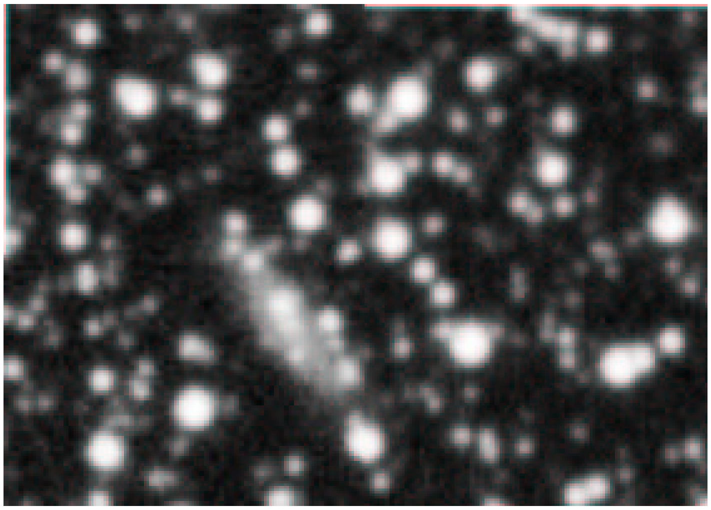
Hamilton Amateur Astronomers

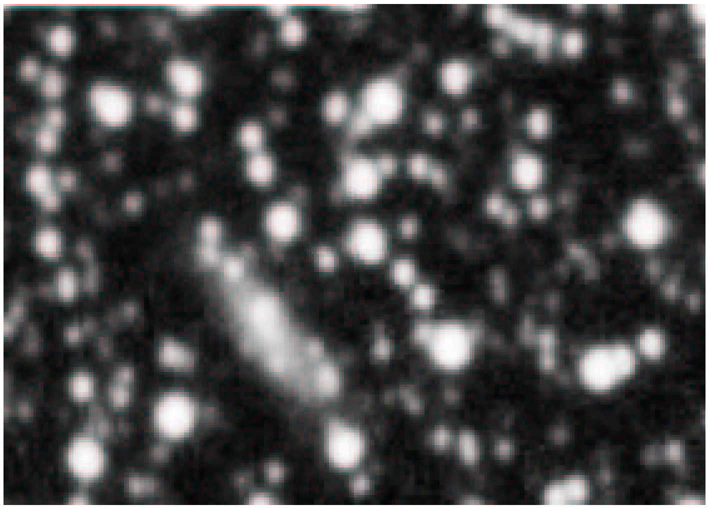
Event Horizon

February 2002
Volume 9 Issue 4

SUPERNOVA 2002B IN ANONYMOUS GALAXY



2B

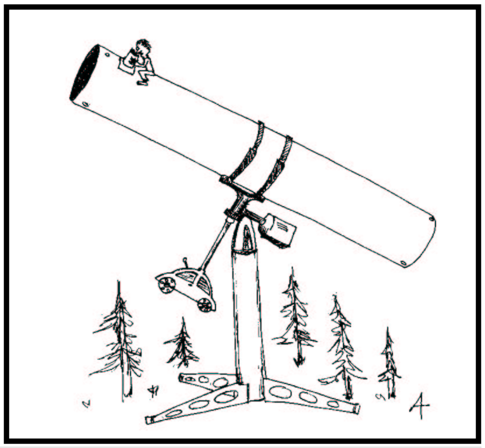


not 2B

Can you spot the Supernova 2002B in the first photo? Our own chair Doug Welch helped to locate this one. ed.

C. Stubbs, University of Washington, reports, on behalf of the SuperMacho microlensing survey team (including also A. Rest, R. Covarrubias, A. Becker, C. Smith, K. Olsen, N. Suntzeff, R. Hiriart, D. Welch, D. Lepischak, A. Clocchiati, B. Schmidt, and K. Cook), the detection with the Cerro Tololo 4-m telescope (+ MOSAIC II imager) on Jan. 7.20 UT of an apparent supernova (R about 20.5) in a galaxy behind the Large Magellanic Cloud.
The new object was not apparent in images taken on 2001 Nov. 22 (limiting mag R about 23) and, based on the accumulated light curve with data points from multiple nights, appears to reach a peak magnitude of R about 20.5 on 2002 Jan. 9.2. SN 2002B is located at R.A. = 5h40m46s.06, Decl. = -71o51’15".1 (equinox 2000.0), which is about 2".2 west of the host galaxy’s nucleus.

2002 January 14 (7791) Daniel W. E. Green



inside ...

Chair's Report

I often am tempted to say "Back in my day ..." these days. You don't really appreciate how very much things have changed until you look back a decade (or two!) It is easy to complain that the skies have gotten much brighter - they have! But there have been many improvements which at least partially compensate for these brighter skies. Let me list a few.

Eyepieces. Back in my day, the way to a wide-field was something called an Erfle. Never heard of them, you say? They were the things we used before the words Nagler and Panoptic made it into the lexicon. The field was wide, alright. Too bad the the stars in the outer half of the field all looked like progressively larger seagulls! You want high power in the winter? Get your cornea nice and close to the tiny lens in the 4mm Orthoscopic. Then breathe heavily to unfreeze it.

Nebula filters. What a concept! Filter out all the stray skylight and let *all* of the nebular light through. It works amazingly well, even in the city. I never saw that kind of contrast even from a dark site in the "olden days".

Aperture! Why, when I was young we used to lie awake at night dreaming about what it would be like to look through a 10-inch telescope with aluminium coatings. Forget 20-inch and ultra-bright.

GOTO scopes? GPS scopes? These weren't even a gleam in anyone's eye! You starhopped. That wasn't a bad thing, of course, but it isn't nearly as amazing as pressing a button.

Astrophotography? Get a nice fast film like Tri-X - ASA 400. "Push process" it. Today's affordable CCD astrocameras have speeds equivalent to ASA 16,000! And they even auto-guide!

Some things really do improve with time. We know much more now and many even more interesting things are in the works. It is sometimes attractive to hark back to more simple times, but things WEREN'T better in every way in the past. That is one of the things which makes this such a great hobby - it is progressive. There are MANY different ways to experience it and enjoy it. I hope the members of the HAA continue to enjoy riding this exciting wave. I know I certainly do!

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

Hon. Chair	Jim Winger
Chair	Doug Welch
Second Chair	Grant Dixon
Secretary	Margaret Walton
Treasurer	Barbara Wight
Obs. Dir	Stewart Attlesey
Publicity	Sheila Overall
Editor/Web	Anthony Tekatch
Membership Dir.	Ann Tekatch
Councillors	
	Ray Badgerow

Web Site
http://www.science.mcmaster.ca/HAA/

Mailing Address
PO Box 65578
Dundas, ON
L9H 6Y6

From the Editor

I would like to thank Rosa Assalone for her tireless efforts in creating the newsletter since 1998. I have volunteered to take Rosa's place and hopefully will be able to do as good of a job as her.

You may notice some changes in the newsletter layout since I am using different tools, please let me know what you [dis]like.

Also, the calendar of events is now a monthly calendar sheet that you can hang on your wall. I've written a Python program to insert the Jupiter Great Red Spot sighting times. Drop me a line if you have any ideas or events that you'd like to appear in the calendar. This months edition includes February's and March's monthly calendar but the March newsletter will only include April's calendar.

This months edition was created using "Scribus 0.5.4" for Linux. Although it is beta software it is a workable free product. Maybe I'll try to use LaTeX next month, beware.

Anthony Tekatch
tekatch@idirect.com

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 tekatch@idirect.com

This month's Q&A theme ... Gravity Sucks

Q. I have been reading about the four major moons of Jupiter and I am surprised by the amount of extreme variation there is between them. One is volcanic, another is ice capped with possible liquid water beneath, others are dry and rugged. What is the reason that they are all so different, being satellites of the same planet? From Brian Chire

A. The answer to this problem becomes much clearer if we arrange the four Galilean Moons in order of their distance from the planet Jupiter. As we start at Io, and proceed outward through Europa, Ganymede, and finally Callisto we will see the satellites' surfaces take on a more stable appearance. This is the direct result of gravitational tidal interaction with Jupiter. The closest satellite Io is under the greatest tidal strain and shows the most dynamic surface, while the furthest satellite Callisto is under the least tidal strain and therefore exhibits the most stable surface. By Astro - Crackerjack

---

Q. I read that there are a very few number of satellites of planets moving in a "retrograde" direction around their planet. This implies to me that most of the bodies in the solar system all revolve in the same direction around the sun or planet. If so, why is this so, and why do those few bodies move in the other direction? Do the same directional movement rules apply outside of our solar system? From Brian Chire

A. Of the sixty-four or so satellites in the solar system only eight move in retrograde orbits. It would appear that the solar system is moving in one direction and this is indeed so. We have to go back to the birth of the solar system, to a time when there was nothing but a massive cloud of gas and dust. For whatever reason this cloud started to collapse with a slight spin. It may have had the spin before it collapsed or the event that triggered the collapse imparted a spin. Gravity became the driving force in the collapse and as the cloud became more compact potential energy was translated into angular momentum. The system sped up and gravitational effects along with angular momentum caused all objects to move in the same direction. It would seem from observation and from deductive reasoning that this effect is general. I should point out that this is a simplified version of reality and the true scenario is much more complex. The more interesting question is - How did the retrograde objects come into being? and that is another whole story. By Astro - Crackerjack

---

Q. It is my understanding that all

cont pg 4 ...

... cont pg 3

galaxies rotate. Do they all rotate the same direction, and if so, why? If not, why do some rotate one way and some the other? Brian Chire

A1. There is no answer to this question. It all depends on your perspective. Looking at the galaxy from one side will show it rotating one way and from the other side it will rotating the other way. Who can really say which way it is rotating? Stewart Attlesey

A2. It isn't really possible to tell if all galaxies rotate one way or the other since that would presuppose that there's an actual top and bottom to a galaxy. There is a relative top and bottom from the perspective of a particular observer (you, for example), but someone viewing from another angle may perceive what you call the top as the bottom.

What is interesting, though, is that no matter what type of galaxy you're looking at they all rotate. The most obvious ones perhaps are the spirals with their pinwheel pattern which give the impression of spinning by just looking at them. Less obvious are the elliptical galaxies which don't have arms: they just seem to be disks with a bulge - some bigger and some smaller - in the middle of them. Even less obvious are the irregular galaxies: but they spin too. How can we tell? When taking a spectrum of various parts of a galaxy, one generally notices that most galaxies have a red-shifted spectrum (there's a handful that don't). That is, each part of the spectrum of the galaxy is shifted towards the red end of a reference spectrum by some constant amount. However, if you look at the relative amount of redshifting in different parts of the galaxy, some parts are a bit more redshifted and some parts are a bit less redshifted. If you subtract the average redshift value from all your different spectra measurements, what you'll notice is that one side is blue-shifted (approaching) and the other side is red-shifted (receding). This is what you'd expect if the galaxy was spinning.

Now, going back to the original question and adding to the answer provided above: An observer on the exact opposite side of the galaxy from you would perceive a blue- and red-shifted side, but reversed. That's because what you'd see as receding would be approaching this other observer, and vice versa. That observer would claim the galaxy is spinning in the opposite direction you would. Who's right? Both of you - it's a matter of perspective and there's no absolute frame of reference to decide one way or the other. Tom Steckner

---

Q. With respect to the previous question. What about looking at all galaxies from the edge of the universe, are the spin axis at different (random) angles to each other? Anthony Tekatch

A1. As far as I know there is a fully random distribution of just about every parameter you can think of, including rotation. By the way, I don't think you can say there is an edge to the universe. If you travel half the distance to what we perceive as the limit of the universe, in any direction, when you get to that point the universe will still have the same distance limit in all directions. In other words, we can only see as far as light has had time to travel since the universe was formed but the universe is larger than that! The inflation theory accounts for the initial expansion of the universe at a speed faster than light. (IIRC) Stewart Attlesey

A2. There actually is no "edge of the universe." I don't know how to explain that other than to provide the analogy I once read. Ones perspective of the universe is something like standing on an imaginary balloon covered in dots (galaxies), with you standing on one of the dots. You can look in any direction and see dots (galaxies), but there's no edge. Further, the expansion of the universe can be visualized by what you would observe while standing on the balloon as it is being filled: the space between the dots increases as they recede from you, but there's still no edge. Unfortuantely this analogy can only show this effect in two dimensions.

The "edge" sometimes described in the newspaper articles in connection with missions looking at the cosmic microwave background (CMB) such as COBE and recent experiments based in the Antartcic is a bit of a misnomer. It is simply an edge from our perspective because as you look ever farther into the universe, you are also looking back in time. Eventually you get to the point where you're looking far enough away, and hence far enough back in time, that galaxies haven't even been formed yet. Look back far enough (in space and thus time) and you're looking at the leftover energy from the Big Bang; i.e., the CMB. From our perspective, this is an edge. However, if there was someone looking back at us from that position they would not see you - they'd see the CMB too since the only signal from our part of the universe which is old enough to have reached them is from the era you are seeing them in their patch of the sky.

So, getting back to the original question, are the spin axes random? Yes, but there's no "edge" against which to compare this - your perspective from our Milky Way is as good a place as any from which to observe and draw this conclusion. Tom Steckner

Holidays

by Charles Baetsen

On Groundhogs, May Poles and Turnips

What do Groundhog Day, May Day and Halloween all have in common? They are all cross-quarter days. Cross-quarter days are those days that are exactly half way between the equinox and solstice (or vise versa). There are four of them (the fourth one being Lammas). In old Germanic and Celtic traditions, the equinoxes and solstices marked the middle of the seasons. Resulting in the cross-quarter days marking their beginnings. Because of this, these days had great importance in these cultures.

Groundhog Day (Feb 2):

The current name for this holiday is an Americanization of the old holiday called Candlemas. Candlemas is the feast day of Brìghde (or Bridget), the Celtic goddess of fire. In some countries it was believed that some type of burrowing animal, normally a hedgehog, would come out on Bridget’s Day to judge the quality of the weather as per the following saying:

Candlemas is fair and clear
There’ll be twa winters this year

This tradition came with the settlers to North America, but since no hedgehogs could be found, groundhogs were used instead. The above saying was re-written as:

If the groundhog sees his shadow we will have six more weeks of winter.

Groundhog Day is precisely half way between the Winter Solstice and the Vernal Equinox. It should be noted that, regardless of whether the groundhog sees his shadow or not, from a mathematical point of view, on Feb 2, there are always six weeks of winter left!

May Day (May 1):

May Day was originally called Beltane for the Celtic god Belenus. It is exactly half way between the vernal equinox and the summer solstice. It was a time of fun and games. In ancient times, lovers would sleep outdoors and celebrate the "great rite" (use your imagination) in the fields to ensure the fertility of the crops. The Druids and their successors raised the Beltane fires on hilltops throughout the British Isles on May Eve (the Celts began their daily cycle at sunset). In later times these fires were replaced with the maypole. Dances were (and still are) done around the maypole during the day. May Day came under severe attack by the Puritans who banned it by an act of Parliament in 1644. May Day did return with the restoration of Charles II in 1660, but the elements of sexual license and social reversal went underground. Since the Puritans frowned on May Day, it has never been celebrated with as much enthusiasm in North America.

Lammas (Aug 1):

This cross-quarter day has all but disappeared from the modern calendar. It occurs exactly half way between the summer solstice and the autumnal equinox. In Northern Europe, summer was considered to end at this time, as the days grow visibly shorter. The Celts honoured the god Lug (god of light) on Lughnassad. Eventually, this holiday became Christianized to become Lammas or the "Feast of the Loaf Mass". This is when early grain would be baked into loaves and offered at mass. A ceremonial highlight of this festival was the "Catherine Wheel" (St. Catherine’s feast day was also on Aug 1st). A large wagon wheel was taken to the top of a near-by hill, covered with tar, set aflame, and ceremoniously rolled down the hill, symbolizing the end of summer. The flaming disk represented the sun god in

cont pg6 ...

... cont pg 5

his decline.

Halloween (Oct 31):

Today this is the best known of the cross-quarter days. The Celts celebrated Samhain (or summer’s end) on this day. By summer’s end they meant that it was the end of the warm part of the year (keep in mind that Europe’s weather moderated by the gulf stream). Samhain occurs exactly half way between the autumnal equinox and the winter solstice. This was the Celtic New Year. The Celtic festival of Samhain was celebrated at the same time as Pomona, a Roman celebration of the harvest. After the Roman conquest of Britain in 43 AD, these two cultures began to merge and bobbing for apples (pommes) and harvests became part of the celebration. In 835 AD, the Catholic Church declared November 1st as All Saint’s Day (or Hallowmas). The previous day then became known as All Hallows Eve (or Halloween).

In old Europe, the wealthier members of a community put together lavish Samhain feasts for their households. The poor would take on the collective identity of the community’s dead, and go from door to door to receive offerings (treats) in the name of their ancestors. At each house they are given a portion of the food that has been set-aside for the dead. Not to hand out food for any reason was considered an act of impiety, and would invite retaliation in the form of property destruction (the trick). This was the origin of the trick or treat custom we see today. In order to see their way at night, people made lanterns from carved out turnips. During the potato famine in the 1840s, thousands of Irish Catholics came to North America and brought this custom with them. Since pumpkins were more plentiful than turnips, it didn’t take them long to start hollowing out Jack-O-Lanterns.

Charles W. Baetsen
va3ngc@rac.ca

Charles Baetsen is a founding member of the HAA. He moved to Peterborough a few years ago with his wife and three kids. Charles is editor of the Peterborough astronomy club newsletter.

Space News - 2002

by Ray Badgerow

Galileo Completes Last Io Flyby

On January 17th, the Galileo spacecraft made its final flypast of the volcanic moon Io,on the I33 orbit. The probe came with 1.5 km of it’s aimpoint and arrived 5 seconds later than expected. This flyby was targeted to the Jupiter facing hemisphere which was not viewed on previous orbits. The command sequence was stopped about half an hour before closest approach (100 km) due to a radiation -induced safing event ,and most of the Io observations were lost. However, observations were made of Europa, Amalthea, Jupiter,and distant views of Io. The last remote sensing observation made during the Galileo tour was a NIMS calibration made on February 1st. The cameras were shut down after that. The Galileo probe is now on a long cruise phase, some 292 days, the longest cruise period since orbit insertion in Dec. 1995. It will fly past Amalthea on Nov. 5,2002 in order to make a mass determination. The mission will end in September 2003 when the orbiter plunges into Jupiter’s atomsphere near the equator.

Hubble Gets An Upgrade

Sometime in late February or March the Hubble Space Telescope will get another visit from the Space Shuttle to have several of it’s instruments upgraded. During the next mission the Hubble will have the Faint Object Camera(FOC) replaced with the versitale new Advanced Camera For Surveys(ACS). In addition, there will new solar panels, electronics,a new power-control unit

cont pg7 ...

Fun in the Sun

by Grant Dixon

When you are asked "told" to write an article, you panic, you have a fuzzy brain moment and think, What to write?. Well, I sit here with a blank piece of paper and think what I should write about. Should it be deep and erudite, or light and whimsical; should it be learned or superficial? As I type I realize everyone loves the trivial, so why not something about the sun? I have selected three short stories about observing the sun: two anomalies and one just a curiosity.

17th Century Solar Rotation

For almost a century the sun went into a period of very low sunspot activity now known as the Maunder Minimum (1645-1715). Just prior to this, there were two well-documented accounts of sunspot activity. One was between 1625-1626 and the other between 1642-1644. In both cases, astronomers were able to ascertain the rotation of the sun. The surprising finding was that just before the Maunder, the sun rotation sped up by 3%. As far as I know no one has been able to successfully explain this phenomenon!

Rapid Surface Change

On January 22, 1900 at 3:00 p.m., Caroline E. Furness was using the observatory at Vassar College to observe the sun. She observed a sun devoid of spots for 15 minutes and then suddenly a spot appeared. The sun was then projected onto a screen to make an image of 15 inches in diameter. The spot was now the size of a pinhead and while she observed this one, another and then another appeared, and finally a fourth appeared. Within 10 minutes all had faded with the exception of the first one. At that time the sun was getting so low the observing session ceased. When Furness returned to observe the sun the next day there were no spots. While the solar surface is very active, I am curious as to why this is the only observance of such a rapid change of sunspot activity.

Fly Me Swiss Air

On January 22, 1959 Yngve Ohman, while observing the sun at the Stockholm Observatory, noticed a black object cross the sun. It created a light surge that lasted two seconds and extended two minutes of arc on either side of the sun. A month later a colleague of Dr. Ohman made a similar observation. This caused a great degree of puzzlement until someone thought that maybe it was the crossing of planes. The Swiss Air force was coaxed into supplying two jets to take part in an experiment. The jets made two transits at a distance of about 10 km and the results were consistent with the earlier observations; therefore, the hypothesis was proven to be correct. To my knowledge this is the only time fighter jets have been used in a scientific solar experiment.

Science 198:824-829, 1977
Popular Astronomy, 8:109, 1900
Sky and Telescope 19:472, 1960

Grant Dixon is a founding member of the HAA. You can find out more about his life and hobbies at: http://home.cogeco.ca/~grant.dixon/index.htm

---

... cont. from page 6 (Space News)

,and a cryocooler and radiator for the NICMOS insturment. We can expect to see new and exciting images from the HST over the next several years. For details see the March 2002 issue of Sky & Telescope.

by Ray Badgerow

Raymond Badgerow is a member of both the HAA and RASC Hamilton Centre. He served as both recorder and librarian for the Hamilton Centre,and is on the HAA board. His email is rbadgerow@mountaincable.net .

Do Black Holes Really Exist?

by Stewart Attlesey

Answer; Probably.

The nature of black holes makes it difficult to say with total certainty that they are real. Theory and indirect evidence make a very strong case for their existence however.

When a star runs out of fuel and can no longer produce enough energy to counteract the force of gravity it will collapse. This can take place over a very short period of time and with great violence as a supernova or it can be a relatively gentle process. The fate of a star is primarily governed by its initial mass. (Having a companion adds some different scenarios to this process.) A high mass star, greater than 8 times the mass of our Sun, will most likely end its life as a supernova. Smaller stars such as our Sun will have a much quieter fate perhaps going through a planetary nebula phase. In both cases the star will lose much of its outer layers. The mass of the remaining inert portion of the star determines its final fate. Up to about 1.4 solar masses, the Chandrasekhar limit, the core will compress down to a white dwarf. Further compression is prevented by electron ’pressure’. At higher masses, gravity overcomes electron pressure and protons combine with electrons to form neutrinos and neutrons with the end result being a neutron star. Neutron ’pressure’ can limit compression up to about 3 solar masses. Beyond this mass there is nothing known that will halt gravitational collapse. The star, in theory, will collapse to a point with zero size! This is called a singularity and the gravity is so high that nothing, not even light, can escape. Black holes appear to have a physical size though due to an ’event horizon’. To understand what the event horizon is, imagine that you are throwing a ball straight up in the air at 100 kilometres an hour. Eventually gravity will pull the ball back to the surface of the Earth. Now step into an elevator that can take you hundreds of thousands of kilometres away from the Earth. You will find that as you travel in this elevator you can throw the ball higher and higher before it returns to you. Eventually you will reach a point where the 100 kilometres an hour velocity of the ball is enough to overcome Earth’s gravity and it will keep on going. Now consider light, which travels at 300,000 kilometres a second. It doesn’t have enough velocity to escape the pull of gravity at the center of a black hole. As you move away from the center you will eventually reach a point where, just like the ball, it can escape. This distance defines the radius of the event horizon. Looking at a black hole from the outside, the event horizon would appear to be its ’surface’. It is merely the point closest to the star that anything surrounding the black hole can still be visible. Since a black hole is by definition black, there is nothing to observe. However, we can see the effects that such massive compact objects have on their surroundings.

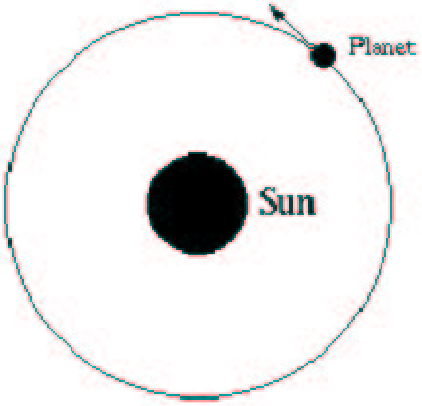
What distinguishes black holes from ordinary objects is high mass in a very small volume and this feature is used to deduce their presence. So how do you weigh an object like a star? Using our solar system as an example, if a planet moves around the Sun in an orbit with a radius r and velocity v you can use the formula $M=(rv^2)/G$. Where G is the gravitational constant and M is mass.

For our Sun we can calculate a mass of

cont pg 9 ...

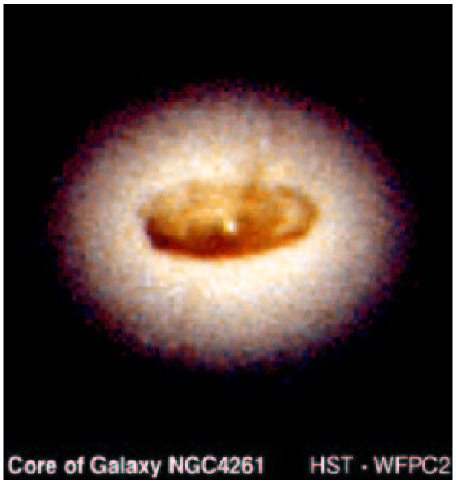
... cont pg 8

2 x 10^{30} kilograms (that's a 2 followed by 30 zeros!)



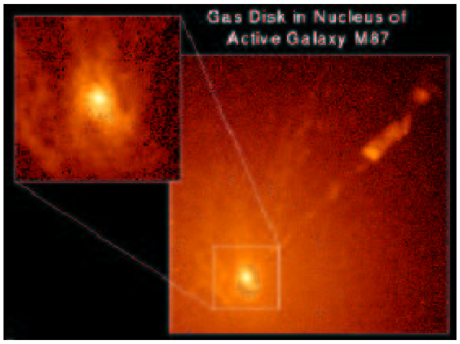
The trick to solving this equation for potential black holes is determining the radius and velocity of objects orbiting it. The velocity can be measured by looking at how the light of orbiting stars is Doppler shifted. This won't work with a system oriented to us like the above example since both objects remain the same distance away from us at all times. For an edge on system, a star approaching us appears bluer, and receding it appears redder. The higher the velocity of the stars the greater the change in colour. To obtain the radius we can measure how wide the orbit appears to us and calculate the radius knowing the distance. To determine the distance of relatively nearby objects we have to rely on using associated objects of known brightness. Measuring the apparent brightness of these objects and knowing how bright they actually are allows us to make this calculation. For objects that are very far away we can use the redshift value and the Hubble constant to estimate their distance. In other words, the farther something is away from us the faster it is receding from us.

Here is an example using the galaxy NGC4261 located 100 million light years away in the constellation Virgo.



Inside the core of this galaxy is a disk that has had its radius and velocity measured. When the calculations were done it was determined that the object at the centre is about as large as our solar system and weighs 1.2 billion times the mass of our sun. There is nothing currently known other than a truly massive black hole that can satisfy these conditions.

Another example is the galaxy M87.



Once again, the core of the galaxy contains an object no larger than the diameter of the solar system and weighs 3 billion times as much as the Sun.

So even though no one has ever seen one it looks like black holes really do exist.

Stewart Attlesey is a founding member of the HAA. He has held the positions of Chair, Editor, Secretary, Recorder and is currently the Observing Director. He has also held the positions of Recorder and Observatory Curator for the RASC Hamilton Centre. (stewart.attlesey@cogeco.ca)

In Sight

Snowflakes fall, and the wind blows
Ice pellets knock on my windows
What a contrast just days ago!
The full moon crowned with a halo
With Jupiter at her side
Glowing brightly, with pride
How quickly everything changes!
The cosmic scene rearranges
Hot becomes cold, clear becomes cloudy
New becomes old, quiet becomes rowdy.
The earth turns. Life grows, by chance?
Our hearts yearn for immortal dance.
Many secrets yet untold
Answers we try to mold
Our minds put to the test
Joy felt in the quest
And beauty to behold
As the cosmos unfolds

Barb Wight

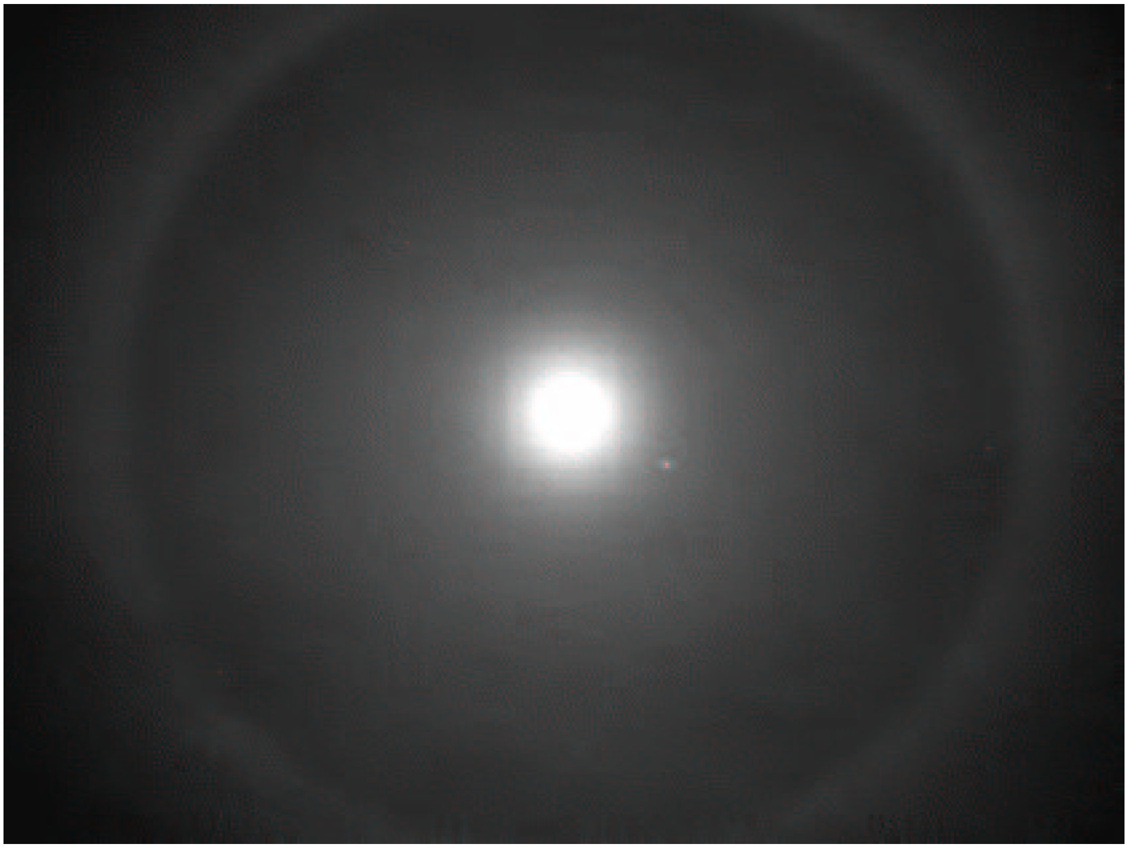


Photo by Stewart Attlesey. It shows a halo around the Moon and Jupiter. Jupiter was 3 degrees west of the Moon on January 26, 2002. Ice crystals in high clouds produce a 22 degree radius halo. The clouds and the exposure required to show the halo rendered the Moon featureless.
Phot specs: Canon G2, Focal length 7mm (equivalent to 34mm in a 35mm camera), f/2, 1/8 second, ISO 50
Here is a great link that talks about halos:
http://www.sundog.clara.co.uk/atoptics/phenom.htm

February 2002

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1 ◑ GRS 5:33am	2 ◑ GRS 1:25am 9:16pm
3 ◑ GRS 7:11am	4 ◑ GRS 3:03am 10:54pm	5 ◑ GRS 6:45pm	6 ◑ GRS 4:41am	7 ◑ GRS 12:32am 8:24pm	8 ● GRS 6:19am **Observing Night** **HAA General Meeting**	9 ● GRS 2:11am 10:02pm **Observing Night**
10 ● GRS 5:53pm	11 ● GRS 3:49am 11:40pm	12 ● GRS 7:32pm	13 ● GRS 5:28am	14 Valentine's Day ● GRS 1:19am 9:10pm	15 ● GRS 7:06am **Observing Night**	16 ● GRS 2:57am 10:49pm **Observing Night**
17 ◐ GRS 6:40pm	18 ◐ GRS 4:36am	19 ◐ GRS 12:27am 8:19pm	20 ◐ GRS 6:14am	21 ◐ GRS 2:06am 9:57pm	22 ◐	23 ◐ GRS 3:44am 11:36pm
24 ○ GRS 7:27pm	25 ○ GRS 5:23am	26 ○ GRS 1:14am 9:06pm	27 ○	28 ○ GRS 2:53am 10:44pm		
		GRS: Jupiter's Great Red Spot visible at night. Eastern time is used.	For observing info, call Stewart Attlesey 827-9105, Marg Walton 627-7361, Rob Roy 692-3245			

January 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	31		

March 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
31						

March 2002

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1 GRS 6:36pm	2 GRS 4:31am
3 GRS 12:23am 8:14pm	4 GRS 6:10am	5 GRS 2:02am 9:53pm	6	7 GRS 3:40am 11:32pm	8 GRS 7:23pm **Observing Night** **HAA General Meeting**	9 GRS 5:19am **Observing Night**
10 GRS 1:10am 9:02pm	11	12 GRS 2:49am 10:41pm	13 GRS 6:32pm	14 GRS 4:28am	15 GRS 12:20am 8:11pm **Observing Night**	16 GRS 6:07am **Observing Night**
17 St. Patrick's Day GRS 1:58am 9:50pm	18	19 GRS 3:37am 11:29pm	20 GRS 7:20pm	21 GRS 5:16am	22 GRS 1:08am 8:59pm	23
24 GRS 2:46am 10:38pm	25 GRS 6:30pm	26 GRS 4:25am	27 GRS 12:17am 8:09pm	28 GRS 6:04am	29 GRS 1:56am 9:48pm	30
31 Easter Sunday GRS 3:35am 11:26pm		GRS: Jupiter's Great Red Spot visible at night. Eastern time is used.	For observing info, call Stewart Attlesey 827-9105, Marg Walton 627-7361, Rob Roy 692-3245		February 2002	April 2002

February 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		

April 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				