SDAA

San Diego Astronomy Association

Promising the Sun, the Moon, and the Stars...and Delivering!

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A Non-Profit Educational Association
P.O. Box 23215, San Diego, CA 92193-3215

SDAA Business Meeting

Will be held at:

SKF Condition Monitoring
4141 Ruffin Road
San Diego, CA 92123-1841
May 14th at 7:00 pm

We Need Your Support at the New Location for SDAA Program Meetings

The next three program meetings will be held at Mission Trails Regional Park. The next meeting is on Wednesday, May 15 and will feature Nick Marilao's presentation on R.T.M.C. See the articles on page 4 for more details.

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Focusing for Astrophotography—Part 2 by Jerry Lodriguss

Editor's Note: This is part two in a series of articles written by Jerry Lodriguss that are being reprinted in the newsletter with his permission. You can see more of Jerry's work at www.astropix.com.

Definitions and Formulas

What is focus?

An optical system can be considered focused when the maximum amount of light from a star is concentrated into the smallest possible area on the film, yielding the smallest possible star size for a given combination of optical quality, seeing, tracking and mechanical considerations.

How is focus achieved?

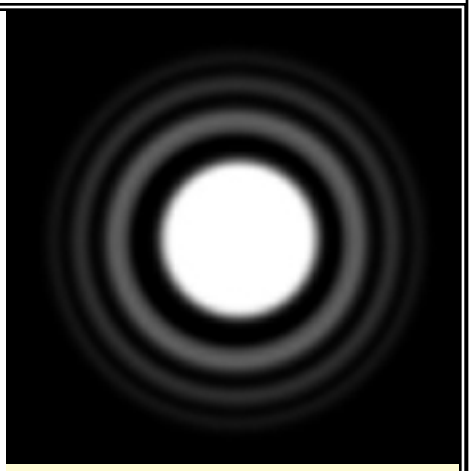
Focus is achieved by making the film's emulsion, or CCD surface, coincident with the focal plane of the telescope.

Depending on the type of telescope, this can be accomplished by physically moving the film (rack and pinion or helical focusers), the primary mirror (Schmidt Cassegrains, Maksutovs), or the secondary mirror (High-end Ritchey-Chretiens and Cassegrains).

Exactly how critical is focus?

It depends on what you are trying to achieve and how you define it. For this examination, we will consider the best focus to be when the telescope and film can record the finest details in terms of contrast and resolution.

The quality of focus will depend on these factors: f/ratio and depth of focus of the optical system; the quality and resolution of the optical system; the resolution,



The Airy Disk

sharpness and contrast of the film; the accuracy of the tracking during the exposure; the quality of the seeing during the exposure; and the accuracy of the focus.

Description of the Image

To talk about focusing a star on film, we have to understand exactly what the image will look like, and what size it will be at the focal plane.

The stars we see in the night sky are so far away that they are essentially points. But the image that forms at the focal plane is not a point, because the light that passes through the circular aperture opening of the telescope suffers from the effects of diffraction.

Diffraction occurs because of the wave nature of light. In practical terms, a disk of light forms at the focal plane instead of a point. It is called the "diffraction" or "spurious" or "Airy" disk, after British Astronomer Royal Sir George Airy.

The Airy Disk

This disk has a measurable diameter that

(continued on page 6)

My LX200 Two-Star Alignment Procedure by Scott Baker

I know we have a lot of Meade LX200 owners in our membership and I thought I'd share with you my method of doing the two-star alignment for Alt/Az mode. How many times have you picked your two alignment stars and slewed to the first one, centered it, did the GOTO to the second one, centered it, then found that your GOTO accuracy was WAY off? You then realized that maybe that first star wasn't the right one after all. I mean, who really knows where Bogardus is in the sky, or can't remember if Pollux is the left or right star in Gemini. So you try it again, and maybe, get it right this time.

I use a procedure that uses the scope's own GOTO to help me. This procedure will only work with LX200 telescopes and not the newer GPS versions. I've written this with a lot of the keystrokes left out, assuming you have done a two-star alignment before, so forgive me if you're a beginner and all this seems strange. If you would like help with your scope, I'll be glad to help you at the next star party, just send me an email and let me know.

I first start by doing the standard setup. I level the scope and point the control panel as accurately as possible at true North. I Level the optical tube assembly and have it pointing due South. Turn on the scope and make sure the time, date and location are very accurate. At this point, Meade would have you start the two star alignment and here is where my procedure differs.

Almost always, at an observing session, there is at least one known bright object in the sky at dusk, be it the Moon, Jupiter, Venus, etc. that we KNOW is that object. So, before I do my two star alignment, I do a GOTO to that bright object, let's say for practicality that it's Venus, which will be in the evening sky for the next several months. So I press [STAR] [9][0][2] [ENTER] and [GOTO] the scope will slew to where it thinks Venus is. Now center Venus in your eyepiece and sync on it by holding down the [ENTER] key until is beeps and says "Object Synced." At this time I usually make sure that my finder scope is aligned as well.

Now let me digress a little and tell you of two tools I use to get the absolute best alignment, that usually results in objects being in the center of my field of view of my 14mm eyepiece, almost every time. These two tools are a 12mm reticle eyepiece and the computer program "Best Pair 2." I use the reticle eyepiece to make sure the alignment stars are exactly in the center of the field of view and "Best Pair 2" to tell me the best two stars to use for alignment at any given time. Now you don't need a laptop at the site to run the program, simply set the time of observing into the program and make a note of the two stars it tells you for when you are at the site. The program is for Windows users (sorry Mac's) and it's FREE! You can download it from the following web site:

http://www.ilangainc.com/bestpair/

What the program does is determine the best two stars based on mathematical formulas that take into account position angle in the sky, atmospheric distinction, etc. and gives you the results. I highly recommend it. Now, back to the procedure.

So we've now synced the scope on Venus (or whatever you used) and aligned our finder scope. Now do a GOTO to the first star of your two star alignment—preferably the star closest to the object you synced on. It won't be in the eyepiece when the scope stops, but it will be in your finder, so center it in the reticle eyepiece. Now start the Meade two star alignment procedure. You'll get to the step where it says to center the first star, which you've already done, so press [ENTER]. Now select your second star from the list and press [GOTO]. Center it, press enter and you're done. No guess work required on the first star, or the second, and you now have a good alignment. The real benefit of this procedure is that you can usually do it before it gets really dark. Most of the Meade alignment stars are bright, and can be seen in the finder well before they can be seen naked eye. All you need is bright planet or the moon to start with. I've even done this procedure in broad daylight, it requires more slewing to find the stars with the scope, but it can be done! I hope you find this procedure useful. Clear Skies!

Eyepiece Shootout 2, 10 mm - 10.5 mm wide-field eyepieces by Bret Akers and John Kuhl

The competitors:

The 10 mm Tele Vue Radian is a 6-element eyepiece with a 60-degree apparent field of view and 20 mm of eye relief. In addition, the Radians are advertised as parfocal with full multicoatings and blackened lens edges. The street price for this eyepiece hovers around $240.

The 10.5 mm Pentax XL is a large 6-element eyepiece with an apparent field of view of 65 degrees and an ED, extra-low dispersion, lens element. Like the Radian, the 10.5 mm Pentax XL has 20 mm of eye relief. The Pentax XL eyepieces are advertised as having "super multicoatings." It's my understanding that this means the multicoatings are not identical on all air-to-glass surfaces, but have been optimized with different coatings when appropriate. The street price for this eyepiece hovers around $228.

Testers and observing conditions:

John Kuhl and I performed this test during the April 13th TDS star party using John's 14" f/4.5 Dobsonian as the test platform. The seeing hovered around a 5 or 6 for most of the test and the 160X magnification that these eyepieces provided was pushing the limit of usable power for that time of the night.

On-axis sharpness: The on-axis sharpness was extremely close. In fact, it was hard to tell any difference between the sharpness the two eyepieces when looking at clusters and the airy disks of stars with varying magnitudes. It's possible that the seeing was the limiting factor for this test, but my guess is that any difference in sharpness between these two eyepieces would be extremely minor at best. Call it a draw on sharpness. Edge: Draw

Off-axis sharpness: See above comments. Edge: Draw

Contrast: Of all the optical evaluations between the two eyepieces, contrast was the easiest to evaluate. The Pentax XL had superior contrast. Period. It's not that the Radian was bad, it looked really good on its own. The Pentax XL, however, was exceptional performer in this category. M65 and M51 were used for comparison and the Pentax XL consistently showed a darker background with more dust lane detail and better defined galactic core. Edge: Pentax XL

Light transmission: Some of the fainter stars in the Beehive Cluster, M44, were used for this test and the results were very close. However, the Pentax XL seemed to pull in some of the fainter stars. Also, when we slewed back to M65 and M51, we noticed that the galaxies' cores looked a bit brighter in the Pentax XL. Edge: Pentax XL

Field flatness: This test was performed in the daytime by looking at distant power lines and noting the distortions and field curvature. The Radian distorted the field of view the least, but it's possible that this was partly due the Radian's slightly narrower field of view. However, the edge was given to the Radian in this test. Edge: Radian

Eye relief and comfort: Since both of these eyepieces have 20 mm of eye relief, a movable eyeguard is provided to give non-eyeglass wearers the proper eye position. The Radian uses Tele Vue's click-stop Instadjust while the Pentax XL has a unique, twist-up rubber eyecup. The Instadjust is definitely much quicker to use and more intuitive, but Pentax XL's solution gives a more precise head position and doesn't give you the unnerving feeling some get when using an eyepiece with Instadjust that has the spring wire tension set too loose. The Pentax XL is also less sensitive to eye placement and was more forgiving when searching for the correct head position. Edge: Pentax XL

Chromatic Aberration: On-axis, these eyepieces were both stellar performers. No chromatic aberrations were visible. Toward the edge of the field on bright objects, off-axis color crept in with the Radian but the Pentax XL remained essentially color free. Edge: Pentax XL

Coatings: Both eyepieces had nice, smooth coatings, but looking down into the Pentax XL was like looking into a black hole. Shining a laser down into the eyepieces also reveals some differences. There is definitely less reflectivity on the Pentax XL lens elements and it becomes apparent that the Pentax XL's coatings vary by lens element when you look at the laser's reflection as it hits each surface. In contrast, the Radian showed almost identical reflections at each surface. Edge: Pentax XL

Conclusions: After we finished the test at TDS and reported our preliminary findings, there were a few people who wanted to see for themselves that the Pentax XL was better in so many categories. As far as I know, everyone who performed the same tests that night cane to the same conclusion. The 10.5 mm Pentax XL outperformed the 10 mm Radian and would be the eyepiece of choice if overall performance is your main concern. However, there is a caveat and it's mostly related to the bulk and weight of the Pentax XL. If your passion is binoviewing or if your scope has balance issues, you may find the 10 mm Radian easier to use and a better choice. In addition, the Radian is rumored to have less light scatter than the Pentax XL or almost any other type of eyepiece. If you have a scope with a very long focal length and intend to use a 10 mm eyepiece as a planetary eyepiece, you may want to interview both eyepieces before making a decision.

Note: The opinions expressed in this review are solely those of the author(s) and do not constitute an endorsement by the San Diego Astronomy Association.

Program Meetings—New Location by John Restivo

Due to a scheduling change by the Ruben H. Fleet Science Center, it has become necessary to relocate the monthly Program Meetings. Thanks to the assistance of Brian Staples, the next three Program Meetings will be held at the Mission Trails Regional Park. The meetings will be held on the third Wednesday of each month: May 15th, June 19th, and July 17th. We will be using the theater/lecture hall in the main administrative center from 6:30 to 9:30p.m. Refer to associated article for more details.

I wish to express the importance of more member attendance to show both Mission Trails Park officials and the Park Rangers our desire to continue this relationship well after July's meeting. This is an excellent location for both our meetings and stargazing. It serves both the public and SDAA in multiple ways and can really help the club in establishing new contacts with city and county officials. Lets show the community what the SDAA has to offer; support the club and make this new location a positive event!

Program Meeting—May 15th by John Restivo

R.T.M.C. (Riverside Telescope Makers Conference), the annual event that brings both amateur and professional astronomers together and slightly drains ones bank account, is scheduled later this month. If you haven't had the opportunity to attend this astro bash or are new to the hobby, you'll definitely want to attend this program meeting presented by SDAA member, Nick Marilao.

Nick has been a member in good standing since 1983. As a substitute teacher for the San Diego Unified School District, Nick has also devoted many evenings to the club's school star party program. For the last five years, Nick has developed his skills in astrophotography. Nick has compiled his last few attendances at RTMC into a fun and interesting slide presentation that allows one to see and enjoy the various amenities. Coupled with his personal experiences, this will be an entertaining precursor for your own trek to the convention. More importantly, you can leave your checkbooks and credit cards home!

The theater has seating for 100 people, so let us make this premier event at Mission Trails Park an impressionable one that both the directors and Park Rangers will remember. WE NEED THE CLUB'S SUPPORT! I cannot emphasize this enough. As an added bonus, weather permitting, telescopes will be set up outside the courtyard amphitheater for stargazing. For being in the city, the skies are impressively dark. The doors open at 6:30 pm and our meeting will start at 7:30 pm. Stargazing and usage of the theater will conclude at 9:30 pm.

Camp With The Stars by Michael Dietz

Our first stint at William Heise Campground this year will be the weekend of May 11th. If you can make it out a day early, we will be hosting a star party for the Girl Scouts at Camp Winacka Friday night just a couple of miles from Heise campground. To reach the Girl Scout Camp follow the directions to William Heise Campground to Pine Hills Road.

Before you reach Frisius Drive, bear right on Eagle Peak Road. Follow Eagle Peak Rd. 1 1/2 miles to the junction with Boulder Creek Rd. Go left 1/4 mile and bear right on Boulder Creek Rd. When it joins Pine Hills Rd., continue on Boulder Creek Rd. 1/2 mile to the entrance to Camp Winacka on the right.

As always, we will set up for solar viewing around noon at Heise in the meadow area. If you have a solar filter please join us in the afternoon. If you plan on attending please let me know at (619) 562-2726 so I can make arrangements to accommodate everyone.

To reach William Heise take Hwy. 67 North through Ramona where it then turns into Hwy 78. Continue East on Hwy. 78 through Santa Ysabel and head towards Julian. A couple of miles before Julian, turn right on Pine Hills Road and head South. Continue about 2 miles to Frisius Drive and turn left. Head East on Frisius Drive about 1 ½ miles to the park entrance. Let the rangers know you are with the SDAA and they will show where we will be camping. We will be set up at the picnic area east of the caravan area.

Acknowledgments by Michael Dietz

The club would like to thank Dean Belcher, Rich Bentley, Carolyn Corless, Mike Dietz, John Dobson, Stu Hall, Doug Hansen, Jose Magsaysay, Nick Marilao, Doug McFarland, Joe McGerald, Garry Mose, Jennifer Pesqueira, Gregory Santos, Cindy and Terry Stewart, Jim Traweek, George Varga, and Bob Wetzel for helping with the school star parties, Camp With The Stars, and Stars In The Park programs. Your efforts are greatly appreciated by the students, parents, and teachers.

Light Pollution Forum Report by Scott Baker

I, and several other SDAA members attended the April 23rd Public Forum on Light Pollution and found it, in my opinion, under whelming. The expected crowd of 100 or so people turned out to be 40 at best. Most attendees were IDA,

SDAA, OPTAS and OCA members. Don't get me wrong, the talk by Dr. Crawford was informative as was the talk and slides done by Russell Sipe of OCA. I just feel that the lack of participation by politicos and the general public was a disappointment. A cameraman from KUSI, I believe, was there. Lisa Bruhn, the new, local section leader reported that there were less than 300 IDA members in Southern California. To me, this was a shock! We really need to get behind this group. If we're to do anything to stop light pollution, the best way is to become a member. It is 100% volunteer run and is financed by membership dues and donations. So go to the IDA web page www.darksky.org, fill out an application and send it in!

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SkyWatch for May, 2002
John Mood

[Times PDT] [* = Easy] [** = Moderate] [*** = Difficult]

Fri., 3 May ---- MARS only 2¼º from SATURN (see below).

Sat., 4 May ---- STAR PARTY @ Tierra del Sol.

Mon., 6 May ---- VENUS only 2½º from SATURN & those 2 planets + MARS fit w/in a 2º 49' field of view in Taurus (see below).

Fri., 10 May ---- VENUS only ¼º [!!!] from MARS (see below).

Sat., 11 May ---- STAR PARTY @ Tierra del Sol.

Sun., 12 May ---- NEW MOON, 3:45 a.m.

Sun., 26 May ---- FULL MOON, 4:51 a.m.

Sat., 1 June ---- STAR PARTY @ Tierra del Sol.

Mon., 3 June ---- VENUS & JUPITER less than 2º apart (see below).

Sat., 8 June ---- STAR PARTY @ Tierra del Sol.

EVENING PLANETS:

As you can see above, all 5 naked eye planets are dancing w/ ea. other shortly after sunset for the 1st ½ of the month. DON'T MISS THIS RARE TREAT! The last time it happened Reagan was prez. You'll need a clear view of the western horizon. In addition to the above noteworthy sights, are the following happenings:--

MERCURY in Taurus is best seen the 1st week of the month (it fades as fast as it drops), but on Monday the 13th, the thin 40-hour-old crescent MOON will be 3º to the lower left of Mercury so you should be able to spot the planet in binocs.

VENUS, MARS & SATURN fit w/in a 5º circle in Taurus from the 3rd thru' the 10th.

On Sun., the 5th, a 9º circle will include 4 planets & Aldebaran.

On Mon., the 13th, all 5 planets are closest together, spanning only 33º of the ecliptic, w/ the MOON just below Mercury (see above).

VENUS is racing from Taurus to its meeting w/ JUPITER in Gemini on 3 June.

& of course, all this time, the MOON is passing ea. planet for several beautiful pairings (& triplings & quadruplings!).

As I noted last month, (1) this is not a one-night deal; watch the planets move in relation to each other & to the several near-by bright stars. & (2), if you get up an hour or 2 before dawn, you can also add NEPTUNE in Capricornus [**] (w/ a telescope) & then URANUS in Aquarius [*½] (w/ binocs), & thereby will have seen all 7 major planets in one night; you younger observers with especially good eyes might even try for Uranus naked eye & bag 6 planets that way.

TIERRA DEL SOL

LAT = 32º 36' 46" N (± 0.l"), LONG = 116º 19' 55" W (± 0.1"), ELEV = 3710' (± 5'), at the bathroom, as determined from USGS 7.5 min 1/24000 map.

Send comments & questions to me by phone (619/225-9639), USPS (4538 Long Branch Av., San Diego, CA 92107) or my newe-mail address

(1happyalien@cox.net).

¡HAPPY VIEWING!

can be calculated. It is surrounded by a series of faint rings which can grow brighter with larger secondary obstructions. So the actual image formed looks like a bright disk surrounded by a dark ring (the interspace) surrounded by the first bright ring, surrounded by another dark interspace, surrounded by another fainter bright ring, and so on till the outer rings become too faint to be seen.

If we can get the film to coincide with the focal plane of the telescope, what we call "focused", this diffraction disk then is the smallest we can ever expect to image a star on film in theory.

Usually, only the brightest part of the Airy disk itself and none of the rings are recorded on film, so the actual size of the Airy disk that would be recorded on film would be less than the numbers given in the table below.

However, in the real world, the size of the star we record on film is always larger, due to other factors such as focus errors, size of the film grain and resolution of the film, irradiation in the emulsion, the quality and color correction of the optics, and the seeing and tracking during the length of the exposure.

Spot Size of the Airy Disk

According to Sidgwick (Amateur Astronomer's Handbook p.38), the formula for the size of the Airy disk d is:

d = 2.44 x lambda x f

Where

- d is the linear diameter of the first interspace (the middle of the dark zone that separates the Airy disk from the first ring)
- 2.44 is a constant
- lambda is the wavelength of the light
- f is the Focal Ratio of the telescope.

Working with a wavelength of 650 nanometers in red light (to give a size more appropriate for film than 550 nanometers in yellow light which the eye is more sensitive to) this works out to:

d = 2.44 x 0.00065mm x f

or

d = 0.001586mm x f

From this formula, we can see that the linear size of the Airy disk is only dependent on f, the focal ratio of the telescope, and that "faster" optical systems form stars with a smaller diameter Airy disk.

For a telescope of a given aperture, if we double the focal length, we double the size of the Airy Disk.

These numbers have been calculated for light only at a single wavelength of 650 nanometers only, and in reality, if you are imaging a continuum light source, these numbers will change, usually growing to the longest wavelength to which the film is sensitive.

Any wavelengths that are not focused correctly, as in achromatic refractors where all of the colors do not come to the same focus, will increase the sizes here also.

These numbers can also change if you are imaging in with a narrow bandpass filter, such as a hydrogen-alpha filter.

Depth of Focus

There is no one "exact point" of focus, but rather a range of focus where the converging and diverging light cones overlap by an amount equal to:

2 x f x d

where

f is the focal ratio of the telescope

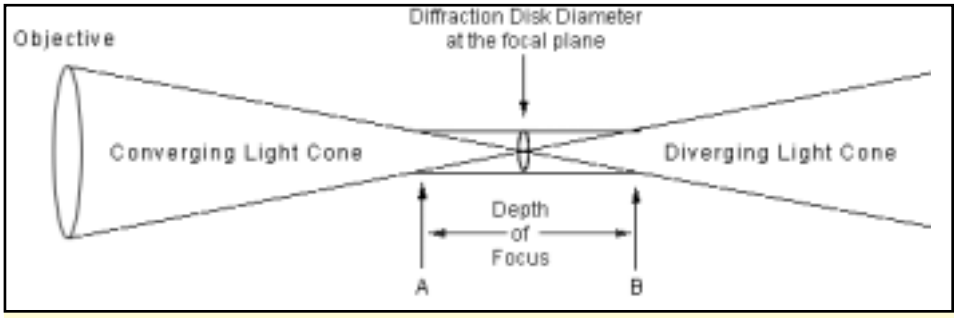
and d is the diameter of the Airy disk.

This is called the depth of focus.

Within the depth of focus, the spot size of the Airy disk stays the same and can be considered focused.

Note that depth of focus is different from depth of field. Depth of field describes the range of focus that appears sharp in a photograph for subject planes in a scene for a given lens at a particular focal ratio.

Depth of focus describes focus at the film plane, and depth of field describes focus at the subject.



Depth of Focus

In this diagram we can see what is actually happening. In most diagrams of the light cone, the focal plane is shown with the light cone coming to a point. Since diffraction causes this point to be a disk in the real world, focus can be considered to be anywhere in the converging or diverging light cone where the diameter of the cone is equal to or less than the diameter of the Airy Disk. In the diagram, anywhere from A to B, which is equal to 2 x f x d.

For an f/8 telescope that can form an Airy disk about 12.7 microns in diameter, there is a range of focus of about 200 microns or .008 inches where the Airy disk will stay at this size. This is for an unobstructed telescope with excellent optics in a best case scenario.

	Linear Diameter of the Airy Disk		
Focal Ratio	in millimeters	in microns	in inches
f/1	0.001586 mm	1.586 um	.000062"
f/1.4	0.002220 mm	2.220 um	.000087"
f/2	0.003172 mm	3.172 um	.000124"
f/2.8	0.004440 mm	4.440 um	.000174"
f/4	0.006344 mm	6.344 um	.000249"
f/5.6	0.008881 mm	8.881 um	.000349"
f/8	0.012688 mm	12.688 um	.000499"
f/11	0.017446 mm	17.446 um	.000686"
f/16	0.025376 mm	25.376 um	.000999"

Linear Diameter of the Airy Disk

	Depth of Focus		
Focal Ratio	in millimeters	in microns	in inches
f/1	.003172 mm	3.172 um	.000124"
f/1.4	.006216 mm	6.216 um	.000244"
f/2	.012688 mm	12.688 um	.000499"
f/2.8	.024864 mm	24.864 um	.000978"
f/4	.050752 mm	50.752 um	.001998"
f/5.6	.099467 mm	99.467 um	.003916"
f/8	.203008 mm	203.008 um	.007992"
f/11	.383812 mm	383.812 um	.015110"
f/16	.812032 mm	812.032 um	.031981"

Depth of Focus

An Airy disk of 12.7 microns in a 130mm aperture f/8 refractor corresponds to a star size of about 2.5 arc seconds.

Problems and Considerations

To get our astrophotos in focus, all we have to do is get the emulsion side of the film to be coincident with the focal plane of the telescope. Simple, right?

Well, unfortunately, not quite. This simple idea can turn out to be remarkably complicated.

First we have to figure out where the focal plane of the telescope is. This is done by various methods of focusing.

Then we have to make the film's emulsion falls within the depth-of-focus range of the focal plane of the optical system and keep it there during the length of the exposure. These are not a trivial tasks. Many factors and considerations contribute to the success or failure of these critical undertakings.

Description of the Telescope's Focal Plane

The first problem is that the focal plane in most telescopes is not a flat plane. It is curved. If the film is held flat all of the stars will not be precisely in focus across the entire film plane.

An optical field flattener corrector lens can used, but it must be matched to the optical system of the telescope.

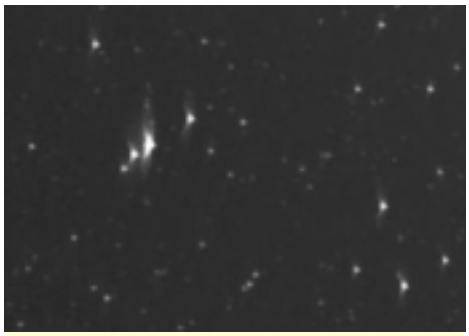
Schmidt cameras correct for this problem by actually bending the film in a special film holder that makes the film plane curve to coincide with the curved focal plane.

For other telescopes used without a field flattener, we can focus about 1/3 of the way from the center to the edge of the field and thus arrive at a compromise focus for most of the frame.

Other Problems

There are other problems not related to focus, such as imperfections in the telescope's optical system like coma, astigmatism, curvature of field, and spherical and chromatic aberration that will degrade star images.

Inadequate tracking, guiding, or polar alignment, as well as poor seeing, dewing and differential atmospheric refraction can all result in stars on film that are less than perfect that can sometimes be mistakenly confused with bad focus. It is important to be familiar with what these errors look like so correct judgments can be made and solutions implemented.



Coma at the Edge of the Field

Exactly how critical is the focus? It depends on several things, including; how critical you are, the resolution your telescope or camera lens is capable of, the resolution your film is capable of, and the depth-of-focus related to the speed of the optical system.

In addition to the optical quality of the telescope and focus accuracy, the resolution of the final image will ultimately be limited by the quality of the atmospheric seeing and tracking of the telescope during the exposure. The last two factors set a lower limit on the resolution that you can achieve on film, so even if your scope and film were capable of resolving much more than about 1 arc second, you will not be able to record this on film during long exposure film astrophotography.

Camera Bodies

It is assumed that a 35mm Single Lens Reflex (SLR) camera will be used for amateur astrophotography because it is easiest with which to aim the telescope and camera, and then frame the object to be photographed. Much of the following discussion applies to larger format cameras like the Pentax 6x7 also.

Nikon F3 and FM2

Other solutions, such as custom camera bodies like the Taurus Astro Camera can be used, but present many similar problems.

Virtually any camera body that is capable of locking the shutter open for extended periods of time can be used for astrophotography, the difficulty is focusing them accurately.

Certain features on camera bodies can be desirable for convenience however. If you plan on focusing through the cameras viewfinder system, then interchangeable focusing screens and removeable prisms can make life much easier, even though they are not an absolute necessity.

Camera bodies for astrophotography are discussed in detail on my camera body discussion page, here only the specifics as they apply to focusing are examined here.

Removable Pentaprism Finders

A removable pentaprism finder is not absolutely necessary, but can add greatly to the convenience and ease of acquiring a celestial object, framing it, and then focusing on it.

Removable Pentaprism and Screen

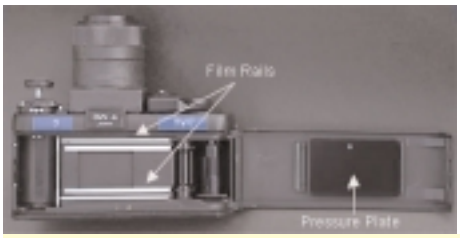
Other accessories can be substituted for the prism, like the Nikon DW-4, a dedicated 6x high magnifying finder that views the entire focusing screen and is diopter adjustable from -5 to +3.

A camera without a removable pentaprism finder can still be used for astrophotography, as witnessed by the incredible work of Chuck Vaughn, but is definitely not as convenient, especially under circumstances such as shooting with a refractor overhead or an SCT pointed near the celestial pole.

Camera companies make right angle magnifying attachments that can help, but generally do not perform very well because of their small field and dim view.

Inside the Camera Body

If you take the lens off the camera and look in the front, you will see a mirror that intercepts the light before it gets to the shutter and film. The light is redirected upward to where it falls on the bottom of the focusing screen. The pentaprism finder then correctly orients the image so it is right-side up and not reversed, and is magnified a bit for ease in focusing. This system works very well for normal daytime terrestrial subjects, but not so well for astrophotography where the focus is very critical.



Film Guide Rails and Pressure Plate

Opening the camera back, you will see two shiny metal rails that guide the film as it goes through the camera from the film cassette to the take up reel.

The edges of the film by the sprocket holes actually sit on the inner rails. The outer rails serve as a guide for the film and a resting place for the pressure plate that is attached to the camera back. The pressure plate holds the film in place in between the inner rails and presses it down so that it is relatively flat.

If the film was held perfectly flat on the inner rails, then we would want the focal plane to be coincident with the plane defined by the inner rails however the film bows back from the inner rails due to its natural curl.

Where IS the focal plane?

The difference in height between the inner and outer set of rails is fixed at about 0.25mm (0.01 inch). It must be large enough to accommodate the thickest film a photographer might want to shoot. The thickness of various films can vary a lot due to the thickness of the base stock that the emulsion is coated on, from the very thin Kodak Technical Pan film to the thick Fuji Velvia.

For instance, Kodak Elite Chrome is 0.13mm (.005 inch).

So when a thin film is used, there is considerable room for it to move and not be held flat. Due to the film curl from being wound up in the cassette, the film will usually press against the pressure plate drawing the emulsion up off the inner rails.

The actual plane of the emulsion will then be the thickness of the film away from the pressure plate. The actual location of the emulsion will vary depending on the thickness of the film, and will usually not be on the inner rails. This is important to remember when knife-edge focusing.

So where do the camera manufacturers define the focal plane inside of their cameras to be? Do they build in a "fudge factor" here for where the focal plane will fall figuring an average that is actually somewhere between the two sets of rail's heights? Nikon says that the distance from the camera lens mounting flange to the film plane is: 46.5mm.

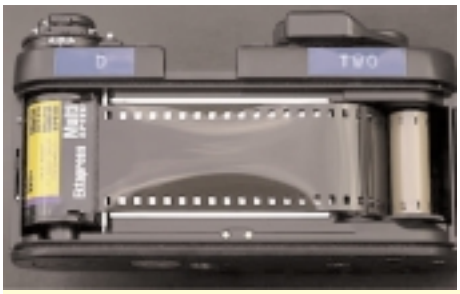
Luckily, we can adopt focusing habits and build a solution into the design of the knife-edge device that will make the question of where the manufacturers locate focal plane moot.

Film Flatness Questions

The film plane must be flat, except in cases where special film holders are constructed to match the film plane to the curve of the focal plane.

It must also not be allowed to move at all during the entire exposure.

Since there can be space for the film to buckle and move due to the difference between the thickness of the film and the difference in height between the inner and outer film guide rails, the question of holding the film flat must be addressed.



Film's natural curl as it sits in the camera

An Experiment

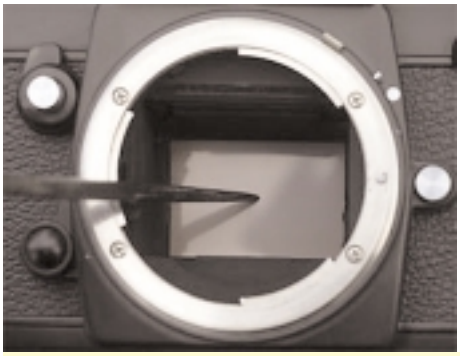
To demonstrate that the film is not really being held perfectly flat inside your camera, try this experiment.

Carefully poke the film with an ice pick

Take a roll of expired film that you were going to throw away, and load it into the camera advancing it several frames. Take off the lens, lock the mirror up, and lock the shutter open.

Examine the film through the front of the camera with a bright specular light source behind you. Angle the light so that it reflects off the emulsion side of the film and you can see the reflection of the light.

Take a pointy device like an ice pick or pocketknife blade and carefully poke at the film. You will easily see it move by watching the specular reflection of the light. Being able to poke it down means



Carefully poke the film with an ice pick

that the film is not being held flat.

If the deviation in flatness is more than the depth of focus, problems will result.

Solutions to this problem can involve specially constructed vacuum backs powered by pumps that literally suck the film back to the pressure plate. Peter Ceravolo uses a pump for mother's breast milk for this purpose.

Note that if you use a vacuum back in a 35mm camera with techpan, the emulsion side of the film is definitely not be sitting on the inner rails and this must be taken into account when focusing.

I have an F3 body specifically dedicated for Tech Pan with the outer rails milled down so the difference in height between the rails is exactly the thickness of the film, so I know my film sits on the inner rails.

Chuck Vaughn does not use a vacuum back, but solves the problem of Technical Pan film being so thin by placing high quality adhesive "Scotch" tape on the pressure plate of his Olympus camera and calibrating the focus of his lens with a focusing scale determined by test exposures on the film with a Hartmann mask. Chuck also has his scale calibrated for temperature variations, even though he shoots in a relatively stable and dry climate.

Some people suggest taking up the slack on the rewind know of the camera and taping or securing it with a rubber band so that it can't come undone during an exposure, the theory being that this pulls the film taut and flat. I used to follow this procedure, however, experiments that I have done with the light source and ice pick indicate that this does not solve the film flatness problem, so I have stopped trying it and notice no difference in the final results.

Orthogonality

The film plane must be perpendicular to the optical axis. Not only must the film plane be held flat during the exposure, the photographer must also take special care to ensure the orthogonality of the film plane, camera and focuser.

Tilted objectives and focusers, found frequently on newtonians; camera bodies not properly attached to the focuser; loose T-mounts; and damaged, worn or incorrectly assembled components can cause orthogonality problems.

Despite careful checking, components can also move during the process of lock down itself. If a single lock down bolt is used the camera can pivot, tilting the film plane. It is recommended that every lock down point be comprised of two lock down bolts, separated by 120 degrees. This provides three points of contact (the two lock down bolts and the point where the two surfaces actually touch) and is the most stable configuration.

Film Plane Immovability

In addition to the film plane being held flat, the entire plane must be immovable during the entire exposure.

This is usually accomplished by securely locking down the focuser, and making sure there is no play or slop in any of the adapters or components. As discussed above, two lock-downs should be used anywhere a lock-down is required.

Other Factors

- Care should be given to maintain and check the integrity of the camera's mechanical systems if focus is attempted through the camera's focusing system. Wear and tear on the lens mount should also be monitored.

  SLR camera mirrors especially can go out of alignment and visual focus through the finder will not coincide with the actual focal plane of the camera body.

  If a used camera body is purchased, attention should be paid to make sure the camera does not have a damaged mirror, screen or prism and focus should either be checked by a knowledgeable technician or by the photographer by actual focus tests of stars on film.

- Attention should be paid to temperature changes that occur during the night. The temperature will almost always fall and focus will change due to contraction of the metal in the telescope assembly.

  Focus should be checked before every shot, especially at prime focus in a telescope system.

- If the photographer has access to more than one camera body and focus is accomplished visually through the camera's optical systems, focus should be compared in each.

  This is easily accomplished by comparing the focus of each body on the same lens. A paper scale can be attached to a long lens and marked where focus is on each, which should be the same place.

- The mirror should be locked up before the shutter is opened to avoid vibration due to mirror slap that can affect the sharpness of stars in an astrophoto.

  The shutter should also be carefully opened with a cable release or the camera's self-timer can be used in conjunction with a "hat trick". The hat trick is simply a piece of opaque material, such as black poster board, that is held in front of the telescope or lens and acts as a shutter for the entire system while the camera body's focal plane shutter is opened. If the camera or scope is moved slightly during the handling of the camera during the opening of the shutter, the film is blocked by the board from exposure to the sky. When vibrations die down the board is removed.

SDAA Board Meeting Minutes by Melinda Baker

April 9th, 2002

The meeting was called to order at 7:08 PM. Board Members in attendance were: Jim Traweek, Dennis Ritz, Jennifer Pesqueira, John Restivo, Bob Wetzel, Terry Stewart, Mike Deitz, Scott Baker, Lloyd Duhon and Bret Akers. Guests in attendance were: Don Spencer, Shawn, Diana & Tiffany Kelly, Brian McFarland, Les Anderson, Charlie Wallis, Lisa Bruhn and Brian Staples.

Due to time constraints, Lisa Bruhn, of the International Dark Sky Association (IDA) gave her presentation first. Lisa, the local chairperson for the newly formed San Diego County branch of the IDA, gave a presentation on her upcoming kickoff event to be held at the Carlsbad Holiday Inn on April 23rd. She encouraged everyone to pass out flyers and attend the meeting.

Minutes of March's Meeting were read by Scott Baker and approved as read.

Library Report by Bob Wetzel: The Science and Engineering Fair was held in March and three judges from the SDAA, Bob Wetzel, Doug Johnson and Scott Baker, attended and judged the astronomy related exhibits. Two winners were declared, one in the Junior Class and one from the Senior Class. Each winner will receive a $75.00 Check, a magazine subscription and a one year associate membership in the SDAA. Bob reports that there are no changes to the Library, and that with the departure from the Space Theater, the library will have to be moved. A temporary site for the library is being sought.

Treasury Report by Jennifer Pesqueira:

Site Report by Terry Stewart: Nothing to report. Concrete pouring of pad extensions and walkways to be delegated to a member(s) of Terry's choice.

Private Pad Report by Jim Traweek: Gravel for the roads around the new private pads is to be delivered Saturday Morning. Jim ask that all new pad owners rake out the gravel in front of their pads.

Correspondence Secretary Report: The SDAA.ORG web site is up to 40 megabytes in size and receives, on average, 40 hits a day. It was decided that the addition of the link to Amazon.com has netted very little for the club and that it is "tacky". A motion was presented to remove the icon, voted and approved. The SDAA phone message machine has been very inactive of late.

Star Party Report by Mike Deitz: Still averaging 14 star parties a month. Upcoming events included solar viewing at Sea World on the 26th and 27th of April, Camp with the Stars at William Heise on May 10th and 11th with a trip to the Girl Scout's "Camp Winacka" on the 10th as well.

Newsletter Report: The next deadline for article submission is the 22nd of April. Lloyd and Bret are endeavoring to have the newsletter in the mail by the first week of each month.

Old Business:

Observatory Site - Many members have been inquiring about the last remaining permanent observatory site at TDS. The Board has been pondering the correct usage of this site for many months, and it was decided, at this time, to put a temporary moratorium on it's use. A motion was made and passed on this idea.

New Meeting Place - A new meeting place is still being investigated with Mission Trail Regional Park presently our best choice. Brian Staples reports that the park has a lot to offer, yet the organization is loose and it's difficult to get a decision on it's use by the club. A motion was made to rent the theater for the next three months, for program meetings, and at the same time develop a relationship with the organization there. The motion was passed by the board. Brian Staples is to submit the paperwork and reserve the site starting in May, on either the 3rd or 4th Wednesday of the month. Other sites are still being investigated.

New Business:

There was a short discussion of having internet access at TDS with the potential of a weather station and web cam. Lloyd Duhon volunteered to create a suitability/feasibility report on the subject. Lloyd was approved by the board to do the report. No time schedule was given.

A new site for the monthly board meetings is needed.

The meeting was adjourned at 9:00 PM.

Clip and Save

2002 Board of Directors and Chairpersons

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Director, Public Pads, Sean Houghton
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Newsletter Editors, Bret Akers and Lloyd Duhon
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TDS Site Director, Terry Stewart
email: t-c-b@juno.com 619-295-2449

SDAA Calendar of Events

May 2002

S	M	T	W	T	F	S
			1 Stars in the Park 7 pm	2	3	4 ◑ Star Party at Tierra Del Sol
5	6	7	8	9	10 Girl Scout Camp Winacka - Julian	11 Star Party at Tierra Del Sol Camp with the Stars @ William Heise Campground
12 ●	13	14 SDAA Board Meeting 7 pm	15 **Program Meeting** Star Party at Flying Hills Elem. 1251 Finch St. El Cajon	16 Barnes And Noble Bookstore 10775 Westview Parkway Mira Mesa	17	18
19 ◐	20	21	22	23 Spring Valley Elementary 3845 Spring Dr. Spring Valley	24	25
26 ○	27	28	29	30	31	

The Back Page

Tierra Del Sol Star Party Report for April 6 by Bret Akers

April 6 at Tierra Del Sol arrived with clouds, light rain, and howling winds—not a good night for observing.

Tierra Del Sol Star Party Report for April 13 by Bret Akers

April 13 was one of the best April observing sessions at TDS in quite a while. The night-time temperature was very mild for April. Most people needed only long sleeves or a light jacket to feel comfortable. Transparency was pretty good and the seeing was ok as it hovered around a 5 or 6 on the Pickering scale for much of the night.

As the sun began to set, the public pads really filled up. By the time it was dark, there wasn't any space left. Everyone was coming out for the first star party of the year that had both clear skies and mild temperatures.

By midnight, the pads had really started to thin out, but the remaining members got a wonderful view as comet Ikeya-Zhang made an appearance at about 3 am. All in all, it was a great night at TDS.

Treasurer's Report by Jennifer Pesqueira

With the addition of the following new members we now have 551 SDAA members. We would like to welcome our new members Jing Chao, Dan Desormeaux, Veronica Lopez, Ruth Mau and Lawrence Walters. May you enjoy clear dark skies.

PASP journals for sale

1998 - 2001 PASP journals for sale. $50 OBO. Call 619-461-9233 or email birdman@bird-friends.com

Membership Information

Send dues and renewals to P.O. Box 23215, San Diego, CA 92193. Include any renewal cards from Sky & Telescope, Astronomy, or Odyssey magazine in which you wish to continue your subscription. The expiration date shown on your newsletter mailing label is the only notice that your membership in SDAA will expire. Dues are $35 for Contributing Memberships; $25 for Senior (Basic) Membership; $3 for each Family membership. In addition to the club dues the annual rates for magazines available at the club discount are: Sky & Telescope $29.95, Astronomy $29, and Odyssey $25.46. Make checks payable to S.D. Astronomy Assn. **PLEASE DO NOT send renewals directly to Sky Publishing.** They return them to us for processing.

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