ATM of BOSTON
Established 1934

STAR FIELDS

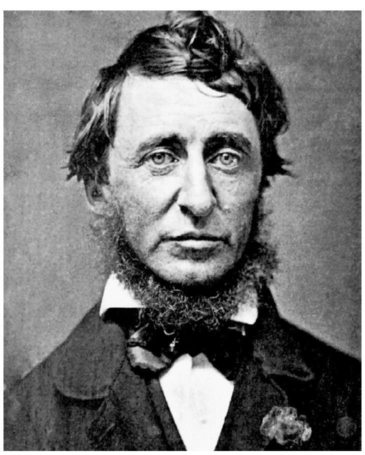
Newsletter of the
Amateur Telescope Makers of Boston
Including the Bond Astronomical Club
Established in 1934
In the Interest of Telescope Making & Using

Vol. 23, No. 5 May 2011

This Month's Meeting…

Thursday, May 12th, 2011 at 8:00 PM
Phillips Auditorium
Harvard-Smithsonian Center for Astrophysics
Parking at the CfA is allowed for the duration of the meeting.

An Astronomer Reads Thoreau



Daguerrotype by Benjamin D. Maxham, 1856

Henry David Thoreau is best known for his observations on botany, biology, economics and politics, but his curiosity knew no bounds. He left behind a journal of his thoughts and experiences, some two million words in length. A reading of the journal reveals a remarkable number of references to astronomy, revealing his interest in the field, even if he was not an regular observer. There are entries regarding astronomical science, night sky objects, atmospheric phenomena, optical effects, and poetry (rather like Astronomy Picture of the Day):

"The boy's sled gets put away in the barn or shed, and there it lies dormant all summer, like a woodchuck in winter. It goes into its burrow just before woodchucks come out, so that you may say a woodchuck never sees a sled, nor a sled a woodchuck, unless it were a prematurely risen woodchuck or a belated and unseasonable sled... The sun now passes from the constellation of the sled into that of the woodchuck." Journal, 25 March 1860

Tom Calderwood is a native of Oregon, becoming a New England transplant to attend MIT, majoring in mathematics. He has worked on software to support the Chandra X-ray Observatory and the sun-observing Hinode satellite. An ATMoB member since 1984, he has made two mirrors at the clubhouse and is the self-proclaimed "master" of the turned-down edge.

President's Message . . .

April was the month of exo-planets. Our speaker discussed exo-planet formation around distant stars, and just a few weeks earlier the Kepler mission made public its findings for its first four months of operations. Even though the world was ready for and anticipating lots of new exo-planet discoveries, the announcements exceeded many expectations.

The first observations of Earth-size planet candidates and the first exo-planet candidates in the habitable zone (where liquid water might exist on a planet's surface) were made public by the Kepler team. There were five discoveries of Earth-size exo-planets that orbit in the habitable zone of their stars. Overall, the data that was released- which came from only the first four months of Kepler's operations- more than doubled the number of known exo-planets from about 550 to over 1230. In addition, 170 stars show evidence of multiple planetary candidates like the Solar System. One of these systems has six confirmed transiting planets with most having orbits smaller than Venus.

Data was taken from observations of over 155,000 stars, which yielded the 1235 candidate planets. What do these numbers imply about the likelihood of planets around other stars? Since the orbits of the planets need to be almost directly lined up with the Earth-star direction in order to see a transit from Earth, then we would expect only a small fraction of star-planet systems (estimates are about 1%) will have planet occultations that Kepler measures. But Kepler found 1235 planets in 155,000 stars, about a 1/150 hit rate allowing for multiple planets. This is about what we would have expected if ALL the 155,000 stars Kepler observed had planetary systems. In fact, our April speaker, Sean Andrews, said the same thing- that most stars probably have orbiting planets.

The big excitement about exo-planets among the general public is whether there might be life on some of these worlds. If most stars have a planetary system, then does this imply anything about the chance of life on other worlds? There are billions of known galaxies in our universe, and each galaxy on average has billions of stars. So, there are probably 1018 to 1020 or more planets in the universe. What is the chance that some of these have life, and what is the chance that some have intelligent life?

A quick look on the Internet shows a wide variety of opinions about this. Some point out that intelligent life on Earth was very improbable and probably wouldn't happen again if the "tape of history was rewound". Others hold the entirely opposite view that, if there is such a huge number of candidate planets stars each, then there surely must be at least a few with intelligent life. The fact is that we just don't know, but the possibility of intelligent life alien to Earth fires up the imaginations of most people. We have no information on what the probability was of life forming on the Earth, and what the probability was that intelligent life would turn out to be dominant (remember that the dinosaurs were in charge 100 million years ago until something removed them from the equation).

So, we can expect lots of dialog in the future about this, but without more facts to go on, each of us will probably continue to interpret exo-planet information according to his or her expectations. But there will be more facts and details in the future, as astronomers learn how to make increasingly more sophisticated observations about our exo-planet neighbors in the universe. Where will this lead?

Keep looking up,

~ Bernie Kosicki, President ~

April Meeting Minutes . . .

Lecture: "Planet Formation in the Disks Around Young Stars"

Photo by Al Takeda

Dr. Sean Andrews

The April meeting (833rd) of the Amateur Telescope Makers of Boston featured Dr. Sean Andrews. He was born and raised just outside Chicago, Illinois. Dr. Andrews received undergraduate degrees in physics and mathematics from Northwestern University and obtained a PhD in astronomy from the University of Hawaii for his work on "Submillimeter-Wave Constraints on Circumstellar Disk Evolution". In the fall of 2007, he came to the Harvard-Smithsonian Center for Astrophysics as a Hubble Fellow. This past fall, Dr. Andrews joined the scientific staff of the radio astronomy division at the Smithsonian Astrophysical Observatory. Much of his research work is focused on using high angular resolution radio-wavelength observations to measure the properties of the planet-forming disks around young stars.

Hundreds of exoplanets have been discovered around nearby stars and a massive effort is underway to find more of them, determine their key properties, and explain demographic trends with models of their formation. However, associating the current exoplanet properties with their formation epoch can be problematic, since the formation process is intimately connected with the physical conditions of their birthplaces: the disks of gas and dust that orbit young stars. Ideally, the mature exoplanet systems could be compared with their younger counterparts that are caught in the act of formation, still embedded in their natal disks. The direct detection of a planet orbiting a young star is challenging. However, some properties of young planets can be inferred indirectly, through their disruptive influence on the structure of the remnant disk material. Dr. Andrews discussed some recent observations that highlight the potential of a new technique that can be used to hunt for very young exoplanets, based on high-resolution radio-wave imaging of their associated protoplanetary disks.

The Story of Planetary Formation

Planetary formation is a new field that has come out of the relatively recent discovery of exoplanets and huge growth in the numbers found. While the technology has been around since the 1950's actual discoveries were not made until the late 1980's. The first published discoveries of extrasolar planets in 1988 (Campbell et al.) and 1989 (Latham et al.) [radial velocity], were followed quickly by pulsar planets in 1991 and 1992 (pulsar timing, Lyne; Wolszczan et al.), the highly published discovery of 51 Pegasi (radial velocity, Mayor et al.) in 1995, multi-planet system Upsilon Andromedae 1996 (radial velocity, Marcy et al.), direct light from 2M1207bin Centaurusin 2004 (VLT, Chauvin et al.), transit method confirmation of HD 209458 in 2006 (Charbonneau et al; Henry et al.), direct images of Fomalhaut b in 2008 (NASA HST) and direct images and spectroscopy of HR 8799 c in Pegasus in 2010 (Marois et al.).

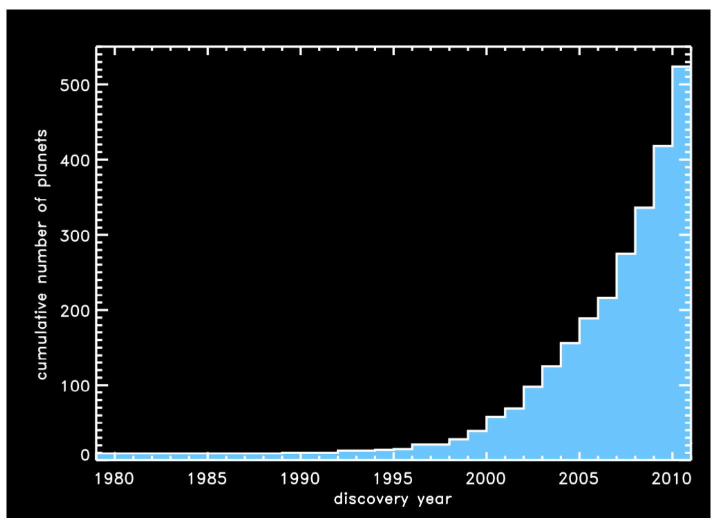


Image courtesy Dr. Sean Andrews

The total number of known exoplanets has grown rapidly since the mid 90s

Since the introduction of the Kepler satellite with its specific mission to discover extrasolar planets via the transit method, the number of detections has skyrocketed. Since the first discoveries, the graph of known numbers of planets and year of discovery graphs as a near perfect exponential function. Now that planets are being categorized, the question of how these planets formed becomes important.The Exoplanet Study Field Splits:Surprisingly for such a young field of study, it has split into new areas: 1) Finding and characterizing exoplanets and 2) Finding an Earth-like planet, characterizing the atmospheres and other details of exoplanets and determining how these planets came to be.

Circumstellar disks as planetary nurseries

The unusual circumstances in Orion that provide a bright background against which we can see silhouettes gave us the first opportunity to image protoplanetary disks. Currently there are two theories for building giant planets, "bottom up" and "top down." The bottom up theory, "Core Accretion," dictates that the gas and dust out of which the star was also born settles toward the midplane. After this, the dust grows into rocks by bumping into each other and sticking. This continues until the rocks grow into planetesimals. When a planetesimal grows to sufficient size (10x Earth), gravity takes over and it grabs the gas in its orbit. This results in systems with rocky planets and gas giants. It works best inside 20 AU. It is very slow, taking 1 to 10 Million years to complete. It benefits from but does not require a massive disk.Planet building from the top down or "Disk Instability" theory works differently. Simulations show that a very massive planetary disk is unstable. As the disk structure evolves it fragments due to the instability that results it areas of dense balls of gas. This process results in only massive gas giants. It works best outside of 40 AU. It is very fast,completing a planetary system is as little as 1,000 years. It requires a massive disk.It is important to know what happens to the biggest planets in order to understand what happens to the small planets. Large planets have a huge influence on the smaller planets. Jupiter has more mass than all the other planets combined.

How much time is available to make planets?

Once the disk material disappears, planet forming is done, by definition. Studies have been done to estimate how long disk material lasts around new stars. This is done by star surveys ("brute force" astronomy) in star forming clusters. In IR, the disk and dust absorb and re-radiate the light from the star. We can estimate what fraction of stars has remaining disks by counting these "red" stars (dust re-radiating the star's light in IR) in these clusters and the "blue" stars (which no longer re-radiate indicating that the disk has been used up). Finally, by comparing the age of the clusters and these fractions, we can determine that half the disks are gone by 3 million years and 90% are gone by 6 million years.

Observational challenges in determining the mass of the disk

If we look at our solar system as an example, there seem to be several ways to look at the question of how much mass is there in the disk. The first is the fraction of stellar mass vs. distance from the star. Another way that results in an interesting function is the surface density (g/cm^2) vs. distance (AU). However, it would be nice to investigate this in extrasolar planet systems. We can see many of these disks against the bright background of Orion, but the problem is that we cannot determine the mass just by seeing the "shadow" of the disk. Dr. Andrews showed us the example of projecting the shadow of his hand against the screen. We would like to see into the interior of these disks (think TSA looking "into" your clothes), not just see their shadow, in order to determine their mass. It is not difficult to find wavelengths at which the disk is bright and the star is dark. The problem is that earth based observations are limited by atmosphere transmissivity. In order to see into the interior of disks, the optimal wavelength is about 10μ but the atmosphere is opaque at that wavelength. A good compromise is using mm and sub-mm wavelengths. Even this, has its challenges. In order to optimize transmissivity, a high altitude and low moisture location is preferable (Boston is not a good location for this). Two optimal locations for this are Mauna Kea in Hawaii and the Chilean Andes, though there are a few sites in North America that are reasonably good.The second problem is the actual size of the disks as viewed from the Earth. A typical disk is at best 2-3 arc seconds across. In order to reach a resolution that provides useful data, a telescope on the order of 500m is required. Since a single dish of this size is not practical, the solution is to use interferometry.

Current observations with the SMA

Dr. Andrews has used the Submillimeter Array (SMA; http://www.cfa.harvard.edu/sma/) in Hawaii for his observations. This telescope array uses 8 6-meter dishes (built at Haystack) with a separation of up to 500m. Large radio telescope installations use interferometry to improve angular resolution while keeping the actual dish size reasonably small. The SMA is run by the Smithsonian Astrophysical Observatory. It is controlled out of offices in Cambridge, MA. It is capable of observing between 0.3mm and 1.7mm. It can produce images 3 arc seconds square with a resolution of 0.3 arc seconds. Observations made at 0.8mm show cold dust, with the brightness converting to mass observed. Dr. Andrews showed us many examples of planetary disks forming in much the same way ours did. Observations show that most planetary systems form in 2-3 million years. Dr. Andrews said more than once that he suspects there are planetary systems around *every* star.Since the disks and the planets interact, there are ways to see very young planets. As planets grow, they form a gap in the diskat about 1 million years that is observable. SMA is capable of observing signatures of planet-disk interactions. However, in order to get better data and see finer details, a larger array is needed.

ALMA, the next step

This is where Atacama Large Millimeter/submillimeter Array or ALMA comes in (links: http://www.almaobservatory.org/https://almascience.nrao.edu/about-alma/full-alma). When completed in 2013, ALMA will consist of an array of 66 12-m dishes, with baselines up to 16 km, and an additional compact array of 7-m and 12-m dishes to enhance ALMA's ability to image extended targets. ALMA is located in Chile. ALMA has state-of-the-art receivers that cover atmospheric windows from 3mm to 0.3mm. Construction of ALMA started in 2003 and will be completed in 2013. Science observations will start in the fall 2011 with 16 antennas and four receiver bands. Recent computer simulations have shown how important this facility will be in providing details on planet formation. This facility will provide 10X the resolution of the HST. It will be able to determine the period of planet years with data from just a few nights. Combining information from high-resolution observations at multiple wavelengths will greatly increase our understanding of the early stages of planet formation.

As a preview, Dr. Andrews showed images of LkCa 15 imaged by SMA and PdBl at 0.865mm and the Keck telescope at 0.0021mm where we can clearly make out the disk perturbed by a young planet and then showing the actual planet. The planet is comparable in luminosity to what we would expect from a 1 million year old Jupiter. This is where the science is going, imaging actual young planets, catching them in the act of growing and acquiring mass.

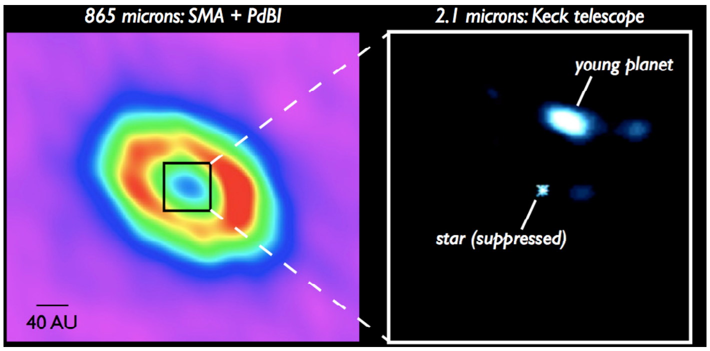


Image courtesy Dr. Sean Andrews

Questions:
What effect does the solar wind have? Very little, just skims a little off the top, not much effect on the disk itself.

What about debris fields orbiting old stars? Since there is no gas left, this is old dust result of objects colliding with each other. In this case it can be blown out by radiational pressure.

Is it possible to get a spectrum of the gas in the disk? Yes, but it is quite cold. Research is being done to look for molecular lines. Some interesting molecules have been detected including organic compounds. Much greater sensitivity is needed.

What about the VLA in New Mexico? It sees much the same kinds of things but its greatest resolution is in the 7-13mm band. It has had recent instrument upgrades that have greatly improved its performance. http://www.vla.nrao.edu/genpub/overview/

Why look for "red" stars for the surveys?Because, while the stars in a cluster emit similar bluish colors, those with disks absorb that light and re-radiate it in the infrared.

How far out can you observe? The math is interesting due to the shape of the spectrum. You can see back to 1/10th the age of the universe, farther than in infrared or visible. With enough resolution to resolve disks, you can see to 5-10 kiloparsecs. Remember, the disks have about 1% the mass of the star at 1 million years and when it is gone, the planets retain about 0.1% the mass of the star

What about binary star systems? It turns out this is not too disruptive to planet forming given that we see planets in such systems. Note: there can be one or two disks in this case.

What about angular momentum?Angular momentum goes into the planets, maintaining the balance.

What about planetary interactions (as might have happened in our solar system)? They happen generally in the late stages of planetary formation when most of the disk has been absorbed

What about the detectors? They are heterodyne super cooled to 4K, however the key tool is the computer correlator that multiplies and integrates the signals. While it is a single pixel detector, this computer has 10^6 power of a standard desktop computer

What's next after ALMA? The Square Kilometer Array (SKA) but construction is not slated to begin until 2019 and will operate at cm and longer wavelengths (3cm to 4.3m). The project plans to include about 3,000 15m dishes at a distance to span a radius of 3,000km. http://www.skatelescope.org/

How can amateurs participate? In the same way that www.galaxyzoo.org has asked regular people to classify galaxies imaged by the HST, the public is encouraged to search for transits in the Kepler data at http://www.planethunters.org/science#sorting . "People are better than algorithms!" Planet Hunters is part of the "Zooniverse" group of projects which can be found at http://www.zooniverse.org/

Links: Dr. Andrews Home Page and another interesting presentation on "The SMA Perspective on Planet-forming Disks around Young Stars" https://www.cfa.harvard.edu/~sandrews/ http://www.cfa.harvard.edu/sma/meetings/Advisory/2010/Presentations/Andrews/andrews.pdf

April ATMoB Business Meeting (9:09PM):

While the count was going on, there was a request by local students for assistance with memorabilia and personal accounts of the Moonwatch program. "We (Clare, Anh-Thu, and Laura) are a group of Harvard students in a history of science curation class working to put together an exhibit on amateur astronomy during the Cold War. The exhibit will be displayed at Harvard University's Science Center beginning May 1st through the summer, with the possibility of staying up through the fall semester. The exhibit focuses on the Moonwatch project to highlight the role of amateur scientists. We're currently in the process of collecting materials to display. We'd be interested in talking with any of you who might have relevant objects that we could borrow for the duration of the exhibit. Ideally, we'd include telescopes, manuals, binoculars, star maps, log books, training guides, and other items related to the practice of amateur astronomy from 1950 - 1965. All items would be displayed according to the practices of Harvard's Collection of Historical Scientific Instruments and loan agreements will be drawn up professionally by our museum registrar. Additionally, we'd be interested in capturing and conveying memories and stories of your experiences (through audio recordings) during this time period (especially with Moonwatch!). Please don't hesitate to get in touch with us if you have any questions.Clare Moran clmoran@fas.harvard.eduAnh-Thu Ngo ango@fas.harvard.edu Laura Neuhausneuhaus@fas.harvard.edu Sara J. Schechner, Ph.D. 617-496-9542 schechn@fas.harvard.eduhttp://www.fas.harvard.edu/~hsdept/chsi.html"

Bernie presented the Treasurer's Report.

Bruce Tinkler provided the Secretary's Report and announced the results of the vote for the Nominating Committee.

There was no Membership Report.

Steve Clougherty provided the Clubhouse Report. A significant amount of work was done on cutting the tops off trees surrounding the clubhouse. For the next work party on April 23rd, the trimming and heavy work will continue, including taking down the snow fence and preparing the lumber and hardware to start building the observatory for the C14. Prior to the work party, a meeting will be held to present and review the plans for the structure. The new grill might be inaugurated at this work party.

Bruce Berger and Glenn Chaple provided the Observing Committee Report. A preliminary version of the new award certificates was shown. Suggestions were provided concerning the tracking of certificate numbers and the inclusion of endorsements. We should be having our first presentations next month. Give an award a try!

Club Events & Announcements were presented by Bernie:

Feb 18-Jul 29	"Understanding the Universe - An Introduction To Astronomy" Clubhouse
Apr 23	April Clubhouse Work Party #4
Apr 26	Harvard Elementary School Star Party
Apr 28	New Member Orientation Night, ATMoB Clubhouse, Westford
May 1	Urban Astronomy in Cambridge, City Hall
May 6	Veritas Christian Academy
May 9	Lexington Public School Star Party –Rescheduled
May 12	An Astronomer Reads Thoreau – ATMoB Meeting, Phillips Auditorium
May 14	Astronomy Day, Clay Center Observatory, Brookline MA
May 21-26	AAS & AAVSO Joint Meeting

Other announcements:
Kelly Beatty provided more details on National Astronomy Day hosted by the Clay Center Observatory. He indicated how grateful the Observatory has been for past ATMoB participation and hoped we would come out in force for this year's event. There will be solar observing from 2pm until sunset (about 6pm). Evening sky observing will run from 7pm until 10pm. There will be preferential parking and meal passes available to volunteers. There IS power available for those who need it. This year we hope to have a couple of volunteers run a "Telescope Clinic" for the public to bring in their home telescopes for us to provide guidance and minor repairs and adjustment. Kelly asked if anyone had a telescope or night binoculars to donate that might be used for door prizes. He concluded by mentioning that his high school class had attended the lecture.

John Sheff made a personal call for volunteers for the Urban Astronomy night, May 1st, which will be part of the Cambridge Science Festival.

Ross Barros-Smith announced he is trying to determine which post offices process the newsletters the fastest with the least amount of damage. Please let him know of your newsletter postmark date/arrival date and if your newsletter was damaged in any way. Ross also announced the deadline for submitting articles for the May newsletter will be Sunday, April 24th at noon. Please let Ross know if you will miss that deadline .

Refreshments were provided by Bernie Volz.

The meeting adjourned 9:44pm.

~ Bruce Tinkler, Secretary ~

Photo by Al Takeda

Ken Launie discusses a 50's era instrument on display at the April meeting

Clubhouse Report . . .

Thursday mirror grinding, Friday night astronomy classes, and Saturday night observing continued, weather permitting. Mud season is still a concern, however the good earth beneath our feet has supported us well. The monthly full moon work party was held one week late due to the large number of members attending the Northeast Astronomy Forum. So the only projects tackled were those possible under cover from the full day of rain.

The day started with a meeting called by the exec board to review details of the home dome observatory construction plans. All the compromises made over the past years since the Telescope Advisory Committee recommended construction were reviewed. The basic plan seems sound but several details need to be worked out over the next month to allow materials to be purchased within the fiscal year. All activities are on hold pending review completion.

The options possible and our history with gas grills were discussed and we narrowed the suggested replacement list for our leaking, rusted, and dead grill. If you have an operating grill you are planning to replace this month, please consider donating it to the clubhouse. We start needing dogs and burgers at the May work session. Please contact Eric Johansson.

Replacement for the old window shade screen used for the astro classes was researched and several considered as replacements as the motor has died in ours. Should your office be considering a new projection screen, please consider donating your operating screen. You may contact Dave Prowten or Al Takeda.

A day was spent repairing the limb chipper unit and delivering it to the clubhouse to continue the cleanup of residue from last month's trim session to keep our observing field clear (B.Maerz).

The new telescope room tables were reassembled and leveled, scopes surveyed, and tools cataloged to allow a smooth start up for this room. Several tool sets are under consideration (D. Prowten).

The 20” dob telescope in the Knight observatory was inspected and users' experiences shared to evaluate the upgrade list (this group is led by D. Prowten).

The snow fence was removed and both plastic mesh fence roll and stakes stored in the barn attic for next winter's use (this effort was led by Bill Toomey and Eric Johannson).

Work continued placing archive material on the clubhouse computer (contact Ed Boynton & Anna Hillier). As the number of workers dwindled, the last project started was the machine shop. Led by John Maher, Nina C. and Barbara B. created two power boxes for use with their telescopes, providing both GFI protected AC outlets and converted 12vdc outlets. These compact devices are carried inside non-metalic boxes with handles that also carry extension cords.

Photo by Al Takeda

Dave Prowten assembling new tables in the telescope room

Our intrepid crew prepared the last spaghetti lunch of the winter Season Thanks to all those who shared their culinary skills to keep us from starving this rainy day.

The thanks for making these efforts possible go to the following members: John Blomquist, Ed Boynton, Barbara Bosworth, Paul Cicchetti, Steve Clougherty, Nina Craven, Anna Hillier, Eric Johansson, Dick Koolish, Brian Maerz, JohnMaher, Eileen Myers, Dave Prowten, John Reed, Art Swedlow, Al Takeda, Bill Toomey, Sai Vallabha, Vladimir Vudler. The exec board meeting was staffed by Bern Kosicki, Mike Hill, Chuck Evans, Steve Beckwith, with observing committee represented by Bruce Berger.

~ Clubhouse Committee Chairs ~
~ John Reed, Steve Clougherty and Dave Prowten ~

Clubhouse Saturday Schedule

May 21	Cichetti & Reed **Work Party**
May 28	Maerz & Panaswich
June 4	McDonagh & Wolf
June 11	Evans & Lumenello
June 18	Takeda & Prowten **Work Party**
June 25	Leacu & Rounsevill
July 2	Paquin & Small

Membership Report . . .

291 members as of April 30
329 at the same time last year

The Amateur Telescope Makers of Boston is a 501(c)3 charitable organization. Please consider making a tax deductible contribution to the club today.

I am available to answer all of your membership questions. Please feel free to contact me via email tom_mcdonagh@yahoo.com or phone 617-966-5221.

Please seek out and welcome our new and returning members:

John LoDico
Charles Summers
David Hill
Piyush Patel
Patricia Hart

~ Tom McDonagh, Membership Secretary~

Newsletter Mailing Feedback…

I have received a small number of complaints two months about newsletters arriving in a damaged/crinkled state. In response to this, I am trying to identify a local post office that handles these mailings in a consistently gentle and timely manner. Last month, the printed editions were dropped off in random handfuls at post offices in Acton, Concord, and Cambridge. I am attempting that again this month. If there is any problem with your delivery please drop me a note at newsletter@atmob.org with "Mail Feedback" in the subject line. Other comments are always welcome as well.

~ Ross Barros-Smith, Newsletter Editor ~

Sky Object of the Month…

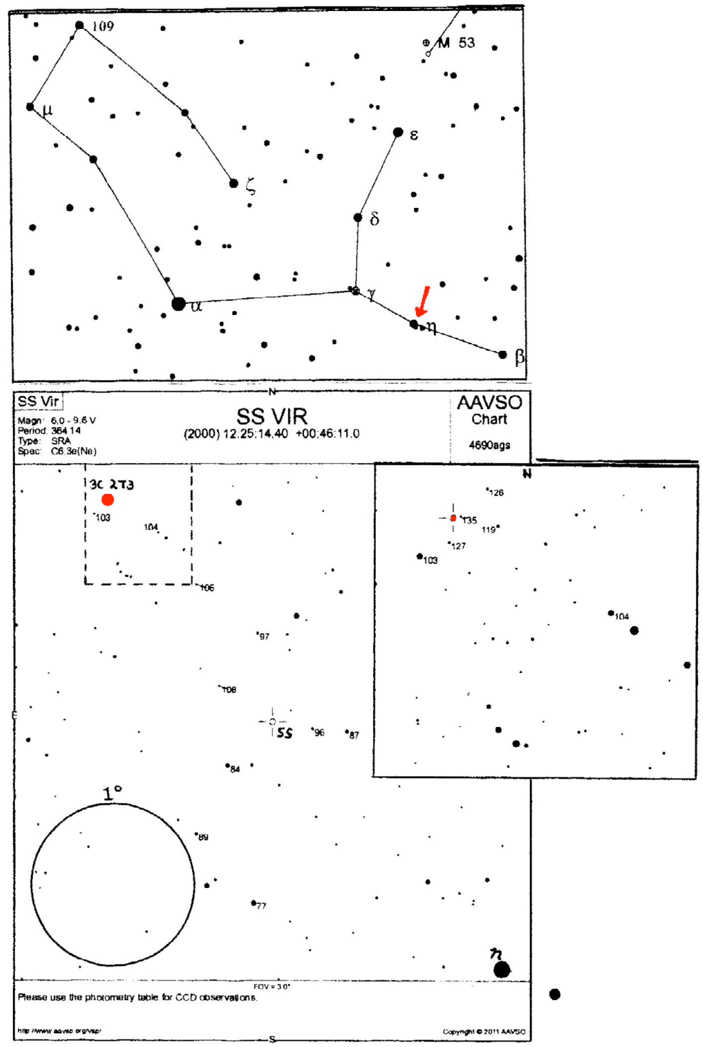
3C-273 – Quasar in Virgo

"How far can you see with that telescope?" It's a question I occasionally hear from visitors who peer into my telescope at public star parties. The farthest my telescopes have taken my eye, I tell them, is 2 billion light years - to the quasar 3C 273.

Visually, 3C 273 isn't much of a "wow" object. It appears as little more than a 13th magnitude star in the constellation Virgo. But what a "star" it is! Like all quasars, 2C 273 is the active core of a distant galaxy. There, a supermassive black hole swallows incredible amounts of gaseous material, in the process releasing as much light as 100 Milky Way Galaxies.

Your 2 billion light year journey to 3C 273 begins with the naked eye star eta (η) Virginis. The accompanying charts will enable you to star-hop from there to 3C 273. Along the way, you'll encounter SS Virginis, a carbon star noted for its rich red hue.

As you gaze at 3C 273, ponder this amazing fact. Those photons striking your retina began their journey earthward during the Precambrian Age when the dominant life forms on this planet were microscopic one-celled organisms. WOW!!!



(Top) Finder chart for3C 273
From Cartes du Ciel
(Bottom and inset) Detailed finder charts for 3C 273
Courtesy AAVSO (magnitudes of field stars shown, decimals omitted)

Images assembled by Glenn Chaple using images from Cartes de Ciel (top) and AAVSO (bottom)

Guide charts for finding 3C 273 (marked in red).

Your comments on this column are welcome. E-mail me at gchaple@hotmail.com

~ Glenn Chaple ~

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June *Star Fields* DEADLINE
Noon, Sunday, May 22nd
Email articles to the newsletter editor at newsletter@atmob.org
Articles from members are always welcome.

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POSTMASTER NOTE: First Class Postage

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OBSERVING AND PUBLIC OUTREACH

STAR PARTY COORDINATOR:
Virginia Renehan starparty@atmob.org

How to Find Us...
Web Page 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.
