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Transit of Venus on June 5, 2012 by CVAS Member Aaron Worley.
**Satellite Eclipses**

**By Tony Mallama**

If you’ve never seen one before, watch a Galilean satellite emerge from Jupiter’s shadow. These visual spectacles zip by much more quickly than lunar eclipses. Io and Europa are especially swift, appearing out of the blackness and brightening to full luminosity in just a few minutes. How closely does the time on your watch compare to the prediction?

Professional and amateur astronomers have been timing eclipses of Jovian satellites ever since the moons were discovered 400 years ago. The first accurate measurement of the speed of light was based on eclipse data. Moreover, terrestrial longitudes were historically determined by eclipse observers using a method proposed by Galileo himself. In modern times, though, the twin goals of eclipse timing are to understand the orbital motions of the four satellites and to improve their ephemerides for the purpose of spacecraft navigation.

Quite a few CVAS members have timed satellite eclipses with CCD cameras. Occasionally two observers record one event, as happened during a disappearance of Europa last October. The close agreement between their light curves, as shown below, attests to high photometric accuracy.

The along-track orbital positions derived from results like these are often accurate to better than one second of time. This translates to about 10 kilometers of position or 0.003 arc seconds at the distance of Jupiter. CCD eclipse timings are the most accurate Earth-based method of Galilean satellite astrometry. Even in space, observations must be made from the vicinity of Jupiter in order to improve upon this mark. Let’s see why the observations are important.

**Io and Europa Resonate with Spectacular Results**

Io orbits Jupiter in 1.77 days while its neighbor Europa takes exactly twice as long. If Io were the only Galilean satellite its orbit would be circular. However, the resonance with Europa forces Io’s orbit into an ellipse. As the distance between supermassive Jupiter and Io changes along this ellipse the tidal forces vary dramatically. The satellite responds to these changes by deforming and the resulting friction heats the interior of Io above the melting point for rock!

The active volcano Tupan Patera is shown on this Galileo spacecraft close-up of Io.

The other satellites are also warmed by tidal heating but the effect diminishes as the distance from Jupiter grows. While Io is volcanic and Ganymede is quite cold, Europa appears to be 'just right' like that bowl of porridge in Goldilocks and the Three Bears. Instead of porridge, though, planetary scientists are intrigued by the likely presence of liquid water below Europa’s icy crust. The planned Europa Jupiter System Mission will
study both ice and water. Some investigations suggest that a prime location to seek liquid water at a relatively shallow depth is the Conamara Chaos region, shown on this page. The search for aquatic life will come later.

The resonance between Io and Europa shows up as a wobble in the satellite motions that is evident in our eclipse timing results. The graph on this page is a plot of observed (O) eclipse times minus those calculated (C) from ephemerides. The periodic oscillation in these ‘O – C’ residuals corresponds to the resonance. The general characteristics of the variations seen in CCD timings agree fairly well with theory. However, even the best ephemeris for Europa, derived from Galileo spacecraft data, does not adequately represent the observations. Our data suggest that the current picture of Europa needs sharpening.

The Conamara Chaos region of Europa may be a relatively thin spot in the satellite’s icy crust. Galileo spacecraft image.

Eclipse timings demonstrate that the orbital motion of Europa is difficult to predict. If the ephemeris were accurate all the data points (circles) would lie near the zero axis. Instead, there is a periodic oscillation (green line) corresponding to the orbital resonance described in the text plus a more random wander (dashed line).

Insights into Jupiter’s Atmosphere

The eclipse timing program was only intended to address the Galilean satellites but when comet Shoemaker-Levy 9 crashed into Jupiter in 1994 it proved to have an altogether different application. The comet had fragmented during an earlier close approach to Jupiter and when the pieces impacted in July they produced conspicuous dark spots in the Jovian atmosphere. The blotches were fall out from fireballs that soared above the Jovian cloud tops following explosions in the lower atmosphere. While the Hubble Space Telescope and Earth-based instruments were able to track the horizontal limits of the spots, their vertical extent was unknown. That’s where eclipse observations figured in because the high altitude debris significantly affected several light curves recorded in August. These aerosols were absorbing sunlight at astonishing heights above the cloud deck and produced
excessive dimming during eclipses as shown in the before-and-after plot below.

![Eclipse light curves recorded after the impact of comet Shoemaker-Levy 9 were fainter than usual due to aerosol absorption up to 300 kilometers above the cloud tops.](image1)

The SL-9 collision was not the first or the last time that eclipse observations served as a probe of Jupiter’s atmosphere. In December 1992 and again in December 1998 the outermost Galilean satellite Callisto skimmed Jupiter’s shadow. The first event was a partial eclipse by the planet’s south pole. The second was another by the north pole, as sketched on this page. Doug Caprette, a long time CVAS member, observed the 1992 eclipse and Bruce Krobusek observed that of 1998. Analysis of the light curves showed surprising evidence that high altitude aerosols with absorbing properties like those associated with SL-9 affected both events. In this case though the aerosols appeared to be associated with the polar regions themselves since light curves at other latitudes were not affected. The Galileo spacecraft had been orbiting Jupiter for several years by the time of the 1998 event and the on-board instruments were examining the polar haze. Galileo scientists were able to detect the obscuration up to about 50 km altitude with their direct observations. However the greater sensitivity of the eclipse light curve technique revealed absorbing matter at much higher levels.

![A fireball from the impact of comet Shoemaker-Levy 9 is seen above the limb of Jupiter in this Hubble Space Telescope image.](image2)

![Callisto slipped partway into the shadow of Jupiter’s north pole as sketched above. Bruce Krobusek’s light curve below recorded the brightness change.](image3)

![Eclipse light curves recorded after the impact of comet Shoemaker-Levy 9 were fainter than usual due to aerosol absorption up to 300 kilometers above the cloud tops.](image4)

![Callisto slipped partway into the shadow of Jupiter’s north pole as sketched above. Bruce Krobusek’s light curve below recorded the brightness change.](image5)

![Eclipse light curves recorded after the impact of comet Shoemaker-Levy 9 were fainter than usual due to aerosol absorption up to 300 kilometers above the cloud tops.](image6)

![A fireball from the impact of comet Shoemaker-Levy 9 is seen above the limb of Jupiter in this Hubble Space Telescope image.](image7)

![Callisto slipped partway into the shadow of Jupiter’s north pole as sketched above. Bruce Krobusek’s light curve below recorded the brightness change.](image8)

![Eclipse light curves recorded after the impact of comet Shoemaker-Levy 9 were fainter than usual due to aerosol absorption up to 300 kilometers above the cloud tops.](image9)

![A fireball from the impact of comet Shoemaker-Levy 9 is seen above the limb of Jupiter in this Hubble Space Telescope image.](image10)

![Callisto slipped partway into the shadow of Jupiter’s north pole as sketched above. Bruce Krobusek’s light curve below recorded the brightness change.](image11)

![Eclipse light curves recorded after the impact of comet Shoemaker-Levy 9 were fainter than usual due to aerosol absorption up to 300 kilometers above the cloud tops.](image12)

![A fireball from the impact of comet Shoemaker-Levy 9 is seen above the limb of Jupiter in this Hubble Space Telescope image.](image13)

![Callisto slipped partway into the shadow of Jupiter’s north pole as sketched above. Bruce Krobusek’s light curve below recorded the brightness change.](image14)
These fruitful investigations of Jovian atmospheric phenomena were an unexpected bonus of the satellite eclipse timing program.

**Deeper into the Solar System**

While Jupiter eclipses its larger moons over 300 times every year the other giants planets cover theirs far less often. Saturnian events happen at intervals of about 15 years near the times of equinox, while for Uranus the eclipse seasons only occur once every 40 years. However, eclipse seasons for both those planets occurred in 2007 and Bob Modic observed one event of each. The first was an ingress of Iapetus into the shadow of Saturn's ring and globe, shown below.

A sizable telescope is needed to record photometry of the faint satellites of Uranus. Bob used the 16-inch Stokes reflector at IHO to observe a rare event in which 14th magnitude Ariel covered 15th magnitude Umbriel. This was a satellite occultation rather than a planetary eclipse but the resulting astrometric information is equivalent. The timing from this light curve and several others indicated that Ariel, Umbriel and Titania, were all lagging behind the positions predicted by nine different ephemerides. No one has yet explained this systematic trend. The result is one of many surprises from the satellite eclipse observing program. Findings like these are the reason that we observe.

***Bob Modic's light curve of Iapetus.***

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Bibliography with CVAS authors listed:


Variable Star of the Season:
OT J071126.0+440405

By Bob Modic

OT J071126.0+440405 is a cataclysmic variable star located in Auriga (07h 11m 25.98s, +44d 04′ 05.0″). This star has a temporary designation instead of a permanent one since it was discovered just a few years ago. OT J071126.0+440405 is thought to be a type of cataclysmic variable called a Polar. A Polar is a binary system consisting of a white dwarf and a M-type (red) dwarf star. The more massive white dwarf draws matter from its companion. In most CVs this matter stream forms an accretion disk around the white dwarf. In a Polar type system, the white dwarf has a strong magnetic field that disrupts the formation of any accretion disk, funneling material instead directly onto the magnetic poles. The interaction of the matter stream with the magnetic field causes the emitted light to be highly polarized, hence the name 'Polar'.

Polars are similar to dwarf novae but don't have outbursts. They instead slowly vary between high and low states. When in a low state, OT J071126.0+440405 is usually magnitude 17V or 18V. During a high state, this variable can be as bright as magnitude 13V. OT J071126.0+440405 is also an eclipsing variable since the orbit of its two components is nearly edge-on as seen from Earth. The eclipses occur every 117 minutes and are up to 5 magnitudes deep. These eclipses provide a way to measure many properties of the binary system, including the relative sizes and separation of the stars, masses, and mass transfer rates.

Observations

During March and April of 2009, OT J071126.0+440405 was seen in a high state. CCD time series imaging of this star was obtained during several nights during that time period using my 8" f/5 Newtonian (March 16) and the CVAS 16" f/7 Newtonian at Indian Hill Observatory (April 17 and 18). Each time series used either 30 or 20 second exposures made with a ST-7XME and a Clear filter. I performed differential photometry on these sets of images using two nearby comparison stars (see table below).

Since the ST-7XME + Clear filter has a response closer to Cousins R than Johnson V, the Rc magnitudes of the comparison stars were used for the plots below. The comparison stars' differential brightness (K-C) is plotted also to show that conditions were good during each time series.

The light curve from March 16 covers about 1.5 orbits of the OT J071126.0+440405 system. During this time, two eclipses are seen as well as a pre-eclipse dip before the first eclipse and no dip before the second eclipse. The eclipses are just over 117 minutes apart. There is also a broader, sinusoidal variation that repeats every orbit. This variation peaks around the time of each eclipse and is at its faintest about half an orbit later.

The light curves from April 17 and 18 show the entirety of the main eclipse, which is 4.5 to 5 magnitudes deep. The onset of each eclipse is rapid but the rate of fading then slows until the star reaches minimum light. The recovery is very rapid, usually taking less than a minute to go from minimum to maximum light. The entire eclipse lasts 8 minutes. A fade of 1 to 1.5 magnitudes is also seen before both eclipses. This fade lasts 5 to 7 minutes and occurs about 18 minutes before the main eclipse.

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Figure 1. Light curve of OT J071126.0+440405 made from 288 CCD images on the night of March 16, 2009. Due to the faintness of the variable during eclipse and because an 8" telescope was used, the variable was not seen on images during each eclipse and there is a gap in the data during those times. There is also a gap near 3:34 UT due to a need to reposition the telescope during the long time series.

Figure 2. Light curve from Figure 1 with a Rc zero point applied. Because the variable was too faint to see on individual frames during eclipse, several images during eclipse were stacked to see if the variable could be detected. On the combined image for the first eclipse, a faint image of the variable was seen and measured. For the second eclipse, no image of the variable was seen. Errors for most data points are +/- 0.05 magnitude, increasing to +/- 0.3 magnitude for mid-eclipse.
Figure 3. Light curve of OT J071126.0+440405 made from 130 CCD images on the night of April 17, 2009.

Figure 4. Light curve from Figure 3 with a Rc zero point applied. Errors for most data points are +/- 0.03 magnitude, increasing to +/- 0.3 magnitude for mid-eclipse.
Figure 5. Light curve of OT J071126.0+440405 made from 188 CCD images on the night of April 18, 2009.

Figure 6. Light curve from Figure 5 with a Rc zero point applied. Errors for most data points are \( \pm 0.03 \) magnitude, increasing to \( \pm 0.3 \) magnitude for mid-eclipse.
Figure 7. Above is a frame from a time-lapse animation of the eclipse that was imaged on April 18, 2009. The animation can be seen at http://www.rjm-astro.net/varaur.gif (7.6 MB). This covers 27 minutes of time and shows the pre-eclipse dip and the main eclipse. OT J071126.0+440405 is located just left of center and a magnitude 16.5V star lies just to the right and slightly above it. The two comparison stars that were used for differential photometry are near the left (14.2V) and right (13.9V) edges of the cropped frame. North is up.

Polars

To interpret the structure in the light curves, it is helpful to visualize what a typical Polar looks like. Astronomers have studied dozens of Polars and have created models that best explain the variations in their light curves (see Figures 8 and 9). The standard model of a Polar has a M dwarf and white dwarf orbiting each other close enough that matter from the M dwarf is transferred to the more massive white dwarf. This matter flows in a narrow accretion stream towards the white dwarf. The accretion stream then encounters the white dwarf's strong magnetic field. Matter in the stream becomes caught up in the magnetic field lines and follows them to the magnetic poles of the white dwarf. Since the magnetic field lines converge on the poles, the matter is funneled onto them at very high velocities and pressures. This results in a tremendous release of energy and light as well as copious amounts of X-rays.

In some models of Polars, the accretion stream is thought to split into two diverging streams as it first encounters the magnetic field of the white dwarf (see Figure 8). These two narrow streams then follow the magnetic field lines to each pole. However, other models suggest a more complex structure where the stream and magnetic field interact. The density of matter in the stream probably varies. Therefore, lower density matter will be diverted by the magnetic field sooner than higher density matter, which travels in a ballistic path farther around the white dwarf before being diverted by the magnetic field. Thus the region where the accretion stream meets the magnetic field may resemble a curtain rather than a narrow stream. Accretion curtains can be seen in Figures 9 and 10.

As mentioned above, the white dwarf's magnetic field acts like a funnel to focus the matter from the accretion stream or curtains onto a small area near each magnetic pole. This "funnel" is also known as an accretion column. Compressed matter flows through the accretion columns and onto the photosphere of the white dwarf. The area where each accretion column meets the photosphere is called an accretion spot or hot spot. The accretion spots are very small, only about 1% to 2% of the white dwarf's diameter. The accretion columns and hot spots account for most of a Polar's light output. In most Polars, one magnetic pole tilts towards the secondary star and most of the accreted matter flows towards that pole. In that case, only one hot spot is usually seen.
In a Polar system, the light we see originates from the following sources (listed brightest to faintest):

1. The accretion spot(s) near the white dwarf’s pole(s) where the accretion stream contacts the white dwarf.
2. The accretion stream (the curtain(s) and column(s) are the brightest parts of the stream).
3. The white dwarf (primary).
4. The M dwarf (secondary).

In an eclipsing Polar system, the main eclipses are caused by the secondary star covering the white dwarf and its associated accretion spot(s).

**Discussion**

Combining the results from all three nights allows for a better determination of the orbital period. The data from March 16 indicates a period of 117.33 minutes (0.08148 days) between eclipses. The data from April 17 and 18 indicates a period of 117.18 minutes (0.08138 days). The difference between the two periods (0.15 minute) may not be significant given the errors associated with the timings. The 117.18 minute period agrees best with what other observers have measured.

The 20 second exposures used on April 17 and 18 were not short enough to resolve the ingress and egress of each eclipse. Especially with the egress, the star is very faint on one image and near full brightness on the next image. This suggests that the actual duration of ingress/egress is considerably less than the length of the exposures. (Indeed, other observers using larger telescopes and very fast exposure times have determined that ingress/egress each take about 1 second). Although Polars can have two accretion spots (one near each magnetic pole), the lack of a step-like ingress/egress in the light curve implies that OT J071126.0+440405 has a single accretion spot. The reason for having only one accretion spot could be that the magnetic field of the white dwarf tilts towards the secondary star, thus favoring the accretion of matter at mainly one pole instead of equally at both poles.

The sinusoidal variation seen on March 16 is most likely caused by the rotation of the white dwarf. As the white dwarf rotates, the accretion spot is pointed
towards us (just before and after the main eclipse). About half a rotation later, the hot spot is pointed away from us and out of view behind the white dwarf. Since the light curves show that the low point of the sinusoidal variation is about half a rotation from the main eclipses, this suggests that the accretion spot lies roughly along the line joining the white dwarf and the secondary. This would be the case if the two stars are in synchronous rotation with each other. A close look at the light curve shows that the low point of the sinusoidal variation is not exactly opposite the eclipses, but occurs 4 minutes earlier. This implies that the accretion spot precedes the line between the white dwarf and secondary by about 13 degrees.

The light curves also suggest that the accretion stream is curved and precedes the secondary star. The pre-eclipse dip is likely caused by the accretion stream eclipsing the accretion spot on the white dwarf. If the accretion spot precedes the line between the white dwarf and secondary by about 13 degrees then it follows that the accretion stream is a curved line that precedes the secondary in its orbit. The light curves also show an asymmetry during the later part of eclipse ingress. The slower rate of fading then might be due to the secondary star gradually eclipsing the accretion stream after the ingress of the white dwarf.

The relative locations of the accretion spot and stream may vary with time. Other observers have noted that the dip caused by the accretion stream was seen after the main eclipse. Likewise, the accretion spot was seen to follow the line between the white dwarf and secondary by about 10 degrees. The dip caused by the accretion stream is sometimes not seen (see the second eclipse in Figures 1 and 2), which suggests that the accretion stream either wanders a bit or sputters.

Some line drawings are shown in Figures 10a-d that illustrate what an eclipse of the OT J071126.0+440405 system might look like close-up as seen from the perspective of an Earth-based observer.

**Figure 10a.** Illustration of the OT J071126.0+440405 system about 10 minutes before the start of the pre-eclipse fade caused by the accretion curtain. Since this system has one dominant hot spot, only one accretion curtain and column are shown for clarity. Main components are labeled.

**Figure 10b.** Illustration of the OT J071126.0+440405 system after the white dwarf has emerged from eclipse by the accretion curtain and just before the start of the main eclipse.
Summary

CCD time series imaging was performed on OT J071126.0+440405 on several nights in March and April of 2009. The resulting light curves allowed several parameters of this Polar to be measured. An orbital period of 117.18 minutes (0.08138 days) was measured. Deep eclipses (~5 magnitudes) were observed with very rapid ingress/egress, which indicated that most of this system’s light output was from a very compact source. The accretion stream was indirectly detected both as it eclipsed the accretion hot spot near the white dwarf and as it was eclipsed by the secondary star. The accretion stream was observed to vary in intensity and location.

OT J071126.0+440405 is an excellent example of a Polar and is very well placed for study during most of the year from the northern hemisphere. Time series observations of eclipsing Polars such as this provide an effective method to measure many properties of these stars. Parameters such as orbital period, relative sizes and orientations of the system components (primary, secondary, accretion stream and hot spots) and mass transfer (high/low states) can be determined. Some of these parameters may change over time, so long-term study is warranted. Ideally, any time series work should be done with large telescopes and high time resolution, but even modest amateur-sized telescopes can yield good results, especially when OT J071126.0+440405 is in a high state.

References

Thorne K., Garnavich P., Mohrig K., 2010, IBVS, 5923
AM Herculis - AAVSO page
Astronomy Pictures of the Season

Venus in the Sierra Mountains

By Ron Baker

Cathedral Peak was one of John Muir’s favorite places in all of the Yosemite. He often passed it while returning to the Valley from his explorations in the high country. During September in 1986, Venus was positioned beautifully above the Cathedral Range of the Sierra Mountains. One evening, as viewed from my vantage point near Lembert dome in Tuolumne Meadows, the planet briefly aligned with the spire at the top of Cathedral Peak.

Although not evident in these photographs, Venus was at 21° south declination, and appeared from this location to set in the southwest. By comparison, at the time of the June 2012 transit, Venus was at 23° north declination. Both positions are within just a few degrees of the planet’s extreme north and south declinations.
The 2012 Transit of Venus

On June 5th, 2012, the planet Venus transited the Sun’s disk as viewed from Earth. This rare event provided observers with a once-in-a-lifetime opportunity, and will not occur again for 117 years. Great historical significance has been attributed to previous transits of Venus. In 1769, transit timings from several locations on Earth allowed astronomers to deduce the first accurate estimate of the astronomical unit (Earth-Sun distance).

Many CVAS members observed the recent transit. The reports appearing in this article provide comprehensive coverage, and range from observing strategies to commentary on the physics of the event.

By Bruce Krobusek

I setup my Meade ETX 90mm scope with a Thousand Oaks glass full aperture solar filter for both visual and photographic use. I put my Panasonic GF1 digital camera in video mode and had a SW radio tuned to WWV nearby. I may have missed 1st contact (it was earlier than I expected) but I let the camera run until Venus was well into the sun’s disk. The photos below were extracted from the video. The video can be viewed with QuickTime software: Venus transit video

By Bob Modic

I observed the transit from both my backyard (the first hour) and a location along the shoreline of Lake Erie. I saw 1st and 2nd contact very well. My visual timing for 2nd contact is 22:21:45 UT +/- 2 seconds. I used an 80 mm f/7 refractor w/ a Baader Planetarium solar filter. For about 5 to 10 minutes before 2nd contact, I think I saw a faint arc of light along the northern limb of Venus. This arc appeared as a hair-thin line curving roughly 30 to 60 degrees past the limb of the Sun. It became more obvious as Venus approached 2nd contact. I did not see an arc along the southern limb of Venus. If this was real and not my imagination, I was seeing sunlight refracted around the limb of Venus. I would like to know if anyone else saw something like this.

While I was observing from my backyard, my Mom came outside for a look as did a UPS driver that was making a delivery on my street.

I saw the last 45 minutes of the transit from a parking lot near the shoreline of Lake Erie. By this time, Venus was nearing the mid-point of the transit.

Using Solar Skreen eclipse glasses, I could see Venus naked eye. To the naked eye, Venus had an apparent diameter about half that of Io transiting Jupiter (as seen through a telescope). There were a few clouds just above the horizon, but it was clear enough to follow Venus down to the waterline. I took a series of photos showing both Venus set and sunset.

There were about a dozen passersby that saw the transit through my scope.

Some had small filters for naked eye viewing. One woman who worked at Euclid Hospital across the street had an exposed piece of film used for X-Rays and another guy had a welder’s helmet! So we all had a mini-transit party. As each person left, we told each other we’d see them again in 2117. :)
By Tony Mallama

We had overcast during most of the event but it cleared a few minutes before the Sun went below the tree line.

With regards to Bob Modic’s observation, an article published in *The Astronomical Journal* in June 2011 suggests that the uneven distribution of light along the planet’s cusp is due to ‘latitudinal differences in atmospheric refractive properties’. The article has several pairs of stereo images from the TRACE spacecraft where Venus appears suspended in front of the Sun.

My colleagues on the SOHO satellite and I previously observed forward scattered light from Venus outside of transit by measuring the planet’s magnitude. We determined that the brightness excess seen in the phase curve of Venus at about 170 degrees (below) is due to refraction of sunlight by droplets of sulfuric acid. This acid haze appears to extend high above the opaque cloud deck. The effect is strong in the B (blue) and V (visual) bands but not in R (red) and I (infra-red). The refractive properties of the droplets and the wavelengths of light passed by the B, V, R and I filters accounts for this effect.

By Steve Kainec

I used a 80mm f9 refractor telescope using Baader AstroSolar safety film. Mainly used a 12mm TeleVue Radian eyepiece for a magnification of 63X, that framed the Sun nicely; with all of it fitting in the field of view. My main impressions were that the silhouette of Venus against the Sun was bigger than I thought it was going to be, how completely black it looked, and how sharp the silhouette edges were. I tried to determine the moment that Venus completely entered the Sun at the II point, but I could not. I can easily see how past observers had difficulties in timing this event precisely.

I had very good viewing conditions for most of this event. Originally I planned on going to Observatory Park, but right before leaving work, I took a look at the IR and Visible cloud cover images and it did not look good inland, but it was clear over the lake. When I walked outside I saw the same thing, I was afraid the clouds would not clear in time. So I called a friend that lives on a street in Euclid which dead ends at Lake Erie, only 10 minutes from my work. We ended setting up in the backyard of the last house on the street. They have a great yard that overlooks the lake which gave us an excellent horizon and mostly clear skies. Besides the transit, we also enjoyed looking at the nice sun spot groupings.

By David Mihalic

I viewed the transit from Cleveland Heights, and made the following photograph.
The 2012 Transit of Venus (continued)

By Marty Mullet

I viewed the transit from Orchard Hills Park in Chesterland Ohio, along with roughly 25 public viewers over the course of the evening.

Best impression I heard: "It's just a dot moving across the sun. But what's impressive is the rarity of the event, and the implications of what you're seeing. A lot of science was born with an event just like this. If you really think about it, this is so cool."

The photo was made with a Kodak C195 digital camera on a 10-inch Dobsonian.

By Phil Sherman

I was blessed with great weather for the Venus transit, viewed from Headlands Beach State Park in Mentor Ohio. At least 40 public viewers joined us for the transit. We had two CVAS members present with scopes for transit viewing. My 8" was set up for imaging while the old C114 was used for visual observation of the transit. A pair of binoculars and a number of solar viewing glasses were on hand, as well as a few pieces of #14 welder’s glass. All optical instruments were protected by Baader solar filter film.

The photo below was made with a Canon T3i digital camera, and 8" Newtonian on an Atlas mount.

By Tom Quesinberry

I went to a Sidewalk Astronomers event at Riverside Park on MainStreet in Chagrin Falls to view the transit. Fellow Chagrin Falls resident, and long-time amateur astronomer Don Himes, was also there with his 8” reflector and support equipment. I took my 5” f/8 refractor which has a visual solar filter.

It was a busy evening in Chagrin Falls and we showed the transit of Venus to several hundred people. CVAS had Public Star Parties at Riverside Park the first 10-15 years we were in existence.

We made that week’s issue of the Chagrin Valley Times, for what it’s worth. The Sidewalk Astronomer’s star parties are fun and educational events.

By George Gliba

Lynne and I were lucky to see the Venus transit at Mt. Wilson Observatory in California, under mostly clear skies. We saw the 2004 Venus Transit from Northway Fields in Greenbelt, Maryland and decided it was a perfect excuse to travel out West to see some things we had always wanted to see anyway, and also visit some family and friends who are not getting any younger.

By chance, while we were at Mt. Wilson with our California friend Candice, we were able to attend a
The 2012 Transit of Venus (continued)

special star party sponsored by the Antique Telescope Society, and Astronomers Without Boarders. We were able to see the transit with several fully restored brass Alvan Clark, John Brashear, and Henry Fitz refractors, which gave us nice views of the transit, and mingle with the crowd, talking to the president of Astronomers Without Boarders, Mike Simmons, and Sky & Telescope associate editor Dennis di Cicco. The biggest scope at the star party was a horizontal 13-inch F/15 Henry Fitz refractor fed by a Heliostat that gave great views of the transit.

As good as observing the transit with these vintage refractors was, the best view was up the mountain with the famous 150 Foot Solar Tower Telescope. This scope was celebrating its centennial, having been built in 1912 by George E. Hale.

It has a 12-inch F/150 Brashear Achromatic Objective that gives a large 16-inch prime focus Solar Image. They have drawn the sunspots visible with this instrument every clear day for a century, but this was the first Venus Transit seen by this scope, because they couldn't see the 2004 transit, and the observatory wasn't yet built in 1882. While there, I ran into Dennis di Cicco again, and he introduced me to longtime Sky & Telescope editor, retired Roger W. Sinnott.

We also saw the outside of the famous 60-inch reflector, and were able to go up to the visitor's lobby to see the famous 100-inch Hooker reflector, once the largest telescope in the world, behind glass windows. It was a great experience.

By Aaron Worley

I observed the transit of Venus across the Sun's disk on June 5th at the Observatory Park event. I was happy to see the large crowds and genuine interest and excitement expressed by the people attending. I brought a 100mm refractor, a Herschel solar wedge, a simple Baader solar film filter, and a monochrome webcam to aid my observations.

I tried to see if Venus was visible before first contact, but didn't have any luck. About 10 minutes after first contact, however, I was surprised and quite pleased to make a solid sighting of the aureole effect, an arc of light refracted through Venus' atmosphere. It was a fuzzy continuous line running the non-transiting limb of Venus. After second contact, it seemed very strange and surreal to see the perfectly dark circle of Venus silhouetted against the bright Sun through the telescope.

It was also fun to view the transit by simply holding up the solar film in front of my otherwise unaided eye. It was difficult to detect Venus when it was near the Sun's limb, but once it coasted out away from the limb it was easy to pick out. I showed this to people standing in line at my telescope, and they seemed at least as excited about the solar film observing as they did about the telescope.

Later during the transit, I set up my webcam and was able to capture a nice image of Venus paired with an "archipelago" of tiny sunspots. 250 out of 700 frames were stacked and sharpened in Registax 5 software, and final touch ups in Photoshop. Equipment used: 100mm refractor on an Orion Astoview mount with clock drive, Baader Planetarium 2" Herschel Safety Wedge Solar Prism (old version), DMK41 monochrome camera from Astronomy Cameras. (Editor's note: Aaron's image appears on page 1 of this issue. The image is oriented with north to the left, and east down.)

By Ron Baker

I observed the transit with a marine sextant from the shoreline of Lake Erie. The instrument's telescope provided less magnification than an ordinary pair of binoculars. But the sextant's filters, designed for taking the sun's altitude, produced a nice view. I was amazed at the very high contrast and definition of the planet against the Sun. A truly beautiful sight.

By Russ Swaney

840 people traveled to Geauga Parks District's Observatory Park to view the transit of Venus. 23 different telescopes and other viewing instruments gave everybody a chance to see this rare event.

Here's a quote from the Parks website: “a very special thanks to members of the Chagrin Valley Astronomical Society for so generously sharing their telescopes with the masses! Your contributions to Observatory Park continue to be out of this world.”
**CVAS Observer’s Log**

**IHO, May 18, 2012, using my 16-Inch Dob**  
**By Steve Kalnec**

Very clear night, at first the seeing was not the best, so could not use too high of power to begin with. During Civil twilight viewed Mars and Saturn. Saturn looked nice and with Mars you could see brighter, “whiter” edges, the polar caps. Then while waiting to get darker, viewed some double stars, most stars viewed were in Bootes which was well placed at this time. A very good book for viewing double stars is The Cambridge Double Star Atlas. In my opinion, viewing double stars is a good way to kill time while waiting for it to get dark and to learn the sky.

After it got even darker viewed various brighter objects, these included M65, M66, M95, M96, M105, M13, and M3. By now it was pretty dark, so I started to try to find some fainter objects. The first object was Copeland’s Septet, which I never tried to find before. Then I viewed Hickson 61, this is a galaxy group called “The Box”, consisting of four NGC galaxies. I was able to see three out of the four galaxies. Then I was asked to find NGC 4631, The Whale galaxy. This is a large galaxy that was well placed at this time being higher up in the sky. It showed up very well, giving a very nice view. Another galaxy, NGC 4627 right next to The Whale, was just barely seen. If it was not listed on my charts, it might have been missed. And nearby galaxy NGC 4656 was also seen, this was easier to see than NGC 4627. Ended the night by showing a new fellow CVAS club member some of the better objects, this included some Messier objects, a few NGCs, and a couple double stars.

**Lake Metroparks Girdled Road Star Party**  
**May 19, 2012, using my 16-Inch Dob**  
**By Steve Kalnec**

Every forecast in the morning said it was going to be a great night with very clear skies, they were all wrong. A couple hours before sunset a wispy cloud layer moved in and stayed the whole night. The seeing was good, so at least the planets looked good. Besides the planets, showed the public the usual Messier objects. Had maybe 40 or so people show up, many thanked us for showing them stuff, had one person expressed interest in joining CVAS.

**Near Earth Object 2012 LZ1**  
**By Ron Baker**

A bright new asteroid was discovered on June 10, 2012 by astronomers at Siding Spring, Australia. The asteroid zipped by the Earth within 15 lunar distances just 4 days later.

During the 2 weeks following discovery, astronomers from roughly 35 observatories throughout the world (including Indian Hill) made follow-up observations and sent astrometry to the Minor Planet Center (MPC). The precise celestial coordinates contained in these observations were used by the MPC to define the asteroid’s orbit. Although the Earth was not threatened during this close approach, the MPC considers the asteroid to be potentially hazardous.

This is the first Potentially Hazardous Asteroid (PHA) discovered within the last few years. It is sobering to think that just a few days before this close approach we did not even know it existed. But this is understandable due mainly to its unusual trajectory. During the month before discovery it was located at 80° south declination, and could not be reached by most ground based observatories. However, after discovery, it quickly moved directly north and became very well placed for northern observers.

The MPC’s initial orbit determination helped the astronomers at the Arecibo Observatory in Puerto Rico observe the asteroid. To locate an object with the large radio telescope, the astronomers need to know its position to within roughly 1 arc minute. The radar images recorded at Arecibo reveal an unexpectedly dark surface, like charcoal. The low albedo (reflectivity) suggests that the object is substantially larger than originally thought. Based on these radar measurements the estimated diameter was revised from 500 to roughly 1000 meters.

We now know that the asteroid has an orbital period of 4 years. It is normally outside the Earth’s orbit, but reaches perihelion at the distance of 1 astronomical unit from the sun. Then it swings well out past Mars again, almost to Jupiter. The orbital plane is inclined 26° to the ecliptic (which is large for an asteroid), and is largely the reason for its northerly sky motion during this apparition.
By June 20, the asteroid had moved into the heart of the Milky Way in the constellation Cygnus. Although located in a very dense star field, I recorded a continuous series of 120 CCD images using the 12 inch SCT at the Indian Hill Observatory (H75). Celestial coordinates for the asteroid were determined by measuring the images with the software Astrometrica, and the astrometry was submitted to the MPC.

At the time of these observations, the magnitude 16 asteroid was moving to the north at 13 arc seconds per minute. I limited the duration of each exposure to 30 seconds to avoid excessive trailing of the target. Groups of 10 images were combined and then measured. The image on this page shows the effect of using the “track on asteroid” feature within Astrometrica. This useful feature increases the signal from faint fast-moving targets, while the displacement of the brighter reference stars is of no significance.

The measured position of the asteroid in the accompanying image is RA 20:11:19.21 ± 0.12 and Dec +38:46:43.9 ± 0.12, at 2012_06_20.18319 UT. The accuracy of astrometric measurements like these is directly related to the quality of the reference star catalogue used in the data reduction. In this case, I used the UCAC3 catalogue.

The stated precision of the measured coordinates relates to how well the star positions in the image fit the star positions in the reference catalogue. Another way to evaluate the accuracy of the measurement is to check the residuals determined by the MPC after the observations are submitted. The residuals for a particular observation indicate how well it fits the MPC’s orbit calculation when observations from other observatories are included.

A high speed animation (4Mb) shows the asteroid crossing the 10 X 12 arc minute field of my CCD. In real time the asteroid crossed the field in an hour.

Potentially Hazardous Asteroid 2012 LZ1 recorded at Indian Hill Observatory (H75) on June 20, 2012. The asteroid is at magnitude 16. The 2 bright stars are magnitude 7. Astrometrica was used to combine images and measure the coordinates.

An ephemeris produced from the current set of orbital elements suggests that the asteroid will not pass the Earth this close again for centuries. However, due to the influence of gravity over shorter time periods, the orbit may change in ways that cannot be predicted. 

**Reflections**

Thy return Posterity shall witness. Years must roll away, but then at length the splendid sight again shall greet our distant children’s eyes.

Jeremiah Horrocks

Upon observing the transit of Venus in 1639.
CONSTANCE QUIZ
By Dan Rothstein

This month’s questions:

1. Identify the bright star known as “the Amazon Star.”

2. Along with many of the scientific instruments that became southern constellations, Thomas Young placed “the Battery of Volta” in the northern sky. Where was it? It is not a major part of a modern grouping.

3. Where is the obsolete grouping of Rangifer the Reindeer, also known as Tarandor.

4. This “monstrous animal” described by John Herschel has parts named Frons (forehead), Occiput (back of the head), Rostrum (beak), Proboscis (trunk) Major and Proboscis Minor. This grouping can be seen only in a telescope.

Answers to last issue’s questions:

1. The string of pearls was another of the many names for the belt of Orion. In different place and cultures, the belt was known as the Walnuts, the Golden Nuts, the Golden Grains, the Line and Row, the Ell and Yard, Jacob’s Rod, the Three Kings, the Three Magi, the Rake, the Mowers, and many more.

2. The Diamond of Virgo is composed of only one star from Virgo, Spica. The other three stars are Denebola in Leo, Arcturus in Boötes, and Cor Caroli in Canes Venatici. The diamond can be split into two roughly equal-sized triangles, Spica, Arcturus, and Denebola forming one triangle, and Arcturus, Denebola, and Cor Caroli forming the other. In George Lovi’s Rambling through the Sky column from old Sky and Telescopes, he calls the southern of these triangles the Spring Triangle, in analogy to the Summer and Winter Triangles we are all familiar with.

3. According to one version of early Arab myth, the sisters of Canopus were the Dog Stars, the lucidas of Canis Major and Minor, Sirius and Procyon. This is a pretty obscure one. I can’t find my original reference to this, so I’ve had to rely on Allen’s Star Names Their Lore and Meaning which has many different references to these stars in many languages. One of the very early Middle Eastern stories (before classic Greece and Rome, as far back as Pharonic Egyptian time) named Canopus Al Suhail al Yamaniyah (the bright one of the south). In fact, many stars in this neighborhood were referred to as Suhail. Sirius is Al Shira al ‘Abur al Yamaniyah, the brightly shining star of passage of Yemen (the southerly direction in which province it set, or on the right-hand side of an observer facing eastward toward Mecca). As recently as on hundred years ago Sirius was still referred to as Suhail. Procyon was Al Shira al Shamiyyah, the Bright star of Syria, (thus named because it disappeared from the Arab’s view beyond that country in the north or left facing Mecca. Sometimes Sirius was shortened to just Al Shira and Procyon was called Al Jummaiza or Al Ghumaiza, the dim watery-eyed one, since her light was dimmer than her sister. The myth refers to the Abur, or passage of Canopus south. Evidently Canopus was formerly located near the southerly parts of Orion. He had to flee into the southern hemisphere after his marriage to Procyon (or he just went wooing her and was refused).

4. The Aboriginal constellation of Djulpan, representing three brothers sitting side-by-side in a (wide) canoe, is our Orion. The three brothers are the belt. Rigel and Betelgeuse are the front and back of the canoe. The stars surrounding the Orion Nebula are a fish, and the stars in the sword are the fishing line.
Talks and Presentations

April 2012

CVAS member Bernie Doherty spoke to our group at our April membership meeting about observing the transit of Venus in June of 2004. Bernie described his observing methods and projected several of his photographs of the event. His presentation was timely, and prepared us well for recent transit last month.

June 2012

At our June membership meeting, CVAS member Chuck Story presented photographs and descriptions of his visit to New Mexico to observe the May 2012 annular eclipse of the Sun. He observed the eclipse from the Magdalena Ridge Observatory in Socorro County, New Mexico. He also shared photos of the radio telescopes taken at the Very Large Array, one of the world’s premier astronomical radio observatories.

2012 Summer Skies

July

1 Sun Venus 4.8° SE of Jupiter (8 UT)
5 Thu Earth at Aphelion (3 UT)
10 Tue Venus brightest mag -4.5 (3 UT)
15 Sun Moon < 1° WNW of Jupiter (2 UT)

August

11 Sat Moon 0.68° E of Jupiter (22 UT)
12 Sun Perseid Meteor Shower
17 Fri Mars & Jupiter at heliocentric opp (13 UT)
24 Fri Neptune at opposition (12 UT)

September

7 Fri Jupiter at W quadrature (10 UT)
22 Sat Autumn Equinox (14:47 UT)
23 Sun Uranus 1 arc minute from 44 Piscium
29 Sat Uranus at opposition (7 UT)

Notes & News

The CVAS website has information about upcoming astronomy events and activities in our area. There is a host of astronomy related information, and links to interesting and useful sites. Send comments and suggestions to the webmaster, Russ Swaney russ_swaney@ameritech.net

*The Valley Skywatcher* has a long tradition as the official publication of the Chagrin Valley Astronomical Society. All material in this issue has been written and provided by individuals within our membership community. CVAS welcomes astronomy related contributions from all members and friends, and this journal provides a unique opportunity to share interests. Published quarterly, the next issue will be available near the end of September. If you would like to contribute material to the publication please contact the editor, Ron Baker rbaker52@gmail.com