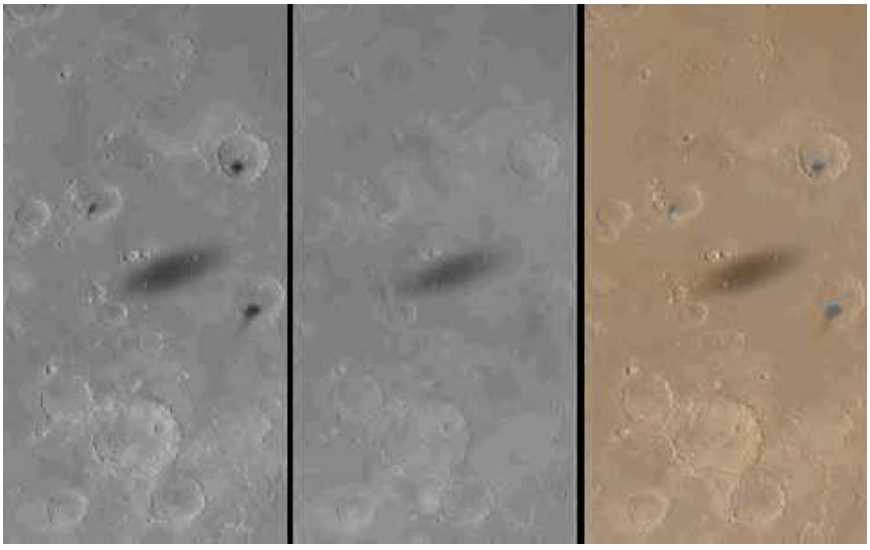
REFLECTIONS REFRACTIONS

of the University Lowbrow Astronomers

November 1999

The University Lowbrow Astronomers is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 807). Meetings begin at 7:30 pm and are open to the public. Public star parties are held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; further directions at the end of the newsletter) on Saturdays before and after the new Moon. The party is canceled if it's cloudy or very cold at sunset. For further information call (313)480-4514.



The Shadow Of Phobos

Credit: Malin Space Science Systems, MGS, JPL, NASA

Explanation: Hurtling through space above the Red Planet, potato-shaped Phobos completes an orbit of Mars in less than eight hours. In fact, since its orbital period is shorter than the planet's rotation period, Mars-based observers see Phobos rise in the west and set in the east - traveling from horizon to horizon in about 5 1/2 hours. These three images from the Mars Global Surveyor (MGS) spacecraft record the oval shadow of Phobos racing over western Xanthe Terra on August 26, 1999. The area imaged is about 250 kilometers across and is seen in panels from left to right as red filter, blue filter, and combined color composite views from the MGS wide-angle camera system. The three dark spots most easily seen in the red image are likely small fields of dark sand dunes on crater floors. Standing in the shadow of Phobos, you would see the Martian version of a solar eclipse!

This Month:

November 6 - Public Star Party at Peach Mountain Observatory. The new moon is November 7.

November 13 - Public Star Party at Peach Mountain Observatory

Nov 17 - Leonid Meteors - A special open house is scheduled at Hudson-Mills Metropark. The Lowbrows invite the public to view the Leonid Meteor Shower and view celestial objects through telescopes provided by the Lowbrows. Open house begins at sunset on Wednesday evening. Will it storm? Lets all have positive thoughts - a clear night, and a spectacular display!!

November 19 - Meeting at 130 Dennison

Next Month:

December 4 - Public Star Party at Peach Mountain Observatory

December 11 - Public Star Party at Peach Mountain Observatory - The Moon is six days old. Jupiter and Saturn are at prime viewing.

December 17 - Meeting at 130 Dennison

Events Continued

Credit: Our Web Site - Dave Snyder
Wednesday November 17, 1999. Special Open House at Hudson-Mills Metropark (Devoted to the observation of the Leonid Meteor Shower).
Thursday November 18, 1999. (1-4 p.m. Detroit Observatory). Self Guided Tour of Observatory. [Directions to Detroit Observatory].
Saturday November 20, 1999. (10:30-11:30am, 170 Dennison Building, University of Michigan). Saturday Morning Physics (The Milky Way, part 1 of 3).
December 1999

Saturday December 4, 1999. (10:30-11:30am, 170 Dennison Building, University of Michigan). Saturday Morning Physics (The Milky Way, part 2 of 3).
Saturday December 4, 1999. (Starting at Sunset). Regular Open House at Peach Mountain.
Tuesday December 7, 1999. (7 p.m. Detroit Observatory). Detroit Observatory Lecture Series. Matthew Linke (Planetarium Director, UM Exhibit Museum). "Winter Sky Preview: Planets, bright stars and constellations projected on the Observatory library's ceiling." [Directions to Detroit Observatory].
Saturday December 11, 1999. (10:30-11:30am, 170 Dennison Building, University of Michigan). Saturday Morning Physics (The Milky Way, part 3 of 3).
Saturday December 11, 1999. (Starting at Sunset). Regular Open House at Peach Mountain.
Thursday December 16, 1999. (1-4 p.m. Detroit Observatory). Self Guided Tour of Observatory. [Directions to Detroit Observatory].

The Great Leonid Meteor Storm of 1833

A first-hand account by Elder Samuel Rogers
Credit: Feature Story: NASA Space Science News presents "Feature Stories", where you can sit back, relax, and enjoy an in-depth look at ongoing research (or sometimes a story that's just plain fun).

June 22, 1999: One of the greatest meteor storms ever seen took place nearly 166 years ago over the eastern United States. During the 4 hours which preceded dawn on Nov. 13, 1833, the skies were lit up by thousands of shooting stars every minute. Newspapers of that era reveal that almost no one was unaware of the shower. If they were not alerted by the cries of excited neighbors, they were usually awakened by flashes of light cast into normally dark bedrooms by the fireballs. [

The great display of shooting stars was caused by debris from comet Tempel-Tuttle which had recently returned to the inner solar system during its 33 year journey around the Sun. The storm marked the discovery of the annual Leonids meteor shower and is widely regarded as the birth of modern meteor astronomy.

Samuel Rogers, the great-great-great-grandfather of Science@NASA reader Neil A. Stonum, was a circuit rider (i.e., a travelling preacher) in the early 19th century. His exploits are recounted in an autobiography Toils and Struggles of the Olden Times, published by Standard Publishing Company in 1880. Rogers was on hand in Antioch, Virginia in 1833 when the Great Leonid Meteor Shower took place, and he wrote this charming account of the historic event.

First-hand account of 1833 Meteor Shower
by Elder Samuel Rogers

I at once sold my little farm in the neighborhood of Antioch, and, having disposed of what stock and stuff I could not take with me, on the 13th of November, 1833, I was ready to start upon the journey for our new home in the West. On the evening of the twelfth, many of our dear friends came into bid us adieu, and they remained until a very late hour, when, after a prayer, the most of them returned to their homes, a few remaining to see us off in the morning.

We had but little rest that night, for, before three o'clock in the morning, we were all aroused from our slumbers, making preparation for an early start. Some one, on looking out of the window, observed that it was almost broad daylight. "That can not be," another answered, "For it is scarcely three o'clock." "I can't help what the clock says," replied the first speaker, "my eyes can not deceive me; it is almost broad daylight --look for yourselves."

After this little altercation, some one went to the door for the purpose of settling the question. Fortunately, there was not a cloud in the heavens; so by a glance, all was settled. I heard one of the children cry out, in a voice expressive of alarm: "Come to the door, father, the world is surely coming to an end." Another exclaimed: "See! The whole heavens are on fire! All the stars are falling!" These cries brought us all into the open yard, to gaze upon the grandest and most beautiful scene my eyes have ever beheld. It did appear as if every star had left its moorings, and was drifting rapidly in a westerly direction, leaving behind a track of light which remained visible for several seconds.
Some of those wandering stars seemed as large as the full moon, or nearly so, and in some cases they appeared to dash at a rapid rate across the general course of the main body of meteors, leaving in their track a bluish light, which gathered into a thin cloud not unlike a puff of smoke from a tobacco-pipe. Some of the meteors were so bright that they were visible for some time after day had fairly dawned. Imagine large snowflakes drifting over your head, so near you that you can distinguish them, one from the other, and yet

so thick in the air as to almost obscure the sky; then imagine each snowflake to be a meteor, leaving behind it a tail like a little comet; these meteors of all sizes, from that of a drop of water to that of a great star, having the size of the full moon in appearance: and you may then have some faint idea of this wonderful scene.

It must be remembered that, in the Western States, at that day, there was not much knowledge among the masses upon the subject of meteorology. No tome in a thousand could give any rational account of this wonderful phenomenon; so it will not appear strange that there was widespread alarm at this "star-shooting," so called. Some really thought that the Judgment Day was at hand, and they fell on their knees in penitence, confessing all the sins of their past lives, and calling upon God to have mercy. On our journey we heard little talked of but the "falling of the stars." All sorts of conjectures were made by all sorts of people, excepting there were but few, if any, wise conjectures, and very few wise people to make them along the way we traveled. Not a few thought it an evidence of God's displeasure, and believed that fearful calamities would probably speedily follow. There were those who believed the Judgment Day was near at hand, and undertook to prove out of the Scriptures that this was one of the signs of the coming of the Son of Man. One old lady was emphatic in the statement that it was certainly a "token of some sign." Statements made even by good-meaning people were often quite erroneous. Some men declared that they saw great balls of fire fall into the water, and heard the sizzling noise, like that made when a red-hot iron is thrown into a slake-tub. Others thought they saw these great balls of fire bursting among the tree-tops.

We may learn of this that, when men are in a high state of excitement, their testimony must be taken with many grains of allowance. I heard of a few who professed religion under the influence of these lights. In that day, for the sinner under conviction to be able to say that he had seen a light, whether he had heard a voice or not, furnished a ready passport into almost any church in the land. I suppose the reformation produced by these meteors was like the appearance of the meteors themselves -- of very short duration. I have no faith in any repentance grounded upon objects of sense. The gospel only is the power of God unto salvation. Love to God and hatred for sin, only can work a permanent change in the life of a man; and nothing short of this can be trusted as permanent in its effects.

From: Ralph Petrozello Date: November 18, 1997 I think that it was in Nov. 1966, I don't remember the exact date, but I remember that thanksgiving was comming up soon. I was 15 years old. My older brother (by three

years) had rented his first apartment and we had just come back from staying up late to finish some painting. We got back to my parents house, perhaps two o'clock in the morning, I'm not sure of what time it was exactly. My parents home is in Endwell, New York...that's upstate, near Binghamton. I remember it was very cold outside that evening. When we got out of the car, something caught our attention. When we looked up there appeared to be hundreds meteors comming out of one point in the sky! The number of meteors kept increasing until it appeared that there were literally thousands of meteors streaming down! (I actually thought I could hear some of them as well!) I can only describe it as looking like you were driving in your car, facing into a snow storm at night with your headlights on! We even woke up the neighbors across the street. They thought we were crazy at first, but thanked us later for disturbing them to see this event that was occurring in the sky. It was very high up in the sky. I would say that we were facing generally in a southerly direction. I remember the point of origin being higher than the top of telephone pole, which was close by. I also remember how impressed I felt by the overall enormity of the event. I remember thinking that it had such a vast looking depth and width, like the inside of an enormous cone! When I read about the possibility of seeing such an event again, I told quite a few of my friends about my childhood experience. (I think some of them thought I was exagerating, but I can assure you that I was not, and I am glad that I had other witnesses.) I don't know if this was the "Leonid" meteor shower, but it certainly left a lasting impression on me.

Web Links

Leonids Live! -site of the live webcast of the 1998 Leonids
History of the Leonids -- from Gary Kronk's excellent Comets & Meteors web site
The Night of Raining Fire -- from Sky & Telescope

Related Stories:

Hunting for Halley's Comet -- May 7, 1999. A high flying weather balloon ascends to the stratosphere in hopes of capturing an Eta Aquarid meteoroid

Meteors Down Under -- May 3, 1999. Information about the eta Aquarids meteor shower and Halley's comet.

Tuning in to April Meteors -- Apr. 27, 1999.Amateur astronomers capture radio echoes from fiery meteors in April 99
April's Lyrid Meteor Shower -- Apr. 21, 1999. The oldest known meteor shower peaks this year on April 22

A Wild Ride to the Stratosphere -- Apr. 14, 1999. A weather balloon hits the stratosphere in search of meteoroids

Meteor Balloon set for Launch -- Apr. 8, 1999. This weekend scientists will launch a weather balloon designed to capture meteoroids in the stratosphere.

Leonid Sample Return Update -- Apr. 1, 1999. Scientists will describe initial results from a program to catch meteoroids in flight at the NASA/Ames Leonids Workshop April 12-15, 1999.

The Ghost of Fireballs Past -- Dec. 22, 1998. RADAR echoes from Leonid and Geminid meteors.

Bunches & Bunches of Geminids -- Dec. 15, 1998. The Geminids continued to intensify in 1998

The 1998 Leonids: A bust or a blast? -- Nov. 27, 1998. New images of Leonid fireballs and their smoky remnants.

Leonids Sample Return payload recovered! -- Nov. 23, 1998. Scientists are scanning the "comet catcher" for signs of Leonid meteoroids.

Early birds catch the Leonids -- Nov. 19, 1998. The peak of the Leonid meteor shower happened more than 14 hours earlier than experts had predicted.

A high-altitude look at the Leonids -- Nov. 18, 1998. NASA science balloon catches video of 8 fireballs.

The Leonid Sample Return Mission -- Nov. 16, 1998. NASA scientists hope to capture a Leonid meteoroid and return it to Earth.

Great Expectations: the 1998 Leonid meteor shower -- Nov. 10, 1998. The basics of what the Leonids are and what might happen on November 17.

55P/Tempel-Tuttle

Discovery and Historical Highlights

Credit: NASA

Ernst Wilhelm Liebrecht Tempel discovered this comet on 1865 December 19. It was then in the evening sky near Beta Ursa Majoris. He described it as a circular object, with a central condensation and a tail 30 arcmin long. Horace Parnell Tuttle (Harvard College Observatory, Cambridge, Massachusetts) independently discovered this comet on 1866 January 6.

Historical Highlights

During the 1865/1866 apparition, the comet was only seen until 1866 February 9. Fortunately enough observations were provided to allow astronomers to determine that the comet was traveling in an elliptical orbit with a period of about 33 years. Nevertheless, the comet was not seen during its expected returns in 1899 and 1932. It was finally recovered in 1965 thanks to a painstaking examination of the orbit by Joachim Schubart (Astronomisches Rechen-Institut).

A few years after the comet's discovery John Russell Hind made the suggestion that the comet might have previously been seen in 868 and 1366. No formal analysis was conducted until 1933, when S. Kanda took up the challenge. He concluded that the comet of 1366 was most likely Tempel-Tuttle, but the comet of 868 was not related. In 1965 Schubart took the comet's 1866 orbit and used a computed to examine the comet's motion through the solar system for 500 years into the past, applying the gravitational effects of the planets all the way. He confirmed Kanda's proof that the comet of 1366 was Tempel-Tuttle and also found that a single observation of a comet by Gottfried Kirch on 1699 October 26 was also Tempel-Tuttle. With three apparitions now available, the orbit was improved and Schubart provided a prediction for the 1965 return. The comet was recovered by Bester (South Africa) on 1965 June 30 and the position indicated that Schubart's prediction had only been 5 days too early.

The comet's best apparition was that of 1366 when it passed 0.0229 AU from Earth--marking the third closest approach of a comet to our planet in recorded history. Astronomers have suggested the total brightness may then have reached magnitude 3. The comet passed 0.0644 AU from Earth in 1699, which marked the 18th closest approach of a comet to Earth. The brightness may then have reached 4th magnitude. The comet's last appearance in 1965 was not very favorable and it failed to exceed magnitude 16. A tail was only noticed during the 1866 apparition and even then it did not exceed 30 arcmin, or equal to the apparent diameter of the full moon.

J. V. Schiaparelli (Italy) wrote a letter to the Astronomische Nachrichten on 1867 February 2 which showed that this comet was probably related to the Leonid storm that was observed during November of 1833 and 1866. A comparison of the comet's orbit with that of the November 1866 Leonid stream showed an almost perfect match.

The comet was recovered with the Keck II 10-m reflector at Mauna Kea by Karen J. Meech, O. R. Hainaut, and J. Bauer on 1997 March 4.6. There was no trace of a coma and the nuclear magnitude was estimated as 22.5. A confirmation using the 3.6-m New Technology Telescope of the European Southern Observatory on March 7.3 also showed no trace of coma and revealed

a nuclear magnitude of 22. The precise positions indicated the 1996 prediction of Donald K. Yeomans (Jet Propulsion Laboratory) required a correction of only -0.06 day.

Although the comet was not expected to become brighter than magnitude 9.5, observers began reporting it was brightening faster than expected as January progressed. By mid-month many observers were already estimating the brightness as near magnitude 8, and by the 23rd observers were typically estimating it as between 7.4 and 7.8. The comet's physical appearance was typically described as very diffuse during January, with a coma diameter of between 8 and 12 arcmin. Some larger estimates were made by observers using binoculars from regions with extremely transparent skies. The comet passed closest to the sun on 1998 February 28.

The November Leonids: Will They Roar?

Credit: Donald K. Yeomans Jet Propulsion Laboratory/California Institute of Technology

Each November when the Earth runs into the dusty debris from periodic comet 55P/Tempel-Tuttle, some Leonid meteor shower activity is noted. These annual displays of meteors, or shooting stars, seem to originate in the constellation Leo so they are termed Leonid meteors. Normally, the observed rate of the Leonid meteors is about 15 per hour under ideal observing conditions. However, every 33 years or so when the parent comet Tempel-Tuttle returns to the Earth's neighborhood, there is a possibility that the Leonid meteors rates can get substantially higher. In some years such as 1799, 1833, and 1966, when the Earth passed particularly close to the tube of debris following in the comet's wake, there were Leonid meteor "storms" noted of up to 150,000 meteors per hour. Periodic comet Tempel-Tuttle passed closest to the sun (reached perihelion) most recently on Feb. 28, 1998 and a month later on March 5, the comet passed through the plane of the Earth's orbit about the sun.

Another way of saying the same thing is to note that the comet passed through the ecliptic plane from north to south or it passed through its descending node. We can expect the maximum Leonid meteor shower activity when the Earth arrives close to this nodal crossing point. The peak Leonid meteor shower activity takes place within one hour but some activity can be observed for a few hours on either side of this peak. In November 1998, there was a meteor rate peak at the expected time of 19:43 hours UT but there was an even stronger peak more than 16 hours earlier. Un

fortunately for observers located in the United States, the November 1999 shower maximum will likely occur during daylight hours. While some slightly enhanced 1999 Leonid activity may be visible just before dawn for U.S. observers on November 17 and 18, the Leonid shower maximum should be best observed by those located near the regions of eastern Europe and North Africa in the early morning hours of November 18.

Table 1. Predicted Leonid Shower Circumstances.

Although enhanced meteor shower activity was evident in 1996 - 1998, more impressive meteor showers may occur in 1999. The times noted can be considered the time at Greenwich England. Times on the east coast of the US would be 5 hours earlier for example.

Predicted time of Date (UTC)	Leonid shower peak of HH:MM	ZHR (Hours)	meteors/hr	Good observing Locations
1996-Nov-17	07:20	05 - 10	60	Eastern U.S.
1997-Nov-17	13:34	12 - 14	40	Western U.S., Hawaii
1998-Nov-17	19:43	03,19:40	250	Europe, Japan
1999-Nov-18	01:48		200 - 5000?	Eastern Europe, North Africa

What sort of Leonid meteor rates can we expect in 1999? Meteor shower rates are often expressed in terms of the so-called zenith hourly rate (ZHR) or the hourly rate of meteors an observer would witness under ideal conditions with the meteors appearing directly overhead (at the zenith). The geometric circumstances between the comet's orbit and that of the Earth for 1999 are most similar to those circumstances during the Leonid showers in 1866-67 and 1931-32. Since the observed Leonid meteor rates in 1866-67 and 1931-32 were approximately 5000 and 200 per hour respectively, we might anticipate a zenith hourly rate in 1999 bounded by the rates witnessed in the earlier events - between 200 and 5000 meteors per hour.

Like the weather, it is extremely difficult to predict the times and hourly rates of meteor showers. Table 1 is meant only as a rough guide. Peter Brown, David Asher and Robert McNaught, all respected researchers of the Leonid meteor phenomena, have suggested predictions of between 1000 and 2000 meteors per hour in 1999 (zenith hourly rate) with the maximum rate occurring on November 18 at 02:08 UT, some twenty minutes later than the prediction in Table 1. In any case, it is well worth the effort to observe the upcoming Leonid meteors since it will be another century after the 1999 event before significant Leonid meteor displays are once again likely.

Related links and suggestions for further reading:

Preparing for the 1999 Leonids from the International Meteor Organization.

'99 Leonid Airborne Mission from NASA/Ames Space Sci

ence Division.
Near-Live Leonid Watching System
Leonids Live!
Estimation of Meteoroid Flux for Upcoming Leonid Storms from NASA's Space Environments and Effects Program.
Gary Kronk's Leonids Page.
The 1998 Leonids: Summary.
Meteor Streams.
Kronk, G.W. 1988. Meteor showers, a descriptive catalog. Enslow Publishers, Hillside, N.J.
Mason, J.W. 1995. "The Leonid meteors and comet 55P/Tempel-Tuttle". Journal of the British Astronomical Association 105(5):219-235.
Rao, J. 1995. "The Leonids: king of the meteor showers". Sky and Telescope 90:24-31.

Yeomans, D.K. 1991. Comets: A chronological history of observation, science, myth, and folklore. John Wiley and Sons, N.Y.
Yeomans, D.K., K, K. Yau, and P.R. Weissman 1996. "The impending appearance of comet Tempel-Tuttle and the Leonid meteors". Icarus 124:407-413.

The 1966 Leonid Meteor Shower Witness Reports

From: Greg Arnquist

I was 15 years old when the Leonid meteor shower was covering our sky. The 1962 Seattle World's Fair was still fresh in my mind, because it was devoted to the future and space was a major theme.

My mother woke me up around 2 in the morning. We went out in the front yard and I was amazed because there were numerous shooting stars filling the sky at any one moment. I was awe-struck and it became a wonderful memory that has been one of most unique- since I love to tell this story. Many people find it hard to believe, but I could hear some of them burning up in the atmosphere. My mom and I spent a long time out there throughly tunned by the experience. (Partly amazed that the sky was clear enought in the northwest).

I would love to be in Asia now, where I assume it would be a similar experience.

From: James W. Young, Wrightwood, California.

This very noteworthy meteor shower was nearly missed altogether, since the weather was cloudy all evening to past 2 AM. As has happened before and since, I awoke at 2:30 AM and looked at the clouds outside. I could see many meteors through the thinning clouds, so went to the observatory - by 3 AM as the complete cloud cover dispersed! There were 2-5 meteors seen every second as we scrambled to set up the only two cameras we had, as no real preparations had been made for any observations or photography. The shower was expected to occurr over the European continent. The shower peaked around 4 AM, with some 50 meteors falling per second. We all felt like we needed to put on 'hard hats'! The sky was absolutely full of meteors...a sight never imagined...and never seen since! To further understand the sheer intensity of this event, we blinked our eyes open for the same time we normally blink them closed, and saw the entire sky full of treaks...everywhere!
A 'fireball' is an extremely bright meteor, sometimes bright enough to read a newspaper. During this shower, we recorded 22 such meteors, all within 1 1/2 hours. It is estimated that the average person sees 4 'fireballs' in their lifetime. The above 'fireball' cast heavy shadows for about 6 seconds, and the luminous train left by it lasted about 10-12 minutes. We photographed over a thousand meteors in 90 minutes.

This same meteor shower is expected to produce a fairly substaintual event this November 1998, but probably in the Far East. If you are interested, look for this event 2 days on either side of November 17, 1998. It is also possible that the same time period in 1999 will produce a similar shower. However, in any case, predictions indicate showers far, far less intense than the 1966 event. But as I learned in 1966, it is better to be ready for something spectacular...that way the only thing you lose, will be sleep!

Table Mountain Observatory, operated by the Jet Propulsion Laboratory (JPL), is located just west of the town of Wrightwood, California at an elevation of 7500 feet.

James W. Young

COMET COMMENTS FOR DECEMBER 1999
By Don Machholz

Periodic Comet Machholz 2 remains in the southern evening sky. In late October Component D was found several arcminutes southwest of the primary component. As the comet brightens perhaps other parts will be found.
In the Elements portion of this column I've included information for Comet LINEAR (C/1999 S4). As stated last month, it should brighten to unaided eye visibility next July in the northern polar region.

During the past month the LINEAR program in New Mexico found three new comets while the automated equipment at Lowell Observatory in Arizona (LONEOS) found three. The Catalina program found two, one being shared with LONEOS.
The satellite SOHO found one new comet. Most notable is that Robert McNaught and M. Hartley discovered a comet (C/1999 T1)

which is faint now but should be visible in amateurs' telescopes next summer. The Southern Hemisphere
is favored until Jan. 2001, when the comet will move rapidly northward.

COMET HUNTING NOTES: We are nearly half-way through the year for the Wilson Comet Award. This award of $20,000 is divided among amateurs who find comets each year (June 12 to the next June 11). This "year", with seven months to go,
only one person is eligible for the award. That is Steve Lynn of Australia who found a comet with handheld 10x50 binoculars on July 13. Obviously the automated search
programs have taken away some of the potential amateur finds, with LINEAR's C/1998 T1 and C/1999 J3 being two recent examples.

EPHEMERIS

141P/Machholz 2

Date(00UT)	R.A. (2000)	Dec	El	Sky	Mag
11-08	18h32.9m	-11d50'	54d E		10.9
11-13	18h47.8m	-11d46'	53d E		10.1
11-18	19h03.8m	-11d39'	52d E		9.4
11-23	19h20.8m	-11d33'	51d E		8.7
11-28	19h39.0m	-11d27'	50d E		8.2
12-03	19h58.5m	-11d25'	50d E		7.7
12-08	20h19.5m	-11d29'	50d E		7.4
12-13	20h42.5m	-11d41'	50d E		7.2
12-18	21h08.2m	-12d04'	50d E		7.1
12-23	21h37.7m	-12d38'	52d E		7.2
12-28	22h12.2m	-13d21'	55d E		7.4
01-02	22h53.4m	-14d07'	59d E		7.8
01-07	23h42.1m	-14d41'	65d E		8.2
01-12	020h37.6m	-14d41'	72d E		8.7

ELEMENTS

Object: P/Machholz 2
Peri. Date: 1999 12 09.2752
Peri. Dist (AU): 0.748905 AU
Arg/Peri (2000): 149.2991 deg.
Asc. Node (2000): 246.1434 deg.
Incl (2000): 012.8116 deg.
Eccen: 0.751075
Orbital Period: 5.22 years
Ref: MPC 35815
Epoch: 1999 12 08
Absol. Mag/"n": 12.0/7.5

Object: LINEAR (1999 S4)
Peri. Date: 2000 07 26.3979
Peri. Dist (AU): 0.766182 AU
Arg/Peri (2000): 150.9998 deg.
Asc. Node (2000): 083.1500 deg.
Incl (2000): 149.3473 deg.
Eccen: 1.0
Orbital Period: Long Period
Ref: MPC 36213
Epoch: 2000 07 26
Absol. Mag/"n": 7.0/4.0

A COSMOLOGICAL CONUNDRUM

By Lorna Simmons

Is it or isn't it? Cosmological accelerated expansion of course? Do the standard candles lie? What is going on? Can't those guys get it together?

It seems that the Supernova Cosmology Project is going full steam ahead, all engines revved. The High-z Supernova Search Team folks are gently tweaking the cosmological machine, perhaps throwing a monkey wrench into the works. These two world-encompassing teams of astronomers, astrophysicists, cosmologists, particle physicists, engineers, you name it (cosmetologists?), are now, seemingly, temporarily at odds about this question. Is the universe, after all, accelerating in its expansion?

Let us backtrack for a minute to get our bearings straight. Just what is all of this fuss about? It appears that when Saul Perlmutter and Carl Pennypacker (of the Lawrence Berkeley Laboratory) initially began their study approximately 12 years ago, they were seeking to determine the rate of slowing of the universe. They then believed that the universe was decelerating in its expansion. Because of the great distances involved, they used the type Ia supernovae as "standard candles." Type Ia supernovae become violent bombs when white dwarf stars, in close binary relationships, accrete material from their binary companion stars onto their own accretion disks, thereby forcing the white dwarf stars eventually to reach the Chandrasekhar limit for white dwarfs of 1.44 solar masses. That means "curtains" for the white dwarf stars. Perhaps it also means "curtains" for the companion stars.

Saul Perlmutter and Carl Pennypacker's initial problem was in getting enough telescope time for their project which seemed to have little chance of succeeding, because these astrophysicists had the difficult task of finding the type Ia supernovae explosions (stellar bombs) which occur infrequently, perhaps once a century at most, in each galaxy. Certainly not an everyday occurrence! Saul Perlmutter and Carl Pennypacker came up with a method for taking a great swath of the sky beginning shortly before the new moon (sound familiar?) in order to take advantage of the dark sky. Steve Holland, team leader for the Supernova Cosmology Project, devised a highly resistive chip which was much thicker than normal chips and which mimics the electrical properties of an exceedingly thin chip. In this way, they would be able to image the brightening before and the dimming afterward of a great number of supernovae explosions. This method proved to be suc

cessful, and to accomplish that task, they did not need so much telescope time for each event, because they could take a great number of type Ia supernovae images simultaneously.

Two worldwide groups were formed in order to have checks and balances on the findings. This gentle challenging of groups would offer the scientific community the assurance of controls over this study. The large group of researchers which included Saul Perlmutter, Carl Pennypacker, and Peter Nugent was named "The Supernova Cosmology Project" (using Cerro Tololo, Keck II, and a third telescope which was designed and engineered at Berkeley Lab specifically for this singular purpose of recording, simultaneously, a large number of type Ia supernovae events). The other group, "The High-z Supernova Search Team" (using Mount Stromlo Observatory and Siding Spring Observatory) was composed of Brian Schmidt, David Reiss and Adam Riess, in addition to a large additional number of researchers, with the purpose of making the same kind of study of type Ia supernovae.

Well, surprises of surprises, they were wrong. The data coming in showed that, far from decelerating as expected, the universe was, instead, expanding and, to make things worse, accelerating in that expansion! For crying out loud! Back to the drawing board! They checked and rechecked their data, but the answer was very clear. Acceleration was "in"; deceleration was "out"! By that time, they were getting more and more telescope time (naturally, because they were onto something big) and were able to develop a method for viewing a great number of these stellar bombs at one time. Remember, the white dwarfs all went supernova at 1.44 solar masses (the Chandrasekhar limit for white dwarf stars), so the supernovae should be recorded as having an extreme sameness in that respect. Also, the astrophysicists took spectra of the composition of the material in the explosions to be even more certain. Same results. Conclusion: They just could not escape the evidence for an accelerating universe.

In comes theorist Michael Turner of the University of Chicago with his long-held theory, suggesting the possibility of a cosmological constant, lambda (named after Einstein's "Lambda" and greatest blunder), as a candidate for explaining the non-zero acceleration. Lambda was considered to be energy density and a repulsive force, as opposed to gravity which was mass density and an attractive force. This interesting theory gave a foundation for the observations of the two teams.

To the blaring of trumpets, the issue of "Science" for 18 December 1998, pronounced the "Accelerating Universe" as the "Discovery of the Year"! Ta da!

Now, hold on a minute. There is now a fly in that ointment. Members of the High-z Supernova Search Team came up with some interesting observations. It seems that there is a discrepancy. Slight variations which had previously gone unnoticed were seen among the type Ia exploding stars. When members of the High-z team took a close look at the early phase of ten nearby type Ia supernovae explosions they found that it took more than 2 days longer to reach their highest brightness level than it took for the average of the far distant supernovae. These unexplained differences in the near type Ia supernovae have called the new theory of the expansion of the universe over time into question. The explosions which had been thought to flare to nearly the same luminosity each time, therefore serving as a measure of their distance, are now showing seemingly strong discrepancies in their rate of brightening. On the other hand, the members of the Supernova Cosmology Project, who have not yet come to the end of their own study and have not yet begun to prepare their findings for the scientific community, are, therefore, unready to respond to these emerging data. Others feel that, while the data are pretty strongly discrepant, they are extremely interesting. Type Ia supernovae are getting the ultimate test for their accuracy as standard candles, and whether push actually comes to shove, the outcome will be always interesting and beneficial to the astrophysical/cosmological science.

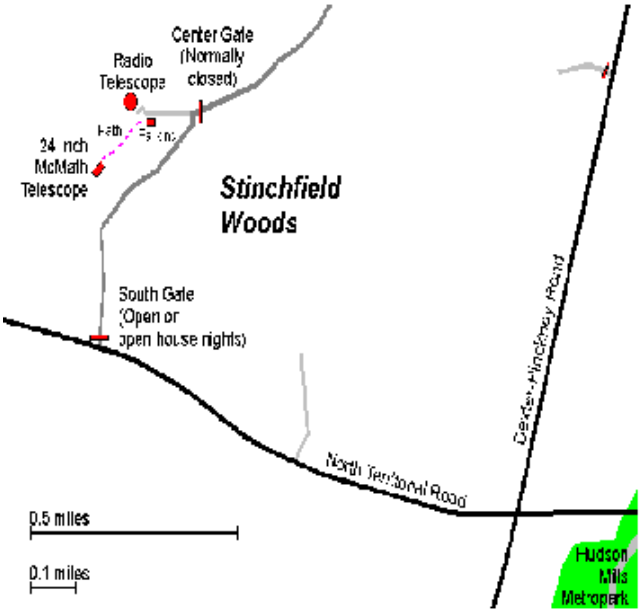
New calibrations might be in the works. Correcting for leftover differences in brightness could be the result of these latest findings. Nobody knows if the difference in the "rise times" of distant type Ia supernovae will provide difficulties in the value of their use as standard candles.
If distant type Ia Supernovae, which have been found to be unexpectedly dim, are indeed intrinsically different from nearby type Ia supernovae, there goes one great standard candle right down the drain! And then again, nothing about measuring the universe is perfect, and the type Ia supernovae provide the best game in town for distant objects. Nobody is ready to throw anything away. Right now, however, the data must be placed on hold, awaiting new findings of the Supernova Cosmology Project which might be some time in coming.

The suspense is unnerving…

Addendum:
Do not worry. The sun, which is expected to become an eventual white dwarf, cannot go type Ia supernova, because it is not in a binary relationship. Therefore you can go back to sleep and forget about all of this nonsense.

Places and Times:

Dennison Hall, also known as The University of Michigan's Physics and Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. It is found in Ann Arbor on Church Street about one block north of South University Avenue. The meeting is held in room 807. Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.



Peach Mountain Observatory is the home of The University of Michigan's 25 meter radio telescope as well as the University's McMath 24 inch telescope which is maintained by the Lowbrows. The observatory is located northwest of Dexter. The entrance is on North Territorial Road, 1.1 miles west of Dexter-Pickney Road. A small maize-and-blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.

Public Star Parties:

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties are canceled if the sky is cloudy at sunset or the temperature is below 10 degrees F. Call 480-4514 for a recorded message on the afternoon of a scheduled Star Party to check on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitoes - bring insect repellent, and it does get cold at night so dress warmly!

Amateur Telescope Making Group meets monthly, with the location rotating among member's houses. See the calendar on the front cover page for the time and location of next meeting.

Membership:

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students and seniors (age 55/+). This entitles you to the monthly REFLECTIONS newsletter and the use of the 24" McMath telescope (after some training). Dues can be paid to the club treasurer Doug Scobel at the monthly meeting or by mail at this address:

1426 Wedgewood Drive
Saline, MI 48176

Magazines:

Members of the University Lowbrow Astronomers can get a discount on these magazine subscriptions:

Sky and Telescope: $29.95 / year
Astronomy: $29.00 / year

For more information contact the club Treasurer. Members renewing subscriptions are reminded to send your renewal notice along with your check when applying through the club Treasurer. Make the check payable to "University Lowbrow Astronomers".

Newsletter Contributions:

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or E-mail to Newsletter Editors at:

Bernard Friberg (743)761-1875 Bfriberg@aol.com
Chris Sarnecki (734)426-5772 chrisandi@aol.com

to discuss length and format. Announcements and articles are due by the first Friday of each month.

Telephone Numbers:

President: Mark Deprest (734)662-5719
Vice Presidents: Lorna Simmons (734)525-5731
Dave Snyder (734)747-6537
Paul Walkowski (734)662-0145
Treasurer: Doug Scobel (734)429-4954
Observatory Director: Bernard Friberg (734)761-1875
Newsletter Editors: Chris Sarnecki (734)426-5772
Bernard Friberg (734)761-1875
Keyholders: Fred Schebor (734)426-2363
Mark Deprest (734)662-5719

Lowbrow's Home Page:

http://www.astro.lsa.umich.edu/lowbrows.html
Dave Snyder, webmaster

Monthly Meeting

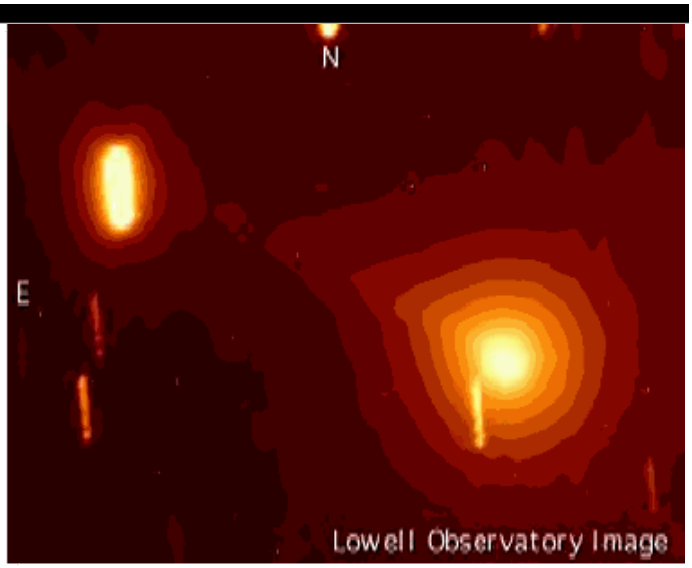
Nov 19, 1999, 7:30 pm

Room 130 Dennison Hall
Physics & Astronomy Building
The University of Michigan

Lorna Simmons talks about Dark Matter

Other members are brining star charts and astronomy items

Thanks to Paul Walkowski for arranging this months meeting



Credit: Lowell Observatory
False color image of comet Tempel-Tuttle taken on February 19, 1998. A tail can be seen extending in the anti-solar direction. The comet was 0.98 AU from the sun and 1.22 AU from the Earth.

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Lowbrow's WWW Home Page:
www.astro.lsa.umich.edu/lowbrows.html

Check your membership expiration date on the mailing label !