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THE MASON-DIXON ASTRONOMER

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From the editor

It is my pleasure to welcome you to the first edition of the new WASI newsletter.

It goes without saying that we owe a great deal of gratitude to Dave Gede for helming this publication through the years. Suffice to say, he's left some rather large shoes for me to fill and I'll do my upmost to serve as your new editor.

Obviously, there are always changes that come with a changing of the editorial guard. I hope you'll bear with me as I learn the ropes of editing a newsletter, and very much welcome your comments and suggestions.

ad astra,

Christian Ready
Editor, MDA
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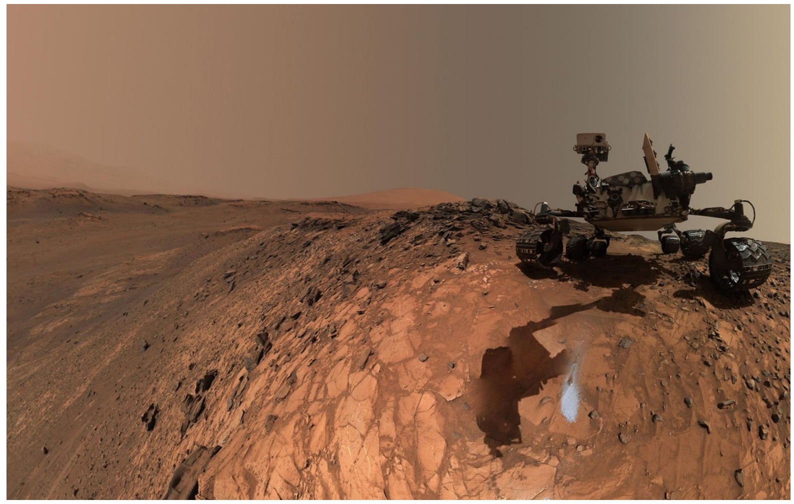

MSL Curiosity revealing ice on Mars (NASA/JPL-Caltech/MSSS)

Star Points: Finding a Pathway to Mars

by Curtis Roelle, Chairman

In March the Mars Reconnaissance Orbiter (MRO) spacecraft achieved its 10th anniversary in orbit around the red planet. With six other active missions from three nations currently either on the planet's surface or orbiting it, I thought now would be a good time to review the current state of Mars exploration, and developing plans for future manned missions.

The main objectives of MRO is returning high resolution imagery to help answer scientific questions and to assist in the selection of landing sites for surface missions. There are currently five orbiters (including MRO) and two rovers operating at Mars.

NASA's 2001 Mars Odyssey has been functioning in Mars orbit since, well, 2001 as it captures surface imagery in infrared wavelengths both day and night along with several other instruments. It also acts as a relay station for communications between the unmanned Opportunity and Curiosity rovers operating on the surface and their NASA handlers.

Mars Express (ME) is an orbiter operated by the European Space

April Meeting

Wednesday, April 13, 7:30pm
Bear Branch Nature Center

Guest Speaker: Dr. Alex Storrs
Associate Professor of
Astronomy, Towson University

Topic: the latest from Pluto and the New Horizons mission.

Dr. Storrs' research focuses on high-resolution images of asteroids, primarily with the Hubble Space Telescope. His "snapshot" survey of asteroids recently confirmed a companion to 87 Sylvia (cf. IAUC 7590), and the discovery of a companion to 107 Camilla (cf. IAUC 7599).

In addition to his teaching and research duties, Dr. Storrs is director of the Watson-King Planetarium and the Observatory at Towson University. Public planetarium shows are held throughout the year on the third Friday of every month at 8 p.m.

Pre-meeting dinner

6:00pm at Harry's Main Street Grill
65 West Main Street, Westminster

Agency (ESA). In Mars orbit since 2003, it was accompanied by a lander named Beagle 2. Although Beagle 2 failed in achieving its mission, ME has been returning 3D and color images ever since.

NASA's Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft reached Mars orbit in 2014 on its mission of contributing to the understanding of processes occurring in the upper Martian atmosphere. In 2012 I had a unique opportunity to visit the facility located in the foothills of the Rockies outside of Denver to observe the spacecraft during its assembly.

India's first interplanetary spacecraft named Mars Orbiter Mission (MOM) entered Mars orbit two days after MAVEN in 2014 where it has been operating ever since. Billed as a "technology demonstration" mission, MOM has five experiments onboard including the low resolution Mars Colour Camera (MCC).

Meanwhile, driving around on the surface of Mars is Opportunity, a roving vehicle transmitting data since landing in early 2004. It is currently exploring a crater named Endeavour. Its twin rover Spirit operated until 2010. After hobbling for years with a stuck wheel, Sprit became mired in deep sand and eventually lost electrical power due to discharged batteries.

The Mars Science Laboratory (MSL) rover, nicknamed Curiosity, landed on Mars as planned inside a crater named Gale in 2012. It is currently navigating some very gnarly terrain on Mars' Naukluft Plateau. Progress is slow as scientists must review returned images to plot the next leg of the route, a few meters at a time.

NASA's manned exploration of Mars is still a ways off. The current administration killed the Constellation program proposed by the previous administration. Constellation's goals included replacing the space shuttle and developing new space vehicles in support of a manned return to the moon by 2020. It was envisioned that the required hardware would eventually be developed for a manned landing on Mars in the 2030s.

On the other hand, the current administration favors a plan to develop and send an unmanned spacecraft to capture either a small asteroid or a boulder from an asteroid and place the retrieved rock into lunar orbit where it would be visited and studied by astronauts. One of the major criticisms of this program is that an eventual manned mission to Mars is not one of the programs primary or secondary objectives.

One element of the canceled Constellation program that survives in the new asteroid return program is the Orion spacecraft Crew Module. Designed as a space vehicle for supporting long duration human exploration, its first unmanned test came in 2014 during Exploration Flight Test 1 (EFT-1) which sent an Orion CM on a suborbital mission lasting several hours.

The next unmanned Orion flight, Exploration Mission 1 (EM-1), is currently scheduled for 2018 and will be the first test with a new rocket launch vehicle called the Space Launch System (SLS) and a service module (SM) being developed by ESA. The SLS will be the most powerful rocket ever built, standing taller and with more thrust than the previous giant – the Saturn V rocket that lifted astronauts to the moon nine times. EM-2, the first manned Orion mission is presently planned for the early 2020s and could send astronauts on a trip around the moon for the first time in 50 years.

Upcoming Events

Constellation Party

Date: Sunday 4/10/2016, 6:00 PM
Location: Charlottes Quest Nature Center, Manchester MD
Contact: Robert Clark (rlclark21157@gmail.com)

WASI Planetarium Show & Star Party

Date: Saturday, 4/16/2016 at 7:30 PM
Location: Bear Branch Nature Center, 300 John Owings Rd., Westminster, MD 21158

Rockville Science Day

Date: Sunday, 4/24/2016, 12:00 PM - 5:00 PM
Location: Montgomery College/ Rockville Campus, 51 Mannakee St, Rockville, MD 20850

Patapsco Family Fun Day

Date: Sunday, 4/24/2016, 1:00 PM - 4:00 PM
Location: Patapsco Valley State Park Avalon Area, Ellicott City, MD

Gravitational Wave Astronomy Will be the Next Great Scientific Frontier

by Ethan Siegal

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.

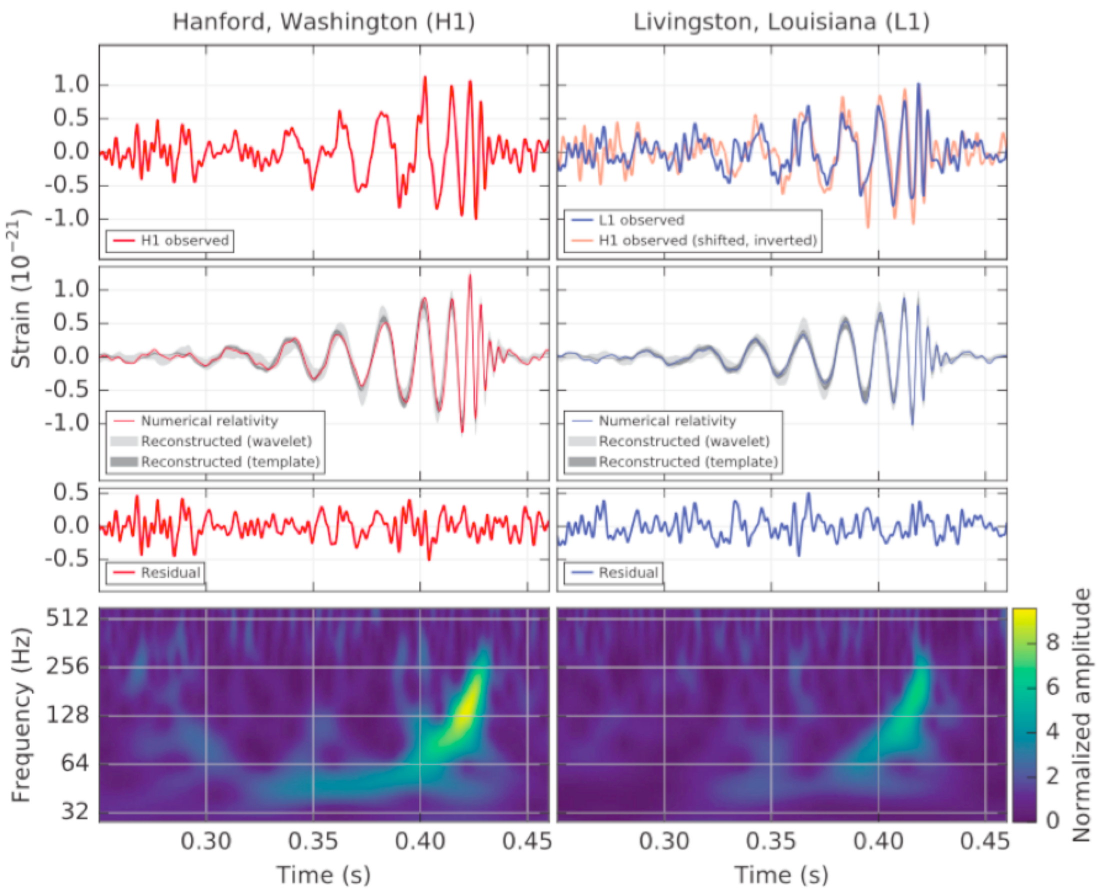

Image credit: Observation of Gravitational Waves from a Binary Black Hole Merger B. P. Abbott et al., (LIGO Scientific Collaboration and Virgo Collaboration), Physical Review Letters 116, 061102 (2016). This figure shows the data (top panels) at the Washington and Louisiana LIGO stations, the predicted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

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