nightwatch
Newsletter of the Pomona Valley Amateur Astronomers

I've loved the stars too fondly to be fearful of the night.
Galileo Galilei

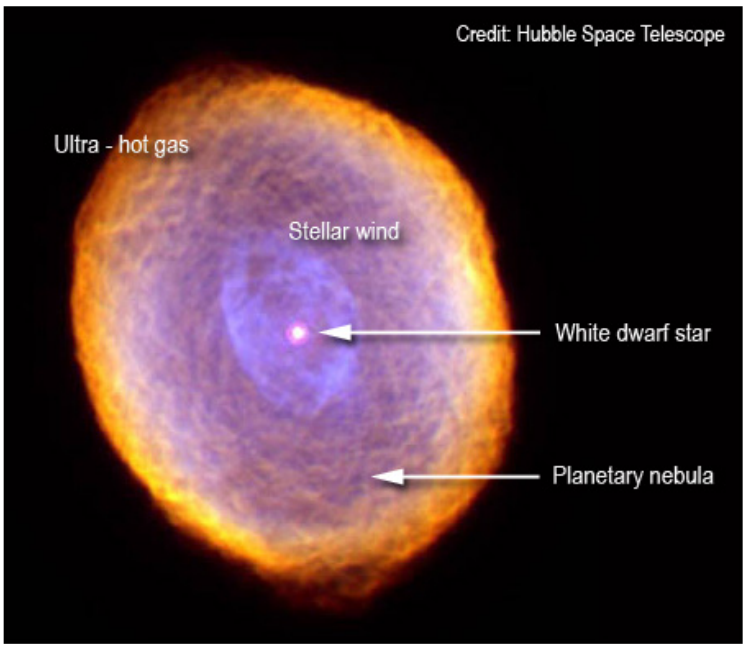
We are reserved in Shanahan B460 through July 2015

Volume 35 Number 3 ***nightwatch*** **March 2015**

What's Up? - Weird White Dwarfs

The weirdest dwarf stars are the white ones. White dwarfs are considered to be the last evolutionary state of stars. They're collapsed stellar remnants made up of mostly electron-degenerate matter. So they can be called degenerate dwarfs. They're extremely dense because they've collapsed to planet size while still having the mass of a large star. So a cubic centimeter of white dwarf matter could weigh a ton. They're very hot, but because they're so small their brightness is limited by their size.

The first white dwarf to be discovered was the companion of the "dog star" Sirius in Canis Major. In 1844, Fredrich Bessel discovered irregularities in the motion of Sirius indicating a companion with equal gravity. But it wasn't visibly identified companion. More examples of these smallest of all stars were soon discovered. They were named white dwarfs.



It was soon realized that white dwarfs were internally weird in comparison to other stars. In a star like the Sun the thermal pressure of gas and radiation keep it from collapsing under its own weight. But white dwarfs no longer have fusion reactions and so they have no typical source of energy. Its electrons have all been ripped off their parent atoms leaving a matter of free electrons and nuclei. So it's the hot active motion of dense electrons that keeps white dwarfs from collapsing rather than normal thermal pressure. Some white dwarfs exist in close binary systems where their gravity pulls gas off the companion star. This leads to an instability that can explode as a Type Ia Supernova.

The origin of white dwarfs is equally dramatic. A typical main-sequence star will gradually expand into a red giant. If this star has insufficient mass to generate the core temperatures needed to fuse carbon an inert mass will build up in its center. This will cause it to drive off its outer layers with strong stellar winds to form a planetary nebula. Its exposed luminous core will emit ultraviolet radiation that ionizes the ejected outer clouds into a colorful shell. The remaining central star becomes a concentrated hot blue star that soon turns into a white dwarf. It can often be seen shining in the center as in the Spirograph Nebula (pictured).

Planetary nebulae and their white dwarfs aren't big enough to be visible to the unaided eye. Most are about a light year in diameter. Their odd planetary nebula name has nothing to do with planets. Charles Messier discovered the first one in 1764 and listed it as M27. It was the Dumbbell Nebula in Vulpecula. In 1785, William Herschel, after famously discovering Uranus, was looking for more planets. He discovered several round nebulae which looked like

(Continued on page 2)

Club Events Calendar

Our speaker in March will be longtime PVAA member Jeff Schroeder. He will speak on observing with the Mount Wilson 100-inch telescope.

March 6, 2015, General meeting
March 21, 2015, Star Party, Cottonwood Spr, Joshua Tree
March 26, 2015, Board meeting, 6:15

April 3, 2015, General meeting
April 18, 2015, Star Party
April 23, 2015, Board meeting, 6:15

May 1, 2015, General meeting
May 21-25, 2015, RTMC (anticipated date)
No scheduled Star Party.
May 28, 2015, Board meeting, 6:15

June 5, 2015, General meeting
June 13, 2015, Star Party

July 18, 2015, Star Party
July 23, 2015, Board meeting, 6:15
July 31, 2015, General meeting

August 15, 2015, Star Party
August 20, 2015, Board meeting, 6:15
August 28, 2015, General meeting

September 12, 2015, Star Party or Annual Mt. Wilson
September 17, 2015, Board meeting, 6:15
September 25, 2015, General meeting

October 10, 2015, Star Party
October 22, 2015, Board meeting 6:15
October 30, 2015, General meeting

November 12, 2015, Board meeting, 6:15
November 14, 2015, Star Party
November 20, 2015, General meeting

December 3, 2015, Board meeting, 6:15
December 11, 2015, Holiday Party, Sizzlin' Skillets 7:00pm

(Weird White Dwarfs continued)

planets so he coined the name "planetary nebula". He felt the material surrounding the hot central star was forming into a planetary solar system. Of course just the opposite was true, any existing planets had already been destroyed. Planetary nebulae recycle material into the interstellar medium as they expand and dissipate leaving their white dwarf behind.

In spite of their circular name, less than 15% have round planet-like shapes. There's the Saturn Nebula or the Ghost Of Jupiter, but others have bipolar shapes with names like Butterfly and Dumbbell. Whether it's the angle of viewing or not is unknown. Recently the Hubble Space Telescope has magnified planetary nebulae to reveal increasingly complex shapes. It's speculated that interactions between expanding gases form odd interlocking shapes as in the Cat's Eye Nebula. The Owl Nebula with its two "eyes" suggests the original existence of two stars. The elaborate Eskimo Nebula gives the impression that a series of explosions occurred with the central star ejecting successive shells. It's all illuminated by the ultraviolet radiation emitted from the central white dwarf star. It produces a wide variety of shell colors. The easily observed Ring Nebula (M57) in Lyra shows blue, green and red images that are successfully larger because each is dominated by a particular spectral emission.

The expansion rate of planetary nebula can be determined by the Doppler shift of optical spectral lines. An increase in size has also been observed in photographic images taken over the years.

There are still endless mysteries to be unlocked about white dwarfs, planetary nebulae and the complex relationship between the two. But both are definitely very weird.

Lee Collins

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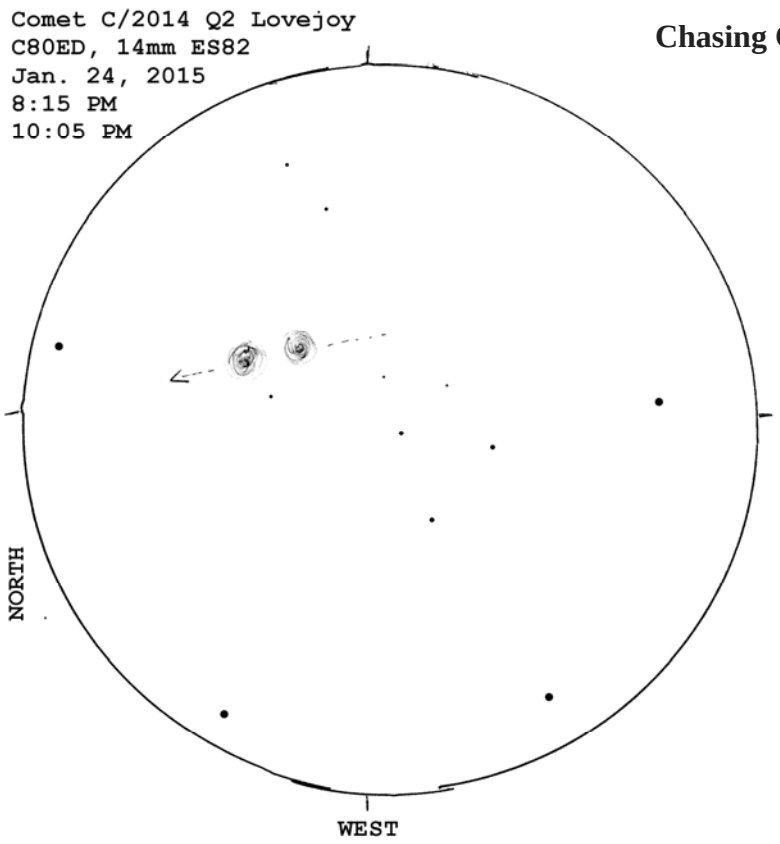

Chasing Comet Lovejoy

I didn't get out to observe very many times in January, but when I did I had a great time chasing Comet Lovejoy. A fun trick has been to go out and sketch the comet and the surrounding star field, then go inside for a while, then come back out and sketch the comet again. It's easy to see the comet move against the background stars in as little as a half an hour.

Matt Wedel

New Activity on the SciJinks Web Site: Lightning Detection

Why would we want a tool to detect lightning? It's pretty hard to miss, isn't it? Well, it turns out there are different kinds of lightning, and detecting some kinds early can help meteorologists predict when a storm will get worse. Read the latest SciJinks article to learn about the history, use, and future of lightning detection. http://scijinks.gov/lightning-detection. SciJinks is a joint NOAA and NASA educational website about weather and other Earth science topics. It targets middle- and high-school aged students.

Dave's Astrotracks
Selected Astronomy Related Music

This is an idiosyncratic list of astronomy related music. There are many more pieces that could go on here, and probably some that you don't think belong. Feel free to create your own list.

In most cases the dates and performers refer to one of the most famous recordings of the piece (though there are exceptions to this, such as in the Classical section where the composer and the date the work was composed are listed).

Most of these were on the lists I showed in the January 2015 PVAA meeting, though I've added a few pieces here. Also, I've added 2 new categories – "People (and Machines) in Space" and "Other Space Music".

Below is a link to my YouTube playlist - Dave's Astrotracks – it includes videos of many of these and others. Feel free to enjoy.

https://www.youtube.com/playlist?list=PLXhGQtPX77w4lqc6ado5_1wEXQPRv0-bu

Dave Kary

First Choices (according to my students)
- *Space Oddity* – David Bowie 1969
- *Rocketman* - Elton John 1972
- *Fly Me To the Moon* – Frank Sinatra 1964

Sun and Moon
- *Moon Over Miami* – Eddy Duchin and His Orchestra 1936
- *How High the Moon* – Benny Goodman Orchestra 1940
- *By The Light of the Silvery Moon* – Fats Waller 1942
- *That Lucky Old Sun* – Frankie Laine 1949
- *Blue Moon* – The Marcels 1961
- *House of the Rising Sun* – The Animals 1964
- *Here Comes the Sun* - The Beatles 1969
- *Bad Moon Rising* – Creedence Clearwater Revival 1969
- *Moondance* – Van Morrison 1970
- *Dancing in the Moonlight* – King Harvest 1972
- *Eclipse (Dark Side of the Moon)* – Pink Floyd - 1973
- *To the Moon and Back* – Savage Garden 1997
- *Norah Jones* – Shoot the Moon 2002
- *Moon and Sun* – Gomez 2007
- *When the Day met the Night* – Panic! At the Disco 2008

Starry Sky
- *Twinkle, Twinkle Little Star* – Jane Taylor 1806
- *Stars Fell on Alabama* – Louis Armstrong and Ella Fitzgerald 1956
- *Vincent (Starry, Starry Night)* – Don McClain 1971
- *Shining Star* – Earth, Wind, and Fire 1975
- *Shooting Star* – Bad Company 1975
- *Southern Cross* – Crosby, Stills and Nash 1982
- *Under the Milky Way* – The Church 1988
- *Stars* – Switchfoot 2005
- *A Sky Full of Stars* – Coldplay 2014

Classical Allusions
- *Planets Symphony* – Gustav Holst 1918
- *Jupiter Symphony* – Wolfgang Mozart 1788
- *Adoration of Earth (Rite of Spring)* - Igor Stravinski 1913
- *Clair de Lune* – Claude Debussy 1905
- *Moonlight Sonata* – Ludwig van Beethoven 1801
- William Hershel

Stars of Instrumental Jazz
- *Moonlight Serenade/Sunrise Serenade* – Glenn Miller Orchestra 1939
- *Stardust* – Artie Shaw 1941
- *Stella By Starlight* Charlie Parker 1952
- *Star Song* – Vince Guaraldi and Bola Sete 1963
- *Equinox* – John Coltrane 1964

The Space Race
- *Satellite Girl* – Jerry Engler and the Four Echos 1957
- *Happy Blues for John Glenn* – Lightnin' Hopkins 1962
- *Telstar* – The Tornadoes (1962)
- *Destination Moon* – Dinah Washington 1962
- *Werner Von Braun* – Tom Lehrer 1965

People (and Machines) in Space
- *Walking on the Moon* – The Police 1979
- *Blast Off* – Stray Cats 1989
- *Sleeping Satellites* – Tasmin Archer 1992
- *Satellite* – Dave Matthews 1993
- *Beach House On the Moon* – Jimmy Buffett 1999
- *Walk Upon the Moon* – John Stewart 2001

Radio, TV, and Movies
- *Dr. Who* – Ron Grainer 1963
- *Star Trek* – Alexander Courage 1966
- *2001 Space Odyssey* – Richard Strauss 1968
- *Benson Arizona (Dark Star)* – Bill Taylor and John Carpenter (1974)
- *Star Wars* – John Williams 1977
- *Close Encounters of the Third Kind* - John Williams 1977
- *Journey of the Sorcerer (Hitch-Hikers Guide to the Galaxy)* – The Eagles 1978
- *Firefly* – Greg Edmonson 2002
- *Battlestar Galactica* – Bear McCreary and Richard Gibbs 20***03***

Aliens
- *Mr. Spaceman* – The Byrds 1966
- *Starman* – David Bowie 1972
- *Rapture* – Blondie 1980
- *Take Me Away* – Blue Oyster Cult 1983
- *Spaceman* – The Killers 2008
- *E.T.* – Katie Perry 2010

Songs that Teach
- *What is a Shooting Star* – Tom Glazer and Dottie Evans 1959
- *Why Does the Sun Shine* – Tom Glazer and Dottie Evans 1959
- *Galaxy Song* – Monty Python 1983
- *Why Does the Sun Really Shine* – They Might Be Giants 2009
- *Monsters of the Cosmos* – Symphony of Science 2013

Recent Songs
- *Drops of Jupiter* – Train 2001
- *Earth Is the Best* – The Phenomenauts 2003
- *Gravity* – John Mayer 2006
- *Starlight* – Muse 2006
- *Supermassive Black Hole* – Muse 2006
- *My Moon, My Man* – Feist 2007
- *When the Day Met the Night* – Panic! At the Disco 2008
- *Cosmic Love* – Florence and the Machine 2009
- *Satellites* – Sleeping With Sirens 2013

Other Space Music
- *Transit of Venus March* – John Phillips Sousa 1883
- *Astronomy* – Blue Oyster Cult 1974
- *Defying Gravity* – Jimmy Buffett 1976
- *Planet Claire* – The B52's 1979
- *Black Hole Sun* – Soundgarden 1994
- *Sailing to Philadelphia* – Mark Knopfler and James Taylor 2000
- *Another Trip Around the Sun* – Jimmy Buffett and Martina McBride 2004

Bear Gulch School Star Gazing Nite

We had fun at Rancho Cucamonga's Bear Gulch School Star Gazing Nite and Astronomy Outreach. The two most exciting things that kids at this grade level were interested in were Jeff's meteor rock collection and the telescopes.

You can tell from the photos that it was an exciting evening!

Cori Charles

The heavyweight champion of the Cosmos

As crazy as it once seemed, we once assumed that the Earth was the largest thing in all the universe. 2,500 years ago, the Greek philosopher Anaxagoras was ridiculed for suggesting that the Sun might be even larger than the Peloponnesus peninsula, about 16% of modern-day Greece. Today, we know that planets are dwarfed by stars, which themselves are bound together by the billions or even trillions into galaxies.

But gravitationally bound structures extend far beyond galaxies, which themselves can bind together into massive clusters across the cosmos. While dark energy may be driving most galaxy clusters apart from one another, preventing our local group from falling into the Virgo Cluster, for example, on occasion, huge galaxy clusters can merge, forming the largest gravitationally bound structures in the universe.

Take the "El Gordo" galaxy cluster, catalogued as ACT-CL J0102-4915. It's the largest known galaxy cluster in the distant universe. A galaxy like the Milky Way might contain a few hundred billion stars and up to just over a trillion (1012) solar masses worth of matter, the El Gordo cluster has an estimated mass of 3 × 1015 solar masses, or 3,000 times as much as our own galaxy! The way we've figured this out is fascinating. By seeing how the shapes of background galaxies are distorted into more elliptical-than-average shapes along a particular set of axes, we can reconstruct how much mass is present in the cluster: a phenomenon known as weak gravitational lensing.

That reconstruction is shown in blue, but doesn't match up with where the X-rays are, which are shown in pink! This is because, when galaxy clusters collide, the neutral gas inside heats up to emit X-rays, but the individual galaxies (mostly) and dark matter (completely) pass through one another, resulting in a displacement of the cluster's mass from its center. This has been observed before in objects like the Bullet Cluster, but El Gordo is much younger and farther away. At 10 billion light-years distant, the light reaching us now was emitted more than 7 billion years ago, when the universe was less than half its present age.

It's a good thing, too, because about 6 billion years ago, the universe began accelerating, meaning that El Gordo just might be the largest cosmic heavyweight of all. There's still more universe left to explore, but for right now, this is the heavyweight champion of the distant universe!

Dr. Ethan Siegel

Learn more about "El Gordo" here:
http://www.nasa.gov/press/2014/april/nasa-hubble-team-finds-monster-el-gordo-galaxy-cluster-bigger-than-thought/
El Gordo is certainly huge, but what about really tiny galaxies?
Kids can learn about satellite galaxies at NASA's Space Place
http://spaceplace.nasa.gov/satellite-galaxies/.

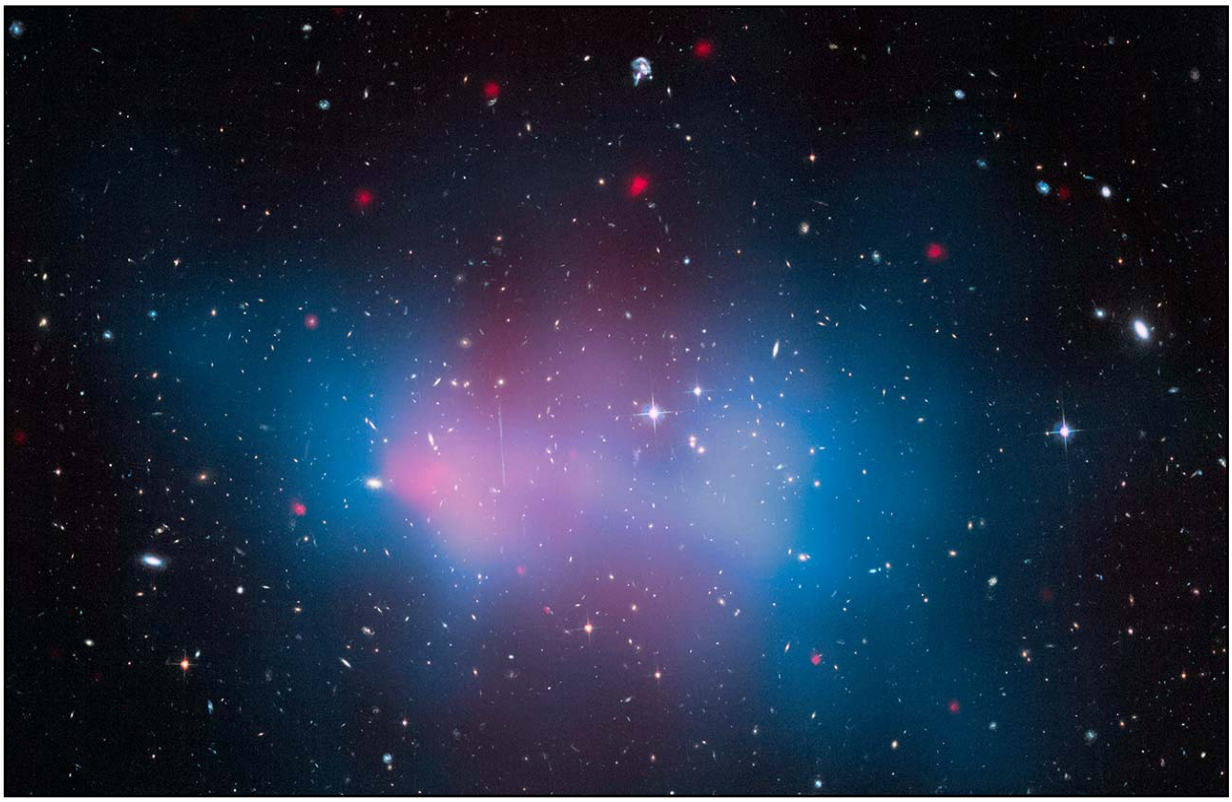

Image credit: NASA, ESA, J. Jee (UC Davis), J. Hughes (Rutgers U.), F. Menanteau (Rutgers U. and UIUC), C. Sifon (Leiden Observatory), R. Mandelbum (Carnegie Mellon U.), L. Barrientos (Universidad Catolica de Chile), and K. Ng (UC Davis). X-rays are shown in pink from Chandra; the overall matter density is shown in blue, from lensing derived from the Hubble space telescope. 10 billion light-years distant,

El Gordo is the most massive galaxy cluster ever found.