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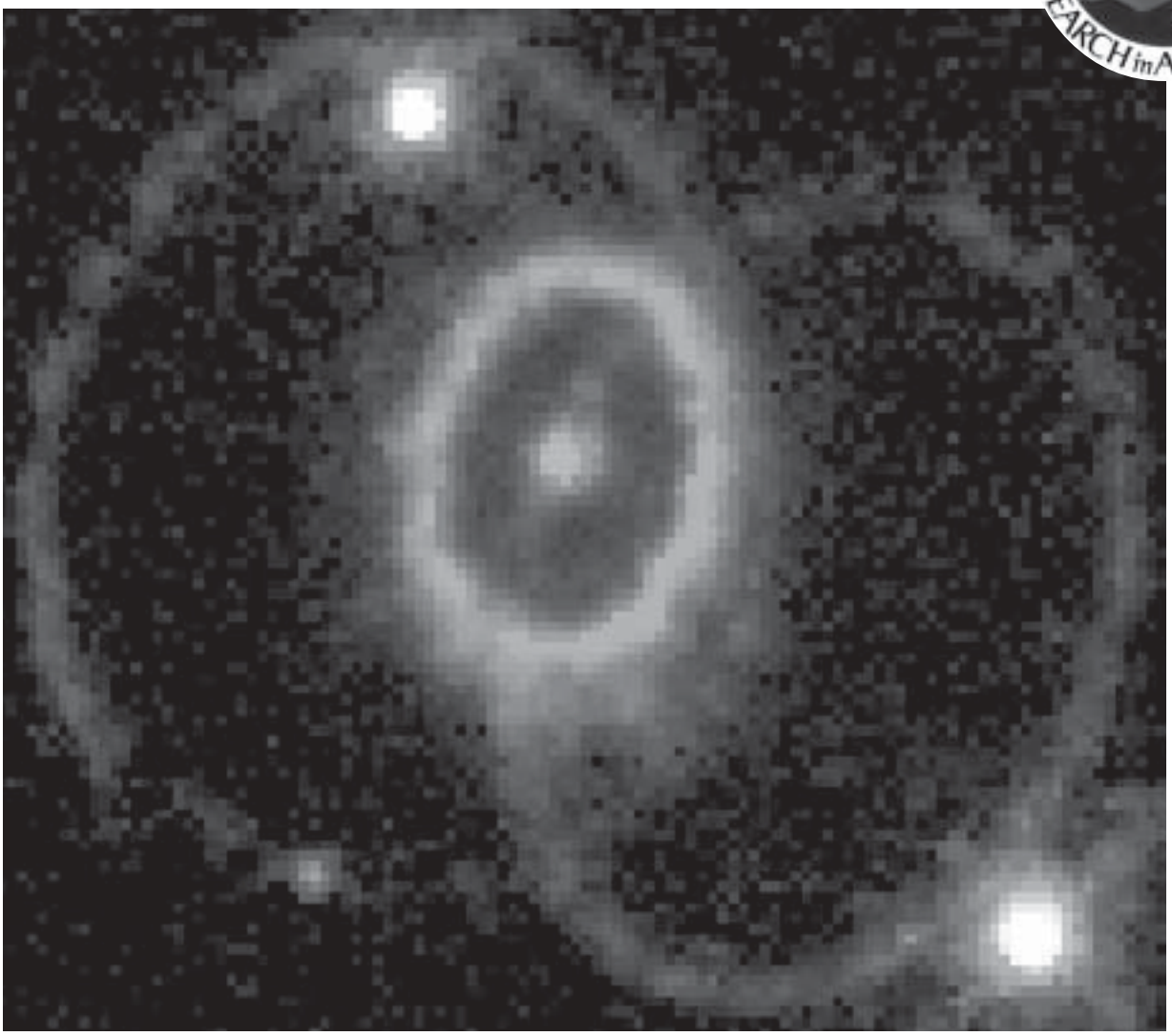
MIRA NEWSLETTER



Twenty Years of Supernova Research

(See article, p.5)

Image of Supernova 1987A by C. Burrows (ESA/STScI), HST, NASA

Contents

This feature is inspired by the questions we have received over the years from interested readers. If you have a question about an astronomical topic, please send it to us.

A correspondent asked about Internet talk of a danger posed to the earth by Comet Holmes, citing a web page that claims that Comet Holmes has completely upset the scientific view of comets.

Dr. Bruce Weaver replies,

That web page is what we refer to as 'squirrel food.' Besides lots of wrong science there are other telltale signs. These include a claim of unique understanding that is scoffed at by the scientific establishment. That is something that happens very, very rarely to real scientists. Most revolutionary ideas are accepted relatively quickly and almost always generate controversy among scientists; 'squirrel food' is ignored as scientists just don't have the time to waste on every goofy idea.

In the case of comets, the tails are dust and gas that have been released by the 'dirty snowball.' Even if the ground-based images and spectroscopy of comets are not to be believed (which they should be, of course, as how else do you understand nature than observing it?), there are images and other data collected from $100 million spacecraft that were designed especially to fly past - or into - comets. While these experiments have produced vast amounts of interesting science, they have not overturned any of our basic understanding of comets.

Internships Available at MIRA

Qualified high school and college students are encouraged to apply for summer internships at MIRA. The ten-week program allows students to work one-on-one with professional astronomers and gain an insight into research and the scientific process.

Interested students should call MIRA at 831-883-1000, or send e-mail to mira@mira.org.

Calendar of Events

MIRA Astronomy Course Begins 27 March

In collaboration with CSUMB's Osher Lifelong Learning Institute (OLLI), MIRA astronomers will lead an eight-meeting astronomy course entitled "Decoding the Mysteries of the Universe."

27 March "The MIRA Story" with Dr. Arthur Babcock.

3 April "General Introduction; the Distance Scale" with Dr. Bruce Weaver.

10 April "Near-Earth Objects and Other Vermin of the Sky" with Dr. Russell Walker.

17 April "Spectroscopy: Fingerprinting a Star" with Dr. Bruce Weaver.

24 April "The Birth and Death of Stars" with Dr. Arthur Babcock.

1 May "Galaxies: Continents of Stars" with Dr. Whitney Shane.

8 May "The Universe: All About Everything" with Dr. Whitney Shane.

15 May "Tour of the Oliver Observing Station: Alternative Energy to the Stars" with Drs. Bruce Weaver and Arthur Babcock.

All classes (except the last) meet at the Hamming Astronomy Center from 2:00pm until 3:30pm. To register for the course, call OLLI at 831-582-5500.

MIRA Classes on Monterey's Sky

In collaboration with the Monterey Regional Park District, MIRA will offer four classes on the skies of Monterey County.

Friday, 30 May, 8:00pm-10:00pm at the Hamming Astronomy Center, MIRA docent Brian Jacobson will give a tour of the multi-ringed giant planet Jupiter.

Saturday, 5 July, from 8:30pm until 10:30pm Dr. Bruce Weaver will discuss "Light and Color in the Open Air" at the Garland Ranch Regional Park Center.

Saturday, 1 August, 8:30pm-10:30 at Garland Ranch Regional Park, MIRA docent Dr. Jim Eagle will provide a "Guide to the Constellations."

Saturday, 23 August, from 1pm until 5:30pm, Dr. Arthur Babcock will lead a tour of the Oliver Observing Station on Chews Ridge. Vans will leave from and return to Garland Ranch Regional Park Center.

For a more complete description of the classes, call MIRA at 831-883-1000.

MIRA gratefully acknowledges memberships and gifts for 2007 from individuals, families, corporations, and foundations.

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The Return of Smith's Cloud
by Dr. Whitney Shane

A few weeks ago, I glanced over the morning paper, and my eye fell upon the words "Smith's Cloud." This brought back memories.

In the early 1960s, I was occupied, at the Leiden Observatory, with a study of the neutral hydrogen distribution and motions in a twenty degree stretch of the Milky Way. The outward-moving spiral arm at three kiloparsecs had just been discovered, and it was thought that some trace of this might be found at greater distances from the galactic center. Following up on a related idea, I extended my survey to twenty degrees on either side of the Milky Way. There was very little of interest to be found in this region, but we did note a rather weak signal indicating neutral hydrogen moving away from us with a velocity that could not be explained by galactic rotation and at a surprisingly great distance from the galactic plane. We thought this to be odd enough that we added some additional observations to our program and, having better things to do, put them aside for someone else to work on.

Gail Smith in 1962.

About this time a new student showed up; her name was Gail Smith. Wanting a suitable student project, we immediately thought of the observations described above. Accordingly we dumped all of the unprocessed observations on Gail's desk and waited for something good to happen. We did not have long to wait, because in 1963 she presented the results in a paper in the Bulletin of the Astronomical Institutes of the Netherlands. This included a description of the observations and a map of the cloud showing neutral hydrogen column density and the distribution in velocity at each point on the sky. This map has been confirmed and extended by subsequent observations using much more sensitive instruments. She also suggested a number of possible interpretations, one of which was that it might be a satellite of the Galaxy. Assuming, in the absence of any better information, that it might be at about the distance of the Magellanic Clouds, she calculated the total mass and the velocity with respect to the Galaxy. The latter turned out to be greater than the escape velocity, which at the time was seen as a disturbing result. Gail searched the Palomar Sky Survey photographs of the region but found nothing that could reasonably be related to the cloud.

After 1963 we enjoyed thirty five years of silence. Then in 1998 a remarkable report appeared of observations made in Australia in which optical emission lines from the cloud, which had never before been seen at optical wavelengths, were detected. It appeared that these lines came from gas whose atoms were excited by ultraviolet radiation from stars in the galactic disk. The strength of the emission made it possible to estimate the distance of the cloud above the plane and thus the distance from the sun, which was 26 kpc. This puts the cloud well beyond the galactic center but at only half the distance of the Magellanic Clouds. A possible association of Smith's Cloud with the recently discovered Sagittarius Dwarf is suggested, although the support for this suggestion is rather weak. The Sagittarius Dwarf is a large and diffuse aggregate of stars, including four globular clusters, which appears to be orbiting very close to the Galaxy, so that it will eventually be accreted. In its passage through the outer parts of the Galaxy it might dislodge and drag along some diffuse matter. Smith's Cloud, which is not very far from the Sagittarius Dwarf and has a similar motion, might be such matter remaining after a recent passage.

A few more years of silence ensued, followed by two recent reports of neutral hydrogen observations. Both were in the form of abstracts of presentations to the American Astronomical Society and apparently not yet published elsewhere so that the available information is very limited. It is noted that the cloud has a cometary morphology, suggesting interaction with the diffuse medium of the halo. This morphology is quite consistent with the data published by Smith, although such an interpretation could hardly have been justified by those data alone. From our current estimates of the gas density in the galactic halo, it is possible to make a new estimate of the distance, which is only 12 kpc. All this, together with the velocity of the cloud, make it possible to estimate its orbit, which will bring it into the disk of the galaxy in 40 million year. (This last bit of gossip is to be found only in a wire service report and is not included in the published abstracts). It is speculated that this encounter will have dramatic consequences, but we need not stay up and wait for it because it will happen on the opposite side of the Galaxy and thus be largely out of our field of view. It does, however, provide a good example of how we currently think that fresh gas may be fed into the Galaxy, thus helping to maintain spiral arms and star formation.

Exploding Stars: Two Amazing Decades of Research After SN1987A by Dr. Alex Filippenko
Review by Rod Norden

The 20th Anniversary Chesley Bonestell Lecture, presented by Dr. Alex Filippenko of UC Berkeley, was a very informative and humorous review of the modern research into finding and analyzing supernovae, especially SN1987A. This research is increasing our understanding of the contents and structure of the universe. Dr. Filippenko has won numerous local and national "Best Professor" awards. Everyone present would agree that his awards were well deserved!

His talk began with a discussion of the unusual aspects of Supernova 1987A, which exploded in the Large Magellanic Cloud only about 170,000 light years away. The closest supernova in almost 400 years, SN1987A was also the first supernova for which we have knowledge of the star before the explosion. Astronomers were very fortunate to see it prior to maximum, so it could be studied on its rise to peak emission. This was very special, as only a very few stars die in a spectacular supernova explosion.

Dr. Filippenko reviewed the differences in classes of supernovae and their causes. Type Ia supernovae occur when white dwarf stars accrete mass which exceeds the Chandrasekhar limit of ~1.4 solar masses, and explode in a violent manner, but with consistent peak luminosity because of their uniform mass at the time of detonation. They are used to measure extreme distances in the universe since apparent brightness decreases with increasing distance. Astronomers studying very distant Type Ia supernovae have observed an accelerating expansion of the universe, which is a very important discovery.

If, however, a star is much more massive than the sun, an even more violent cataclysmic fate awaits, resulting in a Type II supernova. As fuel runs out, the star contracts and its internal temperature rises. At some point the central temperature is sufficient to initiate fusion of a sequence of heavy elements until the star develops an iron core, and thus fusion cannot proceed. Without energy to support all these layers, the core implodes. Neutrons and neutrinos are formed and due to atomic forces the implosion rapidly becomes an explosion fueled outward by the flood of neutrinos. Dr. Filippenko illustrated this rebound with one of his trademark demonstrations of a tennis ball rebounding off a basketball.

Type II supernovae leave either a neutron star or a black hole depending on the mass of the collapsing core.

Three Important Theories Confirmed with SN1987A:

First, since SN1987A appeared to be a Type II supernova, the progenitor star should have been a massive giant star. It was confirmed that Sk -69 202 had about 20 solar masses before the explosion, but was a blue supergiant rather than a red supergiant as is much more common.

Second, neutrinos were predicted to be created in massive numbers by the stellar collapse resulting in Type II supernova. Two neutrino detectors found small pulses of neutrinos exactly at the time when they should have arrived from the explosion of SN1987A.

Third, it was confirmed that heavy elements are formed in the supernova explosions. Emissions from radioactive cobalt were found by gamma ray detectors after the event just as predicted. All the elements in the universe heavier than iron (Fe) were formed in these gigantic stellar explosions. The supernovae seeded the interstellar gases from which our sun formed.

All the heavy elements in our bodies were synthesized in just such events.

Summary:

Dr. Filippenko discussed the brightest supernova ever found, the farthest ever found, the first associated with a gamma ray burst and so many other details in a lively and most humorous fashion. It was very easy to see why Dr. Filippenko is so honored by his students and colleagues alike.

Readers who enjoyed Dr. Filippenko's lecture may be interested to know that a video (16 DVDs in all) of his course "Understanding the Universe, 2nd Edition" is on sale at The Teaching Company, www.teach12.com--Ed.

New MIRA Administrator

Outgoing MIRA Administrator Holly Keifer, right, passes the 'baton' to her successor, Tami Huntley. The next time you're in the neighborhood of the Hamming Astronomy Center, drop by to welcome our new Administrator!

The Spring Sky

by Rod Norden

Friends of MIRA who have participated in MIRA's total eclipse trips, and many others, will remember Rod Norden. An avid observer, he has taken on the job of writing our seasonal sky feature. Our thanks to Dr. Whitney Shane, who shouldered the burden from 1996 through 2007--Ed.

After 12 years of wonderful seasonal sky reports by our Dr. Whitney Shane, he has decided to turn the column over to someone else. As an active observer who is back in the area again, I have decided to give it a try. I think all members should be sure to let Dr. Shane know how much you appreciated his fine and informative work in this column.

The new column will be oriented to beginning, intermediate, and advanced observers among our many members. My aim is to provide information that will help our observers to see some of the more interesting objects in the sky each season.

Fixed Stars

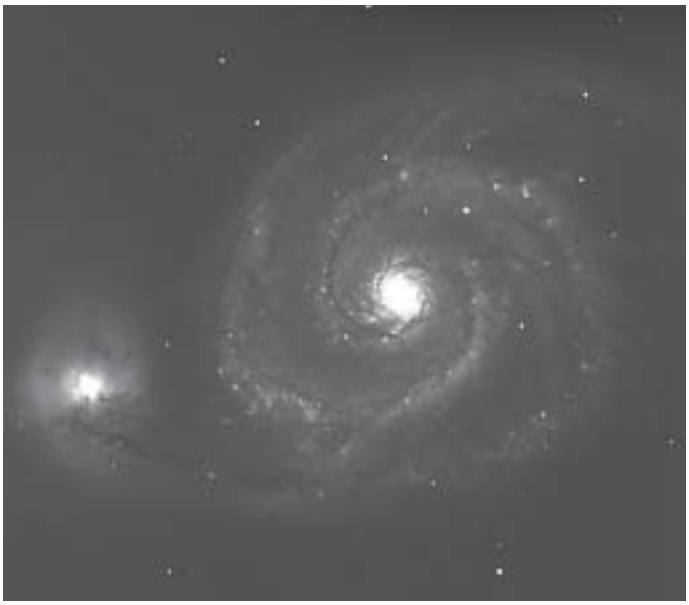
For observers using the naked eye, spring is the season to observe the **Zodiacal Light** in the western sky after sunset and the end of evening twilight from a dark sky site. The ecliptic rises almost vertically in the west after sunset, and the zodiacal light is the glow from the interplanetary dust along the plane of the solar system. It appears like a distended cone of the Milky Way, brightest near the horizon and shrinking to a point about 30-40 degrees up, tilting at a slight angle to the south.

For observers with binoculars, a fine open star cluster is well placed in the evening sky at this time of the year. It is **M44**, the Beehive. Mars will be traversing M44 on 22-24 May, and it will be a spectacular show. (As you are watching this, don't forget the Phoenix Mars landing scheduled for 25 May.)

Observers with a good southern horizon will want to look for the famous globular cluster known as **Omega Centauri** (NGC 5139). It barely clears the horizon here in central California. It is the biggest of all globular clusters in our galaxy. With its about 5 million solar masses, it is about 10 times as massive as other big globulars, and has about the same mass as the smallest whole galaxies. Omega Centauri is the brightest and most luminous globular in the Milky Way. In fact, there is only one globular cluster in the entire Local Group of galaxies that is brighter, and that one is known as globular 'G1' in the Andromeda Galaxy. I will discuss how to find it in the Fall Sky column.

Omega Centauri is on the meridian just a few degrees above the southern horizon about midnight on 15 April, 10pm on 15 May, and about 9pm on 1 June. I have seen it from Santa Cruz across Monterey Bay and from the top of Fremont Peak outside the 30" telescope operated by FPOA. It should be just as easy to view from all south facing beaches from Monterey south and from places near Chews Ridge with very low southern horizons. It is spectacular from more southern latitudes!

While you are poking around in the sky down there, please note that the peculiar galaxy, **NGC 5128,** which contains the radio source Centaurus A, is located just a few degrees north of Omega Centauri.



M51, the Whirpool Galaxy.
MIRA image.

My favorite galaxy in the sky is **M51**, the famous 'Whirlpool.' This galaxy was the first one where the spiral structure was discovered in spring 1845 by Lord Rosse, and is possibly the easiest one in which average amateurs can see spiral structure. I have noted the spiral structure in a 4" refractor in a very dark sky, and the wide spiral arms are generally seen with an 8" or larger in dark skies. It is spectacular in a large Dobsonian of 18" or more.

Observers with telescopes know that spring is the time to explore the famous **Virgo Cluster** of galaxies. It is a very rich area worth wandering through. There are about 50 galaxies brighter than 12th magnitude that are visible in a 6" telescope. Well known objects here are M104, the Sombrero Galaxy, and the active elliptical galaxy M87.

In May 2001, I was able to spend a couple of nights with a group using the 82" Otto Struve Telescope at McDonald Observatory in the Davis Mountains of west Texas. At 891x with the 32mm wide-field ocular, we were able to see the jet emanating from M87 and we were only able to see the center of M104 with its star-like nucleus just above its wide dark dust lane.

Often called the Intergalactic Wanderer, the globular cluster **NGC 2419** in Lynx is a very unusual object and is well placed in the March evening sky, about 7 degrees north of Castor in Gemini. What makes it so unusual is its distance from the center of the Milky Way, about 300,000 light years, which is twice that of the Large Magellanic Cloud. Almost all of the known Milky Way globular clusters are less than 65,000 light years away. NGC 2419 is an object well suited for advanced observers since it appears as a 10th magnitude blob. It should be visible in a 3" or 4" telescope, and an 11" should begin to resolve its brighter stars, and some of our members with even larger Dobsonians will certainly enjoy the view. It was quite a sight in the old 36" Newtonian at Kitt Peak way back in my college days.

NGC 2419, the Intergalactic Wanderer.
Image by Doug Matthews and Charles Betts/Adam Block/ NOAO/AURA/NSF

Planets

Mercury is well placed for evening observation during early May, with greatest eastern elongation occurring on 14 May.

Venus draws closer to the Sun in the morning sky and is at superior conjunction on 9 June. Of special note is the fact that Venus is actually occulted by the Sun on this date and it marks the midpoint between the Transits of 8 June 2004 and 6 June 2012.

Earth has summer solstice occurring at 4:59pm PDT (23:59UT) on 20 June.

Mars remains visible in the evening sky and moves through the open cluster M44 on 22-24 May, which should provide a great view in binoculars, but the planet is too far away to allow much surface detail to be seen with amateur telescopes.

Jupiter rises earlier each evening and becomes a bit larger during the period, with opposition coming on 9 July.

Saturn remains visible in Leo most of the night as it has passed opposition in late February. It is wise to check it often during the period because the rings are becoming less and less visible as we prepare to pass through the ring plane again in 2009 as we did in 1995-6.

Uranus and **Neptune** are low in the eastern sky before dawn during the period. They will be in their prime positions in late summer. The moon will occult Neptune about 2am on 23 June.

Pluto is at opposition on 20 June but is still only at 14th magnitude in Sagittarius, a very crowded part of the sky indeed!

Meteor Showers

The maximum of the **Eta Aquarid** meteor shower is especially favorable this year since it occurs on the same day as new moon on 5 May. The radiant rises about 2AM and is best observed before dawn, and can produce 30 or more meteors per hour at our latitude. This shower is associated with material ejected from Halley's Comet, as are the Orionids of October.

Comets

There are two comets visible during the period brighter than 9th magnitude, but neither is easy to observe. **Comet 17/P Holmes** starts the period with a total magnitude of 5 spread over more than one degree, so it is very hard to see. A new discovery, **C/2007 W1** (Boattini), is predicted to rise from 11th to 8th magnitude as it moves through Hydra and neighboring constellations roughly between Alpha Hydrae and Corvus in the evening sky

It should be noted that 30 June is the 100th anniversary of the Tunguska impact event in Siberia that devastated millions of trees in a circular pattern outward from a central swampy area. Whether it was caused by a comet or meteoroid is still the subject of debate.

Eclipses

There will be no eclipses visible from Central California this spring period.

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