La Superba
By Bill Pellerin, Houston Astronomical Society

There are a variety of amateur observers – those who go to the darkest of sites with the largest of telescopes to see the dimmest of objects, and there are those who (like me), believe that the universe reveals itself in every object we see, including the bright ones. The poet William Blake talked about seeing the world in a grain of sand. If Blake can see the world in a grain of sand surely we can see the universe in a single star.

I write a monthly article for our club’s newsletter in which I provide the information needed to find a star or other bright object in the sky. Then I attempt to tell the reader why that object is interesting. The newsletters are available at www.astronomyhouston.org.

So, let’s look at a bright star that’s easy to see with any telescope and which comes with a good story.

La Superba (Y CVn) is at RA: 12h, 45m, 08s / DEC: 45 deg, 26 m, 25 s in the constellation Canes Venatici. It is especially well placed for viewing in the spring and it’s easy to see. As this is written, in April, 2013, Y CVn is shining at about magnitude 5.0 (you can see a plot of magnitude versus time at www.aavso.org). The designation Y CVn tells you that it’s a variable star; its brightness range is from 4.8 to 6.3 with a period of about 160 days. It’s also a carbon star (see the Astronomical League Carbon Star observing program on this web site). Other parameters:

Distance: 710 light years
We had a fun meeting in April, with a discussion of the Drake Equation and the Fermi Paradox in light of the new age of exoplanet discoveries. In response to the requests of a number of attendees at the last meeting, a PDF copy of the article that served as the primary focus of the presentation has been made available for download at the AAL website (http://groups.ku.edu/~astronomy). For those who can’t get enough astronomy lectures, the following note from the Astronomical Society of the Pacific might be of interest:

We are happy to announce that the Silicon Valley Astronomy Lectures, featuring noted scientists giving nontechnical illustrated lectures on recent developments in astronomy, are now available on their own YouTube Channel, at: http://www.youtube.com/SVAstronomyLectures/

The talks include:
* Frank Drake discussing his modern view of the Drake Equation,
* Michael Brown explaining how his discovery of Eris led to the demotion of Pluto,
* Alex Filippenko talking about the latest ideas and observations of black holes,
* Natalie Batalha sharing the latest planet discoveries from the Kepler mission,
* Anthony Aguirre discussing how it is possible to have multiple universes, and
* Chris McKay updating the Cassini discoveries about Saturn's moon Titan.

The lectures are taped at Foothill College near San Francisco, and co-sponsored by NASA's Ames Research Center, the SETI Institute, and the Astronomical Society of the Pacific.

Many thanks to those who set up observing on our last Spring observing session at Prairie Park. It was nice to finally have the weather cooperate given the bizarre weather of the last few weeks. Our summer schedule for the band concerts will be in the next issue.

Any suggestions for improving the club or the newsletter are always welcome.

Variable type: SRb (Semi-regular)
Temperature: One of the coolest stars you can see at 2200 Kelvin
Mass: 3 solar masses
Size: Radius of about 2 AU or about 430 times the radius of the Sun
Composition: Significant concentration of Carbon-13

So, what's a carbon star and why is it red? The answer to this question is what makes this star interesting. Mid-life stars are said to be on the main sequence, and main sequence stars fuse hydrogen (the most abundant element in the universe) to helium. The Sun is doing this now. When the hydrogen supply runs low, and the star gets hotter it begins fusing helium to carbon at the core of the star. So there’s carbon at the core (the byproduct of helium fusion), with shells of helium and hydrogen surrounding the core. The energy of the star is generated at the core and that energy moves to the outside of the star mostly by convection, a process very similar to what happens in a boiling pot of water. You may have seen images of the Sun that show a granular pattern, most visible in the chromosphere; these granules are the result of convection in the Sun.
A Confetti-Like Collection of Stars

The Small Magellanic Cloud (SMC) is one of the Milky Way's closest galactic neighbors. Even though it is a small, or so-called dwarf galaxy, the SMC is so bright that it is visible to the unaided eye from the Southern Hemisphere and near the equator. Many navigators, including Ferdinand Magellan who lends his name to the SMC, used it to help find their way across the oceans.

Modern astronomers are also interested in studying the SMC (and its cousin, the Large Magellanic Cloud), but for very different reasons. Because the SMC is so close and bright, it offers an opportunity to study phenomena that are difficult to examine in more distant galaxies.

New Chandra data of the SMC have provided one such discovery: the first detection of X-ray emission from young stars with masses similar to our Sun outside our Milky Way galaxy. The new Chandra observations of these low-mass stars were made of the region known as the "Wing" of the SMC. In this composite image of the Wing the Chandra data is shown in purple, optical data from the Hubble Space Telescope is shown in red, green and blue and infrared data from the Spitzer Space Telescope is shown in red.

Astronomers call all elements heavier than hydrogen and helium - that is, with more than two protons in the atom's nucleus - "metals." The Wing is a region known to have fewer metals compared to most areas within the Milky Way. There are also relatively lower amounts of gas, dust, and stars in the Wing compared to the Milky Way.

Taken together, these properties make the Wing an excellent location to study the life cycle of stars and the gas lying in between them. Not only are these conditions typical for dwarf irregular galaxies like the SMC, they also mimic ones that would have existed in the early Universe.

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In some ways, we know more about Mars, Venus and the Moon than we know about Earth. That’s because 70% of our solar system’s watery blue planet is hidden under its ocean. The ocean contains about 98% of all the water on Earth. In total volume, it makes up more than 99% of the space inhabited by living creatures on the planet.

As dominant a feature as it is, the ocean—at least below a few tens of meters deep—is an alien world most of us seldom contemplate. But perhaps we should.

The ocean stores heat like a “fly wheel” for climate. Its huge capacity as a heat and water reservoir moderates the climate of Earth. Within this Earth system, both the physical and biological processes of the ocean play a key role in the water cycle, the carbon cycle, and climate variability.

This great reservoir continuously exchanges heat, moisture, and carbon with the atmosphere, driving our weather patterns and influencing the slow, subtle changes in our climate.

The study of Earth and its ocean is a big part of NASA’s mission. Before satellites, the information we had about the ocean was pretty much “hit or miss,” with the only data collectors being ships, buoys, and instruments set adrift on the waves.

Now ocean-observing satellites measure surface topography, currents, waves, and winds. They monitor the health of phytoplankton, which live in the surface layer of the ocean and supply half the oxygen in the atmosphere. Satellites monitor the extent of Arctic sea ice so we can compare this important parameter with that of past years. Satellites also measure rainfall, the amount of sunlight reaching the sea, the temperature of the ocean’s surface, and even its salinity!

Using remote sensing data and computer models, scientists can now investigate how the oceans affect the evolution of weather, hurricanes, and climate. In just a few months, one satellite can collect more information about the ocean than all the ships and buoys in the world have collected over the past 100 years!

NASA’s Earth Science Division has launched many missions to planet Earth. These satellites and other studies all help us understand how the atmosphere, the ocean, the land and life—including humans—all interact together.

Find out more about NASA’s ocean studies at http://science.nasa.gov/earth-science/oceanography. Kids will have fun exploring our planet at The Space Place, http://spaceplace.nasa.gov/earth.

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The movie “Hayabusa” (2011) recounts the dramatic story of the Hayabusa mission to the asteroid Itokawa. The Japan Aerospace Exploration Agency (JAXA) team fought through a series of technical setbacks before finally returning a sample of the asteroid to Earth in 2010. (2 hours and 20 minutes)
See the trailer with English subtitles at: http://vimeo.com/33305380
Retired Star Found With Planets and Debris Disk

ESA's Herschel space observatory has provided the first images of a dust belt - produced by colliding comets or asteroids - orbiting a subgiant star known to host a planetary system.

After billions of years steadily burning hydrogen in their cores, stars like our Sun exhaust this central fuel reserve and start burning it in shells around the core. They swell to become subgiant stars, before later becoming red giants.

At least during the subgiant phase, planets, asteroids and comet belts around these 'retired' stars are expected to survive, but observations are needed to measure their properties. One approach is to search for discs of dust around the stars, generated by collisions between populations of asteroids or comets.

Thanks to the sensitive far-infrared detection capabilities of the Herschel space observatory, astronomers have been able to resolve bright emission around Kappa Coronae Borealis (κ CrB, or Kappa Cor Bor), indicating the presence of a dusty debris disc.

The star is a little heavier than our own Sun at 1.5 solar masses, is around 2.5 billion years old and lies at a distance of roughly 100 light years. From ground-based observations, it is known to host one giant planet roughly twice the mass of Jupiter orbiting at a distance equivalent to the Asteroid Belt in our own Solar System. A second planet is suspected, but its mass is not well constrained.

Herschel's detection provides rare insight into the life of planetary systems orbiting subgiant stars, and enables a detailed study of the architecture of its planet and disc system.

"This is the first 'retired' star that we have found with a debris disc and one or more planets," says Amy Bonsor of the Institute de Planétologie et d'Astrophysique de Grenoble, and lead author of the study. "The disc has survived the star's entire lifetime without being destroyed. That's very different to our own Solar System, where most of the debris was cleared away in a phase called the Late Heavy Bombardment era, around 600 million years after the Sun formed."

Dr Bonsor's team used models to propose three possible configurations for the disc and planets that fit Herschel's observations of Kappa Cor Bor. The first model has just one continuous dust belt extending from 20 AU to 220 AU (where 1 AU, or Astronomical Unit, is the distance between Earth and Sun). By comparison, the icy debris disc in our Solar System – known as the Kuiper Belt – spans a narrower range of distances, 30-50 AU from the Sun.

In this model, one of the planets orbits at a distance of greater than 7 AU from the star, and its gravitational influence may sculpt the inner edge of the disc. A variation on this model has the disc being stirred by the gravitational influence of both companions, mixing it up such that the rate of dust production in the disc peaks at around 70-80 AU from the star.

In another interesting scenario, the dust disc is divided into two narrow belts, centred on 40 AU and 165 AU, respectively. Here, the outermost companion may orbit between the two belts between a distance of about 7 AU and 70 AU, opening the possibility of it being rather more massive than a planet, possibly a substellar brown dwarf.

"It is a mysterious and intriguing system: is there a planet or even two planets sculpting one wide disc, or does the star have a brown dwarf companion that has split the disc in two?" says Dr Bonsor. As this is the first known example of a subgiant star with planets and a debris disc orbiting it, more examples are needed to determine whether Kappa Cor Bor is unusual or not.

"Thanks to Herschel's sensitive far-infrared capabilities and its rich dataset, we already have hints of other subgiant stars that may also have dusty discs. More work will be needed to see if they also have planets," says Göran Pilbratt, ESA's Herschel project scientist.
SN 1006: X-Ray View of A Thousand-Year-Old Cosmic Tapestry

This year, astronomers around the world have been celebrating the 50th anniversary of X-ray astronomy. Few objects better illustrate the progress of the field in the past half-century than the supernova remnant known as SN 1006.

When the object we now call SN 1006 first appeared on May 1, 1006 A.D., it was far brighter than Venus and visible during the daytime for weeks. Astronomers in China, Japan, Europe, and the Arab world all documented this spectacular sight. With the advent of the Space Age in the 1960s, scientists were able to launch instruments and detectors above Earth's atmosphere to observe the Universe in wavelengths that are blocked from the ground, including X-rays. SN 1006 was one of the faintest X-ray sources detected by the first generation of X-ray satellites.

A new image of SN 1006 from NASA's Chandra X-ray Observatory reveals this supernova remnant in exquisite detail. By overlapping ten different pointings of Chandra's field-of-view, astronomers have stitched together a cosmic tapestry of the debris field that was created when a white dwarf star exploded, sending its material hurtling into space. In this new Chandra image, low, medium, and higher-energy X-rays are colored red, green, and blue respectively.

The Chandra image provides new insight into the nature of SN1006, which is the remnant of a so-called Type Ia supernova. This class of supernova is caused when a white dwarf pulls too much mass from a compan- ion star and explodes, or when two white dwarfs merge and explode. Understanding Type Ia supernovas is especially important because astronomers use observations of these explosions in distant galaxies as mileposts to mark the expansion of the Universe.

The new SN 1006 image represents the most spatially detailed map yet of the material ejected during a Type Ia supernova. By examining the different elements in the debris field -- such as silicon, oxygen, and magnesium -- the researchers may be able to piece together how the star looked before it exploded and the order that the layers of the star were ejected, and constrain theoretical models for the explosion.

Scientists are also able to study just how fast specific knots of material are moving away from the original explosion. The fastest knots are moving outward at almost eleven million miles per hour, while those in other areas are moving at a more leisurely seven million miles per hour. SN 1006 is located about 7,000 light years from Earth. The new Chandra image of SN 1006 contains over 8 days worth of observing time by the telescope. These results were presented at a meeting of High Energy Astrophysics Division of the American Astronomical Society in Monterey, CA.
Hubble Captures Comet ISON

Comet ISON is potentially the "comet of the century" because around the time the comet makes its closest approach to the Sun, on November 28, it may briefly become brighter than the full Moon. Right now the comet is far below naked-eye visibility, and so Hubble was used to snap the view of the approaching comet, which is presently hurtling toward the Sun at approximately 47,000 miles per hour. When the Hubble picture was taken on April 10, the comet was slightly closer than Jupiter's orbit at a distance of 386 million miles from the Sun. Even at that great distance the Sun is warming the comet enough to trigger outgassing from its frozen gases locked up in the solid nucleus. Hubble photographed a jet blasting dust particles off the sunward-facing side of the comet's nucleus. Preliminary measurements from the Hubble images suggest that the nucleus of ISON is no larger than three or four miles across. The comet was discovered in September 2012 by the Russian-led International Scientific Optical Network (ISON) using a 16-inch telescope.

In the case of a carbon star, the core carbon is ‘dredged up’ from the center of the star and carried to the outside of the star. For this reason, when we look at the star we’re seeing some of this carbon. The carbon-based compounds in the outer layers of the star absorb much of the radiation at shorter, bluer wavelengths enhancing the visual redness of the star. The star radiates much of its energy in the infrared (heat) that is invisible to our eyes.

This carbon at the ‘surface’ of the star acts as a blanket around the star causing it to get hotter. As it does, some of the carbon is burned off, the star gets brighter, and a new exterior carbon layer starts to form. This accounts for the variability in brightness that we see.

Carbon Stars are literally off the chart in color. The traditional color designations (OBAFGKM) for stars do not apply to carbon stars, so a special color category for carbon stars was created -- ‘C’. This star falls into that category. This is a low mass star and its final fate will be to become a white dwarf, cool off to a black dwarf, and disappear from view forever. On its way it may produce a planetary nebula, visible for only about 60,000 years.

The name 'La Superba' was attached to this star by Father Angelo Secchi, an Italian astronomer at the Pontifical Gregorian University in the mid 1800's.

Take a look at this star and check out the Carbon Star Observing Program on the Astronomical League web site. My Observing Stellar Evolution program goes into more detail about how stars are formed and evolve, and ultimately die.

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Hubble Sees a Horsehead of a Different Color

Unlike other celestial objects there is no question how the Horsehead Nebula got its name. This iconic silhouette of a horse's head and neck pokes up mysteriously from what look like whitecaps of interstellar foam. The nebula has graced astronomy books ever since its discovery over a century ago. But Hubble's infrared vision shows the horse in a new light. The nebula, shadowy in optical light, appears transparent and ethereal when seen at infrared wavelengths. This pillar of tenuous hydrogen gas laced with dust is resisting being eroded away by the radiation from a nearby star. The nebula is a small part of a vast star-forming complex in the constellation Orion. The Horsehead will disintegrate in about 5 million years.
Most star formation near the tip of the Wing is occurring in a small region known as NGC 602, which contains a collection of at least three star clusters. One of them, NGC 602a, is similar in age, mass, and size to the famous Orion Nebula Cluster. Researchers have studied NGC 602a to see if young stars - that is, those only a few million years old - have different properties when they have low levels of metals, like the ones found in NGC 602a.

Using Chandra, astronomers discovered extended X-ray emission, from the two most densely populated regions in NGC 602a. The extended X-ray cloud likely comes from the population of young, low-mass stars in the cluster, which have previously been picked out by infrared and optical surveys, using Spitzer and Hubble respectively. This emission is not likely to be hot gas blown away by massive stars, because the low metal content of stars in NGC 602a implies that these stars should have weak winds. The failure to detect X-ray emission from the most massive star in NGC 602a supports this conclusion, because X-ray emission is an indicator of the strength of winds from massive stars. No individual low-mass stars are detected, but the overlapping emission from several thousand stars is bright enough to be observed.

The Chandra results imply that the young, metal-poor stars in NGC 602a produce X-rays in a manner similar to stars with much higher metal content found in the Orion cluster in our galaxy. The authors speculate that if the X-ray properties of young stars are similar in different environments, then other related properties -- including the formation and evolution of disks where planets form -- are also likely to be similar.

X-ray emission traces the magnetic activity of young stars and is related to how efficiently their magnetic dynamo operates. Magnetic dynamos generate magnetic fields in stars through a process involving the star's speed of rotation, and convection, the rising and falling of hot gas in the star's interior.

The combined X-ray, optical and infrared data also revealed, for the first time outside our Galaxy, objects representative of an even younger stage of evolution of a star. These so-called young stellar objects have ages of a few thousand years and are still embedded in the pillar of dust and gas from which stars form, as in the famous "Pillars of Creation" of the Eagle Nebula.