Observer Staff
Editor & Publisher:
Richard DeMidio

The NHAS Observer and Diffraction-based Optics

Newsletter of the New Hampshire Astronomical Society

Vol. 2006 No. 8 | "All the news that fits in print" | August 2006

Stellafane

President's Message

At the time of this writing, I will be away helping to conduct the National Park Service's summer astronomy program at Bryce Canyon, Utah. I will try to have happy weather thoughts for those you back here while I enjoy the views from 8,000 feet in the crisp, dry Utah desert air ☺ And since I will be there all month, I leave you in the capable hands of **Paul Winalski** for this month's meeting.

✷ Matthew Marulla
NHAS President 2006

Highlights for this Month

July was **Stellafane** month. We have a few photos and brief reports to share. on page 5. We also feature this month another technical article by **John Bishop**, which can be viewed on page 2

✷ Rich DeMidio
NHAS Secretary 2006

Public Observing

We have had two great sky watches so far this month, on top of a well-attended CMP Monthly viewing. At the Madison Old Home Week, we had **Paul Winalski, Gardner Gerry, Mike O'Shaughnessy, Matt Amar, Joe Derek and Marc Stowbridge** handle the 100 or so visitors to the "Cars & Stars" event.

Photo by Gardner Gerry

We followed an exhibition of old cars, ensuring a great crowd of enthusiastic stargazers. The response from the Madison Community has been great! They really had a good time and were very thankful you made the drive. My wife is a Postmaster in town and heard lots of great comments from folks. The "official" tally was about 100.

Photo by Gardner Gerry

At Camp Berea, on Newfound Lake, the campers were shown the heavens by **Steve Forbes, John Bishop, Paul Winalski, Mike O'Shaunesy, Joe Derek, Matt Amar, Gardner Gerry, Chase McNiss** and **Jen & Marc Stowbridge**. Other than a very bright floodlight, we had a great clear sky, after some lingering clouds finally swept past. Lots of deep sky objects were on view for families with kids needing step stools to see, to teenagers with a growing appreciation for the size of the universe. A third sky watch is scheduled for August 24, at the Audubon Society, just up the road from Camp Berea. This will be a much smaller affair after a camp-fire (with "Some-Mores"!) and great, dark skies. The Center has been working with NASA to develop astronomical events and exhibits. The sky watch will be a part of that effort. Thanks again to everyone who participated in the sky watches!

✷ Marc Stowbridge

Editor's Note: ***Marsha McKay**, Head of Youth Services Goffstown Public Library sent the following to NHAS recently:* Hello Marc, Please forward my thanks and appreciation to all the astronomers that came to Goffstown for our Star Party. We have many wonderful comments from our families that participated in the event. I am still considering having another in late fall or winter, but will have to check the calendar first. Thanks so much!!

Stellafane

This annual event was once again well represented by NHAS members.

Photo by Joe Derek

NHAS had our typical area and members enjoyed the various scope displays, food, camaraderie, and the weather. This report continues on page 5)

Photo by John Newhall

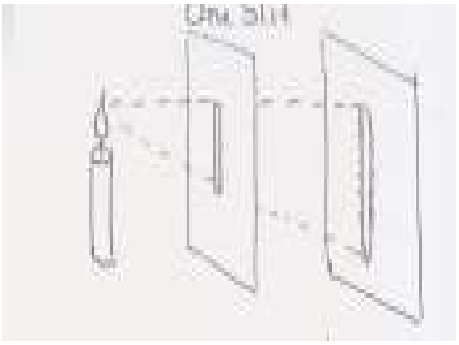
✷ Rich DeMidio

Diffraction-based optics

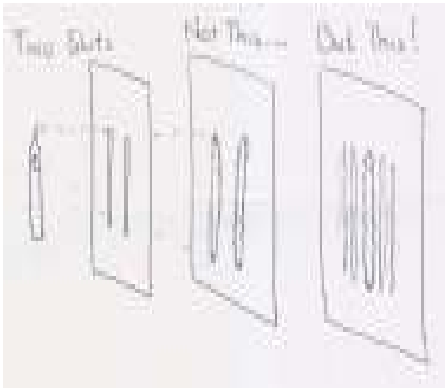
Most of us are familiar with 'diffraction' as a source of error in our optics. But diffraction isn't intrinsically bad, and there are some exciting new technologies that use diffraction to make images rather than degrade them.

Light acts in some ways like little particles (photons) and in some ways like waves. This isn't because light or physicists can't make up their minds, but because the phenomena of our macroscopic world don't map well to the actual behavior of the microscopic world. Light does what it does, and our math models that behavior. We can point to parts of the math that works like billiard balls and to parts that work like ocean waves, but there isn't anything in our world, which works the way light, does at the atomic scale.

In previous centuries the argument wasn't seen as a failure on our intuitions. Newton was sure that light was particles, and Huygens was sure it was a wave. There was evidence on both sides. Newton's crushing final argument was that we didn't see light diffusing around the edges of things, so it couldn't be a wave. Huygens topped this by using the double-slit experiment to show that light was indeed a wave, and that Newton's point only seemed true because the wavelengths involved were so short.

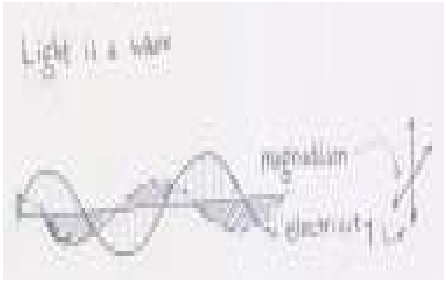


Most of you know about the double-slit experiment. Make one slit in an opaque screen and project light through it to a white screen behind. As most people expect, you see a bar of light. Now cover that slit and make another slit parallel and near to the first. Shine light through it and you get another bar. What happens if you then open both slits? To Newton, and probably to most of us, it would seem reasonable to expect that you'd see two bars of light next to each other.

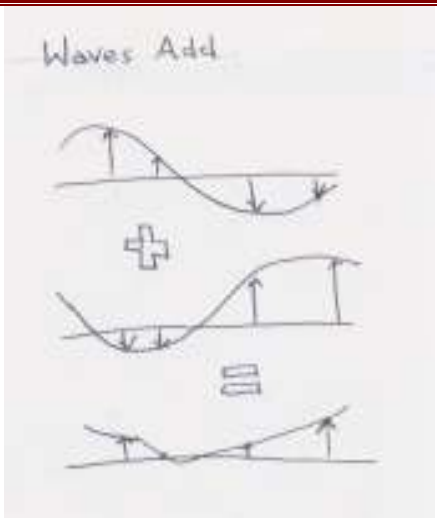


Unfortunately for intuition, that's not what you see; you see one bright bar in the middle, halfway between the positions of the separate bars. On either side of the bright bar are less-bright bars, and another fainter pair to either side of those. Fainter and fainter bars extend on either side.

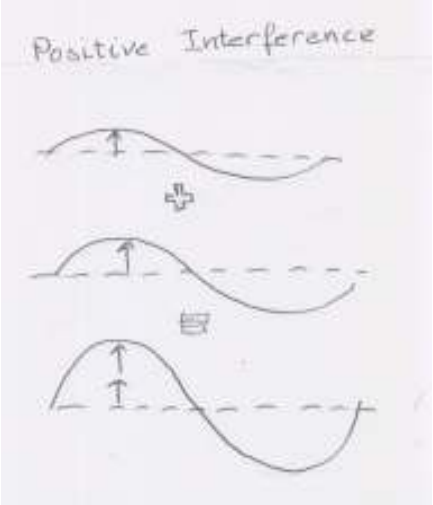
To understand what's happening, we need to know more about waves. Light isn't a wave in something (that was the "ether theory" of the 1910s). It's an alternation between a magnetic field and an electric field. As the magnetic field weakens to nothing, the change in the field creates an electric field. Then the electric field weakens and creates a magnetic field. Maxwell discovered this interaction, and noted that the resulting energy packet moved at a constant speed -- the speed of light.



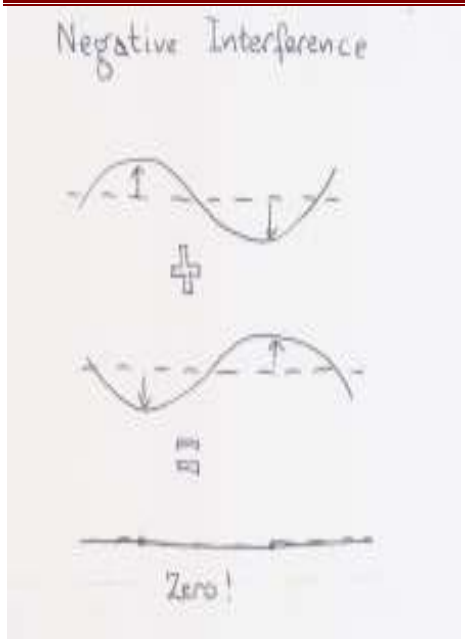
Waves have a wavelength, and amplitude, which is a measure of how "wide" the wave, is (or how strong the fields are in the case of light). Two waves interact at a point by adding their amplitudes at that point. The "phase" of a wave is where it is in its up or down wiggles at a given point in space.



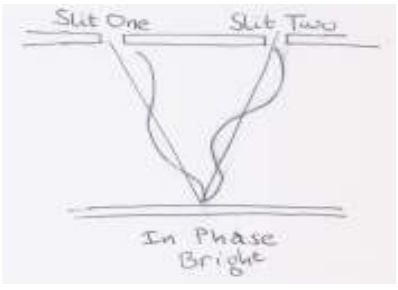
Consider two waves of identical wavelength, which are in phase, so that the "up" part of one is in the same place as the "up" part of another. The result is a single wave of twice the amplitude. This is "constructive" or "positive" interference.



On the other hand, if the waves are completely out of phase, so that the "up" of one is in the same place as the "down" of the other, they will add to zero--there will be no wave there. This is "destructive" or "negative" interference. The waves are still there, as you will see later.



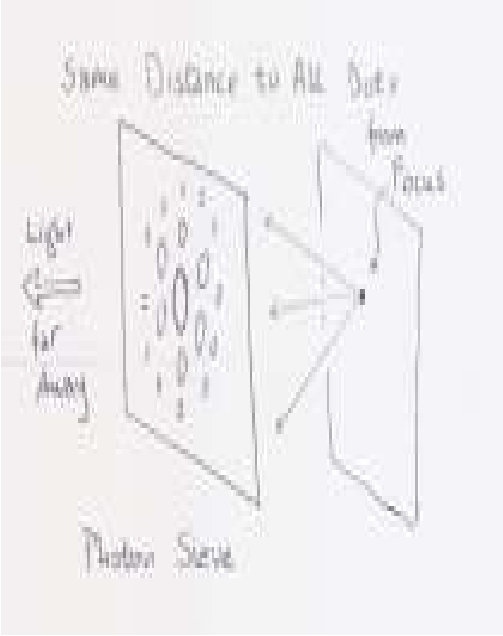
If the waves have different wavelengths, then sometimes they will be in phase and sometimes out of phase. The shape of their addition will be an alternation between constructive and destructive interference. This will look like a single wave of a much longer wavelength. This is the phenomenon which produces "beats" when two nearby notes are played. Note that the fact that part of the final wave has zero amplitude doesn't mean that the waves are gone. The two waves travel through the area of no apparent wave and don't vanish. How they "remember" that they are there when nothing detectable is present I don't know. This addition works with all waves--light waves and ocean waves both "interfere" in this additive fashion. Referring back to the two slits, the bright middle bar of light is equally far from both slits. In other words, it is the region of the white screen, which is the same number of wavelengths from the two slits. The waves from the slits thus arrive in phase, and they constructively interfere to make a bright bar.



A little bit to one side, the distance to the nearer slit is a bit shorter and the distance to the further one is a bit longer. At some point away from the middle, the two distances will differ by half a wavelength. At that point, the light from the two slits will be completely out of phase, and will destructively interfere: that region will be dark.

Further over, the difference in the distance will get larger. When it's a whole wavelength again, the light from the two slits will be in phase again, and you get another bright bar. It's possible to calculate the wavelength of light using this set-up: measure the distance between the slits, the distance to the screen and the distance between the middle of the bright bar and the middle of the dark bar next to it, and a simple calculation will give you wavelength. But I won't do that calculation here. There's another form of diffraction, which has an impact even on a single slit, but I'm not going to talk about that complication, either.

Instead, let's go back to the double-slit experiment and make the slits be circular holes instead. We'll start with one hole. The pattern of the light cast through it is a dot. Now add another hole just far enough away that light from the new hole will get to the center of the light dot on the white screen after traveling exactly one more wavelength. It'll interfere constructively with the light from the first hole, and you'll see a pattern of a bright dot surrounded by a dim ring, with dimmer rings around that, in a circular version of the double-slit pattern. Keep adding new holes just the right distance from all the previous holes so that the distance from the hole to the white screen is always a whole number of wavelengths different from the distance from the others holes. To prevent single-hole diffraction from being an issue, the holes will have to get smaller as you go out. The more holes you have, the brighter and smaller the central dot in the pattern gets, and the dimmer the surrounding rings become. You've created the diffraction-based analogue of a lens!



What you have built is a "photon sieve": an opaque plate filled with tiny holes in carefully chosen locations. Photon sieves aren't just theoretical constructs: they have been made and are in use in two areas that I know of. Metal photon sieves are used to focus x-rays, because no existing material will work as a lens for x-rays. Photon sieves are also used by some photography hobbyists because of the unusual effects they have when used as a kind of "fat" pinhole lens in a camera. They are made by photographing a large black-and-white pattern of dots from a distance on high-contrast film. The negative is a tiny image (black-and-white reversed) image of the pattern.

There's no reason diffraction-based optics couldn't be used in telescopes. We already make computer chips and CDs and DVDs, which have feature

sizes in the size range a visual-light photon-sieve would need to use. I've calculated that a 100-mm f/10 photon-sieve "lens" should be easy to make with current technology. Larger sizes are possible as well, though the focal length goes up faster than the aperture for a given technology of making the holes.

What would a photon-sieve telescope be like? To begin with, it would probably be cheaper as the "lens" element could be made by stamping a pattern on a piece of plastic. No tedious polishing or exotic glasses would be needed. I estimate the cost at only pennies per "lens"! Secondly, it wouldn't gather as much light as a glass lens of the same aperture. Photon sieves are only about twenty percent holes, and thus you'd need a bigger lens for dim objects. But a photon sieve would be a natural choice for a solar telescope, where light isn't the problem.

Thirdly, a photon sieve has a problem akin to chromatic aberration: different wavelengths of light will focus at different distances. Blue will focus closer to the sieve and red further away. There's no analogue to crown glass versus flint glass when making holes, so a conventional glass-correcting lens may be needed (though I don't know how bad the aberration actually is). But here again this isn't a problem for solar viewing -- we could put a H-alpha filter on top of the sieve to select H-alpha light, for example.

I therefore predict that the first widespread use of photon sieves in astronomy will be in disposable solar viewers.

I have made an actual photon-sieve telescope. I ordered two photon sieves from a photography specialty vendor. The bigger one was a 1 mm aperture "lens" with a focal length of 90 mm. I put this in a cardboard tube and used a conventional 25 mm eyepiece to view the image.

It works! At only 1mm aperture, the images are very dim, but I could see considerable detail on the Moon with this primitive 4x telescope. I hope one day to have a larger-aperture photon sieve (I'd love a 4-inch f/10!) so that I could make a real telescope with this fascinating new technology.

✷ John Bishop

Astro Photons

Gardner Gerry – Photo by Chase McNiss

Now that summer is winding down and busy schedules become normal, the group is looking into providing some training courses in the fall. Details will follow but the general plan is to have classes at YFOS with on the job training after each session.

✷ Gardner Gerry

Editor's Picks of the Month: The photo section of the website has seen much activity with the recent weather improvements. Here are few representing a variety of topics

This is a ToUCam II Pro shot of the large sunspot group that has just rounded the limb. It's a sight! Taken through an FSQ-106n with Extender Q 1000frames stacked.

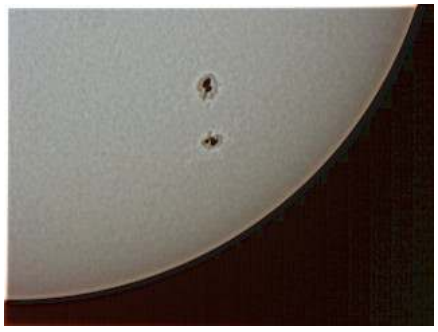


Photo by John Blackwell

After seeing John's shot, I thought I would give it a try. Nice day, but between the clouds and the surface wind, I had to work hard just to get this little bit.

347 - 640x480 frames stacked out of 1704 using Registax, 30 frames a second through 8" SCT @ f10 with the Philip's SPC 900NC Web Cam in B&W mode.

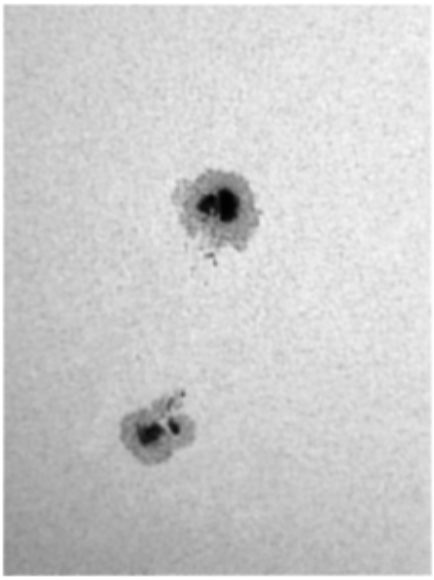


Photo by Chase McNiss

I didn't realize until after I started processing that this is M16 and I took 16 sub frames @300 sec each on the 16th of August. Kind of Ironic.

Photo by John Buonomo

M22, taken on 8/132 at YFOS

Photo by Herb Bubert

Radio Astronomy

Antenna by Bob Sletten

The next radio dish field trip has been identified. It is the New Boston tracking center and represents the last of the major dishes in our area that the group has targeted for a visit. The specific date has not yet been chosen but we are looking at a fall timeframe. As always, stay tuned to email correspondence for details as events unfold. The group is also discussing some specific projects that they wish to attack. Several donations by NHAS members have resulted in a pile of equipment that we are currently looking at for possible usage. As always, this group is open to everyone who enjoys this topic so read the forums for updates on happenings, or feel free to contact me directly with questions and comments.

✶ Bob Sletten

There is a new Radio Astronomy book coming out this month from the ARRL. You can pre order from the ARRL at http://www.arrl.org/ Information below.

✶ John Blackwell

==========quoted==========

Amateur Radio Astronomy
-- by John Fielding, ZS5JF
Explore the contributions of radio amateurs to the science of radio astronomy and how the average amateur can make and set up equipment to study the signals coming from space.

Contents:

Receiving radio signals from outer space. A historical perspective of radio astronomy needed to become active Parameters required for the antenna and receiver through practical low noise amplifiers. Advice on assembling a receiving station and practical information to put together your own A practical design for a "hydrogen line receiver" aimed at at 1420 MHz The author has achieved a great balance between historical narrative and technical information. Amateur Radio Astronomy is not only "a great read" but a practical reference for this fascinating topic.

320 pages. © 2006. Published by Radio Society of Great Britain (RSGB). (ISBN: 1-905086-16-4) #9928 -- $32.95

Membership

*Editor's Note: This month, NHAS welcomes **Alan Shirey** as the new membership chairperson.*

NHAS has two new members since last month's newsletter. **Mark Dwyer** from Merrimack and **Gary Doody** from Goffstown.

Bob Sletten has been the membership chair since before I joined in 2000, and would probably still be doing it had Radio Astronomy not captured his interest. (Great talks and tours!) As new Membership Chair, I hope to continue with several of Bob's initiatives in my formative months.

I have determined that my primary goal in Membership is to quickly integrate new members into NHAS. We have a lot to offer our new members in the way of guidance, knowledge and sharing our passion for astronomy. NHAS, in turn, can benefit from the skills, ideas and time that are available from these new members. In short, we will all benefit if we can get our new members participating in club observing, and special interest activities quickly.

I am also considering ways to engage existing members. NHAS, like all volunteer organizations, need member participation to thrive. If anyone has any suggestions, please forward to me via the membership email.

✶ Alan Shirey

Deep Sky Object of the Month

Observer: Lew Gramer
Your skills: Intermediate
Date and UT of Observation: 1997-06-7/8, 07:00 UT
Location: Rumney, NH, USA (43N)
Site classification: rural
Limiting magnitude: 7.2 (zenith)
Seeing: 3 of 10 - pretty good (but hazy)
Moon up: no
Instrument: 20" f/5 truss dobsonian reflector
Magnification: 70x, 210x, 420x, 640x
Filters used: None, UHC
Object: ngc 7048
Category: Planetary nebula [3b]
Constellation: Cyg
Data: mag 11.3 size 60"x50"
RA/DE: 21h14m +46o17m
Description:
This funny-shaped animal is lost in smaller instruments or worse skies, amid a magnificent field of Milky Way stars.
At 70x and 210x with no filter, the quirky 7048 was easily visible as an irregular, filled haze, casually appearing to touch a nearby (unrelated) star.
Jumping to 420x, the hazepatch actually seemed LESS irregular, as a bland disk with clear separation from the nearby yellowish star to S.
With averted vision at 420x and especially 640x, the flat disk suddenly began to show a hint of annularity (which a later check of CCD images on the net confirmed), appearing somewhat irregular toward the center.
Along the outer edge was a slight "lobe" of nebulosity to the N. Surprisingly, using UHC didn't enhance the view, although it did increase the impression of a ring slightly by darkening the center.
Worth a look if you're sweeping Cygnus' summer planetaries!

✶ Lew Gramer

Stellafane (Con't)

For the benefit of our new members, this event is the highlight of the year for Amateur Telescope makers around the world. It's roots are well established and dates back to the early 20th century.

Since I have been a member, this event has always had a large participation from NHAS. In fact, several NHAS members over the years have received awards for showing their capabilities when it comes to designing and constructing telescopes.

Photo by Chase McNiss

As an example, the above picture depicts one of the scopes built by NHAS member **Joe Derek**, which won an award at last year's event. The creativity and imagination is endless as you walk around viewing the various entries. Our current NHAS president **Matthew Marulla** has also performed as one of the judges for many years. The major focus for this event are the telescope making activities, but there are a few sky watches, weather permitting. Many people also provide lectures and briefings in many areas of Astronomy. I have included a few reports written by some NHAS folks who attended. I suppose that one of these years that I should attend ☺ More information regarding this event may be found at http://www.stellafane.com/

✶ Rich DeMidio

Photo by Joe Derek

The Friday morning radar is good up to a point as wind direction is certainly subject to change. Much of the weather missed Springfield and I was able to set up my tent in dryness. The concession food was very Good Friday night.

Photo by Joe Derek

For the Stellafane suggestion box: when you say Friday night talks are limited to ten minutes, you should mean it. Some people rambled on for half an hour. I thought the best talks were the last two.
True to your old saying, Bert, the evening "torrential downpours were followed by miraculous clearing" (actually it was just one late afternoon downpour) -- some of the best, most transparent sky I'd ever seen in all my years of attending this convention after the Friday night talks.

Photo by Joe Derek

The North American Nebula was easily visible with unaided eyes and so was the nebulosity by the Pelican. The only downside is that I was too tired to observe after 1:30am. Get well rested before the convention and don't do major projects prior to Stellafane that might tire you out. There was an unbelievable binocular chair up on the hill for the competition Saturday morning. It won three well-deserved awards. The NHAS lunch was very good.

Photo by Joe Derek

A great talk about Leslie Peltier by a fellow that used to mow his lawn! There was another excellent talk by Alvin Clark collector John Briggs. Chicken barbecue was cooked just right this year. There was a very nice tribute to Sue Rugelis (Sue's Road). For once, I enjoyed Davy Levy's Shadowgram. Trudy Bell's talk was a winner, but Q&A was grand-standed by a guy - the moderator should have stepped in.

The new Pavilion is enormous - they really thought about what they wanted and it worked very well.

✶ Marion Hochuli

We got up at 5AM on Friday, got out at 6:05AM and got on the line at something like 8 or 8:30 AM. It was hot and humid and cloudy most of the day.

Photo by Joe Derek

And then a miracle happened it cleared up and it was really nice. Saturday was ok, Saturday night wasn't so good.

Photo by Joe Derek

Nice new building for the talks that was great. They moved us there Saturday night because there were reports of tornados in NY.

✶ Larry Lopez

The Bottom Line

Starting Balance	$3671.12 (checking acct)
Deposits/Credits	$262.50 (membership, moose lodge)
A/P	$1267.42 (Insurance, propane, Brian Marsden, Moose Lodge)
Net Acct Balance	$2599.28
Cash Balance	Petty cash drawer (195.25) $2794.53
Membership	133
New members	Mark Dwyer
Donations	None

✷ Chase McNiss

Looking Back at Last Month

Opening Matthew Marulla ran an abbreviated business session saving time for the evening presentation.

Scope of the Month **None**.

Public Observing. Paul Winalski reported that the Goffstown sky watch went over very well this past Wednesday. About 100 people attended with about a dozen scopes provided by NHAS. They also did see an Iridium flare and a bright satellite. Next observing event is in Madison on the club calendar.

Book of the Month, **None**

Committees. Photo Club **Gardner Gerry** reported that the group is having discussions on some training courses in the fall. Web: **Matt Marulla** reported about an inquiry and follow-up discussion regarding RSS feeds to the website. Decided that this would be a good thing and that Matt would investigate. ATMs: **Larry Lopez** reporting that we have some active members in telescope making, but no projects going on. If anyone needs help, throw out the issue and folks will help. Inventory is in progress of what they have.

YFOS **Larry Lopez** reported that the lawn has been mowed and that the site is level now. There has been three trips so far for mowing, Larry is looking for help to get mowing done. Battery died on Mosquito Magnet. The magnet itself is fine except it ran out of propane. If the propane runs out, it kills the battery trying to restart. Probably why the battery died. Matt also reported the cleansing of five hornet nests from the observatory. Membership: **Alan Shirey** reported that we have two members this past month. His main focus will be getting new members acquainted with the club. Current membership is at 132 members

Miscellaneous. **Joel Harris** reported that this is the last meeting prior to Stellafane. Joel is the official coordinator. Handouts from their website were provided. Stellafane is the pilgrimage for the ATM folks with many talks by both professional and amateurs. Swap table is the big event so make sure you get there before Larry ☺ NHAS place is just below the new observatory. Several B&B are within ten miles, which is a good place to stay. Charge is $30.00 at the gate. **Matthew Marulla** and **Rich DeMidio** provided slide shows of the recent Dummer, NH trip. Rich also showed some creative work done during our bad batch of weather involving nature photography utilizing Registax. **Matthew Marulla** explained the status of the proposed amendment to constitution involving electronic voting. A majority vote must occur so the vote must be by paper. We have yet to reach the quorum because membership keeps increasing. Looks like at the October meeting, we will have zero members so whoever is there will represent the majority.

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Evening Program. **Matthew Marulla** "How a black hole can kill you" Based on a talk that Matt saw last year at the high-energy physics conference.

✷ Rich DeMidio

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Write to us:
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Manchester, NH 03108-5823
Attn: Treasurer

Send E-mail to:
info@nhastro.com

Use our web site:
http://www.nhastro.com/

This month's contributors:
Mathew Marulla, Chase McNiss, Bob Sletten, Lew Gramer, Gardner Gerry, Rich DeMidio, Paul Winalski, Matt Amar, Joe Derek, John Buonomo, Herb Bubert, John Newhall, John Bishop, Marion Hochuli

2006 Officers
President: Mathew Marulla
Vice President: John Bishop
Treasurer: Chase McNiss
Secretary: Richard DeMidio

New Hampshire Astronomical Society
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Manchester, NH 03108-5823

NHAS Upcoming Events

Aug 18 – Spitzer Technology Work

Event	Date	Time	Location
Business Meeting	Aug 18	7:00 pm	CMP
Coffee House	Aug 25	Dusk	YFOS
CMP Skywatch	Sep 1	Dusk	CMP
Business Meeting	Sep 15	7:30 pm	St. Anselms College
Coffee House	Sep 22	Dusk	YFOS
CMP Skywatch	Oct 6	Dusk	CMP
Business Meeting	Oct 20	7:30 pm	CMP
Coffee House	Oct 27	Dusk	YFOS