THE SPECTRUM

Newsletter of the Buffalo Astronomical Association Inc.

Published Bi-Monthly *Buffalo, New York* **Apr 2000**

MEETINGS NOTICE — FRIDAY: APR 14

Apr 14th: "UFOs—a serious look" - Robert Galganski presents the evidence and findings on UFOs. He'll detail natural things that may look like a UFO and others that have no explanation. You be the judge!

Meetings: 2nd Fridays @ 7:30 PM Sep-June.
Location: New Science Building Auditorium at Buffalo State College on Elmwood Ave.

We hope to see you at these meetings.
As usual refreshments will follow.

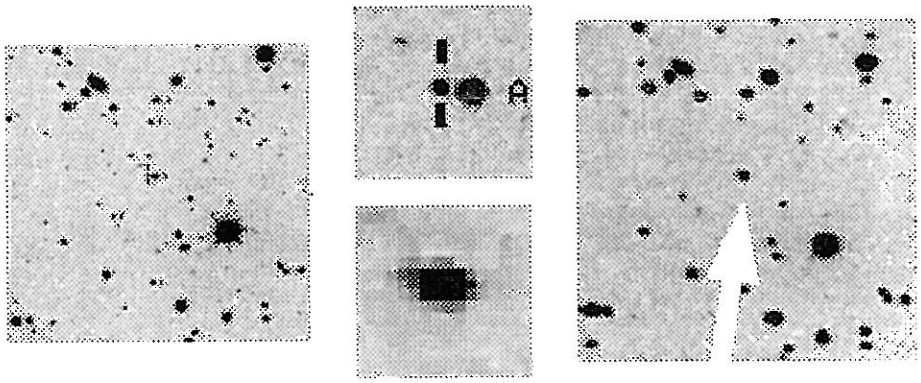
Bring a friend and see what's poppin!

BAA OBSERVATORY TEAM PICKS UP A GAMMA RAY BURSTER!

Headline NASA SCIENCE NEWS

This article is about a most unusual observation made at the Beaver Meadow Observatory in the early morning hours of March 4th, 2000, by four members of the club including; **Frank Chalupka, Dennis Hohman, Tom Bakowski**, and myself, **Bill Aquino**. Most of the text in this article is taken from a series of 18 messages which I posted to the club's e-group (Internet message board) a few days after the observation was made and also from a NASA "Space Science News" online article written by Dr. Tony Phillips. The NASA online article can be viewed at:

http://www.earthsciencenews.com/headlines/y2000/ast14mar_2m.htm



Left and small top photo taken by US Naval Observatory 1m telescope in Flagstaff, AZ; others by the BAA GRB team; each pair is at the same scale. The oval appearance in the BAA zoomed image indicates that there is more than 1 object present. That this could be taken at all with the 12" shows the dedication of these members. The GRB optical image is over 200x fainter than can be seen visually through the 12". BRAVO!!

The unusual object we observed is known as a Gamma-Ray Burst Optical Transient. Which often is referred to as an "Afterglow" and is the faint optical counterpart of a distant gamma-ray burst. These bursts are thought to be titanic explosions from the distant past which cause short but intense amounts of gamma radiation to eventually reach and sweep past the Earth. The gamma radiation does not penetrate the Earth's atmosphere but is instead detected by satellites and interplanetary probes, many of which have been outfitted in recent years with gamma detectors. If enough spacecraft detect the burst it can sometimes be localized to a reasonably small area of the sky. Although spacecraft have been detecting gamma-ray bursts since about the mid 1960's it is only as recently as 1997 when the very first optical afterglow was discovered

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MEETINGS CANCELLATION POLICY

If, for any reason, (most likely snow or ice storms), there might be cause for cancellation of the meetings of the BAA, tune your radio to either WBEN (930) or WGR (550). Also if Buffalo State College has been closed due to inclement weather, so will the meeting of the BAA be cancelled.

BEAVER MEADOW TELEPHONE

The telephone at Beaver Meadow, 716-457-3104, is for emergency use only at no cost. Local calls may be placed for a small charge - see the collection box by the phone. This phone cannot make long distance calls.

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by the Hubble Space Telescope. Since then, the pursuit of afterglows has been a major effort of professional astronomers worldwide using every size telescope and array in their arsenal.

The afterglows have proven to be very difficult objects to observe and only about a dozen or so have been detected and studied. The bursts are isometric, meaning they come at random from completely random areas of the sky. Although on average about a burst per day is detected by our spacecraft, few of them lead us to an afterglow. Whenever a burst is detected astronomers try to localize its position as quickly as possible to within about a square degree. This is done using two or more spacecraft.

Only after a burst is localized can an attempt be made to search for an afterglow and unfortunately only a few of these searches prove to be fruitful.

The basic behavior of an afterglow has been pieced together from studying the few which have been discovered to date. Typically, when an afterglow does occur it can become reasonably bright within the first few minutes after the gamma-ray burst is detected but then fades very quickly (in at least one case, the afterglow reached a magnitude of 8.9 then quickly faded to magnitude 14.0 within about 10 minutes). It is often completely undetectable, even by the Hubble Space Telescope, within less than a week's time and is considered out of range of amateur equipment within 12 to 24 hours. This is not always the case however; the afterglow detected at Beaver Meadow Observatory was around 72 hours old, which illustrates how poorly we currently understand this phenomenon and why many more observations are required before a solid model of their behavior can be constructed. The biggest problem facing professional astronomers today is finding out exactly how these objects behave in the first 24 hours. Almost NO data is available for this portion of an afterglow's light curve.

PRO-AMATEUR COLLABORATION

There are two main reasons for the lapse in data. The first being that our current spacecraft usually require around twenty-four hours or more to localize a burst, and secondly, several more hours are needed by most professionals to mount the correct cameras on their telescopes, calibrate their systems, and then slew over to the localization and begin searching. A new spacecraft, the HETE II, will be launched in May of this year and is specifically designed to provide localization within minutes of the burst's detection. The only other requirement for finding the missing data would then be an array of telescopes around the globe, which are ready-to-go at a moment's notice and capable of making the measurements. That's where amateur astronomers step into the picture and why the four of us were out at the Beaver Meadow Observatory on that cold night.

During the autumn of 1999 the AAVSO (American Association of Variable Star Observers) was invited to participate in a program to search for and monitor the early phases of gamma-ray burst afterglows. This invitation came from a team of professional astronomers specializing in GRBs at the NASA/Marshall Space Flight Center in Huntsville, Alabama. The AAVSO began recruiting amateurs for the program and we decided to join. We planned to use the CCD imaging system at BMO if we could prove the system and ourselves were capable of doing this kind of demanding observing. Our test came sooner than we thought. We received an e-mail message on the afternoon of March 3rd which indicated another afterglow had been detected by professionals and strangely enough, was hovering, just at the upper limits of the BMO system (around 20th to 21st magnitude) instead of fading very rapidly as expected. The weather service was calling for clear skies that night so we agreed to meet at the observatory after work and put both ourselves as well as the BMO imaging system to the test.

FINDING THE INVISIBLE QUARRY

The afterglow did not get up over our northeast tree-line until around 12:30 so we spent the first half of the night discussing our plans, doing some general observing and taking a CCD image of Hubble's Variable Nebula. At around 12:30 or so we started to work on the afterglow. The telescope only has RA and DEC setting wheels so we have to use an "offset" from a nearby bright star. I think we used Zeta Hercules that night and focused our system on it. We were ready to go, but now faced our first and biggest challenge, putting the target on the CCD chip. The field of view for the BMO CCD system is a mere 8 x 12 arc-minutes. We have tried every technique we could think of over the past two years for finding targets but often with limited success, especially on dim objects in obscure fields. We had made three unsuccessful attempts to image comet C1999S4 in January and February, each time not being able to find it at magnitude 13. Obviously we could not use any of our "half-successful" normal techniques for finding a target if we hoped to find the afterglow. Frank had developed a new technique after our frustrations with the comet but it was largely untested. We were only going to get one shot at this observation, the Sun was rising in about 6 hours and the afterglow would certainly be too faint by the next night even if it was somehow clear. Clouds were supposed to roll in some time late that night, so we decided to try Frank's idea and it worked surprisingly well. Within a reasonable time we had the spot in the sky, where the afterglow had been detected (about 72 hours earlier by NASA satellites) centered on the CCD chip. Of course the field was nearly blank in the cameras finding mode.

We were in an area of dim stars and so decided to start probing with 5-minute exposures. We expected to increase the exposure time to around 10 minutes after we

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SPECTRUM DEADLINE

The deadline for the **May-June** issue is

Apr 14th.

Send all submissions to Tim McIntyre
135 Fairvale Dr. Cheektowaga, NY 14225

phone 632-3172 TMcint9320@aol.com
Preferred format is typed or PC readable MS Word or WordPerfect.

- scanning available --
Any format okay -- we really like submissions!

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felt things out. After four or five of the 5-minute exposures were taken we stacked them up and displayed the combined image on our monitor. We made a harsh discovery, the afterglow was there (barely) but significantly merged with a nearby (bright) 18th magnitude star. The seeing was only mediocre that night and we have to hand-guide the telescope, which has an attached 4" refractor for this purpose. If we increased the length of the exposures it might cause the merging to worsen, but if we shortened them we might not collect enough photons. We finally decided to stick with the 5-minute exposures, at least they were accomplishing something, we would just have to do the best we could with the image processing software later. We ended up imaging the afterglow for the next two hours running the camera the whole time in the manual mode, checking each 5-minute exposure we took and doing an occasional dark frame in between several integration's. A total of 12 separate exposures were taken with one being streaked pretty badly, this gave us 11 usable integrations for a total combined exposure time of 55 minutes. Flats and darks-for-flats were done after the 12th exposure was completed in order to later create a calibrated image suitable for astrometric and photometric measurement.

The image processing turned out to be much more difficult than we anticipated. We even found out after the fact that the software we were using had a bug in the averaging algorithm. Thankfully, the professional astronomer (from the US Naval Observatory, Flagstaff) who first alerted us to the afterglow also offered to help reduce the data for us. He did an excellent job and managed to bring out a lot more detail and clarity than we could ever have hoped too. We are very grateful for his efforts. His final analysis of the club's data placed the depth of the total exposure at just about 21st magnitude and the brightness of the afterglow at R=20.15 +/- 0.3 on 000304.327 UT. This is very close to the value professional astronomers were getting at their own observatories at the same time. It is really amazing that something so faint can be accurately measured with such a basic and relatively small aperture system.

A JOB WELL DONE

As some final thoughts, I would like to say that the Beaver Meadow Observatory image demonstrates that amateur astronomers using modest equipment and working closely with professionals can make accurate measurements of afterglows, and may indeed be able to "fill-in" the missing parts of the afterglow light-curve. The next few years will tell for sure. Also, the BMO imaging system underwent a most demanding test of its capabilities and passed. These are things the entire club should be proud of, especially the members who built the telescope so long ago.

— Bill Aquino

A note about Frank's technique

The field-of-view for the BMO system is rather limited at about 8 x 12 arc-minutes. This makes identifying where you are in an obscure field very difficult, regardless of how long an exposure you take. To compensate for this shortcoming we first "offset" from Zeta Hercules landing somewhere near the target. We then created a mosaic (or panoramic) out of four short exposures which was spliced together in a hurry and displayed on the monitor (this gave us a field-of-view of about 16 x 24 arc-minutes, almost doubling the effective size of the CCD chip). We compared this large image to a Digital Sky Survey printout of the area until we could identify where we were, which turned out to be about 25 arc-minutes away from the afterglow. The telescope's paddle control was then used to slide over to the target and place the afterglow on the center of the chip.

MEMBERSHIP CORNER — Tristan DiLapo

Just a short note this month. I'd like to thank those who have renewed their membership in the BAA and I would urge you all to make the most of your memberships. Please join us at one of our monthly meetings, attend one/some/all of our star parties this summer or attend a public event at our observatory. If you have any questions about what goes on at these events, give me a call at 941-5613 evenings.

MEMBERSHIP DIRECTORY

The membership directory is being extensively revised by Alan Friedman for distribution in May.

We need any change of information!

E-mail addresses are being added so please check last year's listing and advise him of any changes. Alan can be reached at 881-4310 and alanFGAG@aol.com.

OBSERVATORY VOLUNTEERS

Mark Swiderski is lining up help for the public season. You don't need to be an expert! You'll have a lot of fun and learn a lot too. Typically there is a cookout before the public arrives. For more info call Mark, 731-9366 or at mswiderski@email.msn.com.

SPECTRUM CHANGES

New Editor:

Tim McIntyre will take over starting with the next issue (May—June). Send all submissions to Tim McIntyre

135 Fairvale Dr. Cheektowaga, NY 14225
phone 632-3172 TMcint9320@aol.com
Preferred format is typed or PC readable
MS Word or WordPerfect.
- scanning available --
Any format okay -- we really like submissions!

Outgoing editor:

Thanks go to Mark Reville for his work on the Spectrum during his tenure.

Old submissions:

Note!!

If you haven't seen your submission in the SPECTRUM **please resubmit** to Tim McIntyre. Some were lost. They will be given top priority! There is NO BACKLOG of articles at present.

- Bill Smith (interim editor)

 Our Milky Way and the Andromeda galaxy are approaching each other at a quarter of a million miles per hour. It looks like in 6 billion years the galaxies may collide although the stars will not -- too much space between them. Large gas clouds will collide triggering bursts of star formation.

BAA ANNALS

Rowland A. Rupp

5 YEARS AGO - We held our annual dinner meeting in March 1995 at Ilio Dipalo's restaurant where **Jack Mack** spoke on the updates and improvements made on the Hubble telescope. At our April meeting, new member **Richard Jones** told us about the astronomical observatories he had visited while living in Tucson, Arizona. A computer buff, Richard had just reached agreement with the BAA whereby he would establish a WNY Space Forum on Buffalo Free-Net.

Dan Marcus, our Observatory Director, reported that the 12- inch telescope would be out of service while **Martin Price** reworked the polar clutch, worm gear and the tangent arm assemblies, making the telescope more serviceable for CCD astronomy. CCD classes were scheduled for February and March.

Steve Kramer's conclusion of his three-part article on David Rittenhouse and his orreries appeared in the SPECTRUM. Also appearing was "A Cruise Down the Milky Way", the title of **Bill Smith's** description of the sights to be seen in the skies of the coming summer.

10 YEARS AGO - "Analemmas" was the topic presented by BAA member **Dave Quagliana** at our meeting in March 1995. In April **Fred Price** spoke on "The History of the World Greenwich Observatory". President **Doris Koestler** thanked **Bruce Newman** for donating Messier and meteor shower charts to the club. She also noted dues were to increase to $15 for an individual membership, $20 for a family.

The second installment of **Ken Biggie's** article on the 1975 construction of Beaver Meadow Observatory appeared in the SPECTRUM. **Ed Lindberg's** "Instrument Notes" was always entertaining; Ed had a good knack with words. This time he reported on some of the experiences he had while teaching courses on telescope building, mostly held at the Buffalo Museum of Science, when amateur mirror grinding was much more popular than it is today. **Jack Empson** announced that we now had a place on the museum's bulletin board, Taxacom.

The death notice of **Hugh Pettit**, an active observer in the BAA, who frequently donated his time and the use of his telescopes for public events, appeared in this SPECTRUM.

15 YEARS AGO - Fifteen years ago in March a member of two years standing, **Dan Marcus**, spoke on "Astrophotography Geared Simply Towards Halley's Comet". Dan was already known for having his astrophotos in The Buffalo News and Astronomy magazine. Rochester's **Richard Karlson** spoke in April on "All About Eyepieces". A note from Observatory Director **John Riggs** reported that approximately 2750 members and general public showed up at BMO over the last 3 1/2 years, while we hosted 14 Boy Scout, school and other groups. A long list of accomplishments and contributions made by members that enhanced the observatory was also given. We were to be hosts to an NFCAAA meeting scheduled at Buffalo State on May 11. **Ed Lindberg** was in charge.

Edith Geiger wrote a profile of **Jerry and Adrienne Morris** for the SPECTRUM. Jerry and Adrienne contributed an article citing the mathematics of limiting magnitude for a telescope of a given aperture. **Ken Biggie's** first of a two-part article on the peculiar object SS-433 appeared as well, as did observation reports by **Carl Milazzo** and **Michael Idem**.

We had lots of bad news: the deaths of **Bob Burdick** and **Lorne Moore** were reported. Bob had been in poor health for a long time, but Lorne suffered a heart attack shoveling snow during the blizzard of 1985. Also, **Walt Whyman** suffered a stroke that left him permanently disabled.

25 YEARS AGO - **Dr. Seville Chapman**, a member of the BAA, was to speak in March 1975, although his topic was not yet known. For April we heard from **Dr. Frank Bajer** on "Lasers, the New Technology". Dr. Bajer held a PhD in chemistry and was on the staff of the Museum of Science. A beginners course entitled "Wonders of the Sky" was scheduled for the coming summer. John Riggs was to conduct it, with the help of other BAA members, in the Fred T. Hall building at Beaver Meadow.

Ernst Both contributed an article on lunar terrain that provoked the concept "Of Moon Cities and Selenites". The BAA sponsored a photo contest for pictures by members depicting this lunar metropolis. Do you remember that a total lunar eclipse occurred on the night of May 24/25, 1975?

35 YEARS AGO - **Norman Vester's** March 1965 talk was entitled "Certain Aspects of the New Cosmology and Their Possible Effects in a Rapidly Changing Society" Wow!. We were scheduled to hold our annual business meeting in April, when amendments to the bylaws were to be proposed. This meeting was supplemented by **Harold Becker's** talk on "Astronomical Photography Techniques".

A biography of **Ernst Both**, written by Edith Geiger, was featured in the March SPECTRUM. Ernst was the museum's Curator of Astronomy at the time. An unsigned article on Mars appeared in April. Amazing how little we knew of our neighbor just thirty-five years ago.

LOOKING FOR CONTRIBUTIONS!

articles	observations
artwork	photographs
book reviews	quotes
CCD images	***plus***
comics	comments
equipment reviews	suggestions
for sale items	

Announcements, special events & volunteer opportunities!

STAR PARTIES

It's time to book

your summer star party!

A great club get-together. Hold one at your home, Beaver Meadow Observatory or even a friend's home in a dark location who will be going away that weekend (tell them later). Usually held on a Saturday night, but that's not a rule.

The only rules are:

1. Do not hold them on public event nights (1st & 3rd Saturdays).
2. Have a great time and share your toys.

To arrange one and reserve a date call Dan Marcus, 773-5015.

Thanks to:

- **Pete Proux** has donated a refurbished Pentium II computer system to the observatory for use in the telescope room to replace our aged 386, which is on its last leg. This is a significant contribution and he put a lot of effort.
- **Alan Freidman** has created a new public night brochure and membership application for use at the observatory and they are really nice. He also put a lot of effort into this and it shows.
- **Dennis Hohman** has organized the club's e-groups site for intraclub communication. (see related article)
- **Bud and Ella Abate, Bev Orzechowski** and other (unknown to the editor) helper bees who put together this year's dinner meeting and donated raffle prizes.

Don't let us forget anyone! The BAA wants to thank **all** our volunteers, so if you know of anyone whose praises are unsung, let the SPECTRUM editors know. We can only print who we're informed about.

MEMBERSHIP SERVICES

To renew, join, or for address changes or questions call or write:

Tristan Dilapo, 8715 Cole Rd. Colden, NY 14033
(716) 941-5613

Publicity please

Whenever members have items published; shown on local media or have given a talk don't forget to get the BAA mentioned so that folks have a reference to come back to.

BAA e-mail site

An email group for communications within the BAA membership and friends. This was developed by Dennis Hohman and is restriction by invitation only (BAA members). Available services include e-mail to the whole group or any member; review the history of messages (900+ in 5 months); view/post items to the calendar of events; and view/post items to our own storage area of files.

You can be alerted for spur of the moment viewing, auroras or just take part in lively discussions of any astronomical nature.

Group email addresses:

Post Message	buffalo_astro_assoc@eGroups.com
Subscribe	buffalo_astro_assoc-subscribe@eGroups.com
Unsubscribe	buffalo_astro_assoc-unsubscribe@eGroups.com
List owner	buffalo_astro_assoc-owner@eGroups.com

To subscribe, send a message to
buffalo_astro_assoc-subscribe@egroups.com
or go to the e-groups's home page at
http://www.egroups.com/group/buffalo_astro_assoc/

— editor

College of Fellows Inductees & Awardee

Marilou Bebak and **Lynn Sigurdson** were inducted into the College of Fellows at the May 2000 Dinner Meeting.

Both have been members for at least 10 years and have served in a variety of capacities in the BAA as well as helped on many, many public events over the years.

Marilou has been a past Board member, been a speaker several times, and assisted the public during Astronomy day and many public events. In her capacity in the Museum of Science education department she also acts as unofficial BAA ambassador to the legions of public she sees.

Lynn has been Secretary a couple terms; a frequent speaker at public events, Astronomy Day and telescope clinics; and part-time laborer during the observatory expansion. I believe she has the distinction of being the only recipient present at the meeting but missed the presentation having to leave early with her son for another engagement prior to receiving this distinction. I guess the board kept that secret a little too good!

Rowland Rupp received the College of Fellows award at the same Dinner meeting. This is awarded for outstanding work in astronomy done outside the BAA. Rowland has been very active in astronomy education giving talks and slide shows to many groups. He has for several semesters run a college level planetarium program. His zeal for education has rubbed off onto many members so one might think he is a pied piper of local astronomy education!

A hearty congratulations to all!

- Bill Smith (interim editor)

Want to see what 12 light-years looks like? That is the physical diameter of the Pleiades star cluster. The Pleiades appears a little over 1.5 degree across. It is 400 light-years distant.

AUDUBON CENTER BUILDING PROJECT

Most of you know by now that the Buffalo Audubon Society is enlarging the Fred T. Hall building at Beaver Meadow Environmental Center. The Board of Directors of the Buffalo Astronomical Association supports this project and asks our membership to contribute to the on-going financial support the Audubon Society needs to complete construction. The BAA has raised approximately $2000 from personal contributions from the membership so far, but the number of members who have made these commitments is only a small fraction of the total membership of our association. Our goal is to reach, or exceed, $3000, a level that will gain us special recognition by the Audubon Society. Twenty, tax-exempt $50 contributions will enable us to meet this goal. We'll gladly accept more.

LET'S GET BEHIND THIS EFFORT - PLEASE ENABLE US TO ACHIEVE OUR WORTHWHILE OBJECTIVE.

Our organization has a quarter century-long relationship with the Audubon Society, which has provided much in benefits to both groups. They own the observatory building, paid for its initial construction in 1975 and for the addition in 1993. They have funded repairs to the structure whenever the cost is significant; we often supply the labor. We have had free access to the Fred T. Hall building in the past, and in the future will have access to lavatories that are part of the addition. The Society mows the grass, maintains the parking lot, pays for the electricity and, perhaps most importantly, provides security for the facility.

Some of our membership may say that they seldom use the observatory, why support this program? Beaver Meadow Observatory is the flagship of the BAA's commitment to astronomy. It is our primary vehicle to bring astronomy to the public and to provide an advanced facility open to all members. After all - observing is the first thing that astronomy is all about.

Contributions to the fund can be made in the name of the Buffalo Astronomical Association by mailing your checks to:

Bud Abate
1575 Love Rd.
Grand Island, NY 14072-2308
773-3232

Beverly Orzechowski
125 Roycroft Blvd.
Buffalo, NY, 14226
839-9109 or 632-7091

— Rowland A. Rupp (for BAA Board)

BEAVER MEADOW OBSERVATORY 457-3104

Public Season starts Apr 1

I would to thank all the people who came out on Saturday night to complete the setup of the new equipment. We received a bonus that evening with a beautiful clear night. We replaced the PC for the CCD camera and the other 2 PC's for printing star charts and processing our images. Our observatory is ready for the 2000 Public Night season. As usual they are the 1st & 3rd Saturday night from April through October.

- **If you would like to present a talk at our Public Night's please call me at 535-0006.**

We have many nights open and with the new slide sets anyone can give a professional looking discussion on any of these topics from the slides, Planetary Nebula, Tour of the Universe, Splendors of the Universe 1 - 5, Hubble images 1 - 5, Secrets of the Sun, The Planetary System etc.

Also as the Public Night season opens I would like to personally invite all the members to come out and share their time with new people and enjoy our new Observatory experience!!! There is much there to be proud of, and again I personally thank everyone for helping this off-season.

— Mark Swiderski, Observatory director

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★ Clip & Save! ★
★★★★★★★★★★★★★★

2000 Public Night Schedule

Saturday	Time	Beaver Meadow Activities
April 1	8:00 – 10:30 PM	Observatory Opens! Tour Leader Training
April 15	8:00 – 10:30 PM	Historic Railroad ride from Arcade to Beaver Meadow
May 6	8:00 – 10:30 PM	
May 20	8:30 – 11:00 PM	**Volunteers**
June 3	8:30 – 11:00 PM	**Always welcome.**
June 17	8:30 – 11:00 PM	**Go ahead.**
July 1	8:30 – 11:00 PM	**You can do it!**
July 15	8:30 – 11:00 PM	
August 5	8:30 – 11:00 PM	
August 19	8:00 – 10:30 PM	
September 2	8:00 – 10:30 PM	
September 16	7:00 – 9:30 PM	Homestead Festival
October 7	7:00 – 9:30 PM	Enchanted Forest
October 21	6:30 – 9:00 PM	

COULD SOMEBODY BE LISTENING?

Now that phobias over Y2K have subsided, we need something new to worry about. One concern impressed upon us over the years is the steady progress made by I Love Lucy into the cosmos. Trailing just behind Lucy are news reports of wars, racial conflicts and threats of man-made global annihilation from a variety of TV and radio sources. Pundits fear that these inadvertent messages may be detected by alien denizens of other star systems who will view our civilization (or lack of it, depending upon your prejudices) with either contempt or acute apprehension.

Of course, the justification for this anxiety depends on whether there is anything out there to intercept these communications. To date, our four decades of SETI efforts to find out about the existence of aliens has been remarkably unrewarding. While we are all aware of the absence of scientific evidence for extraterrestrials, how much thought have we given to whether extraterrestrials, who might be eagerly listening for a message from us, or anyone else for that matter, have even a remote chance of detecting our radio and TV signals.

We are led to believe that as long as our transmissions are sent into space they can be readily detected. We've read that aliens clear across the galaxy, having radio equipment equivalent to what we have had for years at Arecibo, could hear our own transmissions from that site if only the two antenna beams were properly aligned with one another. After all, we are told that way back in 1974 Arecibo blurted a digitally coded message to M13, the great globular star cluster in Hercules, announcing our presence. Do you think it'll get there with enough poop for any of the civilizations in those crowded environs to decode it?

What about these claims? Are they based on real analysis of the properties of radio waves and the ability of practical radio receiving equipment to find these signals? Or, are they products of wishful thinking, not-yet realized breakthroughs in technology, or merely philosophical assertions to shame us into being more wholesome world citizens, lest we embarrass ourselves on a cosmic scale? Maybe they're just intended to stimulate our SETI activities - to keep us searching. What follows is an effort to apply a few of the well known formulas of radio wave communication to this issue of interstellar contact, to see if well intended amateurs can verify the findings of those who make these claims.

So - what's the problem? Well, there are just a few:

INVERSE SQUARE LAW--All electromagnetic signals, whether they are light or radio waves, fall off in intensity according to the square of the distance between the source and the receiver. That means a receiver located ten times further away than another receives only one hundredth the signal strength. A receiver 1000 times further away sees only a millionth of the signal strength. Stars are a long way off, so there's plenty of signal strength to lose by the time we get to the nearer ones, to say nothing of those on the other side of the galaxy. For example: imagine viewing one of the endless re-runs of Lucy transmitted from a TV station 20 miles away. Assuming the TV station radiates as much signal toward space as it directs toward its viewers, the signal strength at an antenna at Alpha Centauri, 4.3 light-years distant, would be 0.000,000,000,000,000,000,000,6 as strong ($0.6*10^{-24}$ in math talk) as the one at the local antenna. And you think you have a snowy picture!

NOISE--Any radio receiving system must consist of an antenna, amplifier and detector, through which the signal passes. Unfortunately, each of these signal processing components adds noise - thermal noise, the same noise that results from any black body radiator. Over the relatively narrow bandwidths of interest this noise is essentially constant with frequency. Simply restated, a receiver has a noise output proportional to both its temperature and its bandwidth. The lower the receiver's noise power, the better its ability to detect weak signals. Two methods are employed to make a very sensitive receiver: lower its absolute temperature, and decrease its bandwidth. There are, unfortunately, limits to these. Temperature is limited to absolute zero, and bandwidth is limited by the received signal. One can gain sensitivity by reducing the bandwidth until it equals the bandwidth of the received signal. Any further reduction will throw away signal as well as noise, resulting in no net improvement. Most importantly, lowering the temperature of the front portions of the receiver, where the signal is weakest, can be very effective. Since noise power is directly related to temperature by Boltzmann's constant, many receivers are cooled with liquid nitrogen or, in extreme cases, liquid helium. Super cooled masers and other exotic techniques are used to reduce effective temperatures to a few degrees Kelvin.

The antenna must look into space and, while it receives the wanted signal, it also receives all the other signals that are present. Best measurements to date indicate that there is residual radiation coming from many sources including stars, galaxies and some non-visible objects, including radiation from the Big Bang . The level of this noise varies, depending upon the direction being observed, but seems to have a minimum level of about three degrees Kelvin effective temperature. This lower level combines with receiver noise to set the lower limit of detection.

Of course, there are some very strong sources of noise, such as our sun. If an observer were to turn his large antenna toward the sun, the radio noise would be intense, as much as equivalent to a black body radiator at one million degrees Kelvin, in some cases. Another point to consider: all larger radio receiving antennas are made of screen or, at least are left unpolished, because otherwise they would focus heat and light and destroy themselves if ever they were inadvertently pointed at the sun.

ANTENNA GAIN AND BEAMWIDTH--Antenna gain is an interesting property for the system designer. It is essentially a simple way to increase the transmitter power or the receiver sensitivity. This is easily seen in conventional TV; the large roof mounted antenna outperforms the rabbit ears every time. This higher gain isn't, however, totally free, because larger antennas lead to smaller beamwidths. In some cases smaller beamwidth is good because it allows one to discriminate against unwanted signals, but most times the result is that pointing accuracy and stabilizing a large structure are

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severe penalties. If one considers the largest structure used for interstellar listening, the 1000 foot Arecibo antenna with its resultant 0.042 degree beamwidth at 1400 megahertz, one can appreciate the problem.

In order to achieve significant listening times at any one point in space, one needs to track out the Earth's rotation. Also, scanning the sky for signals can be a very long, tedious process when done in such small increments. One might ask - why use such a big antenna? The answer is that receiver sensitivity, or the range at which one can detect a signal, is directly proportional to antenna diameter. If only a 100 foot antenna is used in place of the 1000 foot Arecibo antenna the effective range is reduced by a factor of 10. This is certainly significant if one compares the number of stars in a 10 light-year range of Earth and a 100 light-year range.

DETECTION TIME and BANDWIDTH--These two parameters are somewhat interchangeable. If the signal is broadband (that is, it radiates simultaneously at all frequencies in the general band of interest) one can increase receiver sensitivity by either increasing the bandwidth, or by increasing viewing time at any given point in space. If, however, one looks for man-made transmissions, one looks for narrowband signals. Increasing the bandwidth results in poorer sensitivity because the amount of noise increases without any accompanying increase in signal. In the case of SETI, this leaves only the time parameter to alter.

Time is not quite that easy either. Sensitivity increases approximately as the square root of time. That is, increasing viewing time, or integration time as radio engineers call it, by a factor of 100 increases sensitivity by a factor of 10. Since range of detection increases by the square root of sensitivity, increasing sensitivity by a factor of 10 only increases the range of the search by a factor of three. Thus increasing integration time from one to 100 seconds, though not too hard, increases range from, say, ten to thirty light-years. The next 100 fold increase from 100 to 10,000 seconds, or 2.78 hours, is more challenging. Worse yet, it only increases the range of detection to 100 light-years. This explains why the present SETI employs home computers on a large scale to reduce this large quantity of data. Of course, other underlying problems are that the transmission being monitored must stay constant in frequency, and the antenna must be kept pointed correctly over this entire period.

FREQUENCY--There are many radio frequencies possible for monitoring. The radio band between 1000 megahertz and 10,000 megahertz is somewhat ideal here on Earth because the atmosphere is relatively transparent at these frequencies. If one is looking at man-made transmissions, bandwidths of one Hertz are reasonable. Unfortunately this leaves nine billion frequencies to explore. Good news though (depending on how you look at it), many of these frequencies are used for commercial purposes on a regular basis and are hence jammed for observation - the radio equivalent of light pollution. International treaties have set aside about 132 megahertz for radio observation. This still requires 132 million measurements. Because of the problem of using a very sensitive receiver, man-made interference is a very real problem. This is why the most sensitive receivers are located in very remote locations shielded by mountains, such as at Greenbank, WV and Arecibo in Puerto Rico. In fact, these sites even prohibit cars from the area to reduce interference from ignition.

One further problem is Doppler shift. As discussed before, long integration times and narrow bandwidths are used to increase sensitivity. These techniques only work if the received signal stays in the bandwidth during the interval of observation, but planetary and stellar motion may shift the transmitted frequency outside this band. At 1400 megahertz a radial velocity of only one mile per hour shifts the frequency by two Hertz, a real problem for a one Hertz bandwidth receiver.

As long as the velocity is constant during the period of integration, the signal will stay in one frequency band, one just can't be sure which band. A solution to combat this frequency uncertainty is to search multiple adjacent frequencies simultaneously. The advent of very high speed computers has allowed digital signal processing techniques to accomplish this. A drawback of this approach is that it generates very large quantities of data in a short time. Even this method has pitfalls when orbital or rotational motions introduce a Doppler shift that changes while the integration is taking place. If the frequency is shifted outside the narrow bandwidth during this time, the signal is likely to be lost in the noise.

Another method presently used to enhance the review of data is to display a computer screen where received signal amplitude is represented by brightness, with frequency on the horizontal axis and time on the vertical. The plot is generated by displaying each frequency scan as one resolution line in the horizontal. A received signal would then appear as a vertical bright line, an easy artifact for an observer to pick out.

Now that we have considered some of the problems, what are the results? Can our transmissions cross the width of the Milky Way galaxy? Do Lucy's crazy adventures astound viewers 50 light-years distant? Does our squirt of photons in the direction of M13 have a chance of evoking wonder on the part of those who may be there to receive it? Tune in next issue of the SPECTRUM for the answers.

— Carl Klingenschmitt & Rowland A. Rupp

Do-it-yourself SETI

Yes you can do your own search for extraterrestrial intelligence thanks to software from the Planetary Society and the University of California at Berkeley. The SETI@home software uses the Internet to download radio data from Arecibo Observatory in Puerto Rico. The software runs as a screensaver, crunching data while a computer is idle.

A downloaded 250kb chunk keeps a home computer busy for several days searching for spikes or patterns in radio signals from space. If anything interesting is detected, it uploads a report to astronomers for further investigation.

Development on this software took 3 years and more than 200,000 users in 100 countries were using it one week after it was released in May 1999. It is described as a global science project.

It is available for Windows, Mac and 30 Unix varieties. For info and free download go to http://setiathome.ssl.berkeley.edu.

- Bill Smith (interim editor)

Observation Report/ Sat. Jan 29th./ Beaver Meadow Observatory

I am a city astronomer. Not that I wouldn't enjoy a rural observatory in my backyard someday. Today I spend 90% of my observing and imaging time in my backyard in downtown Buffalo, mostly during the late night hours when my young kids are asleep, armed with a variety of small telescopes, none larger than 6 inches.

The last Saturday in January I took advantage of a moment of calm in the lives of my family and some clear transparent winter skies to head to the Beaver Meadow Observatory. I brought along my 4" refractor and altazimuth mount as a back-up but my goal was to observe winter deep sky objects through the club's 20" Dobsonian. My Beaver Meadow (and star party) experience has been limited to summer nights and summer objects - I'd never observed with a large scope east of Andromeda!

A COLD NIGHT w/ THE 20"

To my surprise, (and I must admit, my excitement) the observatory was empty that night. A quick glance at the sign-in ledger gave me a sense that the cold season usage of the observatory is mainly by our hardy CCD imaging team. I had brought a shovel but was delighted to find that the two feet or so of snow in Java had been cleared from the pad by the garage door. I was able to set-up the 20" quickly and took aim at Jupiter and Saturn to check out the seeing. It was fair - but the images seemed poorer than the seeing could account for. Testing some star images made it evident that the 20" is in need of significant collimation. At first I was disappointed and considered setting up my small scope for the evening. But my first view of the Orion nebula changed my mind. I am a big fan of high quality small scopes and love trying to push the limits of what can be observed and imaged with them - but I felt the sudden pang of aperture fever. The rich core of M42 filled the field of view of my 35mm Panoptic eyepiece and the rich nebulosity went on and on outside of it. The knots and swirls of the nebula were far more resolved and three dimensional than I had ever seen. The miscollimation seemed to affect the nebulosity much less dramatically than star images, which were quite blobby. I could resolve only the four brightest members of the trapezium (I can usually see five from my Buffalo backyard and sometimes 6 on nights of good seeing.) And then there was color! That green hue that I'd read about for years was clearly evident - as was a shift of color in the flat edge of the nebula near the star Theta (2) Orionis that appears reddish in short exposure photographs attempting to duplicate the visual experience. The area known as the fish's mouth seemed, for the first time to me, darker than the sky background near it, suggested a layer of dark dust covering the glowing regions (which, of course, it really is.) I had seen this view perhaps a hundred times before - but seeing it for the first time through a large scope was as awe inspiring as any I can remember.

THE ELUSIVE HORSEHEAD

Unfortunately, between the seeing and the optical misalignment, higher power views were unusable. This was especially frustrating as I moved to the Flame Nebula region. The Flame Nebula itself is quite easily found. I could also clearly see the nebulous region that contains the famed Horsehead nebula, but I needed more power to darken the sky background and confidently identify the intrusion of the dark dust lane that forms the horse's head. Higher power would also have helped me position the bright star in Orion's belt, Alnitak, outside the field of view.

I noticed that clouds were starting to roll in. After a quick warm-up in front of the heater, I spent a brief time with the Messier clusters in Auriga. These star clusters were much more affected by the scopes alignment problems than Orion's nebulous regions. I did enjoy a wonderful view of M37(?) an open cluster with a small planetary nebula contained within the field. *[M38 has a 37" diameter planetary Abell 9 at mag 19 off its edge; M46 in Puppis has a 15" mag 9 planetary within. –editor]* This is a wonderful strange sight - and the big scope made the planetary very bright and obvious. I've read that current thinking relates this planetary to the cluster in both time and space.

WINTER'S QUIET BEAUTY

Winter at Beaver Meadow is something we should all experience more often. The quiet and beauty is amazing. The only sound heard during my two hours of observing was the distant growl of snowmobiles. On my drive home, I saw their small headlights bobbing in and out of view as they roar through the deserted snowy fields in search of open convenience marts where they seem to congregate and refuel. I began to imagine them as alien transports on some distant planet I was exploring in my station wagon.

I look forward to helping the club work on the 20" scope's optical adjustment and other observatory projects this spring - and I look forward to sharing these wonderful views with members and the general public during the warm summer nights ahead.

— Alan Friedman

ASTRONOMY DAY

Saturday, May 13 at Tifft Farms

(across from small boat harbor on Furman blvd.)
2pm- into evening (depends on sky conditions).

- Short talks by BAA members (to be announced)
- Astronomy exhibits & demonstrations
- Planetarium Sky tours
- Scopes for viewing
- Volunteers needed !!

Daytime activities and nighttime observing for members and the public are planned. Solar observing will be made with the weather permitting and our regular Public night activities will begin at sunset.

Astronomy Day is an event that every member of the family will enjoy. In addition Tifft Farm will have a variety of nature experiences to share.

If you would like to give a talk, assist the public in observing (day and/or night), or volunteer to help out on Astronomy Day contact:

Bob Hughes 833-2407

 Appearances aren't everything: Aldebaran appears to be in the Hyades cluster that makes up the face of Taurus the bull. Aldebaran is much closer however, being only 65 million light-years away while the Hyades is around 150 l.y. distant.

Amateur level astronomy research

Have you ever asked yourself, "How can I get involved with some amateur level astronomy research?" We have the answer. The Allegheny Region Astronomical Coalition is attempting to develop interest groups throughout the region. Once developed, these interest groups will set up informal meetings and/or egroups to explore the various areas of interest and/or astronomy research. We realize there are individuals that may have a strong interest in solar observing and research, but may have minimal interest in supernovae research. So here is your chance to get involved.

Choose from the topics below which areas you have a strong personal interest in, and mail (or email - tspuck@hou.lbl.gov) the form to Tim Spuck, RR 2 Box S6, Seneca, PA 16346 before May 1, 2000. At that point teams will be established and group coordinators will be identified. If you are willing to be a group coordinator, please identify which groups you would be willing to coordinate. This can be a very exciting opportunity for you .... take advantage of it!

___ Radio Astronomy
___ Minor Planets (asteroid/comet hunting)
___ Lunar/Planetary
___ Solar Observing
___ Supernovae
___ Variable Stars
___ Extragalactic Observations
___ Astrophotography
___ Light Pollution
___ History of Astronomy

— Tom Bemus

Astronomy day is MAY 13th
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The SPECTRUM

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