SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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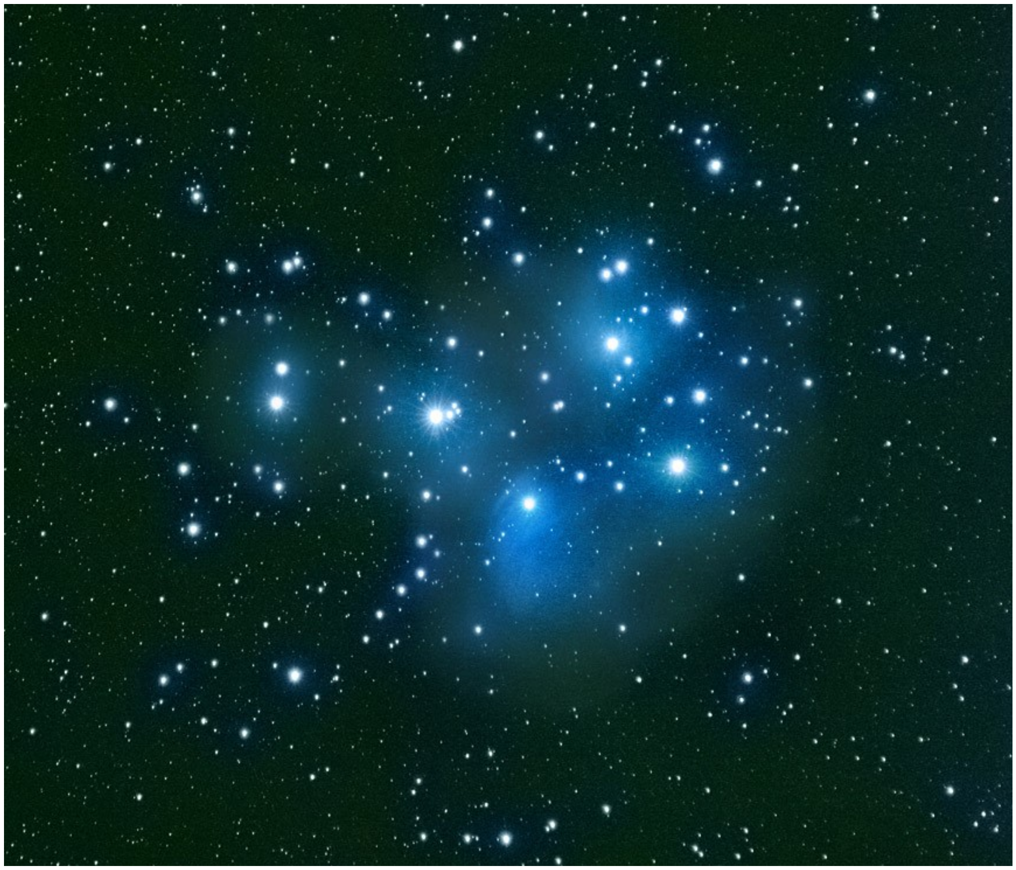


Messier Marathon season is upon us again! This issue features an article on observing faint objects, and a handy Messier Marathon checklist to mark off your conquests. Pictured above is M45, also known as the Pleiades—one of the easiest and most popular objects on the list. Larry McManus created this image from our Anza site in February 2005. See if you can't observe all 108 in one night!

OCA CLUB MEETING

The free and open club meeting will be held March 11 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month's speaker is Jonathan Arenburg of Northrop Grumman discussing the James Webb Space Telescope: Its Mission, Design, and Development

NEXT MEETINGS: Apr. 8, May 13

STAR PARTIES

The Black Star Canyon site will open on March 5. The Anza site will be open on March 5. Members are encouraged to check the website calendar for the latest updates on star parties and other events.

Please check the website calendar for the outreach events this month! Volunteers are always welcome!

You are also reminded to check the web site frequently for updates to the calendar of events and other club news.

COMING UP

The next session of the Beginners Class will be held at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on March 4. The following class will be held April 1.

GOTO SIG: contact Mike Bertin
Astro-Imagers SIG: Mar. 8, Apr. 12
Remote Telescopes: contact Delmar Christiansen
Astrophysics SIG: Mar. 18, Apr. 15
Dark Sky Group: contact Barbara Toy

The Closest New Stars To Earth

By Ethan Siegel

When you think about the new stars forming in the Milky Way, you probably think of the giant star-forming regions like the Orion Nebula, containing thousands of new stars with light so bright it's visible to the naked eye. At over 400 parsecs (1,300 light years) distant, it's one of the most spectacular sights in the night sky, and the vast majority of the light from galaxies originates from nebulae like this one. But its great luminosity and relative proximity makes it easy to overlook the fact that there are a slew of much closer star-forming regions than the Orion Nebula; they're just much, much fainter.

If you get a collapsing molecular cloud many hundreds of thousands (or more) times the mass of our sun, you'll get a nebula like Orion. But if your cloud is only a few thousand times the sun's mass, it's going to be much fainter. In most instances, the clumps of matter within will grow slowly, the neutral matter will block more light than it reflects or emits, and only a tiny fraction of the stars that form—the most massive, brightest ones—will be visible at all. Between just 400 and 500 light years away are the closest such regions to Earth: the molecular clouds in the constellations of Chamaeleon and Corona Australis. Along with the Lupus molecular clouds (about 600 light years distant), these dark, light-blocking patches are virtually unknown to most sky watchers in the northern hemisphere, as they're all southern hemisphere objects.

Image credit: NASA and ESA Hubble Space Telescope. Acknowledgements: Kevin Luhman (Pennsylvania State University), and Judy Schmidt, of the Chamaeleon cloud and a newly-forming star within it—HH 909A—emitting narrow streams of gas from its poles.

In visible light, these clouds appear predominantly as dark patches, obscuring and reddening the light of background stars. In the infrared, though, the gas glows brilliantly as it forms new stars inside. Combined near-infrared and visible light observations, such as those taken by the Hubble Space Telescope, can reveal the structure of the clouds as well as the young stars inside. In the Chameleon cloud, for example, there are between 200 and 300 new stars, including over 100 X-ray sources (between the Chamaeleon I and II clouds), approximately 50 T-Tauri stars and just a couple of massive, B-class stars. There's a third dark, molecular cloud (Chamaeleon III) that has not yet formed any stars at all.

While the majority of new stars form in large molecular clouds, the closest new stars form in much smaller, more abundant ones. As we reach out to the most distant quasars and galaxies in the universe, remember that there are still star-forming mysteries to be solved right here in our own backyard.

This article is provided by NASA Space Place.

With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit **spaceplace.nasa.gov** to explore space and Earth science!

Western Amateur Astronomers Board Meeting Notes

by Tim Hogle, WAA Vice President and OCA Representative

Western Amateur Astronomers (WAA), an umbrella organization whose members are astronomy clubs primarily in the western US (including OCA), had a successful winter board meeting this year at Griffith Observatory on Jan 30th. Clubs represented at the meeting included OCA, Los Angeles Astronomical Society, China Lake Astronomical Society, Eastbay Astronomical Society, Astronomical Association of Northern California, Chabot Telescope Makers Workshop, Astronomical Society of the Desert, Stony Ridge Observatory, Mount Diablo Astronomical Society, and Mount Diablo Observatory Association.

WAA's biggest accomplishment this past year is development of a new, modern web page to replace our outdated one at http://www.waa.av.org. The new one, http://www.waastro.org, is up and running, but a vote at our summer meeting (RTMC) is expected to make it the official site. We expect the new site to become much more dynamic and informative than the old one, as it has the potential for material to be added by users. The completion of the new site is primarily due to the tireless efforts of Richard Ozer, our representative from the Chabot Telescope Makers' Workshop and the 2014 G. Bruce Blair award recipient. Richard is also taking the lead on producing the Blair medal (see below).

Our flagship publication, the New Pacific Stargazer, is continuing to be well received, though a serious illness on the part of our editor, Don Saito, has delayed publication recently. We expect that to take off again very soon. The past issues can be viewed from either of our web sites. And we still invite club members who have something they would like to publish that would be of interest to other amateurs within and outside OCA (astronomical projects, great ideas, subjects of astronomically-sensitive environmental concern, etc) to write it up and contact me. We do have a mechanism for submissions and are actively looking for material to publish, with full credit to the author. My contact info is on the back of the Sirius Astronomer, and I would be happy to provide details on submission of material for publication. (Also, I would again encourage you to submit articles to the Sirius Astronomer as well. Steve Condrey is always looking for new material.)

One of WAA's most well-known functions is to select and award the very prestigious G. Bruce Blair medal to a living individual who has made truly outstanding contributions to amateur astronomy over a significant period of time. The Blair Award has a history going back to 1954; the list of recipients (many of whom are very well known) is posted on the WAA web site.

This year's Blair award recipient is Mr. Nathan McKenna, a Northern California amateur astronomer active with several clubs and a wide variety of astronomy outreach and volunteer activities in that area for many years. Many of these activities go beyond coordinating the typical public telescope events, and include working with the Bay Area scouts for astronomy education, Chabot Space and Science Center staff on planetarium and observatory improvements and the Oakland fire department to reach inner city youth for astronomy.

The award will be presented at the RTMC conference in Big Bear during the May 28 (Saturday) awards ceremony. Please join us to congratulate Nathan on this award and hear more about his specific accomplishments.

Other items of business from the WAA meeting include reports from member clubs in attendance about their activities and concerns, ongoing discussions about possible expansion of WAA's service to and improved communications between member clubs, and planning to volunteer for operating the Camp Oakes telescopes during RTMC. We welcome ideas from OCA members as to what WAA could do to serve the member clubs and individual members in a significant fashion.

WAA will again have an information booth at RTMC again this year, probably near the snack bar. Stop by and say hello. For more info about and a fresh look at WAA, log on to the new web site.

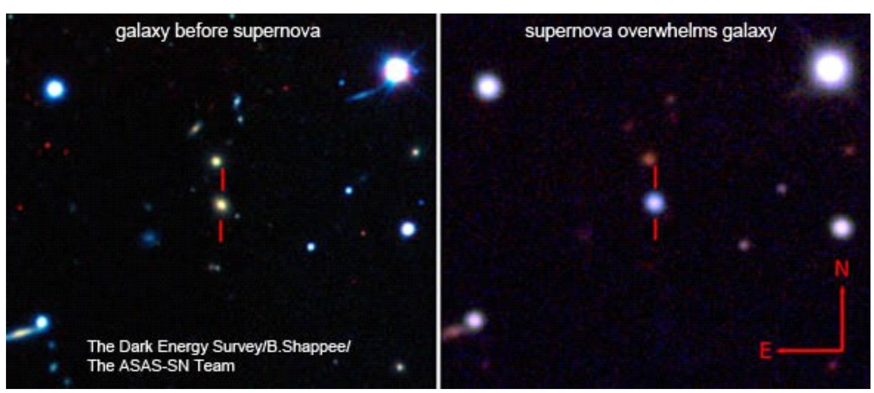
AstroSpace Update

March 2016

Gathered by Don Lynn from NASA and other sources

Gravity waves discovered – Scientists announced February 11 that LIGO, the twin 2-mile long gravity wave detectors in Washington and Louisiana, has for the 1st time detected gravity waves. The detection was made last September, and the LIGO team has since been analyzing the data, writing it up for publication, and carefully looking for any flaws in the interpretation. The announcement paper had over 1000 authors. Big science team! Rumors of the detection have been circulating for months. Gravity waves were predicted by Einstein's General Relativity, and amount to ripples in space-time caused by rapidly accelerating huge masses. They travel at the speed of light. Scientists have been trying to detect gravity waves since 1959, with increasingly sensitive instruments. When a gravity wave rolls by, it alternately increases and decreases space's length, but by a very small amount. The detector consists of a pair of test masses hung from shock absorbing mechanisms, with a laser measuring the distance between the masses extremely accurately (actually a pair of pairs arranged at right angles). The waves that were detected moved the weights by a few thousandths of the width of a proton. But the same signal was detected in both states, 7 milliseconds apart, due to light-speed travel time. When the signal was detected, the LIGO team was in the process of testing vast improvements to the sensitivity that had just been completed. The observing run continued until January, and at least 3 more instances of gravity waves were detected. LIGO was then shut down to implement planned upgrades that will further increase its sensitivity. Theoretically this should result in detections every few days. The wave form exactly matched what was predicted by computer simulations for the merging of 2 black holes, including the ringing of the resulting merged black hole afterward. The whole signal lasted a fraction of a second. By matching the characteristics observed, it was determined that the black holes had masses of 36 and 29 times the mass of our Sun, and were located 1.3 billion light-years away. It was not determined exactly where the merger took place, since it takes detections at 3 places to triangulate the direction. A 3rd gravity wave detector in Italy now undergoing sensitivity upgrading should by autumn allow this. Other ground-based detectors are under construction or planned, and a space-based detector called eLISA is planned. LIGO should also detect neutron stars colliding and certain supernovas. Gravity wave observation will now allow a completely different way to observe the cosmos. Astronomical observations until now have been limited to forms of light. Although this is the 1st direct detection of gravity waves, they were indirectly detected by Russell Hulse and Joseph Taylor in the 1970s. They found that a pair of closely orbiting pulsars was losing orbital energy at exactly the rate predicted by Relativity for being turned into gravity wave energy. They received a Nobel Prize for this in 1993.

Galaxy tearing apart – Astronomers have further observed the most luminous galaxy known, called W2246-0526, whose discovery was announced last May. The new study shows that this galaxy is expelling tremendously turbulent gas. Though turbulent gas has been seen flowing out of other galaxies, this is the 1st time that such gas has been found across the entire galaxy. It is enough flow to be essentially tearing the galaxy apart. Likely the growing supermassive black hole at the center of the galaxy is supplying the energy to blow out the gas. It is not clear if the gas is being thrown out with enough speed to escape the galaxy, or whether it will eventually fall back. This is the brightest of a class of galaxies known as Hot Dust-Obscured Galaxies (or HotDOGs). Only 1 out of every 3000 galaxies belongs to this class, according to observations by WISE (infrared space telescope).



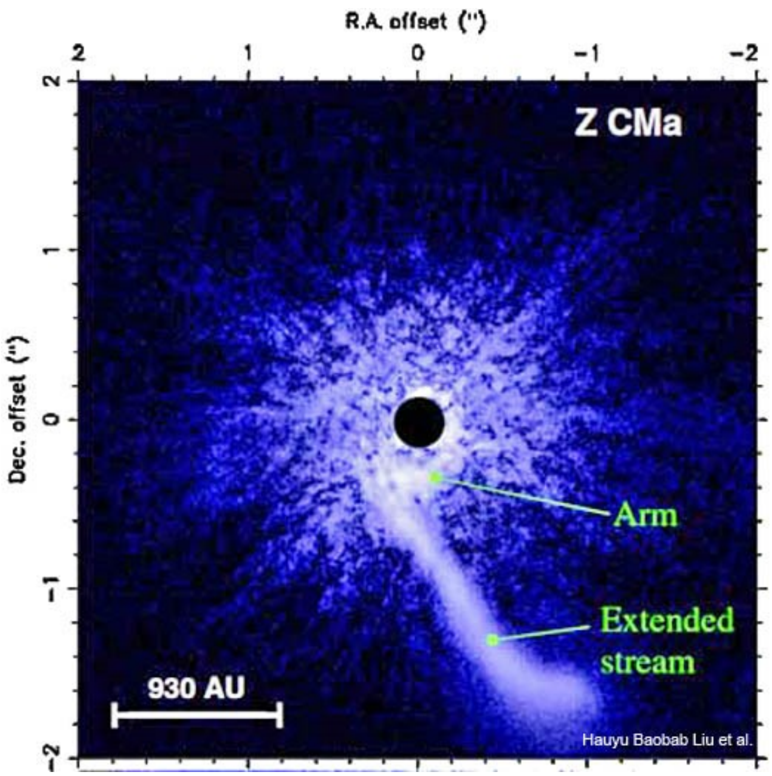
Brightest supernova – Astronomers have further observed the most luminous supernova known, called ASASSN-15lh or 2015L, whose discovery was announced last June. It was discovered by the All-Sky Automated Survey for Supernovae (ASASSN), which uses several 5.5-inch (14 cm) telescopes. At peak brightness, it was 200 times as bright as a typical Type Ia supernova, 20 times brighter than all the stars combined in the Milky Way, and twice as bright as any other supernova ever seen. It had a number of differences from other very bright supernovas, a class called superluminous. It is in a galaxy that is forming stars at a much slower rate, and it was hotter. The longer it is observed, the more total energy it has given off, and the harder it gets to explain where all that energy came from. One theory is that the matter being blown off is colliding with surrounding gas, which adds to the brightness. But spectra taken do not support this. Another theory is that the supernova formed a magnetar, a rapidly spinning neutron star, and the huge amount of spin and magnetic energy is adding to the brightness. However, calculations show that a magnetar does not add quite as much energy as that seen. Theorists are working on subatomic reactions that could add to the brightness, including quarks and pair-instability (electrons and positrons reacting with gamma rays). Also proposed is some interaction between the supernova and a supermassive black hole.

Disappearing quasar – Astronomers who have monitored a distant quasar for 13 years found that all signs of the quasar have disappeared, leaving only its surrounding galaxy to be seen. The black hole must still be there, but is apparently no longer feeding on enough matter to be seen. The quasar is known as SDSS J1011+5442 and was discovered in 2002, at which time it was ferociously eating matter, which supplied the extreme light characteristic of quasars. Such quasars that vary extremely in their light output are now being called "changing look active galaxies". There appear to be 2 varieties of these: where a passing cloud of dust blocks the view of the quasar, and where the quasar abruptly stops feeding on matter. The observations made of this disappearance would be very hard to explain by a cloud, so it is probably of the 2nd variety. It was calculated that it would take 800 years to pull all the material out of the accretion disk into the black hole. But the shutdown took only a few years. So likely some process has interrupted the flow of material from the disk to the black hole rather than having eaten the whole disk. Astronomers will continue to monitor this black hole to see if it turns back on and to understand better what turned it off.

Possible intermediate black hole – A team of astronomers using radiotelescopes has found a gas cloud only 200 light-years from the center of the Milky Way, and the cloud has a surprisingly large range of speeds with which its parts move. A good explanation for the speeds is a compact object within (which could gravitationally pull the gas), such as a neutron star or black hole, but further observations made in infrared and X-rays found no such object. So the best theory is that there is a black hole causing the speeds, but that the black hole is not currently feeding (pulling matter into itself), and so cannot be seen. Computer simulations show that such a black hole would have a mass of roughly 100,000 times the mass of the Sun. Black holes, such as this one, with masses larger than single stars and smaller than the supermassive black holes at the centers of galaxies are quite rare. So astronomers will further study this cloud to see if it is indeed an intermediate mass black hole. Also they are looking for other gas clouds with similar large ranges of gas speeds.

Galaxies discovered – Hundreds of nearby galaxies (many about 250 million light-years away) have been studied for the 1st time, since they were hidden from view by our Milky Way. A new innovative receiver on the Parkes radiotelescope allowed looking through the Milky Way dust while imaging large areas of the sky. The Great Attractor was proposed in the 1980s to explain why all the galaxies in our vicinity are being pulled gravitationally toward a particular direction in the sky. The newly seen galaxies should partially explain this attraction, adding to other discoveries of massive objects since the 1980s. The Parkes study showed 883 galaxies, a third of which had been seen by no other technique.

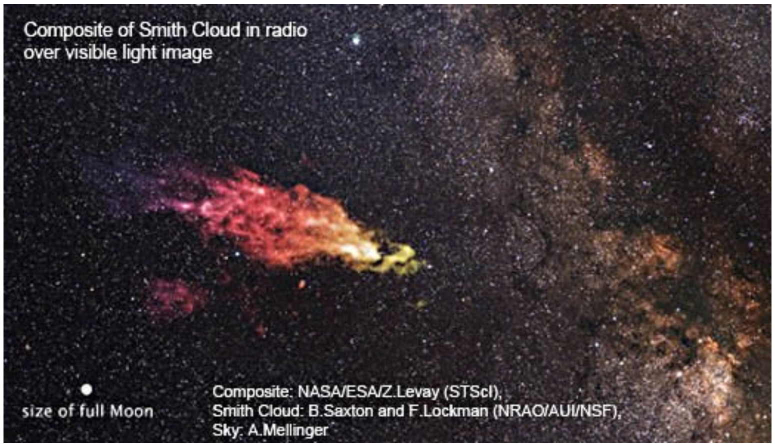
Star formation is believed to occur when gas clouds collapse from their own gravity into protostars, which are then fed by material falling in through an accretion disk. But the process occurs inside thick clouds and is difficult to observe. A new study shows that the accretion isn't steady as thought, but dumps onto the protostar in bursts. This may help explain why computer simulations seem to take too long to build a star, as compared to nature. A team observed 4 protostars that seemed to be much brighter than others. They used adaptive optics to overcome Earth's atmospheric disturbances, then blacked out the brightest spot with a coronagraph, and observed in polarized infrared light. They found a streamer coming out of the accretion disk and other features that computer simulations indicated bursts of accretion should produce. Planned further observations will be made in radio light, which should penetrate from farther within the protostar disks.



LINERs become LIERs – It has been known for about 35 years that some gas between stars in nearby galaxies faintly glows. What powers that gas to glow has been long been debated. The glowing areas have become known as LINERs (Low-Ionization Nuclear Emission-line Regions), on the assumption that the galaxies' nuclei ("Nuclear") were exciting the gas. A new study of LINERs using a new instrument of the SDSS Telescope that takes simultaneous spectra over all the points in an image found that the nuclear explanation does not fit. The exciting source has to be spread out over the whole galaxy. The new best theory is that white dwarf stars that have lost their outer envelopes expose very hot cores that excite nearby gas.

This theory had been previously proposed for elliptical galaxies, but the new study showed it applies to both elliptical and spiral galaxies. Some astronomers are suggesting the "Nuclear" be dropped, but LIERs may not be an appealing name for this glow.

Detecting gas clouds – For 40 years, clouds of hydrogen gas have been found by their spectral lines imprinted on the light from quasars that happen to lie behind the gas. Limitations of this observation method are that there are not quasars in every direction, and when there is one, it samples only one point as seen in the gas cloud (because quasars appear as points). For the 1st time, astronomers have used the same technique but using a background galaxy instead of a quasar. Galaxies are in much greater supply all over the sky, and the gas is measured over the entire extent of the galaxy, not just at one point. The 1st results are that such clouds extend over larger areas than thought. One example was 3 times the diameter of our Milky Way. Because distant galaxies are not as bright as quasars, the new technique requires the largest of telescopes. It has been done with the 10-meter Keck and 8-meter Very Large Telescopes.

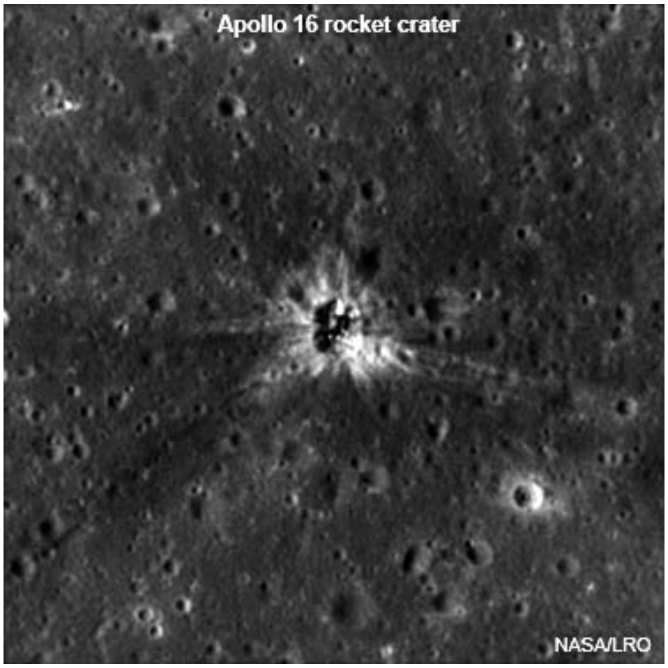


The Smith Cloud (discovered by Gail Smith in the 1960s) is one of many gas clouds falling into the Milky Way at high speed. It contains about 2 million times the mass of our Sun and lies about 40,000 light-years away. A new study of the Smith Cloud using the Hubble Space Telescope and the Green Bank radiotelescope supports the theory that it is Milky Way material, not matter from some outside source, such as intergalactic gas or dwarf galaxy material. The makeup of the cloud was determined by the spectral lines that it imposed on light from 3 background active galaxies. The amounts of heavier elements matched Milky Way material. The Smith Cloud is predicted to hit the Milky Way disk and trigger formation of new stars in about 30 million years. The study team is planning observations to measure the dark matter around the Smith Cloud to determine if dark matter played a part in forming or directing the cloud.

New Horizons (Pluto mission) data has been made into a map of where water ice is found, and that ice was found to be considerably more widespread than previously thought. The new map used a technique that separated the spectral contributions from different icy materials. Most of the water ice was mixed with nitrogen and similar ices. Sputnik Planum, a large nearly flat area in the heart-shaped region of Pluto, shows little or no water ice. This implies this area has a thick coating of other ices covering the water ice that likely lies underneath.

Planet Nine – Two astronomers, including Mike Brown, have announced that the orbits of certain bodies beyond Neptune can be explained only if there is a planet somewhat smaller than Neptune far beyond. They announced this in hopes that other astronomers would join the search for such a planet. The history of planetary astronomy is littered with predictions of planets that turned out not to exist, so don't bet the farm on finding this newly predicted planet. You may recall that Brown discovered Eris, a body about the size of Pluto, but much farther away, and the resulting debate over whether it was a planet ended with the demotion of Pluto to "dwarf planet". To emphasize that the newly predicted body would qualify as a planet, not a dwarf planet, Brown is calling his prediction Planet Nine. Computer simulations show that a planet orbiting far beyond Neptune, with considerable mass, with a certain direction and tilt of its orbit, would perturb small bodies in the Kuiper Belt into a couple of groups where several have actually been found. 6 of the most distant objects beyond Neptune all have orbits in a similar direction. Planet Nine would have to be in an elongated orbit pointing opposite to this group. A 2nd group of bodies beyond Neptune is in orbits perpendicular to the plane of the planets. Planet Nine in simulations also pushed small bodies into this grouping. Presumably Planet Nine would have formed at the time and roughly the place of the current gas giant planets, but was thrown outward by encounters with one of those. Planet Nine is predicted to have a mass much larger than Earth, but smaller than Neptune. This range of mass (often called super Earths or mini Neptunes) is the most common among the thousands of exoplanets known, yet no planet in our Solar System lies in this range. Perhaps there was one that got kicked out long ago.

Instant AstroSpace Updates

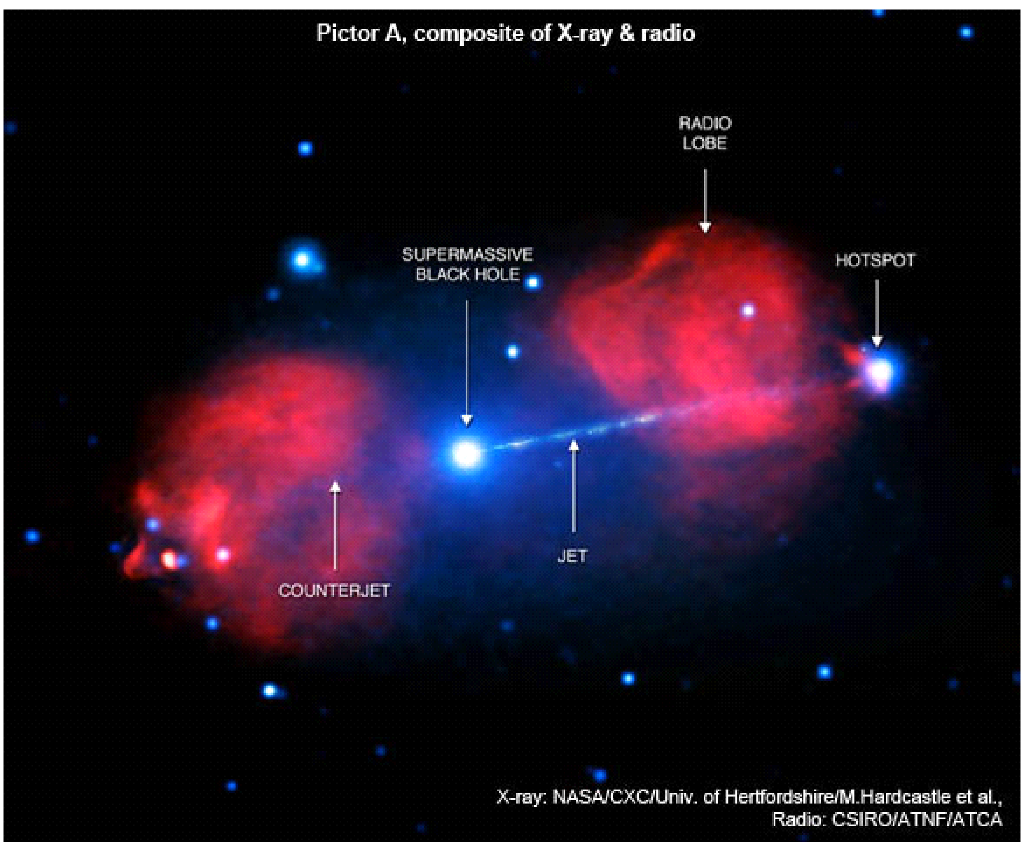


Lunar Reconnaissance Orbiter has imaged the crater left by the impact of the **Apollo 16 rocket** 3rd stage, which was the last unfound large Apollo object on the Moon. Radio contact with that rocket stage had been lost before impact, so its exact location was not known.

The generally accepted theory of the Moon's formation is that during or shortly after the formation of the planets, a body roughly the size of Mars hit the Earth a glancing blow that knocked much of the Earth's surface off, and that material coalesced into the Moon. New measurements of the oxygen isotopes on the Moon and Earth's crust show that it had to have been a **head-on collision**, not a glancing blow, to mix the oxygen in the Earth's crust and the colliding body into what is observed today.

Japan is scheduled to launch **ASTRO-H**, a space observatory covering the broad wavelength range from low-energy, or soft, X-rays to soft gamma rays, and with 10 times the sensitivity of its predecessor, since it is cooled with a 3-year supply of liquid helium. Projected targets include stellar explosions, extreme magnetic fields, strong gravity (such as black holes), galaxy clusters, and neutron stars.

Combining new X-ray and radio observations of the galaxy Pictor A confirm the existence of a counterjet (one pointing away from us) in addition to the often observed jet (generally toward us), and supported the theory that X-ray emission of such jets is caused by **synchrotron emission**, where electrons spiral around magnetic field lines, rather than the other theory of jet X-rays by electrons colliding with the Cosmic Microwave Background.



FINDING FAINT THINGS WITH STAR CHARTS

by Alan MacRobert

Editor's Note: This article originally appeared in March 2015; while the information about Comet Lovejoy is outdated, the general principles outlined herein are still very much applicable. This article is reposted for the benefit of new observers during the Messier Marathon season.

Dear Fellow Astronomer,

I've been hearing from people who've had trouble using star charts to find Comet Lovejoy with binoculars. (By the way, Lovejoy is still in good view.) This gets to the problem of how does *anyone* learn to find faint things in the sky using charts with binoculars? Or a telescope for that matter?

Some figure it out by trial and error, but that's the hard way. A few tricks make for huge shortcuts in mastering this.

1) First: know how big your view is.
To compare what you see in binoculars (or the finderscope on the side of a telescope) with what's printed on your chart, you have to know how much sky - how much of the chart - your binoculars are showing you. In other words: what's the binocular's *true field of view?* For 7-power binoculars, the view is probably about 7° wide. For 10-power binoculars, it's probably about 5° wide. You don't have to know exactly, but you should have a general idea. Now get out your charts. I'll assume you have the Pocket Sky Atlas. because it's super-popular, handy and fairly cheap, and just about ideal for binoculars and small telescopes because it shows stars to as faint as magnitude 7.6 - about the limit of typical binoculars and good finderscopes. Look on the sides of the charts. There's a degree scale running down the sides. This shows declination on the map (like latitude on Earth), but it also shows you how big your 5° field of view appears on the map! On the *Pocket Sky Atlas*, 5° is 1 inch wide. That's probably a lot smaller than you imagined your binoculars showed. It's *much* smaller than most constellations. That's why you see so little of a constellation at a time! Remember this size. Maybe draw it on the inside of the front cover so you'll always have it handy. The star patterns on the charts that fit into that size circle are *the star patterns you'll see in your field of view.*

2) Which way is up? On star charts, celestial north is up. On the sky, celestial north is always *the direction toward Polaris, the North Star.* No matter at what angle that is from wherever you're looking. You do need to know how to spot Polaris. Once you do, you'll know which way is celestial north from wherever you're looking. Turn your chart around so its top matches that direction.

3) Start from a naked-eye landmark near the object you're hunting for. You need to know at least a few constellations. (There's an excellent naked-eye constellation map in the center of each month's *Sky & Telescope* The constellations provide starting points for zeroing in on the exact point where a faint thing on your chart should be. On the chart, working from a starting point you know to your faint target, look for star patterns - triangles, kite shapes, whatever - marking the path. In choosing these patterns, use the brightest available stars that will fit in your field of view. Now, with the binoculars (or your telescope's finder), work your way along this trail, matching the chart with what you see, step by step. This is called "star-hopping." If you get lost, start over. You'll get the hang of it. And then you'll know how to do it for the rest of your life. You'll discover that when you know the *exact* point in your field of view to examine, it's amazing how much deeper you can see. And how much more confident you'll be that you've indeed found what you were looking for.

I hope you'll use these tips to help you enjoy the Comet Lovejoy, while you still can!

Alan MacRobert
Senior Editor, *Sky & Telescope*

P.S. One reason binoculars are nice is they show a view that's right-side up and also is not mirror-imaged. Some telescopes and finderscopes show views that are upside-down or tilted, and/or are mirror-imaged.

Orange County Astronomers
Messier Marathon Form

Date ____________ Location________________

Name __________________ Age* ______ Messier Objects Viewed______ Photographed______
Viewing Equipment: Telescope______ Binoculars______ Naked Eye_____ Camera______
Location Method: Star-hopping______ Setting Circles______ Computerized System______

Scope/Binocular/Camera Size and Description: ____

The following is a list of the Messier objects in the order you might want to view them. The first objects listed set the soonest. The first object is usually visible as the sun sets. Fill in the time at which each object was viewed. Place an "x" in the "P" column for objects that you photographed.

M	Time	P	RA	Dec	Con	Type	Mag
77			02:42.7	00°01'	Cet	Gx	8.9
74			01:36.7	15°47'	Psc	Gx	9.4
33			01:33.9	30°39'	Tri	Gx	5.7
31			00:42.7	41°16'	And	Gx	3.4
32			00:42.7	40°52'	And	Gx	8.1
110			00:40.4	41°41'	And	Gx	8.5
52			23:24.2	61°35'	Cas	OC	7.3
103			01:33.2	60°42'	Cas	OC	7.4
76			01:42.4	51°34'	Per	PN	10.1
34			02:42.0	42°47'	Per	OC	5.5
45			03:47.0	24°07'	Tau	OC	1.6
79			05:24.5	-24°33'	Lep	GC	7.7
42			05:35.4	-05°27'	Ori	DN	4
43			05:35.6	-05°16'	Ori	DN	9
78			05:46.7	00°03'	Ori	DN	8.3
1			05:34.5	22°01'	Tau	DN	8.4
35			06:08.9	24°20'	Gem	OC	5.3
37			05:52.4	32°33'	Aur	OC	6.2
36			05:36.1	34°08'	Aur	OC	6.3
38			05:28.4	35°50'	Aur	OC	7.4
41			06:46.0	-20°44'	CMa	OC	4.6
93			07:44.6	-23°52'	Pup	OC	6
47			07:36.6	-14°30'	Pup	OC	5.2
46			07:41.8	-14°49'	Pup	OC	6
50			07:03.2	-08°20'	Mon	OC	6.3

M	Time	P	RA	Dec	Con	Type	Mag
48			08:13.8	-05°48'	Hya	OC	5.5
44			08:40.1	19°59'	Cnc	OC	3.7
67			08:50.4	11°49'	Cnc	OC	6.1
95			10:44.0	11°42'	Leo	Gx	9.7
96			10:46.8	11°49'	Leo	Gx	9.2
105			10:47.8	12°35'	Leo	Gx	9.3
65			11:18.9	13°05'	Leo	Gx	9.3
66			11:20.2	12°59'	Leo	Gx	8.9
81			09:55.6	69°04'	UMa	Gx	6.9
82			09:55.8	69°41'	UMa	Gx	8.4
97			11:14.8	55°01'	UMa	PN	9.9
108			11:11.5	55°40'	UMa	Gx	10
109			11:57.6	53°23'	UMa	Gx	9.8
40			12:22.4	58°05'	UMa	Ast	8.4
106			12:19.0	47°18'	CVn	Gx	8.4
94			12:50.9	41°07'	CVn	Gx	8.2
63			13:15.8	42°02'	CVn	Gx	8.6
51			13:29.9	47°12'	CVn	Gx	8.4
101			14:03.2	54°21'	UMa	Gx	7.9
102			15:06.5	55°46'	Dra	Gx	9.9
53			13:12.9	18°10'	Com	GC	7.6
64			12:56.7	21°41'	Com	Gx	8.5
3			13:42.2	28°23'	CVn	GC	6.2
98			12:13.8	14°54'	Com	Gx	10.1
99			12:18.8	14°25'	Com	Gx	9.9

Messier Marathon Form
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M	Time	P	RA	Dec	Con	Type	Mag
100			12:22.9	15°49'	Com	Gx	9.3
85			12:25.4	18°11'	Com	Gx	9.1
84			12:25.1	12°53'	Vir	Gx	9.1
86			12:26.2	12°57'	Vir	Gx	8.9
87			12:30.8	12°24'	Vir	Gx	8.6
89			12:35.7	12°33'	Vir	Gx	9.8
90			12:36.8	13°10'	Vir	Gx	9.5
88			12:32.0	14°25'	Com	Gx	9.6
91			12:35.4	14°30'	Com	Gx	10.2
58			12:37.7	11°49'	Vir	Gx	9.7
59			12:42.0	11°39'	Vir	Gx	9.6
60			12:43.7	11°33'	Vir	Gx	8.8
49			12:29.8	08°00'	Vir	Gx	8.4
61			12:21.9	04°28'	Vir	Gx	9.7
104			12:40.0	-11°37'	Vir	Gx	8
68			12:39.5	-26°45'	Hya	GC	7.8
83			13:37.0	-29°52'	Hya	Gx	7.6
5			15:18.6	02°05'	Ser	GC	5.6
13			16:41.7	36°28'	Her	GC	5.8
92			17:17.1	43°08'	Her	GC	6.4
57			18:53.6	33°02'	Lyr	PN	8.8
56			19:16.6	30°11'	Lyr	GC	8.3
29			20:23.9	38°32'	Cyg	OC	7.1
39			21:32.2	48°26'	Cyg	OC	4.6
27			19:59.6	22°43'	Vul	PN	7.4
71			19:53.8	18°47'	Sge	GC	8.2
107			16:32.5	-13°03'	Oph	GC	7.9
12			16:47.2	-01°57'	Oph	GC	6.7
10			16:57.1	-04°06'	Oph	GC	6.6
14			17:37.6	-03°15'	Oph	GC	7.6

M	Time	P	RA	Dec	Con	Type	Mag
9			17:19.2	-18°31'	Oph	GC	7.7
4			16:23.6	-26°32'	Sco	GC	5.6
80			16:17.0	-22°59'	Sco	GC	7.3
19			17:02.6	-26°16'	Oph	GC	6.8
62			17:01.2	-30°07'	Oph	GC	6.5
6			17:40.1	-32°13'	Sco	OC	5.3
7			17:53.9	-34°49'	Sco	OC	4.1
11			18:51.1	-06°16'	Sct	OC	6.3
26			18:45.2	-09°24'	Sct	OC	8
16			18:18.8	-13°47'	Ser	OC	6.4
17			18:20.8	-16°11'	Sgr	DN	7
18			18:19.9	-17°08'	Sgr	OC	7.5
24			18:16.9	-18°29'	Sgr	Ast	4.6
25			18:31.6	-19°15'	Sgr	OC	6.5
23			17:56.8	-19°01'	Sgr	OC	6.9
21			18:04.6	-22°30'	Sgr	OC	6.5
20			18:02.6	-23°02'	Sgr	DN	9
8			18:03.8	-24°23'	Sgr	DN	6
28			18:24.5	-24°52'	Sgr	GC	6.8
22			18:36.4	-23°54'	Sgr	GC	5.1
69			18:31.4	-32°21'	Sgr	GC	7.6
70			18:43.2	-32°18'	Sgr	GC	7.9
54			18:55.1	-30°29'	Sgr	GC	7.6
55			19:40.0	-30°58'	Sgr	GC	6.3
75			20:06.1	-21°55'	Sgr	GC	8.5
15			21:30.0	12°10'	Peg	GC	6.2
2			21:33.5	00°49'	Aqr	GC	6.5
72			20:53.5	-12°32'	Aqr	GC	9.3
73			20:58.9	-12°38'	Aqr	Ast	9
30			21:40.4	-23°11'	Cap	GC	7.2

Types: OC=Open Cluster, GC=Globular Cluster, PN=Planetary Nebula, DN=Diffused Nebula, Gx=Galaxy, Ast=Asterism

Fill in the information at the top of the form. *Include age if under 18 years old. Please turn your completed form in to the Messier Marathon Coordinator or to Barbara Toy, or mail it to: Orange County Astronomers/Messier Marathon, P.O. Box 1762, Costa Mesa, CA 92628.

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