

Jupiter - Saturn Conjunction

By: Germán Morales Chávez

On December 21, 2020, the conjunction between the two largest planets in our solar system will occur. And they have woken up great interest and a series of statements and comparisons, in some cases misguided. So, let's give you a full reference of what will happen and what will be seen.

First, let us remind our readers that two years ago, in the article published on 2018-Dec-30¹, we indicated that at the end of 2020 there would be very interesting news, trying to arouse the curiosity of our readers. Have we achieved it at that time? Later in 2019 and this 2020 in some articles², we already mentioned that Jupiter and Saturn would give something to talk about, and we anticipated the planetary configuration that today is permanent news.

Our readers were on notice a long time ago. But we know that publishing things much earlier has the disadvantage that they fall into oblivion, as it seems happened this occasion. The reality is that this article was only due to be published in a few more days, but the media coverage (and the incoherencies disseminated) is such that we had to advance its publication, at the cost of what we say here is forgotten in a few days and the same questions return.

Well, let's move on to the explanation of the main topic.

What is a conjunction?

When two stars have the same Ecliptic Longitude (or also Right Ascension), they are said to be in conjunction (of course, we are talking about observer-based astronomical coordinate systems with respect to our planet). In simple words, when two stars are visible in the same direction in the sky, we say that they are in conjunction. This implies that there will be a moment in which their angular separation will reach a minimum value (however, not necessarily small).

Angular separation should not be mistaken with real separation (linear distance between the stars), two objects can be seen practically in the same direction and coincident (or almost coincident) in the sky, but being separated by gigantic distances; it is simply an effect of perspective.

How often do these types of conjunctions occur?

In the case of the planets Jupiter and Saturn, every 20 years (speaking in round numbers) they are in conjunction.

We will see how after this month (in February 2021), when the planets are visible again at dawn, their angular separation will increase until they will "meet" again in the sky twenty years from now.

From where the conjunction will be seen?

The conjunction can be seen from practically the entire planet. Of course, due to the movement of both planets (together with our planet's movement), the angular separation will change

¹ <http://www.astronomia.org.bo/astro/248-ConfiguracionEnero.pdf>

² In 2019-nov-22: <http://www.astronomia.org.bo/astro/262-JupiterVenusConj.pdf>,
and in 2020-abril08: <http://www.astronomia.org.bo/astro/270-ConstelacionesPlanetas.pdf>.

continuously, with a minimum that can be seen from the places on Earth where both planets are visible at that moment (on the horizon, preferably after dark).

This minimum separation occurs at 2:00 p.m. in Bolivia (18 UTC) on Monday, December 21. Which implies that, from our country, we will not be able to see the two planets at their minimum angular

separation, which will be 6' 06", something like 1/10 of a degree³; this corresponds to about a little more than one sixth of the Moon's apparent diameter. A few hours after the Dusk in Bolivia, when we can distinguish both planets in the evening sky, they will be 6' 19" apart, which as the reader can infer is not something substantial with respect to the minimum indicated (it is an increase in separation of 13"), which corresponds to a little less than the apparent diameter⁴ of Saturn with which we will see it at that moment (without considering the width of its rings in this value). Thus, the

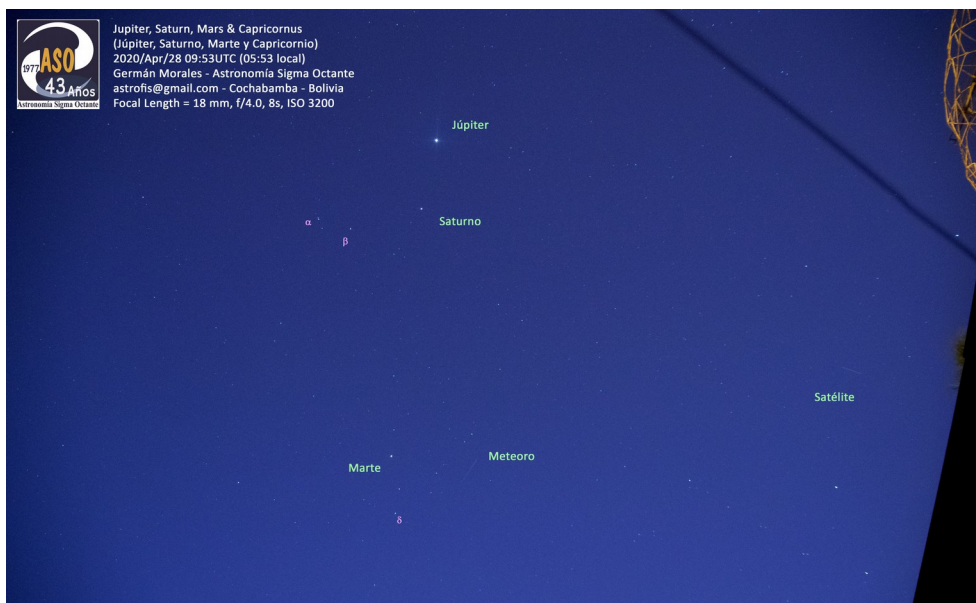


Fig. 1 Photograph taken in April of this year. At dawn, Jupiter and Saturn were visible high in the sky, in addition to Mars, which long ago was in conjunction with each of these planets (articles that can be found on our web pages). At that time, Jupiter and Saturn were separated by an angular distance of 5°.

difference in the span of a few hours will not be drastic, and something almost similar to the best moment of the conjunction will be appreciated.

How to observe the conjunction?

With the naked eye, you can see the change in position of the planets and how their angular separation varies over the days. Precisely, a few days before and a few days after the 21st, it will be very easy to distinguish this variation in angular separation.

Of course, the most attractive thing about this conjunction (and that is why we have waited for it for so long) is that it will be possible to see Jupiter and Saturn in the same telescope field simultaneously.

For a small instrument (with not much magnification, we speak of a field of 1 °), both planets will be able to be seen simultaneously in the field of view from 13 to 30 December.

³ In other words, the separation with which we see Jupiter and Saturn will be equal to 11 times the apparent size with which we see Jupiter. This, of course, can only be appreciated through a telescope, since with the naked eye, Jupiter and Saturn are seen as points of light, and a disk with an apparent diameter cannot be distinguished in the case of these planets.

⁴ Apparent diameter is understood as the angle subtended by the disk of the star in question. That is, the size with which we perceive it, in this case, from Earth.

Due to the distance at which Jupiter and Saturn are, they look very small compared to the Moon (for reference). Although it is about 40 times smaller in diameter than Jupiter, it is seen to be almost 60 times larger in diameter. This is due to the relationship of actual sizes and distances.

With larger instruments (and more magnifications), you will be able to see both planets between December 20 and 24. This is calculated for an observer in Bolivia (or near longitudes). Amateurs know that they can have more or less magnification (which implies a smaller or larger field of view, respectively) by changing the eyepiece. Therefore, the dates we give are a guide to what can be seen. This means that for several days we will be able to see Jupiter and Saturn simultaneously in the eyepiece field. Fantastic!



Fig. 2 - Schematic aspect of what will be observed by telescope on December 21 at 20:00 in Bolivia; it shows a field of view of 1 ° (suitable for most small telescopes (or somewhat larger telescopes with low magnification)).

You can see the size relationship of Jupiter and Saturn with respect to the field of the instrument. Of course, if higher magnifications are used, the planets will be seen with larger discs, and the field of view will be narrower.

leads to name it as a star, except in exceptional situations, where the human eye may not separate them individually, and see them shining as one. But that is not something that can stand out with much difference from what Venus or Jupiter stands out in the sky during the time of maximum brightness of any of these planets.

Third, the author of this article made a series of computer programs to calculate the conjunctions between Jupiter and Saturn, covering the period between 499 B.C. and 2200 A.D. In the results obtained, we can see that, at the time of the birth of Jesus, a conjunction occurred in October of the year 7 B.C. and the following in December of the year 14 A.D. In both cases, the angular separation between the planets was 1°, which implies almost twice the apparent diameter of the Moon, corresponding to the angular separation of most of these conjunctions between Jupiter and Saturn, which occur as we said, every 20 years.

Keep in mind that there is no categorical determination of when Jesus Christ could have been born. Some give as a possible year between 5 to 7 A.D., although the most accepted is that it was 6 B.C. On

Are there other conjunctions?

Of course! It is easy to guess that conjunctions between other planets occur, for example: Jupiter-Venus, Jupiter-Mars, Saturn-Mars, the Moon and some planet, and so on. But of course, that is beyond the intended scope of this article, and while there are very interesting things to say about it, we reserve them to announce and write about them another time.

Is this conjunction the star of Bethlehem?

It is completely unfounded since there is no reason to claim such a thing.

First, the biblical description does not give details that can be associated with some kind of astronomical phenomenon.

Second, a conjunction as in this case between two planets, implies two bright "stars" in the sky relatively "close", and does not present any special form that

the other hand, given the references in the Gospels, it should have occurred around the boreal summer, and not in winter times for the northern hemisphere, as it is currently commemorated⁵.

It can be seen that the dates of these conjunctions do not coincide under any criteria with the possible dates of the birth of Jesus, so that of the Bethlehem is something merely speculative.

Does it happen after 800 years?

That is another erroneous data which who knows who invented it.

We already said that every 20 years there is a Jupiter-Saturn conjunction. What we can say is that the last time that Jupiter and Saturn could be seen with such a small angular separation in the sky, similar to the current one, was July 1623 (almost 400 years ago) when the angular distance⁶ between them was of a little more than 5' against the 6' of this 21.

We can note that after 1623, the next conjunction with a small angular separation value occurred in February 1961, when that value reached 13' (something like a little less than half the apparent diameter with which we see the Moon in the sky).

In March 1226, Jupiter and Saturn were separated by just over 2 arc minutes, that is, a

third of what they will be separated on December 21. But even more, in the indicated period, we have the March conjunction of 372 A.D., when the angular separation was 1.9 arc minutes.

There were several occasions when they were separated by 5, 6, 8 or 10 arc minutes, but it does not make sense to specify more data, what has been said is enough and more than enough to show the wrongness of the statement that is disseminated in this regard.

We will say something else; the next conjunctions of Jupiter and Saturn will occur in the years 2040, 2059, 2080 and 2100, ... The conjunction of March 2080 will present a similar separation (6 arc



*Germán Morales
Astronomía Sigma Octante
Jupiter-Saturno
2020-12-10 23:59 UTC*

Fig. 3 - This photograph is from the day this article was written. Jupiter and Saturn, now separated by a degree and a third, can be seen close to the western evening horizon, in the following days their apparent motion will be easily detectable.

⁵ The reason why Christmas is celebrated in these times, it is well known that it is related to the syncretism of pagan holidays with the "new" official Roman religion of the fourth century coinciding (or close to the winter solstice in the northern hemisphere). Furthermore, uncertainties in the historical calculations led to an error in establishing the starting year of the new chronology that we currently use.

⁶ Just in case, the apostrophe (') is used to symbolize minutes of arc, a minute of arc is the 60th part of a degree. In addition, the quotation marks (") are used to symbolize arc seconds, where each arc second corresponds to one arc minute. Thus, the moon has an apparent diameter of just over 30" which is equivalent to more than 1800'.

minutes) to that of this Monday 21, that is, in 60 years we will have a conjunction of similar characteristics, but it will not be the only one in this time interval.

Will this conjunction produce catastrophes?

Claiming that conjunctions can produce different types of catastrophes like earthquakes, a hurricane (for example), is absurd.

Although the proximity to the same line of sight implies that they are aligned or almost so, it does not imply that new and greater gravitational forces appear. Basically, the gravitational force (which is insignificant) acting on the Earth by said planets, is negligible; This is similar to the one that acts a few days and weeks before and comparatively with the solar (and lunar) attraction, so nothing should be feared about it.

Unfortunately, people with no training in mathematics and physics have opinions (making up wrong conclusions) on subjects in which even a good high school student could calculate and find the true results. It is deplorable that there are unscrupulous people with no moral who try to disorient and scare the population.

Why are all these inconsistencies said?

And surely more things are being said without any support. But we do not have the time or the intention to be on the lookout for all the inconsistencies that circulate in the networks and in the press media.

Why they are said and spread is something attributable to two basic aspects: there are many opinionologists who talk about things that they do not understand well, or they repeat something that they heard around without understanding it; or they want to find a scoop based on the incipient understanding on these issues that they have not yet reached.

Sensationalism and seeking (or affirming the existence of) superlatives or unique and almost unrepeatable things to arouse the attention and interest of the public, is something that is increasingly accentuated. Instead of seeking a thorough understanding of things, there is the seeking of strong impressions and experiences. People are disappointed in what they see when they can see it (or not being able to see it and being left with unsatisfied curiosity).

Whatever the reason, it is not an incentive to generate good habits in awakening the curiosity of the human being, and it misrepresents the foundations of science. It becomes, many times, a sterile and empty of content in which the only interest is to extract applause and gestures of admiration from the public, meanwhile the true understanding of the world in which we live remains a mystery and produces fear (or rejection) in people.

You can ask and you will discover that the majority of people (even those related to the subject) are just hearing about this conjunction.

To this must be added statements of a superstitious nature or wrapped in mystical/esoteric veils with hidden signs that some use to distract people or to profit from it. For this reason, the best solution to these situations is good information, and that is achieved with a true learning that implies a thorough understanding of the topics that are being discussed.

¿Observations for all audiences?

There have been opportunities that, for different reasons and events, we have organized public observations so that those most interested have the opportunity to see through telescopes some planets (mainly) or astronomical events.

On this occasion, we wanted to do something similar, and already last year, an observational activity had been considered. However, the current health situation prevents it from being done.

It would be irresponsible and inconsiderate to carry out this type of activity, taking into account, furthermore, that it could serve as a very conducive means of increasing contagion.

In the astronomy center itself, we have carried out our work and observations practically individually.

In summary

Over the next few days, we will see Jupiter and Saturn near the western horizon at dusk. As the days go by, their angular separation will decrease, until the 21st will be minimal. The following days, we will see how they move away, a visualization of this can be seen in the graph with which this article ends.

With the naked eye, you can follow the apparent movement of these planets, as we have described, but through a telescope, things take on a much more interesting aspect. Since for a few days we will be able to see both planets in the same field of the telescope, it will depend on the type of instrument and the magnifications with which it is observed so that this period is about 5 to 7 days or just two to three.

Hopefully this text clears up some doubts. The author wishes he could expand on a greater and more detailed explanation, but that would cease to be an article and would become a textbook. In fact, this article is longer than the usual ones and it may make some people lazy to read it.

We hope that this is not the case, and that those interested in these topics will find a starting point to understand something more about the natural phenomena that we can contemplate in our wonderful Universe.



The graphic sequence at the end of this note, shows the western sky (between the southwest and the west) and for Cochabamba at 20:00. on December 11, 15, 21, 26 and 31. Basically, it is useful for the whole country, and with small differences in angular separation for any observer at a latitude close to -20° . In case of being more towards the south or more towards the north, the position of the sky will appear rotated with respect to what is presented in this graph. For us in Bolivia, the planets appear to be moving almost vertically relative to each other.

You can also see how throughout the days the sky itself changes, with the stars (and constellations) being lower in the sky every day. The apparent movement of the planets with respect to the stars is appreciated. You can also see how the angular separation decreases until the 21st and then increases. If we use Saturn as a reference, we will be able to appreciate how Jupiter approaches it every day, from "below" to continue towards "above" it. At the same time that this occurs, each day they are seen lower on the horizon.

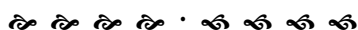
By the end of the year, at the indicated time, they will be about 6° above the horizon (close to set). Therefore, until the first week of January, we will have the opportunity to see them in the evening sky, and we will have to wait for the second half of February to see them again, now towards the eastern horizon in the morning.

Note that, by December 31, in addition to being very close to the horizon, its angular separation will already be 1°

On December 17, the Moon will be close to them (at about 4°), which will also have an aesthetic appeal.

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Germán Morales / ASO, Cochabamba 2020/12/10

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