# THE STAR DIAGONAL

THE JOURNAL OF THE OGDEN ASTRONOMICAL SOCIETY



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## Meeting Announcement

The monthly meeting of the Ogden Astronomical Society will be held on April 14th at 7:30 in the Ott Planetarium at Weber State University.

## President's Message

Hi All,

It's time to break out the telescopes and dust them off, with the end of winter our star party schedule is starting up. We have an Antelope Island star party Saturday the 9th with solar viewing starting at 6:00. Antelope Island is in the process of getting there dark sky designation from IDA. One of the requirements we have been asked to help with is determining the limiting magnitude at the Island. We should be able to do this at our Island star parties over the next few months.

Our meeting for April will be on the 14th at 7:30 at the Ott Planetarium. The main topic will be the Night Sky Network Webinar on the geology of Pluto and Charon presented by Dr Orkan Umurhan.

We have a few school star party requests and we will keep you posted on those, I hope to see you at these activities.

Thanks,
Lee Priest

## OAS Minutes

The meeting began on March 10, 2016 at 7:30 with Lee Priest conducting

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Dr. Palin is teaching an astronomy class, and several members have already signed up. The cost is $39.00 each and the class will be three nights, April 6, 13, and 20 from 6:00 to 8:00 pm.

The St. George star party was clouded out. For those that attended, we had a good time. Some of us went to Snow Canyon and did some hiking. Most of us met at Virgin River Casino and had the buffet on Saturday night. It was fun to get to know each other and hang out.

Our first Antelope Island star party is on the 4/9. Dave handed out cards to those attending the meeting and will mail the rest out. The card will gain you access to the island for the star party.

The meeting was then turned over to Dale Hooper for a lab exercise on the Hubble Law. Dale brought an exercise from the April 1978 Sky and Telescope to allow us to understand the law and do our own measurements. This exercise was originally done by the club back then with Bob Tillotson leading it. Another fun part will be repeating the measurements more accurately to see if I can get better numbers.

The meeting was adjourned at 9:15 where several members went to Village Inn.

## Star Parties

Public

- 4/9 – Antelope Island
- 5/14 – Antelope Island (Astronomy Day)
- 6/4 – Antelope Island
- 8/6 – Antelope Island
- 9/24 – Antelope Island
- 10/1 – North Fork Park
- 10/22 – Antelope Island

Requested

- 4/28 – Burton Elementary

Private

- 5/6-5/7 – Curlew
- 7/27-30 – Monte Cristo
- 8/31-9/5 – Monte Cristo
- 9/30-10/1 – North Fork Park
- 10/28-29 - Curlew

External

- 5/1-8 - http://texasstarparty.org/get-started/
- 6/1-4 – Bryce Canyon Astronomy Festival
- 6/4-11 – Grand Canyon Star Pary
- 8/2-7 – www.oregonstarparty.org
- 9/29-10/1 – Great Basin Astronomy Festival
-

## Year in Space calendars

Lee might still have 2 Year in Space calendars (I forgot to ask him). They are $11.95 each, if you want one but won't be to the meeting you can contact him at levae@aol.com

# 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 radiotelescopes 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.

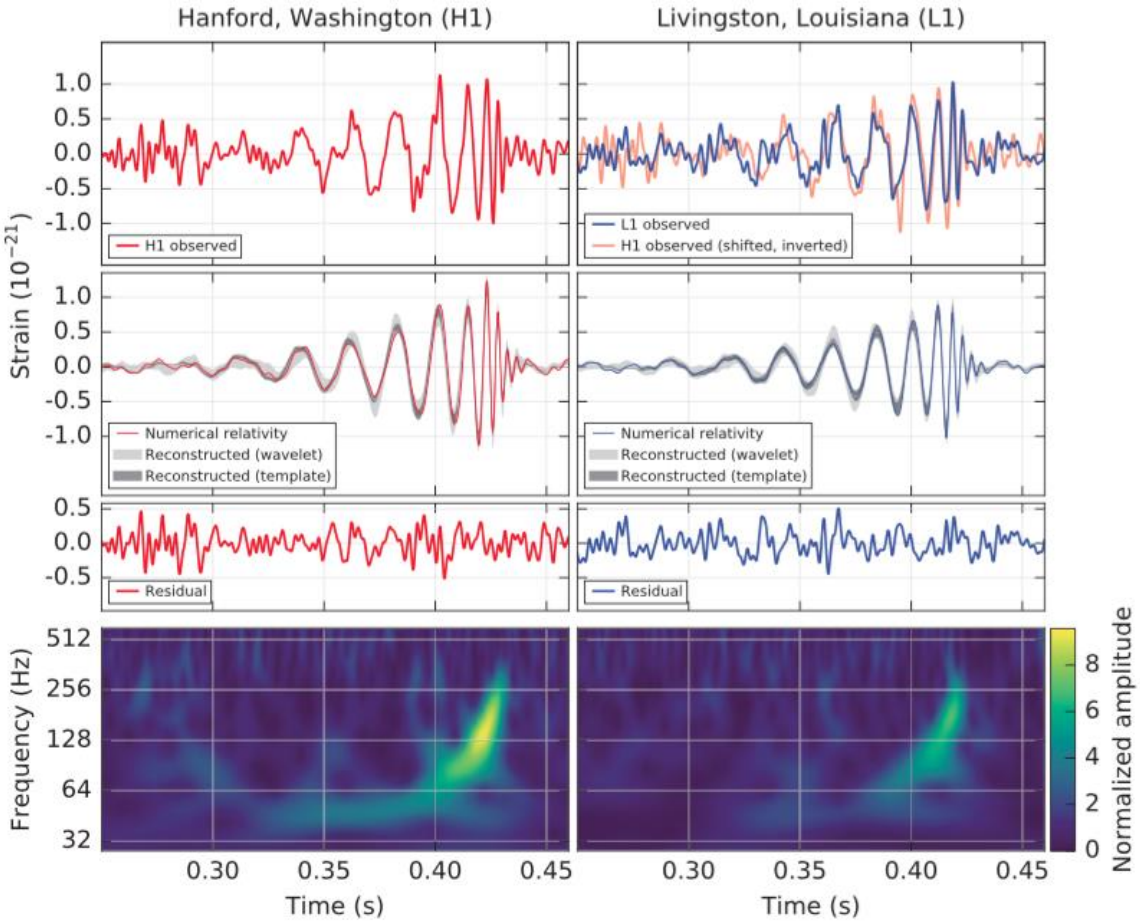


Image credit: Observation of Gravitational Waves from a Binary Black Hole Merger B. P. Abbott et al., (LIGO Scientific Collaboration and Virgo Collaboration), Physical Review Letters 116, 061102 (2016). This figure shows the data (top panels) at the Washington and Louisiana LIGO stations, the predicted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