CONSTELLATION

the official publication of Bucks-Mont Astronomical Association, Inc

Vol 33, No 2 Spring 2018 Scott Petersen, editor

RADIO ASTRONOMY

- by Robert Welsh

Radio astronomy allows the scientific community to observe the Universe at a wavelength much longer than the traditional optical observations. Optical observations occur at wavelengths from red (700 nanometers) to violet (450 nanometers); whereas radio observations take place on wavelengths that cover a range of 10s of meters to millimeters.

A radio telescope system is normally a large parabolic reflector such that the focal point carries a very sensitive radio receiver. These receivers have been traditionally cooled to the temperature of liquid nitrogen (77 kelvin) but now are being cooled to liquid helium temperatures (4 kelvin). The need to cool the receivers yields a high signal-to-noise ratio even though the 'signal' itself is noise.

The noise is generated by two phenomena: the spin flip (angular momentum) of the single electron in the hydrogen atom; or the synchrotron radiation from electrons spiraling in a magnetic field. Whatever natural phenomena that radio astronomers observe allows the mapping of these energies. Additionally, there are is large quantity of spectral lines in the radio part of the electromagnetic spectrum that originate in complex organic molecules.

Using radio waves to understand nature is a tool that furthers the understanding of the physics of astronomical events. Recent measurements have allowed radio astronomers to 'look' into the black hole in the center of our galaxy; whereas, the gas and dust lanes obscure optical phenomena. Using the Doppler shift of known spectral lines allows astronomers to gauge recession speeds and distances to celestial objects.

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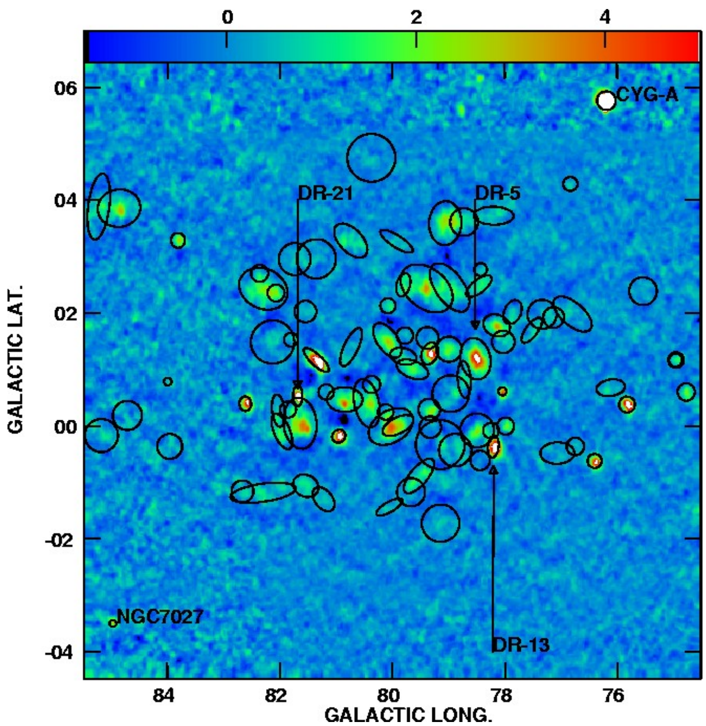

Radio image of the Cygnus Loop taken at a wavelength of 2.1 centimeters using the 13.6 meter system.

The 13.5 meter parabola used to receive the energy of the Cygnus loop at a wavelength of 2.1 centimeters. The object NGC7027 is a planetary nebula at 960 parsecs; the DR regions are star-forming regions in Cygnus at 1840 parsecs; Cyg A is an X-ray source in the constellation Cygnus which contains a black hole at 1900 parsecs. I made this observation as part of the Galactic Plane A study.

For those interested in further information on radio astronomy, I suggest looking at the following web site that I created while working at the National Radio Astronomy Observatory, Green Bank WV: http://www.gb.nrao.edu/~glangsto/lessons/index.html

Robert Welsh, Assistant Professor: Physics & Astronomy
Bucks County Community College, Newtown PA.
Associate Astronomer: Green Bank Observatory

- Robert Welsh made this presentation at the April BMAA general meeting [-ed]

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Bucks-Mont Astronomical Association, Inc
General Meeting Minutes
February 7, 2018

Location: Upper Dublin Lutheran Church, 411 Susquehanna Road, Ambler PA 19002

Meeting called to order by Dwight Dulsky at 7:30p. In attendance: 44 members and guests

Officers: Dwight Dulsky and Lee Zagar (co-presidents), Robert Mittel-Carey (secretary)

- March 7th Meeting – Radio Astronomy with Rob Welsh, N3RW.
- Starwatch calendar completed; to be “officially” released soon.
- Howie Grodzitsky appointed Starwatch coordinator. Bill Scherr appointed assistant to the treasurer.
- Dr. Chris D’Andrea presented a brief recap of the winter 2018 meeting of the American Astronomy Society (AAS).
- Show and Tell
    - Igor – astrophotos of NGC281 the Pacman Nebula, NGC 1574 Northern Trifia Nebula. Also shared his 2018 astrophoto calendar, and a recap on a new location useable by members of the Chesmont club on Hawk Mountain.
- Dwight shared that the Chesmont club is looking into running some “regional” clubs only star parties in June and July.
- Dr. Small of Upper Dublin school district; new school needs public support to keep a planaterium in the plans.

➢ **Main Topic: “Black Holes, Wormholes and the Quantum Labyrinth: How Wheeler and Feynman Revolutionized Astronomy and Physics.” - Dr Paul Halpern**

Dr Halpern of the University of the Sciences gave a great presentation based on his most recent book, and had books available for sale at the end of the meeting that we was willing to sign as well.

Respectfully submitted,
Robert Mittel-Carey, secretary

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SCOTT PETERSEN
CONSTELLATION EDITOR
constellation@bma2.org
TEL: 215.598.8447

Bucks-Mont Astronomical Association, Inc
General Meeting Minutes
April 4, 2018

Location: Upper Dublin Lutheran Church, 411 Susquehanna Road, Ambler PA 19002

Meeting called to order by Dwight Dulsky at 7:30p. In attendance: 42 members and guests

Officers present: Dwight Dulsky and Lee Zagar (co-presidents), Gary Sprague (vice-president), Robert Mittel-Carey (secretary)

- Note: the March 7 General Meeting was canceled due to inclement weather [-ed]

- Notice to club: NEAF dates 4/21-22/18
- Dwight recapped the focus on light pollution for 2018 with photos showing examples.
- Displayed new club banner with an astrophoto submitted by Brad Miller. Working on IDSA signs.
- Howie reviewed current starwatch calendar.
    - 4/21 – Sunwatch
    - 4/22 – starwatch at Nockomixion
- Show & Tell
    - Gary – SpaceX launch photos from 2/6/18
    - Igor – several astrophotos, and his new astrophotography set-up.

➢ **Main Topic: Radio Astronomy – Rob Welsh, N3RW**

Rob presented a brief, but informative overview of radio astronomy; from its very beginnings up to current applications. Additionally, we had several members of two local amateur radio clubs attend due to this presentation. Two from the Warminster Amateur Radio Club (WARC), and one from the Philadelphia Digital Radio Association (PDRA).

Respectfully submitted,
Robert Mittel-Carey, secretary

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2018 BMAA officers

info@bma2.org

Dwight Dulsky, co-president
Lee Zagar, co-president
Gary Sprague, vice-president
Robert Mittel-Carey, secretary
Ed Radomski, treasurer

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Observing for April

Rating Optical Quality

- by Bernie Kosher

- Note: This was originally printed in the CONSTELLATION, April 2000, and revised here [-ed]

You've decided to buy a new scope, or perhaps the optics only for a home made Dob. Or just to replace the mirror in your current scope as the images are inferior. So you collect info from ads, your friends and cruise the internet sites looking for the right thing.

So, having done this, you realize there is an enormous range of prices on the same 10" mirror. Ane they all have different specs. What to do?

Optical quality is not easily defined. One man will be pleased with a scope that another thinks is only average. While a large Newtonian Dob can be passable with fair optics, a planetary refractor would require exquisite (read expensive) optics. Rating one against the other is not a fair test.

The only answer is to try it yourself. Deal with a company or person who will guarantee the product to perform to it's specifications. Do not expect perfection if it is not explicitly guaranteed, but do expect performance to stated specifications.

What is the advantage of superior optics? As you know, the scope brings light to a focus. Due to the wave nature of light, the image of a star is not a point, but a disk of size dependent on the aperture. The larger the aperture, the smaller is the disk (really.) In a perfect scope most of the light will be imaged into this disk with some of the light forming rings. The light will not fall into this disk if the mirror has errors of curvature or roughness of surface. Using star tests one can qualify, but not quantify, the errors. A complete star test is the best testing method but is beyond the scope of this article. We'll cover that in the future.

The generally accepted minimum for decent optics is 1/4 wavefront error. However, and the however is a big one, where and how is this measured by the vendor? For the record, very critical planetary observers claim they can detect a difference in the contrast at 1/20 wave or better.

This 1/4 wave error should be a total wavefront error at the focal plane, and should be smooth over the majority of it's surface to better than 1/20 wave. The error should be measured peak to valley. Note that this includes the reflection off the diagonal of a reflector. In a refractor it should be straight through. You are responsible for the quality of any star diagonal added to the system, and the same goes for eyepieces.

Beware of statements concerning only the mirror surface error, and statements including the terms RMS, averaged and other jargon of the trade. A mirror can be legitimately rated at 1/32 wave and still be 1/4 wave on the wavefront. Here's how this can be done.

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The mirror has, say, a 1/8 wave low zone. Since the light traverses this zone twice (once on the way in, once after reflection) we now have a 1/4 wavefront error. So the vendor rates the mirror as 1/8 wave. Then the marketing department says "This can be rated with the RMS deviation method." Whazzat? RMS means 'root mean square' and in pure usage is the peak of a sine wave divided by 1.4 (round numbers...or multiplied by .707). However, this is done by measuring from the median of the wave. So, if one draws a sine wave with a peak to peak value of 2 units, the RMS value is .707, which is a factor of 2.8. So that same 1/8 wave mirror now is rated at 1/22. The eye is most sensitive to light at about 5500 angstroms (550 nanometers for you metric freaks), but his mirror was measured with a laser emitting light in the deep red at about 7500 angstroms, so we can again multiply by 1.36 and come up with about 1/30. If one goes through the calculations with rounding and exact frequency it is 1/32.

Oh dear. Then add the errors of the diagonal.

A true master of the art of precision mirrors, Peter Ceravalo, wrote an article describing a set of mirrors he made with progressively better optics. The aberrations were all purely spherical undercorrection in the amounts of 1, 1/2. 1/4 and one essentially perfect. These were set up at star party in similar scopes. Many observers were invited to try them out and give their evaluations. The two poor mirrors were detected by almost everyone, but only a few could tell the difference in the 1/4 and perfect mirror. The seeing was described as moderate, which may have prevented the perfect mirror giving it's best performance. The moral? Optical quality is a real thing and should be treated as such.

If the scope you have purchased does not live up to it's stated specs you are justified in returning or exchanging it.

Ratings

Unfortunately, there is no easy answer. I will not recommend any vendor in particular, nor will I recommend you take the advice of a knowledgeable friend on a particular product. The only sure way to be guaranteed of quality is to test it yourself.

Buy only if the the seller absolutely guarantees return and exchange if the product does not meet the stated specifications. This does not mean you can merrily return a scope that does not work as well as the one someone else has. It simply means the product should be returned if it does not do what the seller claimed.

I have yet to hear of a major company refusing to exchange or repair a scope that did not meet specs.

Addendum: The term RMS in optical ratings refers to a system wherein thousands of points on the surface are averaged. I cannot give a full description as there is variance from one authority to another, and I am not qualified to say which is correct. I believe my use of it is valid to a degree.

- BMAA member Bernie Kosher provides occasional articles for the CONSTELLATION [-ed]

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February 2018

What Is the Ionosphere?

- by Linda Hermans-Killiam

High above Earth is a very active part of our upper atmosphere called the ionosphere. The ionosphere gets its name from ions—tiny charged particles that blow around in this layer of the atmosphere.

How did all those ions get there? They were made by energy from the Sun!

Everything in the universe that takes up space is made up of matter, and matter is made of tiny particles called atoms. At the ionosphere, atoms from the Earth's atmosphere meet up with energy from the Sun. This energy, called radiation, strips away parts of the atom. What's left is a positively or negatively charged atom, called an ion.

The ionosphere is filled with ions. These particles move about in a giant wind. However, conditions in the ionosphere change all the time. Earth's seasons and weather can cause changes in the ionosphere, as well as radiation and particles from the Sun—called space weather.

These changes in the ionosphere can cause problems for humans. For example, they can interfere with radio signals between Earth and satellites. This could make it difficult to use many of the tools we take for granted here on Earth, such as GPS. Radio signals also allow us to communicate with astronauts on board the International Space Station, which orbits Earth within the ionosphere. Learning more about this region of our atmosphere may help us improve forecasts about when these radio signals could be distorted and help keep humans safe.

In 2018, NASA has plans to launch two missions that will work together to study the ionosphere. NASA's GOLD (Global-scale Observations of the Limb and Disk) mission launched in January 2018. GOLD will orbit 22,000 miles above Earth. From way up there, it will be able to create a map of the ionosphere over the Americas every half hour. It will measure the temperature and makeup of gases in the ionosphere. GOLD will also study bubbles of charged gas that are known to cause communication problems.

A second NASA mission, called ICON, short for Ionospheric Connection Explorer, will launch later in 2018. It will be placed in an orbit just 350 miles above Earth—through the ionosphere. This means it will have a close-up view of the upper atmosphere to pair with GOLD's wider view. ICON will study the forces that shape this part of the upper atmosphere.

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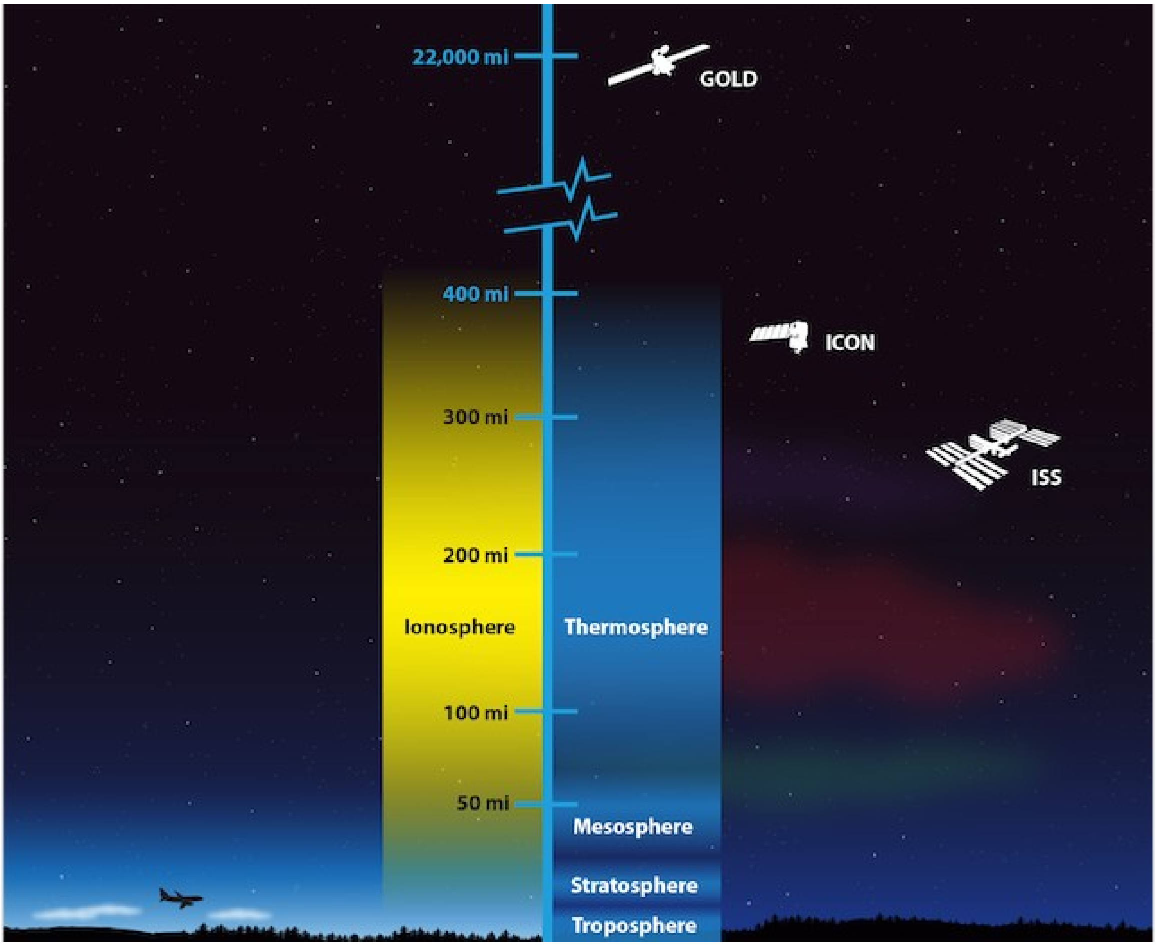
Both missions will study how the ionosphere is affected by Earth and space weather. Together, they will give us better observations of this part of our atmosphere than we have ever had before.

To learn more about the ionosphere, check out NASA Space Place:
https://spaceplace.nasa.gov/ionosphere



This illustration shows the layers of Earth's atmosphere. NASA's GOLD and ICON missions will work together to study the ionosphere, a region of charged particles in Earth's upper atmosphere. Changes in the ionosphere can interfere with the radio waves used to communicate with satellites and astronauts in the International Space Station (ISS). Credit: NASA's Goddard Space Flight Center/Duberstein (modified)

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- Space Place is provided by NASA to local astronomy clubs [-ed]

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March 2018

Measuring the Movement of Water on Earth

- by Teagan Wall

As far as we know, water is essential for every form of life. It's a simple molecule, and we know a lot about it. Water has two hydrogen atoms and one oxygen atom. It boils at 212° Fahrenheit (100° Celsius) and freezes at 32° Fahrenheit (0° Celsius). The Earth's surface is more than 70 percent covered in water.

On our planet, we find water at every stage: liquid, solid (ice), and gas (steam and vapor). Our bodies are mostly water. We use it to drink, bathe, clean, grow crops, make energy, and more. With everything it does, measuring where the water on Earth is, and how it moves, is no easy task.

The world's oceans, lakes, rivers and streams are water. However, there's also water frozen in the ice caps, glaciers, and icebergs. There's water held in the tiny spaces between rocks and soils deep underground. With so much water all over the planet—including some of it hidden where we can't see—NASA scientists have to get creative to study it all. One way that NASA will measure where all that water is and how it moves, is by launching a set of spacecraft this spring called GRACE-FO.

GRACE-FO stands for the "Gravity Recovery and Climate Experiment Follow-on." "Follow-on" means it's the second satellite mission like this—a follow-up to the original GRACE mission. GRACE-FO will use two satellites. One satellite will be about 137 miles (220 km) behind the other as they orbit the Earth. As the satellites move, the gravity of the Earth will pull on them.

Gravity isn't the same everywhere on Earth. Areas with more mass—like big mountains—have a stronger gravitational pull than areas with less mass. When the GRACE-FO satellites fly towards an area with stronger gravitational pull, the first satellite will be pulled a little faster. When the second GRACE-FO satellite reaches the stronger gravity area, it will be pulled faster, and catch up.

Scientists combine this distance between the two satellites with lots of other information to create a map of Earth's gravity field each month. The changes in that map will tell them how land and water move on our planet. For example, a melting glacier will have less water, and so less mass, as it melts. Less mass means less gravitational pull, so the GRACE-FO satellites will have less distance between them. That data can be used to help scientists figure out if the glacier is melting.

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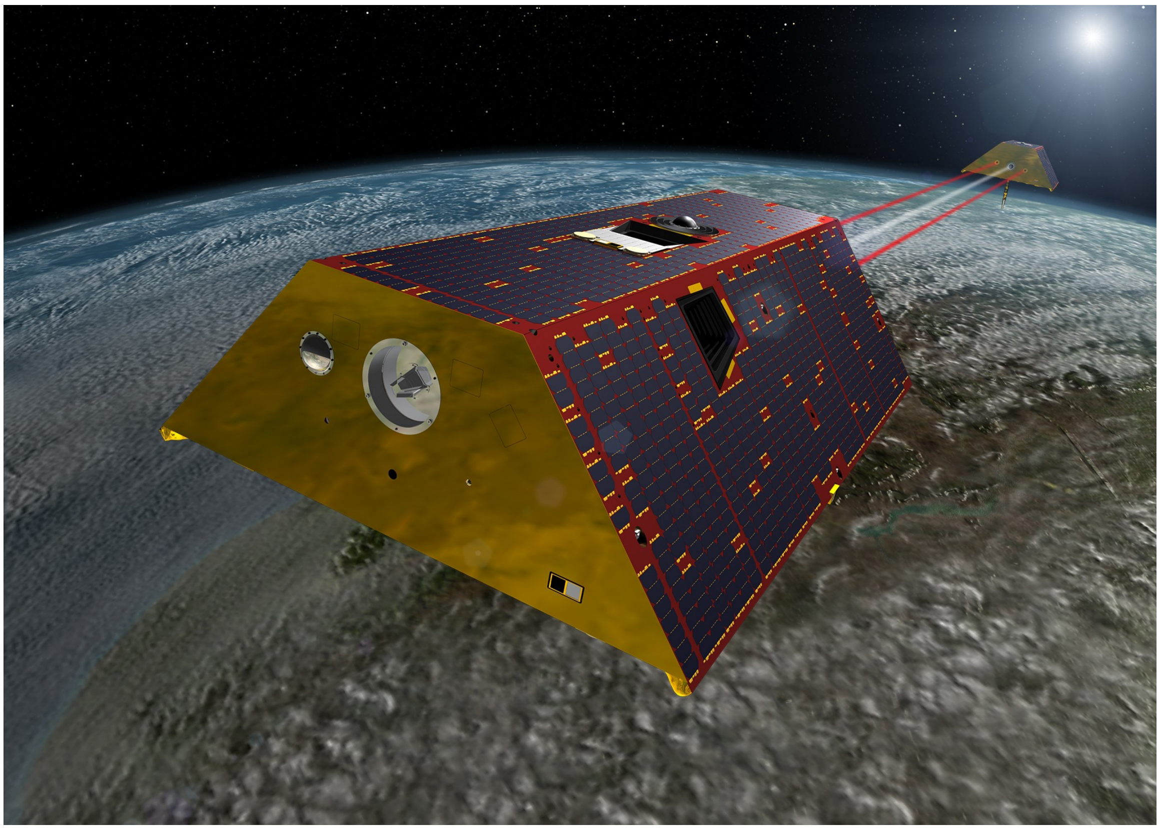
GRACE-FO will also be able to look at how Earth's overall weather changes from year to year. For example, the satellite can monitor certain regions to help us figure out how severe a drought is. These satellites will help us keep track of one of the most important things to all life on this planet: water.

You can learn more about our planet's most important molecule here: https://spaceplace.nasa.gov/water



An artist's rendering of the twin GRACE-FO spacecraft in orbit around Earth. Credit: NASA

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April 2018

What's It Like Inside Mars?

- by Jessica Stoller-Conrad

Mars is Earth's neighbor in the solar system. NASA's robotic explorers have visited our neighbor quite a few times. By orbiting, landing and roving on the Red Planet, we've learned so much about Martian canyons, volcanoes, rocks and soil. However, we still don't know exactly what Mars is like on the *inside*. This information could give scientists some really important clues about how Mars and the rest of our solar system formed.

This spring, NASA is launching a new mission to study the inside of Mars. It's called Mars InSight. InSight—short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport—is a lander. When InSight lands on Mars later this year, it won't drive around on the surface of Mars like a rover does. Instead, InSight will land, place instruments on the ground nearby and begin collecting information.

Just like a doctor uses instruments to understand what's going on inside your body, InSight will use three science instruments to figure out what's going on inside Mars.

One of these instruments is called a seismometer. On Earth, scientists use seismometers to study the vibrations that happen during earthquakes. InSight's seismometer will measure the vibrations of earthquakes on Mars—known as marsquakes. We know that on Earth, different materials vibrate in different ways. By studying the vibrations from marsquakes, scientists hope to figure out what materials are found inside Mars.

InSight will also carry a heat probe that will take the temperature on Mars. The heat probe will dig almost 16 feet below Mars' surface. After it burrows into the ground, the heat probe will measure the heat coming from the interior of Mars. These measurements can also help us understand where Mars' heat comes from in the first place. This information will help scientists figure out how Mars formed and if it's made from the same stuff as Earth and the Moon.

Scientists know that the very center of Mars, called the core, is made of iron. But what else is in there? InSight has an instrument called the Rotation and Interior Structure Experiment, or RISE, that will hopefully help us to find out.

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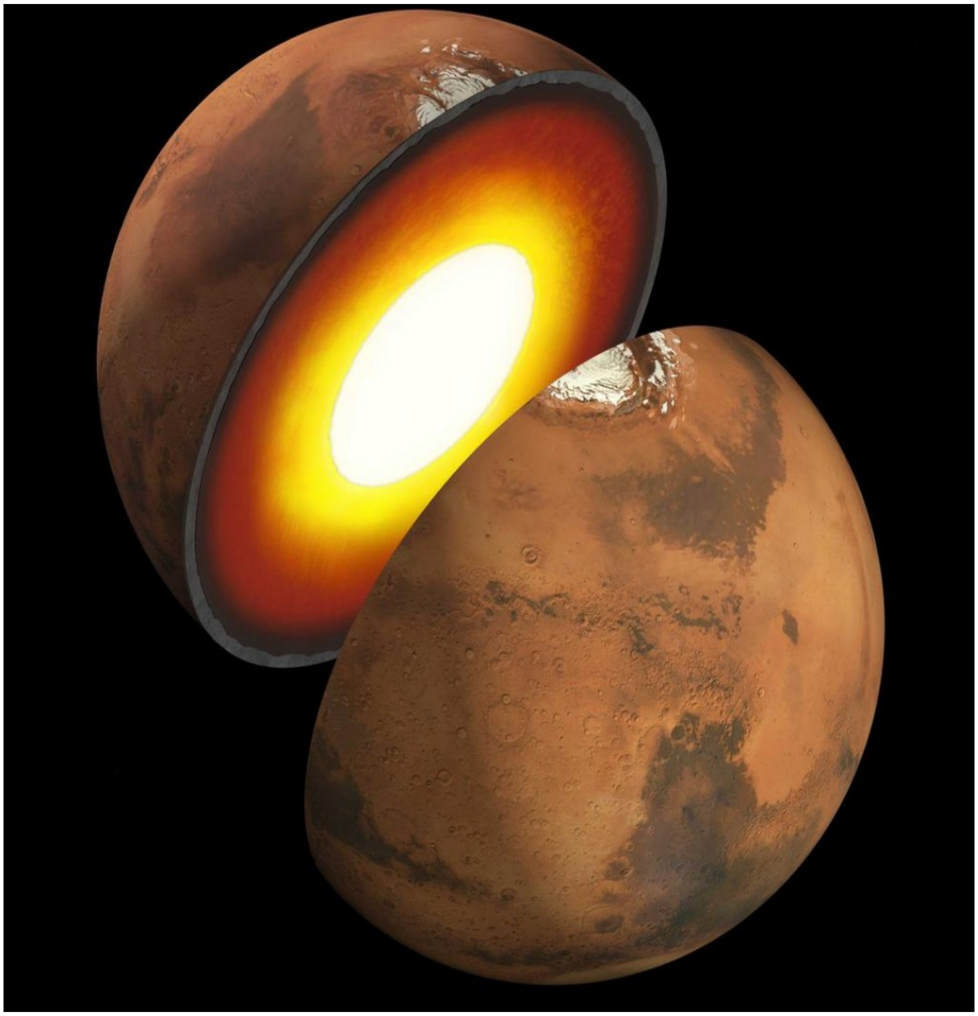
Although the InSight lander stays in one spot on Mars, Mars wobbles around as it orbits the Sun. RISE will keep track of InSight's location so that scientists will have a way to measure these wobbles. This information will help determine what materials are in Mars' core and whether the core is liquid or solid.

InSight will collect tons of information about what Mars is like under the surface. One day, these new details from InSight will help us understand more about how planets like Mars—and our home, Earth—came to be.

For more information about earthquakes and marsquakes, visit: https://spaceplace.nasa.gov/earthquakes



An artist's illustration showing a possible inner structure of Mars. Image credit: NASA/JPL-Caltech

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BMAA Registration Form

☐ Renewal

☐ New Member

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Dues are **$30.00** for an individual or **$40.00** for a family membership (more than one person at same address).

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