



# The Mason-Dixon Astronomer

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## Star Points for May 2008

Mercury: Messenger of Gods

by Curtis Roelle

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Mercury, the nearest of the four terrestrial planets to the sun, orbits our star once every 88 days. With regard to our own planet, Mercury is the third closest to us after Venus and Mars. Mercury's distance from the earth varies from 48 to 139 million miles. Until recently, the planet had not been visited by a spacecraft since Mariner 10 flew past it three times in 1974 and 1975.

That changed in January of this year when NASA's MESSENGER mission (MErcury Surface, Space ENvironment, GEOchemistry, and Ranging) buzzed Mercury at an altitude of only 124 miles. Imagery taken during the flyby encounter has revealed portions of the surface hidden from Mariner 10's cameras.

It's been a long trip since MESSENGER's launch in August 2004. In a game of planetary billiards, MESSENGER has performed gravity-assisted flybys of the earth (August 2005) and Venus (October 2006 and June 2007) in order to gain energy and optimize fuel expenditure. MESSENGER isn't through making bank shots yet. Additional Mercury flybys are planned for this October and in September 2009. If the mission goes according to plan, MESSENGER will finally enter orbit around Mercury in March 2011.

MESSENGER was built for NASA in Maryland at the Johns Hopkins University Applied Physics Laboratory (JHU-APL) in Laurel. The Mission Operations Center is also located at JHU-APL. The program web site is <http://messenger.jhuapl.edu>.

*(Continued on page 3)*

**May Meeting:** Wednesday, May 14, 2008, at 7:30 pm

Our meeting will begin in the Planetarium, where Program Chairman Curt Roelle will kick off the meeting. We'll then move to the Auditorium to hear our Guest Speaker for May, WASI's own Brian Eney, who will share with us highlights of his undergraduate research at Towson University. Read more about Brian and his research on page 7.

**Public Events:** Please see page 8.

## President's Message for May

by Stephen Reisinger

Time. Not space-time, as you might think, since this is an astronomy club, but the time that we have for ourselves in our home life, and the time that we give to our club. Now that we're moving toward summer, two big things crossed my mind this past month, two things that will require our time: our Observatory and our Star Parties.

As most of you read from Brian's posting on the Yahoo group, we're a step closer to getting started on the Observatory. Once this happens, we'll need as much help as possible to get the building constructed, and I'm sure that Skip will be putting together a schedule for volunteer sign-up. Once you sign up, it'll be critical for you to show up on time, every time, so that we can show all the people/companies who will be donating their time, money, and materials, and especially show the Contractor, that we are serious about this project. We need to have enough help every day until the building is completed.

Also, now that we're getting into the heart of "star party season," we all know how busy we'll be and how fast the days and weeks will fly by, just as they always do. Now, what I'm saying to each of you is that, aside from your everyday life of work, home, leisure, and fun, you'll need to find time to pitch in and assist with the raising of the Observatory.

I like to observe as much as the next person, and it seems lately, the last several months and more, that I'm not getting to set up and observe as often as I'd like. There are also reasons revolving around my home life that could tie me down, but I intend to help because I know that this Observatory can and will be a big boon for the whole club.

Once it's up and running, we'll be doing even more star parties at BBNC, but that's the key. We'll be in one place, and the public will come to us. They'll want to do so because of the equipment that we'll have on site. This will benefit us because, instead of having to haul our equipment somewhere and set up, it'll be permanently in one spot and always ready for use. We'll also be able to share our pictures and data with the public through schools and who-knows-what other ways.

So, whether you're mildly interested or extremely excited about our club's next big step, I invite you all to donate your time, help out, and think about the exciting things that we'll be doing in just the next couple of years.

Thank you and clear skies,  
Steve

## Star Points, continued

The planet Mercury was named after the mythological Roman god of science, patron of travelers, and messenger to the gods. One reason for this could have been because Mercury quickly appears and disappears from our view. Its proximity to the sun means the planet spends precious little time in the night sky.

When placed for viewing, Mercury must be observed in twilight either shortly after sunset or before sunrise. Luckily, May provides an excellent time to view Mercury in the evening sky after sunset. Mercury remains at least  $10^\circ$  above the west-northwestern horizon 45 minutes after sunset May 6-18 according to *Sky & Telescope* magazine (<http://www.skyandtelescope.com/>). The sun sets at 08:07 p.m. on the 6<sup>th</sup> and at 08:19 p.m. on the 18<sup>th</sup>. By the way,  $10^\circ$  is about the width of your fist when your arm is outstretched.

*"Star Points"* by Curtis Roelle appears in the *Carroll County Times* on the first Sunday of each month. Visit the website at <http://www.starpoints.org> or send e-mail to [StarPoints@Gmail.com](mailto:StarPoints@Gmail.com).

### Observatory Update

Has everyone heard the great news? On April 29, Brian Eney filed the building permits for the Observatory. The hurdles holding up construction have almost all been jumped. The Permits Office told him that it should take about three weeks to process the permits. "The best part of the day," says Brian, "was that there were NO PERMIT FEES! Since this is a 'County Project,' they waived the ~\$1,000 fee!"

Items still outstanding are down to a few:

- ✓ The signing of an affidavit by the Commissioners' Office, the General Contractor, and the Excavator, before final permits are granted.
- ✓ From the County, the land lease agreement and the Memorandum of Understanding.
- ✓ From BGE, details regarding the electrical supply.

Says Brian, "Other than that we are GOLDEN!"

Although a late-May groundbreaking ceremony is not entirely out of the question, it probably will take place closer to August due to Bear Branch Nature Center's heavy load of summer programs, including summer camps, school-group field trips, and other heavily attended activities.

## ***More Really Good News about the Observatory!***

WASI has recently received a very **big** donation! As a matter of fact, it is the second largest single contribution – including all grants and donations – that we have received to date for our Observatory! Curt Roelle is going to tell us all about it during our upcoming May meeting. If you love amateur astronomy and you care about WASI, you will be smiling ear-to-ear as you listen to him. You'll be amazed at our good fortune! It'll fire up your imagination and warm your heart. Plan to attend! Do not miss this!

### **WANTED!**

**Department Editors and Mini-Department Editors.** Work on a monthly, bi-monthly, or sporadic basis. Do all the writing yourself, or solicit help and have all contributions sent directly to you. Attendance at WASI meetings is not required. You must simply be a WASI member (or family member), take some pride in your work, and serve your Club as a newsletter editor.

To those of you who have contributed to the newsletter in the past, how about *recycling* some of that great work you did? That's what the editors at *Astronomy Magazine* and *Sky & Telescope* have to do. For 25-50 years now they have been telling us what to look for in Leo and Orion, on Mars and Saturn, and on the Sun and Moon, etc. In almost every other department as well, they simply rearrange, expand, link, or change the focus of the *same materials* over and over, adding, when possible, some breaking news, a new wrinkle, or fresh insight. So, please don't feel like you're "cheating." How about digging out those "old" writings? Subtract a bit here, add a bit there, rearrange things a little, include a new insight or two, and contribute to your newsletter once again. Many of us have never seen your work, and new members will be joining us soon. Unless, that is, you'd prefer to contribute entirely new material!

#### **Also wanted:**

- 1) Activities Correspondents to cover social events and group activities sponsored by, or encouraged by, WASI, like our upcoming WASI Picnic on August 2, star parties great and small, conventions, outreach events, our Holiday Dinner, and more. Report as often as you can.
- 2) Guest-Editorialists. You choose the topic and the mood – informative, philosophical, whimsical, personal, etc. – and the approximate date when you wish to contribute.
- 3) Interviewers, with ideas...
- 4) Reviewers of books, equipment, movies, and more.
- 5) Sharers of helpful hints for observers, especially for novices, i.e., *many* of us!
- 6) Your original poetry or prose, or pithily-expressed thoughts and observations.
- 7) Your extractions from, or citations of, other people's work that you find interesting.
- 8) Your "heavenly" drawings, sketches, or photos.
- 9) Your expertise with graphics – much needed for #8, and more!
- 10) You. What would you like to do? Or see done?

Inquiries are welcome, don't hesitate. Contact the Editor at [masondixonastronomer@gmail.com](mailto:masondixonastronomer@gmail.com).

## **Reaching Out...**

### ***“400<sup>th</sup> Anniversary of the Telescope” at the National Air and Space Museum***

#### **Alien Spacecraft Sighted at Udvar-Hazy Center!**

An eyewitness report by Skip Bird

Today, April 12, between 9:00 a.m–3:00 p.m., several thousand visitors were treated to an unusual sight. An alien space craft was sighted **INSIDE** the National Air & Space Museum's Udvar-Hazy Center! This event was witnessed by a wide range of professionals, trained observers, and members of the Center's staff. Not since the 1950's have so many people claimed to have seen an alien spacecraft!

At first I believed this just to be another hoax, or a mass hysteria outbreak, until I saw it also. It was fantastic! The front of it was almost saucer-shaped, with what looked like some kind of rocket or propulsion devices mounted on struts and extending out the back. It was too far away to make a good visual guess on its actual size or to make out any markings. Most guesstimates ranged from 100-200 feet to 1-2 inches. Several people who saw it claimed it was a hoax, some kind of picture hanging *inside the telescope*, which proved to be incorrect, of course. Since no one could see it *without* the telescope (provided by the Westminster Astronomical Society), they suspected of some kind of trickery.

Eventually, it was also sighted by scopes from the Capitol Area Astronomical Association. World famous astronomers Makarand Bidwai, Gary Frishkorn, and Skip Bird were among the first ones to spot it. They claimed that it looked familiar, but were unable to identify it. Eventually, Security got involved (it doesn't look good to have unauthorized alien spacecraft invading our Air and Space Museums and trying to steal secrets), and was combing the entire building trying to capture the elusive space ship. Finally Bob Clark, builder of the “Copy Scope,” tracked down its hiding place and captured it! Thanks to him the world is safe again.

Later in the day, in McDonalds, Gary Frishkorn and someone else overheard a person say: “It was a good thing that I was able to add the 'Enterprise' exhibit without being detained by Security for hours of interrogation. If I ever risk setting it up again, I'll try to remain cool enough to remember to place it upside down!”

Other highlights of the day: Bob Clark kept busy showing his world-famous “Copy Scope,” made from an old copier. Gary Frishkorn kept amazing people with his polarized filters (as always, I learned a lot from him today). And three of our youngest members (Tessa, Thomas, and Tyler Bird) helped out with several of the activities – the Atmosphere Pachinko game, the UV light with UV beads demonstration, and the “scale model of the solar system.” I had the easy job of helping people find the alien spacecraft inside the Air and Space Museum. Just another WILD day of public outreach...

## More Outreach...

### National Sidewalk Astronomy Night

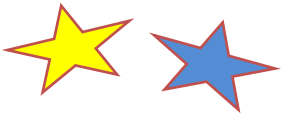
by Dave Gede

*(The following is excerpted, with permission, from Dave Gede's April 13 posting on the WASI\_Astro group web site. Since not all WASI members log on regularly, if at all, and since the topic is important [John Dobson would agree!], we are presenting highlights from his report. Ed.)*

Last night was the Second Annual National Sidewalk Astronomy Night. I was originally going to set up at "The Cow" again, but ended up setting up at "Mars" (across the street at the corner by the old "Ames"). I got set up at about 7:30, just in time for some seriously dark clouds and wind to roll in, so I covered everything up. Even with the scope covered, people came over, and we talked. At about 8:30, just as I was considering breaking down the equipment, I started to notice some cracks in the clouds, and within about 10 minutes I was switching between the moon and Saturn, whenever the clouds would allow. We also had some fun looking at items on the shelves in the Advanced Auto Parts store.

I broke down my equipment at about 10:00. It was getting very windy and starting to get cold. Three kids, that on a normal night would have had me worried about my safety, helped me pack up. They were in their early teens and showed up at about 9:30. I was a tad concerned at first, but they were honestly interested, and they ended up talking with me the rest of the night.

In all, I spoke with 115 people in the 2½ hours I was there. At least, that's how many WASI fliers I handed out, and sometimes a family took only one flier. If you tried doing this event this year, I hope that you had a good experience. I know I did.



### *Just for Fun... Ras or Deneb? – Heads or Tails?*

Well, this month Deneb wins. Have you noticed how many forms of "Deneb" there are among our named stars? "*Dhanab*" is the Arabic word for, yep, you guessed it, "tail." Since there are so many "animals" in our skies, there just have to be lots of tails, too. Here are a few Deneb-stars visible from Westminster:

- 1) Deneb (*Al Dhanab* – The Tail) in Cygnus;
- 2) Deneb Algedi (*Al Dhanab al Jadi* –The Tail of the Goat) in Capricorn;
- 3) Deneb Kaitos (*Al Dhanab al Kaitos al Janubiyy* – The Tail of the Whale Towards the South) in Cetus; and
- 4) Denebola (*Al Dhanab al Asad* – The Tail of the Lion) in Leo.
- 5) \*Deneb (*Al Dhanab al 'Ukab*– The Tail of the Eagle) in Aquila; and
- 6) \*Deneb (*Al Dhanab al Dulfim*– The Tail of the Dolphin) in Delphinus. (You might enjoy knowing that in China this star was named "Pae Chaou," – The Rotten Melon.)
- 7) \*A more southerly example, at about 37°S, is Deneb (*Al Dhanab* – The Tail) in Grus, the Crane, pretty hard to see from Westminster.

**Credits:** With much help from Richard Hinckley Allen's book *Star Names, Their Lore and Meaning*, Dover, New York, 1963.

\*The three "starred" *Denebs*, although examined by Allen, could not be confirmed. Sources consulted were Tirion's Sky Atlas 2000.0, Burnham, and Kepple&Sanner.

## Guest Speaker for May Meeting: Brian Eney

Topics: “Mapping Light Pollution in the State of Maryland Using Ground-Based Observations”  
“Applications of Surface Tension of Liquids in Microgravity”

Brian Eney, a WASI Board Member and former two-term President of our club, went back to college in 2006 (mostly on a dare by a good friend, he says). He is currently working toward a degree in Astro-Physics and Secondary Education at Towson University. His favorite courses, he says, are his lab courses: “It’s usually just me in lab trying to figure out what the heck I am supposed to accomplish.” If all goes as planned, he hopes to graduate in Spring 2009.

During the meeting, he’ll be sharing with us highlights of two different aspects of his undergraduate research over the past two years at Towson. The title of his first topic is “Mapping Light Pollution in the State of Maryland Using Ground-Based Observations.” Most WASI members are familiar with Brian’s longstanding commitment and sustained hard work combating light pollution. While much of his labor over the years has focused on educating the community, he has made appeals to business people and government as well. While WASI members can expect to enjoy hearing about his research, we cannot expect to enjoy hearing the *results* of it. But Brian has *plans* for the local community to help us combat light pollution, and he’ll be presenting these at the meeting also.

The title of Brian’s second topic, “Applications of Surface Tension of Liquids in Microgravity,” is, according to Brian, “geek-speak for putting different liquids into a box, dropping them a big distance, and watching what happens to what’s inside the box.” This is both simple and complex, he explains, “surface tension is caused by the intermolecular forces between molecules. In orbit, water will adhere to itself to form a spherical bubble because of the interaction.”

Many people have asked Brian what got him interested in astronomy. His answer: “I turned two! Ever since then I have been looking up at the stars and planets. According to my dad, I could name the planets in order and name three proper stars per constellation before I knew the alphabet.” What did he do, we asked Brian, *recite* all this stuff? “No,” he says, “not recitation. It was more like when you ask a five-year-old about dinosaurs. He or she will give you an encyclopedia’s worth of material. At least that part of me hasn’t changed since I was five.”

Finally, we asked Brian if there was anyone who influenced him strongly and/or encouraged him regarding math, science, or astronomy – a teacher, perhaps, or a neighbor or relative. Brian’s answer: “I had this very discussion with my mother recently. According to her, I was probably switched at birth, because no one else in the family has any interest in math, science or astronomy! We’ve never really come to a consensus about where my passion for knowledge comes from, other than a possible genetic anomaly.”



## Coming Attractions

### Guest Speakers:

**May:** Brian Eney, speaking on his undergraduate research

**May:** ~~Tony Maranto, speaking on the Spitzer Space Telescope~~ [Tony had to cancel...]

**June:** To be determined

### Upcoming Events:

May 10: Astronomy Day at the Carroll County Public Library, Eldersburg Branch

Astronomy Day at the Carroll County Public Library, Taneytown Branch

Herb Fest at Piney Run

May 17: Swing into Spring Festival, Taneytown

May 23-24 Balticon Sci Fi Convention

## Announcing a New Department: “*Observing It!*”

The burgeoning editorial staff of the *Mason-Dixon Astronomer* is hereby introducing what we hope will become a popular, regularly appearing department relating to the observing experiences of *all* WASI members, both great and small (Yes, children are welcome to publish, too!) Here’s the idea: using our observing logs, or our Astronomical League Observing Club reports (submitted or not), or our drawings or photos, let’s share with one another what we’ve been doing. Some of us will come with decades of experience, while others may come with only months. Each of us, for sure, will have a somewhat different approach. Please share some of your “work” with us, and, while you’re at it, intersperse a few personal comments that tell us a little bit about you as a fellow observer. An example follows.

### Observing It!

Hi! I’m Pam, and my log entries reveal that sometimes I spend more time describing the *observing experience itself* than what I’m actually *seeing* in the eyepiece. Well, I guess that’s because I really do *enjoy* writing about it. Maybe it’s also because I’m a relative beginner – WASI member since 2001, I think – and not a particularly fast study, so I probably need to learn more about *what to look for!* And then my eyesight isn’t so great, either. To make matters a little more difficult, since the beginning of this year I’ve experienced two “posterior vitreous detachments,” one in each eye (yes, I’m seeing a doctor, and no, it’s not likely to turn serious), but I’m definitely seeing less, and I’ve got some big, new, irritating floaters to boot! I also seem to have my own personal Perseids, Geminids, and Leonids, etc., that accompany me morning, noon, and night. So, my penchant for writing about the *experience* of observing more than about what I actually see probably will not change any time soon. The examples below are taken from my Astronomical League reports, all originally recorded into a digital voice recorder, then transcribed and edited. There are three different types of entries.

## Observing It!

**Lunar Club, Optional Activities.** Task: Compare the size of the full moon on the horizon with the full moon on the meridian using a dime held at arm's length.

On 12/04/06, three times in the same day – 0645, 1800, and 2350 hours EST (two “horizons” and a “zenith”) – I did the “dime test.” It works great. Full moon phase actually occurred at 1925 hours. I also did the trick “*look at the moon standing up and then bend over and look at it between your legs*” that Jack Horkheimer suggests, and it works very well, too. The moon looks significantly smaller when you look at it upside down. P.S.: When the full moon comes nearer to zenith, as in winter, this exercise will surely require either youth or exceptional athleticism. ☺

**Messier Club: M35** Date and time, 01-30-06, 08:16p; Lim.Mag. 4.4, Seeing 2.6/5Best, Aperture, 10”; Magnification, 115X and 57X.

At 115X I see many bright, evenly spaced, evenly colored stars, which combine creatively for my viewing pleasure to outline a “Gemini monster,” as a small child might draw one. It has an irregularly shaped head, with arms protruding from the “ear” areas; legs are also attached to the head. Within the “head,” a pronounced *arc* of 15 or more bright stars, punctuated at either end by a yellow-orange star, seems to form the threatening *mouth* of the monster, completing the picture nicely. At 57X this galactic cluster is even prettier, with many gold stars shining brightly, but, alas, without the “monster.”

**Planetary Observers Club: Saturn** [Along with specific tasks, the “POC” asks for “impressions.” Here’s an “impression” that I submitted along with my various “Saturn” tasks, completed 05-23-07.]

Impressions: I’ve learned over the last few years that although Saturn is strikingly beautiful and profoundly inviting as a telescopic target, it is not an easy planet to observe. In a very helpful article on observing Saturn (“A Backyard Guide to Saturn,” *Sky&Tel*, Feb. 2006, pp. 62-64), Alan M. MacRobert commented that Saturn is, for some, “the most beautiful thing in the sky”; but he was forced to concede, wistfully, that “*you can never see Saturn as well as you want*” [emphasis added]. Reading this was genuinely comforting. I’d assumed that my years-long problem of observing Saturn was due entirely to rock-solid lack of skill. Apparently, I am not alone, and the “*others*” don’t necessarily lack skill. *Wistfulness* is defined as “unfulfilled longing or desire.” Many of us *long* to observe and experience more of Saturn’s exquisite beauty with more clarity and detail. Hubble helps, but it’s just not the same as seeing it for yourself, be it ever so humble.

That’s all. Now, please share **your** log entries and/or memorable experiences with us, and don’t forget to include a little personal information also. Send your texts, sketches, and photos to [masondixonastronomer@gmail.com](mailto:masondixonastronomer@gmail.com). We’re waiting to hear from you. Yes, YOU!

## The Science Corner

### *The Saros Cycle: Been here before? Yet?*

by P. Lubkans

Rarely can any of us say that we've stood under the same sky, astronomically speaking. There is a special case, however, with regard to the positional relationship between *sun, earth, and moon* in which each of us can accurately affirm that, yes, I've been here before, right here, exactly right here! This means that if you looked at a 6-day-old moon, say, this month, on May 11, and saw it at an azimuth of  $120^\circ$  (SE) and at an altitude of about  $50^\circ$  at 5:00 o'clock in the afternoon, it will be possible for you to stand in that very spot again and see the "same" 6-day-old moon at an azimuth of  $120^\circ$  and an altitude of about  $50^\circ$  at 5:00 o'clock in the afternoon. The drawback is that *it takes about 54 years!* Equally surprising is the fact that once you're old enough to experience this, you'll keep experiencing the "same moon" day after day for the rest of your life. *Déjà vu*, literally.

We're talking about the Saros cycle, a period of time used by the ancient Chaldeans to predict eclipses. The cycle applies to *solar* eclipses as well, but it will be easier to begin by focusing on lunar eclipses. Yes, the lunar eclipses that you've either seen or missed, partial or total, will *repeat* at the spot where you stand (or stood) or sit (or sat), at almost the exact place in the sky (altitude-azimuth, latitude-longitude, or right ascension-declination), at the same hour of day, with the same shape (degree of partiality, or total) throughout your long lifetime. They will look just the same, discounting atmospherics, etc. Every 54 years.

Now, if you're willing to allow the azimuth (or longitude or R.A.) to *shift* significantly, you can see the same eclipse of the moon (perhaps one that you particularly enjoyed, or missed) every **18 years and  $10\frac{1}{3}$  days** – or, depending upon the number of intervening leap years (4 or 5), every **18 years and  $11\frac{1}{3}$  days**. Is that better? This 18-year-plus period, about  $6,585\frac{1}{3}$  days, **is** the "Saros." The longitudinal *shift* of each subsequent Saros results from that odd "third of a day" that we just noted. It means that the earth must rotate an additional 8 hours – or  $120^\circ$  – westward with each Saros, one-third of the way around the earth. The downside (there's always a downside, isn't there) is that occasionally "your special eclipse" may be occurring on the other side of the planet because the eight additional hours and concomitant  $120^\circ$  shift westward have moved it out of sight. If, however, you can develop "astronomical patience" and wait *three* Saros cycles (a Triple Saros, almost 19,756 full days), the local time of day, season of the year, size of the eclipsed body, and all other details of the eclipse will be – for backyard astronomers – perfect!

Professional astronomers, however, would caution "*almost* perfect." The imperfection amounts to a westward shift of  $1/2^\circ$  for every Saros, a tiny distance, to be sure. But there's "handwriting on the wall" here: these incremental movements will ultimately cause the Saros series to *terminate* because the necessary alignment of earth, moon, and sun will be lost, and eclipses will no longer be possible for this particular series.

So, it follows that each Saros, solar or lunar, has a *lifeline*: 1) an appearance (or "birth") viewed from an area near either of earth's *poles*; 2) an evolution from thin partial eclipse to total (or central) and back to thin partial again; 3) a limited lifetime (1226-1550 years for solar series, and somewhat less for lunar series); and 3) a disappearance (or "dying"), viewed near the *opposite pole*. All Saros series must end, but new ones keep beginning. Currently, there are approximately 40 different Saros series operating simultaneously. (More later. To be continued...)



## **Stellar Compass for Space Explorers**

by Patrick L. Barry

In space, there's no up or down, north or south, east or west. So how can robotic spacecraft know which way they're facing when they fire their thrusters, or when they try to beam scientific data back to Earth? Without the familiar compass points of Earth's magnetic poles, spacecraft use stars and gyros to know their orientation. Thanks to a recently completed test flight, future spacecraft will be able to do so using only an ultra-low-power camera and three silicon wafers as small as your pinky fingernail. "The wafers are actually very tiny gyros," explains Artur Chmielewski, project manager at JPL for Space Technology 6 (ST6), a part of NASA's New Millennium Program.

Traditional gyros use spinning wheels to detect changes in pitch, yaw, and roll—the three axes of rotation. For ST6's Inertial Stellar Compass, the three gyros instead consist of silicon wafers that resemble microchips. Rotating the wafers distorts microscopic structures on the surfaces of these wafers in a way that generates electrical signals. The compass uses these signals—along with images of star positions taken by the camera—to measure rotation.

Because the Inertial Stellar Compass (ISC) is based on this new, radically different technology, NASA needed to flight-test it before using it in important missions. That test flight reached completion in December 2007 after about a year in orbit aboard the Air Force's TacSat-2 satellite. "It just performed beautifully," Chmielewski says. "The data checked out really well." The engineers had hoped that ISC would measure the spacecraft's rotation with an accuracy of 0.1 degrees. In the flight tests, ISC surpassed this goal, measuring rotation to within about 0.05 degrees.

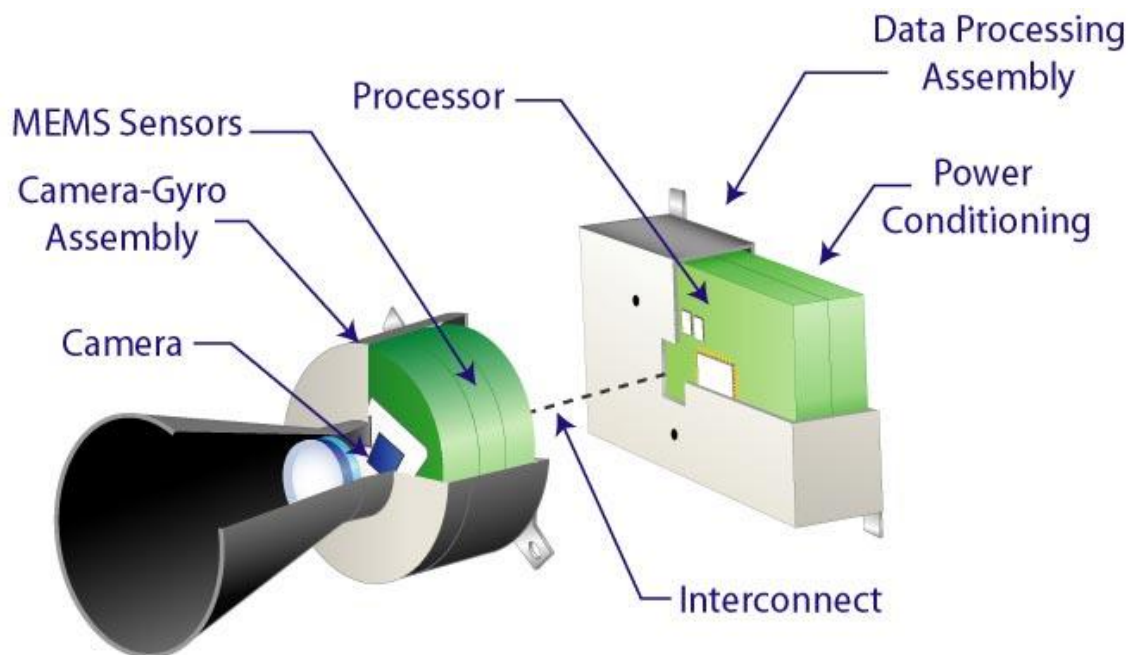
That success paves the way for using ISC to reduce the cost of future science missions. When launching probes into space, weight equals money. "If you're paying a million dollars per kilogram to send your spacecraft to Mars, you care a lot about weight," Chmielewski says. At less than 3 kilograms, ISC weighs about one-fifth as much as traditional stellar compasses. It also uses about one-tenth as much power, so a spacecraft would be able to use smaller, lighter solar panels.

Engineers at Draper Laboratory, the Cambridge, Massachusetts, company that built the ISC, are already at work on a next-generation design that will improve the compass's accuracy tenfold, Chmielewski says. So ISC and its successors could soon help costs—and spacecraft—stay on target.

# NASA's Space Place

Find out more about the ISC at [nmp.nasa.gov/st6](http://nmp.nasa.gov/st6). Kids can do a fun project and get an introduction to navigating by the stars at [spaceplace.nasa.gov/en/kids/st6starfinder/st6starfinder.shtml](http://spaceplace.nasa.gov/en/kids/st6starfinder/st6starfinder.shtml).

*This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.*



*The Stellar Compass is built as two separate assemblies, the camera-gyro assembly and the data processor assembly, connected by a wiring harness. The technology uses an active pixel sensor in a wide-field-of-view miniature star camera and micro-electromechanical system (MEMS) gyros. Together, they provide extremely accurate information for navigation and control.*