The Meridian

Newsletter of the Quad Cities Astronomical Society • May 2014

Meeting Notes

John Robbins, Secretary

May 19. Meeting called to order by Dale Hendricks at 6:40pm. The meeting was attended by 14 members, including a new one and one guest. Members included: Cecil Ward, John Baker, Dana Taylor, Dale Hendricks, John Robbins, Brian Haysbrook, Robert Mitchell, Matt Neilssen, Jeff Struve, Bruce Brooker, Craig Cox, Steve VanHyfte, Al Cattoir and new member Gary Sissel.

Welcome to QCAS, Gary - we know you'll learn a lot by hanging out with us!

Guests included Scott Hock, the new director of the Davenport Parks and Recreation Department.

Agenda

Treasurer's Report. The Society account balance is $1660.44, after purchase of Cecil Ward's 10" Dobsonian.

Upcoming QCAS Events:

May 31st, 7:30pm, QCAS Open House at the Jens-Wendt Observatory, Sherman Park.

July 16 & 17, Scott County Library in Eldridge is hosting a summer skies program with the Star Lab. Dana Taylor is coordinator.

Guest Speaker. Scott Hock, new director of the Davenport Parks and Recreation (DP&R) Depratment, introduced himself and is interested in enhancing park activities to include evening astronomy nights. Locations include the Soccer complex, just west of Davenport Municiple Airport, and Sunderbruch Park, on the west side, off of Telegraph Road. Scott said that DP&R hosts lots of different types of events and has the means to promote them. Having QCAS help to host a couple of viewing events per summer would be a nice addition to the DP&R event schedule.

Among members, there seemed to be solid enthusiasm, recognizing that such events would be a good way to inform the interested public of events held at the Jens-Wendt Observatory. A first time event might be semi-private for city coucil members and their families—this way they would be aware of these activities sponsored by DP&R.

A daytime event could be arranged that would feature solar viewing via filtered scopes and projection.

Facilities. John B reports that he and Bruce checked out Cecil's 10" Dobsonian and give it two-thumbs up report. A check to buy Cecil's telescope was written and paid.

Bruce found a 9 volt transformer and hooked it up to the computer on the 16" scope in the new dome so it does not need to run on batteries. He also fastened 2 clips to the East inside wall of the dome to hold the long, white shutter opening rods securely so they do not get tripped over during observing sessions.

Bruce proposed a more permanent pier mounting for the 16" scope in the dome. His idea was to use steel plate, four braces, and

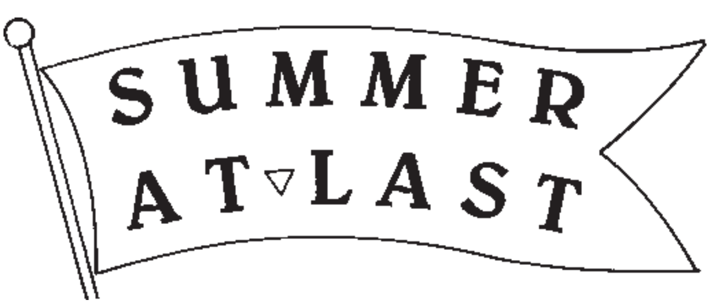
6” pipe (of yet to be determined height) to be mounted to the seismic mass. Details are to be worked out among members serving on the facilities team.

Latest news regarding the proposed multi-use building at Sherman Park is that it is now a 32’x40’ structure located just north of the roll-off roof rails. Details regarding how the cost of utilties are covered are still being discussed with CCCB officials.

Presentations. Bruce Brooker, despite fighting a cold, gave a very interesting review of astronomical spectroscopy. Interest arose due to Dr. Mitchell’s desire to bring spectrocopic capabilities to St. Ambrose University’s Menke Observatory. Earlier in May, Bruce assisted Dr. Mitchell in aligning, preparing and adapting Menke’s 14” Cassagrain for such studies.

In Bruce’s presentation, he helped us remember that color, energy, wavelength and frequency are all inter-related via simple math expressions. As a demonstration of energy states, John Baker “suffered” as Bruce increased the frequency of “slaps” in order to bring the group’s understanding that light of higher frequencies possess higher energy states.

For those wishing to delve more deeply into the topic of spectroscopy, they might find Jim Kaler’s (Univ. of Illinois) Spectra web page useful (click inside blue box to visit).



Confirmed: Stellar Behemoth Self-Destructs in a Type IIb Supernova, Berkeley Lab Researchers Help Catch a Wolf-Rayet Hours After it Goes Supernova

May 21, 2014 - by Linda Vu, Lawrence Berkeley Lab

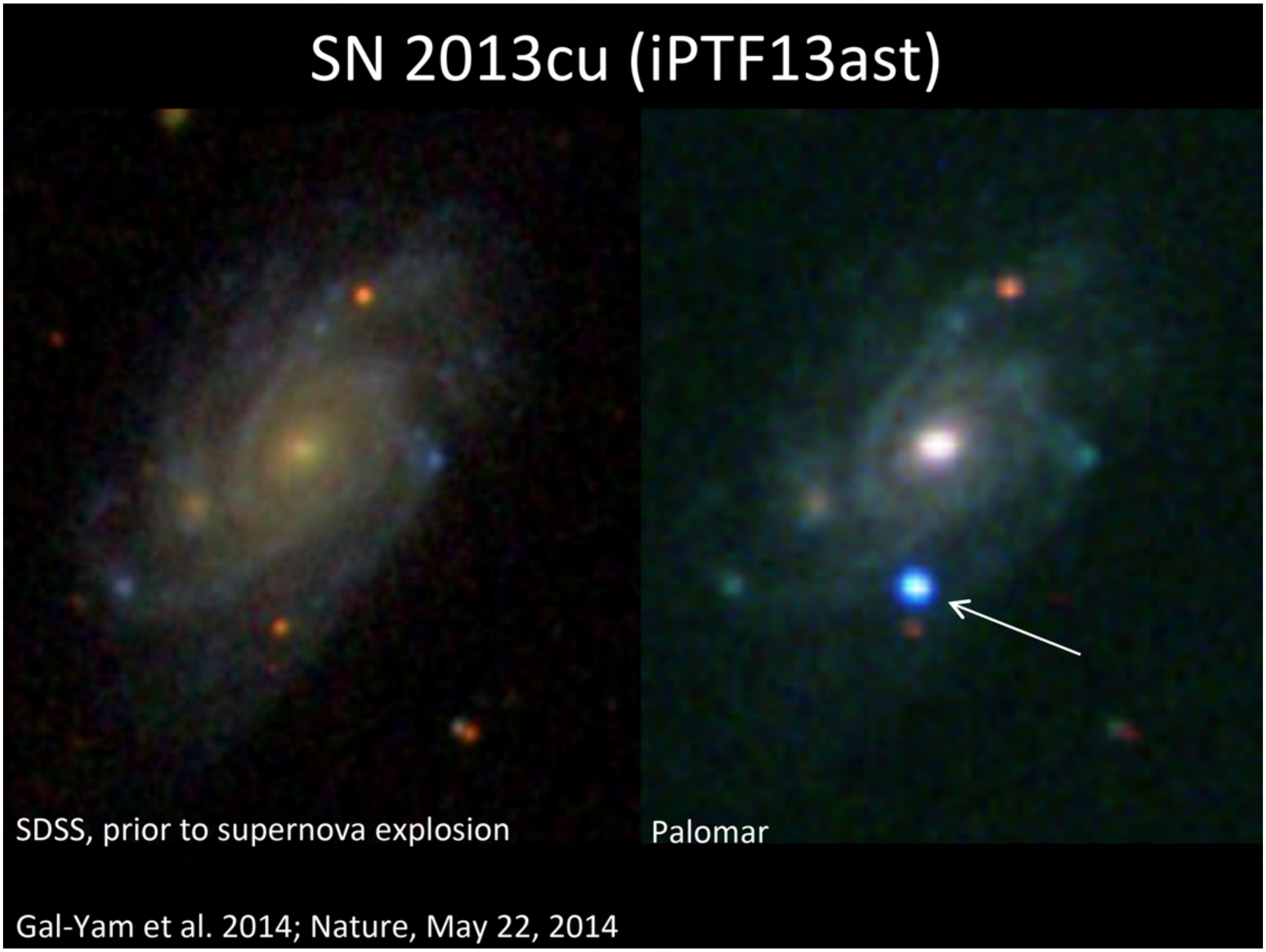
Our Sun may seem pretty impressive: 330,000 times as massive as Earth, it accounts for 99.86 percent of the Solar System’s total mass; it generates about 400 trillion trillion watts of power; and it has a surface temperature of about 10,000 degrees Celsius. Yet for a star, it’s a lightweight.

The real cosmic behemoths are Wolf-Rayet stars, which are more than 20 times as massive as the Sun and at least five times as hot. Because these stars are relatively rare and often obscured, scientists don’t know much about how they form, live and die. But this is changing, thanks to an innovative sky survey called the intermediate Palomar Transient Factory (iPTF), which uses resources at the National Energy Research Scientific Computing Center (NERSC) and Energy Sciences Network (ESnet), both located at the U.S. Department of Energy’s Lawrence Berkeley National Laboratory (Berkeley Lab), to expose fleeting cosmic events such as supernovae.

For the first time ever, scientists have direct confirmation that a Wolf-Rayet star—sitting 360 million light years away in the Bootes constellation—died in a violent explosion known as a Type IIb supernova. Using the iPTF pipeline, researchers at Israel’s Weizmann Institute of Science led by Avishay Gal-Yam caught supernova SN 2013cu within hours of its explosion. They then triggered ground- and space-based telescopes to observe the event approximately 5.7 hours and 15 hours after it self-destructed. These observations are providing valuable insights into the life and death of the progenitor Wolf-Rayet.

“Newly developed observational capabilities now enable us to study exploding stars in ways we could only dream of before. We are moving towards real-time studies of supernovae,” says Gal-Yam, an astrophysicist in the Weizmann Institute’s Department of Particle Physics and Astrophysics. He is also the lead author of a recently published Nature paper on this finding.

“This is the smoking gun. For the first time, we can directly point to an observation and say that this type of Wolf-Rayet star leads to this kind of Type IIb super-



A star in a distant galaxy explodes as a supernova: while observing a galaxy known as UGC 9379 (left; image from the Sloan Digital Sky Survey; SDSS) located about 360 million light years away from Earth, the team discovered a new source of bright blue light (right, marked with an arrow; image from the 60-inch robotic telescope at Palomar Observatory). This very hot, young supernova marked the explosive death of a massive star in that distant galaxy.

nova," says Peter Nugent, who heads Berkeley Lab's Computational Cosmology Center (C3) and leads the Berkeley contingent of the iPTF collaboration.

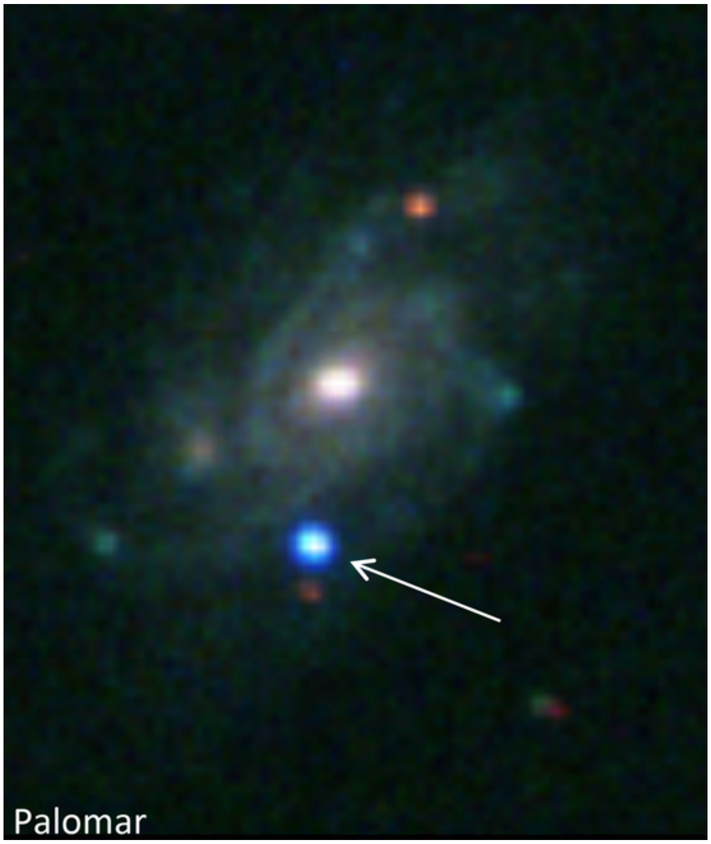
"When I identified the first example of a Type IIb supernova in 1987, I dreamed that someday we would have direct evidence of what kind of star exploded. It's refreshing that we can now say that Wolf-Rayet stars are responsible, at least in some cases," says Alex Filippenko, Professor of Astronomy at UC Berkeley. Both Filippenko and Nugent are also co-authors on the Nature paper.

Elusive Signatures Illuminated in a Flash of Light

Some supermassive stars become Wolf-Rayets in the final stages of their lives. Scientists find these stars interesting because they enrich galaxies with the heavy chemical elements that eventually become the building blocks for planets and life.

"We are gradually determining which kinds of stars explode, and why, and what kinds of elements they produce," says Filippenko. "These elements are crucial to the existence of life. In a very real sense, we are figuring out our own stellar origins."

All stars—no matter what size—spend their lives fusing hydrogen atoms to create helium. The more massive a star, the more gravity it wields, which accelerates fusion in the star's core, generating energy to counteract gravitational collapse. When hydrogen is depleted, a supermassive star continues to fuse even heavier elements like carbon, oxygen, neon, sodium, magnesium and so on, until its core turns to iron. At this point, atoms (even subatomic particles) are packed in so closely that fusion no longer releases energy into the star. It is now solely supported by electron degeneracy pressure—the quantum mechan-



A detailed study of the spectrum (the distribution of colors composing the light from the supernova) using a technique called "flash spectroscopy" revealed the signature of a wind blown by the aging star just prior to its terminal explosion, and allowed scientists to determine what elements were abundant on the surface of the dying star as it was about to explode as a supernova, providing important information about how massive stars evolve just prior to their death, and the origin of crucial elements such as carbon, nitrogen and oxygen.

ical law that prohibits two electrons from occupying the same quantum state.

When the core is massive enough, even electron degeneracy won't support the star and it collapses. Protons and electrons in the core merge, releasing a tremendous amount of energy and neutrinos. This, in turn, powers a shockwave that tears through the star ejecting its remains violently into space as it goes supernova.

The Wolf-Rayet phase occurs before the supernova. As nuclear fusion slows, the heavy elements forged in the star's core rise to the surface setting off powerful winds. These winds shed a tremendous amount of material into space and obscure the star from prying telescopes on Earth.

"When a Wolf-Rayet star goes supernova, the explosion typically overtakes the stellar wind and all information about the progenitor star is gone," says Nu-

The Palomar 48 inch telescope.(Photo by: Iair Arcavi, Weizmann Institute of Science)

gent. "We got lucky with SN 2013cu—we caught the supernova before it overtook the wind. Shortly after the star exploded, it let out an ultraviolet flash from the shock wave that heated and lit up the wind. The conditions that we observed in this moment were very similar to what was there before the supernova."

Before the supernova debris overtook the wind, the iPTF team managed to capture its chemical light signatures (or spectra) with the ground-based Keck telescope in Hawaii and saw the telltale signs of a Wolf-Rayet star. When the iPTF team performed follow-up observations 15 hours later with NASA's Swift satellite, the supernova was still quite hot and strongly emitting in the ultraviolet. In the following days, iPTF collaborators rallied telescopes around the globe to watch the supernova crash into material that had been previously ejected from the star. As the days went by, the researchers were able to classify SN 2013cu as a Type IIb supernova because of the weak hydrogen signatures and strong helium features in the spectra that appeared after the supernova cooled.

"With a series of observations, including data I took with the Keck-I telescope 6.5 days after the explosion, we could see that the supernova's expanding debris quickly overtook the flash-ionized wind that had revealed the Wolf-Rayet features. So, catching the supernova sufficiently early is hard—you've got to be on the ball, as our team was," says Filippenko.

"This discovery was totally shocking, it opens up a whole new research area for us," says Nugent. "With our largest telescopes you might have a chance of getting a spectrum of a Wolf-Rayet star in the nearest galaxies to our Milky Way, perhaps 4 million light years away. SN 2013cu is 360 million light years away—further by almost factor of 100."

And because the researchers caught the supernova early—when the ultraviolet flash lit up the progenitor's stellar wind—they were able to take several spectra. "Ideally, we'd like to do this again and again and develop some interesting statistics, not just for supernovae with Wolf-Rayet progenitors but other types as well," says Nugent.

Pipeline Upgrade Leads to Unexpected Discoveries

Since February 2014, the iPTF survey has been scanning the sky nightly with a robotic telescope mounted on the 48-inch Samuel Oschin Telescope at Palomar Observatory in Southern California. As soon as observations are taken, the data travel more than 400 miles to NERSC in Oakland via the National Science Foundation's High Performance Wireless Research and Education Network and the Department of Energy's ESnet. At NERSC, the Real-Time Transient Detection Pipeline sifts through the data, identifies events to follow up on and sends an alert to iPTF scientists around the globe.

The survey was built on the legacy of the Palomar Transient Factory (PTF), designed in 2008 to systematically chart the transient sky by using the same camera at Palomar Observatory. Last year Nugent and colleagues at Caltech and UC Berkeley made significant modifications to the transient detection pipeline for the iPTF project. Working with NERSC staff, Nugent upgraded the pipeline's computing and storage hardware. The iPTF team also made improvements to the machine learning algorithms at the heart of the detection pipeline and incorporated the Sloan Digital Star Survey III star and galaxy catalogs so the pipeline could immediately reject known variable stars.

They even added an asteroid rejection feature to the automated workflow, which calculates the orbit of every known asteroid at the beginning of the night, determines where the asteroids are in an individual image, and then rejects them.

"All of our modifications significantly sped up our real-time transient detection; we now send high quality supernova alerts to astronomers all around the globe in less than 40 minutes after taking an image at Palomar," says Nugent. "In the case of SN 2013cu, that made all the difference."

The automated real-time detection pipeline was created under the DOE Office of Science's Scientific Discovery through Advanced Computing (SciDAC) program and through additional support from NASA. NERSC provided the storage and systems infrastructure. NERSC and ESnet are also supported by the DOE Office of Science.

Led by Shri Kulkarni of Caltech, iPTF has discovered more than 2000 supernovae during its four and a half years of observations, including many rare and exotic types of cosmic outbursts. The iPTF survey is a scientific collaboration among Caltech, Los Alamos National Laboratory, the University of Wisconsin, Milwaukee, the Oskar Klein Center, the Weizmann Institute of Science, the TANGO Program of the University System of Taiwan, and the Kavli Institute for the Physics and Mathematics of the Universe.

This research was supported by the I-CORE Program "The Quantum Universe" of the Planning and Budgeting Committee and The Israel Science Foundation; grants from the ISF, BSF, GIF, Minerva, the FP7/ERC, and a Kimmel Investigator award; support from the Hubble and Carnegie-Princeton Fellowships; support from the Arye Dissentshik career development chair and a grant from the Israeli MOST; support from the NSF; support from an NSF Postdoctoral Fellowship; support from the TABASGO Foundation, the Christopher R. Redlich Fund, and NSF grant AST-1211916. Some of the data were obtained at the W. M. Keck Observatory, which was made possible by the generous financial support of the W. M. Keck Foundation.

QCAS Meetings: First Monday (workshop) at 6:30pm, and third Monday, (business), at 6:30pm, Bettendorf Library, 2950 Learning Campus Dr., off of 18th Street, Bettendorf.

QCAS Correspondence:

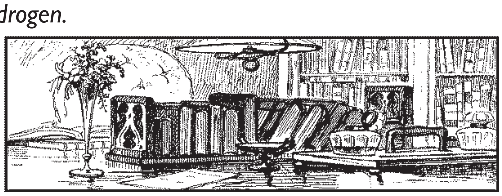
Please send to the society at:
P.O. Box 3706, Davenport, IA, 52808.
Members are welcome and encouraged to submit articles for The Meridian.
Submit Any and all interesting items (via e-mail) to: John Robbins or Dale Hendricks.

This colourful new image from the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory in Chile shows the star cluster NGC 3590. These stars shine brightly in front of a dramatic landscape of dark patches of dust and richly hued clouds of glowing gas. This small stellar gathering gives astronomers clues about how these stars form and evolve — as well as giving hints about the structure of our galaxy's pinwheeling arms.

NGC 3590 is a small open cluster of stars around 7500 light-years from Earth, in the constellation of Carina (The Keel). It is a gathering of dozens of stars loosely bound together by gravity and is roughly 35 million years old.

This cluster is not just pretty; it is very useful to astronomers. By studying this particular cluster — and others nearby — astronomers can explore the properties of the spiral disc of our galaxy, the Milky Way. NGC 3590 is located in the largest single segment of a spiral arm that can be seen from our position in the galaxy: the Carina spiral feature.

To obtain this image, multiple observations were made using different filters to capture the different colours of the scene. This image was created by combining images taken in the visible and infrared parts of the spectrum, and a special filter that collected only light coming from glowing hydrogen.



QCAS Officers and Contacts:

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Treasurer: John Baker
Director: Dana Taylor
Facilities: John Baker
Web Master: Dana Taylor
Outreach: Matt Nielssen
Programming: Jim Rutenbeck

Celestial Calendar

May 25 02 Mercury at Greatest Elong: 22.7°E
25 10:43 Venus 2.3°S of Moon
25 12:56 Moon at Descending Node
28 13:40 NEW MOON
Jun 01 03:07 Jupiter 5.5°N of Moon
02 23:25 Moon at Apogee: 404956 km
04 12:35 Regulus 5.0°N of Moon
05 15:39 FIRST QUARTER MOON
07 19:44 Mars 1.6°N of Moon
08 17:05 Spica 1.8°S of Moon
09 00:36 Moon at Ascending Node
10 14:11 Saturn 0.6°N of Moon: Occn.
12 23:11 FULL MOON
14 22:34 Moon at Perigee: 362062 km
15 06:57 Jupiter 6.3°S of Pollux
19 13:39 LAST QUARTER MOON
19 18 Mercury at Inferior Conjunction
21 05:52 Summer Solstice
21 15:30 Moon at Descending Node
23 08:00 Venus 5.6°S of Pleiades
24 07:54 Venus 1.3°N of Moon
25 01:22 Aldebaran 2.0°S of Moon
27 03:09 NEW MOON
30 14:09 Moon at Apogee: 405932 km

All times are CDT.
List from www.astropixels.com