Santa Monica Amateur Astronomy Club

February, 2016

The Observer

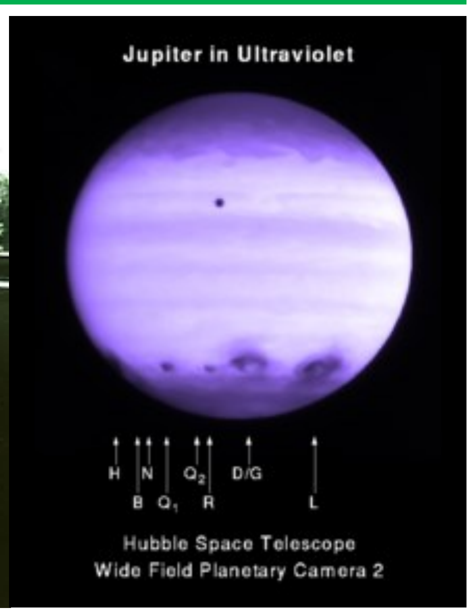
UPCOMING CLUB MEETING: FRIDAY, FEBRUARY 12 (7:30 PM)

Speaker: Tim Thompson

(JPL, Mt. Wilson)

Tim's Topic: Women in Astronomy ...and the Sciences

Women have been responsible for some of the greatest discoveries in astronomy. Tim will talk about a whole range of fascinating topics in astronomy that can be credited to women. It's all science! And all genders are welcome!



INSIDE THIS ISSUE

OUR MEETING SITE:

Wildwood School
11811 Olympic Blvd.
Los Angeles, CA 90064

Free parking in garage, SE corner of Mississippi &Westgate.

COVER ILLUSTRATION:
Left: Carolyn Shoemaker, co-discoverer of comet Shoemaker-Levy 9, at the 18" discovery telescope, Palomar. Right: Jupiter gets walloped by the comet fragments, July 1994.

Women in Astronomy…How many of these do you recognize?

Answers on the back page. No peeking before you guess!

Here's an interesting, upcoming talk at Caltech!

All of these talks are free, with free parking right next to Beckman Auditorium…couldn't be easier!

Heading east: Exit the 210 Fwy at Hill (just after Lake) in Pasadena. Bear all the way right at the end of the ramp, and make a right turn on Hill (heading south). A mile or so, then right on Del Mar, and left into Michigan, to the lot. See your favorite map app!

Beckman Lecture, Caltech

Wednesday, February 10, 2016 8:00 pm

Beckman Auditorium

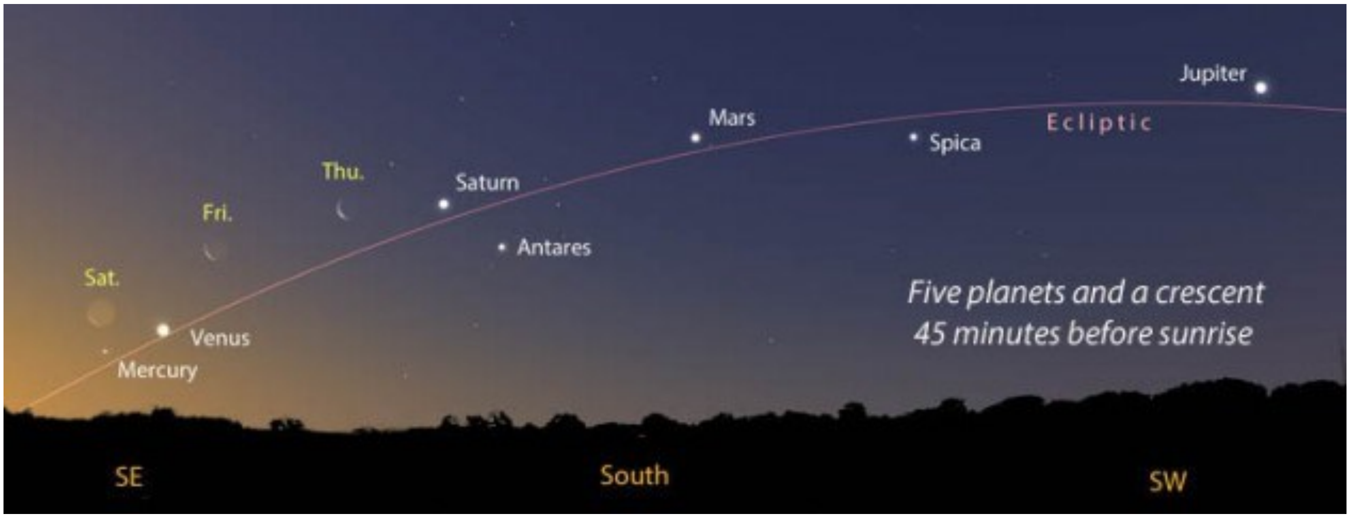
Gregg Hallinan, Assistant Professor of Astronomy

"Chasing Extrasolar Space Weather"

The Earth's magnetic field protects its atmosphere from the solar wind, particularly during explosive events known as coronal mass ejections. Similar magnetic fields may be crucial in defining the habitability of exoplanets, particularly when their host stars are young and very magnetically active.

Hallinan's presentation will focus on his group's efforts to detect such extrasolar space weather on nearby stars, including both the intense emissions produced by stars during flares and coronal mass ejections and the aurora produced by planets when they experience extreme geomagnetic storms. A new radio telescope at Caltech's Owens Valley Radio Observatory plays a key role in this effort by imaging the entire viewable sky every few seconds in the search for the signatures of these events.

—Gregg Hallinan Assistant professor of astronomy at Caltech.



It's not too late! You can still see five planets lined up in the early morning sky—six, if you count the earth, and why wouldn't you? Mercury is going to be the limiting factor in this show, as it turns around and sinks back down into the 'dawn's early light'. Until we approach Valentine's Day, the game is still on!

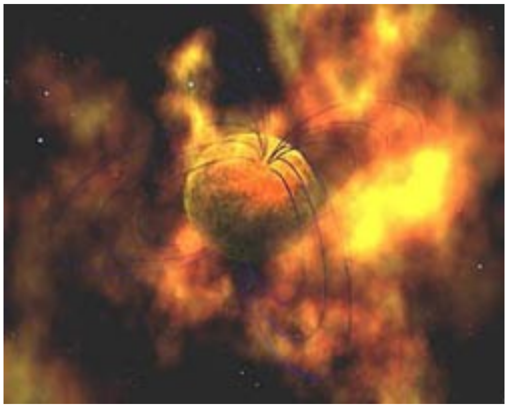
See Sky and Telescope for more information. You can listen to their podcast. Also, check out the Griffith Observatory Sky Report on their website.

There's Something About ASASSN-15lh…

The All Sky Automated Survey for Supernovae (ASASSN) has found something truly remarkable—the brightest explosion ever witnessed by humanity. ASASSN-15lh is a whopping 200 times more powerful than the average supernova, 570 billion times brighter than the sun, and 20 times brighter than our entire Milky Way galaxy, with its several hundred billion stars! As if "ordinary" supernovae aren't ridiculously energetic enough…

ASSASN consists of an array of small telescopes based at major observatories around the world. These scopes use machine-learning algorithms developed at Los Alamos to limit false detections, so astronomers can quickly zero in on true supernova explosions. ASSASN has discovered some 250 supernovae since the collaboration began in 2014—but last June (2015), two telescopes at Chile's Cerro Tololo Observatory, each just over 14 cm in aperture, discovered a super-luminous supernova that seems to have shattered all previous records.

Two more things about this super-luminous supernova (or 'hypernova') stand out as unusual: At 3.8 billion light years away, it's relatively close. (Only astronomers can get away with that kind of language!) And it's in a relatively bright, active galaxy—which is unusual for objects of this class. In fact, everything about this object seems to be puzzling…



LEFT: Artist's conception of a magnetar, one possible explanation for ultra-luminous supernovae. These objects have, by far, the most powerful magnetic fields observed in the universe.

There's another problem with ASASSN-15lh: It's *too* bright.

Lately, the study of supernova has itself been blowing up. A supernova is a massive star that runs out of usable fuel. In the classic model, the core collapses, and a powerful shock wave of emitted neutrinos blasts the outer layers of the star apart. But the classic model runs into trouble. It's a tricky calculation to make—only 1% of the neutrino energy emerges in the supernova—and it doesn't always produce an explosion.

An alternate view is enjoying a renaissance: The most luminous supernovae are powered by magnetars, neutron stars with outrageously powerful magnetic fields. The magnetic field of the earth is about half a gauss. A strong sunspot field is 4,000 gauss. Magnetars have fields of 10^{15} gauss—that's two quadrillion, or two thousand trillion, times the strength of earth's magnetic field!

How powerful is that magnetic field? At 100,000 miles away, a magnetar would erase every bit of information from every credit card on earth. At 1,000 miles away, the magnetar's field would distort the electron clouds in your body's atoms beyond the point where you could maintain your basic biochemistry. Closer to the magnetar, hydrogen atoms would be distorted to hundreds of times their length, but would be thinner than an ordinary electron cloud. X-rays would split; electrons would fail to oscillate in electric fields—basic physics would be distorted almost beyond recognition.

One idea is that neutrinos *do* blast out from the supernova, clearing out a cavity in the gas that allows the magnetar field to fly outward, and act like a piston on the surrounding gas. The tremendous field, hitting the expelled gas from the explosion, rapidly brakes the magnetar, causing its tremendous rotational energy (over 10^{52} ergs) to be transferred into light. Add magnetic waves, starquakes and all kinds of mayhem—and you just might have an ultra-luminous supernova. Maybe…

ASASSN-15lh is so extreme, the team's co-principal investigator, Krzysztof Stanek, turned to the movie *This is Spinal Tap* to find a way to describe it: "If it really is a magnetar, it's as if nature took everything we know about magnetars and turned it up to 11" . (Spinal Tap: "It's like "11 on a scale of 1 to 10.") "We have to ask, how is that even possible?"

"The honest answer is at this point that we do not know what could be the power source for ASASSN-15lh," said Subo Dong, lead author of the Jan. 15, 2016 paper in *Science*. The discovery, he noted, "may lead to new thinking and new observations of the whole class of ultraluminous supernova."

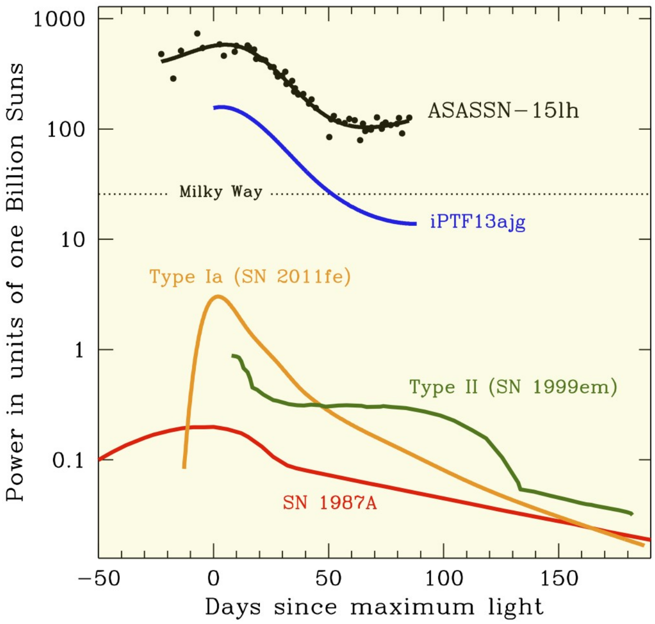
To shine so brightly, this particular magnetar would have to spin at least 1,000 times a second, and convert all that rotational energy to light with nearly 100 percent efficiency. It would be the most extreme example of a magnetar that scientists believe to be physically possible. And that's pretty extreme!

"Given those constraints," OSU astro professor Todd Thomson said, "will we ever see anything more luminous than this? If it truly is a magnetar, then the answer is basically no."

The Hubble Space Telescope will help settle the question later this year, in part because it will allow astronomers to see the host galaxy surrounding the object. If the team finds that the object lies in the very center of a large galaxy, then perhaps it's not a magnetar at all, but instead tied to some strange kind of nuclear activity around a supermassive black hole…or something even more bizarre, whatever that might be.

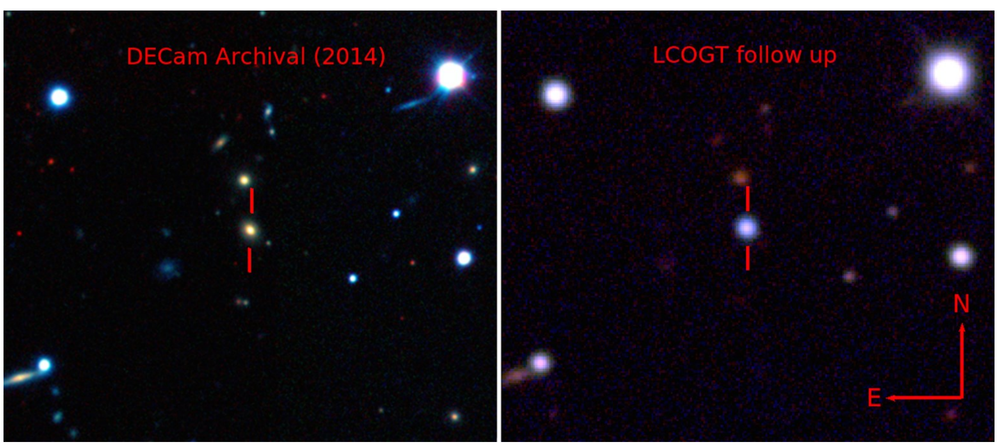
Stay tuned!

ASASSN-15lh



ABOVE: Light curves for various supernovae. ASASSN-15lh is what students today call “extra”. Ultraluminous supernovae like ASASSN-15lh are hydrogen-poor.

ABOVE: Discovery telescopes at Cerro Tololo, Chile. These are named “Cassius”. The ones on Hawaii are named “Brutus”. Do we detect a theme in the ASASSN program?

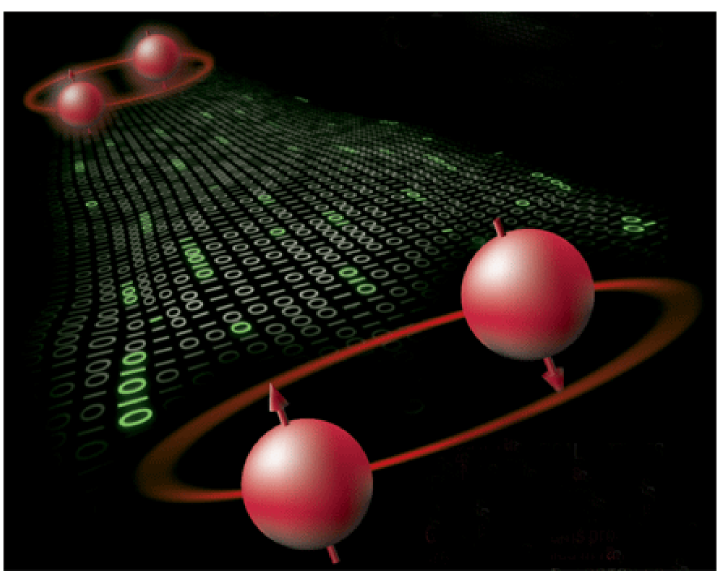


ABOVE: Before and after pictures of the galaxy, 3.8 billion light years away, in which ASAS-SN 15 was discovered. LCOGT is the Los Cumbres Observatory Global Telescope Network, connected with our very own University of California at Santa Barbara.

Oh…there’s something else about ASASSN-15lh. Can you guess what it is? (Ask at the meeting.)

What an Entangled Evening!

An overview of "Some Entangled Evening" from our preferred seating on the balcony. Club members had a commanding view of the proceedings from their luxury box. (Maybe.) We mentioned this event at the club meeting, and there were a few extra tickets...unfortunately, only a few club members were able to make it. Somehow, we still feel "entangled" with the whole group!

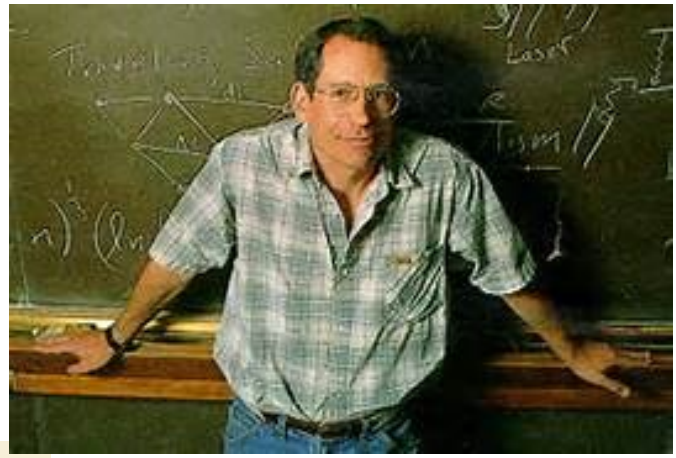


What is quantum entanglement? One of the most exciting concepts of our time! When we know some property of a whole quantum system, but not the properties of its individual particles, those particles are said to be "entangled". Their individual identity is ambiguous and indeterminate. Einstein didn't like it one bit (or "Q-bit", meaning quantum bit). Yet quantum information, consisting of these ambiguous states, may allow us to build computers with staggering capabilities.

Some physicists now believe that entanglement is what creates space and time! The "arrow of time" is simply the direction of increasing entanglements and connections. And space is simply the way entangled particles bind together, and build up information. Entanglement destroys the old concept of "locality" in space, as particles may be entangled clear across the cosmos! Quantum teleportation? Quantum information? We'll see!

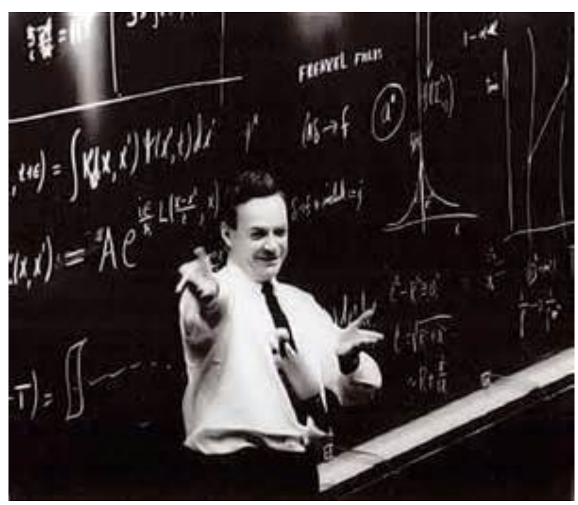
Some of the Participants at “Some Entangled Evening”

Yuri Milner, financier. With a background in physics, and a net worth of $3.1 billion, Milner has announced that he will be giving $100 million to SETI, our effort to communicate with ET. We’re definitely going to be phoning a lot of homes with that money. (Future club member??)



John Preskill, the evening’s host, is Richard Feynman Professor of Theoretical Physics at Caltech, and Director of the Institute for Quantum Information at Caltech. Preskill is known for making bets with his friend, Stephen Hawking—and winning them. Not the best singer, it turns out—but a pioneer of the Q-Bit.

David Wineland won the 2012 Nobel Prize in Physics for his work using super-cooled ions to make quantum systems that could be used in quantum computing.



Richard Feynman, unlike Schrodinger’s Cat, is generally conceded to be not alive—but his work lives on, and his vision of quantum computing was the theme of the evening. His “Messenger Series” lectures may be found at “Project Tuva” on the Microsoft website—when it’s working.

Food for thought…

We're Back! The group at our latest after-meeting hangout, Izzy's at the northwest corner of Wilshire and 15th. Everyone is always invited to join us after the meeting. Just ask where we're going that night…

Familiar faces: Know all of these club members? Right—Lynne, Don, Jason, Mimi. Left—Vicky and the kids, Jim, Robert. Matzah ball soup seemed to be the order of the night. (The word "matzah" can be spelled at least three different ways. —ed.)

For a full bio of our speaker, Tim Thompson, look at the July 2015 bulletin!

Caroline Herschel:

Discoverer of eight comets. Worked with her brother, William, and later her son, John, to build the best telescopes of the day, and catalog the nebulae.

Vera Rubin: Her outer galaxy rotation curves convinced the astronomical world that dark matter was real.

Emmy Noether: Showed that every conservation law in physics was coupled to a symmetry of nature. OK, physics and astronomy.

Beatrice Tinsley: Demonstrated stellar evolution of star populations in galaxies. Became a professor at Yale.

Jocelyn Bell Burnell: Discoverer of pulsars, with her advisor, Anthony Hewish.

Annie Jump Cannon: Perfected stellar classification; classified over 430,000 stellar spectra at Harvard.

Cecelia Payne-Gaposhkin: Applied Saha Ionization equations to show that stars are mostly hydrogen, which must then be the most abundant element in the universe.

Henrietta Swan Leavitt: Discovered period-luminosity law for Cepheids, a starting point for modern distance scales in the universe.