



a publication of the Minnesota Astronomical Society

AUGUST, 1990

VOL. 15, NO. 4

UPCOMING EVENTS

August

- 1 Maximum of the Alpha Capricornid meteor shower.
- 3 MAS field trip to the Tower-Soudan Mine. See "Announcements" for details.
- 6 Full moon.
- 7 Regular monthly MAS meeting. See "Announcements" for details.
- 8 Maximum of the Upsilon Pegasid meteor shower.
- 10 Registration deadline for Northwoods Star Party. See "Announcements" for details.
- 11 Perseid star party at Metcalf Nature Center. (Shower maximum occurs a.m. hours of Aug. 12.)
- 14 The Moon occults the Pleiades. See Sky & Telescope, page 175, for details.
- 17-18 Star party at Metcalf Nature Center.
- 18 The Moon occults Jupiter and its moons. See Sky & Telescope, pages 177 and 179, for details.
- 17-19 Chippewa Astronomical Society Northwoods Starfest. See "Announcements" for details.
- 20 New moon.
- 21 Nationwide moonwatch to detect the crescent moon. See Sky & Telescope, page 174, for details.
- 24-25 Northwoods Star Party at the Long Lake Conservation Camp, near McGregor, Minn. See "Announcements" for details.

September

- 4 Full moon.
- 4 Regular monthly MAS meeting.
- 14-16 Chicago Astronomical Society Astrofest. See "Announcements" for details.
- 18 New moon.
- 21-22 Star party at Baylor Regional Park.

SEEING DOUBLE

By Bob Liesenfeld

The last time some of the basics of double star observing were covered. In this edition, we'll take a closer look at some of the instrumentation used in double star work.

Estimates of the position angle and separation of a pair can be made by eye, but in order to make accurate measurements, some type of micrometer is needed. These can range from the very simple to complex automated instruments.

A simple type of micrometer that is easily adapted to almost any telescope is a reticle placed in the field of a positive eyepiece. This can consist of a piece of glass upon which have been etched a number of fine lines, such as shown in Figure 1. Also needed will be a ring slip fitted to the barrel of the eyepiece calibrated in degrees with an index affixed to telescope. A large plastic protractor does nicely here. See Figure 2.

In order to make use of such a device, one must first determine the angular distance between adjacent lines. This can be done using the same technique described in the preceding edition to find the true field of an eyepiece. In the example shown, each line was found to be approximately five arc seconds apart. This information can then be used to determine the separation between two stars in the field by positioning one of the stars on a line and estimating the distance of the other star. See Figure 3.

Figure 1

Continued on page 3

TELEPHONE NUMBERS

- | | |
|------------------------------|----------------|
| MAS events and announcements | (612) 643-4092 |
| Minnesota Starwatch (U of M) | (612) 624-2001 |

ANNOUNCEMENTS

Compiled by Max Radloff,
MAS secretary

The next regular meeting will be on Aug. 7 in the auditorium of the Science Museum of Minnesota, St. Paul.

The speaker will be University of Minnesota graduate student Martha Anderson, who will speak on her research on Cassiopeia A, a supernova remnant. Anderson's talk has been rescheduled from April when problems with the slide projector forced postponement of her program.

The following month's program will be on Sept. 4. It will be given by MAS President Steve Korzenowski, who will talk about some aspects of the uncertainty principle.

The MAS will sponsor a field trip to the Tower-Soudan mine on Friday, Aug. 3, including a special tour of the U of M proton decay and neutrino experiments.

Plans are for individuals to drive up separately and meet at the mine. If you want to car pool or need a ride, call Max Radloff. The times of the tours were yet set as this goes to press but they will be on the phone message.

The Chicago Astronomical Society will again sponsor Astrofest from Sept. 14-16 at Camp Shaw-Waw-Na-See near Kankakee, Ill. More information will be available at the August meeting or by writing to Astrofest, P.O. Box 596, Tinley Park, IL 60477.

If you would like information on what astronomical software that is available through the MAS, please call Mike Kibat at 884-0039 to find out about availability and distribution. Mike often has to travel on business so if you can't reach him, just try again in a couple of days.

GEMINI

Editor: Carl Harstad, 15710 County Road 9, Apt. 209, Plymouth, MN 55446-4200. Telephone (612) 550-1254.

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"Gemini" is published semi-monthly, with occasional special editions, by the Minnesota Astronomical Society, an affiliate of the Science Museum of Minnesota, 30 East 10th Street, St. Paul, MN 55101.

All members of the Society receive "Gemini." Non-members may subscribe to "Gemini" for \$8 per year by sending a request and enclosed check made out to "MAS" to the editor at the address listed above.

Send articles and exchanges directly to the editor. Articles for publication are due the 15th day of the month preceding the month of publication. This is usually the same as the 15th day of the month following the month of publication of the preceding issue.

The blocks that were laid last fall as the foundation of the warming house at Metcalf Nature Center were vandalized sometime in April.

To provide a least minimal security at Metcalf, the board decided to reinstall the lock on the gate. It will have four wheels which will be set to the NGC number of the Helix Nebula (7293). If you are the last to leave, please lock the gate and give the wheels a spin.

The Chippewa Valley Astronomical Society will have its annual Northwoods Starfest on Aug. 17-19. Registration is \$25 and includes a bed in a cabin, dinner on Saturday, and breakfast on Saturday and Sunday. Bringing your own tent or camper is fine. You must provide lunches and Friday dinner, but the kitchen is available and there are plenty of charcoal grills. The observatory was featured in the last issue of Gemini. There is also a nature center with an interpretive center and hiking trails and a county park within a few blocks of the observatory.

Send your registration by Aug. 10 to Kevin Litten, 921 W. Willow St., Chippewa Falls, WI 54729. Kevin's telephone number is (715) 726-2382.

The dates for the remaining 1990 star parties are given below. Star parties will be on Friday evenings, with Saturday as an alternate in case of bad weather. Weather information will normally be on the phone line (643-4092) after 6:30 p.m. on the date of the star party.

Aug. 11 Metcalf (Perseid meteor shower)

Aug. 17 or 18 Metcalf

Aug. 24 and 25 Long Lake Conservation Center

Sept. 21 or 22 Baylor

Oct. 19 or 20 Metcalf

The Aug. 24 and 25 star party will be held together with the Brainerd and Duluth clubs at the Long Lake Conservation Center, a dark site roughly 10 miles west of the very small town of McGregor, Minn.

You can arrive anytime after noon on Friday and must leave by noon on Sunday. In addition to the nighttime observing there are daytime activities available at the site.

Fees are \$5 per night for tenting or bringing a camper and \$10 per person per night for a bed in a bunkhouse. Costs for meals are:

Saturday breakfast \$4.00

Saturday dinner \$6.00

Sunday Brunch \$5.50

There will be beverages and snacks available during the evenings. If you want meals, you must register by Aug. 10. Please sign up at the August meeting or call Max Radloff at 451-7680.

Long Lake Conservation Center is off Highway 210, between Aitkin and McGregor. Take Highway 65 (same as Central Avenue) north through Cambridge to McGregor, then go west on Highway 210 to County

Continued on page 3

ANNOUNCEMENTS

-----Continued from page 2

Road 5. There is a large sign on the north side of Highway 210 at County Road 5 for the Conservation Center. Follow the signs from there to the center. It is a 2 1/2 to 3-hour drive from the Twin Cities to the Conservation Center.

The driveway is narrow and has deep ditches. It is recommended that if you meet another vehicle on the driveway, one of you should pull off into one of the other driveways rather than pulling to the side of the road.

This site is alongside a lake in a wooded area. Bring warm clothing and bug repellent. There are several lakes in the area for those who want to fish or canoe during the daytime. Gasoline is available at McGregor.

We regularly get questions about membership renewal. The MAS does not send out renewal notices. About three or four months before your membership expires, you will receive a card from Sky & Telescope informing you that your subscription is about to expire. To renew your membership, return this card along with your dues to our treasurer, Richard Nelson. Sky & Telescope will eventually send a second notice but by then it will be difficult to get your magazine on time.

SEEING DOUBLE

-----Continued from page 1

To measure the position angle of a pair, turn off the clock drive, rotate the eyepiece until one of the lines is parallel to the direction of drift of the stars through the field and lays on the brighter member of the pair. Now rotate the protractor until the index points to 90 degrees. Next turn the drive back on and rotate the eyepiece once again until the same line now passes through the center of both stars to be measured. Reading the value indicated on the protractor will give the position angle of the pair.

Figure 2

These steps should be repeated several times and the average value of separation and position angle recorded as the final result. Needless to say, this type of micrometer has limited accuracy and a reasonably good drive is needed; however, it is definitely better than none at all!

Another type of micrometer is a comparison image device. This unit consists of a means by which an artificial pair of stars is projected into the field along with the image from the sky. The artificial stars (such as a pair of pin holes in foil) can be manipulated to change the spacing and position angle which is then read off a pre-calibrated scale. The idea is to make the "local" pair match the appearance of the real stars.

The author has seen modified off-axis guiders used in "reverse" to project an image into the field. If well made, this type of micrometer is capable of a higher degree of accuracy than a reticle.

At this point, some mention should be made of what one can expect from a given telescope when examining double stars.

It's a well known fact among amateur astronomers that a larger diameter objective translates into more detail or resolution. This is a critical parameter when applying a telescope to the study of doubles, especially close pairs.

The well known empirical formula, Dawes Limit (remember him?) states that for a given-sized objective, a certain resolution limit applies. The formula $4.56/A = \text{resolution in seconds of arc}$, where A is the clear telescope aperture in inches, gives a good idea of just how close two stars can be and still be seen to be more than a single object.

For example, a 6-inch telescope yields a result of .76 seconds. This is not to say that you can aim a 6-inch scope at a double with a separation of .76 seconds and expect to see two discs of light with dark sky between them. It does mean that with good optics and good seeing and stars of moderate and equal brightness, you can expect to be able to tell there are two stars.

Notice that emphasis on brightness and seeing. Doubles with components that differ by more than one or two magnitudes and a given separation are much more difficult to split than a pair of the same separation and nearly equal brightness. Seeing is an all-important subject that I plan to discuss in a future edition.

Next time we will examine other micrometers, including a diffraction type and one of the oldest and best, the filar. Next full moon, why not put the high-tech filters away and try Izar, or Alberio. You may find a whole new dimension to the sky.

FOR SALE

4.25-inch Astroscan reflector from Edmund Scientific with 28mm Edmund and 9mm Orion eyepieces. Price \$200. Call George Day at 533-2694.

Figure 3

VOICE IN THE WILDERNESS

By Harold Doweiko

Think a minute. How much money do you have invested in telescopes and equipment? If you calculate the cost of the telescopes, a few lenses or so, tripod or telescope stand, motor drive and so on, you might be surprised at how much money you have invested in astronomical equipment over the years.

If you add a camera or two or a personal computer, it all adds up rather quickly. Before you know it, you have invested one, two, five, or even ten thousand dollars into astronomical equipment over the years.

Did you know that your insurance might not cover your telescope in case of fire or storm damage? I did not discover this until I contacted my insurance agent to ask what insurance coverage there was on my 8-inch Schmidt-Cassegrain if I were to take it with me to Mexico in July (1991) to observe the total eclipse of the sun.

I was shocked to discover that not only would my homeowner's insurance not cover the telescope while I was in Mexico, but that as things stood at the time, it would not cover my replacement cost of my tele-

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scopes even here in Minnesota!

When I purchased this home, my wife and I tried to arrange for the best insurance that we could afford. But from what my insurance agent recently told me, insurance is designed for the "typical" household.

This is true whether you have homeowner's insurance or renter's insurance. Both policies are designed to cover what the "typical" household would include. This means such things as furniture, clocks, stereos, television sets and so on.

How many homes have astronomical telescopes? Unfortunately, very few. So in the eyes of your insurance agent, these instruments are classified as being "special" items, in much the same way that a gun collection would be. They are not covered by a typical homeowner's policy or renter's insurance policy. Rather, you would have to invest in a special insurance policy just for your telescopes or other equipment.

This means that you will have to list all of the equipment that you are insuring, providing either copies of the sales receipts or similar verification for the telescopes, lenses, tripods and so on that you wish to insure. A special "rider" in your insurance policy would then be added on and, for an extra fee, your equipment will be insured. (It is also possible to purchase an insurance policy just for your astronomical equipment if you should wish to do so.)

As for whether this special insurance policy will cover the 8-inch Schmidt-Cassegrain while I am in Mexico, we had to write to the home office of the company for a ruling on this. I was warned not to assume that any special equipment would be covered while I am out of this country, until the home office made a decision.

So there are two lessons from this experience. First, make sure that you have adequate insurance for your equipment at home. Second, make sure that you take the necessary steps to insure your equipment if you plan to go to Mexico for the eclipse in 1991.

MEMBERSHIP AND SUBSCRIPTION FEES

\$30 Regular membership with subscription to "Sky & Telescope"
\$21 Student membership with subscription to "Sky & Telescope"
\$8 Student membership without subscription to "Sky & Telescope"

All memberships include a subscription to "Gemini", membership in the Astronomical League and a subscription to their publication, "The Reflector." Student memberships are available only to full-time students.

FOR SALE

Four-inch 2045 Meade Schmidt-Cassegrain with 8 X 50 illuminated finder, wedge and tripod, drive corrector, and four eyepieces: Meade 29 and 9mm, Edmund 15mm and University Optics 6mm. \$900. Contact Walter Hayes at (612) 454-7815.

DEEP SKY EYE

By Max Radloff

At one of the recent meetings I was asked how difficult it is to see the North American nebula. The person who asked had not found it after several searches and was surprised when I said that it was not that difficult an object and it could be seen with the naked eye. As curious as it may seem, it is possible for an object to be visible to the naked eye and yet elude an observer who diligently searches with a telescope.

The objects that are considered either easy and difficult by different observers are extended objects of low surface-brightness. They are usually emission nebulae like the North American nebula or the California nebula, but the class includes some galaxies like M 33.

These objects can have quite a bright magnitude in a catalog and appear quite striking in photographs but can also be quite frustrating to locate. Low surface-brightness means that the object is only slightly brighter than the sky itself. Even in the best conditions, these objects will be quite faint and subtle and poor sky conditions or the wrong observing techniques can make them invisible.

Start looking for these objects by trying to find them when conditions are right. If an object is only a little brighter than the sky it will simply disappear when there is any light pollution, moonlight, haze, or auroral activity. Observe from a dark site when the air is transparent. It is easy to check the transparency of the air while the sun is up by observing how blue the sky is near the horizon. Normally the sky becomes whiter near the horizon.

The days when the blue is more intense, especially at a low altitude, indicate dry transparent air.

You can also monitor the color of the sun as it sets. A red sun at sunset indicates moisture in the atmosphere, a yellow-orange color shows clear air. Good checks at night are the naked eye visibility of faint nebulous objects like M 13 or the Andromeda galaxy.

Weather conditions can change rapidly, but with a little practice you will be able to tell at a glance whether it will be a night with good prospects for finding faint objects. A few times a year there is one of those nights when things you have many times looked for in vain appear as if by magic.

Next time, I will discuss observing techniques in some detail, but when you look for low surface-brightness objects, look for something that is both large and faint. You may be looking at the object and not realize it because you are anticipating something smaller and/or brighter. Good objects to try in order of increasing difficulty are the Veil, the North American and the Delta Cygni nebulae.

I have started a series of articles for Deep Sky magazine on observing open clusters that are not in the NGC. The first one, featuring the five clusters discovered by Clyde Tombaugh during his extensive search for trans-Neptunian planets, is scheduled for the fall issue.

Good luck and clear skies.

IVAN POLICOFF
LOOKING FOR
A FEW GOOD PERSONS

By Steve Korzenowski ,
MAS president

Ivan Policoff, MAS member and astronomy professor at the U of M, is looking for volunteers to help run a few lab sessions for his astronomy class this fall. If the volunteer desires, he or she can even teach a lecture or two or serve as a T.A. (teaching assistant).

As a volunteer, you will be asked to help run a few field sessions. They

will be conducted at Metcalf if weather permits. There are two or three field experiments in all.

If you volunteer, you will need a lab manual. MAS will sell the lab manual at prices below that of the U of M bookstore and it will be available in the fall. For those of you who are not involved in the class, the manual has served as a source of ideas for experiments and field projects. If you are looking for

Continued on page 6

NON-ELECTED POSITIONS

LIBRARIAN

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PROGRAM DIRECTOR

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Phone: (612) 646-8138.

SOFTWARE DISTRIBUTION

Michael Kibat
4717 Nord Circle
Bloomington, MN 55437
Phone: (612) 884-0039

STUDENT REPRESENTATIVE

David Quam
P.O. Box 13259
Minneapolis, MN 55414
Phone: (612) 625-1112

IVAN POLICOFF

-----Continued from page 5
something new to try, you might want to think about picking one up. The MAS price will be \$13.

If you have any questions, you can give me or Ivan a call.

Steve Korzenowski, 544-8335
Ivan Policoff, 484-1520

FUND RAISING EFFORTS

Our fund raising drive for the observatory will be under way by the time Gemini is mailed. The corporations that we approach are often much more willing to fund a project if one of their employees is involved with the group asking for funds.

If you work for a corporation that has a foundation, we need your help. The best approach would be for the employee to present the proposal to the foundation. If you are not comfortable doing this, a member of the funding committee will accompany you and do most of the talking if necessary.

It will still be very helpful if we only can use your name and say that one of the corporation's employees is a MAS member and is in favor of the observatory.

If you can help in any way, or if you are not sure if your company has a foundation, please call one of the following people:

Al Ominsky, 331-2062
Max Radloff, 451-7680
Mary Williams, 882-8604

It is critical to have the support of the MAS membership in this effort.

MINUTES

A request was made that the minutes of board meetings be published and, since there were a fair number of people interested in this at the July 3 regular meeting, the minutes of the board meetings and a record of all questions formally voted on at the regular meetings will be published.--Max Radloff, Secretary

MAS Board Meeting April 25, 1990

A meeting of the Board of the Minnesota Astronomical Society was held Wednesday evening, April 24, 1990, at the home of Richard Nelson. Present were board members Steve Korzenowski, Bob Liesenfeld, Max Radloff, Richard Nelson, Don Day, and Steve Boike. The meeting was called to order at 8:05 p.m.

It was reported that the blocks that had been laid at Metcalf for the warming house have been vandalized. After much discussion, a motion to send a letter of thanks and a check for the value of the blocks to Bill Volna failed on a tie vote. It was then voted to proceed with the construction of the warming house and to site it on the northeast corner.

Rick Nelson will send a letter of appreciation to Bill Volna. It was voted to reinstall a lock at Metcalf. Bob Liesenfeld will investigate what type of lock is best.

It was voted to close the savings account at Eastern Heights State Bank and consolidate these funds with the other observatory funds in the money market account at Highland Bank.

Bob Liesenfeld will make preparations for moving the telescope from Dick Bauer's to town and will handle publicity for MAS events. Max Radloff will call other observatories about how they administer the programs at their observatories.

The meeting adjourned at 10:15 p.m.

MAS Board Meeting June 20, 1990

A meeting of the Board of the Minnesota Astronomical Society was held Wednesday evening, June 20, 1990, at the home of Richard Nelson. Present were board members Steve Korzenowski, Bob Liesenfeld, Max Radloff, Richard Nelson, Don Day, and Steve Boike. Also present was Bill Volna.

The meeting was called to order at 7:45 p.m.

KSTP will air a 30-second video about the MAS as a public service announcement if we can find someone to appear in the tape.

The Science Museum wants the MAS to run its astronomy programs. In return we will receive 85 percent of the revenue generated. These would consist of about six Starwatch programs a year, some sidewalk astronomy, and perhaps some planetarium programs in the Omnitheater. There are enough volunteers to do the programs already scheduled and Max Radloff will plan the future programs with Chuck Penson from the museum.

It was voted to authorize the purchase of the photometer that was offered for sale at the NCRAL convention if it is still available and can be bought for a good price. Max Radloff will call the person that was selling it.

Don Day is negotiating with the Roseville schools to get space for his mirror-making classes. He said chances are good for getting some space free of charge.

The grass at Metcalf needs mowing. Don Day and Max Radloff volunteered to mow it and recruit additional help if needed so it will be mowed by this weekend's (June's) star party.

A discussion followed on how to proceed with the construction of the warming house at Metcalf. Since there is no one willing to act as project supervisor, it was decided that the various tasks would be divided between those who volunteered to work on the warming house, with the board being responsible for the general planning.

The meeting adjourned at 9:15 p.m.

MAS Regular Meeting July 3, 1990

At the regular meeting of July 3, 1990, it was voted to cast our ballot for Astronomical League president for Jim Fox, to cast our ballot for vice-president

Continued on page 7

MINUTES

-----Continued from page 6
for Larry Jahn, and to approve the two proposed amendments that would create a student AL membership category and would allow the AL to borrow money from the Trust Fund in a dire emergency.

PEGASID METEOR SHOWER WATCH

The 16th annual Upsilon Pegasid Meteor Shower Watch is currently underway. The watch marks a continuing effort to track the orbital elements and other characteristics of this relatively new meteor shower. The maximum of the shower is thought to be Aug. 8. Unfortunately, full moon occurs Aug. 6, so the most advantageous time to observe these meteors will be early mornings prior to full moon or later in August, especially the weekend of Aug. 18.

The velocity of these meteors is slightly slower than the Perseids and slightly faster than the Delta Aquarids. The average magnitude is slightly fainter than that of the Perseids. The most commonly reported color is yellow-white. Most shower members have not left significant trails.

On Aug. 19, 1982, the European Meteor Network photographed an Upsilon Pegasid fireball with five of its Czech cameras. The magnitude of the fireball was -14.0.

The current focus of research, literally, is photography of the shower radiant.

Any observations or photographs of this shower should be forwarded to: Hal Povenmire, 215 Osage Drive, Indian Harbour Beach, FL 32937. His telephone number is (317) 777-1303.

AUGUST METEOR PHOTOGRAPHY

By Carl Harstad

August usually the premier month for meteor photography, with showers such as the Perseids and Upsilon Pegasids occurring. For those of you who wish to try photographing meteors, here are some basic recommendations:

1. Don't waste your time and film taking meteor photographs unless it is close to the maximum of a shower, you know the radiant and likely location of meteors that will occur, you are in a relatively dark location and the night is not moonlit.
2. Piggy-back your camera on telescope with a clock drive, if you have one, and run the drive at sidereal rate. That way the meteor trails will be very distinct against the background of stars. If you don't have a telescope with a clock drive or don't want to go to the hassle of setting up your scope, mount the camera on a regular photographer's tripod.
3. Set the camera on time exposure (B). If you don't have a time-exposure shutter lock on your camera, a wide, tight rubber band wrapped around the camera over the shutter release will work fine. Bring a spare in case you snap it! You can also use a locking shutter release cable.
4. Use a 50mm, or normal, lens, preferably one with a fast focal ratio (f/1.4-f/1.8). Normally, do not use a wide-angle lens. It will increase your

chances of catching a meteor in the field of view but, unless the meteor is very large and bright, it will not appear on the negative. A telephoto lens is not recommended unless you are trying to capture telescopic meteors because the focal ratio is higher (usually f/2.8) and the field of view very small.

5. Use a very fast film, preferably black and white. T-Max 3200, which can be pushed to 6400 or 12800, is recommended. It is readily available locally at National Camera Exchange or other commercial photography retailers. If you try color, meteor experts are recommending Konica SRV 3200, which I have not yet tried.
6. If you have access to electricity at the observing site, bring a hair drier and an extension cord. (There must also be driers that plug into your cigarette lighter on your automobile, even though I don't have one.) Toward early morning, the best time for photographing meteors, lenses tend to dew up. Set the drier on the lowest setting! You only need to remove the dew, not melt the camera.

If you don't have electricity at your observing site, you can always remove the camera to your automobile and hold it by the heater or defroster briefly to remove the dew. Don't try to dry it by wiping off the lenses. That leaves water and lint on them and they tend to fog up again almost immediately.

7. Use short exposures, especially in the metropolitan area where skies are relatively bright. ASA 400 film fogs in three to five minutes. You can expect ASA 3200 film, which is eight times faster, to fog much more quickly. Although I have not used the T-Max 3200 film, which came out at the start of this year, it could potentially fog in 30 seconds under the Twin Cities light dome!

I suggest trying various exposures from 15 seconds up to three or four minutes to determine the optimal exposure for the film and observing site you use. That way you can use the optimal exposure time on future meteor-photography excursions.

8. Due to the short exposures necessary, it is best to restrict your photography to the optimal hours for the shower you are attempting to photograph. This usually means the hours after midnight until morning twilight, when you have the best chance to record a meteor on film because they are more

Continued on page 8

METEOR PHOTOGRAPHY

-----Continued from page 7

frequent. Otherwise, you will go through more film than anyone can afford to. Photographing six hours with one-minute exposures would require 10 36-exposure rolls!

9. If you think a meteor passed through your field of view, close the shutter immediately and record the time, frame number, constellation, direction of travel, color, estimated magnitude and whether any train was left. (Keep your paper covered or it will get damp as the night progresses and you will be unable to write on it. A clipboard with a cover sheet works well.)

10. Have your film developed at a professional lab or do it yourself if possible. If that is not possible or too expensive, be sure to request "Develop only." It is usually difficult to determine when frames start and end on astronomical photographs. Unless you want your film cut in mid-frame, request "Do not cut!" When you cut it yourself, cut it in four or five-frame lengths.

To avoid damage to your negatives, store them in the plastic negative sheets available at photo stores. Each sheet holds about 35 frames, or one long roll, of 35mm film. A package of 25 sheets currently cost about \$5.90, or only 24 cents per a

36-exposure roll of film. (You can usually find one frame that isn't worth saving; the other 35 frames will fit into the sheet.)

11. Don't forget to enjoy the show while you're taking photographs. Bring a reclining lawn chair, warm clothes, a blanket, some goodies (be sure to bring enough to share; I might be there too) and something to drink. Then lean back and enjoy the meteors.

Remember, very few, if any, of the meteors you will see in a given night will pass through the field of view of your camera while the shutter is open. Also, many meteors will be too swift and/or too faint to leave a record on the photographic emulsion.

If your camera has a field of view of three by five degrees, it is trained on only 1/2,160th of the visible 180-degree celestial dome! Even if you optimize your chances by photographing near the radiant of the meteor shower and at the optimal time, it will take a certain amount of good luck to capture that spectacular meteor photograph you are after.

So, if you come up with lots of star trails and nothing else, welcome to the hobby of meteor photography! If you keep trying and do things right, sooner or later you will get that photo that is important to astronomical research and rates "Sky & Telescope" or the wall of your study.

GEMINI

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