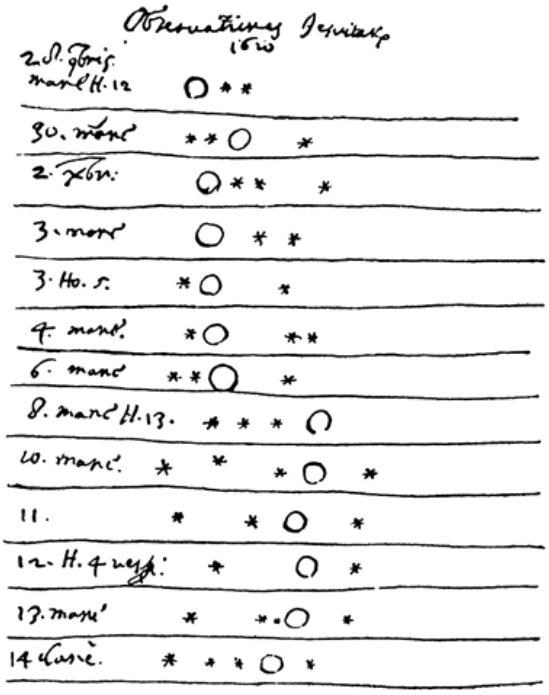
Observation of Jupiter and Saturn with binoculars and telescope.

With the use of binoculars we can perfectly observe the brightest satellites of both planets and certain planetary aspects.

First, when observing Jupiter and Saturn with binoculars, the first thing we will highlight is that a circle is appreciated, instead of a point image as when we see a star. Although they are all spherical objects, the planets of the Solar System, being closer to the Earth, we solve them in their real circular shapes on the celestial vault when observing them with binoculars, which is not the case with stars, due to the immensity of the distance that separates us from them.

Second, the magnification provided by binoculars allows us to distinguish the brightest satellites orbiting the giant planets. Jupiter has 79 cataloged satellites. Four of them are the largest, in order from largest to smallest, Ganymede, Callisto, Io and Europa, with diameters of 5,262 km the largest and 3122 km the smallest, followed by 5 satellites with diameters between 50 and 200 km, 7 satellites with diameters between 10 and 50 km and 63 satellites with diameters of less than 10 km. Of all of them we will be able to see with the binoculars the 4 largest, which in order of distance from the planet are Io, Europa, Ganymede and Callisto. These satellites have been known since 1610, when the Italian astronomer, physicist and engineer Galelio Galilei pointed his rudimentary telescope at Jupiter and noticed the existence of several points of light that seemed to accompany it. A detailed observation suggested that they were objects orbiting the planet Jupiter.



This, which today seems trivial to us, in the seventeenth century was the beginning of a great revolution in human thought. Until that date, it was a dogma of faith to believe that the Earth was at the center of the Universe and all other objects revolved around it. Galileo with his

methodical observations discovered that another object in the universe, Jupiter, behaved as the center of its environment. The fact that there are two centers in the universe casts doubt on the dogma of believing the Earth as a universal center.

We challenge you to follow with binoculars (or better, a telescope if you have one) the movement of the four satellites discovered by Galileo and to record their position and depending on what you obtain, determine if they are objects that rotate around the planet already sort them according to their distance from the planet. For this we provide you with the following table, to which you can add rows as you make your observations, (you can use the registration form that is attached at the end):

Date (mm/dd/yyyy)	Time TU (hh/mm)	Galilean satellite position
		◯
		◯

Some facts to know about binoculars before you start observing:

Binoculars are measured with two numbers expressed as axb. The first number, a, indicates the magnification and the second number, b, refers to the diameter of the front lenses of the instrument. For example, 10x50 binoculars indicate that it gives 10x magnification and that the front lenses are 50 mm in diameter. It should be taken into account that the amount of light that enters the lens is directly proportional to the square of the aperture, therefore the larger the diameter, the brighter the objects will be observed, which is very useful for observations with low light, such as made at night.

As planets and their satellites are very small point objects, to better appreciate them we must mount the binoculars on a stable tripod with a special adapter and place ourselves in a place sheltered from the wind to avoid possible vibrations, thus we will have a more static observation. This same appreciation is also valid for observing any celestial object, be it the Moon or the stars. If we observe by holding the binoculars with our hands, our own vibration will cause the image to move too much, preventing detailed appreciation.

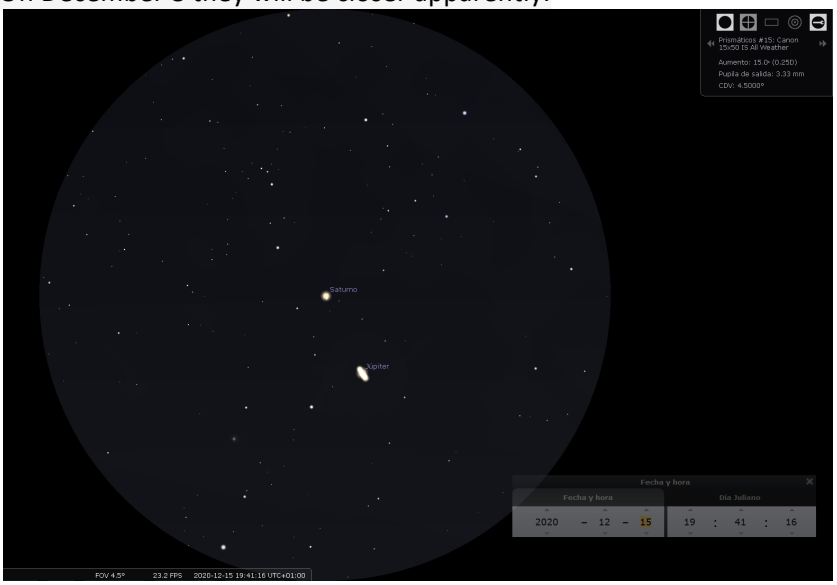
If we use a 5 ”(inch) diameter telescope, we will see the moons better, farther apart and the planet's disk somewhat larger, so something can be seen in its atmosphere.

On December 1, with 7x50 binoculars (7x magnification and 50 mm aperture), when observing Jupiter and Saturn, both will enter the field of view of the binoculars at the same time. We will see them like this:

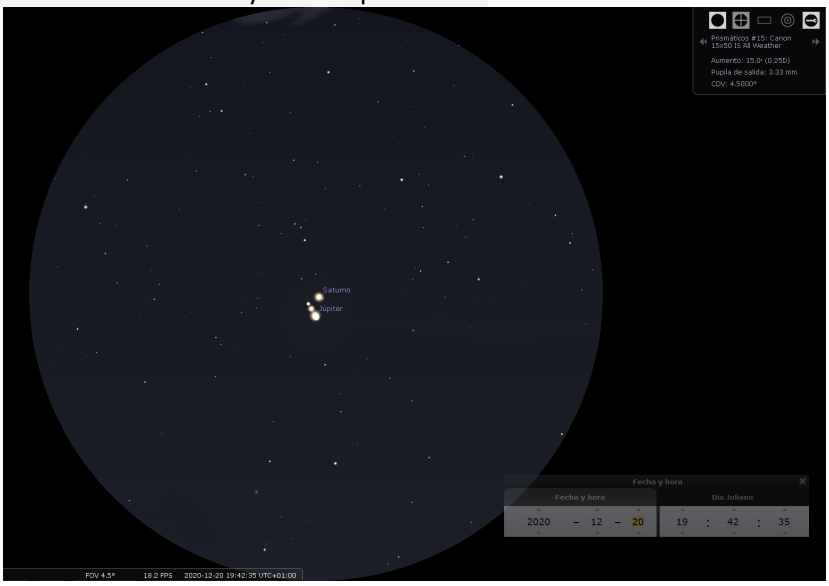
With 15x50 binoculars we will observe the approach of the two giants of the Solar System like this:

December 1st.

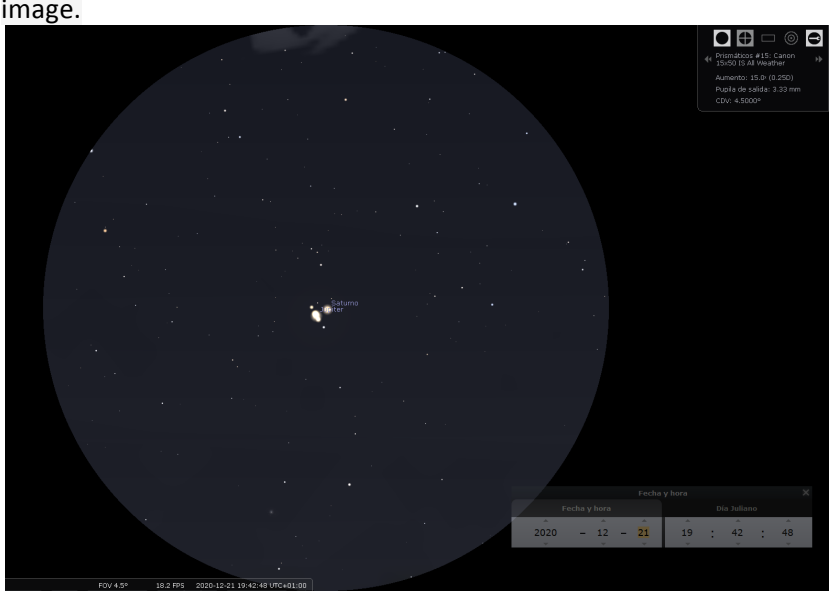
On December 8 they will be closer apparently.



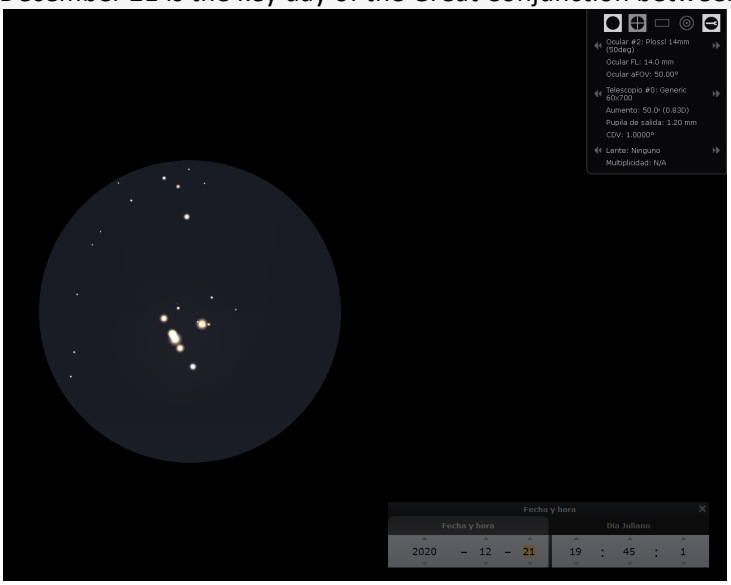
On December 15 they will be quite close.



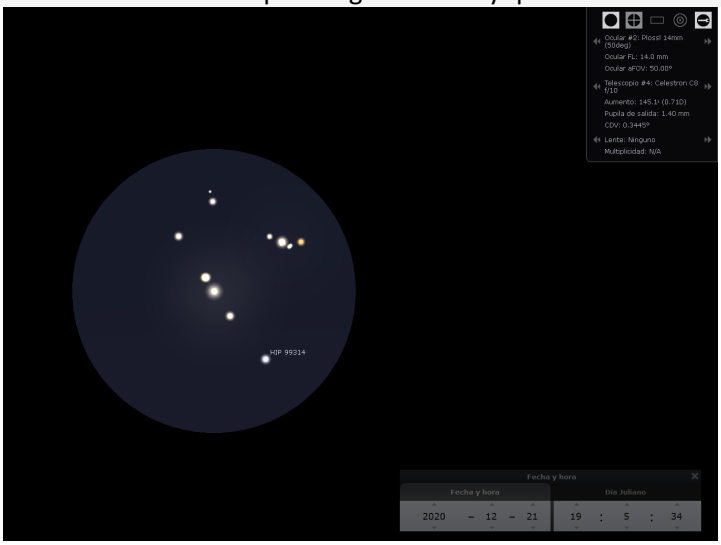
On December 20, one day before the closest approach, it will also offer us a magnificent image.



December 21 is the key day of the Great Conjunction between Jupiter and Saturn.



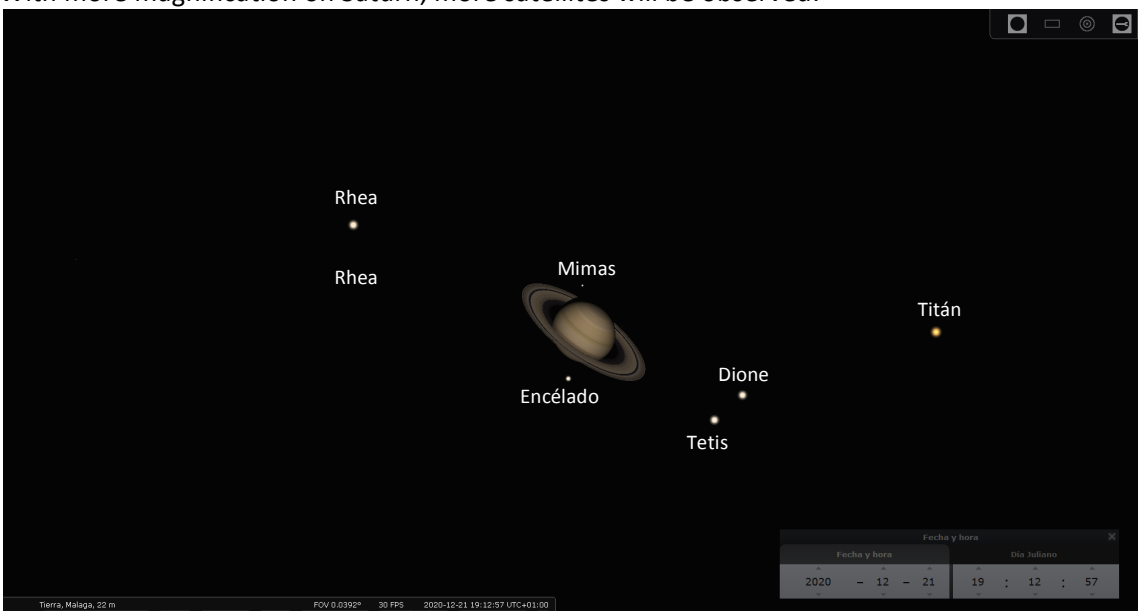
With a 60x700 telescope using a 14mm eyepiece we will see them up close.



With an 8-inch diameter telescope at f / 10 and a 14 mm eyepiece we will see this wonder: Jupiter in all its splendor surrounded by its four Galician satellites, three on the left, two of them very close together, Io and Ganymede and something else Callisto away and one to the right, Europe. In the same field of vision will be Saturn, to which the ring and some of its satellites will be observed.

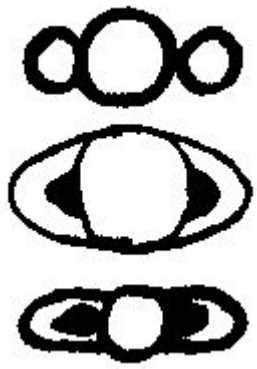
With a larger aperture telescope, an 11-inch one, we will be able to observe many details in the planetary atmospheres, in addition to the rings of Saturn and more satellites of Saturn, such as Titan, the brightest of them all, Rhea, Tethys, Dione, Iapetus and even Enceladus.

With more magnification on Saturn, more satellites will be observed:

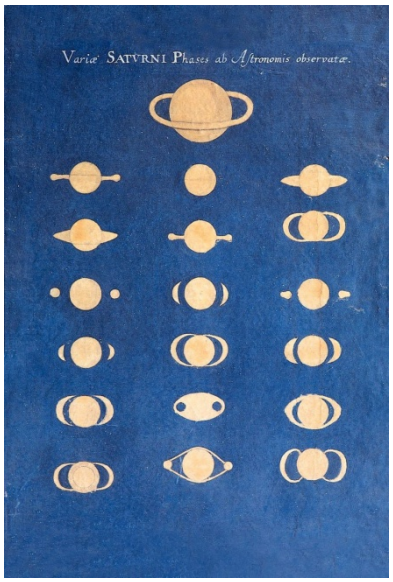


There are some mobile apps that tell us where the satellites of Jupiter or Saturn are located, some of which also allow us to rotate the field of view to observe them from the side or from above and thus have a clearer effect of perspective.

The rings of Saturn can be guessed with binoculars, as long as they are mounted on a tripod, although at this time what we will see will be an elongated disk, the rings of the planetary disk not being separated, this is because at this time the ring is quite inclined with respect to the line of sight of observed from the Earth. Galileo also failed to resolve the separated ring of the planet and drew it as having huge "ears." To be able to observe the rings well, a telescope is required.



Saturn drawing by Galileo



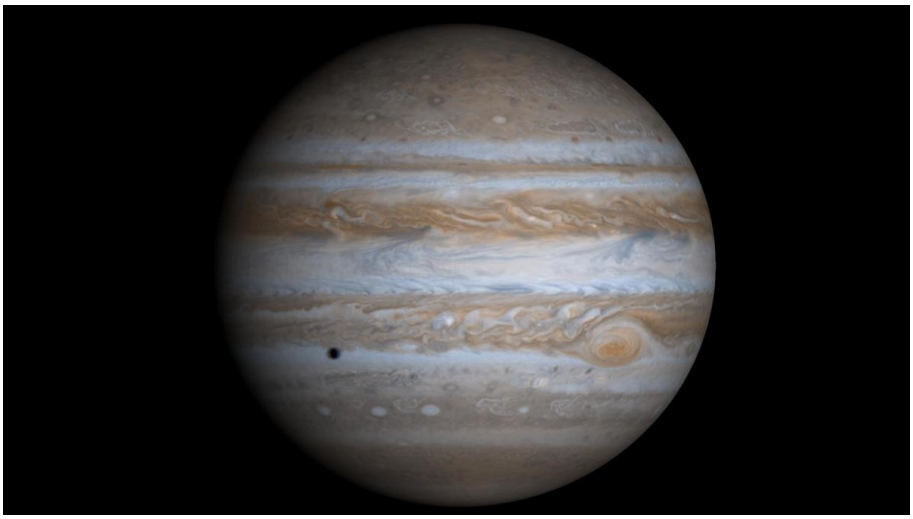
Saturn drawing by María Clara Eimmart

Jupiter and Saturn in detail as seen with an 8-inch or larger telescope.

Jupiter and Saturn are fundamentally gaseous planets, when we observe them with a larger diameter telescope we will be able to appreciate some details in their atmospheres.

To appreciate more details in the atmosphere of Jupiter, it is necessary not to have turbulence in the Earth's atmosphere, as these distort the image and it looks agitated. To achieve the best quality in the sky for astronomical observation, a stable sky is required and the object to be observed is high above the horizon, as far as possible from the horizon. This will not be the case in this observation, since on these dates and until the end of December both planets will be quite low in the sky, about 20 degrees from the horizon, so we will have to count on some turbulence that will prevent seeing them completely clear. However, you will be able to appreciate several of its moons and some details of the atmosphere.

In Jupiter, there are two light brown belts in the center of the planet surrounded by whiter stripes called zones. They are lighter because they contain ice crystals. Sometimes other thinner belts are also seen between the equator and the poles.



The belts have shades ranging from grayish to brownish with reddish tones. White nodules are sometimes seen at the border between the belts and the zones.

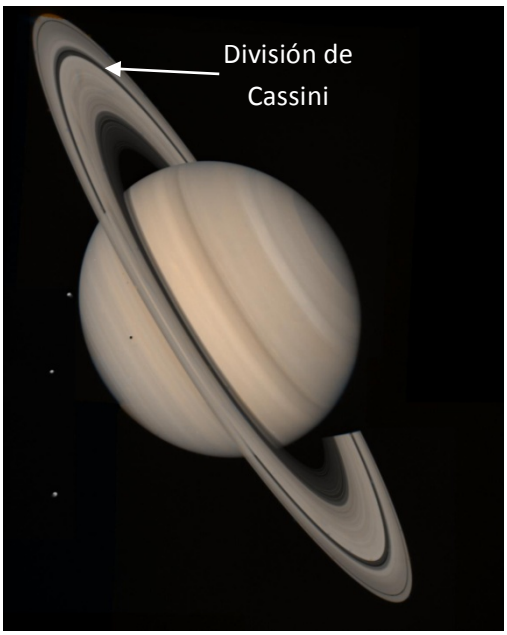
With a telescope of more than 5 inches, it is possible to see a huge anticyclonic storm over the southern equatorial belt that has been active for more than 360 years. Galileo did not get to see it with his rudimentary telescope. It is about 30% larger than Earth.

Jupiter rotates on itself very fast, it completes a revolution in just 10 hours, as it is so large, that makes it wider at the equator than at the poles and that is why we see it flattened. The poles are a little darker.

Due to the rotation period of Jupiter, if we want to observe the spot, once it appears we have about 5 hours to see it, then we will have to wait another 5 hours for it to appear again. Its color is variable and can go from intense red to light red or pink and sometimes with a very pale color. There is an app that indicates when Jupiter's red spot is visible.

With the use of colored filters some details are accentuated more than others and by exchanging them the details in the atmosphere can be better observed. The four main satellites of Jupiter sometimes pass in front of the planet from our point of view. When that happens you can see its outline or its shadow on the surface, or disappear behind the shadow of the planet or behind the planet itself.

With a telescope we can observe one or two pale equatorial belts on its surface on Saturn and the planet's pole somewhat obscured. In the ring, when it is tilted with respect to our view from Earth, as it happens now, the so-called "Cassini Division" is seen, a strip almost devoid of material, which in contrast to the rest of the material scattered by the ring look black. With larger aperture telescopes it is possible to see other smaller divisions in the ring as well.



To learn more about these planets and how to observe them with a telescope and cameras, we recommend attending the workshops and talks that have been organized to celebrate the event "Giants Meeting: The Great Jupiter-Saturn Conjunction".

Federación de Asociaciones Astronómicas de España

Position of the Galilean satellites of Jupiter

Date (mm/dd/yyyy)	Time TU (hh/mm)	Galilean satellite position
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