



Only those who will risk going too far
can possibly find out how far one can go.
T.S. Eliot

Newsletter of the Pomona Valley Amateur Astronomers

Volume 36 Number 6

nightwatch

June 2016

President's Message

It's planet season, with Jupiter, Mars, and Saturn all lined up across the evening sky. Doubly so since NASA's Juno probe is scheduled to arrive at Jupiter on July 4. If anyone has made any memorable observations or gotten interesting photos, please share them with us at the meeting.

Fate intervened to keep us from our scheduled nights observing with the big telescopes at Mount Wilson. The 100-inch telescope was not ready for our June 3 visit, so the observatory had to cancel on us. Then the next night, smoke from the Simi Valley fire shut down our observing session with the 60-inch telescope after just a couple of hours. The 60-inch session had been rescheduled for the evening of Wednesday, July 6. I believe there may still be a couple of spots open - please let Ron Hoekwater know if you are interested in going.

Our June 24 speaker is Jason Gallicchio. The title of his talk is, "A Long Winter: Cosmic Microwave Background Science with the South Pole Telescope."

In Jason's own words:

"I spent all of 2013 within a mile or so of the geographic South Pole. I ran a 10-meter microwave telescope attached to the same building as BICEP. The two telescopes are constantly scanning the same patch of sky away, mapping the radiation left over from the big bang at the highest accuracy and highest resolution of any telescope in the world. Such accurate maps, especially of polarization patterns, tell us about the instant after the big bang. Any matter (dark or not) between us and the cosmic microwave background distorts the patterns in a way that lets us learn about its structure. Pretty photos and interesting stories will be provided."

Matt Wedel

Club Events Calendar

June 24, 2016 **General Meeting – Jason Gallicchio – CMB Science with the South Pole Telescope**

July 30, 2016 **Star Party - Grandview**

July 14, 2016 **Board Meeting**

July 22, 2016 **General Meeting**

Aug 27, 2016 **Star Party – Cow Canyon Saddle, Mt Baldy**

Aug 11, 2016 **Board Meeting**

Aug 19, 2016 **General Meeting**

Sept 3, 2016 **Star Party– Cow Canyon Saddle, Mt Baldy**

Sept 8, 2016 **Board Meeting**

Sept 16, 2016 **General Meeting – Dr. Elijah Quentin – Stars Consumed by Black Holes**

Oct 1, 2016 **Star Party--Afton Canyon**

Oct 6, 2016 **Board Meeting**

Oct 14, 2016 **General Meeting**

Oct 29, 2016 **Star Party**

Nov 10, 2016 **Board Meeting**

Nov 18, 2016 **General Meeting**

Dec 3, 2016 **No Star Party**

Dec 1, 2016 **Board Meeting**

Dec 9, 2016 **Xmas Party, no General meeting**

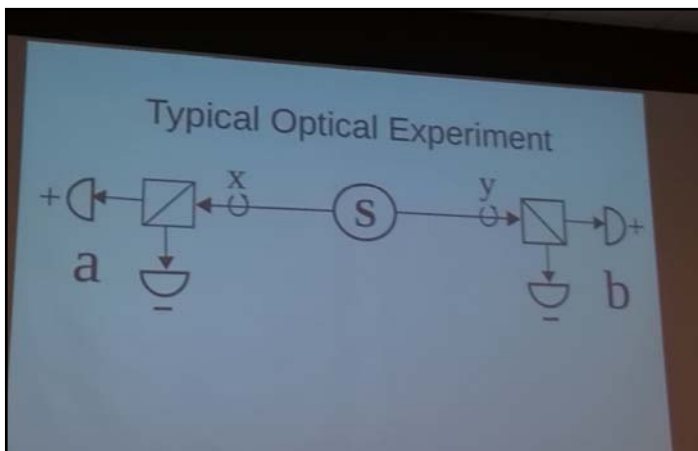
PVAA General Meeting 05/20/16

Club President Matt Wedel opened the meeting greeting the first time attendees, and mentioning a few announcements. The election of PVAA Officers and Board Members showed no drama, as everyone ran unopposed. On a side note, the 100" Mt. Wilson observatory night was canceled, as the observatory is having some maintenance done, and the well-attended 60" Mt. Wilson observatory night was cut short due to a wild fire several miles away that put too much dust into the atmosphere, hindering the seeing. We were limited to viewing Jupiter, a globular cluster, and a faint galaxy made even fainter by the atmospheric dust. The 60" night has been re-scheduled for Wednesday, July 6th. The 100" will only be rescheduled if more people sign up. The July Star Party, opened to members AND the general public has been scheduled for Saturday night, July 30th at Grandview. We will update our website to include instructions on how to get to Grandview.

The speaker for the evening was Assistant Professor Jason Gallicchio of Harvey Mudd College. His topic was "Using Quasars To Test The Mysteries Of Quantum Mechanics." Prof. Gallicchio has been to the South Pole more than once to use the 10 meter Radio Dish located there. He talked about how light can be polarized, and a phenomena characterized by Albert Einstein as "Spooky action at a distance" -or- "Quantum Entanglement."

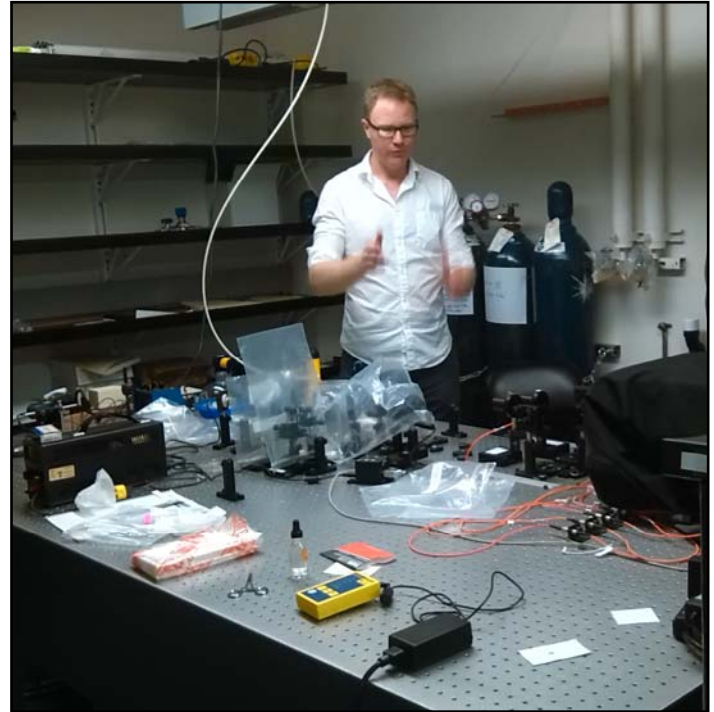
Jason took us through some history of Quantum Entanglement, citing John Bell's experiments in the 1960s, and Freedman and Clauser in 1972 who first successfully conducted the Bell test. He also brought up loopholes in the experiments, or making sure scientist didn't "cheat" accidentally or otherwise, when doing their experiments. While I cannot show his well laid out, informative and yet entertaining presentation, there is a good YouTube video by Veritasium on Quantum Entanglement:

<https://www.youtube.com/watch?v=ZuvK-od647c>



Where S is the source that produces pairs of entangled photons, sent in opposite directions. Each photon encounters a two-channel polariser whose orientation can be set by the person doing the experiment. The photons, depending on their spins, either hit the Plus (+) or Minus (-) detectors at either end. Once you have measured which detector it hits on one end, you should know which detector it will hit on the other.

After the meeting the professor took us down to his lab, and showed us his equipment.



<http://frank.harvard.edu/~jason/southpole2013/PanosJason/>

<http://www.nist.gov/pml/div686/20151105loophole.cfm>

Veritasium You Tube

"Quantum Entanglement: Spooky action at a distance"

<https://www.youtube.com/watch?v=ZuvK-od647c>

Gary Thompson

PVAA Officers and Board

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What's Up? - Water World Moon

After Io, Jupiter's next large moon is Europa. It's entirely covered with a frozen over sea that could contain life forms. Slightly smaller than Earth's Moon, it's like an off-white cue ball. It has the smoothest surface in our Solar System. Its pearly ice crust is marked over with brownish mineral colored cracks called *lineae*. These must have been formed by eruptions of warmer water forced up through its crust. Other regions of jumbled chaotic ice seem broken iceberg fragments rising out of a warm sea to be frozen again. Just how liquid or warm that sea really is beneath its cold crust is unknown. That could only be established by a probe drilling a hole to take a plunge. Any liquid warmth would be caused by that tidal flexing which also makes Jupiter's innermost moon Io volcanic.

Evidence has been found of slowly moving plate tectonics in Europa's icy shell. This would be the first evidence of geologic tectonics on a surface other than Earth. There are signs of sea salt coating surface features that indicate that the subsurface sea is interacting with Europa's rocky core. Such a warm moving sea might be the home of alien life. Having the same name origin as one of Earth's most populated continents makes it seem as if it should harbor life.

He then took her to the isle of Crete. Here she became the first queen of Crete. Not a bad deal. Her bullish abduction is a popular lusty subject of much painting and sculpture. The bull is often associated with the constellation of Taurus through which the Jupiter system passes.

But the nature of Europa's watery world remains a mystery. Like the other Galilean Moons, it's tidally locked to Jupiter with one hemisphere constantly facing the gas giant. Its orbit is almost circular and takes only three and a half days. Europa spins faster than it orbits suggesting movement between a hidden sea and its crust. The frozen surface could be 20 miles or only 660 feet thick. Any liquid sea beneath it might be 60 miles deep or more. Gravitational effects caused by Jupiter could cause internal flows, making it warmer than its distance from the Sun would indicate. In 2012, the Hubble Space Telescope captured an image of a plume of water vapor erupting from Europa. This would indicate a warm subsurface sea. The only other evidence of erupting geysers is on Saturn's tidally flexed inner ice moon Enceladus.

The Hubble Telescope's High Resolution Spectrograph revealed Europa to have a thin atmosphere of molecular oxygen.

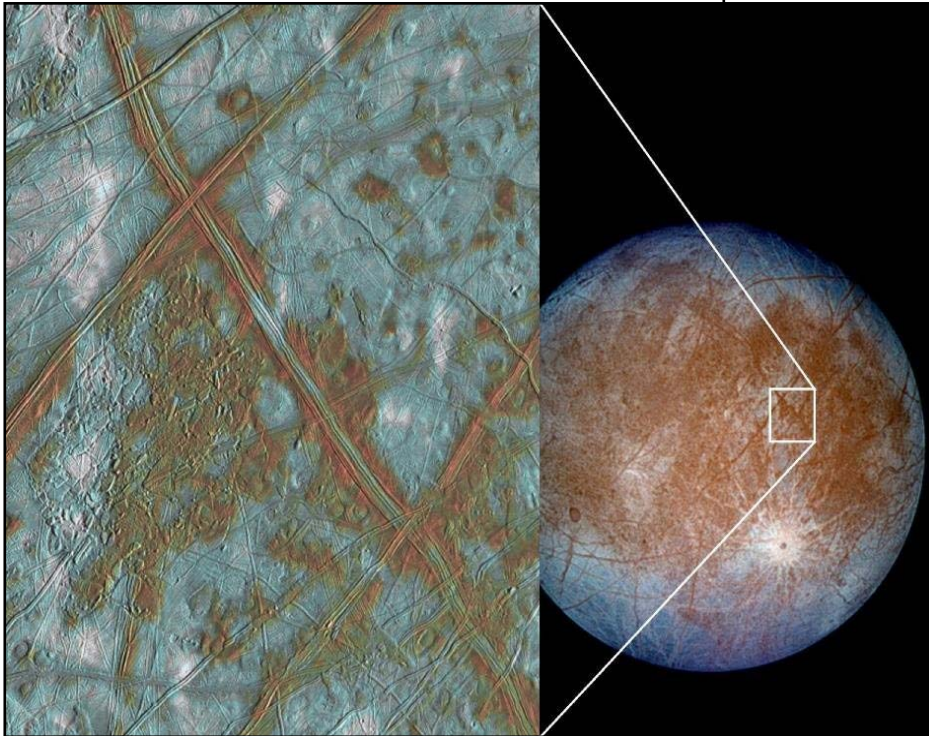
It wouldn't be of biological origin, but could be caused by charged particles from Jupiter's huge magnetosphere sputtering into Europa's icy surface. Europa would be a dangerous landing site. It would be fatal for astronauts to always be exposed to hard radiation on its frozen crust. Exploration of Europa would have to be carried out by robotic probes.

Close in observations of Europa started with the flybys of Jupiter probes, Pioneer 10 and 11 in 1973-74. In 1979 the Voyager probes produced more highly detailed images of Europa's odd crust. In 1995 the Galileo probe orbited Jupiter. In 2007, New Horizons took additional pictures of Europa on its flight out to Pluto.

The Galileo probe gathered the most information as it orbited in the Jupiter system for eight years. Its studies supported the concept of Europa's liquid ocean beneath a ice crust. The probe also found indications of a similar salty liquid

sea beneath the surfaces of two other large moons, Ganymede and Callisto.

Theories about the possibility of some form of primitive life in Europa's subsurface sea have inspired lobbying for new flights to Europa. In 2014 a bipartisan bill included funding to support a Europa mission. The Jupiter Icy Moon Explorer (JUICE) is also planned by the European Space Agency (ESA) to explore Europa and Ganymede. The search for hidden alien life forms continues.



Europa is the smallest of Jupiter's four large moons. It was discovered in 1610 by Galileo. It's now known to be larger than all the newly named dwarf planets, including Pluto. At the suggestion of Johannes Kepler these moons were named after Jupiter's lovers by another early telescope observer, Simon Marius.

Europa's beauty and a high lineage gave her an attractive status. Jupiter hid his abduction of her from his wife Juno by assuming the form of a horny white bull. When Europa innocently climbed on his back, Jupiter carried her out to sea.

Hubble's Bubble Lights Up the Interstellar Rubble

When isolated stars like our Sun reach the end of their lives, they're expected to blow off their outer layers in a roughly spherical configuration: a planetary nebula. But the most spectacular bubbles don't come from gas-and-plasma getting expelled into otherwise empty space, but from young, hot stars whose radiation pushes against the gaseous nebulae in which they were born. While most of our Sun's energy is found in the visible part of the spectrum, more massive stars burn at hotter temperatures, producing more ionizing, ultraviolet light, and also at higher luminosities. A star some 40-45 times the mass of the Sun, for example, might emit energy at a rate hundreds of thousands of times as great as our own star.

The Bubble Nebula, discovered in 1787 by William Herschel, is perhaps the classic example of this phenomenon. At a distance of 7,100 light years away in the constellation of Cassiopeia, a molecular gas cloud is actively forming stars, including the massive O-class star BD+60 2522, which itself is a magnitude +8.7 star despite its great distance and its presence in a dusty region of space. Shining with a temperature of 37,500 K and a luminosity nearly 400,000 times that of our Sun, it ionizes and evaporates off all the molecular material within a sphere 7 light years in diameter. The bubble structure itself, when viewed from a dark sky location, can be seen through an amateur telescope with an aperture as small as 8" (20 cm).

As viewed by Hubble, the thickness of the bubble wall is both apparent and spectacular. A star as massive as the one creating this bubble emits stellar winds at approximately 1700 km/s, or 0.6% the speed of light. As those winds slam into the material in the interstellar medium, they push it outwards. The bubble itself appears off-center from the star due to the asymmetry of the surrounding interstellar medium with a greater density of cold gas on the "short" side than on the longer one. The blue color is due to the emission from partially ionized oxygen atoms, while the cooler yellow color highlights the dual presence of hydrogen (red) and nitrogen (green).

The star itself at the core of the nebula is currently fusing helium at its center. It is expected to live only another 10 million years or so before dying in a spectacular Type II supernova explosion.

Ethan Siegel



Image credit: NASA, ESA, and the Hubble Heritage Team (STScI/AURA), of the Bubble Nebula as imaged 229 years after its discovery by William Herschel.



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RTMC 2016



Ron's new scope



Jupiters moons thru Ron's scope



Matt Wedel giving talk at Bose Hall

