



The Mason-Dixon Astronomer

Westminster Astronomical Society of Maryland

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Star Points for January 2000

By Curtis Roelle

The End of the Universe As We Know It

Last month we discussed the future evolution and eventual death of our sun according to the current theory. If humanity expects to survive it will jettison our current solar system no later than several billion years from now and find another. What will the future hold after that? What changes will occur over time in the universe of our descendants?

To understand the future we first visit the past. The current prevailing creation theory is known as the "big bang." An observation supporting this theory is that galaxies appear to be receding from each other like shrapnel hurled from a primeval explosion. If we assume that this interpretation is correct then the next question is, will the expansion continue forever or will the combined pull of gravity from all other galaxies eventually end the expansion and perhaps cause the universe to contract in a "big crunch?"

A "closed" universe is one in which ceasing expansion leads to contraction. The notion of a contracting universe has led some to consider the concept of time reversal in which clocks will begin running backward! This conjecture leads to absurd conclusions such as brown leaves leaping onto trees and then turning into buds. The trees themselves shrink into acorns which that fly up to connect themselves onto tree branches. Can photons of light spray from our eyes and be absorbed by the stars? Ideas such as these are illogical in a universe where time is observed to move only in the forward direction.

Recent estimates of how much mass exists in the visible universe indicates that there is far less than what is needed to halt the expansion. Astronomers conclude that the universe may instead be "open" and will continue expanding forever. If this is so then how will the universe change over the course of eons? London mathematician Jamal Islam discusses the future in his book, "The Ultimate Fate of the Universe."

In the future the expansion of the universe will cause galaxies we see today to appear smaller and fainter as they drift away. At the same time the stars in our own galaxy will stay nearby and remain visible.

In order to survive in the future the human race would need to migrate from star to star every several billion years as each host sun ages and dies. Through parallel migrations over time countless solar systems may eventually be colonized throughout the Milky Way.

During such a migration a segment of civilization might pack up its things and shuttle off for a journey lasting generations. Having arrived at their new destination the narrative of their collective adventure would form a slice of the cultural heritage passed down through succeeding generations, perhaps not unlike the story of Noah's ark.

Stars are formed out of gas and dust. Over the course of a star's life and eventual death material gets ejected that eventually gets recycled in new stars. However, any matter that has been converted into metals such as iron is no longer suitable for making young stars. The available supply of raw star materials will be used up and

in perhaps as little as 100 billion years the final generation of stars will have burned themselves out.

All galaxies, including our own, will eventually darken as their stars cease to shine. The light emitted from every star that ever lived will have been radiated into space at the speed of light.

Massive stars will have long since collapsed into black holes.

Black holes are theorized to be produced when extraordinarily massive stars explode as a supernova.

Great quantities of energy, much of it in the form of X-rays, gets emitted as material spirals into a black hole, heating up before disappearing. If a civilization could find a black hole to live near it may be possible to generate energy by discarding trash into the black hole and collecting the energy released. Unfortunately the supply of trash is a finite non-renewable resource. You end up with a limited energy supply and a fatter black hole.

Wouldn't it be nice if you could "withdraw" energy from a black hole? Fortunately, Roger Penrose and Stephen Hawking discovered a method for doing so.

The conventional wisdom is that nothing, including light, may ever leave a black hole once it has gone in. Using mathematics Hawking demonstrated that black holes can indeed lose mass and energy through an "evaporation" process. Penrose has described a process where the decay of radioactive particles in the vicinity of a rotating black hole can "steal" energy away from it. The black hole feels the effect as a reduction in its spin rate.

How long could a civilization survive around a stellar mass black hole? Over time gravitational encounters between three or more black holes will cause 99% of them to be ejected from the galaxy.

Those that remain will collect near the center of galaxy where they will coalesce into a single galactic black hole with a radius of half the distance from the sun to the planet Pluto.

The clusters of galaxies we see today will be clusters of galactic black holes when the universe reaches the age of one billion billion (ten to the 18th power) years. Gravitational interactions will cause 99% of the galactic black holes to be ejected from the system. When the universe is one billion billion billion (ten to the 27th power) years the remaining galactic black holes will have formed a supergalactic black hole with a mass of perhaps one hundred billion suns.

A civilization that has learned the techniques of "farming" energy from rotating black holes could exist as long as they have access to them. However, all black holes regardless of mass are expected to have evaporated by the time the universe is 10 billion billion billion billion billion billion billion billion billion (ten to the 100th power) years old.

The trick will be avoiding the 99.99% of black holes that get ejected into an isolated existence in deep space. Instead, pick one that remains near the center of the galaxy where it may coalesce with other black holes and grow. The bigger the black hole, the longer it will last. Once the black holes are gone the universe continues grows ever colder.

Astronomers currently estimate the age of the universe to be between 10 and 15 billion years. Stars will shine for the first 100 billion years and then the universe turns forever dark as the black holes slowly evaporate over the countless eons. One blink of an eye during the epoch of light is, by comparison, many times longer than the epoch of light is to the future age of darkness ruled by black holes.

In an open universe a finite amount of available energy must last for all eternity. After that life will be forced to cease its dependence on the physical universe in ways we may only speculate about. Will life eventually evolve into a form of consciousness without need of water, flesh, blood, or even bodies?

The answers to these questions are far beyond the scope of the Sunday morning hobby page. May these questions serve as food for your Sunday afternoon thought and meditation.

OBSERVATIONS

Hubble Space Telescope 12/26/99 from San Diego, CA

By Gene Dolphin

This was a special evening at home in San Diego. Armed with updated Satellite visibility times from <http://www.bester.com/satpasses.htm> my wife and I completed appetizer, dinner and dessert preparations for friends from across town and their relations from across the country. Kathy applied her kitchen wizardry and prepared a magnificent meal. I set up a couple telescopes out front while awaiting the 1st of two passes across the southern night sky of the Hubble Space Telescope.

The 1st pass was to span from 17:13 – 17:27 p.m. The sun had recently set and there was ample skyglow off to the west. Our guests called at 17:05 p.m. to let us know that they would be arriving late, too late for the celestial appetizer (HST flyby). Just before heading outside, I verified my watch was set to the correct second. After finding a suitable observing spot in front of the house, a couple neighbors walking their dogs came by and were interested in the notion of seeing the HST crossing the southern sky. One of them came back around the corner afterwards to see if we had spotted the satellite ... and in time to see it for herself.

Due to the sky glow, I wasn't able to detect the beginning of the flyby from the west. I was able to spot the HST about 17:18 p.m. It was due south and up over 45 degrees above the horizon. Kathy came quickly outside to spot this 2nd

magnitude object as it swung across the sky. Its path stretched ESE and the HST disappeared from sight about 10 degrees above the horizon as it went into earth's shadow.

In another 5 minutes, our guests arrived. I turned the C-5 and 8" Dobsonian scopes onto Jupiter, Saturn and the Pleiades. Even in the suburbs of San Diego, these showpieces delight the eye. Saturn, at 200 X was stunning. Three of its moons could be easily seen, as well as the Cassini Division. Another walker came by on the sidewalk and stopped to take a look and visit a while.

After our guests went inside to warm up, I packed up the scopes and joined the gang for a really fine meal. We visited for another half-hour and I noticed that the 2nd flyby was at hand, so slipped away quietly to the front of the house to keep watch. This pass was to span from 18:56 ◊ 19:09 p.m. The western sky was noticeably darker and I was able to spot the "rise" of the HST at the appointed hour. About this time, I was joined by my wife and our visitors, all eager to see the event. This 2nd HST flyby path was lower to the southern horizon, with maximum elevation at 29.1 degrees. It was fun to watch/hear the surprise when the HST vanished from sight just after passing slightly east of due south (from its entry into the earth's shadow) when it was apparently only half-way across its sweep across the southern horizon.

Last Night in 1999 at LBRP

By Ralph Kantrowitz

Last night, Dec. 11th, was most likely the last gathering at the Little Bennett horse lot before 2000. Sky transparency was excellent; all the stars of the Little Dipper were visible, as was the faint glimmer of the Milky Way high above. Last night's group included Eric Adams, Michael Hubbard, Ralph Kantrowitz and Dave Bonnell. Black Hills Park Naturalist Glen Cumming, who stopped by on his way home from the Tri-State Astronomers annual banquet, later joined us.

The seeing was not as good as last weekend, micro turbulence obscuring the fine planetary details seen then.

One of the evening highlights was Eric's spotting of two faint fuzzies in his Takahashi FS78. He had unwittingly followed Messier's trail, locating M81 and M82 in the same finder field. A close-up view of M82 in Dave Bonnell's 10-inch revealed the irregular external shape and internal structure. The Orion nebula was fabulous in all scopes and the placement of Lepus near its maximum altitude allowed us to view something new to us - IC418, the Raspberry Planetary. It was reminiscent of the Ghost of Jupiter, appearing as a fuzzy star at low power and a bright blue disc at high powers. The Raspberry appellation comes from the view in very large scopes,

which show a pinkish tinge. The Eskimo nebula in Gemini was also very bright; the central bright area and fuzzy hood readily apparent.

I had looked forward to the 'Red' spot transit and Io's transit across Jupiter. The GRS was not visible, only the hollow, the leading SEB was much darker than the SEB trailing the GRS and a conspicuous white band was located beneath the SEB trailing the GRS. There were a number of knots in the NEB and at least one faint festoon curving southward from the NEB to a thin EB. The start of Io's transit was readily visible, since Jupiter is starting to show a 1 percent unlit phase, across which bright Io was easy to see. By the time the shadow followed Io across the disk, the altitude and seeing of Jupiter were diminished, making the shadow a small black notch and then dot across a shimmering image.

Both Michael and Glenn found NGC 457 in Cassiopeia, a.k.a. the ET cluster because of its uncanny resemblance to the movie alien. I made a point of tracking from M38-36-37-35 through Auriga into Gemini with my 7x50 finder, enthused by the cloud puff nature of these clusters on a clear night. The double cluster in Perseus was lovely in all scope and both these and the Beehive in Cancer were visible to the naked eye at altitudes above 45 degrees. I managed also to view the Crab (M1), Mini-Dumbbell (M76) and Owl (M97) Nebulae as well. Andromeda and its companions were clearly visible in a low power eyepiece, as was M33.

We saw a number of bright meteors, at least two of which seemed to come from the general direction of Gemini. Alas duty and responsibility called at last and we headed home for a good night's sleep.

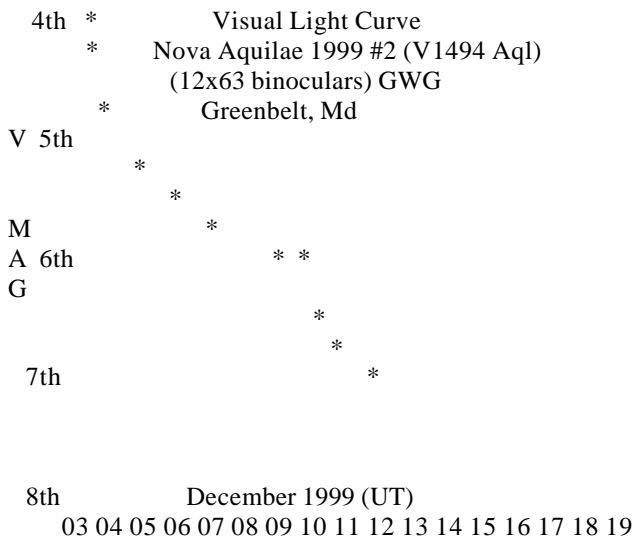
Brightest Northern Nova in 24 Years!

By G.W. Gliba

A new galactic nova was discovered visually by Alfredo Pereira, of Caboda Roca, Portugal with 14x100 binoculars on Dec. 1.785 UT at m_v about 6.0, and independently by Gary T. Nowak, of Essex Junction, VT, using a pair of 7x35 binoculars on Dec. 1.958 UT at mag 5.6, according to IAUC 7323 and IAUC 7325. Several amateur astronomers in the eastern USA were able to observe the nova on the evening of December 2nd, when it was about 4th magnitude, and visible to the naked-eye in suburban skies. It had a distinct yellow-orange color when compared to nearby delta Aquilae (F0 IV) in 12x63 binoculars. Before outburst, the nova was just one of millions of seemingly ordinary 16th magnitude stars visible with a fairly large telescope. So, the outburst amplitude is 12 magnitudes, which is not unusual for a fast galactic nova.

When last seen on December 19th the nova was at 6.9 magnitude and fading. This is the brightest galactic nova in the northern sky since Nova Cygni 1975, which reached 1.8 visual magnitude on Labor Day weekend that year. There were fairly bright novae in 1984 (Vul 6.0 magn.), 1991 (Cyg 4.5 magn.), and 1993 (Cas 5.3 magn.), but Nova Aquilae 1999 #2 (V1494 Aql) edges them out as the brightest northern sky nova

in over 24 years! Below is a visual light curve, based on estimates made with the AAVSO (aa) chart using 12x63 binoculars, of this cataclysmic binary star system.



WAS Events For January 2000

By Ron Smith

1. The standard astronomical epoch J2000.0 coincides with 12h Dynamical Time, today, or about 11:59 UT.
2. Sundials are 4 minutes slow today.
3. Earth reaches perihelion at 5h UT (distance 147,102,790 km).
4. The Quadrantid meteors are active before dawn.
5. Latest sunrise of the year at latitude 40 degree north.
6. New Moon (1:14pm EST).
7. Galileo discovers Jupiter's moons Io, Europa, and Callisto, 1610
8. Latest onset of morning twilight.
9. Thomas Henderson makes the first distance measurement to Alpha Centauri, 1839
10. Crescent Moon passes 2d south of Mars at 2pm EST.
11. William Herschel discovered Titania (III) and Oberon (IV), moons of Uranus, 1787
12. WAS monthly meeting, 7:30pm, Bear Branch Nature Center.
13. Galileo discovers Jupiter's Ganymede, the largest moon in the solar system, 1610
14. First Quarter Moon (8:34am EST).
15. Mercury reaches superior conjunction around sunset.
17. Sundials are 10 minutes slow.
19. Moon at perigee, 23h UT (distance 359,362 km, Diameter 33'15").
20. Full Moon (11:40pm EST) - Total eclipse of the Moon.
22. USAF concludes that less than 1% of UFO's are unknown objects, 1959
24. Neptune is in conjunction with the Sun.
27. Asteroid 2 Pallas lies 6' south of Omicron Puppis at midnight.
28. Last Quarter Moon (2:57am EST).
29. NASA space shuttle Challenger explodes, 1986
31. US entered the Space Age with the launch of Explorer 1, 1958

Editor's Eyepiece

Communications

Newsletter: I am in dire need, still, of some one to take my place in the paper form of the newsletter. Since I now have full time employment for reliable income AND continuing to stick with my two businesses on the side, as well as being an office of local chapter of IAAP (www.contingent.com/mcciaap) I am more than happy to continue with the web site updates, but can not put the time into the paper form of the newsletter. I would greatly appreciate it if some one would be willing to contact Curt or myself directly and let us know that you're willing to help us out by taking on this responsibility. My email and phone - (301) 482-1384 astro@contingent.com.

Web site: The domain name site is finally in full working order. I just need to transfer over the files which with FrontPage is NOT as easy as it may sound - so... please continue to view the site as www.contingent.com/wasmda until further notice, or the original site which Curt has been managing under erols - www.erols.com/roelle/was I would like to give full credit to Curt Roelle as site originator and BlueBird Observatory for link resources copied and added to the wasmda temporary site to create a comprehensive Internet resource link directory. I always invite/appreciate both negative and positive feed back on the site.

SOLAR CALENDAR HERE

LUNAR CALENDAR HERE

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