility of improving the view of the stars, while we illuminate those places where we desire more light.
To carry out this experience obtain one cardboard box of certain dimensions that will allow the student to look inward. To draw the constellation that you select

Fig. 7a and 7b: Cardboard Box, design of the constellation Orion on one side

Fig. 8: View of Orion from inside the box. Each hole represents a star.

Fig. 9a: Tennis table ball unshielded. Fig.9b: Tennis table ball with a hemisphere painted.

(in this example is that of Orion) and mark the stars as points first; later the holes will be made taking into account the diameter of each, depending on stellar magnitude (figures 7a and 7b). The constellation as drawn on the outside of the box should be the mirror image of the constellation, so that it will be seen as it appears in the sky when you look inside the box.

The box must be painted black on the inside so that if one looks directly inside, the constellation have the appearance of what is shown in figure 7. The "stars", or points that represent them, will be illuminated by the input of the external light inside the box.

Fig. 10a: We removed the protector of the flashlight.
Fig. 10b: Flashlight with the tennis table ball simulating the street lamp.

Prepare two tennis table balls, making a hole that would allow it to fit over a flashlight. One of the balls is left as it is, and the other is painted with synthetic enamel of any color in the upper hemisphere, representing thus a so-called "shield" that prevents that light from projecting up (figures 9a and 9b).

To perform the experiment you need to use flashlights in which you can remove the protective top and leave the light bulb as shown in figures 10a and 10b. The tennis table ball is inserted into the flashlight.

The experiment was performed in two stages: First with just the box. At this time, turn off the lights during the experiment. Both models are tested with the same flashlight to avoid variations in the intensity of light. Project the light both unshielded (figure 11a) and shielded (figure 11b) projecting the light onto a smooth nearby surface, for example a wall or piece of cardboard.

Second see what happens inside the box. The situation shown in figures 12a and 12b, for cases with and without shield respectively. You can use a digital camera to take photos of what happens inside the box if it is not possible that participants can look inside. External lights in the room where the experiment takes place should be on.

You will notice what is happening very clearly. In the first situation, in the case of outdoor lighting, we see the situation with the baffle controls light pollution: the emission into the sky is greatly reduced.

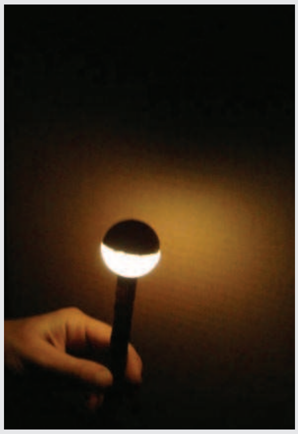

Fig. 11a: Lamp without shield. Fig. 11b: Shielded Lamp.

Fig. 12a: Appearance of the night sky with lanterns without shielded. Fig. 12b: Appearance of the night sky with lights shielded

In the second situation, when using both types of flashlight inside the box, we are simulating the situation of a night with unshielded lamp that sends extra lighting in the sky, called the glow, which obscures the view of the stars. In the case of digital camera, using automatic exposure, you can not even focus properly at the stars. By contrast, the flashlight adapted to control light pollution, it is clear that this device allows the sky to be much darker and the camera is able to clearly record the constellation of Orion.

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