



## STAR FIELDS

Newsletter of the Amateur Telescope Makers of Boston  
Including the Bond Astronomical Club  
Established in 1934  
In the Interest of Telescope Making & Using

Vol. 12, No. 11      December 2001

### This Month's Meeting...

Thursday, December 13th, 2001, at 8:00 PM  
Phillips Auditorium, Harvard-Smithsonian  
Center for Astrophysics

### This Month's Speaker...

THIS MONTH'S speaker will be Dr. Jeremy Heyl. His talk is titled "Severe Weather on Neutron Stars". Recent observations of neutron stars during X-ray novae hint that the thermonuclear explosion on their surfaces may excite waves in the neutron star atmosphere with frequencies of about one cycle per second. On the Earth the analogs to these waves are the Rossby waves which distort the path of the jet stream and help fuel El Nino. On a neutron star, these waves are observed as variations in the flux observed during a nova.

Dr. Heyl is a Chandra fellow at Harvard Observatory. He was a Lee A. DuBridge fellow at Caltech. He earned his master's at Cambridge University and his Ph.D. at the University of California, Santa Cruz. His current research is focussed on high-energy astrophysics, specifically neutron stars and black holes. He has also worked on galaxy collisions and cosmology.

Join us for dinner at 5:45 PM at the Changsho Restaurant located at 1712 Mass Ave. in our fair city, Cambridge.

### President's Message...

THE LEONIDS meteor shower last month put on a most impressive show. It was the best meteor shower I have ever seen! At the peak of the shower the meteors were occurring so quickly that I could envision the radiant using the technique of back extrapolating the path of the meteor trails. This was especially evident when multiple meteors heading in different directions would appear simultaneously.

The clubhouse was a beehive of activity starting around 6:00pm Saturday night and ending around 7:00am Sunday morning. The Channel 4 news team was present early in the evening filming several members in the process of reporting the

news event. We managed to power up the TV in time to see lots of our members on the 11 o'clock news. EILEEN MYERS and BRUCE BERGER had Clubhouse duty that night so you know everyone ate well. A lot of folks brought food and there was plenty of hot cider and coffee to drink.

The size of the crowd was estimated to be around 140 people. Folks were bundled up against the cold and reclined on everything from the ground to mats to lawn chairs for a view of the sky show. At one point the Clubhouse sofa was carried off the side porch and onto the observing field affording an excellent "armchair" view of the heavens. I collected about a half dozen micrometeorites in a 4x8 foot plastic lined tray filled with a few inches of water. The tray was set up on Saturday afternoon in my backyard and 3 days later I swept it with a magnet to collect the little meteors. You need to use a 30x-power microscope to see them. I will bring them to the next meeting if anyone is interested in seeing them.

I would like to thank DAVE PROWTEEN for all the effort he has expended in the management and construction of our new roll off roof observatory. Things are looking good Dave. Thank you.

We held the ED KNIGHT appreciation dinner at the Changsho to honor his 50 years of contribution to the club. His son and daughter were present and many humorous stories were exchanged. It was a wonderful evening. Thank you again Ed for all you have done for us.

*-Bob Collara, President-*

### November's Minutes...

PRESIDENT BOB COLLARA opened the meeting of the Amateur Telescope Makers of Boston, including the Bond Astronomical Club. OUR GUEST speaker was Dr. Fred Baganoff, research scientist at MIT, who began with an 18-minute video tape made by NASA on the Chandra X-ray telescope. Dr. Baganoff used Chandra to monitor the center of our galaxy. He recorded a powerful X-ray outburst when looking toward Sagittarius A\*, an intense radio source that astronomers believe is powered by the black hole. During a span of just a few minutes, X-ray emissions from Sagittarius A\* became 45 times brighter than normal, before declining to pre-flare levels a few hours later.

At the business meeting club officers gave their reports. Member-at Large BRUCE BERGER described the club's plan to raise \$750 from member donations to buy a Mosquito Magnet for the clubhouse. All donations are tax deductible. The club's treasury will match the \$750. BERNIE VOLZ quipped, "The mosquitoes will know who didn't pay." MARIO MOTTA made another announcement for the dinner in ED KNIGHT's honor. Mario also will be selling copies of the "Observer's Handbook 2002" published by the Royal Astronomical Society of Canada at December's meeting. The handbook will sell for \$15. Several star parties were announced. Bob reviewed the minutes of the Executive Board meeting. At the recent AAVSO (American Association of Variable Star Observers) meeting LOU COHEN was elected as Treasurer. A final date for the Baxter State Park trip needs to be picked. HOWARD LEVAUX showed photos he took on the club trip to NYC to visit the Hayden Planetarium.

*-Eileen Myers, Secretary-*

## Membership Report...

THERE ARE 311 paid members to date as of the close of the year.

*-John Small, Membership Secretary-*

## Treasurer's Report...

FOR THE month of October, we had \$1,612.90 in revenue and \$1,886.86 in expenses for a net loss of \$273.96 for the month.

As of October 30, 2001 our assets were:

Checking Account - Regular	\$ 18,978.50
Investments	\$ 19,006.66
Total Current Assets	\$ 37,985.20

Of the total, \$2,596.16 is in the Land Fund and \$155.00 is for clubhouse key deposits.

*-Bernie Volz, Treasurer-*

## Clubhouse Report...

### SATURDAY OPEN CLUBHOUSE SCHEDULE

December 1	Steve Mock	Gary Walker
December 8	Paul Cicchetti	Eric Johansson
December 15	Jack Drobot	Lew Gramer
December 22	John Reed	Tom Wolf
<b>December 29</b>		<b>Work Party #11</b>
December 29	Bruce Berger	Bruce Gerhard
<b>December 31</b>	<b>New Year's Eve Party</b>	<b>7 PM - 1 AM</b>
January 5	<b>Closed</b>	
January 12	David Richardson	Jim Suslowicz
January 19	Eric Johansson	John Reed
January 26		<b>Work Party #1</b>
January 26	John Small	Gary Walker

THE WORK party on November 3rd went well. We managed to raise half of the roof structure to the observatory. BRIAN MAERZ chipped and shredded a bunch of brush with his chipper/shredder. ED KNIGHT did some more testing of the furnace to determine why it keeps shutting down right after starting. He strongly believes that the problem lies with a cold chimney. The basement becomes colder than the outside causing a no-draft situation in the chimney. When the furnace comes on, all of the fumes and smoke "backwash" into the furnace and it shuts down. It was determined that we should have a technician from the company we get oil from to check this out.

Several days later MIT installed a new water pump in the pump room. This system produces more flow, but it was found out that there was a small pin hole leak in one of the plastic tubes that feeds the pressure transducer. This caused a minor flood, but was eventually fixed.

On the November 10th a few souls helped with the rest of the roof structure install. Unfortunately, we were four rafters short of completing, but we managed to attach the collar ties to those rafters and install the north gable end. The "knee" wall on the south was added a few days later. The unstained T-111 plywood to the observatory was "painted" a week later.

On the 16th I had the furnace technician at the clubhouse. After checking the system out he agreed that the problem does not lie with furnace itself, but with the cold chimney effect. A way

will be determined to accomplish a "pre-heat" of the chimney before the furnace is started.

On the weekend on the Leonids, it was estimated that well over 100 people came to the clubhouse to enjoy the show.

*-Paul Cicchetti, Clubhouse Director-*



Cartoon by George Foster

## Star Party Thank You's...

THE LYNNFIELD star party was a great success on Monday, November 19th, with over 320 children and parents attending. Thanks to club members who volunteered:

ROBERT COHEN, CHARLIE MCDONALD, TAL MENTALL, MARIO MOTTA, PETER PSYHOS, and AL TAKEDA.

*-Mario Motta-*

I WISH to thank the folks who set up telescopes at the two Marlboro Middle School star parties: ERNIE GINNETTI MIKE HILL, EILEEN MYERS, STEVE SARGENT and BOB SMITH. There was great enthusiasm expressed by the crowd as Saturn rose and became more visible.

*-Stephen Sargent-*

## Upcoming Star Party...

THERE WILL be a star party for the 6<sup>th</sup> grade at the McCarthy Middle School in Chelmsford, MA on Tuesday, December 18<sup>th</sup>. Last year BILL TOOMEY put on a great inside show, and about 8-10 others showed up with scopes for outside viewing. McCarthy science teacher Bob Noonan would like to invite more than the 80 or so people who came last year if we can handle it. Please contact me at [berger@mediaone.net](mailto:berger@mediaone.net)

*-Bruce Berger, Member-at-Large--*

## Ed Knight with Family and Friends – “...the way we were”...



Past Officers at ATMOB Clubhouse WESTFORD MA 1981  
Bob Gardiner Anna Knight Anna Hillier Ed Knight  
Dora Gardiner Jim Gagan

Past Officers at ATMOB Clubhouse WESTFORD 1981  
Sam Gardiner Anna Knight Anna Hillier Ed Knight  
Dora Gardiner Jim Gagan

*This photo was carefully restored by Paul Valletti*

## Observing Leonids at the Clubhouse...

FAAAANTASTIK! Not that I mean to sound like a furniture commercial, but that's the word that comes to mind as I sit and recall this morning's (November 18) fabulous sky show at the ATMOB's Westford clubhouse. I have never seen such a spectacular astro event and been with such a great group of ATMOB members, friends, family and so many complete strangers that I estimate about 120 people visited the clubhouse and observing field between 6:15PM Saturday and 6:00AM Sunday.

The excitement started to build when the Channel 4 News truck arrived at 7:30 PM carrying reporter Christina Hagan and a friendly yet unnamed cameraman. Christina showed true interest as she questioned and probed for background material prior to shooting. On camera were RACHEL AUBUCHON, RICH NUGENT and his son Conor, EILEEN MYERS, STEVE BECKWITH, MARSHA BOWMAN and her husband Ray, BOB COHEN and an assortment of others, including yours truly. While maybe 90% of the footage wound up on the "cutting room floor", it was really exciting to have them there. We got to watch ourselves on the 11:00 news that night. (I was the one in the purple jacket.)

Many people were treated to a feast of cheeses, cold cuts, lasagna, cookies, and crackers provided by the evening's co-hosts EILEEN MYERS and BRUCE BERGER and others. I have never seen so many people at the clubhouse!

Temperatures maintained a steady 26° through the night, and the absence of any wind made it almost pleasant for all. Although clouds threatened the early evening, by midnight visibility was reduced by only a slight faraway haze to the south and southeast. We all saw meteor activity in short spurts or isolated streaks throughout the night, but the Leonids started showing themselves in full bloom after midnight, and built steadily to a crescendo of an estimated 1000/hr just before dawn. The sights were spectacular,

and the oohs and aahs from the crowds reminded me of a 4th of July fireworks display.

Cars were arriving in twos and threes into the early morning and this continued right up until 5AM. Several members suggested that we plant some kind of a light barrier along the roadway to shield viewers from the headlights, and this is something we should take up at our next Executive Board meeting. While I feared otherwise, cleanup was not too difficult because the crowds, members and strangers alike, cleaned up their little piece of viewing area before leaving. Inside the clubhouse many overcame their weariness to clean, put away and vacuum up the debris. We locked up at about 6:00AM, after which President Bob, Barbara Bosworth, friend Ernie Taylor and I met in Chelmsford Center for breakfast before going home to bed.

All in all it was a truly exciting event.

*-Bruce Berger-*

## Observing Leonids at Stellafane...

I HAD not seen any meteors early in the evening, but just after midnight two golden earth-grazers of first magnitude streaked across the horizon from the direction that Leo was about to rise from. The shower had started. The temperature was -3C, (28F). I curled up in a blanket on the cold floor for about an hour, but my toes got colder and colder and I couldn't sleep. I got up, went out to the Jeep, and dug up some chemical handwarmers, stuffed them in my socks, and retreated to the blanket. I was conscious of a few OOHs and AAHs in the next few hours and got up just after 4 AM. By then about twenty observers and a few astrophotographers had assembled outside. By 4:30 AM we were seeing clusters of two, three, even five meteors in a period of one second. The radiant was distinctly in the sickle of Leo. The great majority of meteors left trains for a few seconds, a few for about 30 seconds. Many appeared to be attacking Orion, and others headed almost directly at us. Every quadrant of the sky was busy with bright streaks. A peak was reached at 4:50AM but then they just kept coming, like in the old woodcut of the Paris Shower.

We saw a number of golden yellow ones, green and white and blue ones, and a few broke apart. I also noted what appeared to be trains without a nucleus. I wonder if those might have been specks of ices and frozen gases? As the dawn brightened so that only 1st magnitude stars and Jupiter were visible, Iliana Filby was still counting the bright ones. In an hour's time we estimate we saw between 1000 and 3000 meteors, three aircraft, and two satellites.

In 1967, Dennis Milon, Mike Mattei, and I saw a remnant of the 1966 outbreak from Oak Ridge Observatory, Harvard, MA at a rate of 3000 per hour, but that storm only lasted for 15 minutes. The 2001 storm was far superior, especially for brightness, even better than the Perseids (albeit they appear in much warmer weather).

*-Paul Valletti-*

## Observing Leonids in NH...

ALTHOUGH IN this shower/storm using an analogy of rain to meteors, not even the most protective of rain gear could have kept you dry from this downpour. From the clouds drifting by until the first rays of sunlight in the dawn, this was truly the best night of my life watching this rain of stars, literally tens per every 3 seconds. In some cases I saw 3 stacked on top of each other in rapid succession, boom, boom, boom. There were bolides galore,

some with trains that lasted many tens of minutes. Watching the trains through small binoculars showed a twisting of the tendrils of smoke as they drifted lazily among the upper atmospheric winds. At times the trains brightened slightly when passing near a bright star.

There were very bright bolides everywhere. While lying down facing West and watching the region of Cassiopeia, my friend STEVE Mach (MOCK) was illuminated by a bright bolide in the southeast. His shadow appeared on the domes of the observatory behind him. Another meteor literally exploded into a magnitude -10 explosion as we were looking to the east. There were 2 bolides in the southwest within a few seconds of each other, each producing magnitude -4 balls of fire. These also had trains that lasted for tens of minutes.

*-Dave Aucoin-*

## Observing Leonids in China...

Written by LEW GRAMER, Outreach Director and active observer with the North American Meteor Network (<http://www.namnmeteors.org>)

I WAS honored to be the sole US representative for the "2001 Sino-Dutch Leonid Expedition" to China this November. I was in China, together with members of the Dutch Meteor Society, at the kind invitation of senior astronomer Zhu Jin, of the "NAOC" (National Astronomical Observatories of China). Dr. Zhu's primary research interest is in asteroids, but in the last several years Jin has expanded his research to encompass the study of meteors and meteoroid streams. He is a member of the IAU "Commission 22" (Meteors, Meteorites and Interplanetary Dust), and is active in Commission 22's Pro-Am Working group, which aims to further the cooperation between amateurs and professionals in the field. My time in China was just 10 days - hardly enough to appreciate my very first experience outside of the West. These are some of my impressions, just one week after returning from that experience.

I spent a few days before and after the Leonids in Beijing. Beforehand I stayed in a graduate student dorm on the main NAOC campus in the northern part of the city. Following the Leonids I was in a small hotel mainly frequented by Chinese business people, just a 20 minute walk from Tiananmen Square, Mao's Tomb, and Forbidden City.

During the main period of Leonid "background" activity, i.e. the nights of 15 Nov through 20 Nov, our host Zhu Jin arranged for the Sino-Dutch team (among them some of Jin's own grad students, colleagues, and interns) to observe and live at Xinglong Station, one of NAOC's main observing facilities, lying at 860m atop a ridge in Hebei Province, 120km northeast of Beijing. Xinglong is the site of China's 2.16m, and several other large telescopes - among them the main research instrument of Jin's team, a 90/60cm Schmidt scope. For the maximum nights, teams of Dutch and Chinese observers fanned out to three other sites 50-70km distant from Xinglong, giving the baselines necessary to do multistation photography and video of the Leonid activity. Of course one DMS team remained at Xinglong also. Among their research goals, in addition to the simple rate determinations we were all there to make, were to calculate precise trajectories for Leonids from various "storm components" surrounding peak night. This can allow not only particle orbit determinations, which might prove invaluable in improving the "dust models" on which

most Leonid predictions have been based in recent years. It can also give quantitative data on meteor "burn heights", which may provide clues to meteoroid/comet composition, and may ultimately help research on organic "volatiles" in comets, and the origins of life of Earth. Clearly, DMS and Dr. Zhu were interested in more than simple ZHRs.

Xinglong lies at the end of a long, perilous 3-hour bus drive via Chinese highway and mountain road, up into the Yan Shan mountains. There is a town of Xinglong a few km away, as well as two or three tiny mountain villages full of warm people and grinding poverty. The Station was a whole new world for this Westerner - made yet stranger by the fact that our entire team lived among and in the same style as all the other astronomers and students. We slept in communal dorms with one shared "facility" per dorm; and a big thermos for each room, which we could fill up with boiling water from the kitchen once a day if we wanted to have drinking water. This experience of living as a Chinese astronomer would live was perhaps the thing that most impressed me during my visit. I saw no distinction between revered astronomers and new graduate students: if anyone desired to fill their thermos, they would awake promptly at the right hour, no matter how hard a night of work they may have done at the telescopes, and trudge through the cold to the communal dining area with thermos in hand. On washing day, everyone brought their sheets and blankets down to be washed by hand as well. These Chinese professional astronomers were not merely highly dedicated, but also physically tough as well. I was humbled by this.

For all five nights of observing (and to be frank, I inadvertently slept through the final post-storm night of 19/20 Nov!), Xinglong's observers were stationed at the top of a shaky ladder climb, on the roof of a building attached to the 90/60cm dome. The big telescope's dome blocked out the lower elevations in the East for our observers. But this was not a serious problem, for as any meteor observer will tell you, shower meteors really do appear all over the sky! During the height of the storm, we were joined by a youngster: the 8-year-old daughter of our host, Dr. Zhu. Our young guest enjoyed all the excitement of the adults and students for a while. But once the sandman made his visit, she became mightily unimpressed by the 40-per-minute bursts and fireballs, and curled up beside daddy. Otherwise, throughout the incredible experience of the "Great 2001 Australasian Meteor Storm", all observers present in Xinglong were anxiously recording every nuance of the changing activity.

This was my first experience recording a true meteor storm. (I have recorded less intense "outbursts" from the Leonids and Perseids in previous years, as well as the "Fireball Shower" from the Leonids in 1998.) Among the more intriguing insights I gleaned from the experience:

1) It is impossible to be TOO prepared. I had been (so I thought) quite "paranoid" in my preparations for observing this event, and I still found myself wishing I had better equipment with me. (Among my "wish I had's" was a LOUDER period timer: my little wristwatch will ding every minute without any problems. And I'll usually hear it through the winter layers without problem: but when I am in a group of 10+ other observers, and fireballs are happening every 2 or 3 minutes, it simply isn't loud enough!)

2) Facing the radiant of a shower - at least during highly enhanced activity periods - really DOES appear to enhance one's perception! (I had never been sure of this myself. But during the last hour of the sustained fusillade which was the Australasian Leonid storm, I had to conclude albeit subjectively, that this was indeed the case!)

3) It IS possible - and some had doubted this - to actually estimate the magnitude of every meteor one sees, at least up to short bursts of 40 per minute, and sustained rates above 20/minute. But then, my longest contiguous period above 20 meteors/min was only 10 minutes! (Now as for my accuracy in these estimates - maybe it was as bad as 50 percent or so at the busiest times! But based on comparison with other observers, and my own post-reactions during lulls, I would be willing to give good odds that I did not substantially over- or underestimate my magnitudes, on average, during any period.)

Seeing a meteor storm for the first time in my life, unquestionably, was a personal zenith for me. However, I was surprised to find that a still greater thrill actually came AFTER the Sun came up, and the meteors stopped "falling". As I was staring through bleary, bloated, red eyes at a computer screen, transcribing the THOUSANDS of verbal magnitude estimates from my sound recorders, and then later working and analyzing these estimates with spreadsheets and ad hoc computer programs to produce my IMO "quick reports", something dawned on me: lying there in my sleeping bag I had witnessed one of Nature's most awesome spectacles. And not merely seen the event, but actually made a record of it (one of many such records that night), which humanity truly might use to increase our understanding of the Universe. This was my first time experiencing this feeling. I suspect this sense is rare even for professional scientists - so how precious it seemed to me, a "mere" amateur, all those thousands of miles from home.

Again, I must thank our gracious host, Jin, for giving me the chance to participate in this great scientific adventure! I am in his debt, and I am now more than ever, a committed meteor astronomer for life.

*-Lew Gramer-*

I WOULD like to share info with other members on Leonids  
fltlucia@aol.com

*-Tom Lucia-*

## Observing the Geminids...

THE GEMINID meteor shower will peak on Thursday night, December 13 around 11 PM. See more information in the "Heads Up For December" column on the back page.

## New Year's Eve Party...

BRING A tasty dish to share, dress warmly, and join us at 7PM to welcome in 2002 together with good food, good friends, and good observing. Bring family and friends too. RSVP to Eileen at [starleen@charter.net](mailto:starleen@charter.net) or 978-461-1450 x0 (day) // 978-456-3937 (evening). Last minute partygoers and late arrivals are welcome! Please call with any suggestions for games or prizes.

*-Eileen Myers and John Reed-*

## Other News...

A "COLORING & Activity Book" with outlines of stamps celebrating spaceflight is now available from the United States Postal Service. Ask for Publication 39, free at your local Post Offices in single copies or in bulk. It can also be downloaded (.pdf format - 2,897 KB) from [www.usps.com](http://www.usps.com) (search for coloring books). It is appropriate for grades K-12. The Barrows Elementary School has already requested 75 copies for their fifth grade astronomy module.

*-Charlie McDonald-*

THE SMITHSONIAN Astrophysical Observatory (CfA) has posted that in the event of storms or other emergencies employees and others may call 617-495-7311 to see if the building will be closed. This will be a recorded message.

*-Anna Hillier-*

LEW GRAMER forwarded information about the educational websites created by Alwyn Botha, who lives in Hartbeespoort, South Africa. The websites contain quizzes and information on a middle and high school level. Take a look at the two detailed photographic maps of the Moon he made at <http://www.moon-phases.com/>. This website has 300 quizzes about the maps. Each question has a small picture of a part of the Moon. You have to identify craters, rills, mountains, etc. Some of his other educational astronomy websites some are:

<http://www.the-solar-system.net>

<http://www.galileo-galilei.org/>

<http://www.the-planet-jupiter.com>

Also look at <http://www.the-solar-system.net/webquests/high-school-science-websites.html> to see his other educational websites. Drop him a line (see <http://www.the-planet-jupiter.com/about-jupiter.html>) if you are as impressed as I am.

*-Eileen Myers-*

## For Sale...

NEW MEADE ETX-60 AT with carrying case and tripod with case, 2x Barlow Lens, MA9mm and MA25mm eyepieces, erecting prism. Call 508-787-0069 (Marlboro) and ask for Jean.

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**January Star Fields deadline is SUNDAY, December 30th**

**Email articles to Star Fields Editor / ATMob Secretary**

**Eileen Myers at [starleen@charter.net](mailto:starleen@charter.net)**

**Articles from members are always welcome.**

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**POSTMASTER NOTE: First Class Postage Mailed December 7, 2002**

Amateur Telescope Makers of Boston, Inc.  
c/o John Small, Membership Secretary  
9 Bear Hill Terrace  
Westford MA 01886-4225

**FIRST CLASS**

**How to Find Us...Web Page [www.atmob.org](http://www.atmob.org)**

**MEETINGS:** Held the second Thursday of each month (September to July) at 8:00PM in the Phillips Auditorium, Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge MA. For INCLEMENT WEATHER CANCELLATION listen to WBZ (1030 AM)

**CLUBHOUSE: Latitude 42° 36.5' N Longitude 71° 29.8' W**

The Tom Britton Clubhouse is open every Saturday from 7 p.m. to late evening. It is the white farmhouse on the grounds of MIT's Haystack Observatory in Westford, MA. Take Rt. 3 North from Rt. 128 or Rt. 495 to Exit 33 and proceed West on Rt. 40 for five miles. Turn right at the MIT Lincoln Lab, Haystack Observatory at the Groton town line. Proceed to the farmhouse on left side of the road. Clubhouse attendance varies with the weather. It is wise to call in advance: (978) 692-8708.

**EXECUTIVE BOARD 2001-2002**

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**Heads Up For December...**

*To calculate Eastern Standard Time (EST) from Universal Time (UT) in December subtract 5 from UT.*

Thur-Fri Dec 13-14 – Geminid meteor shower. Radiant near Castor. 120/hr when radiant is at the zenith. Expect about 1 per minute if observing from a dark area. 35 km/sec or 21.7 mi/sec. Bright, medium speed. Dec 14 1:30 UT to 6:30 UT, max.4h UT.

New Moon. Associated with Apollo asteroid 3200 Phaethon, Geminid meteor particles are denser than those of cometary meteor showers, suggesting that they may be asteroidal fragments rather than more friable comet dust.

Fri Dec 14 – Annular Solar Eclipse, but not visible in the NE

Fri Dec 21 – Winter Solstice 2:20 PM EST

Fri Dec 28 – Occultation of Saturn by the Moon. For Boston Saturn disappears at 4:07 AM EST and reappears at 4:28 AM EST. The Moon will be two days short of full. Saturn will disappear behind the dark limb of the Moon. Saturn (mag -0.3).

Sun Dec 30 – Penumbral Lunar Eclipse – The Moon passes through the outer fringe of the Earth's shadow. Look for a slight darkening of the Moon's southern limb around 3:25 AM EST (first contact); 5:29 AM EST is the middle of the eclipse – Moon nearest to the center of Earth's shadow; 7:33 AM EST eclipse ends (last contact). The magnitude of the eclipse is 0.919, that is, the penumbra reaches across this fraction of the Moon's diameter.