THE STAR

THE NEWSLETTER OF THE
MOUNT CUBA ASTRONOMICAL GROUP
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OUR PROGRAMS ARE HELD THE SECOND TUESDAY OF EACH MONTH AT 7:30 P.M. UNLESS INDICATED OTHERWISE
MOUNT CUBA ASTRONOMICAL OBSERVATORY
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GREENVILLE, DE
FOR DIRECTIONS PLEASE VISIT
www.mountcuba.org

PLEASE SEND ALL PHOTOS AND ARTICLES TO
pestrattonmcag@gmail.com

NEXT MEETING: FEB. 10 TUESDAY 7:30 p.m. MCAO. TOPICS SHORT TALKS

Scott Jackson on "Building a Telescope" Maryanna Webb and Robert Stack on Guiseppe Campani, a lens and Telescope Builder from the 17th Century.

JANUARY'S MEETING REVIEW

The January 2015 Astronomy Group meeting initially promised an excellent and timely view of a comet! However as the meeting drew to a close, so did the sky. We were able to catch a few stars and planets on the way home.

In the meantime Hank demonstrated simple tools, some homemade, that can assist with a pursuit of astronomy, or at least serious astronomy education. A printed image of Earth from space can be positioned to reveal precisely the appearance of Earth from the Moon. And it can determine, at last, whether the Great Wall of China can be seen from the Moon.

A device that can accurately measure the apparent angular position of an object in the sky can measure the angle between the horizon and the Moon, the Sun, any star, and/or the heights of trees interfering with celestial observations. This device is constructed with a plastic protractor, a piece of string, a large paperclip, and a drinking straw. If we determine that the Sun is 50 degrees above the southern horizon at the Mount Cuba Astronomical Observatory (or any place nearby), it must be either September 23 or March 20. On the other hand, if the Sun stands 26-1/2 degrees above the southern horizon, we should be wearing ear muffs and mittens, because the date will be December 21.

Elsewhere in this issue of The STAR you will find information about other ways to pursue direct and rewarding paths toward knowledge of astronomy.

EDITOR'S NOTE:

Recently, I came across an article on best Binoculars for Astronomy. I know some of you have Binoculars and use them for viewing. I shall share the information I found but would be interested in including any comments, good or bad, about the list. Perhaps some of our members would like to share information on their Binoculars as well.

Best Small Binoculars

Editor's Choice: Oberwerk Mariner 8x40 (Cost: $150)

Oberwerk's Mariner 8x40 binoculars have won the Space.com Editors' Choice award for Best Small Binoculars for Astronomy.

Best Medium Binoculars

Editor's Choice: Celestron SkyMaster 8x56 (Cost: $210)

Celestron's SkyMaster 8x56 binoculars have won Space.com's Editors' Choice award for Best Medium Binoculars for Astronomy.

Best Large Binoculars

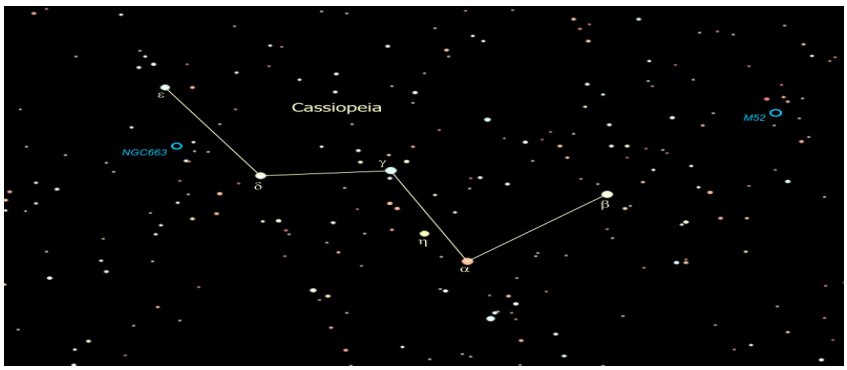
Editors' Choice: Celestron SkyMaster 25x100 (Cost: $300)

MCAG PUBLIC OUTREACH:

Hank and crew are working on the development of a Summer Camp. The cost is $150. Ages 6-8 8:30 to 10:30 a.m. | ages 10-12 1:00 to 3:00 p.m. The camp will be held for two weeks beginning June 15th. Location: MCAO 1610 Hillside Mill Road, Greenville, DE 19807. For more information hbouchelle@live.com **or 302-982-7830**

CONSTELLATIONS:

Cassiopeia.

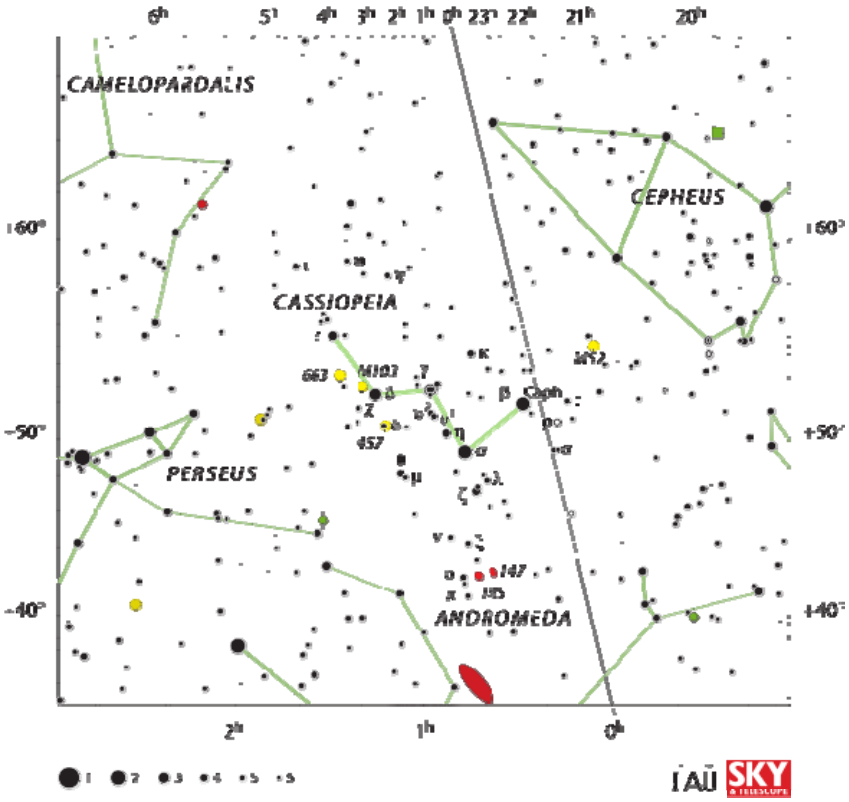


Cassiopeia is a constellation in the northern sky, named after the vain queen Cassiopeia in Greek mythology, who boasted about her unrivalled beauty. Cassiopeia was one of the 48 constellations listed by the 2nd-century Greek astronomer Ptolemy, and it remains one of the 88 modern constellations today. It is easily recognizable due to its distinctive 'M' shape when in upper culmination but in higher northern locations when near lower culminations in spring and summer it has a 'W' shape, formed by five bright stars. It is bordered by Andromeda to the south, Perseus to the southeast, and Cepheus to the north. It is opposite the Big Dipper. In northern locations above 34ºN latitude it is visible year-round and in the (sub)tropics it can be seen at its clearest in from September to early November in its characteristic 'M' shape. Even in low southern latitudes below 25ºS is can be seen low in the North.

Cassiopeia has a very distinct shape. She looks like a "W" or "M" in the sky, depending on where she is. Some legends say that Cassiopeia was chained into the sky and sometimes hangs upside-down to remind others not to be so boastful.

Cassiopeia is a northern circumpolar constellation, so it can be viewed all year long. It is home to several clusters, or groups of stars. M52 is a large cluster on the western edge.

With a telescope, many distant objects can be spotted. There are a few nebulae within Cassiopeia, including the Bubble Nebula and IC 1805. This nebula is located just to the east of the constellation. Finally, a number of galaxies can be spotted, including NGC 185, which is a small distance south of the "W".



Right ascension	**$22^h\ 57^m\ 04.5897^s$– $03^h\ 41^m\ 14.0997^s$[1]**
Declination	**77.6923447°–48.6632690°[1]**
Family	**Perseus**
Area	**598 sq. deg. (25th)**
Main stars	**5**
Bayer/Flamsteed stars	**53**
Stars with planets	**7**
Stars brighter than 3.00^m	**4**

The four brightest stars of Cassiopeia are all brighter than the third magnitude.

- **Alpha Cassiopeiae, traditionally called Shedir (from the Arabic Al Sadr, "the breast"), is a double star. The primary is an orange-hued giant of magnitude 2.2, 229 light-years from Earth. The secondary is widely separated from the primary and is of magnitude 8.9. Its traditional name means "the breast".**
- **Beta Cassiopeiae, or Caph (meaning "hand"), is a white-hued star of magnitude 2.3, 54 light-years from Earth. 16th-century Arabian astronomer Al Tizini gave this star the name Al Sanam al Nakah, (The Camel's Hump), referring to the contemporaneous Persian figure.**
- **The two other notably bright stars in Cassiopeia are both variable stars. Gamma Cassiopeiae is a shell star, a type of variable star that has a very high rate of rotation. This causes the star to be somewhat unstable and periodically eject rings of material. Gamma Cassiopeiae has a minimum magnitude of 3.0 and a maximum magnitude of 1.6; it is currently approximately magnitude 2.2. Delta Cassiopeiae, also known as "Ruchbah" or "Rukbat," meaning "knee," is an Algol-type eclipsing variable star. It varies by 0.1 magnitudes around magnitude 2.7; its period is 2 years and 1 month. Ruchbah appears to have a blue-white hue and it is 99 light-years from Earth.**

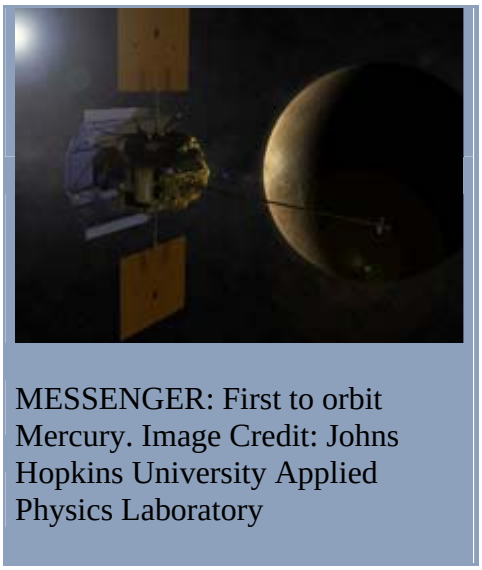
FROM THE WORLD OF ASTRONOMY:

The Planet Mercury.

Sun-scorched Mercury is only slightly larger than Earth's moon. Like the moon, Mercury has very little just 88 Earth days. atmosphere to stop impacts and it is covered with craters. Mercury's dayside is super-heated by the sun, but at night temperatures drop hundreds of degrees below freezing. Ice may even exist in craters. Mercury's egg-shaped orbit takes it around the sun every 88 days.
10 Need-to-Know Things About Mercury:

1. **Mercury is the smallest planet in our solar system -- only slightly larger than the Earth's moon.**
2. **It is the closest planet to the sun at a distance of about 58 million km (36 million miles) or 0.39 AU.**
3. **One day on Mercury (the time it takes for Mercury to rotate or spin once) takes 59 Earth days. Mercury makes a complete orbit around the sun (a year in Mercury time) in**

4. **Mercury is a rocky planet, also known as a terrestrial planet. Mercury has a solid, cratered surface, much like Earth's moon.**
5. **Mercury's thin atmosphere, or *exosphere,* is composed mostly of oxygen (O_2), sodium (Na), hydrogen (H_2), helium (He), and potassium (K). Atoms that are blasted off the surface by the solar wind and micrometeoroid impacts create Mercury's exosphere.**
6. **Mercury has no moons.**
7. **There are no rings around Mercury.**
8. **Only two spacecraft have visited this rocky planet: Mariner 10 in 1974-5 and MESSENGER, which flew past Mercury three times before going into orbit around Mercury in 2011.**
9. **No evidence for life has been found on Mercury. Daytime temperatures can reach 800 degrees Fahrenheit (430 degrees Celsius) and drop to -290 degrees Fahrenheit (-180 degrees Celsius) at night. It is unlikely life (as we know it) could survive on this planet.**
10. **Standing on Mercury's surface at its closest point to the sun, the sun would appear more than three times larger than it does on Earth**.



MESSENGER: First to orbit Mercury. Image Credit: Johns Hopkins University Applied Physics Laboratory

Mercury's eccentric orbit takes the small planet as close as 47 million km (29 million miles) and as far as 70 million km (43 million miles) from the sun. If one could stand on the scorching surface of Mercury when it is at its closest point to the sun, the sun would appear more than three times as large as it does when viewed from Earth. Temperatures on Mercury's surface can reach 800 degrees Fahrenheit (430 degrees Celsius). Because the planet has no atmosphere to retain that heat, nighttime temperatures on the surface can drop to -290 degrees Fahrenheit (-180 degrees Celsius).

Because Mercury is so close to the sun, it is hard to directly observe from Earth except during dawn or twilight. Mercury makes an appearance indirectly -- 13 times each century, observers on Earth can watch Mercury pass across the face of the sun, an event called a transit. These rare transits fall within several days of 8 May and 10 November. The first two transits of Mercury in the 21st century occurred 7 May 2003, and 8 November 2006. The next are 9 May 2016, and 11 November 2019.

Strange hollows on the surface of Mercury. Image Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

Mercury speeds around the sun every 88 days, traveling through space at nearly 50 km (31 miles) per second faster than any other planet. One Mercury solar day equals 175.97 Earth days.

Instead of an atmosphere, Mercury possesses a thin *exosphere* made up of atoms blasted off the surface by the solar wind and striking micrometeoroids. Because of solar radiation pressure, the atoms quickly escape into space and form a *tail* of neutral particles. Though Mercury's magnetic field at the surface has just one percent the strength of Earth's, it interacts with the magnetic field of the solar wind to episodically create intense *magnetic tornadoes* that funnel the fast, hot solar wind plasma down to the surface. When the ions strike the surface, they knock off neutrally charged atoms and send them on a loop high into the sky.

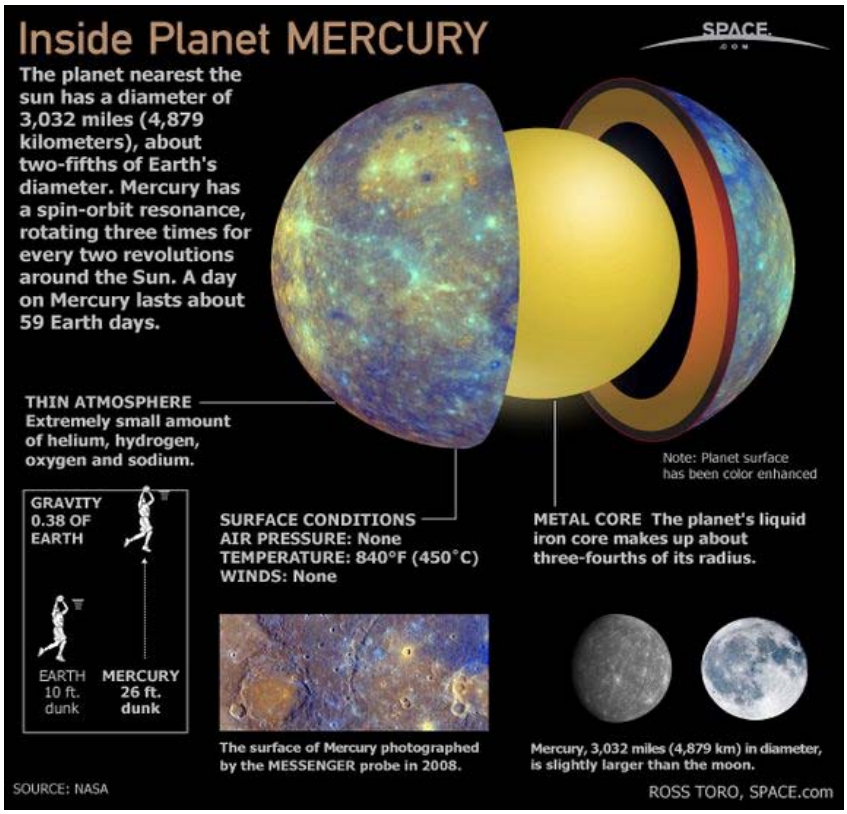
Me**rcury's surface resembles that of Earth's Moon, scarred by many impact craters resulting from collisions with meteoroids and comets. Very large impact basins, including Caloris (1,550 km, or 960 miles, in diameter) and Rachmaninoff (306 km, or 190 miles), were created by asteroid impacts on the planet's surface early in the solar system's history. While there are large areas of smooth terrain, there are also lobe-shaped scarps or cliffs, some hundreds of miles long and soaring up to a mile high, formed as the planet's interior cooled and contracted over the billions of years since Mercury formed.**

Mercury is the second densest planet after Earth, with a large metallic core having a radius of about 2,000 km (1,240 miles), about 80 percent of the planet's radius. In 2007, researchers used ground-based radars to study the core, and found evidence that it is partly molten (liquid). Mercury's outer shell, comparable to Earth's outer shell (called the mantle and crust), is only about 400 km (250 miles) thick.

The first spacecraft to visit Mercury was Mariner 10, which imaged about 45 percent of the surface. NASA's MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) mission flew by Mercury three times in 2008-2009 and has been in orbit around the planet since 18 March 2011. Almost the entire planet has now been imaged, revealing a surface that has been shaped both by extensive volcanism and impacts.

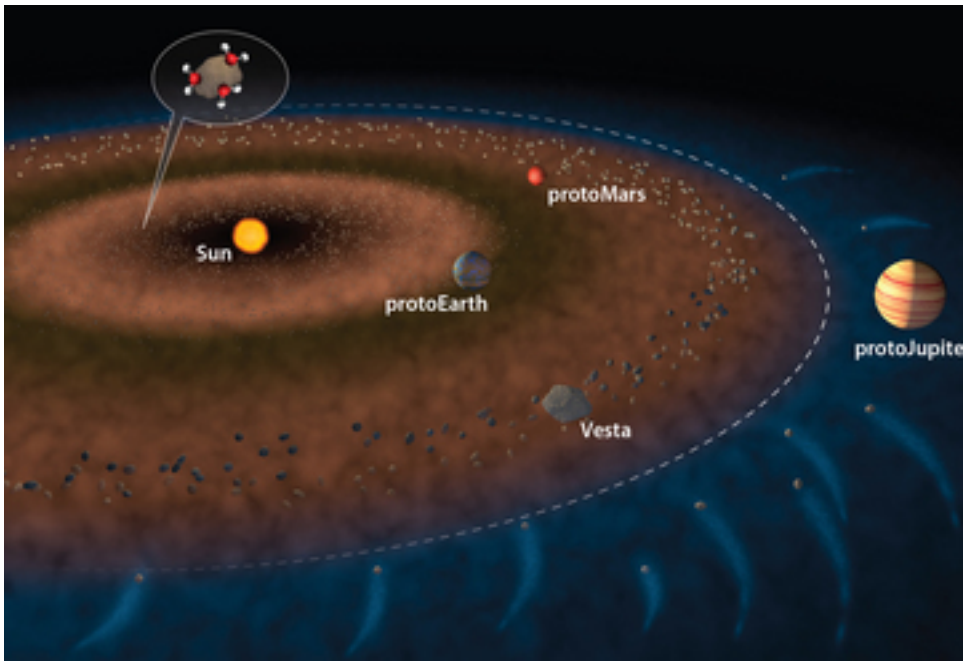
Data from MESSENGER's scientific instruments have provided a trove of scientific discoveries. These include the identification of a new landform known as *hollows*, measurements indicating that Mercury has a remarkably high abundance of the volatile elements sulfur and potassium, and the discoveries that Mercury's magnetic field is offset relative to the planet's equator and that the planet has a highly unusual internal structure. In 1991, astronomers on Earth using radar observations showed that Mercury

may have water ice at its north and south poles inside deep craters. MESSENGER observations have shown that the materials identified by radar are present only in regions of permanent shadow, consistent with the idea that they are cold enough to preserve water ice, despite the extreme high temperatures experienced by sunlit parts of the planet.



POINTS OF INTEREST:

Earth's Water Existed 135 Million Years Earlier than Thought



An illustration of the early solar system shows proto-Earth, proto-Mars, Vesta within the asteroid belt, and proto-Jupiter. The dashed white line represents the "snow line" boundary for water ice in the solar system.
Credit: Jack Cook, Woods Hole Oceanographic Institution

The water that supports life on Earth may have been on the planet much earlier than scientists previously thought, new research suggests.

While the environmental conditions in Earth's early years made it impossible for water to remain on the planet's surface, scientists have found evidence that the ingredients for water were protectively stored inside rocky bodies near our planet — and maybe inside Earth itself. The new findings suggest that there was water in the inner solar system 135 million years earlier than previous evidence had shown.

"Our findings show the earliest evidence of water in the inner solar system," said Adam Sarafian, a Ph.D. student at the MIT/Woods Hole Oceanographic Institution in Massachusetts and lead author of the new study.

How Long Would It Take For Humans To Get To The Closest Star From Our Sun? Space Travel.

One must first understand that outer space is big. Really, really, *really* big. That's why NASA has no plans at present to send a spacecraft to any of the 1,876 known planets (as of January 9, 2015) beyond our solar system.

Alpha Centauri is the nearest star system to our sun at 4.3 light-years away. Can we even go that far? The answer is … not easily.

A distance of 4.3 light-years equals *trillions* of miles away from Earth – nearly 300,000 times the distance from the Earth to the sun.

How might we travel to Alpha Centauri, the next-nearest star? And how long would it take to get there?

Would a conventional rocket work?

Consider the Space Shuttle, which traveled only a few hundred kilometers into space. If Earth were the size of a sand grain, this would be about the width of a hair in contrast to a 10-kilometer distance to Alpha Centauri.

You'd need about 10,000 shuttle main engines in sequence just to build up a decent speed (say, 1/100th light speed).

The Space Shuttles weren't starships. At a maximum speed of about 17,600 mph (about 28,300 kph), it would have taken a Space Shuttle about 165,000 years to reach Alpha Centauri.

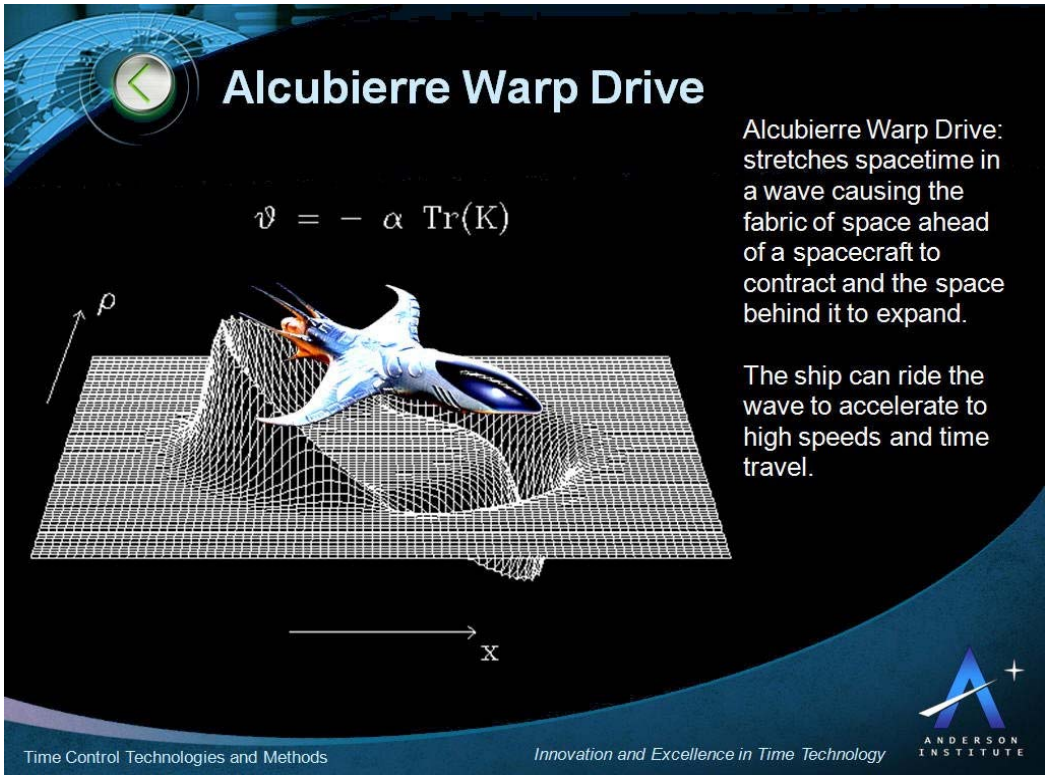
These can get us to space, but won't take us to the stars.

How about the Voyager spacecraft? These two unmanned space probes – Voyager 1 and Voyager 2 – were launched in 1977. They're now heading out of our solar system. The Voyagers aren't aimed toward Alpha Centauri, but if they were, they'd take tens of thousands of years to get there.

On the other hand, eventually, the Voyagers will pass other stars. In about 40,000 years, Voyager 1 will drift within 1.6 light-years (9.3 trillion miles) of AC+79 3888, a star in the constellation of Camelopardalis. In some 296,000 years, Voyager 2 will pass 4.3 light-years from Sirius, the brightest star in the sky. Hmm, 4.3 light-years. That's the distance between us and Alpha Centauri.

The problem with conventional rockets is that, if you're carrying fuel, you need *more fuel in order to carry your fuel* to accomplish star-to-star travel.

How about Alcubierre Warp Drive?



Using current technology, a trip to Alpha Centauri would take tens to hundreds of thousands of years.

But what if we would travel *faster than light*? Sound impossible?

A couple of years ago, Dr. Harold "Sonny" White – who leads NASA's Advanced Propulsion Team at Johnson Space Center – claimed to have made a discovery which made plausible the idea of faster-than-light travel, via a concept known as the Alcubierre warp drive.

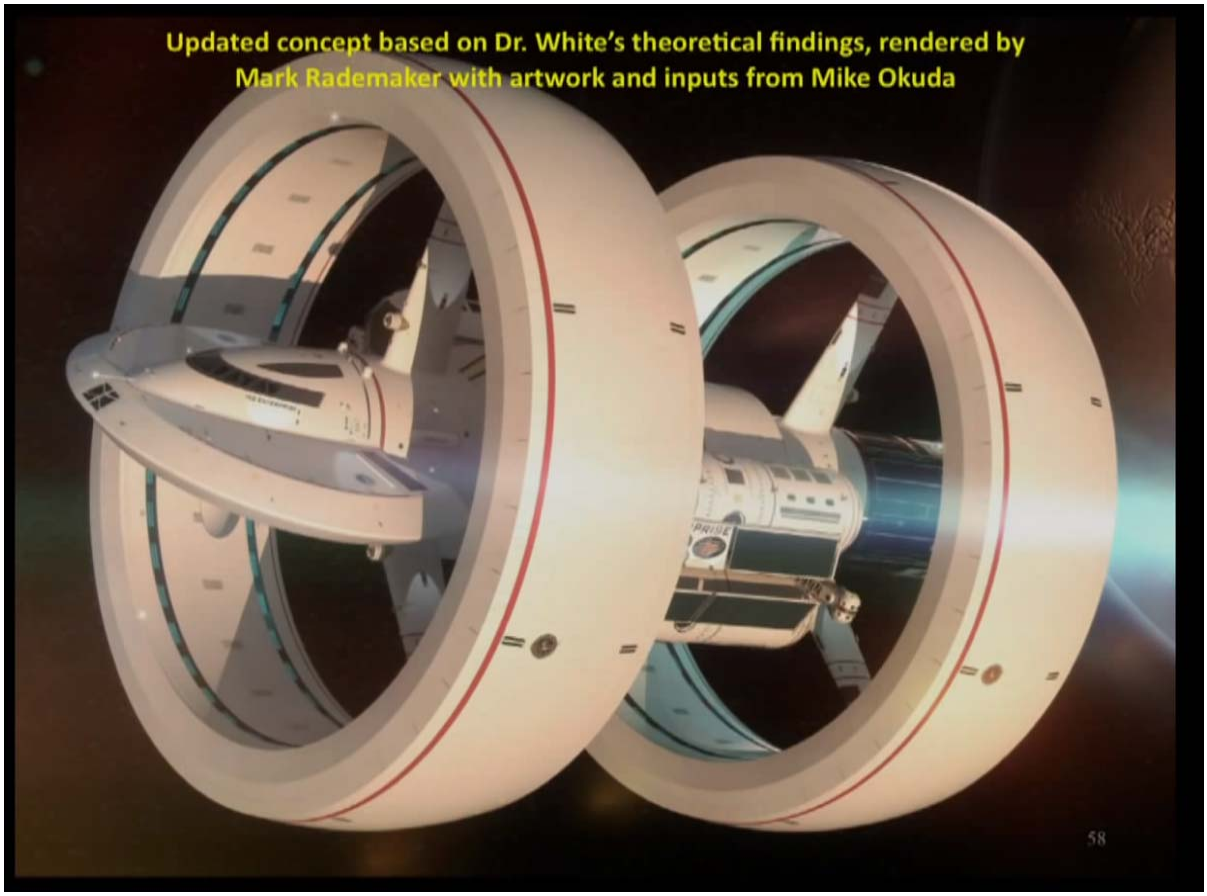
This concept is based on ideas put forward by Mexican physicist Miguel Alcubierre in 1994. He suggested that faster-than-light travel might be achieved by *distorting spacetime*, as shown in the illustration above.

Harold "Sonny" White has been working to investigate these ideas further, and, in June of 2014, he unveiled images of what a faster-than-light ship might look like. Artist Mark Rademaker based these designs on White's theoretical ideas. He said creating them took more than 1,600 hours, and they *are* very cool.

Is it faster-than-light travel possible, via the Alcubierre warp drive? As with conventional propulsion systems, the problem is energy. In this case, it's the type of energy the warp drive would need. Daily Kos said:

In order to form the warp field/bubble, a region of space-time with negative energy density (i.e. repulsing space-time) is necessary. Scientific models predict exotic matter with a negative energy may exist, but it has never been observed. All forms of matter and light have a positive energy density, and create an attractive gravitational field.

So faster-than-light travel via the Alcubierre warp drive is highly speculative, to say the least. With current technologies, it's not possible.



Above

What a spaceship with warp drive might look like.

However, if it could be accomplished, it would reduce the travel time to Alpha Centauri from thousands of years to *just days*.

Other alternate propulsion methods have been discussed, for example, antimatter engines. They work on the principle that, when antimatter and matter meet, they annihilate each other, releasing vast amounts of energy.

Scientists have observed bits of antimatter in particle accelerators. But no one knows how to create enough antimatter, or how to store it, for a trip to the stars.

How about light sails? This very romantic notion for travel among the stars would rely on thin, lightweight reflective sails, powered by the sun, other stars, or even lasers fired from Earth. You start slow, but accelerate up to light speeds. However, no one imagines a light sail could enable us to travel to Alpha Centauri within a human lifetime.

But the propulsion issues are just part of the problem. The real problem might be *when to decide to go*.

Future Human Evolution

The *real* problem with traveling to Alpha Centauri.

Let's suppose that faster-than-light travel isn't going to become a reality. Suppose we have to choose another method of travel – a conventionally powered space arc of some kind, or even an antimatter drive, or a solar sail. Now suppose we set out for a trip among the stars.

Suppose that, generations from now, our descendants arrive at a planet in the Alpha Centauri system.

They might be greeted by brass bands and crowds of earthlings – who left later, but traveled via a more efficient process – and so made the trip in a shorter time. All aboard!

Bottom line: At 4.3 light-years away, the Alpha Centauri system is the nearest star system to our Earth and sun, but getting there would be extremely difficult.

WEB SITES OF INTEREST:

http://spacewatchtower.blogspot.com

PUBLIC NIGHTS AT MCAO:

9 Feb. 2015	**Hank Bouchelle**	**The Sun as seen from Pluto**
23 Feb. 2015	**Scott Jackson**	**Exoplanets**

If you know of anyone who is interested in Astronomy or someone who would like to learn more, please do not hesitate to extend an invitation to them to attend our meetings. If they have an interest in joining, our application is below.

Mount Cuba Astronomical Group
Membership Form

The Mission of the Mt. Cuba Astronomy Group is to increase knowledge and expand awareness of the science of astronomy and related technologies. Benefits include:

Monthly newsletter that includes details about the group's activities and articles on astronomy as well as other related subjects.

Monthly programs on subjects and topics of astronomical interest.

Free or discounted subscriptions to astronomy related publications.

Free registration to MCAG workshops and classes.

Mention Mount Cuba Astronomical Group and receive a 5% discount at Manor Books in New Castle (http://www.yelp.com/biz/manor-used-books-New Castle)

Name_____

Email Address_____

Home Address_____

Phone (optional)_____

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