Smoky Mountain Astronomical Society

S.C.R.A.P.S.

Society's ChRonological Astronomical PaperS

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President's Message
To: SMAS

From:
Michael McCulloch

The SMAS Christmas Party has been scheduled at the Chop House on Kingston Pike in Franklin Square.

http://www.thechophouse.com/mapknox.html

The reservation is for a maximum of 15 people on December 3rd (Friday) at 7 PM. Cash bar will be available and 18% gratuity will be added to each check. Each person may order anything from the menu. Cost ranges from $10 and up. See the menu at:

http://www.thechophouse.com/chmenu.html

Due to the limited space, please RSVP as soon as possible to Lee Erickson via email at:

leeerickson@earthlink.net
or via cell phone at: 865-805-2437

We need a headcount of those interested in attending.

Unfortunately, I personally will not be able to attend.

What You Missed at the Last Meeting—Angela Quick

SMAS Meeting
Friday, November 12, 2004
Main Campus, Pellissippi State Technical Community College

The meeting began at 7:00 with 14 members present.

Astronomical League Observing Chair Ron Dinkins presented the:
Binocular Messier Object Observing Award to Wayne Thompson.
Congratulations, Wayne!

Bob Arr answered the Wiz challenge from the July issue of SCRAPS. The question was, "On how many nights of the year would it be possible to view the entire celestial equator from Unicoi Crest?" The answer is any time there is more than 14 hours of night, which at Unicoi Crest would be 30 days either side of the winter solstice. Bob solved the problem by using the computer program "Guide" to see when dawn appeared on the horizon at Unicoi Crest's latitude. Pete Bush used the Naval Observatory's web page to look up when night would be more than 14 hours. Erik Iverson did the math for calculating rise and set times of a star from Jean Meeus' equation book for celestial mechanics.

Angela Quick asked for volunteers to show telescopes to children at Ft. Craig Elementary School in Maryville on Wednesday, November 17. Bob Arr and Lee Erickson will participate for certain; others are welcome.

Dr. Guidry, our guest speaker at the October meeting, returned to continue his lecture on cosmology. Dr. Guidry spoke from 7:30 to 9:00, expanding on the material covered in October and using more cool online illustrations to explain the concepts. Thanks, Dr. Guidry, for an enlightening conversation!

The Wiz

Dear Wiz,

That English professor from UT, Mike Guidry, he really talks good, but what is he talking about?

G. Allrong

(Continued on page 3)

Dear Godit,

He ain't – isn't – an English professor, he's an astrophysicist. Just because he talks good don't – doesn't – mean he teaches English. But it helps.

He's explaining what astronomers and physicists have discovered that makes them believe in the Big Bang. Not everybody does, you know.

Since much of the theory incorporates abstract concepts, abstract ideas from religion, mysticism and partial physical evidence often compete. Anybody can construct mental houses of cards to suit their agenda.

Guidry is simply setting the record straight about what physical evidence supports the Big Bang. Primary among these are:

Cosmic Background Radiation
Galactic redshifts in general
Distant Type 1a supernova redshifts
Observed light element distribution (Hydrogen, helium, a few light gasses)
High energy particle research and nucleosynthesis (a-bombs!)

These are powerful arguments, based on physical realities. Any competing theory would have to confront them with persuasive counter arguments also based on physical realities.

Our hat's off to Dr. Guidry for a wonderfully expansive presentation, plus his great patience in fielding questions. In English, no less!

Astronomy Outreach—Lee Erickson

On Wednesday November 17, 2004 Angela Quick, Bob Arr and Lee Erickson spoke to 3rd and 4th graders at Ft. Craig Elementary public school in Maryville TN.

We spoke to three groups of about 35 students each. While the children were gathering before the lecture, we asked them what they had learned about astronomy - especially the planets. (We knew that they had been studying the planets by some hand-drawn posters they had displayed in the hallways.)

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We then presented a Power Point lecture that Angela Quick had made up. This presentation kept us on track, and it nicely integrated text for the lecture with pictures.
The lecture began with two rules:
Do not look at the Sun
Do not touch the lenses, mirrors or glass parts of the eyepieces.
We asked everyone to repeat the rules out loud.

We covered the components and light path of refracting, reflecting, and compound telescopes. Pictures helped to convey the shapes and sizes of typical telescopes that amateurs might use.

We also covered the characteristic mounts for each: a tall tripod for refractors, Dobsonian for most reflectors, and fork mount for compound telescopes. We indicated, of course, that there is variety to what amateurs owned, and not all telescopes had the usual mount. We finished by repeating the rules again, and then as time allowed some questions and answers.

The children were then split into three groups to look through the telescopes we brought. Angela Quick had a refracting telescope with a Sun filter, Bob Arr brought one of the SMAS Dobsonian telescopes for kids, and Lee Erickson brought an ETX. Angela was setup outside to observe the sun but clouds prevented the sun from being observed by most of the group. She then directed the telescope onto the recently discovered daytime constellation "Cell Tower". Bob Arr, with the help of some of the children set up the Dobsonian in the school library so that it could look out a window at the distant horizon to the daytime constellation "Tree Tops". Lee Erickson had a portable daytime object, the "Paper Moon", which when placed at the opposite end of the library was observed to have an apparent diameter of about 1 degree or twice that of the actual moon. When viewed through the ETX this paper moon was observed to have visible mountains and craters that were not visible with the unaided eye. The three groups rotated through all three telescopes so that everyone got to see these daytime "astronomical" objects. Most of the children paused only briefly at the eyepiece, but some stayed a long time looking at detail. A few described what they saw with enthusiasm.

I hope that we sowed some seeds in some of these children – 21st century's new scientists, and nourished the existing sprouts of desire in others. They in turn brought to me the terrific feeling of playing, of learning, and of seeing the world through new eyes - a joy that the young can feel so intensely.

Innovations—Eric Neumann

Here is a simple and cheap method to make a top end counterweight for any Schmidt or Maksutov telescope, just adjust the procedure to suit your particular needs. These instructions are specific to my camera and Meade ETX-90 EC Telescope.

I'm using my trusty Pentax K1000 camera body and Meade's standard t-tube. I used a digital balance and actually weighed the force that the camera was putting on the OTA when level (the alt axis lock must be free). I then weighed a measured short piece of #8 bare copper wire and determined a weight per foot for the wire. I also measured the moment arm for the camera (the distance from the alt axis to the back of the camera * weight as measured) and used the length from the alt axis to the front end of the OTA to find that I needed about 15 feet of #8 wire.

I began by winding the wire around a piece of 3" PVC pipe in a very tight coil. I drilled a hole big enough to poke the wire into to hold the end while winding. The coil springs out when you let go and is almost big enough to go around the OTA. I then trimmed off the bent end of the coil. I slipped the coil up and over the end of the OTA one turn at a time. After I had about 1 or 1 1/4 inches of coil pushed onto the end of the OTA, I rewound the rest of the coil over itself to keep it reasonably short. Finally, I wrapped the coil with black electrical tape to hold it together.

The weight is compact, holds itself tightly to the OTA, and my scope is balanced to within a couple of ounces with the Pentax attached. The copper is soft, and although it leaves copper colored marks on the front lens cell, they rub off easily enough. Installation and removal requires a slight twisting motion in the direction that expands the coil.

The Compact Telescope—Bob Arr

Is this the start of something big?

Wayne Thompson sent me this article recently. I must say, it sounds almost too good to be true. (Is that a clue?) I thought it might be of interest to everybody in the club, so I emailed the magazine publisher, and asked for permission to put it in SCRAPS. They graciously consented.

Maybe I let my imagination run away with me, but after reading the article I began to visualize an SCT with a 12” primary, f/6, 20 inches long, weighing 20 pounds. For good measure, I mounted it on a sturdy motorized equatorial mount with GPS, Goto, tracker, and a 50,000 objects database. Absurd, right?

Then I figured the whole thing would come in under four grand. Totally absurd, right? Time will tell.

This one-piece Gregorian is wildly ingenious. The primary is spherical, but it doesn’t use (or need) a corrector lens, so no more fogging. It reaches stable ambient temperature in a couple minutes. It’s so light even she can set it on the mount. It never (yes, I mean *never*) needs collimating: the optics are all machined in one piece. Oh, did I say optics? For what it’s worth, there isn’t a single piece of glass inside the whole telescope. Absurd is no longer adequate.

Well OK, it isn’t an SCT. It’s the new “Compact Telescope” developed by fSona Communications Corp. Could it happen? Maybe. Read on!

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Compact Design Telescope

Most applications that use telescopes opt for one of two designs: the Gregorian or the Cassegrain. Of these two, the latter is most often used. A new telescope that improves on the Gregorian hopes to challenge that with a design that has applications in free-space optics, astronomy, tracking and stabilization.

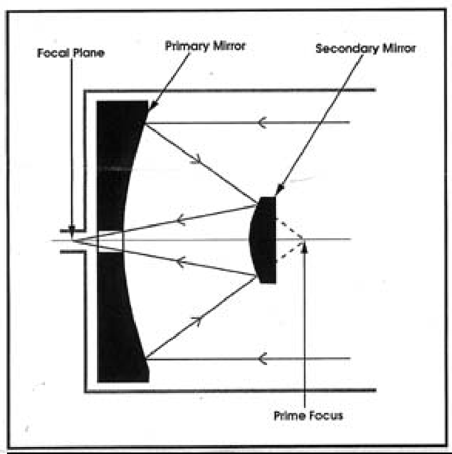

Fig. 1. Invented in 1672, the Cassegrain telescope features a convex hyperbolic surface placed before the focal point of the primary mirror.

The staying power of the Gregorian and Cassegrain designs testifies to their genius. The Scottish mathematician James Gregory developed the Gregorian telescope in 1663. The French scientist and sculptor Guillaume Cassegrain invented the Cassegrain nine years later. Both are reflecting (as opposed to refracting) telescopes involving a primary and a smaller secondary mirror. In the Cassegrain, the secondary mirror is a convex hyperbolic surface placed before the focal point of the primary mirror (Figure 1).

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In the Gregorian, the secondary mirror is a concave ellipsoidal surface placed behind the focal point (Figure 2).

The different configurations yield different results. The primary and secondary mirrors in the Gregorian telescope are concave, allowing easier testing of both. This is especially important considering the dependence of a reflecting telescope's performance on the quality and alignment of the mirrored surfaces. Also, the Gregorian does not invert the image, unlike the Cassegrain, which avoids the need for inverting optics.

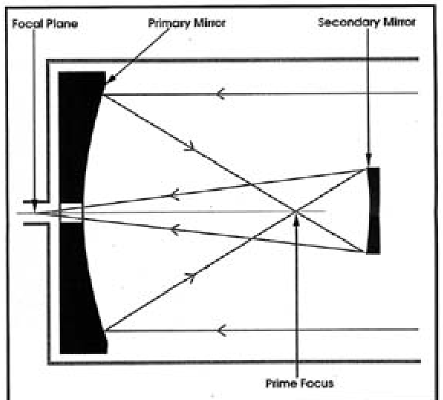

Fig. 2. The earlier Gregorian telescopes features a concave ellipsoidal surface placed behind the focal point, which offer several benefits but requires a much longer tube.

Simple concept

Yet the Cassegrain design is the more popular one today because it is significantly smaller. Having its secondary mirror beyond the focal point of its primary mirror forces a Gregorian telescope to be almost twice as long as a Cassegrain. This is detrimental to the weight and stability of the structure, the power requirements of a drive mechanism and more.

Telescope designs have become increasingly complex in an effort to maximize performance, such as light-collecting power, thermal stability and precision, while minimizing the size and weight of the instrument. The patented "modified Gregorian" Compact Telescope from fSona Communications Corp. of Richmond, British Columbia, Canada, offers the advantages of the Gregorian in the size of a Cassegrain.

Modification to the traditional Gregorian design is fairly simple and elegant in concept but relies on state-of-the-art materials and manufacturing processes. The first step is to take a standard Gregorian telescope and to place a flat mirror approximately halfway between the primary and secondary mirrors. The next is to fold the entire system in half so that the flat mirror looks like a secondary mirror and the original concave secondary mirror is buried inside the primary mirror (Figure 3).

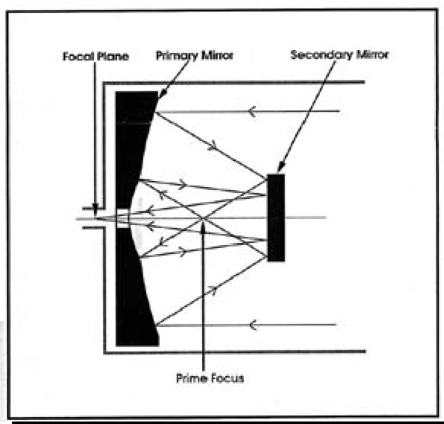

Fig 3. The modified Gregorian design combines the primary and secondary mirrors into a "double mirror" and adds a flat mirror. The length of the telescope is approximately half that of a standard Gregorian, and two-thirds that of a standard Cassegrain.

In this design, the primary and secondary mirrors combine to form one "double mirror." The length of the telescope is approximately half that of a standard Gregorian and two-thirds that of a standard Cassegrain. In fact, this telescope can be as short as one-seventh its own focal length, yet all the attractive features of the Gregorian design are maintained.

The benefits go beyond those of the Gregorian and Cassegrain combined. In the original designs, the concentric alignment of the secondary and primary mirrors is critical.

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Tight tolerances on this alignment increase manufacturing and assembly costs, and make the telescope more susceptible to thermal and mechanical variations. In the new design, the alignment of the flat secondary mirror is much more straightforward because it is insensitive to concentric alignment.

The design avoids the alignment process by relying on standard machining tolerances for parallelism. Moreover, the flat mirror is easier and less expensive to manufacture than a curved one. The alignment of the original curved secondary mirror is effectively ensured because it is machined with the primary mirror as a single part.

This feature is made possible by diamond turning, a single-point precision cutting process similar to lathing. It can produce high-quality optical surfaces on plastics, metals and crystals. With postpolishing, the surface quality of a fabricated part may be 10 to 20 Angstroms - good enough for most applications from the ultraviolet to the infrared. The method can produce mirrors up to 1.5 m in diameter.

Diamond turning also enables the telescope to be machined out of a lightweight material such as aluminum, rather than glass. In this way, the mirror and its mount can be made as an integrated part, effectively combining optical and mechanical design into a single effort (Figure 4). Large, solid sections can be hollowed out to minimize weight, using supporting ribs or a honeycomb structure. Mounting features such as tapped holes and alignment pins can be integrated into the mirror substrate, eliminating the need for separate brackets, screws and other mounting parts.

Matching the mirror material to that of the rest of the structure also matches their coefficients of thermal expansion. Thus, the telescope is completely athermal, without thermally induced aberrations or shifts in focus. This can be important in high-precision applications.

FSona designed the Compact Telescope for applications in optical wireless telecommunications, or free-space optics. In the current competitive telecom market, it is desirable to keep manufacturing costs low. Taking advantage of diamond turning to reduce the number of parts and to simplify assembly gives the instrument an advantage over standard designs.

Because free-space optics hardware typically is mounted outdoors on towers and rooftops and, consequently, exposed to all sorts of weather conditions, the ruggedness of the telescope's combined optical/mechanical design is a benefit for this application. Moreover, being athermal allows reliable free-space optics links to be deployed everywhere from Siberia to South Carolina to Saudi Arabia.

The smaller size, lower weight and increased optomechanical stability of the telescope are advantageous for other applications as well. The military values these features in field-deployable systems for communications, surveillance or reconnaissance. The ability to carry equipment to a key location and the degree to which it stands out can be the difference between success and failure in certain missions. The same is true for disaster recovery applications, such as setting up communications links, surveying damaged areas or spotting trouble at a distance.

For airborne applications - and especially in space - payload size and weight translate directly into program dollars. For every pound that is shaved from a satellite, for example, thousands of dollars in fuel and propellant are saved. Every reduction in cubic inch of volume makes more room for other mission instrumentation.

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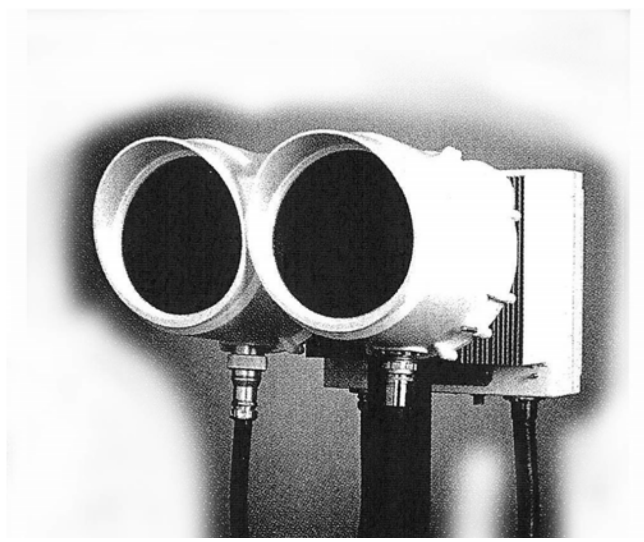
A particularly cumbersome feature of airborne telescopes is the protective dome that must shield the optics from the environment. Its size is generally defined by the diameter and length of the telescope, and its function requires it to have a certain amount of rigidity and, therefore, weight. Obviously, the shorter the telescope, the better.

Making a telescope out of a single material - and thus creating an inherently athermal structure - lends it the kind of precision required for many astronomical applications. Moreover, as with the Gregorian telescope from which it was derived, the Compact Telescope does not invert the image, and it is naturally corrected for spherical aberration and coma.

Dynamic functionality

The telescope lends itself to another modification that turns it from a passive device into a dynamic mechanism. Because the secondary mirror is a simple, flat surface, it can be controlled in pan and tilt to steer the beam and to actively position the focal point. In other words, the stationary secondary mirror is easily replaced by a fine-steering or fast-steering mirror .



This enables the instrument to act as an active tracking device. Military applications include mobile surveillance, weapons target acquisition and reconnaissance. Astronomical applications include tracking deep-space objects or neighboring planets. And in the commercial world, there are uses in video surveillance and in the entertainment industry .

Similarly, by steering the beam to keep a focused spot on a detector , the telescope can be used for image stabilization. In this case, the feature is used to maintain alignment of the beam under the influence of external disturbances. Applications include mobile video and surveillance. It also is advantageous on airborne platforms such as unmanned aerial vehicles, on which optical devices must compensate for motion and for mechanical vibration.

FSona used the Compact Telescope for both active tracking and stabilization in its prototype of a next-generation optical wireless transceiver (Figure 5). To maintain a reliable commu-

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nications link between two transceivers, they must be precisely aligned with each other along their mutual line of sight. External disturbances such as building motion or wind gusts can move a transceiver out of alignment, disrupting the link, so it is important to maintain alignment and to keep the incoming light beam focused on the detector. At the same time, the transmitted beam must be redirected along the line of sight toward the opposite transceiver.

In short, each transceiver must stabilize its own motion while tracking that of its counterpart. The advanced optical wireless system accomplishes both using fast-steering mirrors and the modified Gregorian telescopes.

Meet the authors

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The Star Of Bethlehem—Peter J. Bush

Now when Jesus was born in Bethlehem of Judea in the days of Herod the king, behold, there came wise men from the east to Jerusalem,
Saying, Where is he that is born King of the Jews? For we have seen his star in the east, and are come to worship him.
When Herod the king had heard these things, he was troubled, and all Jerusalem with him.
And when he had gathered all the chief priests and scribes of the people together, he demanded of them where Christ should be born.
And they said unto him, In Bethlehem of Judea: for thus it is written by the prophet,
And thou Bethlehem, in the land of Juda, art not the least among the princes of Juda: for out of thee shall come a Governor, that shall rule my people Israel.
Then Herod, when he had privily called the wise men, enquired of them diligently what time the star appeared.
And he sent them to Bethlehem, and said, Go and search diligently for the young child; and when ye have found him, bring me word again, that I may come and worship him also.
When they had heard the king, they departed; and, lo, the star, which they saw in the east, went before them, till it came and stood over where the young child was.
When they saw the star, they rejoiced with exceeding great joy. *Matthew 2:1-10*

For an interesting discussion of the astronomical interpretations of the Star of Bethlehem see: **http://askelm.com/video/real/xmas_star.swf** and **http://www.probe.org/docs/starbeth.html**

Merry Christmas—Pete

December 2004

SUN	MON	TUE	WED	THU	FRI	SAT
UTK—roof of Neilson Physics Building on The Hill at UT TAO —Tamke-Allan Observatory Public Stargaze Watts Bar Lake, Roane County			1	2	3 SMAS Christmas Party @ The Chop House	4
5	6	7	8 Chanukah	9 Crescent Moon near Venus & Mars in Dawn Sky	10	11 *New Moon*
12	13	14	15	16	17	18
19	20	21 Winter Solstice	22	23	24	25 Christmas
26 *Full Moon*	27	28	29	30	31	