International Educational Programme **Catch a Star! 2007**

Project: **Research and Observation of the Solar Eclipse**

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Content:

1. Introduction

1.1 Summary

In our project we concentrate on the research and observation of the solar eclipse. In the first part of the project we turn to the problem of the origin and prediction of the solar eclipse and we shortly describe a history of its observations. We mention also the other occultations, transits and eclipses that look like the solar eclipse. Then we ask a question, ''what is the scientific meaning of the solar eclipse?'' To get an answer we used also observation possibilities of the VLT.

In the second part we describe the total solar eclipse that took place on 29th of March 2006. It was possible to observe the total solar eclipse from a very narrow strip for example in Libya, Turkey or Russia. We compare this eclipse with the other eclipses that belong to the same series of eclipses called saros.

The partial solar eclipse was observable from a larger area of the Earth. It was observable also in the Czech Republic. So we decided to involve the other students of our high school Gymnázium Písek to the observation of this phenomenon. Our main aim was to inform them about the solar eclipse (about its origin, meaning etc.). Besides the observation we realized also the presentation in our assembly hall where we spoke mainly about the observation of the solar eclipse on 29th of March 2006.

1.2 Our team

Jan Měšťan and Jan Kotek have been studied a high school Gymnázium Písek. Jan Měšťan is very interested in astronomy. He studies German, English and Spanish. Jan Kotek likes besides astronomy also history and geography. He studies German and English. Our team leader is Mr. Marek Tyle, the teacher of IT and physics. He teaches in French and Czech languages.

2. Origin, types and predictions of the solar eclipse

2.1 How does the solar eclipse originate?

As we know, the solar eclipse originates when the Sun, the Moon and the Earth are situated in a straight-line position. In the time of the solar eclipse is the Moon situated in a New moon position and casts a shadow on the Earth.

Visible sizes of the Moon and the Sun in the sky are approximately the same, because the Moon is situated approximately 400 times nearer to the Earth than the Sun and its diameter is approximately 400 times smaller than the diameter of the Sun and so the occultation is possible.

A similar situation can happen also during the lunar eclipse (Figure 1), when the Moon and the Earth swop their positions. It means that the Earth casts its shadow on the Moon. Everyone who sees the Moon upon the horizon during the lunar eclipse can observe the lunar eclipse.

Figure 1: *Partial lunar eclipse on 7th of September 2006 (photo: Jan Měšťan).*

It is possible to observe similar occultations and eclipses like lunar and solar eclipses very often in the universe. Total solar eclipse is possible to observe on Jupiter, when a moon Io casts a shadow on it (Figure 2). The same situation happens for example, when the moon Titan casts a shadow on Saturn.

We can also observe transits of planets over the solar disc if these planets are situated nearer to the Sun, than the observer (Figure 3). From the Earth we are able to observe transits of planets Mercury and Venus. The transit of Venus had an important role in the past, because it was possible to measure the Earth-Sun distance (Astronomical unit) due to its observation.

Figure 2: *Jupiter and Ios shadow (credit: Cassini Imaging Team, Cassini Project, NASA).*

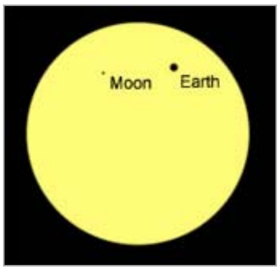

Figure 3: *Earth transit observable from Mars in the year 2084.*

We can also indirectly observe transits of extrasolar planets over far stars. It is possible to observe new planets out of the solar system due to these observations. We are allowed to discover extrasolar planets during these transits, because the star brightness goes down. This decline is very slight. The first extrasolar planet detected due to this method was described in the year 1999.

2.2 Types of solar eclipses

Astronomers distinguish 2 basic types of the solar eclipse. The first type is the total solar eclipse. This eclipse happens, when the Moon is very close to the Earth and when the Earth is very far away from the Sun (Figure 4). The Moon casts a shadow on the Earth (Figure 5) and the trace of the lunar shadow is called path of totality. Path of totality can be thousands of kilometres long, but usually it isn't wider than 250 kilometres. The total solar eclipse is very rare on one locality of the Earth and it can take max. 7.5 minutes in extraordinary cases.

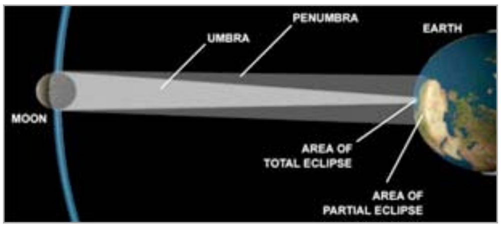

Figure 4: *Total solar eclipse scheme (from 3D Atlas of the Universe).*

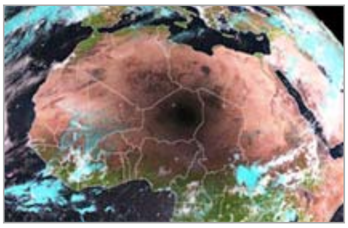

Figure 5: *Lunar shadow during the total solar eclipse on 29th of March 2006 (copyright © 2006 EUMETSAT).*

The second type is the annular solar eclipse. It happens when the Moon is very far away from the Earth and the Earth is very close to the Sun (Figure 6). From this reason is the Moon not able to cover the whole Sun (Figure 7). This type of eclipse takes max. 12.5 minutes in extraordinary cases.

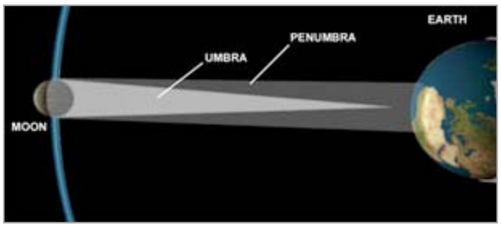

Figure 6: *Annular solar eclipse scheme (from 3D Atlas of the Universe).*

Figure 7: *Annular solar eclipse on 3rd of October 2005 (photo: Milan Antoš).*

A very rare type of the solar eclipse is the so called hybrid eclipse. It happens when diameters of the Moon and of the Sun are approximately the same. During this eclipse the observer can see on the Earth both types of the solar eclipse, because of the roundness of the Earth.

All mentioned solar eclipses are followed by the partial solar eclipse that is possible to observe from a penumbra.

2.3 How to predict the solar eclipse

The first written record of the observation of the solar eclipse is from the year 2137 B.C., when two Chinese court astronomers were executed, because they forgot to alert their emperor about coming total solar eclipse. And so the Chinese people weren't ready to drive away a dragon that was supposed to eat the Sun.

Figure 8: *The Incas are driving away the solar eclipse by making noise and hitting animals (18th century).*

We need to know three important orbital periods of the Moon to find the periodicity of repetitions of solar eclipses. These are synodic, draconic and anomalistic month.

Synodic month

It is a time that elapses between two lunar phases (in a case of the solar eclipse between two New moons). Synodic month lasts 29.53059 days (29 d 12 h 44 min).

Draconic month

The solar eclipse doesn't happen in every New moon position, because the orbit of the Moon is inclined by about 5° to the ecliptic. This angle goes down and goes up with a period of 173 days - these changes are very slight and they don't have an important influence on the prediction of the eclipse.

Draconic month is a time that elapses between two passages of the Moon through the ecliptic. If the Moon is situated too much under or too much above the ecliptic in the New moon, then the Moon passes the Sun (Figure 9). The Moon must be situated near one of two nodes (ascending or descending node), so as the eclipse can originate. The distance of the Moon to the node can't be bigger than 18.4°, so as the partial solar eclipse can be possible. The total or annular solar eclipse can happen when this distance is smaller. Draconic month lasts 27.21222 days (27 d 5 h 6 min).

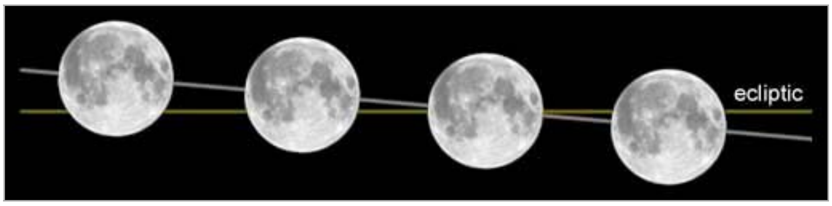

Figure 9: *The Moon crosses the ecliptic.*

Anomalistic month

The Earth-Moon distance is very various, because of the elliptic orbit of the Moon. The Earth-Moon distance at lunar apogee is 405696 kilometres and then the diameter of the Moon isn't able to cover the Sun. The Earth-Moon distance at lunar perigee is 363104 kilometres and in this case the Moon is able to cover the Sun. From the view of the prediction of the eclipse is for us also important the time that elapses between two lunar perigees. Anomalistic month lasts 27.55455 days (27 d 13 h 19 min).

Figure 10: *Full Moon at perigee and apogee.*

We must find the least common multiple of these three periods to find the time of the origin of the solar eclipse (Table 1). With using this method we find that solar eclipses are repeated after 18 years and 9 or 11 days, 7 hours and 43 minutes (the number of days is influenced by the number of leap years). This period is called the saros cycle and it contains 223 synodic, 242 draconic and 239 anomalistic months.

Synodic month	S = 29,53059 days
Draconic month	D = 27,21222 days
Anomalistic month	A = 27,55455 days
223 S ≈ 242 D ≈ 239 A	
SAROS = 223 S = 6585,32157 days	

Table 1: *Saros cycle = 6585,32157 days.*

Shortcomings of the saros cycle and their consequences

We use inexact numbers to find the periodicity of repetitions of solar eclipses. From this reason several shortcomings are caused after the saros cycle.

The most serious is the difference between the saros cycle (6585.32157 days) and 242 draconic months (6585.35724 days). The difference is 51.36 minutes. The Moon moves toward nodes and every other eclipse happens 51.36 minutes later.

The Moon goes down in the case of the ascending node (Figure 11). It means that the lunar shadow moves approximately 300 kilometres southward on the Earth's surface after every saros cycle. The first eclipse (T) starts near the polar region. The lunar shadow moves southward and at the end it passes the Earth.

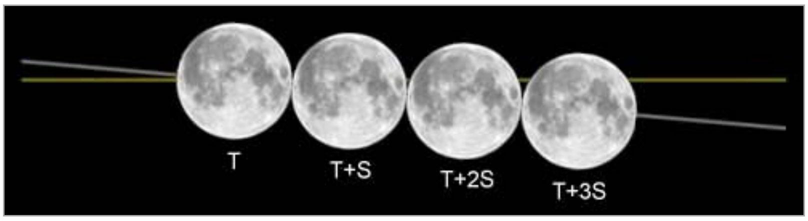

Figure 11: *Solar eclipses at the ascending node.*

The Moon goes up in the case of the descending node (Figure 12). It means that the lunar shadow moves approximately 300 kilometres northward on the Earth's surface after every saros cycle. The first eclipse starts near the South Pole. The lunar shadow moves northward and at the end it passes the Earth.

Figure 12: *Solar eclipses at the descending node.*

Eclipses can't be repeated infinitely. The saros series contains on average 41 various solar eclipses and 29 lunar eclipses. The series of saros eclipses last approximately 13 to 16 centuries. Eclipses vanish after this time and so series decline. There are more saros series and they fade into one another. Some of series are in the stage of creation of partial solar eclipses and the others for example in the stage of creation of total solar eclipses. We can observe at most seven eclipses in one year (4 to 5 solar eclipses and the other lunar eclipses).

The other periods that help to predict eclipses are Tritos and Inex. These periods aren't frequent. Tritos lasts 11 years and Inex lasts 29 years.

3. Scientific meaning of the solar eclipse connected to the VLT

The solar eclipse is very scientifically significant for us. The most important scientific meaning is based on the study of the Sun and its interior (Figure 13).

The solar activity affects the magnetosphere, the ionosphere, but also the biosphere of the Earth. And so the study of the physical properties of the solar chromosphere and mainly of the solar corona is very significant for the mankind. Both of these spheres are in normal circumstances hidden. The solar photosphere is very easily observable from the Earth in the normal conditions. We can't observe the interior of the Sun but it is possible to deduce its structure from the observation of the solar exterior.

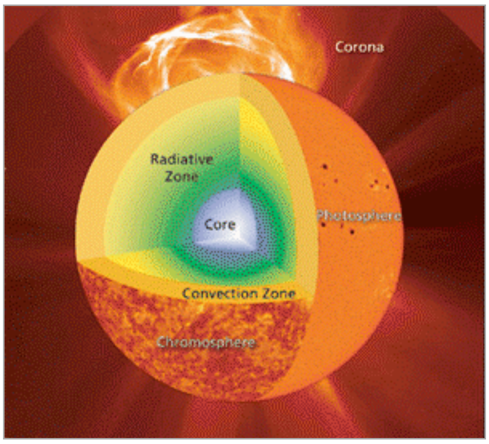

Figure 13: *Solar structure (credit: SOHO, ESA, NASA).*

We describe observation possibilities of the VLT (Figure 14) in connection with the scientific meaning of the solar eclipse. Because the VLT could help with the observation of the solar eclipse and it could help us to answer unsolved problems of the study of the solar atmosphere.

Figure 14: *Paranal observatory on the top of Cerro Paranal (© European Southern Observatory).*

3.1 The solar chromosphere research

The solar spectrum contains a lot of absorption lines (they were discovered in 1814 by J. Fraunhofer), because there are various gases in colder spheres of the solar atmosphere. These gases absorb various wavelengths of the solar spectrum. A very visible absorption line in the solar spectrum is H-alpha line (656 nm) that is caused by presence of hydrogen. It is possible to observe the solar chromosphere with H-alpha filters (Figure 15).

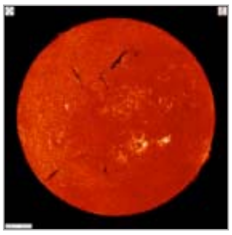

Figure 15: *Sun in H-alpha (credit: Big Bear Solar Observatory).*

The observation of the chromosphere is also possible during the total solar eclipse (Figure 16). We can observe the chromosphere and prominences for a while before the start and after the end of the eclipse. Prominences are observable usually for a longer time. Observation conditions of the chromosphere and prominences are influenced by the character of the total solar eclipse and by the position of the observer on the path of totality.

When diameters of the Sun and the Moon are approximately the same we can observe prominences during the whole time of the eclipse. The time of the observation of the chromosphere is extended with the larger distance from the central line of the path of totality. The further we are the more we can see the solar limb.

So it is necessary to take the spectrum of the chromosphere (Figure 17) during several seconds to determine the chemical composition and the temperature of the solar chromosphere. This spectrum is called the flash spectrum.

Figure 16: *The chromosphere after the 2nd contact during the total solar eclipse on 3rd of November 1994 (© 1994 Úpice observatory and Vojtech Rušin, © 2004 Miloslav Druckmüller).*

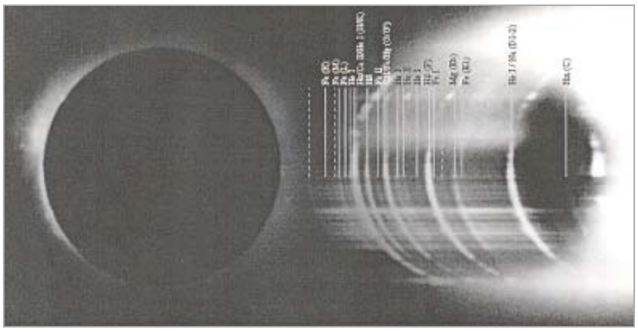

Figure 17: *The flash spectrum during the total solar eclipse on 11th of August 1999 (photo: Klaas Bakker, Amsterdam).*

Contribution of the VLT to the observation of the solar chromosphere

To get the flash spectrum of the chromosphere could help for example spectrographs **SINFONI** (UT4, Cassegrain focus) or **CONICA** (UT4, Nasmyth B focus) with **NAOS**.

Figure 18: *SINFONI (© European Southern Observatory).*

Figure 19: *NaCo (© European Southern Observatory).*

It is appropriate to do to spectrographs adjustment to get the flash spectrum. We can put a slit off the optical way (the slit is substituted by the narrow chromosphere crescent). Then there are monochromatic pictures of the chromosphere crescent in the final picture of the spectrum. These monochromatic pictures are adequate to spectral lines of the chromosphere.

3.2 The solar corona research

There are lots of important processes in the solar corona. Changes in the corona can be in progress for a short-term, but also for a long-term in connection with individual cycles of the solar activity.

The observation of the corona can answer a lot of our questions about its structure and origin and about the development of the solar activity or properties of the magnetic field of the Sun. One of unsolved problems is for example high temperature of the corona that is around 1000000 K. Another problem is also coexistence of the hot corona and colder prominences.

The observation of the solar corona isn't so easy as the observation of the chromosphere. The contrast between the solar photosphere and the corona is in the visible light bigger than 1:1000000. One of possibilities is the observation of the corona with a help of the coronagraph. The coronagraph makes with the occulting disk an artificial solar eclipse. The best solution is to put the coronagraph out of the atmosphere of the Earth. This method is used for example by the SOHO probe. A disadvantage of the coronagraph is the impossibility of the observation of the area where the corona touches the solar surface. We can't use the smaller occulting disc, because of the light diffusion.

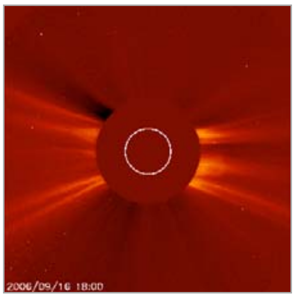

Figure 20: *The solar corona (credit: SOHO – LASCO, ESA, NASA). The small ring presents the size of the Sun.*

Another possibility is the observation of the corona at shorter wavelengths. This fact was used by the Japanese probe Yohkoh that had observed the corona in soft X-ray till the year 2001.

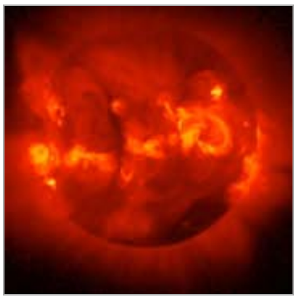

Figure 21: *Sun in soft X-ray (credit: Yohkoh Soft X-ray Telescope). The solar surface is invisible, because it shines at wavelengths between 380 - 760 nm.*

Contribution of the VLT to the observation of the solar corona

The best possibility how to observe the solar corona is the total solar eclipse. Instruments VLT **FORS1** (UT2, Cassegrain focus) and **FORS2** (UT1, Cassegrain focus) can help us to study the coronal structure. Both of these instruments could make detailed pictures of the solar corona during the total solar eclipse. And so they can help us to study processes happening in the corona.

Figure 22: *FORS (© European Southern Observatory).*

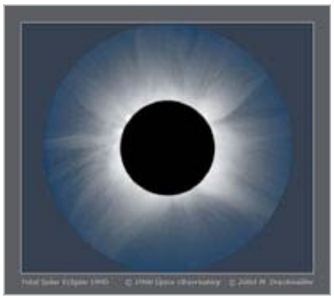

Figure 23: *The solar corona during the total solar eclipse in the maximum of the solar activity (© 1995 Vojtech Rušin © 2004 Miloslav Druckmüller).*

Figure 24: *The solar corona during the total solar eclipse in the minimum of the solar activity (© 1990 Úpice Observatory, © 2004 Miloslav Druckmüller).*

We can observe for a short-term a part of the inner corona, prominences and also the chromosphere during the annular solar eclipse.

3.3 The other meanings of the solar eclipse

There are more meanings of the solar eclipse besides the observation of the corona and the chromosphere. There is a decline of the brightness during the total solar eclipse and it is possible to observe stars and the other objects around the solar disc. We can observe or even discover for example asteroids or comets. There was discovered a dust ring by a group of Chinese and Indonesian astronomers during the total solar eclipse in the year 1983 - this ring is situated near the ecliptic plane.

We can proof the general theory of relativity with a help of exact measuring in a case of observing stars near the solar limb. Their positions are influenced by the spatiotemporal curvature in the surroundings of the Sun (Figure 25). It would be possible to use the **VLTI** (The Very Large Telescope Interferometer) to these observations.

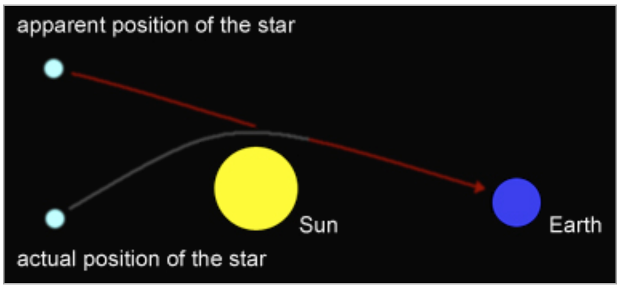

Figure 25: *Bending of starlight by the sun.*

During the solar eclipse we can measure the mutual position of the Sun, the Moon and the Earth. Thanks to old records of observations of solar eclipses we can date various historical events.

A very interesting aspect is so called Baily's Beads. They are observable just before or just after the total or annular solar eclipse. Baily's Beads are last rays that light through valleys on the lunar limb (Figure 26). Thanks to the observation of Baily's Beads we can approximately assume the structure of the lunar surface.

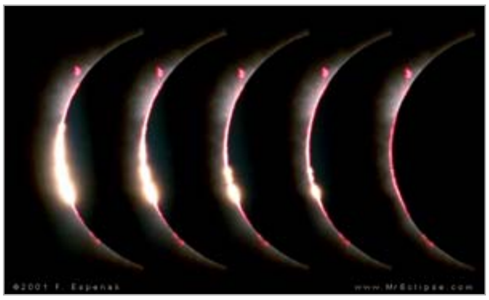

Figure 26: *Baily's Beads Sequence (© 2001 F. Espenak).*

Flowers close their blooms and many daily animals go to sleep, because of the big decline of the brightness during the total solar eclipse. Lots of botanic, ethnological, biological, psychological etc. studies are done during the solar eclipse.

3.4 Solar eclipses at Cerro Paranal

The geographical coordinates of Cerro Paranal (2635.43 m) are 24° 40' S, 70° 25' W. We used PC programmes Starry Night Bundle Edition and Redshift 5.1 (Figure 27) to find an occurrence of solar eclipses at Cerro Paranal.

Observing of the solar chromosphere and the solar corona is possible to do best during the total solar eclipse. At first we had a look at the nearest total solar eclipse that can occur at Cerro Paranal.

Figure 27: *Work with Redshift 5.1.*

Cerro Paranal is unfortunately poor in the occurrence of total solar eclipses. There will pass several paths of totality in this millennium, but the total solar eclipse will be here on 2nd of November 2339. This eclipse could be useful for observing of solar prominences and the solar chromosphere, because Cerro Paranal will be situated on the northern edge of the path of totality.

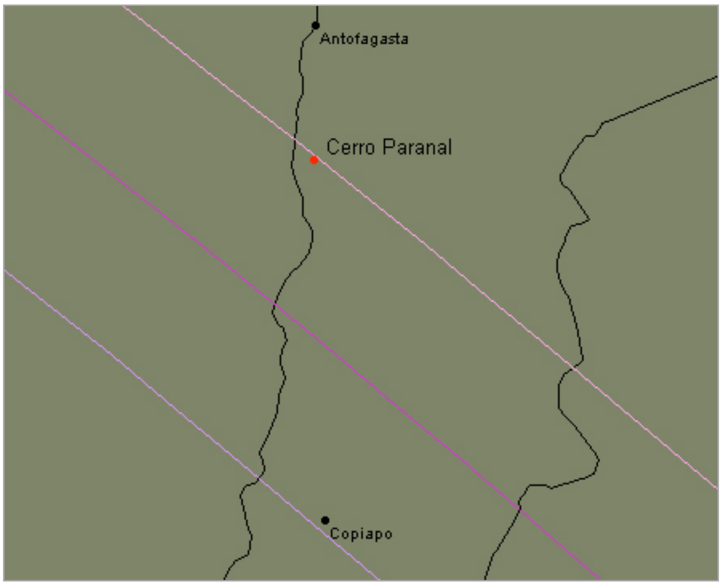

Figure 28: *A part of the path of totality of the total solar eclipse on 2nd of November 2339 (from Redshift 5.1).*

We will be more successful when we find the occurrence of annular solar eclipses. There will happen several annular eclipses at Cerro Paranal in this millennium. The next one will happen on 20th of October 2218. Unfortunately this eclipse will occur too low above the horizon and its observation will be very difficult.

The other annular solar eclipse will be on 11th of February 2241. This eclipse will be unique, because Cerro Paranal will be situated on the southern edge of the path of the annular solar eclipse - the best position for observing of Bailys's Beads and the inner corona during the annular solar eclipse is just near one of the edges of the path of the annular solar eclipse.

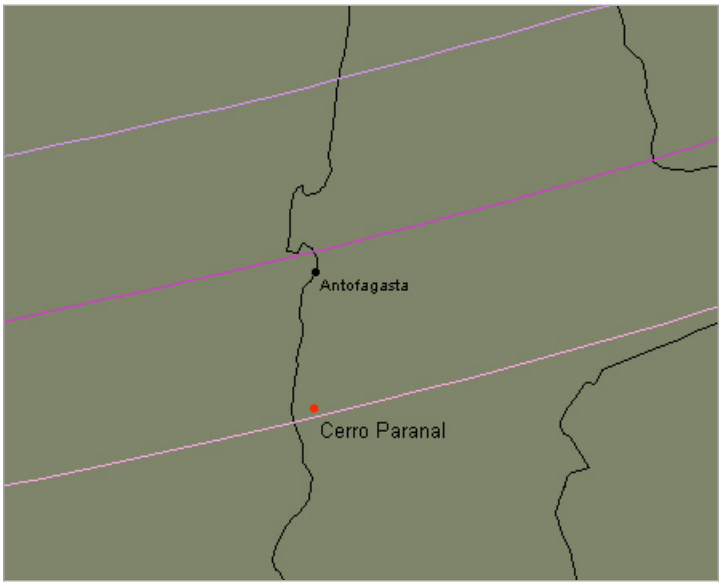

Figure 29: *A part of the path of the annular solar eclipse on 11th of February 2241 (from Redshift 5.1).*

The VLT could help us to observe the solar eclipse and could answer a lot of various questions about the solar eclipse. But there is one problem, the next total or annular eclipse at Cerro Paranal will happen in several centuries.

In the present we can't discuss about the observation of the solar eclipse at Cerro Paranal using the VLT. The real meaning of the VLT is based on observing of other space objects and phenomena besides the solar eclipse.

Observation conditions at Cerro Paranal are excellent for the observation of such objects. We can hope that thanks to the VLT will be done lots of new discoveries!

4. Observation of the solar eclipse at Gymnázium Písek

4.1 The total solar eclipse on 29th of March 2006

The total solar eclipse on 29th of March 2006 was the 29th eclipse of Saros series 139. The last eclipse of these series occurred on 18th of March 1988 (max. duration: 3 min 47 s) and the next one will happen on 8th of April 2024 (max. duration: 4 min 28 s).

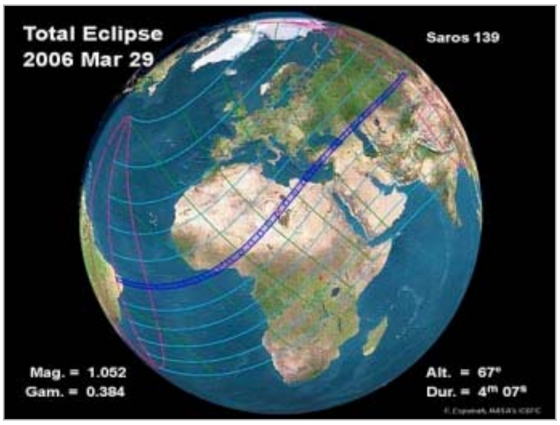

Figure 30: *Path of totality of the total solar eclipse on 29th of March 2006 (Fred Espenak, NASA´s GSFC).*

The total solar eclipse on 29th of March 2006 was exceptional, because the majority of the path of totality went on the land. The total eclipse began in northern Brazil. At first the lunar shadow moved very fast (max. 9km/s) and it passed over the Atlantic Ocean in half an hour. The shadow went on over the Africa – Togo, Ghana, Benin, Nigeria, Niger, Chad, Libya and Egypt. The speed of the lunar shadow went slower. In a territory between Chad and Libya the total solar eclipse lasted the longest time (4 min 7 s), its speed was the lowest (0.7 km/s). The maximum width of the path totality was 184 kilometres. The lunar shadow began again going faster and the duration of the total solar eclipse was shorter. The lunar shadow moved on over the Mediterranean Sea, Turkey, the Black Sea, Georgia, Russia, the Caspian Sea and Kazakhstan. The eclipse was finished in an area between Russia and northern Mongolia. The lunar shadow moved over the Earth's surface fully 3 hours 12 minutes and it travelled 14.500km and it covered 0.41% of the Earth's surface.

When we compare the total solar eclipse on 29th of March with the other eclipses of Saros series 139, we find out that this one doesn't belong among the most extreme eclipses. A very interesting is a hybrid solar eclipse that occurred on 11th of August 1627 (eclipse mag. 1.000). The width of the path of this eclipse reached 2 kilometres and the duration of the total eclipse was only 1 second. The longest total solar eclipse of Saros series 139 will be the eclipse on 16th July 2186. This eclipse will last 7 minutes 29 seconds (eclipse mag. 1.080) and width of the path of totality will be 267 kilometres.

4.2 Information about the partial solar eclipse in Písek

Last time we could observe the solar eclipse in the Czech Republic was on 3rd of October 2005. This eclipse wasn't easily observable, because of the occurrence of clouds. The next partial eclipse happened in the Czech Republic on 29th of March 2006. So we decided to observe this eclipse at our high school Gymnázium Písek.

Písek is situated in southern Bohemia and its geographical coordinates are 49° 18' N, 14° 09' E. We chose the platform in the area of our high school for the observation of the partial solar eclipse (Figure 32). This terrace offered easy entrance for students and other people. The geographical coordinates of this point are 49° 18´ 25´´ N 14° 09´ 08´´ E (according beta.mapy.cz).

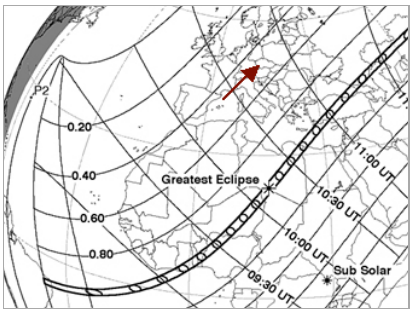

Figure 31: *The approximate position of Písek on the map of the total solar eclipse (Fred Espenak, NASA´s GSFC).*

Figure 32: *Observation area at Gymnázium Písek.*

We used Solar eclipse calculator by Xavier Jubier to calculate basic facts about the partial solar eclipse (Table 2). A PC programme Starry Night Bundle Edition helped us with the graphic presentation of the eclipse.

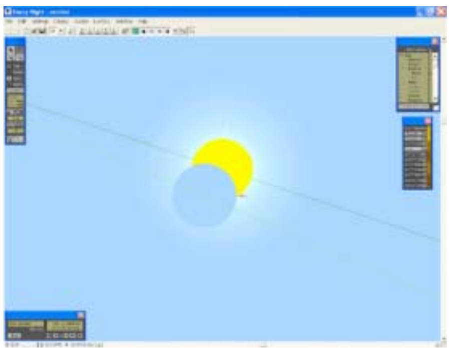

Figure 33: *Work with Starry Night Bundle Edition.*

	TIME (UT)	Sun altitude	Sun azimuth
1st contact:	9:44:46.0	+41°	152°
Mid eclipse:	10:47:04.9	+44°	173°
4th contact:	11:49:52.8	+43°	194°
Magnitude at mid eclipse	0.49521		
Coverage	39.1%		

Table 2: *Basic facts of the partial solar eclipse.*

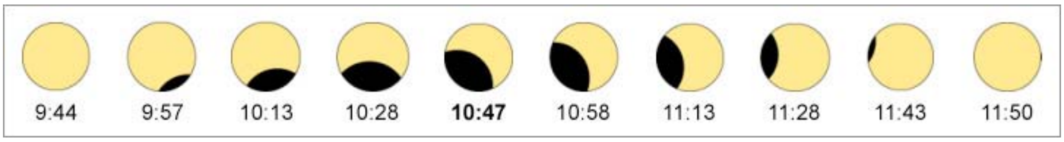

Figure 34: *Graphic presentation of the eclipse (in UT).*

4.3 Preparation of the observation of the partial solar eclipse

The main aim of our observation was to show the partial solar eclipse to students of Gymnázium Písek. We gave the presentation about the observation for representatives of classes in our assembly hall 15 days before our action.

Main points of the presentation:

- General information about the solar eclipse (its origin, types, meaning for a man etc.)
- Information about the total solar eclipse on 29th of March (path of totality, max. duration etc.)
- Observation of the partial solar eclipse at Gymnázium Písek (observation device, observation safety etc.)
- Scientific experiments done during the observation (measuring of the decline of brightness and temperature etc.)
- How to make a filter for the observation of the eclipse
- Organization of the observation

The organization of the observation was very important because the observation point should be visited by 22 classes (644 students) with their teachers.

Everybody got an information leaflet about the observation at the end of our presentation. This leaflet should help representatives to pass on our information to their schoolmates. Besides this presentation students could be informed by 3 special notice boards at our high school.

Figure 35: *Our presentation on 14th of March 2006.*

Figure 36: *Jan Měšťan is giving a lecture*

Figure 37: *Mr. Marek Tyle is supporting our presentation.*

Figure 38: *Jan Kotek is distributing information leaflets.*

4.4 Observation device

Observation device for students of Gymnázium Písek

- 13 solar filters made of X-ray photographs
- Binoculars MINOLTA 10x50 with 2 Baader AstroSolar filters - tripod VELBON CX 300
- Refractor 50/600 with using of the projection method – altazimuth mount
- Reflector Proximus 100 NEWTON 100/1028 with using of the projection method – altazimuth mount

Figure 39: *13 solar filters.*

Figure 40: *MINOLTA 10x50.*

Figure 41: *Construction of the projection tablet to the refractor.*

Figure 42: *NEWTON 100/1028.*

The other observation device

- Digital multimeter DT-8820 with luxmeter
- Digital thermometer WS 7206 with DCF 77
- Digital cameras CAMEDIA C-5000 ZOOM (3x optical zoom, 5Mpix) and Canon PowerShot S1 IS (10x optical zoom, 3.2Mpix)

Figure 43: *DT-8820.*

Figure 44: *WS 7206.*

Figure 45: *CAMEDIA C-5000 ZOOM.*

Figure 46: *Canon PowerShot S1 IS.*

5. Observation day

Meteorological conditions seemed very contrary in the Czech Republic the day before the solar eclipse.

The situation wasn't better on 29th of March. There was cloudy, overcast and a strong west wind was blowing in Písek. The meteorological situation was nearly hopeless till 9:15 UT and we thought we would have to cancel the observation. Later the sky luckily cleared up and we could do the observation!

Figure 47: *Satellite picture of the Europe on 29th of March 2006 at 12:00 UT (copyright © 2006 EUMETSAT).*

Since 9:40 UT classes began to visit the observation platform according scheduled times. It was also possible to watch live programme of the total solar eclipse from Turkey in our assembly hall.

The temperature of the air was around 11 °C. There was still strong wind outside. Sometimes the Sun hid itself behind clouds. We couldn't do planned scientific experiments (measuring of the decline of brightness with a help of DT-8820 and of the temperature with a help of WS 7206), because of such weather. But we could spend more time to help students with using of observation device (Figures 48-55).

The live programme of the total solar eclipse in the assembly hall was commented by Mr. Marek Tyle (Figures 56-59).

Here you can see photos we took by digital camera CAMEDIA C-5000 ZOOM during the observation of the eclipse (Figures 48-63). We used AdobePhotoshop 7.0 CE for editing these photos.

Photos from the observation point (Figures 48 – 55)








Photos from the assembly hall (Figures 56 – 59)




Photos of the partial solar eclipse (Figures 60 – 63)

Projection of the partial solar eclipse on the palm.

The partial solar eclipse on the projection tablet behind the refractor.

The partial solar eclipse through the welding glass.

The partial solar eclipse during the finishing phase on the tablet behind the reflector. There is a group of sunspots in the picture.

6. Conclusion

In our project we tried to choose only the main important facts about the solar eclipse. We wanted to show that the observation of the solar eclipse has got a scientific meaning even today. We are glad we could show the solar eclipse to students of Gymnázium Písek, although the weather wasn't fine. We hope that we helped to extend their knowledge about the solar eclipse.

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Software

3D Atlas of the Universe
Starry Night Bundle Edition
Redshift 5.1
AdobePhotoshop 7.0 CE

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