The SPECTROGRAM

Newsletter for the Society of Telescopy, Astronomy, and Radio

VOL 2, No. 5 January, 2002

January's Meeting

The next meeting of S*T*A*R will be Thursday, January 3rd, at 8:00 PM. The meeting will be held at the King of Kings Lutheran Church, 250 Harmony Street, Middletown.

This month's meeting will feature a presentation by Paul Nadolyn of STAR Astronomy Club. Paul will discuss light pollution and his sky glow profiler, **http://www.monmouth.com/~paulbeth/paul/astro/skyglow/**.

In this Issue

From the Editor

Thank you to this month's contributors. The Spectrogram is your newsletter and appreciates your support. Articles may be submitted to Greg Cantrell at monthly meetings or electronically at cantrell@optonline.net .

Calendar

September 6, 2001
What I did on my Summer Vacation

October 4, 2001
David Malin's video, "The Man Who Colors Stars".

November 6, 2001
Ed Collett
STAR Astronomy Club

December 6, 2001
David Britz & Gordon Waite
STAR Astronomy Club

January 3, 2002
Paul Nadolny
STAR Astronomy Club

February 7, 2002
Dr. Michael Strauss
Princeton University

March 7, 2002
Dr. Charles Liu,
Hayden Planetarium

April 4, 2002
Dr. Edward Devinney
Rutgers University

May 2, 2002
TBA

June 6, 2002
Dr. Tad Pryor
Rutgers University

Night Vision

by Ernie Rossi

Many times when I am viewing deep sky objects or faint planetary detail and someone from the public or a novice amateur astronomer peaks through the telescope he can never see the detail I can. Why, are my eyes better, am I imagining things, and the answer is NO. Now if I have a trained observer come over he will be able to identify what I am seeing and maybe even more. So then what is the answer, is a trained observer and myself have a special way of seeing, and part of the answer to this question is yes. What I am going to explain is how to prepare your eyes to see faint and difficult objects and that they must be trained together with your mind to be able to see minute detail. Our eyes have to dark-adapt before we can see astronomical objects optimally. Usually this requires fifteen to twenty minutes (or more) in an environment as dark as the sky you will be viewing. First of all, the pupil needs to dilate to its maximum aperture in order to collect the most light, as night vision is contained in the biochemistry of the eye. A pigment known as rhodopsin is contained in our rod cells and is sensitive to very low light levels. We need to use our rods, as opposed to the color-vision cone cells, in order to see faint, extended objects like nebulae and galaxies. Any source of bright light will saturate the rod cells, destroy the sensitivity of the rhodopsin, and require twenty minutes further of dark adaptation. Rhodopsin is less sensitive to red light then to other colors. This is why astronomers read star charts and make log entries with the help of dim, red lights. Our red-absorbing cone cells allow us to read, while we maintain most of our dim-light sensitivity. Even red light sources, if too bright or aimed at the eye, can cause loss of dark adaptation. The failure of many novice astronomers to see faint objects or pick out fine detail is due not only to their eyes not being fully dark adapted, but to their eyes being untrained. When a novice can't see the detail I can see, I then explain in detail what to look for and how is the best way to position your eye and the object. Low and behold he usually then sees it. His words usually are "Oh I see it now." When our eyes have not seen an object before, we are not sure what to look for. It takes time and patience to get used to the appearance of an object; only when we have cleared this obstacle can we perceive the finer detail. One must of course guard against creative observing, in which the observer believes he/she sees details that are not actually visible. Deep-sky objects for instance, often appear as faint blobs or are invisible to first-time observers. Finding these objects, most of which are far to faint to be visible with the naked eye, can be more rewarding then viewing them once they have been located. There is something satisfying in having "conquered" an object which one has searched for over the course of many nights.

Averted vision: When you look directly at an object, most of its light is falling on cone cells in the fovea of your retina. This provides the best color vision when looking at bright objects, but since the cones are not sensitive to dim light, direct vision is not the best way to detect a faint object. Instead, look to the side a bit; you have more rod cells away from the fovea. This is called averted vision. Extended Vision: When trying to see more detail in an object you have found, try looking at it with either averted vision or direct vision for 30'seconds to a minute or more. Extended vision is not well-understood but apparently the eye can build up an image over time, something like a time exposure in a camera. This seems to work best on faint objects. Stephen James O'Meara famous writer and keen eye observer uses this method, and usually stares at the objects for much longer periods of time to catch every photon of light.

Additional Tips: Some observers use a black patch over the eye they view through to make sure no light has a chance to interfere with his vision and that his pupil is dilated to maximum. Another method while viewing to guard against possible distractions and unwanted light is to pull a black cloth over your head when observing. Additional method used to betray an elusive object is to move the suspected object in and out of view, or jiggle the telescope slightly so that you may see the contrast between the object and the background sky, so it can more easily be perceived by your eye. The use of correct filters is also very important when viewing objects such as nebulae and galaxies. If you have any comments or questions, you can contact me at 732 727-0411 or via email EROSS140@aol.com.

Topic # 2. The Spherical Earth

by Edward Collett

One of the greatest discoveries ever made about the Earth is that it is not flat but spherical. Initially, as we look around at our surroundings the Earth does, indeed, appear to be flat; it certainly does not appear to be spherical. Moreover, this realization is correct! It was not until about 2000 years ago that the spherical Earth began to be accepted. At the end of this topic, a mathematical analysis will be given that shows why the observation of a “flat” Earth over a small region is correct, however.

One convincing demonstration that the Earth is a sphere and not flat is to watch a ship with a tall mast sail from a port and disappear below the horizon as the ship travels away from an observer. While this behavior can demonstrate the sphericity of the Earth, concrete information can also be obtained from observing this disappearance. The observation can be used to determine either a) the expected distance between an observer and a ship when the ship disappears below the horizon if the radius of the Earth is known or, more interestingly, b) the radius of the Earth if the distance between an observer and a ship's disappearance can be measured.

The important relations to be considered are 1) the distance between the observer and the ship and 2) the height of the mast. The relations can be related by considering the following figure.

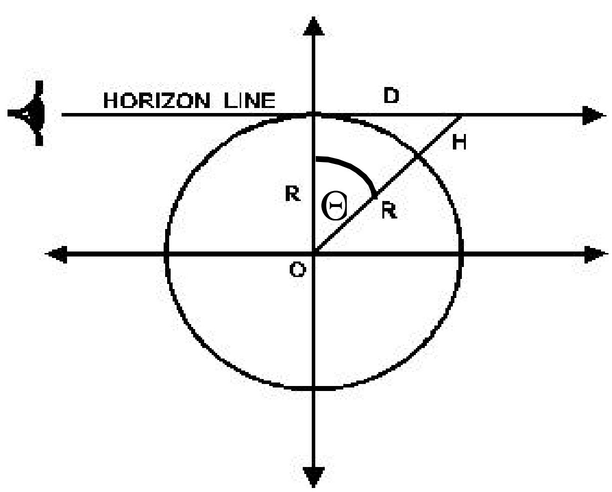


Figure 1. Determination of the relation between the radius of the Earth and the distance between an observer to the point where the ship disappears below the horizon (the horizon line). The “eye” represents the eye of the observer, *D* is the distance between the observer and the ship when the mast appears to drop below the horizon (line), *R* is the Earth's radius, and *H* is the combined height of the ship's body and mast.

From Pythagoras' theorem and **Figure 1,** we see that

$$R^2 + D^2 = \left(R + H\right)^2 \qquad (1)$$

Eq.(1) can be solved for either *D* or *R*. If *D* is expressed in terms of *R* then the distance can be determined when the ship will disappear below the horizon (line). On the other hand, the radius of the Earth can be determined by measuring the distance when the ship is observed to drop below the horizon. Since the ship’s mast is much smaller than the Earth’s radius, $H = R$, eq.(1) can be solved for either *D* or *R* and written to a very good approximation as

$$D = \sqrt{2HR} \qquad (2)$$

or

$$R = \frac{D^2}{2H} \qquad (3)$$

The distance *D* where the ship (mast) will drop below the horizon can now be found by assuming the height, *H*, of the ship's visible hull and its mast is 30.5 meters (100 feet) above the water. The radius, *R*, of the Earth is 6.38×10^6 meters (approximately 3,964 miles). Substituting these values into eq.(1) yields a distance $D = 12.3$ miles.

The more interesting calculation, however, is to determine the Earth’s radius by measuring the distance between the observer and the ship’s mast when it drops below the horizon. Assuming the distance *D* between an observer and the ship is measured to be 12.3 miles then the Earth’s radius would be 6.38×10^6 miles.

Finally, as mentioned above, it is of interest to show that very small areas on the spherical Earth appear as flat. First, we determine the area of a sphere and then a limited area of the sphere. To show this, consider the following figure.

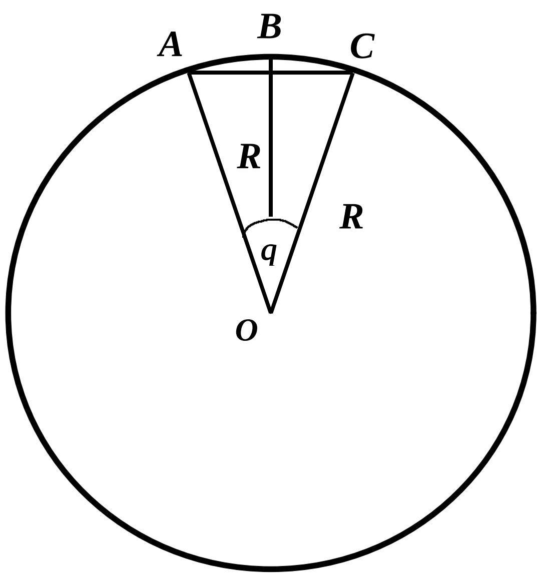


Figure 2. In the figure $\overline{OABCO}$ represents a cone and the area to be determined is the spherical cap $\overline{ABC}$.

The differential area of the cap is

$$dA = (R \sin q \, df) \cdot (R dq) = R^2 \sin q \, dq \, df \qquad (4)$$

where df is the azimuthal angle around the line $\overline{OB}$. Integrating eq.(4) over the entire sphere, the total area *A* is

$$A = R^2 \iint_A \sin q \, dq \, df = R^2 \int_0^{p} \sin q \, dq \int_0^{2p} df \qquad (5)$$

Carrying out the integration in eq.(5) the total area of a sphere is seen to be

$$A = 4p R^2 \qquad (6)$$

Eq.(5) can be used to find the area of the cap by limiting the angle q to a subtended angle Θ and writing eq.(5) as

$$A = R^2 \int_0^{\Theta} \sin q \, dq \int_0^{2p} df \qquad (7)$$

Integrating eq.(7) yields

$$A = 2p R^2 (1 - \cos \Theta) \qquad (8)$$

Eq.(8) is the area of the spherical cap subtended by the angle Θ. For a very small area $\Theta = 1$ and $\cos \Theta \approx 1 - \Theta^2/2$. Substituting this approximation into eq.(8) yields

$$A = p R^2 \Theta^2 \qquad (9)$$

From **Figure 1**, for small angle Θ

$$\tan \Theta \approx \Theta = \frac{D}{R} \qquad (10)$$

Substituting eq.(10) into eq.(9) then gives

$$A = p D^2 \qquad (11)$$

Eq.(1) is the area of a circle on a two-dimensional plane. Thus, for a very, very small area on the sphere (Earth), eq.(6) becomes eq.(11), the area of circle. The idea that the Earth is flat is substantiated by the mathematics. The reason for the flat-Earth belief is clear, however. Early peoples only had access to their immediate surroundings and under this condition, the area is “correctly” given by eq.(11).

Interestingly, measuring the Earth’s radius using a ship’s mast does not appear to have ever been reported (or tried). The reason is very simple. One would have to know the distance from the observer to the ship very accurately. Until recently this could not be done (radios). So how does one determine the Earth’s radius? The answer is that this measurement to determine the Earth’s radius was carried out more than two thousand years ago. In the next topic, this measurement will be discussed.

Testing Telescopes: Other ``Knife-Edge'' Tests

By Michael Lindner
(Caustic test diagrams and photos courtesy Job Oostindie)

The Foucault test is nice, but there are some drawbacks to it. To get more accuracy, there must be more zones measured, but that means that each zone will be narrower, until it becomes difficult to determine when one zone is evenly graying. Likewise, without a mask it is hard to know where each zone starts and ends, but with a mask, the edges of the openings have diffraction effects that can make it hard to ``read the shadows." Then there's the difficulty in precisely matching the brightness of two spots on the mirror that are far apart from each other.

Because of these problems, various similar tests have been devised. Each one has its strengths and weaknesses, but each relies on the same principles as the Foucault test; that an object close to an image of a slit formed by the mirror under test will appear to darken the part of the mirror whose rays it blocks. In fact, most of these tests can be performed with just a few modifications to a Foucault tester.

The most familiar of these is the Ronchi (pronounced "RON KEE") test, invented by Vasco Ronchi. In the Ronchi test, a grating is placed in front of the eye instead of a knife-edge as in the Foucault test. The grating consists of many dark and clear stripes, side by side. Ronchi gratings are often made on film, or may be made by winding a pair of wires around a form, then unwinding one of the pair. The gratings are rated by the number of lines per inch, such as 30 or 100. With a perfectly spherical mirror, the image through the Ronchi grating will look like there are a series of dark lines across the brightly lit mirror. The number of lines depends on how many lines per inch are in the Ronchi grating, as well as how far from the center of curvature the grating it. As the grating gets closer to the center of curvature, the number of lines gets lower and lower. At the center of curvature, there is one line visible, and its edge acts like the knife-edge in a Foucault tester. In other words, the test reduces to the familiar Foucault test.

Of course, mirrors of interest aren't usually spherical, but parabolic. The lines will appear to be curved, in that case. Figure 1 shows a typical Ronchi image. By comparing the curvature of the lines to those computed, the optician can determine whether the mirror is close to the desired shape. Mel Bartels has written software to simulate Ronchi tests so that the curves can be more easily compared (see http://www.efn.org/~mbartels/tm/ronchi.html).

Advantages over the Foucault test are that you can see the entire mirror at once, and there is no comparison of shades of gray. On the other hand, it is difficult without a lot of practice to look at the curves and know how much and in what direction the errors in a mirror are.

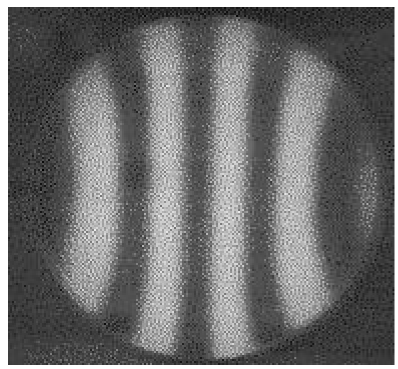


Figure 1: Ronchigram

Ronchi screens are available from Edmund's Optics (http://www.edmundoptics.com/IOD/DisplayProduct.cfm?productid=1731) or from Willman-Bell (http://www.willbell.com/). Some places on the Internet to look for Ronchi test information are:

http://www.atm-workshop.com/ronchi-test.html
http://www.geocities.com/CapeCanaveral/9601/ronchi.htm
http://www.atm-workshop.com/ronchi-sim.html
http://www.phil.uu.nl/~gjv/atm/ronchishadows.html
http://www.theskyguide.com/atm/ronchitesting.html

http://www.stellafane.com/atm/atm_foucault_tester/atm_tester_plans_1.htm
http://www.turbofast.com.au/astrotel/ronchi1.html
http://members.aol.com/RonWin20/index.html
http://www.efn.org/~mbartels/tm/ronchi.html
http://www.geocities.com/CapeCanaveral/9601/ronchi.htm
http://www.telescopemaking.org/ronchi.html

George Mosby came up with a unique way to get around some of the problems with the Ronchi test. His idea was to make a grating with curved lines computed such that they would produce straight looking lines when placed in front of a parabolic mirror. He published his idea in the November 1974 issue of ***Sky & Telescope***. The advantage of the Mosby test is that it is easier to determine if a line is straight then to estimate if two curved lines curve the same amount.

The down side is that in order to be sensitive, the grating must have 3 lines, and be 0.0287" in diameter, and be very accurately made and placed accurately relative to the radius of curvature. Each different diameter and focal length requires a different grating to be made. Lastly, there is a relatively narrow range of acceptable sizes and focal lengths that can be accommodated.

Figure 2 shows a Mosby grating for an 8 inch f/7 mirror. If you're interested, you can buy an inexpensive Mosby grating from Willman-Bell (http://www.willbell.com/).

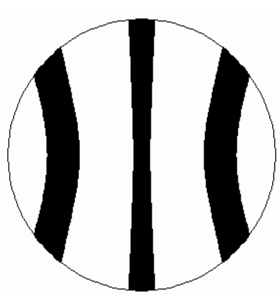


Figure 2: A Mosby Grating (actual size would be 0.0287” in diameter)

Some places on the Internet that describe the Mosby test are
http://users.telerama.com/~mdholm/atm/invron/invron.html
http://www.fortunecity.com/marina/manatee/1879/mosby.htm

A lesser-known variant of the Foucault test is the wire test. In the wire test, the knife-edge is replaced by - you guessed it - a wire. The test is performed just like the Foucault test except instead of matching gray areas on opposite sides of the mirror, the shadow of the wire is positioned over the zone to be tested. The shadow appears to be a circle with a line down the center. Figure 3 shows a wire test. This test has all of the advantages of a Foucault test without some of the subjectivity of matching gray spots. Its only down side is that the wire and slit must be very thin, and the slit must therefore be very brightly lit.

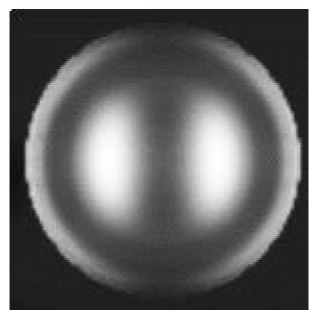


Figure 3: Wire test (dark circle is position of zone being tested)

Some places on the Internet that discuss the wire test are:
http://www.mmresearch.com/articles/article1/
http://wyant.optics.arizona.edu/WireSeidel/WireSeidel.htm

The last of the knife-edge variants I’ll discuss is the caustic test (although there are more obscure tests I’m skipping). The word ``caustic’’ refers to the surface formed by the set of focal points for a curved surface, especially one with spherical aberration. Yes, it’s in the dictionary that way.

In the caustic test, the a wire is used, but this time the wire is moved in two dimensions; toward and away from the mirror as in the Foucault test, and also from side to side. The side-to-side motion must be measured accurately to 1/10,000”! In describing the Foucault test, I misled slightly to make the description of what was going on simpler. In the Foucault test the knife-edge is not actually at the center of curvature for a zone, but at the intersection of the optical axis and the normal to the caustic for the zone. At that position, the two sides of the mirror darken together. To be completely accurate for a point off of the center of the mirror, the point at which the slit comes to a focus will be slightly off from the optical axis. This is illustrated by Figure 4.

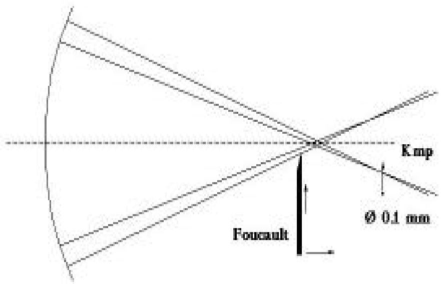


Figure 4: Foucault versus Caustic positions (marked Kmp)

To measure the caustic, a wire is used that is almost exactly the same size as the slit, but slightly thinner. The mirror is masked except for the zone being tested. The wire is moved both in/out and side/side until the wire appears as a dark line centered between two light lines. The positions are read, and the next zone is measured. The mathematics is somewhat more complicated than the Foucault test, but fortunately computers do the work.

The caustic test is the most accurate of the tests we have described, but also the most difficult to set up and to carry out. The tester must be more complex than the tester used for the other tests, since it must move in two directions, and move very accurately in one. It can be used on short focal length mirrors than the other knife-edge tests. Figure 5 shows how the wire’s shadow is centered when the light bands on either side are equal in size and brightness.

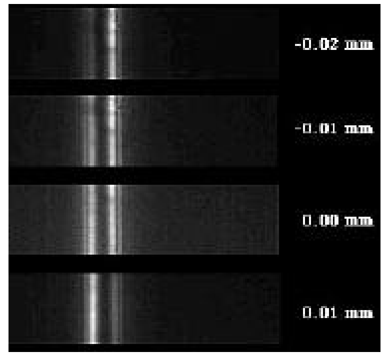


Figure 5: Performing a caustic test

Some places on the Internet dealing with the caustic test are:
http://home.introweb.nl/~joboosti/caustic/cp0.htm
http://members.gotnet.net/bald/atm/caustic.htm
Next month: the exciting world of null testing!

STAR Meeting Minutes

November 6, 2001
Red Bank Women's Club

by Chris Olszewski

STAR, beginning our hegira as we search for a more permanent home, held its third meeting of the 2001-2002 year at 8PM on Tuesday, November 6, 2001, in the Red Bank Women's Club. Despite the new venue, the meeting was fairly well attended with upwards of about 30 people in the audience. Despite the cozy new meeting place, the lack of heat made the meeting a cool place to be (and not in a good way!)

Main Program:
There were two main events in this night’s program. David Segelstein led the first half, and Ed Collette the second.

Astrophotography

David Segelstein described some of his astrophotography technique and results, from using his 10" scope and a barlow for field flattening. Apparently, the barlow did not quite work as intended. David (probably one of our more experienced astrophotographers) said that he does a lot of his photography "around town" (i.e., in

New Jersey). Unfortunately, this locale has a lot of light pollution, which limits the exposure time with his usual film to about 20 minutes. Exposures longer than this start to pick up background light in the sky, and drown out what he's trying to image.
He also treated us to some of the marvelous fruits of his labors. He gave examples of images with and without filters; pointed out some image artifacts (vignetting?) to the audience; and described his image processing steps (using E200 film; professionally scanned; pixels returned to him and his PC for further processing).
In a somewhat whimsical vein, Dave wanted to blame his astrophotography on Steve Walters. (I don't remember whether Steve accepted this blame or not).

Telescope Optics

Ed Collette gave an entrancing and very useful lecture on simple telescope optics. Ed had developed some educational software (Mathcad/Studyworks?) for optics, and he said it was really good. Ed's presentation was extremely clear, and he explained some of the simple equations governing optics. He used some very practical applications of these equations to explain how different optical parameters (magnification, exit pupil, objective diameter, etc.) determine the behavior and usefulness of different type of telescopes. (Check out the November Spectrogram to see some of his examples.) This information could be very useful as members begin to make out their holiday shopping lists.

Short announcements and discussions:

1. Mike Lindner mentioned that we were going to have our newbie star party in the Buck Mills recreation area of Colt's Neck, on either November 16th or 17th , at 7 PM. All are welcome. [The event was a great success: thanks for organizing it, Mike!]
2. Randy Walton had some calendars for sale.
3. Somebody (Andy Zangle? Larry Campbell? - I'd really like to give credit to the right person) had some spectacular pictures of the Aurora that were taken the previous day or two. Marvelous!
4. The Leonids are coming: morning of November 19. [They were spectacular!]
5. The board is still hunting for a home. They will inform the members via the web site, mail, or phone, of when and where the next meeting will be.

The following submitted by Fred Block

Now Anyone Can Make a Discovery

By Tariq Malik

Astronomy's next great discovery may be found not by telescope, but instead with little more than a laptop computer, an Internet connection and a learned and persistent amateur. In fact, astronomers are already pulling new findings from old data, the start of what some say is a looming change in how science gets done.

Called virtual astronomy, the research technique is a break from using telescopes and other instruments for direct observational data gathering.

Instead, scientists will pore over a mounting bounty of new and old data collected by the Hubble Space Telescope, the European Southern Observatory and others telescopes.

"We've become so advanced [technologically] that we're now dealing with a data avalanche from our observations," said Joseph C. Jacob, who works on the Digital Sky Project, a joint venture by the California Institute of Technology and NASA's Jet Propulsion Laboratory to connect four astronomical databases through one Internet web portal.

The amount of dusty data is remarkable.
Hubble alone collects about a terabyte of information each year, roughly the equivalent about 231 million pages of typed text. Some telescopes under development are expected to pump out that much data in a day. And in most cases, researchers said, far more data is collected than needed at the time. The observations are later revisited by different scientists, sometimes up to two or three times, for use in new studies.

Current efforts to mine the archives are mostly manual and require that each research group adjust the data to fit their format, said Robert Hanisch, a senior scientist at the Space Telescope

Science Institute, which manages Hubble.

"It [virtual astronomy] makes practical what people now try to do manually by taking care of a lot of the bookkeeping," said Hanisch, who is also project manager of a U.S.-based effort to establish a national virtual observatory.

In the last few years, a number of "virtual observatories," as they are called, have sprung up to tap into these reams of data.

The Germany-based Astrophysical Virtual Observatory and Astrovirtel programs, managed by the European Southern Observatory, are two examples.

In August, European scientists announced that their use of Astrovirtel led to a readjustment in the size of the space rock 2001 KX76, a distant object located outside the orbit of Pluto in a region known as the Kuiper Belt. The use of virtual astronomy, researchers said, allowed investigators to study the rock's orbit over a longer period of time, and calculate a new diameter of 745 miles (1,200 km) or more. The United Kingdom's Astrogrid project, which began last fall, is aimed at developing the computing infrastructure necessary for the massive amounts of data to be collected by research installations in upcoming years, and virtual observatory efforts are underway in Australia as well.

Last month, the National Science Foundation awarded a five-year $10 million grant for the development of a U.S. National Virtual Observatory, of which Hanisch is project manager. It will involve a coalition of 17 research organizations.

Researchers say virtual astronomy should help amateurs who want to contribute to scientific progress.

"Astronomy is a very special field in that it has always had a very large population of amateurs who pool their data together," said Johns Hopkins University astronomer Alex Szala, who heads the NVO project with computer scientist Paul C. Messina of the California Institute of Technology.

"A virtual observatory, like the National Virtual Observatory, is a wonderful tool to teach new scientific discoveries, and I think they'll get more than a few people to go scavenger hunting for data," Szala said.

When the NVO is completed, in about 15 years, research data will be online and available to scientists, teachers and students, all of whom will be able to download data straight into a personal computer. Such programs, scientists say, could level the playing field for professional and amateur astronomers hoping to make a new discovery.

"We could, for example, put up data taken two weeks earlier, and scientists, students, everyone will have the same chance to study and find out something new," Szalay said.

The ultimate goal, he added, is to have a system set up like an Internet search engine that can seek out and present archived research in specific, useable formats, which would lead to a cross-fertilization of ideas between different disciplines of study.

The most obvious inter-discipline dialogue, between computer scientists developing user interfaces and astronomers hoping to access more information, is growing every day. Szalay hopes that virtual technology will connect specialized researchers within astronomy, such as X-ray, radio and other scientists, to piece together the most complete picture of the cosmos possible.

Astronomers won't be blazing an entirely new trail by doing virtual research.

Virtual observations of Earth are underway, too, so that scientists can share data collected by satellites looking down on the planet rather than out at the stars.

In June, the biological-modeling firm Physiome Sciences, Inc. partnered with the University of Connecticut Health Center's Virtual Cell program, a computer program that mimics the behaviors of an actual cell. The program allows scientists to use bioinformatics, the mining of biological data with computers, to research and develop potential pharmaceuticals in a virtual computer environment.

Even some professional coaches in the National Basketball Association have taken to data-mining. They use a computer program called Advanced Scout to study the statistics and performances of opposing teams in order to develop more effective strategies in future games.

Although there are number of separate efforts to create virtual astronomical or astrophysical observatories around the world, their goal is a common one, and not as competitive as one might think. In fact, many are interlinked with one another in hopes that future astronomers will, one day, be able to sift through databases around the world.

"We're all working on a sort of master schedule," Hanisch said, adding that by January 2003, NVO, Astrogrid and others all hope to have some sort of online query system set up to search databases for specific observations. "This has to be a collaborative effort to be a success."

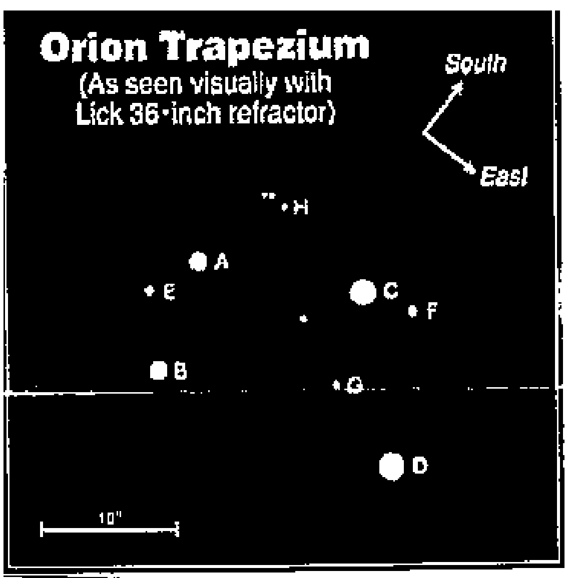
Observers Challenge: The Orion Nebula's Trapezium

by Ernie Rossi

How many stars are in the Trapezium? I ask this question many times, and the usual answer is four. Embedded within M42 (the Orion Nebula) is the multiple star Theta Orionis, otherwise known as the Trapezium for its trapezoidal shape. The Trapezium is the most observed quadruple star in the sky. Its members have magnitudes of 5.4 (star C), 6.3 (star D), 6.7-7.7 (star A), and 8.0-8.7 (star B). The separations areas follows: A-B is 8.7", B-D is 19.2", D-C is 13.3", and C-A is 12.9". This tight clump of stars visible in a small telescope with around 50X. In 1889, S.W. Burnham identified six additional stars in Trapezium using the 36" Lick refractor under excellent observing conditions (see the drawing at end of article). I have read where someone claimed to have seen 6 stars with telescopes as small as 60 MM, and some articles claim that at least a 10" telescope is needed. The two additional stars that usually can be seen with amateur size telescopes are the E & F stars. Their magnitudes are around 11, but they are difficult to see due to glare from the brighter stars and the unsteady air.

During the winter months, Orion is overhead in the early evening for best viewing. I decided to run a test on an average night using several telescopes of different sizes side by side. A 4" apochromatic refractor, a 6" f/10 Maksutov, a 6" f/8 Newtonian, and a 10" f/6 Newtonian. Before the test, the Newtonian reflectors were collimated. All four telescopes have excellent optics and top-of-the-line eyepieces were used. The night was January 15, 2001 with temperatures around 20 degrees, the transparency was good and the steadiness was only average, in a light polluted sky with a visual magnitude of about 4. I did find that a dark sky is important for seeing dim objects, but not that important for splitting bright objects. You can see more then 4 stars in the Trapezium as long as you have the light grasp capability to see the dimmer stars. I have a friend who lives in Maine with dark skies and a long focus 4" refractor who has never seen more then 4 stars in the Trapezium. All four telescopes showed pinpoint star images and easily separated the double star Castor in the constellation Gemini with low magnification. I first tried using a Teleview Genesis 4" refractor, but no matter what magnification I tried, I couldn't see more than the four brightest stars. Doing this in a darker sky with steadier seeing conditions I was able to see a fifth star. Under a very dark sky with excellent seeing conditions I believe six stars are possible with this scope. The 6" Intes Maksutov was tried next. I thought I glimpsed the E, or fifth star which lies near star A. Even though it's about the same magnitude as star E, the sixth star (F) is more difficult to see because it lies close to the brighter C star. With the 6" Newtonian f/8 which has a Criterion mirror, I was able to see 6 stars, but both the E & F stars were blinking in and out of view due to the unsteady atmosphere. I have seen both of these stars sit there like a picture with this telescope when the air was more stable. The final scope was the 10" f/6 which has a Meade research grade mirror, and at 272X all six stars were easily seen. A large telescope doesn't always mean you will be able to see six stars. If you have a large scope (10" or more) and hope to see more then four stars it will depend on the steadiness of the atmosphere, moisture, and the alignment and quality of your scope. The large scope could amplify the light from the bright star so much that the glare overwhelms the dimmer stars and makes them invisible. I have been outside of

Sperry observatory in Cranford observing 6 stars in the Trapezium with a 10" scope, and then run in and look through their 24" Cassegrain only to see four stars. I have also experienced this with the 26" Paul Robinson telescope at NJAA observatory. My personal record for seeing the maximum number of stars in the Trapezium was several months ago in a 6.5 magnitude sky under fairly steady conditions was 8 stars, and 9 stars using the I/3 eyepiece and a 25" telescope. These stars are between 16 & 17 Th. magnitude. Many observers have looked at the Trapezium many times and were never able to see, or even knew that there were more then four stars. When I show them the additional stars, most observers usually exclaim, "Wow there are more then four stars." So test your observing skills, eyesight, and telescope and see if you can find more then 4 stars in the Trapezium. I would like to hear who could do it with a telescope under 10," maybe someone can do it with a 3 or 4 inch scope. If you can, it will give you a real feeling of accomplishment. You can email me at EROSSI40@aol.com, or use the suggestion Board.



Upcoming Events

January 26, 2002 – The Rutgers University Geology Museum will hold their **34th annual open house** from 9:00 AM to 4:00 PM in Scott Hall room 123. For information contact William Selden, Collections Manager, at (732) 932-7243 or rwselden@rci.rutgers.edu.

February 10-16, 2002 – The **Cedar Key Star Party** will be held in Cedar Key, near Chiefland, Florida. For more information, visit http://members.aol.com/bemusabord/cedarkey.html

February 11-16, 2002 - The 18th annual **Winter Star Party**, sponsored by the Southern Cross Astronomical Society, will be held at the Girl Scout Camp on the Florida Keys. Contact registrars Lucille & Fred Heinrich, e-mail heinrich@atlantic.net, phone 904-362-5995, or fax 904-362-5996.

February 13-17, 2002 - The **Orange Blossom Special Star Party** will be held at the Hickory Hill Observing Complex, 10 mi. SE of Brooksville, and sponsored by the St. Petersburg Astronomy Club. For information see their website http://home1.gte.net/hoffmanc/index.html; or contact Dennis or Ellen Farr 19309 Eastbrook Dr., Odessa, FL 33556; 813-792-0721; Dnefarr@aol.com.

March 14-16, 2002 – The **Sugar Hill Star Party & Messier Marathon** will be held by the Sunset Hill House, Sugar Hill, New Hampshire. Visit http://www.sunsethillhouse.com for more information

May 18-19, 2002 – The Rockland Astronomy Club and Sky & Telescope Magazine present the **11th annual Northeast Astronomy Forum (NEAF)**, to be held at Rockland Community College in Suffern, New York. For more information, visit http://www.rocklandastronomy.com/neaf.htm.