Hamilton Amateur Astronomers

Event Horizon

November 2002 Volume 10 Issue 1

THE GALILEAN TELESCOPE *by Glenn Muller*

My graduation to progressive lenses (invisible bifocals), was a recent life-phase that got me surfing for details on *presbyopia.* The research struck a note when I found that magnifying glasses had been used to read TV Guide since before 1350 AD. After that, polishing and grinding techniques allowed for production of small lentil-shaped disks (*lenses* in Latin) and these could be paired into frames. Before long, the wearing of convex lenses became a symbol of higher learning. By 1450, concave lenses for the refractive error *myopia* had been developed and the stage was set for the invention of the telescope.

In this regard, spectacle makers were uniquely poised yet there is debate over who first discovered the properties of combined lenses. A century of evolvement in magnifying strength may still have been needed, for not until 1608 did German craftsman Hans Lipperhey apply to patent "*a* certain device by means of which all things at a very great distance can be seen as if they were nearby". The application was denied but Lipperhey, contracted to provide several binocular versions for the Netherlands national government, was generously recompensed. News of the great invention spread rapidly throughout Europe, and by 1609 three-powered spyglasses, by different makers, were sold in France and Italy. That was the year an English cartographer, Thomas Harriot, recorded the first telescopic sketch of the Moon - only weeks before an Italian mathematician named Galileo Galilei would pick up the ball and really run with it.

After building his own three-powered spyglass in June of 1609, Galileo presented an eight powered one to the Venetian Senate. Here, the myth that he invented the telescope began. With the same principle used earlier in the year to "invent" the microscope, Galileo improved on Lipperhey's design and claimed it as his sole creation. Come mid-October and he was exploring the heavens with a twenty-powered instrument.

His configuration featured a plano-convex objective with a 30-40" (750-1000mm) focal length, and a plano-concave ocular in a smaller tube with a focal length of 2" (50mm) that could be adjusted to focus. Far from perfect, the lenses in these long thin tubes had a greenish tinge due to the iron content and were usually riddled with tiny bubbles. While the view was pretty good in the middle, at the periphery it was so poor the objective had to be stopped down to about three-quarters of an inch (18mm). Though the magnification was in the range of 15-20X, the field of view was only 15 arc-minutes.

It was enough to see Jupiter's four large moons and, though their present names were suggested by Johannes Kepler, in March of 1610 Galileo documented his discovery and described details of our own Moon in *Sidereus Nuncius* (The Starry Messenger), a book which would make him famous. Leader of the field for almost a year, the pack caught up in 1611 by verifying the phases of Venus and with several independent discoveries of sunspots, but by then the Galilean telescope had been popularized.

A variation on the basic design incorporated two convex lenses. For increased brightness and magnification, astronomers adapted to an inverted image. Unfortunately, adding more lenses degraded the view so much it offset any advantage. Since Galileo's convex/concave design had progressed to lengths of six feet, and could also be used terrestrially, it remained the scope of choice for the next thirty years.

As the latter half of the seventeenth century saw larger lenses, with fewer flaws, there was an academic acceptance of the inverted view for the astronomical telescope. A race to develop more powerful instruments, based on length, soon saw creations exceeding twenty feet. A good example is Christiaan Hyugens's scope of 1656.

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Chair's Report

First, I would like to thank Grant Dixon for standing in for me in October - by all accounts the meeting led by him was a great success. Grant has always had a way with crowds - his many years of entertaining and educating folks in the planetarium have not been forgotten!!

Second, November is the start of a new membership year. This, of course, means that we will be encouraging those of you who haven't already renewed to do so at your earliest opportunity! Even better, it also means that a new Council will be elected. As I mentioned in September, Barb Wight has given up the position of Treasurer after many, many years of service without a single grand jury indictment and we wish her a well-deserved recuperation! Assuming that the election of the new Council goes without incident, we will be welcoming Cindy Bingham into this thankless position! The good news is that we are in sound financial health thanks to the watchful eye of Barb.

Thanks also to all of the past year's Council members. They have made it a pleasure to be a part of this group and I am very grateful for their willingness to do the work of the HAA and for their many excellent ideas.

This month marks what appears to be the last chance to see a Leonid meteor storm for a long, long time. We will be having a very early morning star party at the Binbrook Conservation are on Tuesday, Nov 19th - I hope you can join us! (Of course, the likelihood of it being clear on such an auspicious morning is practically zero!) If you can't make it out to Binbrook, try watching at home. If it is cloudy, consider "listening" to the meteors on your FM radio!

Welcome to the 2003 membership year! I hope that it will be our best yet!!

Doug Welch

Doug Welch is the current chair of the HAA and also a founding member. You can find out more about Doug at:
`http://www.physics.mcmaster.ca/people/faculty/Welch_DL_h.html`

HAMILTON AMATEUR ASTRONOMERS

Event Horizon is a publication of the Hamilton Amateur Astronomers (HAA).

The HAA is an amateur astronomy club dedicated to the promotion and enjoyment of astronomy for people of all ages and experience levels.

The cost of the subscription is included in the $25 individual or $30 family membership fee for the year. Event Horizon is published a minimum of 10 times a year.

HAA Council

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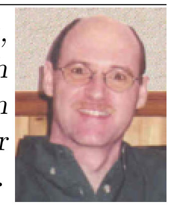
... continued from page 1

At twenty-three feet, it had an aperture several inches wide; magnification was near 100X and the FOV was 17 arc-minutes. As glassmakers gradually eliminated the defects, it followed that multiple lenses were arranged for terrestrial use.

This marked the end of the road for the Galilean telescope. In the coming decades it would be passed over for more specialized instruments, some of which would reach enormous proportions, but even when eclipsed by innovation its place in history was bonded forever to the name of Galileo.



When not squinting at the TV listings, Glenn Muller likes to focus on DSO's with his wife, Gail, from their backyard in Grimsby. They invite you to view their webpage at: `http://home.interlynx.net/~mullers/`

Ask the Experts

If you have any questions about astronomy we have experts in the following fields that are ready to answer your questions; galactic astronomy, astrophysics, stellar physics and variables, astrophotography using emulsion/print film, polar-aligning an equatorial mount, scanning photos and image processing.

Send in your questions to
`editor@amateurastronomy.org`

Q. I have heard that scientists have recently discovered that the expansion of the universe is accelerating rather than slowing down. How did they determine this, and is there an explanation? If we assume that the acceleration will continue, what does this mean for us and for the future of the universe ?

Question by Brian Chire

A. The accelerating expansion of the universe was first thought a possibility when Einstein introduced a factor (called the cosmological constant) into his gravitational equations. In 1998, accurate observations of distant Type Ia supernovas combined with galaxy redshifts led to the conclusion that the expansion seems to be accelerating. The supernovas provided the distance to the galaxy and the redshift is a measure of the speed the galaxy is moving away from us.

There is no solid explanation at present, but there are some suggestions of a cause. One is a positive push caused by a hidden energy reservoir in the vacuum of space. There are also suggestions that the observations are being interpreted incorrectly due to unknown particle physics.

Don't worry about it, your life will not be affected in any noticeable way. As for the universe, it means that it will not collapse in on itself, but rather expand forever at an increasing rate.

Answer by Bill Tekatch

Two Eyes are Better than One (or II > I) *By Greg Emery*

The use of binoculars in astronomy is nothing new. Two eyes allow for better visual resolution as well as a slight enhancement in colour perception. This fact, as well as the increased field of view of binoculars, is reinforced by the fact that many books aimed at the novice Amateur Astronomer recommend purchasing binoculars prior to purchasing a telescope. The Beginner's Handbook, published by RASC, in fact suggests using binoculars as well as unaided observation until a level of understanding of the night sky has been attained to warrant purchasing a telescope.

The use of binoculars is beneficial over monocular vision and should be included with every astronomer's equipment. But why leave the advantages of using two eyes behind when making the transition to telescopes? Several high end manufactures of astronomical equipment sell binocular viewers. These are placed in the light path between the secondary mirror and eyepiece for Newtonians or between the objective lenses and eyepiece for refractors. A recent review of these Bino-Viewers appeared in Sky and Telescope (September 2002).

Another twist to this question is to mate two telescopes together and thus create binoculars. Various people have done this using a variety of sizes and optical designs – 150 mm Cassegrains, 200 mm Newtonians, 440 Newtonians and on. I recall that someone belonging to a mail list I am on is constructing a 550 mm Newtonian Binocular Telescope.

I have designed, and will be building my own Binocular Telescope over the next year or so. Before detailing the design of the optical system, I should note the additional problems which binocular telescopes present to the observer. First off the eyepieces must be parallel as well as planar. Secondly, the distance between the eyepieces must be somehow adjustable to allow for the differing interpupillary (distance between the pupils varies through the population) distance of different observers. Third, and foremost in my mind, is the collimation nightmare. Not only must each optical tube in the binocular be collimated as a standard Newtonian, a tertiary mirror (star diagonal) must also be placed in the optical path. A total of 6 mirrors must be tweeked as opposed to two for a standard Newtonian. But the nightmare hasn't ended yet – each optical tube must also be aligned such that they point to the exact same point in space (co-collimation). If this seems like too much work for a simple night of viewing pleasure, consider the benefits.

Placing two optical tubes together to produce a binocular doubles the total area of the mirror for light gathering. A 200 mm binocular telescope has similar light gathering ability to a single mirror of 280 mm. The human brain will merge the images formed at the two retinas and produce an image with better depth perception. The actual resolution of the optical system is limited to the resolution of the mirror, which is dependant on the mirror diameter. A 200 mm binocular telescope will have the same resolution capability as a 200 mm telescope but the light gathering ability of a 280 mm telescope.

My design consists of a primary which is a 200 mm f/5 mirror. The optical design requires additional side throw to accommodate the tertiary mirror that is needed to allow for binocular viewing. This necessitates that the secondary mirror be quite large, in fact the elliptical secondary has a minor axis of 58 mm, which corresponds to just under a 30% obstruction ratio. This obstruction is large, but will ensure that, under proper collimation, 100% illumination to at least 80% of the field will be obtained. The tertiary will be a planar mirror similar to a star diagonal. The focusing for the images will accomplished with a low profile Crayford type focuser placed between the secondary and tertiary mirrors. The housing for the tertiary mirror will rotate to allow for more comfortable viewing positions at zenith.

Interpupillary distance will be adjusted by having the secondary cage rotate. As long as the constraint that both secondary cages are rotated through the same angle, the rotation of field will be equal and the brain will be able to merge the separate images. When it comes to merging the images, it was once believed that the f-ratio of both primary mirrors had to be essentially exact. Current evidence, although anecdotal, suggests that a difference in focal lengths of up to 1% will be indistinguishable to the observer. Discrepancies larger than this can lead to headaches and other symptoms in long observing sessions.

Co-collimation will be achieved through adjustment of screws in the tube rings which support each optical tube. The tube rings will be connected together to form a yoke, which can mount to a pier. Collimation of each individual system will be accomplished with three pairs of push-pull bolts.

If all of this seems like too much work, then I probably shouldn't mention that I plan to grind all six mirrors myself. Well, on the bright side, at least I will have something to do on cloudy nights!

Some of the references and resources I use for this, and other projects are:

- Telescope Optics – Rutten and Van Venrooij
- How to Make a Telescope – Jean Texereau
- Amateur Telescope Making (Vol I – III) – Albert Ingalls
- ATM Mailing List
- `http://hometown.aol.com/davetrott/page4.htm`
- `http://lerch.yi.org/atm/`
- `http://www.stargazing.net/wvas/BigBinocs/Binocular.htm`
- `http://perso.club-internet.fr/legault/obstruction.html`

Greg Emery has been an amateur astronomer for just over a year. Besides being optimistically ambitious, Greg enjoys observing deep sky objects. He can be reached for comment by email at `emeryg@mail.mohawkc.on.ca`

NASA's Space Place

Black Holes: Feeling the Ripples

Astronomers have finally confirmed something they had long suspected: there is a super-massive black hole in the center of our Milky Way galaxy. The evidence? A star near the galactic center orbits something unseen at a top speed of 5000 km/s. Only a black hole 2 million times more massive than our Sun could cause the star to move so fast. (See the Oct. 17, 2002, issue of Nature for more information.)

Still, a key mystery remains. Where did the black hole come from? For that matter, where do any super-massive black holes come from? There is mounting evidence that such "monsters" lurk in the middles of most galaxies, yet their origin is unknown. Do they start out as tiny black holes that grow slowly, attracting material piecemeal from passing stars and clouds? Or are they born big, their mass increasing in large gulps when their host galaxy collides with another galaxy?

A new space telescope called LISA (short for "Laser Interferometer Space Antenna") aims to find out.

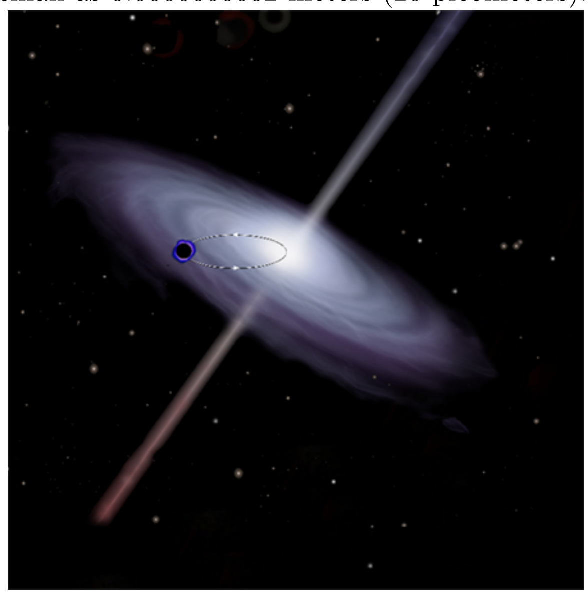
Designed by scientists at NASA and the European Space Agency, LISA doesn't detect ordinary forms of electromagnetic radiation such as light or radio waves. It senses ripples in the fabric of space-time itself–gravitational waves.

Albert Einstein first realized in 1916 that gravitational waves might exist. His equations of general relativity, which describe gravity, had solutions that reminded him of ripples on a pond. These "gravity ripples" travel at the speed of light and, ironically, do not interact much with matter. As a result, they can cross the cosmos quickly and intact.

Gravitational waves are created any time big masses spin, collide or explode. Matter crashing into a black hole, for example, would do it. So would two black holes colliding. If astronomers could monitor gravitational waves coming from a super-massive black hole, they could learn how it grows and evolves.

Unfortunately, these waves are hard to measure. If a gravitational wave traveled from the black hole at the center of our galaxy and passed through your body, it would stretch and compress you by an amount far less than the width of an atom. LISA, however, will be able to detect such tiny compressions.

LISA consists of three spacecraft flying in formation- a giant triangle 5 million km on each side. One of the spacecraft will shoot laser beams at the other two. Those two will echo the laser signal right back. By comparing the echoes to the original signal, onboard instruments can sense changes in the size of the triangle as small as 0.0000000002 meters (20 picometers).



The image, an artist's rendering of a black hole.

With such sensitivity, astronomers might detect gravitational waves from all kinds of cosmic sources. The first, however, will probably be the weightiest: super-massive black holes. Will "feeling" the ripples from such objects finally solve their mystery, or lead to more questions? Only time will tell. Scientists hope to launch the LISA mission in 2011.

Submitted by Nancy Leon
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NASA New Millennium Program/Space Place
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Pasadena, CA 91109

http://spaceplace.nasa.gov

Book of the month

Observing Variable Stars: A modern resource for anyone interested in observing and understanding variable stars. Submitted by Doug Welch.
Visit the "Books" link at `amateurastronomy.org` for this and many other HAA recommended books.

Magazine Discounts

Members of the Hamilton Amateur Astronomers are entitled to special discounted subscriptions to Sky & Telescope and Astronomy magazines:

- Astronomy Magazine: $40 U.S. for 1 year (12 issues), $76 U.S. for 2 years (24 issues)
- Sky & Telescope: $37.95 U.S. for 1 years (12 issues)

The discounted annual rates represent a savings to club members of $10 U.S.
If you're interested in taking advantage of the reduced subscription prices, contact me.

Ann Tekatch
905-575-5433
tekatch@sympatico.ca

Upcoming HAA meetings:

```
   Date: Friday, December 13, 2002
Speaker: Steve Barnes, Sky Optics
  Topic: TBA

   Date: Friday, January 10, 2002
Speaker: Geoff Gaherty
  Topic: An Amateur's Experiences Learning to Observe Variable Stars
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Upcoming events:

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 Date: Saturday, 7 December 2002
Topic: Discovering Galileo
Actor: Mr. John Gauvreau
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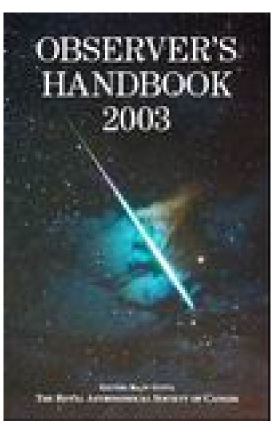
http://nebula.on.ca/hamiltonassoc/lectures.htm

Order your 2003 Observers Handbook and Calendar



2003 RASC handbooks and calendars Order your 2003 RASC handbooks and calendars. Handbooks are $18, calendars are $12 each. Contact Margaret Walton `mwalton@cogeco.ca` to place your advance order. We will take orders at the meetings up to the December meeting.

Hamilton Amateur Astronomers Membership Renewal

November 1, 2002 - October 31, 2003

Name: ____

Address: ____

Province: ________________ Postal code: __________________

Phone number: (___)____________ E-mail: ____________________

Type of membership:

Individual $25.00/year _____

Family $30.00/year _____

Royal $50.00/year* _____

Friend $100.00/year* _____

Patron $250.00/year* _____

Voluntary Donation: $__________

*These levels of membership confer the same rights and privileges as a Family membership. We greatly appreciate the additional financial support our members provide by signing up as a Royal, Friend or Patron member. *All membership dues are eligible for tax receipts.*

Total: $__________

Please make your cheque payable to:

Hamilton Amateur Astronomers
P.O. Box 65578
Dundas, Ontario
L9H 6Y6

Membership renewals are due November 1, 2002

HAMILTON AMATEUR ASTRONOMERS
BALANCE SHEET
AS AT OCTOBER 31, 2002
(Unaudited)

		Oct 31 2002	Oct 31 2001
ASSETS			
	Bank	2538	2127
	Investments	2000	2000
	Inventory	0	300
	Prepaid Expenses	77	77
	Total Current Assets	4615	4504
	Fixed Assets -Equipment	1287	1287
	Total Assets	5902	5791
LIABILITIES			
	Accounts Payable	0	94
	Deferred Revenue	350	445
	Total Liabilities	350	539
EQUITY			
	Opening Balance	5252	4492
	Current Year	300	760
	Closing Balance	5552	5252
	Total Liabilities and Equity	5902	5791

Prepared by Barbara Wight, Treasurer

HAMILTON AMATEUR ASTRONOMERS
INCOME STATEMENT
AS AT OCTOBER 31, 2002
(Unaudited)

	Oct 31 2002	Oct 31 2001
INCOME		
Donations -Membership Fees	1940	1540
Donations -Other	0	235
Messier Marathon	95	490
Observers Handbook/Calendar sales	481	464
Interest Income	0	368
Total Income	2516	3097
EXPENSES		
Newsletter printing	382	369
Newsletter postage	314	435
Meeting and Observing Expense	109	112
Promotion	32	84
Observers H/B/Calendar cost of sales	419	468
Insurance	783	667
General Administration	0	22
Post Office Box rental	77	80
Donation Expense	100	100
Total Expenses	2216	2337
SURPLUS/DEFICIT	300	760

Prepared by Barbara Wight, Treasurer

December 2002

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4 Total solar eclipse, centered on 7:31 UT and visible from southern Africa (beginning) and south-central Australia (end). Greatest eclipse: 2m 4s	5	6 **Observing Night**	7 **Observing Night**
8	9	10	11	12 Geminids meteor shower until the 14th	13 **HAA General Meeting**	14
15	16	17	18	19	20	21
22	23	24 Christmas Eve	25	26	27 **Observing Night**	28 **Observing Night**
29	30	31 New Year's Eve GRS 7:07pm				
			For observing info, call Stewart Attlesey 827-9105, Rob Roy 692-3245, Ann Tekatch 575-5433		November 2002	January 2003

November 2002

					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

January 2003

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	