The Prairie Astronomer

April 2015 Volume 56, Issue #4

April Program:

Deep Sky Observing - Dave Knisely

Cover Photo:
Barnhard 347
by Rick Johnson

In This Issue:

The Newsletter of the Prairie Astronomy Club

NEXT PAC MEETING

Tuesday April 28, 2015 7:30 PM
Hyde Observatory

Program

Dave Knisely will present a program on Deep Sky Observing: techniques used for deep-sky observing including proper equipment, site selection, dark adaptation, atlases and books, magnifications, etc.

Upcoming Programs (tentative):

May: PAC Dinner
June: Solar Observing Party
July: Review of Nebraska Star Party
August: The Sky is Falling (Michael Sibbernsen)
September: Beginning Astrophotography (Brett Boller)
October: Nebula Filters (tentative)
November: How to Buy a Telescope
December: PAC Holiday Gathering

Pac-list Has Moved

The old pac-list listserv has been moved to Google Groups. The new email address is pac-list@googlegroups.com Everyone who was subscribed to the old list has been added to the new list. This list is open to anyone, not just PAC members. To subscribe click here: GoogleGroups.

Buy the book! The Prairie Astronomy Club: Fifty Years of Amateur Astronomy. Order online from Amazon or lulu.com.

The Prairie Astronomer is published monthly by the Prairie Astronomy Club, Inc. Membership expiration date is listed on the mailing label. Membership dues are: **Regular $30/yr, Family $35/yr**. Address all new memberships and renewals to: **The Prairie Astronomy Club, Inc., PO Box 5585, Lincoln, NE 68505-0585**. For other club information, please contact one of the club officers listed to the right. Newsletter comments and articles should be submitted to: **Mark Dahmke, P. O. Box 5585, Lincoln, NE 68505 or** mark@dahmke.com, no less than ten days prior to the club meeting. The Prairie Astronomy Club meets the last Tuesday of each month at Hyde Memorial Observatory in Lincoln, NE.

Events

PAC Meeting
Tuesday April 28th, 2015, 7:30pm
Hyde Observatory

PAC Meeting
Tuesday May 26th, 2015, 7:30pm
Hyde Observatory

MSRAL, May 29-31, Univ of Arkansas

PAC Meeting
Tuesday June 30th, 2015, 7:30pm
Hyde Observatory

Nebraska Star Party, July 12-17

Newsletter submission deadline May 16

Club Officers

President	Jim Kvasnicka (402) 423-7390 jim.kvasnicka@yahoo.com
Vice President	Brett Boller proboller86@yahoo.com
2nd VP (Program Chair)	Dave Churilla dchurilla@neb.rr.com
Secretary	Lee Taylor otaylor88@gmail.com
Treasurer	John Reinert jr6@aol.com
Club Observing Chair	Jim Kvasnicka jim.kvasnicka@yahoo.com
Outreach Coordinator	Dan Delzell dan@delzell.net
Website and Newsletter Editor	Mark Dahmke mark@dahmke.com

Night Sky Network

Club Membership Info

REGULAR MEMBER - $30.00 per year. Includes club newsletter, and 1 vote at club meetings, plus all other standard club privileges.

FAMILY MEMBER - $35.00 per year. Same as regular member except gets 2 votes at club meetings.

STUDENT MEMBER - $10.00 per year with volunteer requirement.

If you renew your membership prior to your annual renewal date, you will receive a 10% discount.

Club members are also eligible for special subscription discounts on Sky & Telescope Magazine.

Club Telescopes

To check out one of the club telescopes, contact Dave Churilla. If you keep a scope for more than a week, please check in once a week, to verify the location of the telescope and how long you plan to use it. The checkout time limit will be two weeks, but can be extended if no one else has requested use of a club scope.

100mm Orion refractor: Available

10 inch Meade Dobsonian: Available

13 inch Truss Dobsonian: Available

Internet

PAC: www.prairieastronomyclub.org
Night Sky Network: https://nightsky.jpl.nasa.gov/
CafePress (club apparel) www.cafepress.com

www.hydeobservatory.info
www.nebraskastarparty.org
www.OmahaAstro.com
Panhandleastronomyclub.com
www.universetoday.com/
www.planetary.org/home/
http://www.darksky.org/

PAC Star Party Dates

Dates in bold are closest to the new moon

2015 Star Party Dates
Jan 16,**23**, Feb 13,**20**
Mar 13,**20**, Apr 10,**17**
May 8,**15**, Jun 12,**19**
Jul 10,**17**
NSP **Jul 12-17**
Aug 7,**14**, Sep 4,**11**
Oct **9**,16, Nov 6,**13**
Dec 4,**11**

Lunar Party Dates
Mar 27, Apr 24, Jul 24, Aug 21

(Lunar party dates are tentative, sites to be determined.)

PAC E-Mail:

info@prairieastronomyclub.org

PAC-LIST:

Subscribe through GoogleGroups. To post messages to the list, send to the address:

pac-list@googlegroups.com

Club Apparel

Order club apparel from cafepress.com:

Shop through Amazon Smile to automatically donate to PAC:

Address

The Prairie Astronomer
c/o The Prairie Astronomy Club, Inc.
P.O. Box 5585
Lincoln, NE 68505-0585

PAC Meeting Minutes

Minutes for the meeting of March 31, 2015.

President Jim Kvasnicka called the meeting to order. 10 members 4 guests

Upcoming events:

Hyde Observatory is open 8-11PM Saturday nights.

Behlen Observatory will be open on Fri-Sat April 3-4 for the lunar eclipse.

Astronomy Day is at Mueller Planetarium 1:30-4:30 PM. Michael Sibbernsen will host a star party on April 18 from 8-11:30 at Branched Oak lake. MSRAL, the Mid-States Regional meeting of the Astronomical League will be May 29-31 at the University of Arkansas.
The 22nd annual Nebraska Star Party will be July 12-17 at Merritt Reservoir.

Jim reviewed requirements of membership & benefits of joining the club. Jim provided his monthly observing report.

There were two observing awards to present. Bob Kasvinsky has completed the Caldwell list and the Herschel 400 list. Congratulations, Bob!

Club business:

Jim reminded us of our payment to him for compensation for mowing expenses and his mother for use of the farm. We have reviewed the situation every March, and have renewed the agreement each time. Dave Churilla moved to renew this for the coming year with $200 to Marlene Busboom and $100 to Jim for mowing expenses. The motion was seconded and carried unanimously.

Treasurer's report:

John reported on club finances, including that we still have the $450 for the Earl Moser memorial and that the Amazon.com reimbursement last month amounted to $19.03.

Dan Delzell noted that the club has received an 8-inch Zhumell OTA and would like to consider building a base for it. Discussion centered around Brian Sivill's expertise on the subject and his advice on building one. Brian suggested we hold a telescope building session for those interested in making their own 'scopes. After some discussion, Jim asked for a motion to appropriate some money for such a project. Dan made the motion to spend $100 to build the base, Lee Taylor seconded. The motion carried unanimously.

There was discussion about purchasing eclipse glasses for the August 2017 eclipse. Also we talked about PAC's attitude toward requests for assistance during the eclipse; to wit: While we won't be committing any PAC resources/membership to any particular event, we will make requests known to the membership and individual members are free to volunteer for such requests.

Adjourn to Jim's program on current observing lists/programs and awards from the Astronomical League.

Respectfully submitted by,

Lee Taylor

Comet dust: Planet Mercury's 'invisible paint'

Scientists have long puzzled over the planet Mercury's excessively dark surface. New research suggests that carbon from passing comets could be the planet's mystery darkening agent.

PROVIDENCE, R.I. [Brown University] — A team of scientists has a new explanation for the planet Mercury's dark, barely reflective surface. In a paper published in Nature Geoscience, the researchers suggest that a steady dusting of carbon from passing comets has slowly painted Mercury black over billions of years.

Mercury's dark surface has long been a mystery to scientists. On average, Mercury is much darker than its closest airless neighbor, our Moon. Airless bodies are known to be darkened by micrometeorite impacts and bombardment of solar wind, processes that create a thin coating of dark iron nanoparticles on the surface. But spectral data from Mercury suggests its surface contains very little nanophase iron, certainly not enough to account for its dim appearance.

"It's long been hypothesized that there's a mystery darkening agent that's contributing to Mercury's low reflectance," said Megan Bruck Syal, a postdoctoral researcher at Lawrence Livermore National Laboratory who performed this research while a graduate student at Brown University. "One thing that hadn't been considered was that Mercury gets dumped on by a lot of material derived from comets."

As comets approach Mercury's neighborhood near the sun, they often start to break apart. Cometary dust is composed of as much as 25 percent carbon by weight, so Mercury would be exposed to a steady bombardment of carbon from these crumbling comets. Using a model of impact delivery and a known estimate of micrometeorite flux at Mercury, Bruck Syal was able to estimate how often cometary material would impact Mercury, how much carbon would stick to Mercury's surface, and how much would be thrown back into space. Her calculations suggest that after billions of years of bombardment, Mercury's surface should be anywhere from 3 to 6 percent carbon.

The next part of the work was to find out how much darkening could be expected from all that impacting carbon. For that, the researchers turned to the NASA Ames Vertical Gun Range. The 14-foot canon simulates celestial impacts by firing projectiles at up to 16,000 miles per hour.

For this study, the team launched projectiles in the presence of sugar, a complex organic compound that mimics

Dr. Pete Schultz, professor emeritus of geological sciences at Brown University - and founding member of the Prairie Astronomy Club.

the organics in comet material. The heat of an impact burns the sugar up, releasing carbon. Projectiles were fired into a material that mimics lunar basalt, the rock that makes up the dark patches on the nearside of the Moon. "We used the lunar basalt model because we wanted to start with something dark already and see if we could darken it further," said Peter Schultz, professor emeritus of geological sciences at Brown and a co-author of the new research.

The experiments showed that tiny carbon particles become

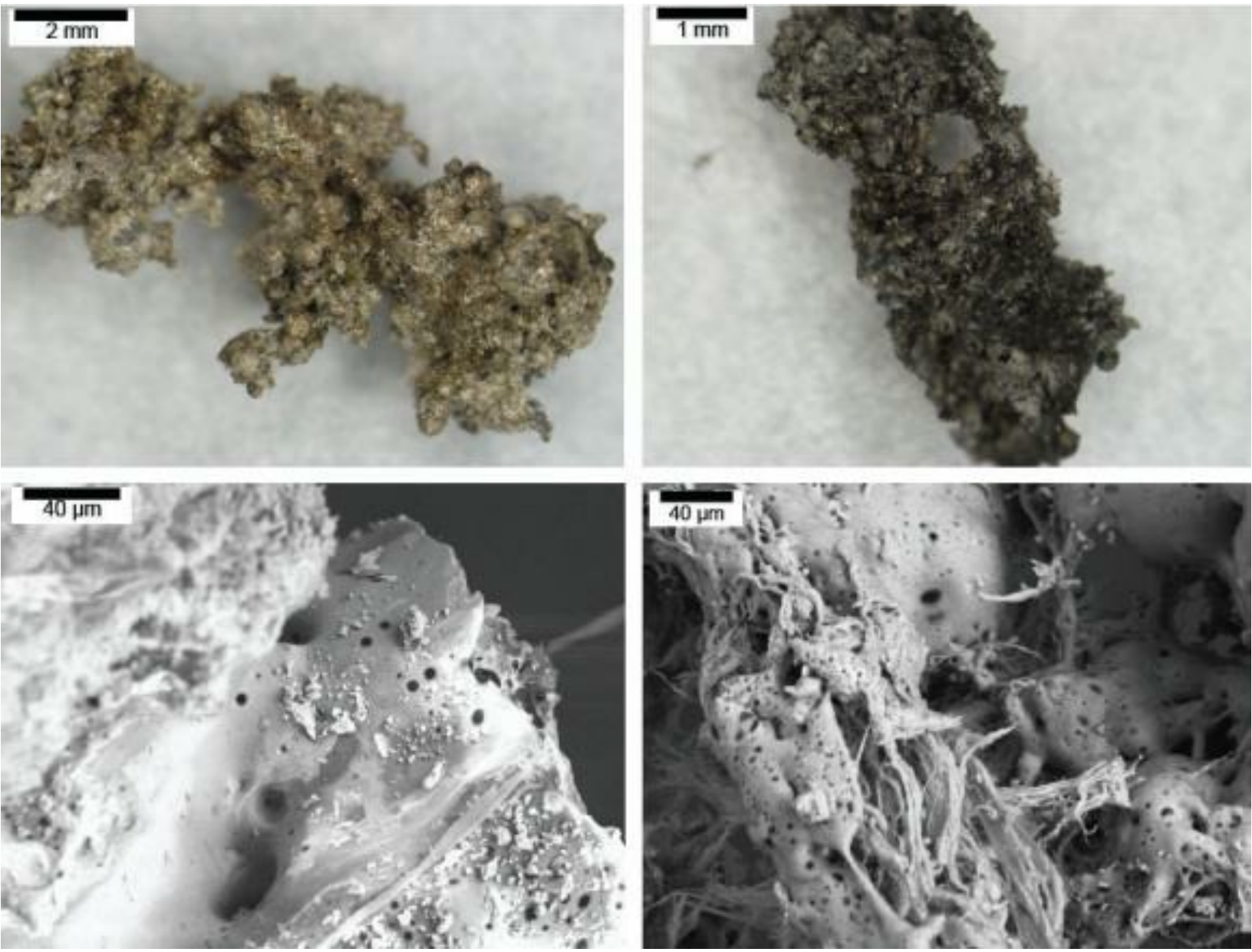
deeply embedded in the impact melted material. The process reduced the amount of light reflected by the target material to less than 5 percent — about the same as the darkest parts of Mercury.

Importantly, spectroscopic analysis of the impact samples revealed no distinctive spectral fingerprints, again similar to flat spectral signatures from Mercury. "We show that carbon acts like a stealth darkening agent," Schultz said. "From the standpoint of spectral analysis, it's like an invisible paint."

And that paint has been building up on Mercury's surface for billions of years.

"We think this is a scenario that needs to be considered," Schultz said. "It appears that Mercury may well be a painted planet."

The research was supported by NASA's Planetary Geology and Geophysics program (NNX13AB75G) and the NASA Earth and Space Science Fellowship program (NNXC12AL79H). Miriam Riner from the Planetary Sciences Institute was a co-author on the paper.

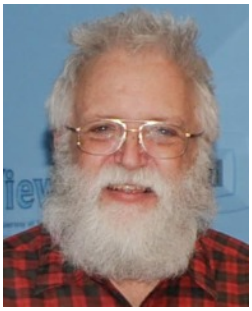


When heavenly bodies collide

Impact material generated without the presence of carbon from complex organics, top left, is lighter than material generated with carbon, top right. Scanning electron microscope images, bottom row, show finer-scale structure and texture variations.

Cover Photo: Barnhard 347

Rick Johnson



Barnard 347 is a very dense dark nebula seen against the left (eastern) wing of the Butterfly Nebula beside Sadr the star at the cross point of the Northern Cross/Cygnus the Swan. The entire nebula complex around Sadr is IC 1318 The blue reflection nebula in the upper right corner is GN 20.25.3 though its position is centered on the orange star to its left. But then I find many bright nebulae don't seem to fit their centered position. The slightly brighter nebula clouds above Barnard 347 is DWB 76. There are many other bright and dark nebulae listed in SIMBAD but they are so poorly defined I won't point them out.

The sky says Sadr is 1500 light-years away. Most estimates of the nebula's distance put it 2,000 to 5,000 light-years distant indicating Sadr isn't likely the illuminating source. The nebula appears rather thin as stars are easily seen through it except where there are dark nebulae obscuring the bright nebula and stars such as Barnard 347. I find no attempt to put a distance on Barnard 347. So it may be a dense cold region in the otherwise warm hydrogen that is collapsing to form stars or it is in the foreground. The fact a few stars are seen against the dark cloud's densest region would argue it is sufficiently distant that at least some foreground stars have a reasonable change of getting in front of it. That may argue it is a cold dense region in the bright nebulae.

The sky says the blue star at the heart of GN 20.25.3 is only 37 light-years away. That seems unlikely for the nebula's distance so something else must be illuminating it. The orange star to the left is a bit more distant at 167 light-years, still close. Such red stars rarely create blue reflection nebula though can when the nebula is directly in front of the star but that isn't the case here. So I have no idea what is lighting up this reflection nebula unless it is so close. If so it may be the closest reflection nebula to us. Certainly closest I know of. The dust lit by M45's stars are the closest I was aware of. Maybe someone out there can fill solve this issue.

I have no idea why I took three blue frames. I left no notes that indicated this was planned. Likely a typo in my script file is to blame.

14" LX200R @ f/10, L=4x10' RG=2x10' B=3x10', STL-11000XM, Paramount ME

A beautiful Aurora display from ISS, taken March 26, 2015 by astronaut Samantha Cristoforetti. This image includes light from four sources: city lights, aurora, atmosphere in sunlight and stars.

May Observing: What to View

Jim Kvasnicka

This is a partial list of objects visible for the upcoming month.

Planets

Mercury: Look for it about 8° above the WNW horizon.
Mars: Low in the sunset and difficult to see.
Venus: Increases in brightness to magnitude -4.4. Venus attains its highest altitude on May 8th when it is 38° above the horizon.
Jupiter: Decreases from magnitude -2.1 to -1.9 with a disk 35"wide.
Saturn: Reaches opposition on May 22nd. The rings remain tilted 24° from edge on.
Neptune: Rises about an hour before dawn.
Uranus: Not visible in the morning twilight.

Messier List

M49: Galaxy in Virgo.
M51: The Whirlpool Galaxy in Canes Venatici.
M61: Galaxy in Virgo.
M63: The Sunflower Galaxy in Canes Venatici.
M64: The Black Eye Galaxy in Coma Berenices.
M85: Galaxy in Coma Berenices.
M94: Galaxy in Canes Venatici.
M101: The Pinwheel Galaxy in Ursa Major.
M102: Galaxy in Draco.
M104: The Sombrero Galaxy in Virgo.
Last Month: M40, M65, M66, M95, M96, M105, M108, M109
Next Month: M58, M59, M60, M84, M86, M87, M88, M89, M90, M91, M98, M99, M100

NGC and other Deep Sky Objects

NGC 4725: Galaxy in Coma Berenices.
NGC 4754/4762: Galaxy pair in Virgo.
NGC 4866: Galaxy in Virgo.
NGC 5297: Galaxy in Canes Venatici.
NGC 5353/5354: Interacting galaxy pair in Canes Venatici.

Double Star Program List

Kappa Bootis: Yellow and blue pair.
Iota Bootis: Yellow primary with a dim blue secondary.
Pi Bootis: Pair of white stars.
Epsilon Bootis: Yellow and greenish yellow stars.
Xi Bootis: Yellow pair.
Delta Bootis: Yellow primary with a blue-white secondary.
Mu Bootis: Two yellow stars.
Zeta Corona Borealis: Light blue and greenish yellow pair.

Challenge Object

NGC 5044: The brightest is a group of galaxies in Virgo that includes NGC 5035, NGC 5037, NGC 5047, and NGC 5049.

NGC Objects: NGC 4754 and 4762

Jim Kvasnicka

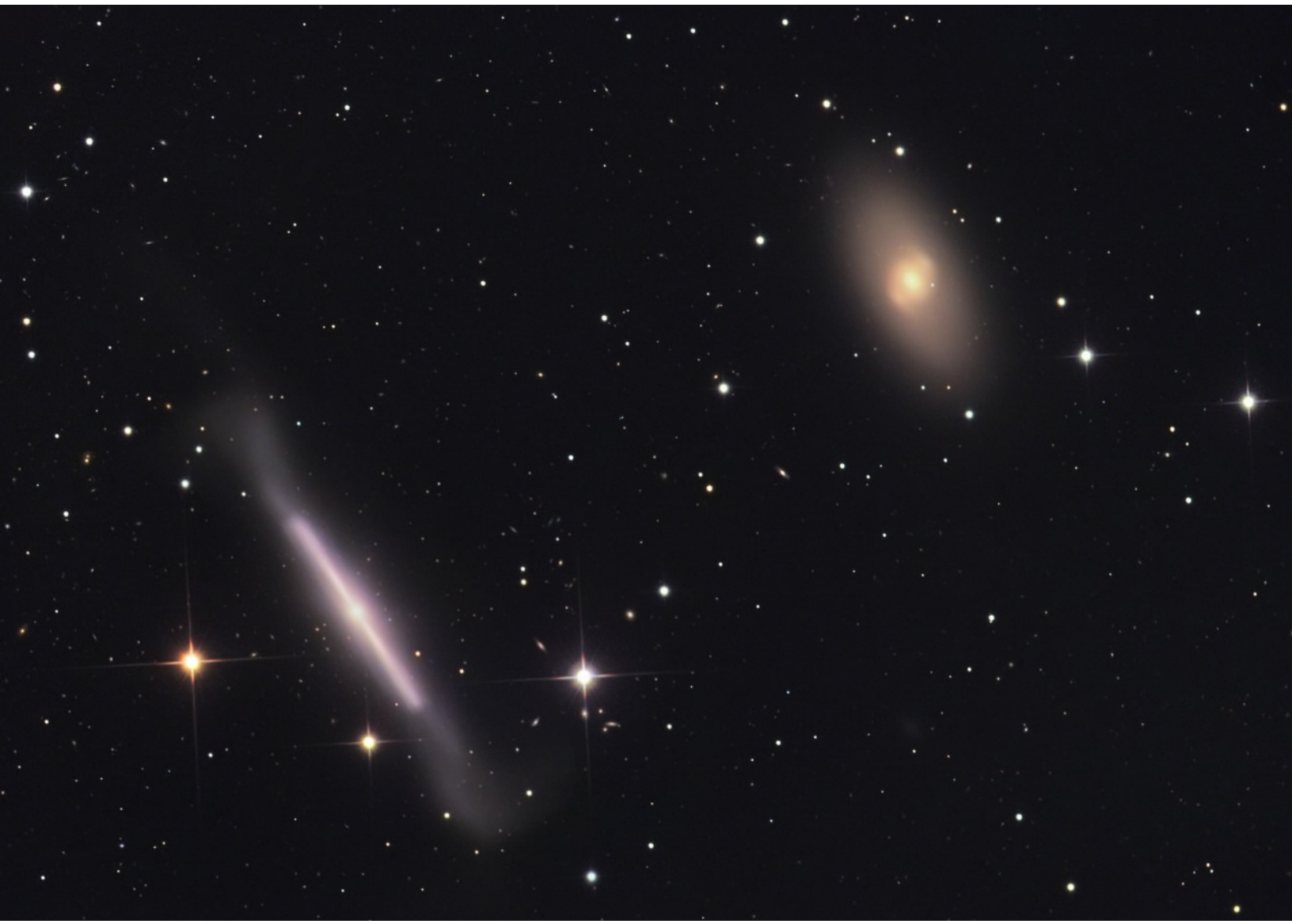
NGC 4754 and NGC 4762 are a galaxy pair in Virgo. They are part of the Virgo Galaxy Cluster and both fit into the same FOV in your telescope.

The two galaxies were discovered by William Herschel in 1784. The two galaxies are very different in appearance. NGC 4754 is an oval shaped galaxy and NGC 4762 is a thin spindle.

NGC 4754 has an apparent size of 4.6' x 2.6' with a magnitude of 10.6. In a 10 inch telescope the galaxy will appear 2' x 1'

NGC 4762 has an apparent size of 9.1' x 2.2' with a magnitude of 10.3. In a 10 inch telescope the galaxy will appear 4' x 0.5'.

Both NGC 4754 and NGC 4762 are part of the Herschel 400 Observing Program and the Two In the View Observing Program.



NGC 4762: Type SB0, distance: 9.9 Mpc/32 MLy, NGC 4754: Type SB0, distance: 17Mpc/56 Mly. SBIG STL-11000M, Exposure time: L: 20x900 sec., R,G,B: 3x900 sec., all 1x1 bin June 17th…21st.2009, Skinakas Observatory at Crete, Greece, remote-controlled from Bad Arolsen/Germany, SBIG 2" LRGB filter set for STL, Ganymed 60cm-Hypergraph in secondary focus (f=4938.3 mm) Photographers: Josef Pöpsel, Beate Behle

April Star Party Report

Dan Delzell

Jim Kvasnicka, Zack Moore, Rhoda Priest, Mark Fowler and I attended the April 10 Star Party. The Clear Sky Chart predicted that it'd be clear with average seeing and transparency. It was obvious as we were setting up that we wouldn't be that lucky as there where high, scattered clouds and haze.

This was the first official star party with Jim's and my new telescopes, so we were excited to put them through their paces.

While still in twilight, we tried to view Sirius B, the white dwarf companion of Sirius. Sky and Telescope ran an article this month about how it's becoming easier and the best time to view is during twilight so the glare of the primary isn't as bad. We were successful. AT 228x, you had to wait for the seeing to steady, but "The Pup" was visible very close to the primary and just below one of the diffraction spikes. . This picture is close to what we saw.

It's worth trying when you're out with your telescope.

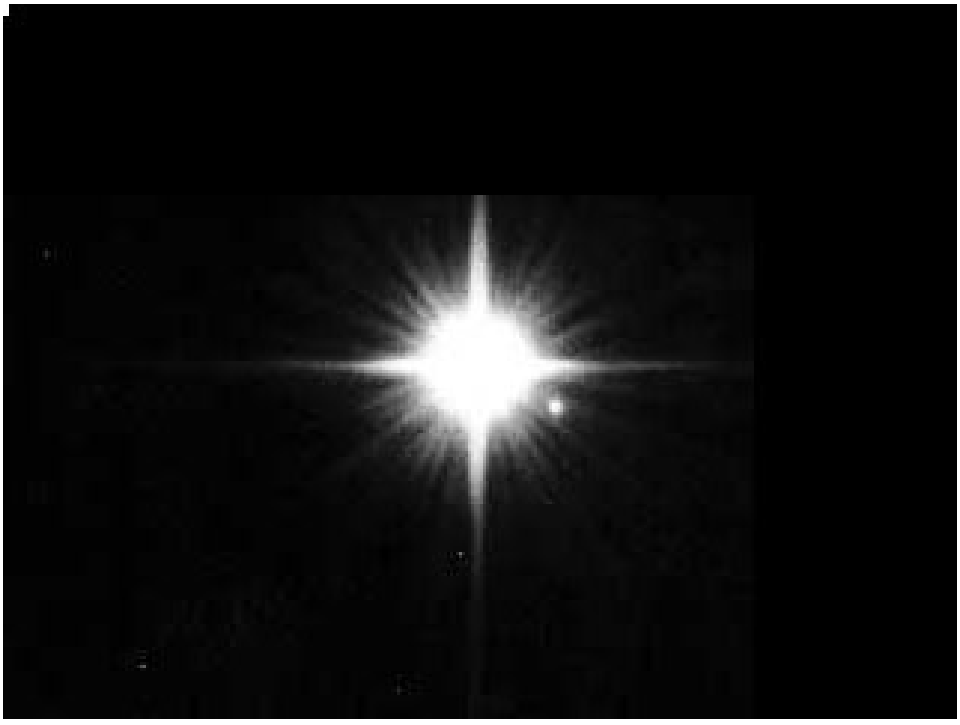
We observed Venus and Jupiter until it was dark enough to move to deep sky.

Jim was busy working on Hershel's and Zack and Rhoda were working to find various objects in their scope. Mark and I worked on the Hershel galaxies in Leo.

But unfortunately the transparency got worse as the night progressed. Eventually we lost rho leonis (Mag 3.85) to the haze around 11:15 and decided to pack up. Jim and I both got around a dozen Herschels and had a great time observing with Zack, Rhoda and Mark.

David Pennington and his wife arrived at the observing site right after we left. We're very sorry we missed them and look forward to observing with them in the future.

Unfortunately the forecast for the April 17 Star Party is not looking good. Here is hoping that we'll have clear, dark, steady skies in May and more of you can join us.



The Solar System and Beyond is Awash in Water

As NASA missions explore our solar system and search for new worlds, they are finding water in surprising places. Water is but one piece of our search for habitable planets and life beyond Earth, yet it links many seemingly unrelated worlds in surprising ways.

"NASA science activities have provided a wave of amazing findings related to water in recent years that inspire us to continue investigating our origins and the fascinating possibilities for other worlds, and life, in the universe," said Ellen Stofan, chief scientist for the agency. "In our lifetime, we may very well finally answer whether we are alone in the solar system and beyond."

The chemical elements in water, hydrogen and oxygen, are some of the most abundant elements in the universe. Astronomers see the signature of water in giant molecular clouds between the stars, in disks of material that represent newborn planetary systems, and in the atmospheres of giant planets orbiting other stars.

There are several worlds thought to possess liquid water beneath their surfaces, and many more that have water in the form of ice or vapor. Water is found in primitive bodies like comets and asteroids, and dwarf planets like Ceres. The atmospheres and interiors of the four giant planets -- Jupiter, Saturn, Uranus and Neptune -- are thought to contain enormous quantities of the wet stuff, and their moons and rings have substantial water ice.

Perhaps the most surprising water worlds are the five icy moons of Jupiter and Saturn that show strong evidence of oceans beneath their surfaces:

Ganymede, Europa and Callisto at Jupiter, and Enceladus and Titan at Saturn.

Scientists using NASA's Hubble Space Telescope recently provided powerful evidence that Ganymede has a saltwater, sub-surface ocean, likely sandwiched between two layers of ice.

Europa and Enceladus are thought to have an ocean of liquid water beneath their surface in contact with mineral-rich rock, and may have the three ingredients needed for life as we know it: liquid water, essential chemical elements for biological processes, and sources of energy that could be used by living things. NASA's Cassini mission has revealed Enceladus as an active world of icy geysers. Recent research suggests it may have hydrothermal activity on its ocean floor, an environment potentially suitable for living organisms.

NASA spacecraft have also found signs of water in permanently shadowed craters on Mercury and our moon, which hold a record of icy impacts across the ages like cryogenic keepsakes.

While our solar system may seem drenched in some places, others seem to have lost large amounts of water.

On Mars, NASA spacecraft have found clear evidence that the Red Planet had water on its surface for long periods in the distant past. NASA's Curiosity Mars Rover discovered an ancient streambed that existed amidst conditions favorable for life as we know it.

More recently, NASA scientists using ground-based telescopes were able to estimate the amount of water Mars has lost over the eons. They concluded the planet once had enough liquid water to form an ocean occupying almost half of Mars' northern hemisphere, in some regions reaching depths greater than a mile (1.6 kilometers). But where did the water go?

It's clear some of it is in the Martian polar ice caps and below the surface. We also think much of Mars' early atmosphere was stripped away by the wind of charged particles that streams from the sun, causing the planet to dry out. NASA's MAVEN mission is hard at work following this lead from its orbit around Mars.

The story of how Mars dried out is intimately connected to how the Red Planet's atmosphere interacts with the solar wind. Data from the agency's solar missions -- including STEREO, Solar Dynamics Observatory and the planned Solar Probe Plus -- are vital to helping us better understand what happened.

Understanding the distribution of water in our solar system tells us a great deal about how the planets, moons, comets and other bodies formed 4.5 billion years ago from the disk of gas and dust that surrounded our sun. The space closer to the sun was hotter and drier than the space farther from the sun, which was cold enough for water to condense. The dividing line, called the "frost line," sat around Jupiter's present-day orbit. Even today, this is the approximate distance from the sun at which the ice on most comets begins to melt and become "active." Their brilliant spray releases water ice, vapor, dust and other chemicals, which are thought to form the bedrock of most worlds of the frigid outer solar system.

Scientists think it was too hot in the solar system's early days for water to condense into liquid or ice on the inner planets, so it had to be delivered -- possibly by comets and water-bearing asteroids. NASA's Dawn mission is currently studying Ceres, which is the largest body in the asteroid belt between Mars and Jupiter. Researchers think Ceres might have a water-rich composition similar to some of the bodies that brought water to the three rocky, inner planets, including Earth.

The amount of water in the giant planet Jupiter holds a critical missing piece to the puzzle of our solar system's formation. Jupiter was likely the first planet to form, and it contains most of the material that wasn't incorporated into the sun. The leading theories about its formation rest on the amount of water the planet soaked up. To help solve this mystery, NASA's Juno mission will measure this important quantity beginning in mid-2016.

Looking further afield, observing other planetary systems as they form is like getting a glimpse of our own solar system's baby pictures, and water is a big part of that story. For example, NASA's Spitzer Space Telescope has observed signs of a hail of water-rich comets

raining down on a young solar system, much like the bombardment planets in our solar system endured in their youth.

With the study of exoplanets -- planets that orbit other stars -- we are closer than ever to finding out if other water-rich worlds like ours exist. In fact, our basic concept of what makes planets suitable for life is closely tied to water: Every star has a habitable zone, or a range of distances around it in which temperatures are neither too hot nor too cold for liquid water to exist. NASA's planet-hunting Kepler mission was designed with this in mind. Kepler looks for planets in the habitable zone around many types of stars.

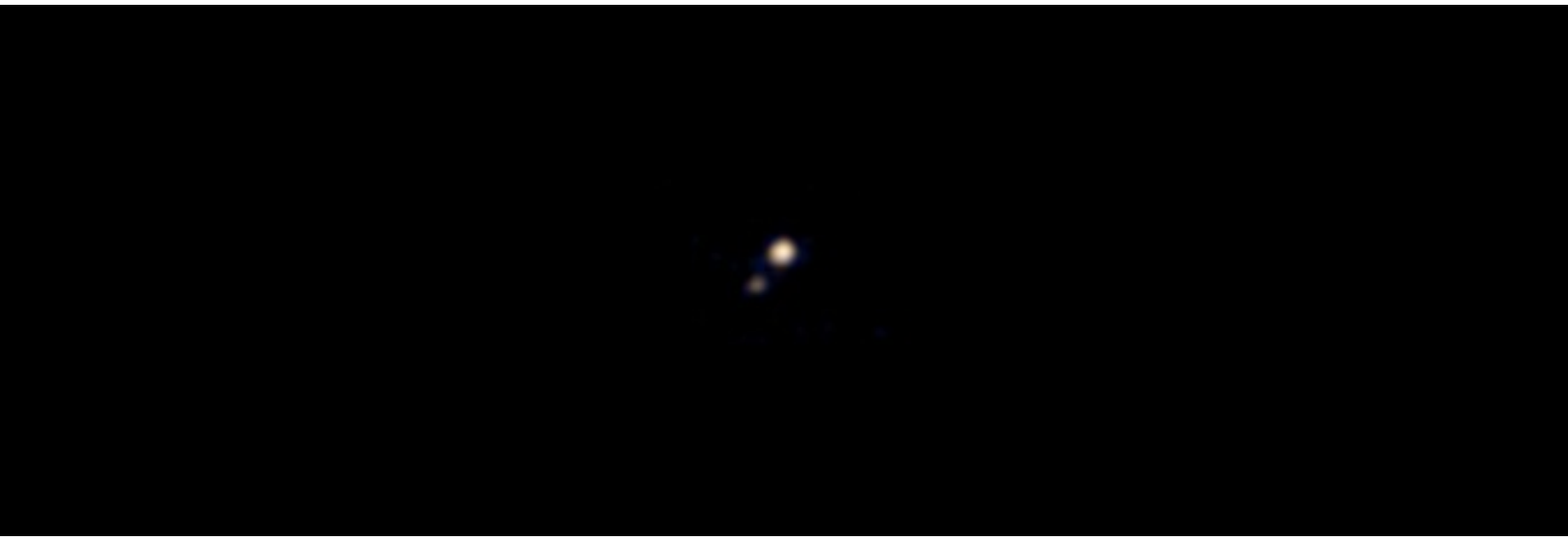
Recently verifying its thousandth exoplanet, Kepler data confirm that the most common planet sizes are worlds just slightly larger than Earth. Astronomers think many of those worlds could be entirely covered by deep oceans. Kepler's successor, K2, continues to watch for dips in starlight to uncover new worlds.

The agency's upcoming TESS mission will search nearby, bright stars in the solar neighborhood for Earth- and super-Earth-sized exoplanets. Some of the planets TESS discovers may have water, and NASA's next great space observatory, the James Webb Space Telescope, will examine the atmospheres of those special worlds in great detail.

It's easy to forget that the story of Earth's water, from gentle rains to raging rivers, is intimately connected to the larger story of our solar system and beyond. But our water came from somewhere -- every world in our solar system got its water from the same shared source. So it's worth considering that the next glass of water you drink could easily have been part of a comet, or an ocean moon, or a long-vanished sea on the surface of Mars. And note that the night sky may be full of exoplanets formed by similar processes to our home world, where gentle waves wash against the shores of alien seas.

For more information about NASA's exploration of the solar system and beyond, visit:

http://www.nasa.gov



This image of Pluto and its largest moon, Charon, was taken by the Ralph color imager aboard NASA's New Horizons spacecraft on April 9 and downlinked to Earth the following day. It is the first color image ever made of the Pluto system by a spacecraft on approach. The image is a preliminary reconstruction, which will be refined later by the New Horizons science team. Clearly visible are both Pluto and the Texas-sized Charon. The image was made from a distance of about 71 million miles (115 million kilometers)—roughly the distance from the Sun to Venus. At this distance, neither Pluto nor Charon is well resolved by the color imager, but their distinctly different appearances can be seen. As New Horizons approaches its flyby of Pluto on July 14, it will deliver color images that eventually show surface features as small as a few miles across. Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

Our Sun Came Late to the Milky Way's Star-Birth Party

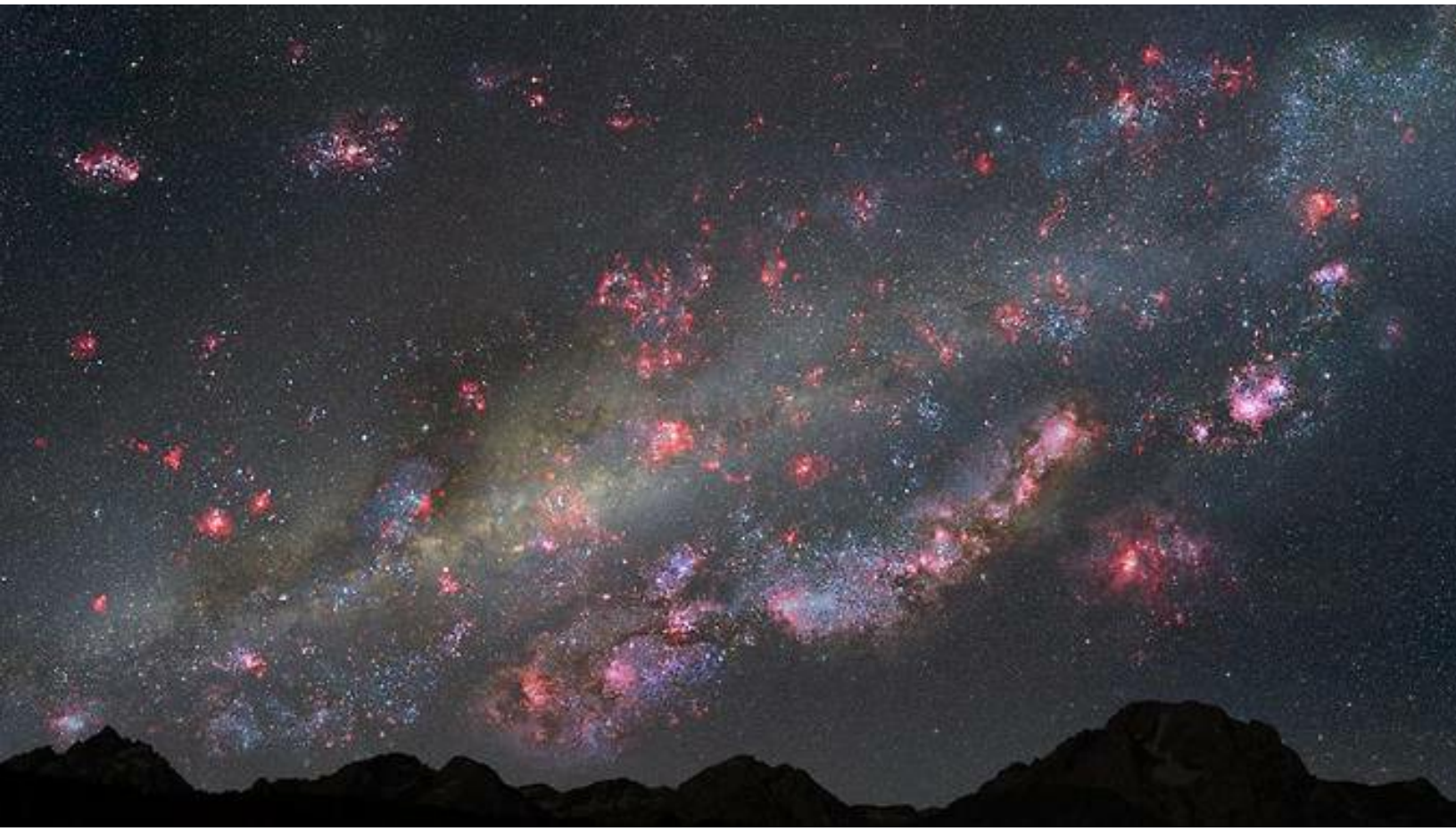
In one of the most comprehensive multi-observatory galaxy surveys yet, astronomers find that galaxies like our Milky Way underwent a stellar "baby boom," churning out stars at a prodigious rate, about 30 times faster than today.

Our sun, however, is a late "boomer." The Milky Way's star-birthing frenzy peaked 10 billion years ago, but our sun was late for the party, not forming until roughly 5 billion years ago. By that time the star formation rate in our galaxy had plunged to a trickle.

Missing the party, however, may not have been so bad. The sun's late appearance may actually have fostered the growth of our solar system's planets. Elements heavier than hydrogen and helium were more abundant later in the star-forming boom as more massive stars ended their lives early and enriched the galaxy with material that served as the building blocks of planets and even life on Earth.

Astronomers don't have baby pictures of our Milky Way's formative years to trace the history of stellar growth so they studied galaxies similar in mass to our Milky Way, found in deep surveys of the universe. The farther into the universe astronomers look, the further back in time they are seeing, because starlight from long ago is just arriving at Earth now. From those surveys, stretching back in time more than 10 billion years, researchers assembled an album of images containing nearly 2,000 snapshots of Milky Way-like galaxies.

The new census provides the most complete picture yet of how galaxies like the Milky Way grew over the past 10 billion years into today's majestic spiral galaxies. The multi-wavelength



Artist's view of night sky from a hypothetical planet within a young Milky Way-like galaxy 10 billion years ago, the sky are ablaze with star birth. Pink clouds of gas harbor newborn stars, and bluish-white, young star clusters litter the landscape. Image Credit: NASA/ESA/Z. Levay (STScI)

study spans ultraviolet to far-infrared light, combining observations from NASA's Hubble and Spitzer space telescopes, the European Space Agency's Herschel Space Observatory, and ground-based telescopes, including the Magellan Baade Telescope at the Las Campanas Observatory in Chile.

"This study allows us to see what the Milky Way may have looked like in the past," said Casey Papovich of Texas A&M University in College Station, lead author on the paper that describes the study's results. "It shows that these galaxies underwent a big change in the mass of its stars over the past 10 billion years, bulking up by a factor of 10, which confirms theories about their growth. And most of that stellar-mass growth happened within the first 5 billion years of their birth."

The new analysis reinforces earlier research which showed that Milky Way-like galaxies began as small clumps of stars. The galaxies swallowed large amounts of gas that ignited a firestorm of star birth.

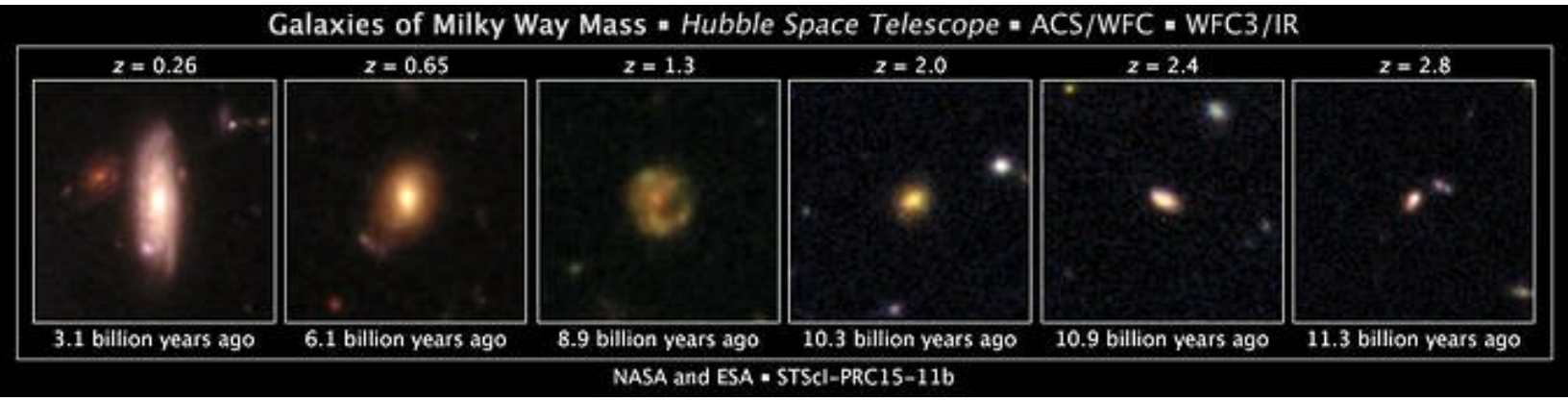
The study reveals a strong correlation between the galaxies' star formation and growth in stellar mass. So, when the galaxies slow down making stars, their growth decreases as well. "I think the evidence suggests that we can account for the majority of the buildup of a Milky Way-like galaxy through its star formation," Papovich said. "When we calculate the star-formation rate of a Milky Way-like galaxy in the past and add up all the stars it would have produced, it is pretty consistent with the mass growth we expected. To me, that means we're able to understand the growth of the 'average' galaxy with the mass of a Milky Way galaxy."

The astronomers selected the Milky Way-like progenitors by sifting through more than 24,000 galaxies in the entire catalogs of the Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey (CANDELS), taken with Hubble, and the FourStar Galaxy Evolution Survey (ZFOURGE), made with the Magellan telescope.

They used the ZFOURGE, CANDELS, and Spitzer near-infrared data to study the galaxy stellar masses. The Hubble images from the CANDELS survey also provided structural information about galaxy sizes and how they evolved. Far-infrared light observations from Spitzer and Herschel helped the astronomers trace the star-formation rate.

The team's results will appear in the April 9 issue of The Astrophysical Journal.

For images and more information about the Hubble Space Telescope, visit: http://www.nasa.gov/hubble or http://hubblesite.org/news/2015/11



These six Hubble snapshots show how galaxies similar in mass to our Milky Way evolved over time. Milky Way-like galaxies grow larger in size and in stellar mass over billions of years.

Image Credit: NASA/ESA/C. Papovich (Texas A&M)/H. Ferguson (STScI)/S. Fabe

Astronomy Day 2015

About 300 visitors came out for Astronomy Day at the University of Nebraska State Museum. Volunteers included Brett Boller, Dan Delzell, Jim Atkins, Jim Kvasnicka, Rick Brown, Bob Kacvinsky, Dave Churilla, Mark Dahmke, Zach Thompson.

Best question of the day: a kid came over to look at the telescopes and asked "Is Astronomy Day a real holiday?" –Mark Dahmke

Photos by Mark Dahmke

More photos from Astronomy Day…

From the Archives: March, 1995

President's Letter - by Dave Scherping

It was Friday March 3rd. The skies were clear and the moon was only 2 days old. It wasn't even very cold out. The FEW of us who attended the star party at the Beaver Crossing site (Tom Miller, Dave Hamilton, Martin Gaskell with two of his students, and me) were treated to some of the best views of deep sky objects we had ever seen.

These were provided by Tom's 30' Obsession. In the past, I often referred to a good image as being 'nearly as good as a photograph", but with Tom's 30", the views are always better than the photos! Remember when it took some imagination to see the Horsehead Nebula? When was the last time you saw spiral structure in M81 or the "bridge" between the galaxies of M51? Have you ever seen an 18th magnitude galaxy?

Without averted vision? Plus, the views of Mars were by far the best I've ever seen.

The club scope was there too, providing a supurb view of the Rosette nebula, using Tom's 32mm wide-scan with an O-III filter. Also, Dave's 8" gave some great views of the double cluster, Owl nebula, and several galaxies. Unfortunately, around midnight, clouds started moving in, so we packed up and called it a night. Still, it was a great night of observing. Hopefully we'll have good weather and a huge tumout at the Atlas site on the 24th and at Mahoney on the 31st.

The Nebraska Star Party program will be finalized shortly. As of March 15th, Dr. Wakefield Dort of Univ of Kansas will give a presentation on the Merna Meteor Crater and give a tour on the way home. Brenda Culbertson & Gary Hug of Harveyville, Ks will do programs on Solar Observing & CCD Imaging, respectively. From the PAC, Lou Dorland will give a presentation (topic TBD), Brian Schaaf will give a program on about Aurora Phenomena, and Mike Sibbersen & Kendra Stahl have generously volunteered to do a Magic Show. Plus, we have definite "maybes" from several other people. I'll keep you informed as details unfold. Registrations keep coming in, many from out-of-state and a few locally. If you're planning on attending, please register as soon as possible. There's only a couple of cabins left, so if you want one, contact Tom Miller pronto. As for door prizes, I've received 24 so far, valued at over $1000. Also, NSP information may be obtained from America On-Line, Compuserve, and GEnie.Plus, thanks to Mark Dahmke, NSP & PAC info is on the Internet World-Wide Web. This includes the newsletter, NSP registration brochure, maps, &more. [See Mark's article elsewhere in this newsletter] Nice job Mark! The next NSP Planning Meetings are scheduled for: March 30th &April 27th -- 7:00 pm @ Miller Grass Seed Co.,1600 Cornhusker Hwy.

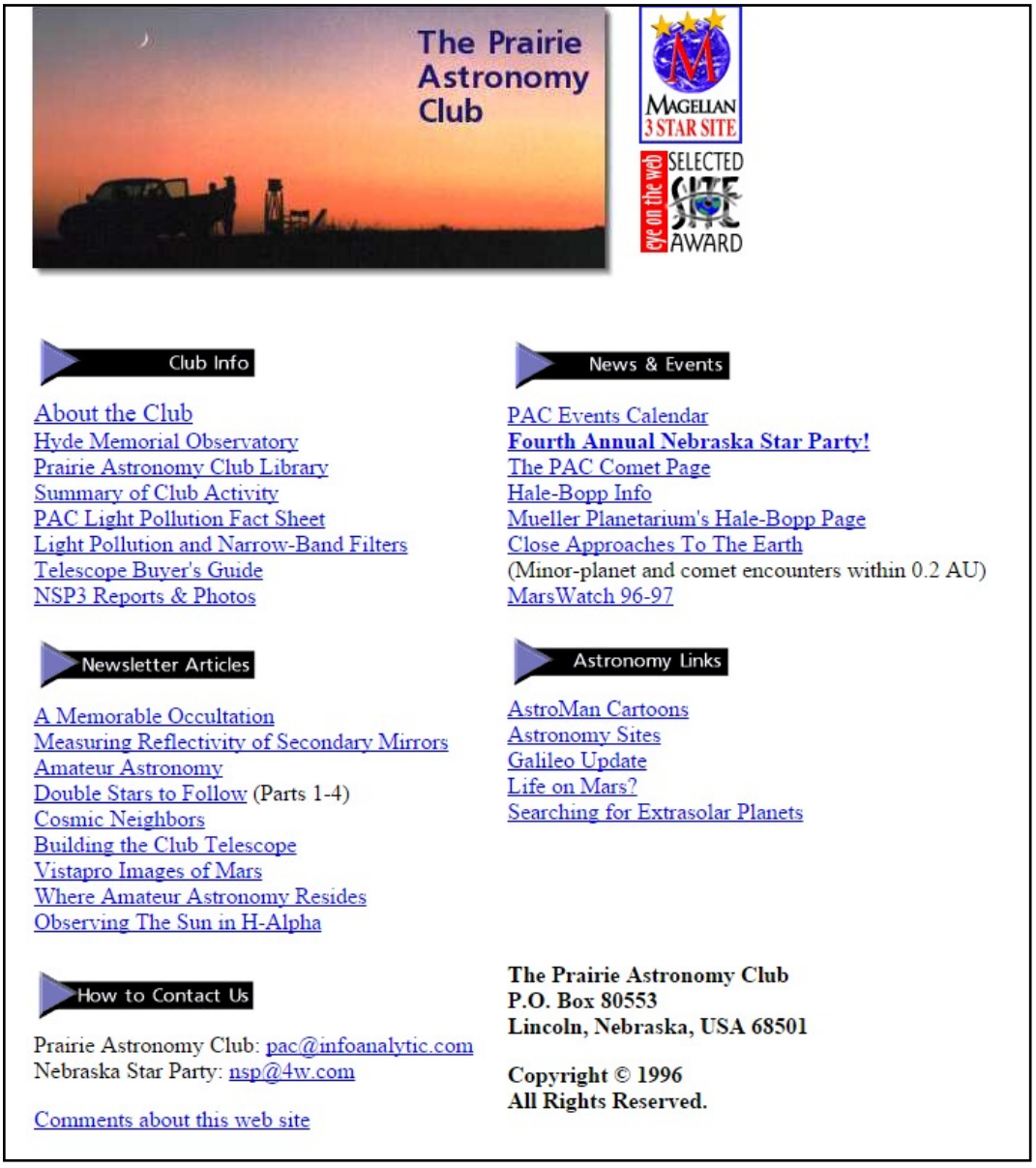
PAC Website Turns 20

Mark Dahmke

It's hard to believe but PAC has had a website for 20 years. I joined PAC in 1994 and in January, 1995 started my business, Information Analytics. I noticed other astronomy websites and decided that PAC and NSP should have their own, so, without really asking the board first, I designed both sites and then showed them to Club President Dave Scherping. Shown here is the earliest version I could find - from early 1996. The site used this basic design until I redesigned it in 2001 and added the member database and members-only area.

A few years ago we switched over to Night Sky Network for the member communication functions and the site was rebuilt using Wordpress.

It's truly amazing how the technology has changed in 20 years. The club now has Facebook and Twitter accounts and the website works with smartphones and tablets, but our articles on things like "how to buy a telescope" have endured through all of these redesigns and still get lots of traffic. Good content is what drives traffic from search engines to websites - and PAC can be very proud of the excellent member-contributed content present on the website and in the newsletter.



The PAC website - as it appeared from March, 1995 until early 1998.

Best Astronaut "Selfie" Ever, taken by Samantha Cristoforetti

"There's coffee in that nebula"… ehm, I mean… in that #Dragon. ISS Flight Engineer Samantha Cristoforetti of the European Space Agency in Star Trek uniform as Dragon arrives at the International Space Station on April 17, 2015. Credit: NASA

SpaceX Dragon is attached to deliver 2 tons of science and supplies for ISS crew.