nt Horizon Volume 23, Number 8 June 2016

From The **Editor**

Many thanks go out

to everyone who

submitted articles,

letters and images

this month! The

Have a great

and Clear Skies,

Bob Christmas,

Summer.

Editor

editor 'AT'

result is a fascinating

content-packed E.H.!



Chair's Report by Bernie Venasse

Welcome to SUMMER !!

This is the final Chair Report prior to our summer 2016 break. There will be no monthly meetings nor will there be Event Horizon publications until September.... but there is still lots happening.

Member observing at Binbrook Conservation Area... watch your eMail for notices. Public Outreach sessions are scheduled as follows:

- June 18 at Grimsby Welcome Centre
- July 9 at Bayfront Park
- August 12 Family day and Perseid Event at Binbrook C.A.

The month of May was full of activity. The Mercury transit was viewed by many of our members. Unfortunately, some of us were otherwise occupied by our jobs..... sigh.

Our Astronomy Day Outreach session at Bayfront Park was a success once again although there was not an opportunity to do any solar observing. The skies remained variable through the evening but were clear enough to offer views of the Moon, Jupiter, M42, etcetera.

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amateurastronomy.org

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Chair's Report (continued)

The general Meeting on May 13th was well attended and our speakers were quite entertaining and informative. Special thanks go out to Paul Delaney, Matthew Mannering and Kevin Salwach. Good luck in your pursuits this summer. Be safe. Clear skies....

Take part in our survey at <u>www.amateurastronomy.org/survey</u>.



H.A.A.'s Loner Scope Program

We at the HAA are proud of our Loner Scope Program.

If you don't have a telescope of your own and want to make use of one for a month or so, you can borrow one of our fine loaner scopes.

Please contact Jim Wamsley, at 905-627-4323, or e-mail Jim at:

secretary 'AT' amateurastronomy.org

and we'll gladly get one signed out for you.



HAA Helps Hamilton

To support our community, we collect non-perishable food items and cash for local food banks at our general meetings. Please bring a non-perishable food item to the meeting or a donation of cash and help us help others.



Our donations go to <u>Hamilton Food Share</u>, which delivers them to various food banks around the Hamilton area.

If you would like to help or have any questions about this initiative, please contact the H.A.A.

Masthead Photo: Mars, Saturn, Antares (alpha Scorpii) & the Rho Ophiuchi Region on May 2, 2016, by Bob Christmas.

Taken from near Barry's Bay, Ontario, with Canon 40D & 100mm telephoto lens, tracked on Super Polaris EQ mount. 14×1 minute = 14 minutes total exposure time, at ISO 1600 and f/2.8.

Letter to the Editor

A comment about "How Many Stars are There?" in Bruce Pawlett's "Space Stuff" column last month, which I found enjoyable to read.

Bruce mentions the Yale Bright Star catalogue tabulates some 9,096 stars down to magnitude 6.5 and that for any particular location only half that number - 4,548 - would be visible at any given time (implicitly making the reasonable simplification, to make his point, that the stars are evenly distributed in the sky). This is actually only theoretically true, and then only for an observer at the equator.

First, for anyone north or south of the equator, part of the sky will never rise above the horizon for that observer. For example, someone at 45°N can see the entire northern sky, but only "half" the southern sky; i.e., only 3/4 of the sky in total or only 3,411 stars. ("Half" is in quotes because deriving the actual number is more complicated than this. That's because the true area obscured on the celestial sphere by the horizon can't be based on a simple linear fraction using the number of degrees north or south you are. To calculate it accurately would require applying the rules of spherical trigonometry. To understand the point, look at any globe and compare the length of a degree of longitude at the equator vs. the pole.)

Second, this number is reduced even further when you consider atmospheric extinction (decreased sky transparency) the lower one looks towards the horizons; e.g., how much dimmer the setting Sun is vs. when it's high in the sky. So, roughly, you can cut that number in half again.

Even with this significantly reduced number, Bruce is right to point out that the number of stars in the sky seems so much greater than is really the case.

Sincerely,

Tom Steckner



HAA Outreach Report - Bayfront Park by Kimberly Andrus

Although it had been raining earlier in the day and it was overcast and cold, there were more members of the public visiting the stargazing outreach night, at Bayfront Park (May 14th), than expected. There were many interested in the club and members spent time giving the public information, tours of the sky, and encouragement towards a hobby in astronomy. The interested individuals were so enthusiastic that one woman hugged our Councilor at Large, Denise White, for her efforts in sharing her view of the sky.

The clouds were drifting in all evening creating very poor conditions for viewing, however, we were able to glimpse the moon and some constellations long enough to allow for visitors to see something interesting. The temperatures, that International Astronomy Day evening, dropped down to 4° C and the winds never did die down, it was a chilly night and our shared love of the sky and fellowship of the club kept us warm.

The Sky this Summer 2016 by Matthew Mannering

On May 9th we were treated to a transit of Mercury across the face of the Sun. Les and I were set up before 7am waiting for the transit to begin with a half hour to spare. The transit started on time and we immediately noticed that Mercury looked a lot smaller than Venus did when we watched it transit the Sun in June of 2012. There are two reasons for this. Mercury is further away than Venus (83.4 million km vs. 43.2 million km) and Mercury is a lot smaller (4,879 km vs. 12,104 km diameter).

Later in the day, Les and I, along with Jim, made our way to John's house and set up our scopes. We thought we were going to be clouded out for egress, but magically, the cloud moved out of our way with less than two minutes to spare. We all got to see the tear drop effect as Mercury began egress which was a nice bonus.

As I mentioned in the May Event Horizon's "The Sky this Month" this is prime time for viewing **Mars. Saturn** follows Mars by about one half an hour. In addition, **Jupiter** is still high in the sky at dusk. Les, Ed and I set up a couple of scopes last week and concentrated on the planets for a few hours. We started with Jupiter and the Great Red Spot which was just appearing at the limb. A while later, Mars was high enough to start observing and although the seeing was lousy, we did manage the Polar cap and the dark ring around it called Utopia Umbra. Only occasionally did we see any markings in the southern hemisphere and no detail there whatsoever. At the end of the evening we turned the scopes to Saturn and as always enjoyed the view of the rings and the Cassini gap.

With summer solstice fast approaching on June 20th, it's worth remembering that your nightly window for deep sky photography is rather limited. The center line of the Sun must be 18° below the horizon for twilight to end and become truly dark. By mid June, twilight doesn't end until shortly after 11pm and starts again at 3:30am.

In summer, most of the really interesting objects are found in the southern sky within or close to the Milky Way and almost always below 35° altitude. To make matters worse, any object below 20° will probably be in the atmospheric 'soup'. For example on June 30th the beautiful globular cluster **M22** will be due south at an altitude of 22° (nice coincidence). So not only do you have a short window of darkness, you also have a short window of opportunity when the object you want to photograph or observe is at its highest point due south in the sky. Try and take this into account when planning your observing sessions.

Summer is also prime time to try and catch a glimpse of **Pluto**. It's necessary to sketch the field of view when observing Pluto. Pluto is so dim and unremarkable that you won't be able to differentiate it from the background stars unless you sketch the view in the eyepiece over a period of a few nights. Pluto will be the "star" that moves from night to night. June 25th is a great night (as well as the nights immediately before and after) to try and catch a glimpse of it. Pluto will pass only 2 arc minutes below the magnitude 2.85 star 'Albalda' in Sagittarius.

To observe Pluto around June 25th get your hands on an 8" or larger telescope and try the following:

Once you have Albalda centered in the field of view, bump up the magnification on your scope as high as possible. Try a scope/eyepiece combination that produces a half degree field of view on a non tracking telescope or a quarter degree field of view on a tracking scope. This will help increase the contrast of the stars against any background glow in the sky. The view should look something like the top of the next page.

(Continued on <u>page 5</u>)

The Sky this Summer 2016 (continued)

The first view of Pluto is through an 8 inch SCT with a 7mm eyepiece with an apparent field of view (FOV will be marked on the eyepiece) of 72° giving a real FOV of 0.234° .



The second view is through a 12 inch Dob with a barlowed 26mm eyepiece with an apparent field of view of 60° giving a real FOV of 0.52° .



The Sky this Summer 2016 (continued)

To arrive at the approximate field of view with a specific eyepiece, I use a simple calculation:

Magnification = Telescope Focal length / Eyepiece Focal length Actual Field of view = (Eyepiece FOV / Magnification)

So here is an example based on the 8" SCT view shown above.

Magnification = 2032mm / 7mm = 290.2 Actual FOV = (68° / 290.2) = 0.234°

The Planets

(Rise and set times are given for when the planet reaches 5 degrees above the horizon)

Mercury

- June 15 through the 23rd very low in the eastern morning sky at 5:15am.
- July 25th through August 8th very low in western sky at 9:15pm.

Venus

- Very close to the Sun in June and most of July.
- Look for it very low in the western sky before 9pm at the end of July.
- In August look before 8:40 up to the 15th and before 8:30 up to the 26th.

Mars

- June 1st at 9:30pm in the SE, elevation 15°. Setting at 4:25am.
- July 10th at 9:30pm due S, elevation 25°. Setting at 1:28am.
- August 15th at 9:30pm in the SSW, elevation 19°. Setting at 11:45pm.
- At the end of August, Mars will have shrunk to an apparent diameter of 10 arc seconds which means that seeing any detail on the surface will become increasingly difficult from this point onwards. Sets at 11:10pm.

Jupiter

- June 1st SW at 9:30pm, elevation 47°. Setting at 1:45am.
- July 1st just south of west at 9:30pm, elevation 30°. Setting at 11:50pm.
- August 1st west at 9:15pm, elevation 13°. Setting at 10:00pm.
- August 28th setting at 9:30pm.

Saturn

- June 1st SE at 9:30pm, rising. Setting at 5:30am.
- July 1st almost due south at 10:00pm, elevation 24°. Setting at 3:25am.
- August 1st due south at 9:30pm, elevation 27°. Setting at 1:20am.
- September 1st SSW at 9:00pm, elevation 22°. Setting at 11:20pm.

Uranus

- June 1st rising in the east at 4:00am.
- July 1st rising in the east at 2:00am.
- August 1st rising in the east just after midnight.
- September 1st rising in the east at 10:00pm. Due south at 4:30am.

Neptune

- June 1st rising in the east at 2:30am.
- July 1st rising in the east at 00:30am.
- August 1st rising in the east at 10:30. Due south at 3:30am.
- September 1st rising in the east at 8:30pm. Due south at 1:30am. Setting at sunrise.

(Continued on page 7)

Events (highlight events are marked "!!")

-June 3rd:	- Saturn at opposition.		
-June 4th:	- New Moon.		
-June 11th:	$-$ Jupiter less than 4 $^{\circ}$ east of the Moon at 10pm.		
-June 12th:	— First Quarter Moon.		
-June 20th:	— Full Moon.		
	- Summer solstice.		
-June 25th:	 — !! Pluto 2 arc minutes below the star Albalda in Sagittarius. 		
-June 27th:	 Last Quarter Moon. 		
-June 30th:	— !! Mars .3° east of NGC 5897 a mag 8.5 globular cluster.		
- lulv Ath	- New Moon		
- July 7th	- Regulus 2.3° north west of the 3 day old Moon at 10pm		
- July 11th:	– First Quarter Moon		
- July 19th:	- Full Moon		
- July 22nd/23rd	- !! Neptupe occulted by the Moon at 23.59 Reappears at 00.54 on the 23rd		
- July 26th	- Last Quarter Moon		
- luly 20th	- II Possible grazing occultation of Aldebaran by the Moon at 6.32am (plus or minus 2)		
	minutes) Make sure you check for an exact location and time yourself!		
	minutes). Make sure you check for an exact location and time yourself.		
-August 2nd:	- New Moon.		
-August 4th/5th:	- Venus, Mercury, the Moon and Jupiter are gathered low in the western sky at 9pm.		
	(See August 4th chart below and the August 5th chart at top of page 8)		
	(Continued on <u>page 8</u>)		
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Expenses included Speaker's Honorarium, \$50 and \$8 for the month before. Revenue includes \$55 for the 50/50 and \$75 for memberships.



A Report on the Educational Presentations and Public Outreach of the Hamilton Amateur Astronomers by John Gauvreau

This is the second year in which the club has specified a council position to oversee our public education efforts (at my recommendation) and I have been fortunate enough to have that position entrusted to me. I felt it was time to fill everyone in on what kind of activities the HAA has been involved in. In the last issue of the Event Horizon, chair Bernie Venasse mentioned doing his first library presentation, along with Leslie Webb and Jim Wamsley. I am delighted that he found it so enjoyable. Certainly, I always do. He encouraged other members to try and I would do the same.

Bernie said that he found it "not at all difficult", and although I, like many other members, have many years of experience doing these presentations, I have always found a challenge hidden in them. Of course I also find them fun, rewarding, educational and often inspiring. The challenge comes in finding a way to reach each and every member of an audience in a meaningful way, when those members may vary in age from children to seniors, and may vary in experience from rank beginner to the most experienced and knowledgeable participant. Whether it is a troop of 6 or 7 year old cubs and brownies, a classroom of grade 6 students studying space science or a random selection of public, you have perhaps an hour at best to inspire them. They have walked in to your presentation because they obviously already have some interest, and your goal is to make sure that they have even more when they walk out an hour later. Basically, their interest is there, and the universe is there, and it is your job to connect the two. But facing these challenges encourages me to know my material better, so that I can explain it better in a way that is clear, accessible and enjoyable to everyone in the room. And yes, it should be enjoyable of course. The goal is to educate and entertain at the same time. Undertaking this task is entirely worthwhile, and as I said, eminently rewarding.

I do want to thank Bernie and Les for stepping in with only a few weeks' notice when I was obliged to be at work on an evening when I was scheduled to do this library show. My thanks to Jim extends far beyond this one show to many others he has done with me. Jim has specialized in sharing his meteorite collection with attendees, giving them a chance to not only learn about, but also touch these very tangible examples of the celestial universe beyond our Earth. Over the years he has put together a compre-*(Continued on page 10)*



A Report on the Educational Presentations and Public Outreach of the Hamilton Amateur Astronomers (continued)

hensive kit that is perfect for these presentations. I have often seen a large crowd huddled around a table where Jim is explaining the meaning behind these space rocks. I also want to give considerable credit to long-time member Don Pullen who has done many, many library programs over the years. For those who have seen Don give talks at our club meetings, you know what an engaging speaker he is. Since the beginning of the club's year I have delivered programs for 6 libraries, 1 elementary school, 1 conservation area, 1 outside club, 1 brownie group and the regional science fair. I suppose this has been a fairly quiet year so far. In past years there have been at least comparable numbers, although the balance shifts from time to time (for instance, last year I visited 5 outside clubs). I am booked at 4 more libraries between now and September. Each venue means adapting a program to suit it, and each audience has special needs and requirements. For instance, I have developed a program for cubs and brownies that covers much of their astronomy badge requirements and does it in a manner that meets the challenges of teaching space science to such young children.

One other club member that deserves special recognition is Matthew Mannering. Of course he is currently the club's Observing Director and, as such, is at the front of the room at each monthly general meeting giving a wonderful presentation to the members and public in attendance. However these audiences of 60 to 100 people could hardly prepare him for a presentation in front of 1,100 students and teachers at the Bay Area Science and Engineering Fair. Matthew joined me in March of this year and delivered two brief but excellent talks to the students. The purpose of these presentations is to occupy the students while the judges have an opportunity to review their projects. It is an opportunity to educate them while keeping their minds off the fact that the months of work they have put into their project is on the line and coming to a rapid conclusion. As such, the organizers of the science fair endeavour to find speakers that are engaging and inspiring. I have been honoured by BASEF by being asked to deliver one of the key presentations for each of the past four years. Each of these talks has been written specially for the fair and each is a unique experience. As much as I enjoy speaking to a classroom or library, where an audience or class of about 20 allows for personal interaction with everyone in the room, speaking from a stage in front of 1,100 offers a different kind of exhilaration. One can only hope that you are reaching at least somebody in that audience that will be inspired by the material



(Continued on <u>page 11</u>)

Images Credit:

Katherine Smith

(both this and previous page)

A Report on the Educational Presentations and Public Outreach of the Hamilton Amateur Astronomers (continued)

presented, and in return the cheers and enthusiastic applause from over a thousand people is more than rewarding enough for all the work that goes in to writing and preparing such a large show.

The rest of the club is often involved in public outreach as well. During the warmer months, from March through October, the club hosts a monthly public observing session at one of four locations that we rotate through. These lively events take place at either Bayfront Park in Hamilton, McQuesten Park, also in Hamilton, the Gateway Niagara Information Centre in Grimsby, and once each year during the Perseid Meteor Shower at the Binbrook Conservation Area. At these locations, any and all members of the club are invited and encouraged to come out and share their hobby with the public. Many members bring their telescopes and offer views of the moon and planets, and even more come without scopes to share their knowledge and experience, giving the public a brief glimpse into another world, or worlds. At these occasions, each and every member becomes an ambassador for not just the club, but for the hobby of astronomy and the ideals of science and exploration. I have on many occasions seen our members do the name of the Hamilton Amateur Astronomers proud and it may be at these events where our club makes its greatest contribution to our community.

Visiting parks, conservation areas, libraries, schools, art galleries and other venues (which I may have forgotten) is a task in the club that keeps me busy but that I also find very rewarding. Meeting so many people that want to share our passion for astronomy is inspiring and always a pleasure. And the idea that there is passion is perhaps the most key point. Among all the questions that I am asked at these events the one comment that comes back to me from the public that I meet is that there is such passion for this material. With that I cannot argue and if I succeed in conveying that then we are succeeding in our goals to reach out and involve the public in our field. If you would like to accompany me on any of these outreach events please get in touch; the public is waiting out there and will be happy to meet you.



A New Member Perspective by Kimberly Andrus

I joined Hamilton Amateur Astronomers over a year ago and in that time I have not been very active partially because of conflicting schedules and partly out of shyness. I have been interested in the hobby of astronomy for as long as I can remember. I can't imagine anyone not being interested in astronomy or science.

This past winter I decided to increase my involvement with the club and I was met with very encouraging and friendly members including Jim Wamsley, past club Chairman and Bernie Venasse, current club Chairman. Jim has been welcoming from the beginning of my membership. He has welcomed me out to the Cosmology group, informed me on the club activities, and assisted me with borrowing a club telescope. I had the telescope for a month and quickly navigated the sky from my backyard. The 4" Newtonian was easy to use with a basic tripod and push-to mount (manual). It would be simple for any beginner to use and assisted me in applying some of the theory that I have acquired over the years. I started observing the Moon in various phases and Jupiter and quickly realized that I had to buy my own equipment.

There are many members in the club who are happy to assist new members with the purchase of a new telescope and I would recommend doing your own research as well. While I would not recommend beginners make a quick a decision in buying a telescope, researching your purchase with the many resources available today will assist you in making this important investment. The prices vary widely and there are many options in telescopes, viewfinders, lenses, filters, telescope mounts, and tripods. If you think you plan to do some astrophotography then this should be considered when purchasing your first equipment as well. The HAA holds telescope clinics regularly and this is a good place to get assistance from seasoned members of the hobby. So, don't be shy, research for yourself, and ask for assistance from any of the helpful members of the club. That is what Hamilton Amateur Astronomers is here for; "the enjoyment and advancement of astronomy." Enjoy the membership and welcome.

Expanding Confusion: Misconceptions About the Universe by Bruce Pawlett

Ugh! I do enjoy intellectual challenges but why does cosmology have to be so mind bending. I recently watched a Veritasium YouTube video "Misconceptions About the Universe". It was excellent in providing some basic insight to a casual viewer by describing what the Observable Universe and related topics are but a simplification left me puzzled. My OCD kicked in and I had to figure it out.

I discovered the source paper the video was based on: "Expanding Confusion: common misconceptions of cosmological horizons and the superluminal expansion of the universe" by Tamara Davis and Charles Lineweaver, 2003 (University of New South Wales, Sydney Australia). Their objective obviously was to clarify some common misconceptions related to the expansion of the Universe. Reviewing the paper did provide some insight but it was somewhat complex so I needed additional sources to figure it out.

First, some background information, I am sure most are aware that in 1929 astronomer Edwin Hubble overturned the belief that the Universe was static and unchanging with the publication of his paper that calculated the expansion rate of the Universe. In 1998 two independent projects (Supernova Cosmology Project and the High-Z Supernova Search Team) simultaneously discovered that not only is the Universe expanding but also its expansion rate is accelerating. Nobel prizes were awarded to team members from both teams.

When discussing the Big Bang - Inflation model for the creation of the Universe the inflation period is often referred to as Superluminal Expansion since the expansion rate was faster than the speed of light. The "Expanding Confusion" paper while not disputing that some initial expansion took place faster than the speed of light questioned the justification of use of the term "Superluminal Expansion".

The use of this term implies that the entire Universe at that time was undergoing superluminal expansion and that is unknown. As per the paper, this could only be justified if the superluminal expansion included all distances down to the Planck length of 1.6×10^{-35} m (~10-20 x the diameter of a proton, calculated shortest possible distance and beyond which our concepts of space & time break down). In other words, the initial inflation period of the Universe may have been very fast but it may not be dissimilar to the situation since then, where objects of great distances always have been, are and always will be moving apart relative to each other at faster than light speeds. It is clarified that nothing can move through space faster than the speed of light but there is no such relativistic restriction on space itself.

Since the recession velocities of distant objects exceed the speed of light there is a particular distance where the recession speed is equal to the speed of light. This distance exists in all directions, thus a sphere can be envisioned. This sphere is called the Hubble Sphere; any object beyond it is receding faster than light speed. The proper radius of the Hubble Sphere or Hubble Length is c/H where c=speed of light and H is the Hubble constant. At this cosmological time the Hubble Sphere is about 14 billion light years.

It is a common misconception that we cannot see anything past the Hubble Sphere. In decelerating Universes, H decreases as the rate of expansion decreases and the Hubble sphere size increases (Hubble sphere recedes). In accelerating Universes, there is an intermediate range where the velocity can increase even if H is decreasing as long is it is decreasing more slowly than the distance is increasing. It is believed this is the current situation. (The Universe has always been expanding but its expansion rate has not always been accelerating. Since the density of dark energy remains constant as the Universe expands the total amount of dark energy increases. It has only been about 2 - 3 billion years that the volume of space as become large enough for dark energy to be dominant over the gravitational effect of matter in the Universe). Thus, the Hubble sphere was and is currently receding. As long as the Hubble Sphere recedes faster than the photons just outside of it, those photons will end up in the subluminal region and we will eventually be able to observe them. (*Continued on page 13*)

Expanding Confusion: Misconceptions About the Universe (continued)

(In the Veritasium video it was stated that the Hubble Sphere increases in size due to the accelerated expansion of the Universe. That statement is what led me to investigate. As per the previous paragraph that is not exactly true, the Hubble Sphere increases in size with a decrease in expansion rate but there is an intermediate range where the Hubble sphere will continue to expand in spite of an accelerating expansion).

Any photons that we now observe that were emitted in approximately the first 5 billion years of the universe were emitted by objects that are, were and always have been moving away from us faster than light speed. The Particle Horizon is the distance to the most distant object that we can observe; it is how far the object has become since the beginning of time. The Particle Horizon represents the Observable (or Known) Universe and has a proper radius of about 46 billion light years making the total distance that can be observed of about 93 billion light years. This "proper" distance is the current instantaneous distance that one would have to travel with the Universe's expansion frozen.

While the Particle Horizon represents the distance that light can have travelled since t=0 (beginning of the Universe) to a given time t, the Cosmic Event Horizon (CEH) is the distance light can travel from time t to time t=infinity. "It is a boundary to the observable Universe. Beyond it is the region of our Universe from which we can never receive any new signal; that is any signal that is emitted today. That is because the distance that signal has to travel to get to us is expanding faster than the speed of light before the signal reaches us."

What is mind bending is that The Cosmic Event Horizon can be and is closer to us than the Particle Horizon. We cannot see events that occur beyond the Cosmic Event Horizon (~16 billion light years) but we can see galaxies beyond it by the light they emitted long ago. As our Universe expands, more and more of it will cross the CEH and will be lost to us forever. Milky Way astronomers in the far, far future would likely come to the conclusion that the Milky Way is the only galaxy in the Universe. The image below from the paper graphically illustrates the concepts.

The diagram shows the Particle Horizon crossing the "now" line at~46 billion years and the Event Horizon at ~16 billion years. The image below is an artistic approach for illustrating the observable Universe. I highly recommend downloading and viewing a full size version.

(Continued on page 14)



- Scale factor (a) is a linear representation of the size of the Universe (current size = 1)
- Light Cone past light cone shown (within the cone are the set of events in spacetime that can affect us at time = now)
- Proper Distance as defined above, other diagrams show alternative distance measurements, but add complexity.

Expanding Confusion: Misconceptions About the Universe (continued)



Image Credit: Pablo Carlos Budassi

Artist's logarithmic scale conception of the observable universe with the Solar System at the center, inner and outer planets, Kuiper belt, Oort cloud, Alpha Centauri, Perseus Arm, Milky Way galaxy, Andromeda galaxy, nearby galaxies, Cosmic Web, Cosmic *microwave radiation* and Big Bang's invisible plasma on the edge.

Note - artist perception shows the CMB etc. at edge but if somehow we could instantly travel there it would no longer be that, it would be whatever it evolved into, just more Universe.

While researching this I also discovered a posting on Caltech Physicist Sean Carroll's website about Energy Conservation. While we are on the topic of misconceptions about the Universe we may as well add this one. Dark energy is the term applied to force that is attributed to the accelerating expansion of the Universe. While dark energy is not understood it is believed to be the energy of empty space and has a constant density of 10⁻¹⁰ joules/m³. Energy is not conserved in an expanding universe.

Carroll's explanation is based on General Relativity: "Einstein tells us that space and time are dynamical, and in particular that they can evolve with time. When the space through which particles move is changing, the total energy of those particles is not conserved..... Energy and momentum evolve in a precisely specified way in response to spacetime around them. If that spacetime is standing completely still, the total energy is constant; if it's evolving, the energy changes in a completely unambiguous way."

(*Continued on <u>page 15</u>*)

Expanding Confusion: Misconceptions About the Universe (continued)

Carroll added that the red shift that photons experience while travelling through expanding space is another example of the violation of energy conservation. If we track a fixed number of photons, the number of photons remains the same but the energy per photon decreases, so the total energy decreases. For experimental evidence Carroll sites the success of "Big Bang Nucleosynthesis". This is the prediction of the initial concentration of hydrogen, helium and lithium created in the first few minutes after the Big Bang. According to Carroll, "the fact that energy is not conserved in an expanding universe is absolutely central to getting predictions of primordial nucleosynthesis correct".

The Veritasium video ended with a comment that the Universe may be infinite, and if it is infinite it was always infinite and an expanding infinite universe must be expanding into itself. If this is so, the Universe could not have come into existence at an infinitesimally small single point but the Big Bang happened everywhere.

Astrophysicists using the BOSS (Baryon Oscillation Spectroscopic Survey) wide angle reflector telescope in New Mexico accurately mapped out 1.2 million galaxies and determined that the Universe is extremely flat and reported that at the 223rd meeting of the Astronomical Society that the Universe is probably infinite. Our most precise measurements indicate a flat universe and a flat universe is infinite. However, our most precise measurement is not infinitely precise!

An infinite universe expanding into itself may explain the constancy of dark energy density with expansion. There is much evidence for the Universe's Big Bang beginning (less so for the initial expansion theory and we really don't know what precipitated the Big Bang) but can a universe be born via the Big Bang mechanism and be infinite (Big Bang everywhere)? If our universe is finite undergoing infinite expansion into what is it expanding? Does anyone really know what an infinite universe is? What is the difference between an infinite universe and one that has expanded for a time "t" that is approaching infinity?

What does "t" approaching infinity actually mean? The Second Law of Thermodynamics states that entropy or the amount of disorder will always increase and in reality the arrow of time exists because of this. Imagine an expanding universe infinite or otherwise that reaches the point where all the stars, planets and galaxies have ceased to exist, all the black holes have fully evaporated. The universe has reached a point of maximum entropy or maximum disorder. There is nothing left to experience time except the expanding space itself. Then, due to slight variations in dark energy a fluctuation occurs that sparks a new Big Bang. Do we reset the clock at t=0 again? Perhaps what we call t=0 for our Universe is a scenario similar to the above?

Max Tegmark (MIT Professor of Physics) in his book "Our Mathematical Universe: My Quest for the Ultimate Nature of Reality" describes a mathematical limitation to the "possible ways in which a universe the size of ours can be arranged. His conservative estimate (maximizing the number) is 10 to the power of 10118, which is a fantastically huge number but nevertheless small in comparison to infinity. He describes an infinite universe as one of what he calls Level 1 parallel universes ("...simply universe-sized parts of our space that are so far away that light hasn't yet had time to reach us)". There is a finite way of arranging these parallel universes so at some point they must repeat (duplicate). Since we are discussing an infinite universe then these constituent parallel universes must repeat an infinite number of times. This is often interpreted to mean we all have an infinite number of doppelgangers.

Now if we extrapolate Tegmark's explanation to the finite number of neurons and synapses in my brain, there should be a limit to how confused I (without doppelgangers) can become in contemplating all of this. However, does introducing new data to my neural network multiply this confusion limit. Are there limitations on new data? If not, am I doomed to infinite confusion? I think I need a nice glass of Malbec to further contemplate and perhaps Buzz Lightyear summed it up best with his catchphrase "To Infinity and Beyond".

NASA's Space Place



NOAA's Joint Polar Satellite System (JPSS) to revolutionize Earth-watching

By Ethan Siegel

This article is provided by NASA Space Place.

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If you want to collect data with a variety of instruments over an entire planet as quickly as possible, there are two trade-offs you have to consider: how far away you are from the world in question, and what orientation and direction you choose to orbit it. For a single satellite, the best of all worlds comes from a low-Earth polar orbit, which does all of the following:

- orbits the Earth very quickly: once every 101 minutes,
- is close enough at 824 km high to take incredibly high-resolution imagery,
- has five separate instruments each probing various weather and climate phenomena,
- and is capable of obtaining full-planet coverage every 12 hours.

The type of data this new satellite – the Joint Polar Satellite System-1 (JPSS-1) -will take will be essential to extreme weather prediction and in early warning systems, which could have severely mitigated the impact of natural disasters like Hurricane Katrina. Each of the five instruments on board are fundamentally different and complementary to one another. They are:

1. The Cross-track Infrared Sounder (CrIS), which will measure the 3D structure of the atmosphere, water vapor and temperature in over 1,000 infrared spectral channels. This instrument is vital for weather forecasting up to seven days in advance of major weather events.

2. The Advanced Technology Microwave Sounder (ATMS), which assists CrIS by adding 22 microwave channels to improve temperature and moisture readings down to 1 Kelvin accuracy for tropospheric layers.

3. The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument, which takes visible and infrared pictures at a resolution of just 400 meters (1312 feet), enables us to track not just weather patterns but fires, sea temperatures, nighttime light pollution as well as ocean-color observations.

(*Continued on <u>page 17</u>*)

NASA's Space Place (continued)

4. The Ozone Mapping and Profiler Suite (OMPS), which measures how the ozone concentration varies with altitude and in time over every location on Earth's surface. This instrument is a vital tool for understanding how effectively ultraviolet light penetrates the atmosphere.

5. Finally, the Clouds and the Earth's Radiant System (CERES) will help understand the effect of clouds on Earth's energy balance, presently one of the largest sources of uncertainty in climate modeling.

The JPSS-1 satellite is a sophisticated weather monitoring tool, and paves the way for its' sister satellites JPSS-2, 3 and 4. It promises to not only provide early and detailed warnings for disasters like hurricanes, volcanoes and storms, but for longer-term effects like droughts and climate changes. Emergency responders, airline pilots, cargo ships, farmers and coastal residents all rely on NOAA and the National Weather Service for informative short-and-long-term data. The JPSS constellation of satellites will extend and enhance our monitoring capabilities far into the future.



Images credit: an artist's concept of the JPSS-2 Satellite for NOAA and NASA by Orbital ATK (top); complete temperature map of the world from NOAA's National Weather Service (bottom).

Eye Candy the Members' Image Gallery



Mars, Saturn and Antares near the Horizon at Binbrook C.A. on April 29, 2016, by Kevin Salwach Rebel T5 with an 18mm lens at ISO 1600, f/5.6; 20 second exposure. This is Kevin's very first attempt at astrophotography!



Mars, Saturn and Antares near the Horizon at Binbrook C.A. on April 29, 2016, by Bruce Pawlett

Eye Candy the Members' Image Gallery



Transit of Mercury across the Sun, May 9, 2016

Mercury



Sunspots of Active Region 2542

Top Left: mid-morning, by Peter Wolsley Celestron 8" EdgeHD with Full Aperture Solar Filter & 0.7 Focal Reducer/Flattener, Nikon D5300, ISO 100, 1/800th sec exposure.

Top Right: lunch hour, by Bob Christmas Tamron 300mm lens with Baader filter, Canon 40D, ISO 100, f/11; 1/400th sec exp.

Bottom Right: Transit of Venus of June 5, 2012, for comparison, by Peter Wolsley



Cartoon Corner by Alexandra Tekatch 2 27 0 お 0 0 24 "Dude, the gravity waves are gnarly today!" The Scope Store at Camtech Largest Selection of Telescopes, Binoculars and Microscopes in the Golden Horseshoe Dealer for Celestron, Orion, Vortex, Bushnell, Nikon and Pentax We now carry the Sky Watcher line of products! Proud supporter of the HAA 588 Concession St., Hamilton, ON, L8V 1B1 (905) 389-8545 www.camtechphoto.com

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- Public transit available directly to McMaster campus
- Tickets \$7 per person; private group bookings \$150
- Different shows every week
- Upcoming shows include:
 - June 1: Introductory Astronomy for Kids (1st Wed of every month)
 - June 8: Celestial Harmonies
 - June 15: The Astrophysics of Everyday Life
 - June 22: Robotic Renaissance
 - June 29: Cosmic Footprints
- For more details, visit <u>www.physics.mcmaster.ca/planetarium</u>

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- Upcoming shows include:
 - Jul 6: Introductory Astronomy for Kids (1st Wed of every month)
 - Jul 13: Cosmic Corpses: Nebulae, Neutron Stars and Black Holes
 - Jul 20: Carl Sagan's Universe
 - Jul 27: The Great Debate: Galaxies and their place in the universe
- For more details, visit <u>www.physics.mcmaster.ca/planetarium</u>

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- Different shows every week
- Upcoming shows include:
 - Aug 3: Introductory Astronomy for Kids (1st Wed of every month)
 - Aug 10: Navigational Astronomy
 - Aug 17: Dammit Jim, I'm an astronomer!
 - Aug 24: Cosmology
 - Aug 31: Tour around the Solar System
- For more details, visit <u>www.physics.mcmaster.ca/planetarium</u>

UPCOMING EVENTS

June 10, 2016 - 7:30 pm – HAA Meeting at the Hamilton Spectator Auditorium. Our main speaker will be Michael Cook of Newcastle Observatory.

June 18, 2016 - 8:00 pm - 11:00 pm – Public Stargazing Night at the Niagara Gateway Tourism Centre, Grimsby, ON.

July 9, 2016 - 9:00 pm - 11:00 pm – Public Stargazing Night at Bayfront Park in Hamilton. August 12, 2016 - 8:00 pm - 11:00 pm – Perseids Meteor Shower Public Night at Binbrook Conservation Area. Stay tuned for more details.

September 9, 2016 - 7:30 pm – HAA Meeting at the Hamilton Spectator Auditorium.

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Observing site for the HAA provided with the generous support of the Binbrook Conservation Area Come observing with the HAA and see what a great location this is for stargazing, a family day or an out- door function. Please consider purchasing a season's pass for \$79 to help support the park. <u>http://www.npca.ca/conservation-areas/binbrook/</u> 905-692-3228		Webmaster: webmaster@amateurastronomy.org

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