



# EPHEMERIS

The official newsletter of the Prescott Astronomy Club (PAC)  
*e-phem-er-is*: a time-based listing of future positions of solar system objects

## APRIL 2016

### UPCOMING EVENTS



Wednesday, April 6 - Regular PAC meeting @ 6:30 PM in Rm 107, Bldg 74, Embry-Riddle Aeronautical University. Club member Leah Cole will present "Light Pollution" - an overview of why light pollution is so undesirable and some of the things that can be done to mitigate its effects. Local ordinances will also be covered.

Saturday, April 9 - Starry Nights @ 8:00 PM at Pronghorn Park in Prescott Valley. Sign up at meeting on April 6.

Wednesday, April 13 - METASIG @ 5:00 PM at a local restaurant. Sign up at meeting on April 6.

Wednesday, April 20 - Board Meeting @ 6:30 PM.

Thursday, April 21 - Third Thursday Presentation @ 6:00 PM in the Founder's Suite, Prescott Public Library. Dr. Will Grundy, Lowell Observatory, will present "New Horizons Mission to the Pluto System". Dr. Grundy is co-investigator and leader of the surface composition theme team on NASA's New Horizons mission to Pluto. Dr. Grundy will provide an overview and update on the amazing amount of scientific data returned from Pluto and our solar system beyond.

Monday, April 25 - Friendly Pines Camp @ 8:00 PM presentation and star party for 28 5th-graders from Summit Schools. Sign up at meeting on April 6.

Friday, April 29 - Prescott High School @ 8:00 PM star party. Sign up at meeting on April 6.

Saturday, April 30 - Camp Wamatochick @ 8:00 PM star party for Kiwanis Kids Camp. Sign up at meeting on April 6.

## OBSERVING MINI-MARATHONS

A proposal has been made that PAC conduct a couple of observing mini-marathons. The first mini-marathon, focusing on double stars, would be held Saturday, May 14, 8:00 PM to 12:00 midnight at Jeff Stillman's home in Chino Valley. A second mini-marathon, focusing on deep-sky objects, would be held in September. Details about this proposal will be described and discussed at the April 6 general club meeting.



## GRAVITATIONAL WAVE ASTRONOMY WILL BE THE NEXT GREAT SCIENTIFIC FRONTIER

By Ethan Siegel

Imagine a world very different from our own: permanently shrouded in clouds, where the sky was never seen. Never had anyone see the Sun, the Moon, the stars or planets, until one night, a single bright object shone through. Imagine that you saw not only a bright point of light against a dark backdrop of sky, but that you could see a banded structure, a ringed system around it and perhaps even a bright satellite: a moon. That's the magnitude of what LIGO (the Laser Interferometer Gravitational-wave Observatory) saw, when it directly detected gravitational waves for the first time.

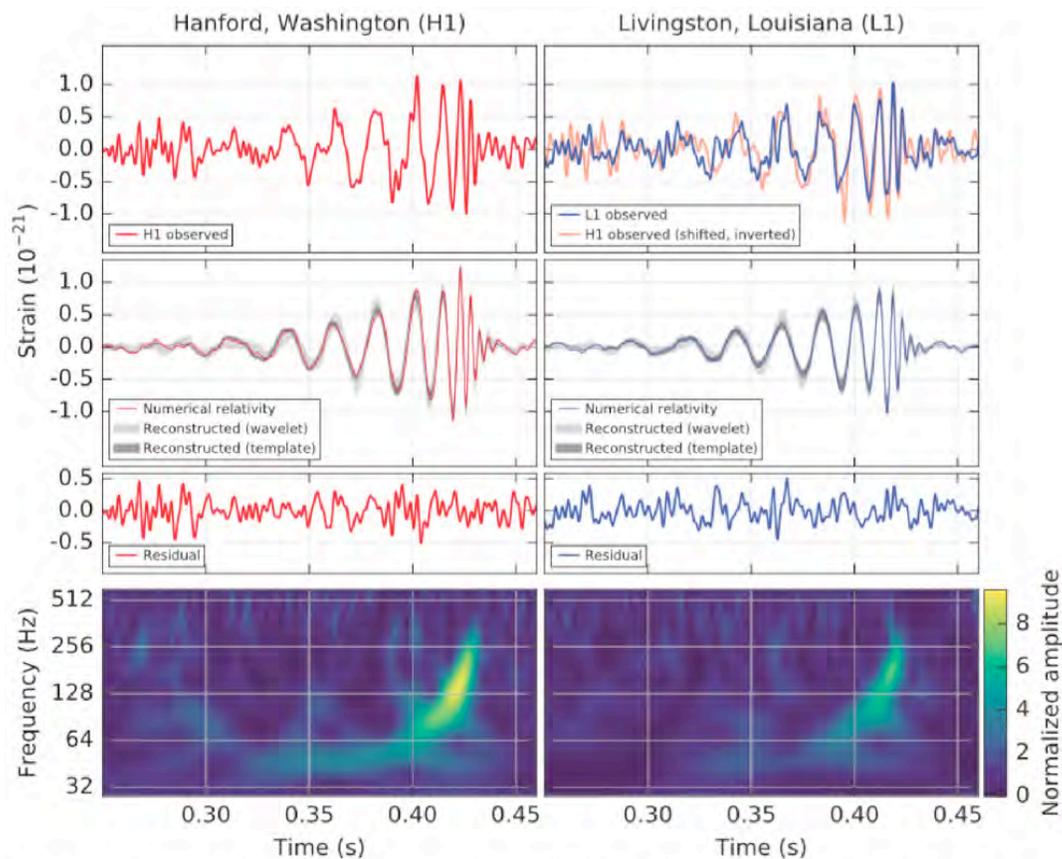


An unavoidable prediction of Einstein's General Relativity, gravitational waves emerge whenever a mass gets accelerated. For most systems -- like Earth orbiting the Sun -- the waves are so weak that it would take many times the age of the Universe to notice. But when very massive objects orbit at very short distances, the orbits decay noticeably and rapidly, producing potentially observable gravitational waves. Systems such as the binary pulsar PSR B1913+16 [the subtlety here is that binary pulsars may contain a single neutron star, so it's best to be specific], where two neutron stars orbit one another at very short distances, had previously shown this phenomenon of orbital decay, but gravitational waves had never been directly detected until now.

When a gravitational wave passes through an objects, it simultaneously stretches and compresses space along mutually perpendicular directions: first horizontally, then vertically, in an oscillating fashion. The LIGO detectors work by splitting a laser beam into perpendicular "arms," letting the beams reflect back and forth in each arm hundreds of times (for an effective path lengths of hundreds of km), and then recombining them at a photodetector. The interference pattern seen there will shift, predictably, if gravitational waves pass through and change the effective path lengths of the arms. Over a span of 20 milliseconds on September 14, 2015, both LIGO detectors

(in Louisiana and Washington) saw identical stretching-and-compressing patterns. From that tiny amount of data, scientists were able to conclude that two black holes, of 36 and 29 solar masses apiece, merged together, emitting 5% of their total mass into gravitational wave energy, via Einstein's  $E = mc^2$ .

During that event, more energy was emitted in gravitational waves than by all the stars in the observable Universe combined. The entire Earth was compressed by less than the width of a proton during this event, yet thanks to LIGO's incredible precision, we were able to detect it. At least a handful of these events are expected every year. In the future, different observatories, such as NANOGrav (which uses radio telescopes to the delay caused by gravitational waves on pulsar radiation) and the space mission LISA will detect gravitational waves from supermassive black holes and many other sources. We've just seen our first event using a new type of astronomy, and can now test black holes and gravity like never before.



*Image credit: Observation of Gravitational Waves from a Binary Black Hole Merger B. P. Abbott et al., (LIGO Scientific Collaboration and Virgo Collaboration), Physical Review Letters 116, 061102 (2016). This figure shows the data (top panels) at the Washington and Louisiana LIGO stations, the predicted signal from Einstein's theory (middle panels), and the inferred signals (bottom panels). The signals matched perfectly in both detectors.*

## PRESCOTT REGIONAL SCITECH FEST

On Saturday, February 27, the Prescott Astronomy Club participated in the 3rd annual SciTech Festival and it was a great success. PAC had two booths this year: 8 solar telescopes outside and a booth inside the mall. The visitors to our scopes were treated to a very active sun, showing both sunspots and prominences. For many, this was the first time they had viewed the sun and were amazed.

Thanks to: Pam Schavik, a NASA/JPL Solar System Ambassador, for solar glasses and other sun related materials and for working the booth inside the mall; Jack Szelka, Joel Cohen, David Viscio, Randy Shivak, Neil Stockton, John Carter, Greg Lutes and Jerry Shaw for sharing their telescopes and expertise; Jeff Stillman for working the inside booth; Russ Chappell for event badges; Stephen Eubanks for membership forms; Neil Stockton for a very nice tri-fold display of the sun; Marilyn Unruh for the NASA Nigh Sky kit and to Pat Birck for providing pizza for lunch.



## IF IT'S CLEAR

By Fulton Wright, Jr., PAC

Celestial events (from Sky & Telescope magazine, Astronomy magazine and anywhere else I can find information) customized for Prescott, Arizona. Remember, the Moon is 1/2 degree or 30 arcminutes in diameter. All times are Mountain Standard Time.



On Tuesday, April 5, from 2:35 AM to 3:17 AM, the shadows of Io and Europa are on Jupiter.

On Wednesday, April 6, you can observe some events with Jupiter's moons. Here is the schedule:

06:52 PM Io moves in front of the planet.

06:55 PM Sunset

07:32 PM Io's shadow falls on the planet.

07:48 PM Europa moves behind the planet.

09:06 PM Io moves from in front of the planet.

09:46 PM Io's shadow leaves the planet.

09:59 PM Ganymede moves in front of the planet.

11:54 PM Europa appears from Jupiter's shadow.

12:43 AM (Thursday) Ganymede's shadow falls on the planet.

01:14 AM Ganymede moves from in front of the planet.

03:57 AM Ganymede's shadow leaves the planet.

04:54 AM Jupiter sets.

On Sunday, April 10, at 2:33 PM, you can see the Moon occult Aldebaran (magnitude 1). This is a daytime event so you will probably want a telescope at high power to watch it. Look for the crescent Moon, 60 degrees above the Southeast horizon. The star should be located on the dark side of the Moon, opposite the "horns". The star reappears at 3:55 PM on the bright side of the Moon.

On Sunday, April 17, between sunset (7:05 PM) and Mercury-set (8:44 PM), you have your best chance of seeing Mercury this year. Look low in the west for the magnitude 0 planet. It will also be good for a few days around this date.

On Sunday, April 24, after about 10:30 PM, you can see the gibbous Moon, Mars, Aldebaran, and Saturn all rising together in the south-east.

## FOR SALE

Please visit the Classified Ads section of the club website to view the items posted there for sale:

<http://prescottastronomyclub.org/classified-ads/>

New items are added now and then, so don't miss out on something that you would like to get for yourself...or a friend.



## PAC MENTORS

If you need advise on the purchase of astronomy equipment, setting up equipment, astrophotography, etc., contact a PAC mentor.

John R. Carter Sr. - General - 928-458-0570

Jeff Stillman - Astrophotography - 928-379-7088

David Viscio - General - 928-775-2918

Greg Lutes - Visual Observing - 928-445-4430



## OBSERVING LISTS

Observing lists are available on the PAC website to provide guidance and goals for visual and astrophotography programs. Current lists are:

Astroleague Lunar 100

Bright Nebulae

Dunlop 100

Globular Clusters

Herschel II

Messier

Planet Maps

Royal Astronomical Society of Canada Finest NGC

Saguaro Astronomy Club Best NGC

Telescope Showpieces

Binocular Showpieces

Caldwell

Face-On Spiral Galaxies

Herschel 400

Hidden Treasures

Open Clusters

Planetary Nebulae

S&T Lunar 100

The Secret Deep



The lists are in PDF format and can be downloaded and printed for use.

## PAC WEBSITE & YAHOO GROUPS

Website: <http://www.prescottastronomyclub.org>

E-mail: <mailto:pacinfo@prescottastronomyclub.org>

General PAC user group:

<https://groups.yahoo.com/neo/groups/Prescott-Astronomy-Club/info>

Astrophotography special interest group:

<https://groups.yahoo.com/neo/groups/pacastrophotography/info>



## BOARD OF DIRECTORS

President: Jeff Stillman

Vice President: David Viscio

Secretary: Doug Tilley

Treasurer: Stephen Eubanks

At Large: Joel Cohen

At Large: Dick Lewis

At Large: Fred Arndt

At Large: John Baesemann



## PAC COORDINATORS

Astronomical League Coordinator: Pat Birck

Facebook: John Carter

Highland Center Coordinator: David Viscio

Hospitality: Corinne Shaw & Dick Lewis

Magazine Subscriptions: Stephen Eubanks

METASIG: Marilyn Unruh

PAC Affiliate Partner w/ NAU Space Grant Program – Jerry & Corinne Shaw

PAC Store Sales: Dick Felgenhour

Property Records: Fred Arndt

Schools & Camps Outreach: Pat Birck

Third Thursday Coordinator: Corinne Shaw & Pat Birck

Webmaster: Russell Chappell

Membership: Stephen Eubanks

Newsletter: David Viscio

Refreshments: Janie Thompson

Publicity Coordinator: John Carter

Starry Nights Coordinator: Open



Astronomy Picture of the Day - March 16, 2016

Hallgrímur P. Helgason

Phoenix Aurora Over Iceland



All of the other aurora watchers had gone home. By 3:30 am in Iceland, on a quiet night last September, much of that night's auroras had died down. Suddenly though, a new burst of particles streamed down from space, lighting up the Earth's atmosphere once again. This time, unexpectedly, pareidolically, they created an amazing shape reminiscent of a giant phoenix. With camera equipment at the ready, two quick sky images were taken, followed immediately by a third of the land. The mountain in the background is Helgafell, while the small foreground river is called Kaldá, both located about 30 kilometers north of Iceland's capital Reykjavik. Seasoned skywatchers will note that just above the mountain, toward the left, is the constellation of Orion, while the Pleiades star cluster is also visible just above the frame center. The new aurora lasted only a minute and would be gone forever - possibly dismissed as an embellished aberration - were it not captured in the featured, digitally-composed, image mosaic.