



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

Vol. 19, No. 11    December 2007

## This Month's Meeting...

Thursday, Dec. 13<sup>th</sup>, 2007 at 8:00 PM

Phillips Auditorium

Harvard-Smithsonian Center for Astrophysics

*Parking at CfA is allowed for duration of meeting*

This month we welcome Dr. Charles Lada, Associate Director of the Radio and Geoastronomy Division at the Harvard-Smithsonian Center for Astrophysics, whose research work has centered on trying to unlock the secrets of star and planet formation in the Milky Way.

Most of what we know about the origins of stars and planets we have learned in the past quarter century, yet the question of stellar origins is among the oldest in astronomy. In this talk, "The Search for Stellar Origins from Antiquity to the 21st Century," Dr. Lada will explore the question of why it took so long for star formation to become an active branch of astronomical research. He will review ideas and concepts about the nature of stars and stellar origins from the ancient Greeks to Newton and then to William Herschel who in the eighteenth century proposed a surprisingly modern picture of star formation. Dr. Lada will discuss the "dark ages" of the nineteenth century when the infusion of new technology and physics set back research in this field for more than a century. He will also review the advances in physics and astronomy in the early twentieth century that set the stage for the renaissance in star formation research that began in mid to late twentieth century and continues unabated today.

Primarily an observational astronomer, Dr. Lada was initially trained as a radio astronomer, but later became a very active infrared astronomer. He has worked with both ground-based and space-based telescopes. He was among the first scientists to discover and investigate giant molecular clouds and among the first to find and study molecular outflows and jets associated with star formation. Dr. Lada developed a classification scheme for young

stellar objects and protostars that has been used by researchers in the field for the last 20 years to investigate these objects. More recently he had been working on understanding the origin and early evolution of star clusters, protoplanetary disks, and dense molecular cloud cores, the sites of star and planet formation. Dr. Lada has developed an interest in the history of astronomy and his lecture will relate some of the fascinating and unexpected things he has learned about the development of humankind's thinking concerning stellar (and planetary) origins, from biblical times to the present.

Please join us for a pre-meeting dinner with our speaker at 5:45PM, Chang Sho Restaurant located at 1712 Massachusetts Avenue in our fair city, Cambridge, MA.

~ Virginia Renehan ~

## President's Message...

I hope everyone had a wonderful Thanksgiving Holiday. It's my favorite time of year. I'm thankful for so many things, especially living in such a beautiful area with reasonably dark skies and for all of my astronomy friends from whom I continue to learn so much.

At last month's meeting, in addition to our wonderful speaker, it was a fun to hear an impromptu word from member Brian Marsden about our early warning asteroid/neo detection system which picked up on an inbound near-earth-object, only later determining it was ESA's Rosetta satellite on approach for a gravity assist flyby. This of course peaked my interest about Rosetta and I found an interesting website about its mission at <http://smc.cnes.fr:80/ROSETTA/> complete with some nifty animations. So too, Gary Jacobson gave those of us on the north shore advanced notice of an asteroid occultation of a 9.5 magnitude star TYC 1963-01413-1 by the asteroid Pythia on January 4<sup>th</sup>. Great stuff! By the way Mario, I'll be over.

For more space debris, let's hope for clear skies the night of our meeting and into the early morning hours. The Geminid Meteor shower returns and promises to be a good show. Teachers and parents, for a fun and beginner-friendly piece on the Geminids and other winter highlights, tune-in to member Kelly Beatty's pod cast at [www.skyandtelescope.com](http://www.skyandtelescope.com)

This month also brings the official start of winter. Winter solstice is right around the corner, with the shortest period of daylight occurring on December 22<sup>nd</sup>. But the latest sunrise and earliest sunset don't occur on that date. Rather, the earliest sunset occurs nearly two weeks before the solstice and the latest sunrise occurs nearly two weeks after the solstice. What skews the timings? Challenge your astronomy students to explain.

A hint is in the pattern of times for solar noon. Have students observe and record the sun's highest point in the sky each day (preferably and compare it to civil noon. In September, solar noon was around 11:37. In November, solar noon was as early as 11:28. It leveled off for a few days and is now getting later and later again until it will reach 11:50 in the early weeks of January. Solar noon has been occurring later each day by 10 to 30 seconds. In other

words, the “solar clock” is running a bit slow compared to civil time. Wow!

What if our watches kept solar time? That is, the length of a second would change slightly every day so there would be exactly 24 hrs from solar noon to solar noon. Then the rise and set times would behave as expected. Our use of civil time, in which the second has a fixed length (atomic seconds), gives a uniform length of day equal to the length of an *average* solar day. In short, we continue to confuse our students and root firmly their science misconceptions!

As always, if you have any questions, feel free to contact me at [vrenehan@gis.net](mailto:vrenehan@gis.net). Clear Skies, and I wish all of you Happy Holidays and a very Happy and Healthy New Year!

~ Virginia Renehan, President ~

## Nov. Meeting Minutes . . .

The November meeting of the Amateur Telescope Makers of Boston and the Bond Astronomical Club featured Dr. Robert A. Gonsalves, Emeritus Professor in the Department of Electrical and Computer Engineering at Tufts University. His talk, “*Phase Diversity Imaging: Real Time Correction of the Atmosphere and Telescope*”, described how to sharpen images by using multiple images to produce a model of the optical system and atmosphere.

Dr. Gonsalves began with a brief discussion about how adaptive optics “essentially introduce a phase aberration that corrects a phase aberration introduced by another medium”, such as the atmosphere. The adaptive optics need to be sent a wave-front distortion estimate to be able to induce these corrections in real time. Phase diversity allows a model to be made to control those elements.

He went on to describe the “Phase Retrieval” problem of observing the modulus of a complex function and deuce the phase. As Gonsalves pointed out that “you can’t”. However he went on and stated that “suppose I tell you that underlying function is smooth. What an engineer says has analytic continuity. Analytic continuity just means that if you know the function of all of the derivatives of every point then you can analytically continue to function into the plane. It’s a crazy concept. A number of professors once said, it’s like putting your finger on an elephant’s trunk and sensing all of the slopes in the trunk at that point and then analytically continue to the entire elephant. It’s an unbelievable concept...That is what is behind phase retrieval. “

The concept of Phase Diversity came about as Gonsalves was striving for his PhD at Northeastern University. As with most PhD thesis, he thought the Phase Diversity algorithm he was working on was useless (Dr. Gonsalves has a patent on how to determine the wave-front from a

point spread function). That changed in April 1990 when the Hubble Space Telescope was not able to focus.

Dr. Gonsalves was one of a group of researchers and companies invited by NASA to figure out why the Hubble Space Telescope was flawed and to come up with a prescription. The “Fourier transforms, analytic continuity, all those things that I thought were useless suddenly they are right on the ... money”. Five other members of the same group also came up with the same answer which gave a higher confidence to NASA. Using the prescription NASA was able to install a set of corrective optics to fix Hubble’s problem.

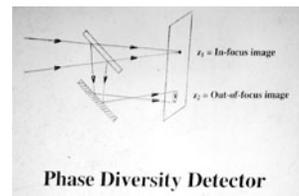
While Phase Retrieval works on a single point source, an extended object is convolved and smeared by the point spread function. Gonsalves reasoned that if you use adaptive optics you are changing the optics and thereby changing the phase. He “likened it to how the brain does when you are looking through a picket fence. When you’re looking through a picket fence, you probably have all seen this, notice this when you’re looking through a screen. You don’t want to look just like this because your eyes will get all confused with the screen. But if you move your head around a little bit like that, the brain puts it together and you can see the object that you are trying to see very clearly. So the multiple images and the processing power of the brain could be incorporated into an algorithm.”

One method of Phase Diversity is to place a beam splitter into the light path and produce a second out of focus image simultaneously with your first in focus image. It will “look just like the first one except different speckles. So there is new information.”

Aside from the Hubble problem, solar researchers have been using this technique for over 10 years in the Canary Islands. The Sun has a huge amount of signal to noise ratio which allows the beam splitting technique to be used. Dr. Gonsalves reports that “the people on the solar imaging are ecstatic over this idea.”



Dr. Robert A. Gonsalves



Phase Diversity Detector  
Phase Diversity Detector Diagram

Before the business meeting, Brian Marsden was hoping to announce the possible “Tunguska event” object called 2007VN84 that according to his calculations would strike the Earth on Tuesday. He announced that the Earth grazing object is actually the space probe Rosetta which is using the Earth as gravity assist mechanism to help it reach the outer solar system.

Marsden also talked about the brightening of Comet Holmes. He was The thing that interested Brian “was that it did precisely the same thing at the same part of its orbit five months after perihelion passage in 1892 when Edwin Holmes discovered it in London.” He also noted that there was another outburst 6 weeks after the first

discovery. He is hoping that the same pattern occurs this time in December or January.

The Secretary, Treasurers and Clubhouse reports were given.

The chairman of the new Observing Committee, Steve Beckwith, announced the schedule for workshops and classes at the Clubhouse.

1. An introductory astronomy course video presented by John Mahre. Friday evenings at 6:30 p.m.
2. Mike Mattei will be putting on a class on how to draw Mars on Sat, Nov. 17.
3. John Boudreu will be doing some webcam instruction on the same night as above. Sat, Nov. 17.
4. Glenn Chappell will be putting on a workshop mapping the brightness of the variable star Algol at the clubhouse. He will also introduce people to three naked eye variables, Delta Cephei, Eta Aquilae and Beta Lyra. Sat. night, Nov. 10.

Please contact the Observing Committee for ideas on future classes or workshops.

For information please refer to the [atmob.org](http://atmob.org) website or contact any of the Observing Committee members. See the end of this newsletter for telephone numbers.

Virginia Renahan announced some of the upcoming star parties. We always need volunteers so please sign up.

Jeff Albero talked about his commercial venture in producing an airplane carryon Dobsonian kit. Parts are half inch maple plywood made on a CNC router. The kit does not include a spider but Jeff recommends the FPI protostar. The only two focusers that will work are the JMI reversed crayford and the Kineoptics helical crayford Focusers. The setup is optimized for an inch and a quarter drawtube. He is selling the kit for \$500 with a 10% discount for ATMOB members.

Dick Koolish showed a Comet Holmes image taken with a digital camera with a 135 mm lens on a tripod.

Bruce Berger has discovered amateur astronomy in China. He visited the director of the Beijing planetarium and was invited to a star party attended by three amateur astronomy groups. He was also interviewed on Chinese TV about his homemade telescope and his opinion of the Chinese space program. He also showed some pictures of the Beijing star party.

Neil Fleming continued his astrophotography lecture by talking about image processing.

~ Al Takeda, Secretary ~

## Clubhouse Report . . .

### November Work Party

Thanks to these members: Kelly Beatty, Steve Beckwith, Bruce Berger, John Blomquist, Paul Cicchetti, Steve Clougherty, Dick Koolish, Brian Maerz, John Maher, Mike Mattei, Glenn Meurer, Eileen Myers, George Paquin, Dave Prowten, John Reed, Stephan Schmitt, Art Swedlow, Al Takeda, Sai Vallabha also: Gary Jacobson and Fred Ward

Work started early on Saturday morning November 24th. At 10 a.m., Brian M, Stephan S., and Kelly B. were found chipping away at the first pile of tree debris left from the impromptu tree topping earlier in the month performed by Brian M., John B., John R., and Steve B., and Marion H. That session completed the first cut at restoration of the eastern horizon from the observing field. Later on Saturday, the chipping crew completed the last pile on the south end of the observing field.

Also seen at 10 a.m. were John B. and John M. hard at work mowing the lawn around the house and observing areas. Once clear of the mowers, the snow fence was erected on the inside of the rear circular drive by Paul C., Richard K., Steve C., and Al T. Since the gas trimmer refused to start, trimming and mowing west of the Knight Observatory remains for the December work party.

The first rows of granite block foundation for the near barn, old four holer were cemented in place by Steve C., Richard K., Kelly B., and John R. An insulated covering was constructed around the site to allow proper curing. Rain and cold weather delayed further progress as we wait for the first winter thaw.



(L-R) Brian Maerz at the chipper and Al Takeda lights up the near barn.  
Photos courtesy of Al T (left) and Dick Koolish (right)

The Mosquito Magnets were secured for the winter and temporarily stored in the near barn by Glenn M., Dave P., Steve B., and John R. These units will need refurbishing before the next bug season. Dave P. and Bruce B. constructed an insulated box around the Knight Observatory computer to test computer operation during the cold weather season. We hope this cures recent computer telescope control problems. Fred Ward delivered the first box of

donated power tools for our machine shop to Gary Jacobson through Bruce Berger. Thanks again, Fred.

Eileen M., George P., and Sai V. worked diligently to place donated Sky and Telescope magazines in binders for library use. The index system was tested by a 40 year search for articles on pier design parameters. Two specific articles were found; but the search showed all bound copies must be checked for completeness since some donated copies had sections cut out from certain issues.

The cold weather brought back the Bailey Hill spaghetti lunch with salad and garlic bread. Art S., Sai V. and Eileen M. prepared a delicious lunch. The sauce is the product of many astronomical weekends of culinary experimentation while observing at Bailey Hill with ATMoB's Gary Walker. Several members hiked Millstone hill after lunch.

As the work wound down late in the afternoon, several discussion groups were found in the meeting room, expanding the previous month's sessions on observing Mars, variable star observing, and CCD image processing.

Come and join us for the next Full Moon Work Party on Saturday, December 22nd.

**Correction:** Anna Hillier should have been mentioned in last month's Clubhouse report.

### Clubhouse Saturday Schedule

Dec 8	Eric Johansson	Brian Maerz
Dec 15	John Maher	Glenn Meurer
Dec 22	WP#13: John Panaswich, Art Swedlow	
Dec 29	David Siegrist	John Small
Jan 5	TBA	TBA

~ John Reed, Steve Clougherty, and Dave Prowten ~

## Star Party Thank You's . . .

**Ditson School – Billerica** Thanks to John Blomquist, Neil Fleming, Joe Henry, Scott Romanowski, Al Takeda and Dave Wallace for making the Ditson Star Party a success. Neil Fleming gave a nice presentation inside before observing began. The crowd was enthusiastic, with more than expected knowing about Comet Holmes!

~Scott Romanowski

**AIAA at the Clubhouse** American Institute of Aeronautics and Astronautics members and family had a terrific time at the clubhouse Friday night. Turnout was very good. The evening clouds broke just as John Maher and Bruce Berger opened the C14. They introduced our guests to their first views of the summer triangle, the Ring Nebula, Alberio, Epsilon Lyra, and Comet Holmes. John Reed opened up the big dob much to the fascination of the kids, while Chuck, Nanette and John Blomquist set up their telescopes for sky tours. Al Takeda gave a slide

presentation indoors and several AIAA diehards stayed quite late discussing astronomy and astrophotography. Many thanks to ATM's Nanette Benoit, John Blomquist, Bruce Berger, Steve Beckwith, Chuck Evans, John Maher, John Reed, Virginia Renehan, and Al Takeda. Also in attendance were new ATMoB members Helios Lam, Steve Morlock and his son Fred, and Mike Adami- Sampson and his sons Nicholas and Harrison. Thanks to the AIAA for good conversation and the pizza they brought for everyone.

**Wilson Middle School, Natick** Despite the cloudy weather, it was another successful event at the Wilson School thanks to Ross Barros-Smith, John Blomquist, Bob Phinney, John Maher, George Roberts and Al Takeda. Bob set up planetary scales (very popular with the kids), brought 3-D photos of the Moon and Mars for use with 3-D glasses, a meteorite and a space shuttle tile.

Attendance was high with 150 eighth graders. Many parents also attended. The event was better attended than last year. John B., John M. and Neil set up telescopes and demonstrated go-to capability and what it was like to look thru a telescope. They had excellent views of the cloud bottoms and wonderful views of a school schedule posted on the far wall of a related school building a couple hundred yards away – top floor - pointed out by a single frond of a fir tree judiciously framing the window. Kids and parents were wonderful and were amazed by the view.

George did 4 star-lab shows that went very well. Neil also had a presentation/slide show running. Many kids and adults thought it was attached to the telescope eyepiece, displaying what the scope was looking at right then despite the clouds - ATMoB misconception busters were hard at work. Neil kindly shared his spare car blanket with some of the shivering students. All in all, a great night. The school can't wait to have us back next year, but most importantly, the students can't wait too!



George Roberts (right) with the Star Lab at Wilson Middle School. Photo by A.L.T.

### West Elementary – Andover High Plain - Andover

Andover Star Party Thank You's

There were two successful star party events in Andover in November. Members of ATMoB and NSAAC both assisted with telescopes, binoculars, and laser guided constellation tours.

On its 3rd attempt this year (and first start party ever) West Elementary had 150 parents and children from the 4th and 5th grade attend an event on Nov 7th. Assisting were (and I may be missing some as I didn't make it outside until some people had packed up) James Bastable, James Foy, Neil Fleming, Scott Romanowski, David Wilbur, and Joseph Rothchild. Thanks should also go to Mass. Electric which was needed to turn off the "death ray" lights.

And on its 6th attempt, despite rain earlier that day and a few clouds threatening that night, High Plain Elementary had 100 parents and children from the 4th and 5th grade attend an event on Nov 29th. Assisting were Scott Romanowski, George Paquin, John Blomquist, Fred Sammartino, James Foy, Kevin Ackert, Neil Fleming, John Maher, and, James Bastable.

Thank you again to everyone that assisted.

**Brewster LaMacchia**

## Observing Committee Report . . .

Mike Mattei and John Boudreau ran workshops on (respectively) drawing and imaging planets. Both sessions focused on Mars and were excellent primers for its opposition at the end of this month. The sessions, held on November 10<sup>th</sup> were attended by fifteen members. A week earlier, Glenn Chaple gave a work shop on variable star observing. Details can be found in his article in this month's Starf Fields.

A telescope collimation workshop is being targeted for January. Once we have firmed up the date, it will be posted on the website and an alert will go out to the club's email announce list. If you have any ideas for workshops that you would like to attend – or possibly teach, please contact me via email or phone.

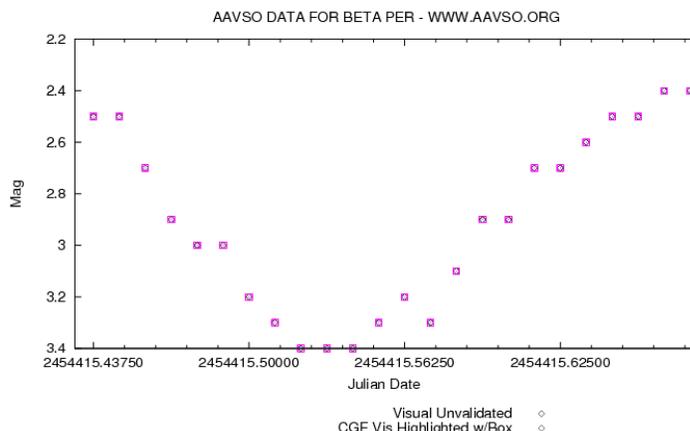
~ Steve Beckwith, John Maher and Mike Mattei ~

## ATMoB Variable Star Workshop . . .

Beta Persei (Algol) is a noted eclipsing binary whose brightness changes are readily visible to the unaided eye. Algol normally shines at magnitude 2.1, but every 2.87 days a dim companion passes in front of the star, reducing the system's brightness to magnitude 3.4. An entire eclipse takes about 10 hours, but most of the activity can be captured in a 6-hour span centered on mid-eclipse.

Clearing skies on Saturday afternoon, November 10, produced ideal conditions for the ATMoB Variable Star

Workshop, the focal point of which was an eclipse of Algol. Joining me were ATMoB members Tom Calderwood, Richard Cosma, Sidney Johnston, Frank Yulling, and John Reed. As darkness descended, the eclipse was already underway, Algol shining at magnitude 2.5. Making visual estimates at 15-minute intervals, we tracked Algol's steady decline – mid-eclipse occurring around 7:30 p.m. Between observations, we had the options of warming up in the clubhouse or braving the cold to view planetary nebulae through Joe Henry's 16-inch Dob or Abell galaxy clusters with a 25-inch Dob operated by Steve Clougherty. Now and then, a brilliant Taurid meteor lit up the sky. By the time we wrapped up the session around 10:30 p.m., Algol had nearly returned to full brightness.



Glenn Chaple's Algol data plots from the night of November 10.

~ Glenn Chaple ~

## Membership Report . . .

There have been several new members joining the club over the last couple months:

Mike Adami-Sampson	Townsend, MA
Nebuchadnezzar Alejandrino	Norwood, MA
Christine Benoit	Boston, MA
Guillermo Bleichmar	Cambridge, MA
Paul Colangelo	Malden, MA
Heleno DePina	Dorchester, MA
Charles Federico	Wilmington, MA
Colin Fenton	Wellesley Hills, MA
Audrey Fenton	Wellesley Hills, MA
Gregory Getchell	Weymouth, MA
Michael Ginieski	Wakefield, MA
Edwin Henneken,	Scituate, MA
Joe Kehoe	Upton, MA
Helios Lam	Boston, MA
Victoria Masotta	Natick, MA
James McLaren	Wellesley, MA
Kristen Reyzer	Maynard, MA
David Wagner	Bolton, MA
Christopher Young	Cambridge, MA

~ Dave Siegrist – Membership Secretary ~

## Comet Holmes Images . . .

I am sure many of you have been tracking the progress of Comet Holmes/17P. It burst from its 17 magnitude obscurity to a naked eye object in a matter of hours in October. The following is a small number of images that members have taken of this unique comet. The images are not shown at the same scale because they were taken through different telescopes.



2007Oct.25 – C-8 f/11 prime, Canon 20D. 20 sec (Al Takeda)  
Imaged at the Locke Middle School Star Party



2007Oct28 – C-9 /f11 , Canon 400D, 10 subs x 20 sec. , (Art Swedlow)  
The nucleus is the left dot in the coma, the right dot is GSC 3334 784.



2007Nov.6 – Tak E180, 17 subs x 30 sec (Al Takeda)  
Notice the ion tail going off to the right in this heavily processed image.



2007Nov.11 – FS128, ST-2000XCM, 10 subs x 30 sec (John Blomquist)



2007Nov.18 – Tak E-180 f/2.8, Canon 20D, 20 subs x 15 sec (Al Takeda)  
The bright star in the coma is Mirfak, in Perseus.



2007Dec.1 – Tak E-180 f/2.8, Canon 20D, 7 subs x 30 sec (Al Takeda)

## For Sale . . .

For Sale: 1.25" Vixen Lanthanum eyepieces, 2.3mm and 4mm. \$30 each. Long eye relief. 2.3 gives 50x per inch of aperture at f/4.5.

Contact Tom Calderwood.  
tjc@cantordust.net or 781-643-6014.



2007 New Year's Eve Revelers

## New Year's Eve Party . . .

Dear Members of ATMoB, their family and friends,

Yes, no matter what the weather, the party is always on!

Come to the ATMoB New Year's Eve Party

The ATMoB Tom Britton Clubhouse in Westford will be open Monday evening, December 31<sup>st</sup> at 6:30pm until past midnight, whatever the weather! There will be food, fun, games, prizes and music inside.

**Bring some tasty food to share with others** and join us in welcoming 2008. Together with good friends and some good observing (we are very hopeful this year – last quarter Moon too), relax, share a few laughs and win a prize answering questions from one of Art Swedlow's challenge games. This will also be the chance for folks to see some of your latest astrophotography efforts projected on a large screen, so bring those photos along on your laptop or on a CD.

Bring family and friends too and take a tour of the clubhouse. Don't forget those boots and warm clothes for observing or just to walk around outside and look at the club's many scopes. Bring a musical instrument and play a few tunes - this crowd knows the oldies!

Partygoers are welcome at any time. We'll be shouting "Happy New Year" every hour on the hour, starting with the arrival of 2008 at the Royal Observatory in Greenwich, England (UT) (local time 7:00pm) and continuing through its arrival at Eastern Standard Time at local midnight.

Any questions? Email Eileen at [starleen@charter.net](mailto:starleen@charter.net) or 978-461-1454 (work)// 978-456-3937 (home).

With best wishes for a healthy and happy New Year,  
Co-hosts Eileen Myers and Art Swedlow

~ Eileen Myers ~

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**Jan. Star Fields deadline  
Sat., Dec 29<sup>th</sup>**

**Email articles to Al Takeda at  
[secretary@atmob.org](mailto:secretary@atmob.org)**

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**POSTMASTER NOTE:** First Class Postage Mailed Dec. 8<sup>th</sup>, 2007

Amateur Telescope Makers of Boston, Inc.  
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34 Millwood Dr  
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Mike Mattei (978) 264-0017  
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**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.

**Heads Up For The Month . . .**

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

Dec 9 New Moon  
Dec 14 Geminid Meteor shower (peaks at 17:00 UT)  
Dec 17 First Quarter Moon  
Dec 18 Mars is closest to Earth (54.8 million miles away)  
Dec 22 Winter Solstice  
Dec 23 Full Moon  
Dec 31 Last Quarter Moon