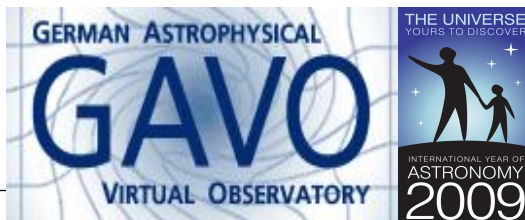
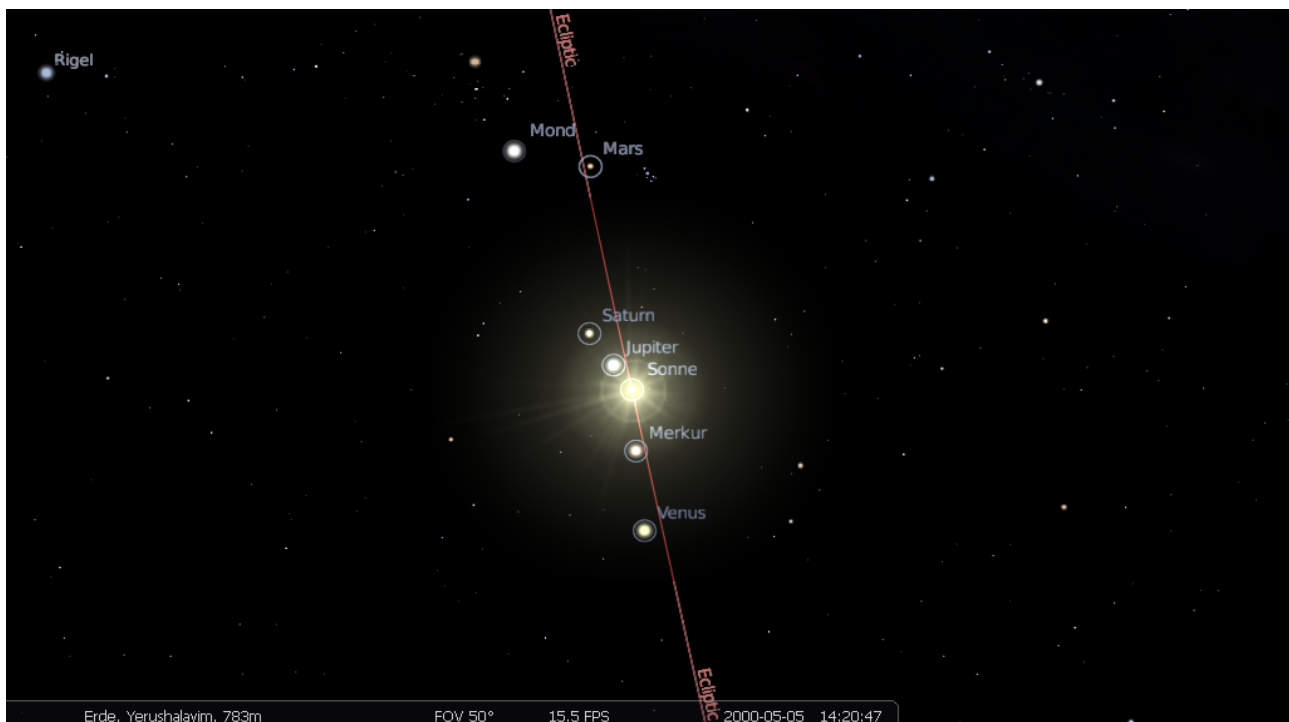


Planetary Conjunctions, the Star of Bethlehem and the End of the World in 2012

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Within this use case you will learn about an event that has been recorded by astronomers for thousands of years. Planetary conjunctions are events that are easy to find mentioned even outside scientific literature. You explore the motion of planets both around the Sun and in the sky, learn about planetary conjunctions and try a guess at what really might have been the Star of Bethlehem.

If used in the classroom this basic use case is technically very simple. Before performing it, however, the teacher has to provide a simple geometrical model of the solar system.

The motion of the planets

The planets of our Solar System have been formed in a large disk of gas and dust that surrounded the young Sun.

Because all the planets come from the same disk, their orbits are all more or less in the same plane – that of the disk!

When viewed from the Earth, it looks like as if all planets follow a line on the sky when they move in front of the background stars.

This line is called „ecliptic“ and it is defined by the apparant path of the Sun along the celestial sphere – which is really nothing else than the path of the Earth around the sun.

Because we observe the motion of the planets from a moving planet – the Earth – the apparant motion of the other planets on the sky can be quite complex.

Especially notable are *conjunctions*: an event when two celestial bodies (in our case planets) are very close to each other in the sky.

Of course this does not mean, that the planets are also close to each other in reality – it only appears to us in such a way from the Earth.

Conjunctions have always been of great interest to people; especially to astrologers. In former times they thought that the planets are symbols of the gods or the gods themselves and when they meet on the sky, they will fight each other or discuss the fate of the humans and thus conjunctions could herald good or bad news.

Astrology is, of course, nonsense – but planetary conjunctions are still popular today. Many people still believe in old superstitions and think of certain conjunctions as a harbinger of doom.

Observing the motion of planets with Stellarium

Stellarium (<http://www.stellarium.org>) is a free program to simulate the sky and the motion of the celestial objects.

One can specify a certain location and a

certain date and then watch how the sky would look for these specifications:



Figure 1: Specify Time and Location

The objects in the sky move in real time – but of course one can accelerate the motion using the controls of stellarium.



Figure 2: Control the speed of time

It is also possible to search for any object in the sky:





Figure 3: Search an object

For a quick demonstration, let's use the place of your current location and the current time and search for the planet Jupiter. If Jupiter appears on the sky, it depends on its current visibility. Maybe it is only „visible“ during the day? Then the light of the sun would be too strong for a planet to still be observable.

In Stellarium, you could „switch off“ the atmosphere:



Figure 4: Controlling the View

Then you can see the sky as it would appear during the day if no sunlight would disturb our view. You can now center on Jupiter - (use the  symbol) - and then accelerate the  time.

Jupiter moves around the sky on a certain path which is very close to the ecliptic. You can let Stellarium display the ecliptic by pressing the „-“key.

Lets follow the motion of the other planets (Mercury, Venus, Mars, Saturn, Uranus, Neptung). Do all of them follow the ecliptic exactly? Who shows the greatest deviations?

The Star of Bethlehem

Some scientists believe that the „Star of Bethlehem“ as described in the bible was a real celestial event. Some astronomers have proposed that it was a conjunction between some planets that was later described as a „star“

One possibility that could be the basis of the „Star of Bethlehem“-myth is a conjunction between Jupiter and Saturn that happend on 12. September of the year 7 BC.

Use Stellarium and try to watch the sky as it has looked like in ancient Israel. But note the following points:

- If you want to use the city of Jerusalem as a location: in Stellarium it is stored under the

hebrew name „Yerushaláyim“ (of course you can use also any other city in the area).

- There was no year zero! December 31st of the year 1 BC is directly followed by January 1st of the year one. However, Stellarium has a year zero. The year 7 BC is thus the year "-6" in Stellarium.



Figure 5: Saturn and Jupiter in the year 7 BC

An other possible conjunction that the „star of Bethlehem“ could be based on happend in the year 3 BC on August 12th. There Venus and Jupiter appeared to be almost in the same place of the sky.

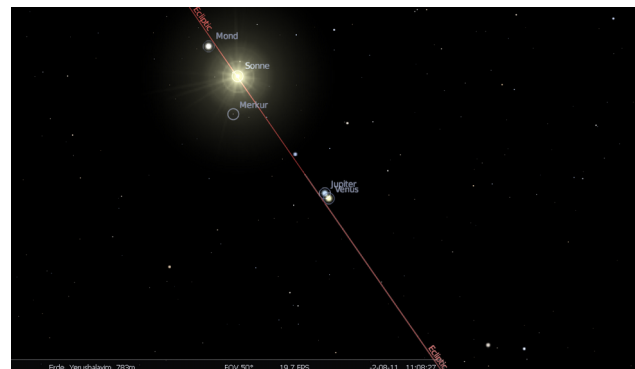


Figure 6: Venus and Jupiter one day before conjunction

A planetary alignment in 2012?

People and especially the media often talk about „planetary alignements“. They mean, that the planets would all aligne along a line on the sky which would result in various desasters (floods, earthquakes, etc).

Depending on how the planets aligne, it would look different from earth. If the planets appear along a line on the sky, then there real positions in the solar system of course are *not* aligned. If thatwas the case, i.e. if all planets form a „real“ line (e.g. if you

could look on the solar system from above), then from Earth it would look like as if all planets would be on the same point in the sky.

But such a situation will never occur. The chances for such an alignment are so small that even the lifetime of the whole universe is way too short for it to happen.

Some people claim that such a conjunction will happen on December 21st of the year 2012 and that the combined gravitational force of the aligned planets will cause great catastrophies.

With Stellarium you can easily check that claim. You will see, that there is no such alignment on December 21st, 2012. Mercury and Venus come a little bit close to each other but nothing more happens!

You can also try to calculate the forces of the planets acting on Earth. Jupiter is the largest planet in the solar system; 300 times more massive than Earth. Use Newton's law and calculate its force on Earth. Then calculate the force the Earth feels from the Moon. You will see that the force from the Moon is much larger – Jupiter's force is a hundreds of times weaker (because Jupiter is far away from Earth). The forces of the other planets are even weaker. Their position in the sky has no relevant influence on the force they are acting on the Earth! Even if a „line of planets“ would happen – it could not cause a catastrophe on Earth!

We have already seen, that all planets move along a line on the sky – the ecliptic. So even if the planets do not appear as a line in the real solar system, it sometimes can happen that they appear to be close to each other on the ecliptic.

Such an event happened in May 2000. There the planets Mercury, Venus, Mars, Jupiter and Saturn and the Sun and the Moon were very close to each other.

You can use Stellarium to look at this phenomenon. Since all the objects were very close to the Sun, it was not possible to observe the conjunction on the real night sky in 2000. When the sun had set, all the planets would have set with the sun and during the day the Sun would be too bright to observe the planets. And in Stellarium you have to „switch off“ the atmosphere too to observe the planets close to the sun.

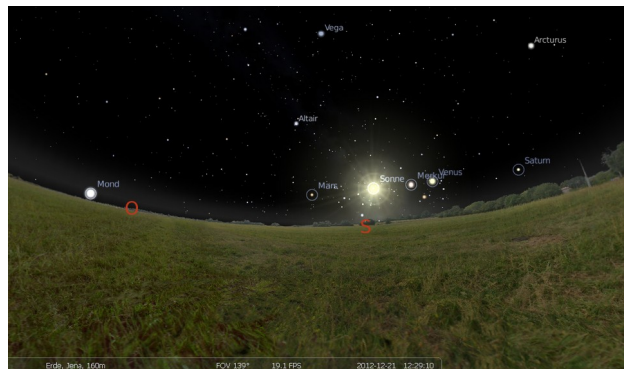


Figure 7: The sky on Dec. 21st, 2012

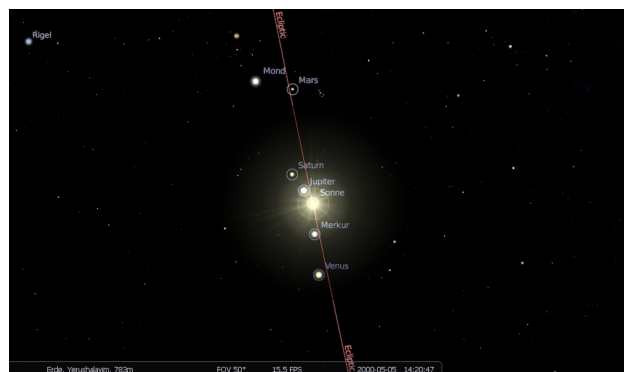


Figure 8: Planetary Alignment in 2000



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