You Have Mail

Peter Eschman

There are two email notification systems used by TAAS today. The first type is what we call the Board of Directors Official Email List (or BODOEL). This distribution list is built from our TAAS membership database, and contains email addresses for all TAAS members who have given us their email address as part of their membership application. This list is used for official email topics authorized by the Board of Directors, with email distribution by blind carbon copy (bcc), so that email addresses are concealed for privacy reasons. Typically these email messages appear to originate from gnto@taas.org, and I send out messages based on event notices I receive. These notices are typically sent out on Tuesday or Wednesday of any week that we have scheduled events. These messages always end with the phrase “These messages were approved by TAAS Board of Directors”.

The second email notification system that we use is our TAAS-L listserv. Our TAAS-L listserv is composed of TAAS members who have joined to form a discussion group related to TAAS and amateur astronomy in general. Your email address will only be added to this group when you chose to join TAAS-L, and it is up to you to take the steps to join. TAAS-L is limited to TAAS members, and since it operates as a private discussion group, new subscriptions must be approved. TAAS-L has been configured as a private discussion group to limit spam or other messages not related to TAAS and amateur astronomy. TAAS-L messages are archived on a weekly basis, and can be accessed from the listserv homepage, which is https://list.unm.edu/cgi-bin/wa

TAAS-L serves as an automated email message relay so that email addressed to the list is sent to all list members. Individuals can reply to a message in a public way by addressing their response to the list, or may reply in private by addressing a response directly to the originator. The way you select a different reply method will depend on the type of email program you use, and we can try to give instructions for your specific case, if needed.

At this time, TAAS-L has 84 subscribers and we invite other TAAS members to join in our discussions on topics that range from objects observed, to equipment questions, to neat web sites we have seen. Recently we have had some wonderful alerts about a spectacular International Space Station pass, bright Iridium flares, Lunar juxtapositions, new comets and other great sky phenomenon.

If you would like to join us, you can subscribe to TAAS-L by sending the following message:
To: listserv@list.unm.edu
Subject: <leave subject line blank!>
Message body:
subscribe TAAS-L <your first name> <your last name>

Here is what my subscription request looked like:
To: listserv@list.unm.edu
subscribe TAAS-L Pete Eschman

Please note a few details:
1) There is no “e” on the end of listserv, so your message to listserv@, NOT listserve@
2) Be sure to send the message using the same email account from which you wish to receive the list messages.
3) The message body should only contain the subscription request, so there should be no footer, sender’s signature or other extra text. Messages to the listserv should be in plain text, not formatted text such as HTML.

Please remember to print or save the subscription acknowledgement you receive after your subscription has been approved. TAAS-L specific instructions can be found at the end.
President’s Message

Over the past several articles I have been introducing in each article one member of TAAS who has contributed their time and efforts to making TAAS a better organization that is more fun and meaningful for everyone. Since this issue is the last of my year as president I thought I would list more than one. This is not because the contribution of each of these members is less than the contribution of those of previous articles but because I want to make sure that they got their tremendous efforts mentioned now rather than later. This year has been a year of big changes for TAAS and without the efforts of a few key persons much of these changes would have not happened.

One of the major changes that took place in 2004 was the upgrade and modernization of the Isengard mount. If anyone had tried to use the Isengard a few months back they would have found this wonderful telescope that has thrilled so many of us with its magnificent views very difficult to use. This is mainly due to parts of the old German equatorial mount simply wearing out. Alison Schuler had generously donated money in the memory of her late husband Lyman Sandy. Now it was up to someone to lead a group of volunteers in installing the hardware needed to bring our beloved Isengard back to being a useful instrument. Pete Eastman as the GNTO Director jumped in and led the way. After many long days of upgrading the mount the Isengard is now better than ever. Not only is it easier to move and again tracks the sky (it had been slipping) it now has go to capability. This is not the only improvement at GNTO this past year. In many ways GNTO has been improved and renovated to provide us with a resource that is the envy of amateur astronomy organizations who has visited it.

There are two people I would like to mention for their dedication to an often-overlooked program at TAAS. Nearly every Friday night there are a few docents who introduce the public to the night sky. The crowds are not always as big as at a school star party or and Oak Flat star party but since these events happen about forty eight to fifty times a year the total number of people touched by UNM Friday Nights is substantial. Jay Harden has been the coordinator of the UNM Friday Nights for many years now and has faithfully shown up at the UNM observatory to greet the TAAS docents and members of the public. Earlier this year Jay’s wife became ill and Jay has had to stay home to take care of her. We all owe a big thanks to Jay for his dedication to the UNM Friday Nights and we all hope Ruth is better soon and Jay can return. In Jay’s absence there is another TAAS member who has stepped in and allowed TAAS to continue to reach the public. Brock Parker is filling in for Jay but is no stranger to the UNM Friday Nights. Brock has often been at UNM entertaining the attendees with his often humorous and always informed discussions on the objects of the night sky. So again we have a dedicated TAAS member stepping up to keep the public outreach going.

Another public outreach that was in a bit of jeopardy at the beginning of the year was the School Star Party. One TAAS member in particular has been a docent at more school star parties over the past several years than any other member of TAAS. Without John Lanning’s continued support it would have been difficult to continue with this fine program to educate the students of Albuquerque and the surrounding area in the subject of astronomy.

This is by no means the end of the list of those who have contributed their time and efforts to making TAAS a successful astronomical society. However, these folks stand out for the tremendous level of effort that they provided over that past several years and in particular this past year. My one holiday wish for TAAS is that there will always be members who give of themselves in the name of sharing our passion for astronomy. This can only take TAAS into the future as a thriving and meaningful society we all can be proud of. Well since I am writing this on Friday evening I will end now, I want to go down to UNM to support Brock and continue the tradition. See you there!

TAAS General Meeting News

Stuffed with Thanksgiving Turkey dinner and looking to devour some astronomical information, TAAS members arrived at Regener Hall on Saturday, November 27th. The speaker, Dr. Horton Newsom from the Institute of Meteoritics, spoke about Meteorite Impacts in India and Africa and the relationship of those impacts to Mars.

December is a busy holiday season for many of us and rather than filling every weekend this month with TAAS events, we have replaced our sidereally-scheduled general meeting with our yearly member appreciation/solstice celebration banquet. On Sunday, December 19th at 6:00pm, please come to the Radisson Hotel in Albuquerque to share in our fellowship and help us to reflect on a very busy and very successful 2004. The price of admission for this event is only $10.00 for each member and $10.00 for one guest (additional guest plates cost $24.00). The actual cost per plate for this event is $24.00 per plate, but TAAS wants its members to know how much we appreciate them, so we’ve subsidized the fee! Plan to come and join us in the fun, fellowship, prizes and trivia. Meet the many members who make TAAS such an outstanding organization! If you haven’t received your invitation in the mail yet, please contact Heather Mann at 505-771-0126 or e-mail vp@taas.org. We really hope to see many of you at the banquet, so bring your appetite and join us on the 19th!
Our luck has not been very good lately and the last two GNTO events were canceled because of very poor weather conditions. Our observing opportunity on November 13 and our Training sessions on November 27 were the victims this time. In both cases, a cancellation notice was sent to our TAAS-L listserv, and a voice message was placed on our TAAS HotLine (296-TAAS) in message box 2, which is normally used to announce special events. These steps will be followed in the future, if we need to cancel other GNTO events.

December 11 “new moon” observing marks our only GNTO event for December. This event falls exactly on the new moon, so it should be great. It is possible that some folks will be at GNTO on January 1, but this will be a spontaneous occurrence, which may be accompanied by messages on TAAS-L.

Our scheduled events for January include a “new moon” observing event on January 8, followed by Training sessions on January 15. At this time, we are planning to hold another in our series of Constellation Tours, along with the training on the use of the Isengard 16” reflector and the two loaner scopes at GNTO. We also hope to have a CCD Imaging demonstration as part of our plan to revive Level 3 training and our imaging program. If enough people are interested, we will also offer a Level 2 training session, which covers computer hardware and astronomy-related software available at GNTO. I will announce start times for the various training sessions, demonstrations, and the constellation tours at a later date.

You really should think about coming down to GNTO. We have two great loaner scopes on easy to use Dobsonian mounts, and our Isengard 16” is providing some really great views these days. Plus, you owe it to yourself to see the new drive system on the Isengard! With all this great equipment at our facility, you do not need have your own equipment to enjoy GNTO. The comfortable Ortega Building is available for socializing, and our Guest Trailer is available for coffee and hot chocolate, so bring any snacks you’d like to share.

GNTO committee meetings are open to any interested TAAS members and this is a great way to get more involved with your observatory. We need your help. Our next scheduled meeting is December 16 when we will meet at 6:30 P.M. at JB’s Restaurant on Eubank just north of I-40. Please note that this is a new meeting location. There is no committee meeting scheduled for January. If you have questions about access and availability of GNTO, please contact me (Peter Eschman, gnto@taas.org, home phone: 873-1517).

I hope to see you soon at your observatory.

of this acknowledgement message, along with instructions for getting help and how to unsubscribe from the list.

TAAS member Sam Lockwood also runs a neat message list called NM_Astronomy. This Yahoo newsgroup is intended to be a statewide resource for amateur astronomers. Its purpose is to give all astronomers and various clubs across the state a common discussion and announcement forum. Members include astronomers from almost every area, club, and astronomical institution in New Mexico. Messages posted in NM_Astronomy are available for public viewing at http://groups.yahoo.com/group/nm_astronomy. When I checked recently, this list had 102 subscribers.

Subscription information for TAAS-L and NM_Astronomy can be found on our TAAS web site, partway down the first page, in the section “Get Connected with a Listserv”. This section of our web site provides a bit more information on the two lists, and offers a somewhat automated way to subscribe to them.

Recent challenges to email distribution from the BODOEL and TAAS-L have stemmed from AOL, Compuserve and others blocking email from unm.edu domain. This causes problems for TAAS because TAAS-L runs on the UNM Listserv, and taas.org is within the UNM IP number address space. Organizations will sometimes block email from certain Internet addresses (IP numbers) if they feel that computer viruses or worms are originating from these addresses. This process is known as blacklisting.

Because of the large number of computers on the UNM campus, some always become infected when new computer worms or viruses are released “into the wild”. UNM takes aggressive steps to disable the network connection of infected computers, but it takes a little bit of time to enable new counter-measures for each new threat. In my opinion, some organizations over-react by imposing such extensive blacklisting, which may last for a number of days. The problem with blacklisting is that at the time we would like to notify people of email delivery problems, our notices are blocked. Because the block may apply to the UNM email server and may also involve the listserv, results are always unpredictable. To compound the problem, there is little that can be done, other than to have the affected subscribers complain to their organization, and request that the block be lifted. Of late, I have had to send to some BODOEL recipients using gnto@comcast.net as well as gnto@taas.org.

How can you help? Please make sure your correct email address is part of your membership data. If you have several email accounts, please use the one for TAAS that has fewer counter-measures, such as aggressive firewalls or spam filters. Unfortunately, these types of email delivery problems are only going to get worse in the future. If you think you should be receiving BODOEL or TAAS-L messages, and have not seen any for a while, please check our web site to see if we have posted any notices about email delivery problems.

Email delivery problems aside, you can see that there are lots of great email resources related to TAAS. On the BODOEL level, you can stay in touch with scheduled events including public star parties, school star parties, and GNTO events. On our TAAS-L listserv you can join in sharing information, getting questions answered, and keeping in touch with “late breaking” astronomical events. With NM_Astronomy, you can keep tabs on the statewide scene. Please take advantage of these resources, and contact me if you have any questions.

The Official Newsletter of The Albuquerque Astronomical Society
### December 2004

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### Educational Outreach

**TAAS Outreach to Double Eagle Elementary**

*8901 Lowell NE*

**December 9, 2004 7-9 P.M.**

Please join us on Thursday, December 9 for the next installment of TAAS Educational Outreach, as we travel to Double Eagle Elementary School at 8901 Lowell NE. Assuming the weather permits, we should have a great night, with pizza provided by the PTA. This PTA is very well organized and they will conduct their own activity to make star maps for the kids.

To get to Double Eagle, take Paseo Del Norte east from I-25, past Eubank. Turn left on Lowell, and go about 3/4 miles north to the school. The school is on the left (west) side of the road.

Telescope Docents: Just before reaching the school parking lot, look for a gated, gravel road that turns west, on the south side of a row of portable classrooms. As you enter the gravel road, the portable classrooms will be on your right. Drive around the west end of these classrooms, and our scopes will be set-up on a concrete court, north of the portable classrooms. Two more portable classrooms have been moved into the space, so the area for the scopes is not as large as last year. However, there should be enough space and it is a nice dark spot. If we get too many scopes, docents may have to unload their scopes and than park their vehicles on the south side of the portables. We can sort this out when we get here. The gate will be open no later that 5:30, and I'll have the usual “Telescope Vehicle” signs posted. Also, maps and info are posted at www.taas.org.

The Rainbows in the Night Sky show will be in a portable classroom next to the scope field. Comet making and a new feature called “Astronomy, Questions and Answers” will be in the cafeteria, along with snacks. In the event of a weather cancellation, it will be announced by 6pm on the TAAS Hotline (254-8227), and also posted on the TAAS website ASAP. Any questions should be directed to Dee Friesen (856-1593 or friesend@aol.com).

Dee Friesen

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**Universe**

**Journal**

The Official Newsletter of The Albuquerque Astronomical Society
January 2005

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**ATM Workshop**

Ray Collins/Mike Pendley
atm@taas.org

The Amateur Telescope Making Workshop meets the first and third Wednesdays of each month at Valley High School, 1505 Candelaria—the north side of Candelaria, just west of 12th street. The meetings begin at 7 P.M. and are in Building E, Room #3.

**Winter Solstice Banquet**

Sunday, December 19, 2004
6:00 P.M. - 8:00 P.M.

Radisson Hotel, Silver Room
2500 Carlisle Blvd. NE

Reservations required by December 13th
($10 per member. Each member can bring one guest @ $10, additional guest @ $24.)

Notes

GNTO = General Nathan Twining.
GNTO Training = GNTO Observing and Training.
UNM = University of New Mexico Observatory. Call the TAAS hotline @254-8227, or the UNM hotline @ 277-1446 to confirm, or unm_coordinator@taas.org.
ACSA = Albuquerque Coffee Shop Astronomers. Contact Sammy Lockwood for information or visit www.taas.org and select sidewalk astronomy.
ATM = Amateur Telescope Making. Call Michael Pendley for information @ 296-0549, or atm@taas.org.
P & A = UNM Physics and Astronomy. Corner of Lomas and Yale.
School Star Party.
TAAS Reports & Notices

UNM Report

Jay Harden, UNM Campus Observatory Coordinator
unm_coord@taas.org

This note from UNM indicates that access to the UNM Observatory will be limited for the next month or so. The good news is that the new lighting for the parking area will be fully shielded so that impact to the Observatory is limited. Other news is that the Observatory now has a new telescope in the main dome that is providing better viewing than the old instrument.

Pete Eschman

The north end of the Zone “M/SP” OBSERVATORY PARKING LOT will have rolling disruptions throughout the remainder of the semester as crews will be trenching and placing conduit for the installation of NEW PARKING LOT LIGHTING. During the first phase of the project the EAST ENTRANCE WILL BE CLOSED temporarily. Please use the north or west entrances. THE LOT WILL REMAIN OPEN throughout construction and patrons are asked to observe temporary traffic control devices. This area remains targeted for paving in the immediate future and, WEATHER PERMITTING, will be open as a PAVED FACILITY for the spring academic term.

Full Color Sidereal Times Now Available

Barry Spletzer

In a sweeping move to provide top quality communications to our members while conserving our precious resources, TAAS is pleased to re-announce the availability of this newsletter the Sidereal Times in full color. That’s right, catch the blush of the monthly, speaker, the blue eyes and red hair of that cute 6-year-old at the School Star Party, the depth and vibrance of all the full-color illustrations.

The catch is that the full-color version is only available at our website: www.taas.org. If you prefer to download and read your newsletter on your computer rather than receive a paper copy by mail, please notify the TAAS treasurer, Shannon Mann at treasurer@taas.org to have your name removed from the Sidereal Times mailing list. This will provide you with the newsletter of your choice, save TAAS money, and earn you the undying (okay, maybe slowly dying) gratitude of our Sid Times printer – me.

Membership Services for:
• Membership Inquiries
• Events Information
• Volunteer Opportunities

Contact Ray Collins at member@taas.org

for:
• Membership Dues
• Magazine Subscriptions
• Address/e-mail changes

Contact Shannon Mann at treasurer@taas.org

P.O. Box 50581 Albuquerque, NM

Editor’s Note

Please note that the deadline for the January 2005 issue of the Sidereal Times will be Friday, January 7th, as the finished manuscript must be at the bulk-mailer before Monday, January 10th, so that you will receive it by e-mail that day or by s-mail the following Saturday. My e-mail address is editor@taas.org.

Due to technical difficulties, the November Treasurer’s report will not be available this month. In brief, however, I am able to say that we had about 6 new members join TAAS in November, all account balances increased slightly, including our special projects fund (due to a re-allocation of funds from our TAAS Screensaver sales) and that we are finishing the year in solid financial standing. Cheers to all and happy holidays!

Messier 2005

Have you always wanted to observe all of the Messier objects, but never seemed to get around to doing it? Well, all hope is not lost. A Special Interest Group (SIG) is being formed that will encourage a person to observe all of the Messier objects over the course of 12 months, by using a plan that divides the objects into the ones that are most observable each month of the year. Using this plan, an observer can readily locate the most observable objects for that month without spending a great deal of time in any one observing session. This enables a person to miss a scheduled session and easily make up for it at the next session. The SIG will start its activities in January 2005. The group will have two scheduled observing sessions a month in the greater Albuquerque area. Then about every two to three months, the group will travel to GNTO to use the TAAS facilities to re-observe the objects from the past few months. Together, TAAS members can learn to locate, identify and observe all of the Messier objects in an orderly manner. In addition, the group will have the opportunity to become familiar with the use of the GNTO facilities and most of all have fun.

Dee Friesen is organizing the Messier 2005 SIG and welcomes any suggestions on how to make it a successful project. Information will be posted on the TAAS web site to assist with the coordination of activities. Dee can be reached at 856-1593 or friesend@aol.com.

Location, Location, Location

• Chaco Canyon
  6185’ elevation
  Latitude  Longitude
  36° 01’ 50”N  107° 54’ 36”W
  36.03°  -107.91°
  36° 1.83’  -107° 54.60’

• Oak Flat
  7680’ elevation
  Latitude  Longitude
  34° 59’ 48”N  106° 19’ 17”W
  34.99°  -106.32°
  34° 59.80’  -106° 19.28’

• UNM Campus Observatory
  5180’ elevation
  Latitude  Longitude
  35° 5’ 29”N  106° 37’ 17”W
  35.09°  -106.62°
  35° 5.48’  -106° 37.29’

To convert from Degrees, Minutes, Seconds:
Divide seconds by 60, then add minutes, then divide by 60 again.
For security reasons, GNTO location is available by request only, so please contact Pete Eschman for GNTO information.

Courtesy Pete Eschman

The Official Newsletter of The Albuquerque Astronomical Society
Observer’s Page

From the Ivory Basement

22. Diffraction

The Exciting Conclusion

Barry Spletzer

Author’s note: I have been writing this series of articles for about 2 years now. In that time, I have tried to shed some light on many topics relating to astronomy. With this latest installment, I seem to have run out of topics. Before slipping quietly away into oblivion, I am asking for ideas for future articles. If you have a suitable topic for me to address, please let me know via e-mail at barry@swcp.com.

Last time I started my discussion of diffraction and got as far as explaining how interference from two point sources of light gives light and dark bands. My goal this time is to show how this effect, caused by the very nature of light waves, impacts astronomy, telescopes, and optics.

The whole basis of diffraction is that light travels as waves rather than rays. Waves spread out like ripples in a pond. As I mentioned last time, when light passes through a narrow slit, the light and the slit interact producing a source of ripples, that is it acts as if the light is radiating from the slit. I also showed how light passing to two closely spaced slits produces a pattern of light and dark bands. My goal this time is to show how this effect, caused by the very nature of light waves, impacts astronomy, telescopes, and optics.

The idea that light passing through an opening acts as if the opening is filled with a very large number of light sources is just plain weird. There really is not a good solid explanation in classical physics of this phenomenon but, trust me, treating light in this manner produces all the effects that we observe. Figure 1 illustrates the behavior of light passing through a single opening. To get this picture, I set up two razor blades very very close to each other and shined a laser pointer through the gap then took a picture of the light striking a piece of paper. To give you a comparison, the figure shows the pattern from multiple slits I discussed last time along with the single slit pattern. I used the term “wide” in the figure because even though the width of the slit is about equal to the diameter of hair, it is still 50 light wavelengths wide. The important thing to notice here is that the difference between the center bright spot and the other spots is much greater for the single slit than for the multiple slits. Altogether, the center spot is much brighter and the edge spots are much dimmer.

Just like last time, it is possible to figure out mathematically what these patterns of bright spots should look like. You can add the contribution of the various sources together and determine how bright the light is at any point. This is exactly what I did last time when analyzing two separate sources. Here, there are many more sources and it takes a while to figure it out. Figure 2 shows the behavior of light passing through a slit that is only five wavelengths (0.0001 inches) wide. The light spreads out some after passing through the slit but you do not see any of the additional bright bands that you might expect. This is only because those bands are so much dimmer than the main bright spot that they do not show up in this figure. This is a real problem in the representing light sources on the printed page. For example, the North Star is a double star and its dimmer companion is about 200 times dimmer than the North Star itself. Even so, this dim companion is easily visible in a telescope right next to the North Star. If you try to represent this difference in brightness on paper, you find that an object 20 times dimmer than pure...
white looks completely black and is invisible. That is what has happened in Figure 2. To compensate for this, I have adjusted the brightness so that these dimmer areas still show. Figure 3 shows the same pattern with the brightness of the dim bands turned up. Now, in addition to the band of light streaming through the opening, there are a number of dim bands spreading out on both sides. These are very similar to the bands we saw with a double slit last time but they are much, much dimmer. All of the diffraction figure shown from here on have the brightness enhanced to show these dim bands.

As you might expect, as the opening gets wider, the side bands get dimmer and closer to the main beam of light. Figure 4 shows the pattern of light streaming through an opening that is 50 wavelengths wide. The bands are still there, but they are very dim and very close to the center now. Keep in mind that, at 50 wavelengths, this opening is about the width of a hair. As I showed in Figure 1, light passing through a slit gives a bright center band and dimmer bands on both sides. If, instead of a slit, I use a circular hole, the pattern becomes a bull’s-eye instead of a series of lines. Figure 5 shows a typical diffraction pattern resulting from light passing through a circular opening.

All this might be interesting but what in the world does this have to do with telescopes? No one has a telescope with a 50 wavelengths aperture. Even a modest 4-inch telescope is about 200,000 wavelengths and diameter. It is hard to imagine how tiny those bands of light must be with the light passing through such a large opening.

These bands do show up in a telescope image precisely because of the way a telescope is constructed to concentrate light. Light coming straight down a telescope is concentrated into a point. Light entering at an angle of one degree shows up one degree off center. For a ten-inch telescope, this corresponds to almost one inch off center. The bands of light that I showed spreading out in the previous figures act the same as a light beam coming in at a slight angle. As you saw above, the angle of these bands of light gets smaller as the opening gets bigger. For a 10 inch telescope, the angle of the 1st band is about 1/2 arc second (about 1/100 and the diameter of Jupiter). Additional light bands are about equally far apart. Each of these bands coming through a circular opening creates a ring of light, each one a little bigger than the one before. The telescope concentrates all the light in the center to point, but these rings focus to a series of concentric rings surrounding the point. In short, the images of a star in a telescope looks like that of Figure 5. To put this in perspective, Figure 6 shows an image of a portion of Jupiter next.
O b s e r v e r ’ s  P a g e

Figure 7: Star images in a 10-inch telescope with different obstructions

There are some important things to note here. First, this is the image from a perfect telescope. These rings are not caused by an improperly or imprecisely ground mirror or any other problem with the optics. No matter how carefully we make an optical system, these diffraction effects will exist. The diffraction exists because the mirror or lens has an edge not because of the properties of the optics itself. Even the most expensive telescopes suffer from diffraction effects. On the bright side, the larger the opening is, the closer the bands are together. This means that larger telescopes produce smaller sharper images of stars.

The star image shown in the previous figure is that for a 10 inch telescope with perfect optics and no obstruction. As we place obstructions in the light path such as the secondary mirror or the spider, the star image gets bigger and fuzzier. Figure 7 shows several such images all for a 10 inch telescope. From left to right to the images are for an unobstructed mirror, one with a 2.5 inch secondary, with a 4-inch secondary, and with a 2.5-inch secondary and a four vane spider. Although the differences are not pronounced, any object in the light path does degrade the image by spreading out the light.

All this leads up to the much used term “diffraction limited optics”. This means that the optics of a telescope are close enough to perfect so that the light coming down the center of telescope is focused into spot no larger than the spot produced by the diffraction effects. You can find any number of arguments about the precise definition of “diffraction limited optics,” but this is the general idea.

In summary, no matter what we do, diffraction will be present and will limit how sharp an image can be obtained. There is a bright side (no pun intended) to diffraction. With diffraction, the longer wavelengths (red), are diffraction more. With refraction (such as light passing through a lens) shorter wavelengths (blue) are refracted more. One of the most difficult aspects of optical design using lenses is color correction. Since blue colors are always refracted more, it is very difficult to get all wavelengths to focus at the same point. By using the fact that diffraction affects blue the least and red the most, refractive (glass) and diffractive (mico-grating) elements can be combined to give excellent color correction. This is currently the state-of-the-art in optics. Recently, the first commercial camera lens combining diffraction and refraction has come to market. For you camera buffs, this is the Canon 400mm/F4IS. At over $5000, it is definitely state-of-the-art. Just because this lens uses both refraction and diffraction to make an image does not mean that it does not suffer from a diffraction effects caused by the edge of the lens. As I said before, these effects cannot be avoided.

Let’s keep Barry from oblivion and send him some ideas for future articles. Please send your suggestions to barry@swcp.com. Thanks, Ed.
The basic sketch you’ll find there of galaxy formation is fairly simple: a vast cloud of diffuse hydrogen and helium gas condenses under gravity, and dense spots in the cloud collapse to form stars. Voila! A galaxy.

But real galaxies are much more complex than that. A galaxy is a swirling “soup” of billions of stars and roaming black holes, scattered clouds of gas and dust, random flashes of star birth and exploding supernovas, and an unseen and mysterious substance called “dark matter.” Over time, all these ingredients mix and interact—pulling and compressing and colliding—and somehow that interplay leads to the galaxies we see today. No wonder it’s such a hard problem to solve!

Just over one year into its three-year mission, GALEX is already shedding some new light on the problem.

“Some of the discoveries GALEX has made will change our understanding of how galaxies develop and when, where, and why stars form in galaxies,” says Peter Friedman, a researcher at Caltech and Project Scientist for GALEX.

This small space telescope, called the Galaxy Evolution Explorer (GALEX for short), makes its discoveries by taking pictures of millions of galaxies scattered over the whole sky. Some of these galaxies are close by (at least by astronomical standards of “close”), while others are as much as 10 billion light-years away. Because light takes time to travel through space, we see these distant galaxies as they appeared billions of years ago. Comparing young galaxies from the distant past with older, modern galaxies will teach scientists about how galaxies change over time.

Looking at these pictures, scientists were surprised to find many newborn stars in the outer parts of old, mature galaxies. Scientists had assumed that as a galaxy ages, the clouds of gas needed to form new stars in these outer reaches either got used up or blown away. Finding so many new stars in these regions of old galaxies (such as Centaurus A, Messier 101, and Messier 81) shows that, apparently, they were wrong.

Friedman says that astronomers don’t know yet how to explain these new findings. Rethinking and improving theories to explain unexpected discoveries has always been the way science makes progress—and GALEX is certainly making progress.

One thing is certain: It’s time to re-write some old textbooks.

For more information, see http://www.galex.caltech.edu/

Kids can do a galaxy art project and learn more about galaxies and GALEX at http://spaceplace.nasa.gov/en/kids/galex/art.shtml.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.
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