Issue 2017-12

IO – December 2017

The Newsletter of the Eugene Astronomical Society

PO Box 7264
Springfield, OR 97475

Next Meeting: *Thursday, December 21*

Potluck and Swap Meet

(Summary by Jerry Oltion)

The December meeting is our annual potluck and swap meet. Bring food to share and gear to sell! We'll meet in the conference room to the right side of the exhibit hall. We may set up our gear in the exhibit hall, so bring spare folding tables if you have any.

EAS

President
Diane Martin (541-554-8570)

Secretary
Jerry Oltion (541-343-4758)

Additional Board members
Jim Murray
Oggie Golub
Andy Edelen

Annual Club Dues $25
Meetings at 7:00 at the
Science Factory, Eugene

EAS is a proud member of the
Astronomical League

First Quarter Friday Report

Our November First Quarter Friday was held at the College Hill Reservoir on November 24. The skies cooperated enough to observe a few objects (mostly the Moon, Albireo, Almach [Gamma Andromedae], M15, and M31), and a few members of the public stopped in to observe through five telescopes.

Our final First Quarter Friday for 2017 is December 29 (87% lit). Bring a scope and join in!

First Quarter Fridays have been scheduled for 2018. The chosen dates are:

January 19 (7% lit)	February 23 (49% lit)	March 23 (40% lit)
April 20 (27% lit)	May 18 (15% lit)	June 15 (6% lit)
July 20 (60% lit)	August 17 (45% lit)	September 14 (29% lit)
October 12 (15% lit)	November 9 (5% lit)	December 14 (44% lit)

Membership Dues are Due!

EAS membership runs from *October* thru *September*. If you haven't renewed already, please bring your payment to the meeting or mail your dues to the Eugene Astronomical Society, PO Box 7264, Springfield, OR 97475. Dues are still the same low $25 they've been for years. Make your checks payable to Eugene Astronomical Society.

November Meeting Report

Our November 16th meeting featured a talk by Bernie Bopp on the discovery of gravity waves by scientists working with data from LIGO, the Laser Interferometer Gravitational-Wave Observatory.

On September 14, 2015, just before 11 AM Greenwich Time, two gravity-wave detectors vibrated for a quarter of a second with an amplitude less than the diameter of a proton. This vibration marked the merger of two black holes over a billion light-years away. This was the first detection of gravity waves.

Leading up to his discussion of this event, Bernie first discussed the fundamentals of gravity: as one of the four primary forces in the universe (with the strong and weak nuclear forces and electromagnetic radiation), which are collectively in turn one of the two primary concepts needed to understand the universe (the other being subatomic particles). It was Einstein who added gravity to Newton's model of space as a 3-D coordinate system; Einstein demonstrated that space is warped by mass/gravity, and more-massive objects, i.e. black holes, can warp space to a greater extent, such that they can "punch a hole" in the fabric of space itself. Einstein, however, was not convinced that gravitational waves would ever be detected, despite his general relativity being proven by observing the light of distant stars being bent by the Sun during a solar eclipse.

Gravitational waves are created by extremely-massive objects in motion: objects such as supermassive stars orbiting each other, galaxy clusters (which can "lens" the light of objects behind them), neutron stars, and pulsars. One such object was discovered in 1974—a double pulsar whose orbits were decaying and were thus radiating gravitational waves; this led to the discovery of gravitational radiation.

But how does LIGO work to detect these gravitational waves? The concept of interferometry—combining light from multiple detectors to become a single, more sensitive detector—has been around for a hundred years. LIGO does this with gravitational waves. A 200-watt laser beam is split at a 90-degree angle (X and Y "arms") and reflected back to the detector by high-precision mirrors. The returning signal should be perfectly smooth, unless jostled out of alignment by a gravity wave, which will make the beam oscillate before reaching the detector. To ensure that no terrestrial processes give false signals, the arms of the detector are three to four kilometers long and contain only temperature-controlled vacuum. The arms are heavily insulated against vibration, and any terrestrial process that could cause such a vibration would only be detectable at one of the three existing LIGO sites (making it clear that it was a false detection).

The first detection at LIGO was a quarter-second long and saw an increase in both amplitude and frequency a thousandth of the width of a single proton. It was detected at the Hanford, WA and Livingston, LA LIGO sites, and the 0.007-second delay between the two sites' detection was exactly what would be expected given their geographic separation. The data indicated the merger of two black holes, of 36 and 29 solar masses, into a single 62-solar mass object. (The extra three solar masses were converted into the gravitational waves that were detected.)

At present, six detections have been made by the three existing LIGO sites (the third site is near Pisa, Italy, and was not yet online when the first detection was made). The first five of these detections were of black hole mergers; the sixth indicated the merger of two neutron stars. These neutron stars were smaller in mass and size than the previously-detected merging black holes, resulting in a higher-frequency signal of six seconds' duration. The neutron star merger was also detected as a gamma-ray burst and, a day later, as an optical phenomenon in the galaxy NGC 4993 (in the constellation Hydra). This event was labeled a *kilonova*—having a thousand times the radiation of a standard nova—and indicated the merger of neutron stars of 1.2 and 1.6 solar masses.

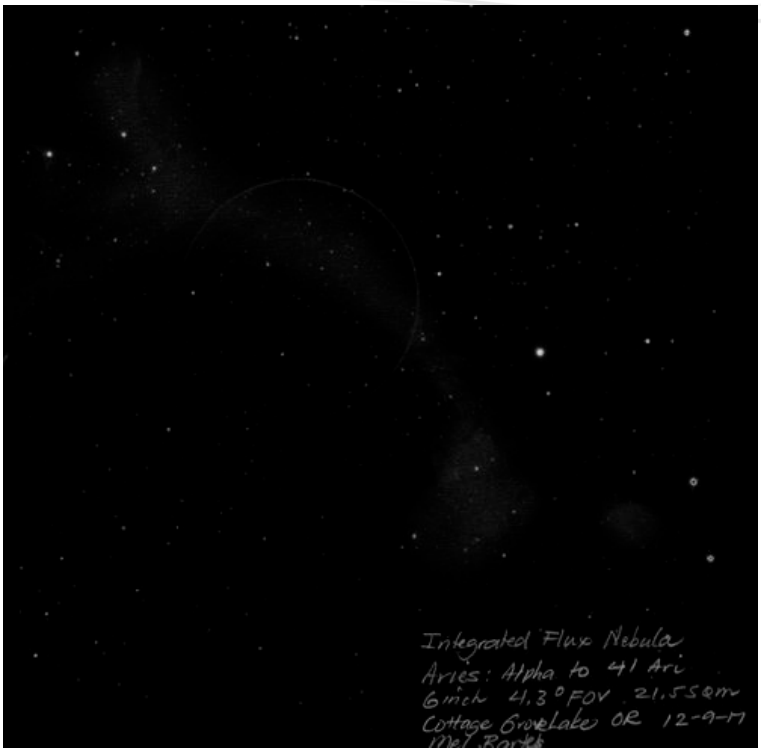
Having discussed the past and present of LIGO, Bernie closed with a discussion of its future. A number of other LIGO sites are being built, most notably in India and Japan. Of even greater importance is the construction of a space-based LIGO called LISA (Laser Interferometer Space Antenna) which would allow for a larger array free from terrestrial vibration, and which could therefore detect signals at much lower frequencies, such as the creation of supermassive black holes (like those at the center of galaxies).

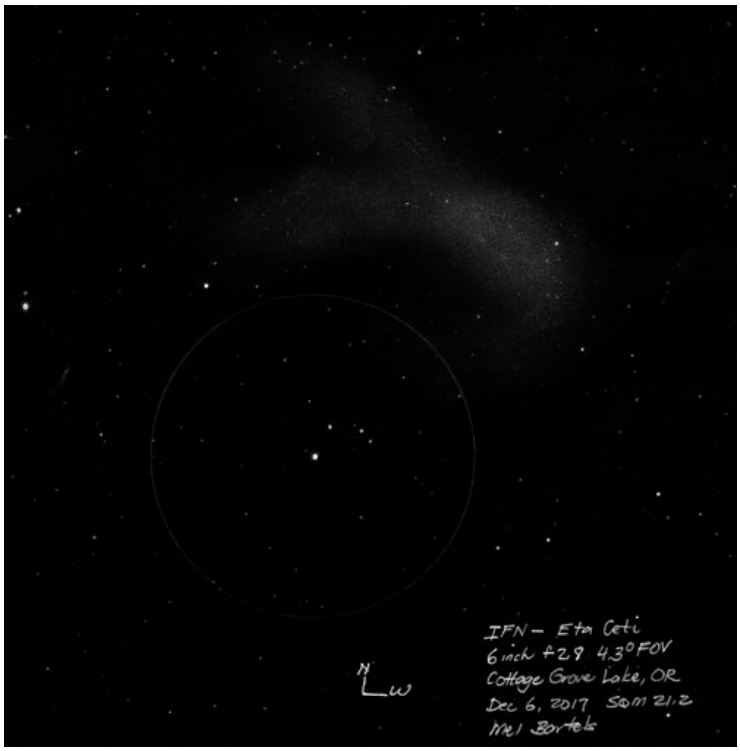
Thanks, Bernie, for the fascinating discussion!

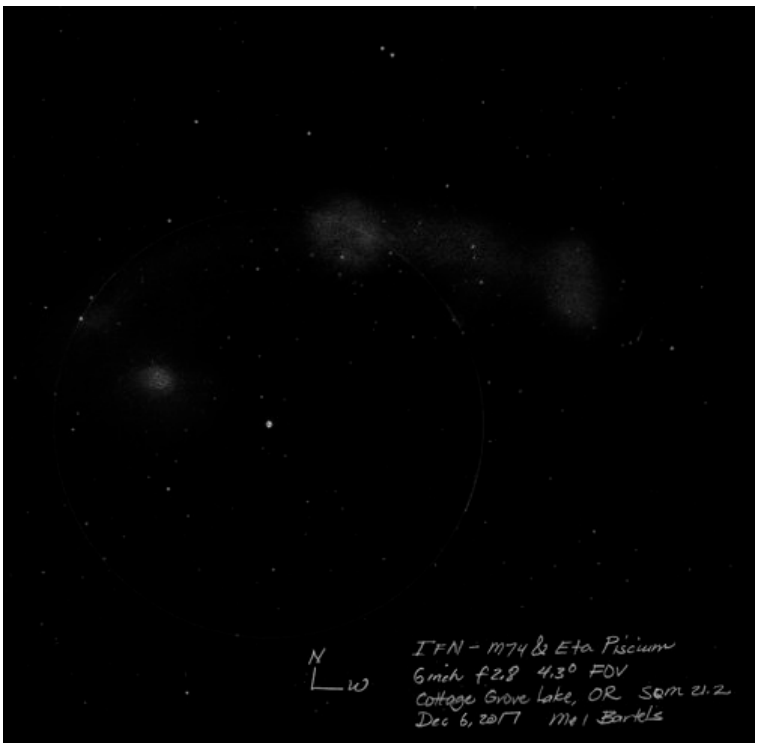
EAS Members' Gallery

Above: The planet Uranus, December 10th.

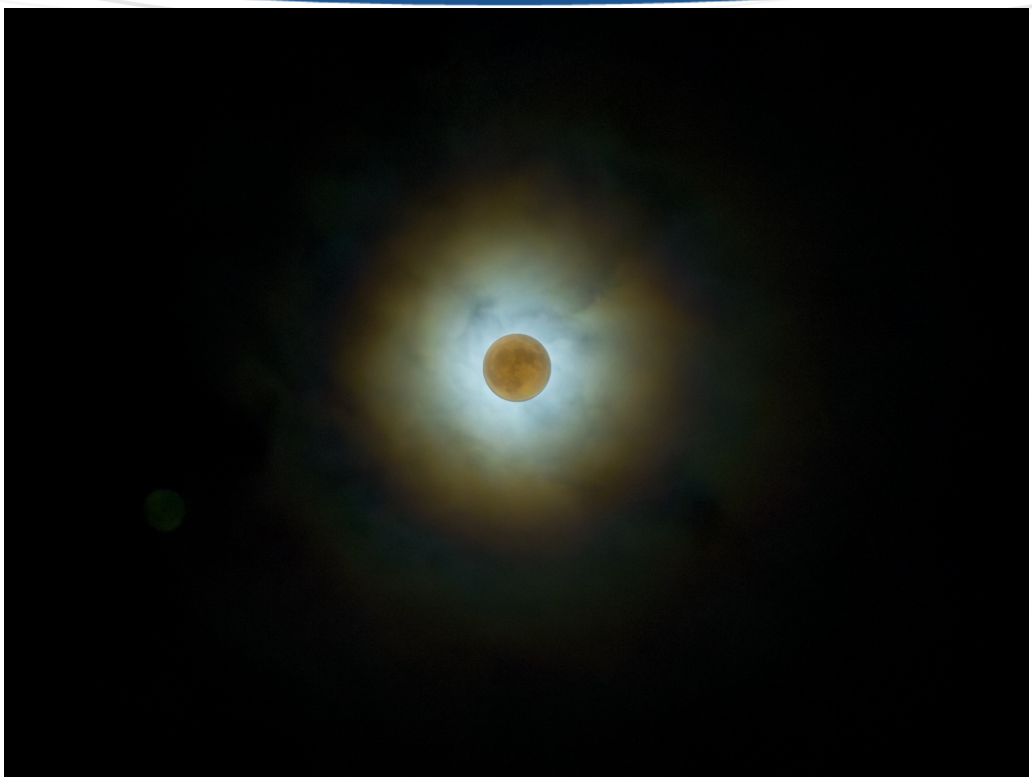
Below: Uranus with moons, December 10th. *Photos by Jeff Phillips*.







Sketches of Integrated Flux Nebulae: along the constellation Aries (top left), near Eta Ceti (center right), and near M74 in Pisces (bottom left). *Sketches by Mel Bartels.*



Top: December 3rd Supermoon. Bottom: Prairie City sunset. *Photos by Joe Earp.*

Top: Orion setting, November 24th. Bottom: Betelgeuse and environs. *Photos by Alan Gillespie.*

Augurs of Spring. *Photo by Alan Gillespie.*

Sun & Moon rise and set for December

Date	Moon Rise	Moon Set	Twilight Begin	Sun Rise	Sun Set	Twilight End
12/1/2017	15:44	04:44	05:44	07:28	16:35	18:19
12/2/2017	16:25	05:59	05:45	07:29	16:35	18:18
12/3/2017	17:14	07:14	05:46	07:30	16:35	18:18
12/4/2017	18:10	08:26	05:47	07:31	16:35	18:18
12/5/2017	19:14	09:31	05:48	07:32	16:34	18:18
12/6/2017	20:23	10:27	05:49	07:33	16:34	18:18
12/7/2017	21:33	11:15	05:50	07:34	16:34	18:18
12/8/2017	22:43	11:55	05:51	07:35	16:34	18:18
12/9/2017	23:50	12:29	05:51	07:36	16:34	18:18
12/10/2017	-	13:00	05:52	07:37	16:34	18:18
12/11/2017	00:56	13:28	05:53	07:37	16:34	18:19
12/12/2017	01:59	13:56	05:54	07:38	16:34	18:19
12/13/2017	03:01	14:23	05:54	07:39	16:34	18:19
12/14/2017	04:02	14:53	05:55	07:40	16:35	18:19
12/15/2017	05:02	15:24	05:56	07:41	16:35	18:20
12/16/2017	06:00	15:59	05:56	07:41	16:35	18:20
12/17/2017	06:57	16:39	05:57	07:42	16:36	18:20
12/18/2017	07:50	17:23	05:58	07:43	16:36	18:21
12/19/2017	08:38	18:11	05:58	07:43	16:36	18:21
12/20/2017	09:23	19:04	05:59	07:44	16:37	18:22
12/21/2017	10:02	20:01	05:59	07:44	16:37	18:22
12/22/2017	10:38	20:59	06:00	07:45	16:38	18:23
12/23/2017	11:10	22:00	06:00	07:45	16:38	18:23
12/24/2017	11:40	23:02	06:01	07:46	16:39	18:24
12/25/2017	12:08	-	06:01	07:46	16:40	18:24
12/26/2017	12:36	00:05	06:01	07:46	16:40	18:25
12/27/2017	13:06	01:11	06:02	07:47	16:41	18:26
12/28/2017	13:38	02:20	06:02	07:47	16:42	18:26
12/29/2017	14:15	03:31	06:02	07:47	16:43	18:27
12/30/2017	14:58	04:45	06:03	07:47	16:43	18:28
12/31/2017	15:49	05:58	06:03	07:47	16:44	18:29

STORAGE JUNCTION

Thank you, Storage Junction

Storage Junction has donated the use of a storage unit for us to hold our loaner telescopes when they're not in use. EAS would like to thank Storage Junction for their generosity and support for our group. Please give them a call if you need a storage space, and tell your friends. Storage Junction is located at 93257 Prairie Road (at the intersection of Hwy 99 and Hwy 36, 3 miles south of Junction City) Phone: 541-998-5177

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Observing In December

Full | Last Q | New | 1st Q

Dec 3, 7:47 AM	Dec 9, 11:51 PM	Dec 17, 10:30 PM	Dec 26, 1:20 AM
Mercury Set: 5:36 PM	Mercury lost in Sun	Mercury lost in Sun	Mercury Rise: 6:01 AM
Venus Rise: 6:45 AM	Venus Rise: 7:00 AM	Venus Rise: 7:18 AM	Venus lost in Sun
Mars Rise: 3:34 AM	Mars Rise: 3:30 AM	Mars Rise: 3:25 AM	Mars Rise: 3:19 AM
Jupiter Rise: 4:54 AM	Jupiter Rise: 4:37 AM	Jupiter Rise: 4:13 AM	Jupiter Rise: 3:46 AM
Saturn Set: 5:41 PM	Saturn Set: 5:24 PM	Saturn lost in Sun	Saturn lost in Sun
Uranus Set: 3:35 AM	Uranus Set: 3:10 AM	Uranus Set: 2:38 AM	Uranus Set: 2:02 AM
Neptune Set: 11:44 PM	Neptune Set: 11:21 PM	Neptune Set: 10:50 PM	Neptune Set: 10:15 PM
Pluto Set: 7:10 PM	Pluto Set: 6:47 PM	Pluto Set: 6:17 PM	Pluto Set: 5:43 PM

Items of Interest This Month

Orion! 'Nuff said.

12/3 Moon cruises through Hyades all night, occults Aldebaran just before moonset/sunrise (6:18, reappearance 6:45) (Note: this is a "supermoon, i.e. moon is near perigee when full.)

12/6 Earliest end of evening twilight

12/9 Earliest sunset

12/11–12/21 Asteroid Phaethon at its brightest (10.7 mag.) This is the source of the Geminid meteor shower.

12/13-–12/15 Geminid meteor shower

12/20 morning: Jupiter rises within a degree of Zubenelgenubi (Alpha Librae)

12/21 Winter solstice 8:28 AM

12/29 First Quarter Friday star party

12/30 Moon occults Aldebaran 3:15 PM, reappearance 4:04 PM. Moon will be low in east, nearly full.