NIGHTFALL
Huachuca Astronomy Club of Southeastern Arizona

November 2012

President's Notes

Next Meeting: The next meeting of the Huachuca Astronomy Club will be Friday, November 2, 2012 at the Student Union Building, Community Room at Cochise College at 7 pm. The guest speaker will be Dr. David O'Brien, a research scientist at the Planetary Science Institute in Tucson. Dr O'Brien will present "The Giant Asteroid Vesta: Highlights from NASA's Dawn Mission." NASA's Dawn mission has recently completed its year-long orbital exploration of the asteroid Vesta, and is now on its way to its second target, the asteroid Ceres, where it will arrive in 2015. In addition, he will show a number of close-up images of Vesta taken by Dawn. Dr O'Brien has won a number of awards, and a minor planet was renamed "O'Brien" in his honor. We will also be holding our annual elections after the talk. For more information, please visit www.hacastronomy.com.

Image from NASA spacecraft Dawn of the large minor planet Vesta with artist superimposed view of Dawn departing with ion drive:

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Arizona Science and Astronomy Expo: On Friday and Saturday, November 10 and 11, the ASAE will be held at the Tucson Convention Center. This is a big deal! The organizer is none other than Alan Traino who runs the biggest astronomy show on the planet, called NEAF. As it now stands, many dozens of vendors and organizations will have booths at this expo. In addition, two NASA astronauts will speak in addition to a long list of other distinguished astronomers. For more information, please visit: www.scienceandastronomy.com. Don't miss it!

Public Night at the Patterson: The next Patterson Observatory public night is Thursday, November 15. We had another great turnout at the last public night on October 18, and we appreciated the visit by Jeff Ofstedahl's high school science class.

Total Solar Eclipse: On November 13, there will be a total solar eclipse. You'll need to join up with a tour group in the Southwest Pacific or fly on your own to northern Australia to see this one.

Leonid Meteor Shower: This shower peaks in the early morning on November 17. There will be no moon up, so this could be a great time to watch the shower.

Return to Douglas: The astronomy night for Paul Huber Middle School in Douglas has been rescheduled for November 20. Last year's star party extravaganza was exciting, and we had about 300 students, teachers, parents, and friends. Again, we will need a lot of help this year.

Audubon Research Ranch: Everything went well with clear and calm skies for the astronomy night at the Audubon Society's Research Ranch near Elgin on Oct 20. Thanks to Bob Hoover who helped with this event.

Candidates for HAC Board of directors: The elections will be held at our November meeting. For those running for reelection, thank you for your service, and for those stepping down, like Glen Sanner and Keith Mullen, we greatly appreciate all you have done and continue to do for HAC!

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Secretary: Ted Forte
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Doug Snyder

Past President: Wayne Johnson (not elected position)

Clear skies and bright stars,

Bob Gent
President, Huachuca Astronomy Club

A Cosmic Tease:
Trials of the Herschel Space Telescope Science Teams

By Dr. Marc J. Kuchner

Vast fields of marble-sized chunks of ice and rock spun slowly in the darkness this week, and I sat in the back of a grey conference room with white plastic tables spread with papers and laptops. I was sitting in on a meeting of an international team of astronomers gathered to analyze data from the Herschel Infrared Observatory. This telescope, sometimes just called Herschel, orbits the Sun about a million miles from the Earth.

The meeting began with dinner at Karl's house. Karl charred chorizo on the backyard grill while the airplanes dribbled into Dulles airport. Our colleagues arrived, jetlagged and yawning, from Germany, Sweden, and Spain, and we sat on Karl's couches catching up on the latest gossip. The unemployment level in Spain is about twenty percent, so research funding there is hard to come by these days. That's not nice to hear. But it cheered us up to be with old friends.

The meeting commenced the next morning, as the vast fields of ice and rock continued to spin—shards glinting in the starlight. Or maybe they didn't. Maybe they didn't exist at all.

You see, this team is looking at a series of images of stars taken by a device called a bolometer that is blind to ordinary starlight. Instead, the bolometer inside Herschel senses infrared light, a kind of light that we would probably refer to as heat if we could feel it. But the idea of pointing the bolometer at the stars was not to collect ordinary starlight. It was to measure heat coming from the vicinity of these stars, like an infrared security camera, in case there was something else to be found lurking nearby.

And lo and behold, for a handful of stars, the bolometer measurements were off the charts! Maybe something was orbiting these stars. From the details of the bolometer readings—which channels lit up and so on—you would guess that this stuff took the form of majestic fields or rings of icy and rocky particles. It would be a new kind of disk, a discovery worth writing home to Madrid about.

At left is Samuel Pierpoint Langley, who developed the bolometer in 1878. His instrument detects a broad range of infrared wavelengths, sensitive to differences in temperature of one hundred-thousandth of a degree Celsius (0.00001 C). In 1961, Frank Low developed the germanium bolometer, which is hundreds of times more sensitive than previous detectors and capable of detecting far-infrared radiation.

There are several teams of astronomers analyzing data from the Herschel Space Telescope. They call themselves by oddly inappropriate sounding acronyms: GASPS, DUNES, DEBRIS. For the time being, the scientists on these teams are the only ones with access to the Herschel data. But in January, all the data these teams are working on will suddenly be released to the public. So they are all under pressure to finish their work by then. The team whose meeting I was sitting in on would like to publish a paper about the new disks by then.

But it's not so simple. The stars that this team had measured were relatively nearby as stars go, less than a few hundred light years. But the universe is big, and full of galaxies of all kinds—a sea of galaxies starting from maybe a hundred thousand light years away, and stretching on and on. Maybe one of those background galaxies was lined up with each of the stars that had lit up the bolometer—fooling us into thinking they were seeing disks around these stars.

The team argued and paced, and then broke for lunch. We marched to the cafeteria through the rain. Meanwhile, vast fields of marble-sized chunks of ice and rock spun slowly in the darkness. Or maybe they didn't.

What else did Herschel recently uncover? Find out at http://spaceplace.nasa.gov/comet-ocean.

Editor's Note: *Dr. Marc J. Kuchner is an astrophysicist at the Exoplanets and Stellar Astrophysics Laboratory at NASA's Goddard Space Flight Center. NASA's Astrophysics Division works on big questions about the origin and evolution of the universe, galaxies, and planetary systems. Explore more at http://www.science.nasa.gov/astrophysics/.*

This is a recent image from the Hubble Space Telescope called the Extreme Deep Field. Different cameras were used over several years to examine a very small dark spot in space. What Hubble revealed was over 5,000 galaxies at a very remote location.

BOOK REVIEW

Cindy Lund

Roving Mars: Spirit, Opportunity, and the Exploration of the Red Planet
by Steve Squyres

Back when I was in college, two rovers, Spirit and Opportunity, were built and sent to Mars. Roving Mars is the story of how Jet Prolusion Laboratory (JPL) got the assignment, built the rovers, and operated them on Mars. It was written by the mission's chief scientist, Steve Squyres. The book is very well written. Even though I knew full well that the mission had been successful, I found myself worried that the rovers wouldn't get built in time, or would crash onto Mars, or would break or wear down at the beginning of their missions.

Roving Mars is divided into three parts. The first part, Beginnings, tells of the proposals Steve worked on that were not selected by NASA, and the selection of the Mars Exploration Rover project (Spirit and Opportunity). The second part, Development, is about how the rovers were built and launched. The third part, Flight, tells of the rovers landing on and exploring Mars.

Steve first wrote a proposal for an instrument to be sent to Mars in 1993. He and his team designed and created a camera. Unfortunately, they got the size requirements wrong. The space for the camera was low and wide, but the camera they designed was tall and thin. Steve's team lost that round. In 1996, NASA asked for proposals for a Mars mission. Steve's team designed a Lander with a small rover to study rocks, but NASA selected the Mars Polar Lander instead. In 2000, Steve began working on designing a rover named Athena, which went through several iterations. Eventually it turned into the Mars Exploration Rover project which was selected by NASA. Steve's team also got a request, "Can you build two rovers?"

After getting the go ahead to send two rovers to Mars, the JPL team still faced extremely tough challenges. The biggest was getting the rovers ready in time for the 2003 launch window. The relationship between Earth and Mars's orbits is such that every 26 months there is a two to three month period where a spacecraft can be sent to Mars with minimum energy costs. So, if Spirit and Opportunity were not launched by July 14, 2003, there wouldn't be another chance until 2005. The JPL team had just 34 months to design, build, and test the rovers before sending them to Mars.

JPL soon ran into difficulties. The rovers were too heavy and they went over budget. Thankfully, NASA provided them with an extra 158 million dollars, in addition to the $688 million already allocated.

They had to pick two landing sites. Steve wanted one of them to be Gustav, a big crater which they thought a river might have once emptied into. However, there would likely be a lot of wind at Gustav, and the rovers were not designed to recognize if the wind was moving them horizontally. If they were, the rover could just move against the wind to compensate, so it wouldn't be moving sideways at touchdown. The Lead System Engineer, Rob Manning, knew that a multibeam radio sensor would work, but it would weigh five kilograms, and there wasn't enough mass margin for that scenario. Rob talked to spacecraft attitude control expert Miguel San Martin, who had a solution, "Just give me two pictures". They developed the Descent Image Motion Estimation System or DIMES. It took two pictures, which the computer compared to determine the rovers horizontal velocity. It worked, and Spirit landed at Gustav.

They also had problems with the parachutes. Adam Steltzner designed parachutes for the rovers, but when he tested the finished parachutes, they exploded. So Adam redesigned the parachutes. He made three designs, one heavily reinforced that would not perform well, but would also not shred, one was reinforced only where needed so it would perform very well and one in between. He then had them tested. The middle one didn't shred, but it didn't open. The weakest one opened, but was far too slow to do so. Then Adam realized what the problem was.

The vent was too big. They chute technician took a piece of red nylon and used it to shrink the vent. Then the chute opened correctly.

Even after the rovers were safely on Mars, JPL was not through with solving problems. After 18 sols (Martian days) on Mars, Spirit stopped transferring data. Over the next three days the JPL team determined that Spirit was in a fault mode, since it only responded to commands sent at a low uplink rate. After thinking it through, Glenn Reeves theorized that Spirit's computer was continually rebooting. On sol 20 of Spirit's mission, JPL was able to get data from Spirit, but only real time data, no archive data. The next day, Glenn had the idea that the issue might be a problem with the flash file system, since they didn't get any archive data. Fortunately, Glenn had added a command called INIT_CRIPPLED, so they could bypass the flash file system. Using INIT_CRIPPLED, JPL regained control of Spirit, shut it down, and let it recharge. Spirit was then able to continue its mission.

The book also describes what the rovers discovered on Mars. Opportunity landed at Meridiani, in a crater, which the JPL crew named Eagle Crater. There it found spherical granules which were full of hematite. Finding hematite usually means there was water. They also found evidence of ripple cross bedding. After exploring Eagle Crater, Opportunity went over to another larger crater, which the JPL crew named Endurance Crater. There Opportunity studied the layers of rocks exposed by the crater. They are sulfates laden with hematite filled with the same spherical granules seen in Eagle Crater. Meridaini was probably once a salt flat or playa.

Spirit landed in Gustav, where it saw some hills in the distance, JPL named them the Columbia hills after the Columbia space shuttle. There, Spirit found bedrock. The rocks have sulfur, chlorine, phosphorus, and hematite. They were probably formed in a volcanic eruption and later, had water flowing through them.

Overall, Roving Mars is an excellent book that gives a dramatic recount of the creation, testing, and launching of two rovers, Spirit and Opportunity and of their explorations and discoveries on Mars.

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2012—ARIZONA's Astronomically Handy Sky Calendar from Doug Snyder—2012

ARIZONA SKY PHENOMENA Calendar—All Times shown are MOUNTAIN STANDARD TIME*

January 2012
HIGHLITE: Shadow Transits on Jup.
01 Su New Year's Day; HNY2012 !
03 Tu Dbl. Shadow Tr., 2327hrs.,G&Eu
Quadrantid Meteors Pk@2400h. view a.m. of 4th**; an 80% moon sets just after 0300 hrs.
09 Mo ○ Full Moon 0031 hrs.
10 Tu Dbl.Shadow Tr., 2326hrs., Eu&G
11 We Comet P/2006 T1(Levy); mag.7?; perihelion@2343 hrs, 1.0074AU
16 Mo Spica 2°N. of Moon, 0100 hrs.
☾ Last Quarter Moon 0209 hrs.
21 Sa Mars at mag.-0.3, size 10.7″
23 Mo ● **NEW MOON** 0040 hrs.
30 Mo ☽ First Quarter Moon 2110 hrs.

February 2012
HIGHLITE: C/2009 P1 Garradd
03 Fr **Comet Garradd,** 0.5° from M92 Globular in Hercules, 3am
07 Tu ○ Full Moon 1454 hrs.
09 Th Venus 0.3° N. of Uranus, pm; mag. –4.1 & +5.9; size: 16″, 3.4″; eyepiece recommended
10 Fr Zodiacal Lt. in W., pm, next 2 weeks; after twilight.
14 Tu ☾ Last Quarter Moon 1005 hrs.
21 Tu ● **NEW MOON** 1535 hrs.
25 Sa Venus 3° S. of waxing Moon
26 Su Jup. 4° S. of Moon, pm
29 We ☽ First Quarter Moon 1822 hrs.
Leap-day: 2012 has 366 days

March 2012
HIGHLITE: Planetary Arrangements
03 Sa Mars @**opposition**, 1335 hrs., size at 13.9″, mag. –1.2
05 Mo Mars closest to Earth, 1000hrs
Merc. evening planet in W., 7″
08 Th ○ Full Moon 0239 hrs.
10 Sa Zodiacal Lt. in W., pm, next 2 weeks; after twilight
14 We ☾ Last Quarter Moon 1826 hrs.
19 Mo Vernal **Equinox**, 2214 hrs.
22 Th ●**NEW MOON** 0738 hrs.
Dbl. Shadow Tr., 1935hrs., I&G
27 Tu Venus G_Elong. E., 46°, in western sky after sunset
30 Fr ☽ First Quarter Moon 1241 hrs.

April 2012
HIGHLITES: Saturn, Lyrid Meteors
03 Tu **Venus** 0.5° S. of M45 (Pleiades) in early evening, western skies
06 Fr ○ Full Moon 1219 hrs.
13 Fr ☾ Last Quarter Moon 0350 hrs.
15 Su **Saturn@ opposition**, 1100hrs
18 We Merc. morning planet in E., 8″
21 Sa ● **NEW MOON** 0019 hrs.
Lyrid Meteors, Pk 2200hrs.
28 Sa **Astronomy Day #1 2012**
29 Su ☽ First Quarter Moon 0259 hrs
30 Mo Venus at brightest mag., –4.7

May 2012
HIGHLITE: Annular Solar Eclipse
05 Sa η-Aquarid Meteors; unfavorable year due to moon; pk.1200hrs.
○ Full Moon 2036 hrs.; largest in 2012
12 Sa ☾ Last Quarter Moon 1447 hrs.
20 Su ● **NEW MOON** 1648 hrs.
Annular Solar Eclipse; best Arizona site: near city of Page; low altitude Sun; starts at 1724 hrs., max. at 1834 hrs.
28 Mo ☽ First Quarter Moon 1317 hrs.

June 2012
HIGHLITE: Solar Transit of Venus
04 Mo Partial Lunar Eclipse; penumbra starts 0148 hrs.; partial at 0259 hrs; partial ends 0506 hrs
○ Full Moon 0412 hrs.
05 Tu **Transit of Venus**; start at 1510 hrs.; still in progress at sunset at 1916 hrs.
11 Mo ☾ Last Quarter Moon 0342 hrs.
19 Tu ● **NEW MOON** 0803 hrs.
20 We Summer Solstice, 1607 hrs.
26 Tu ☽ First Quarter Moon 2031 hrs.

July 2012
HIGHLITE: Jupiter's Morning Light
01 Su Merc., west sky, pm twilight, mag. +0.4, size 8.1″
03 Tu ○ Full Moon 1152 hrs.
10 Tu ☾ Last Quarter Moon 1849 hrs.
12 Th Venus, am, brightest mag., -4.7
14 Sa Comet 96P/Machholz, Perihelion
18 We ● **NEW MOON** 2125 hrs.
21 Sa Dbl.Shadow Tr., 0354hrs, Eu & I
26 Th ☽ First Quarter Moon 0157 hrs.
28 Sa Dbl.Shadow Tr., 0446hrs, Eu & I
29 Su S. δ– Aquarid meteors Pk. in am, unfavorable year, 78%Moon
30 Mo Jupiter, am, size 36″, mag. –2.1

August 2012
HIGHLITE: Perseid Meteor Shower
01 We ○ Full Moon 2028 hrs.
09 Th ☾ Last Quarter Moon 1156 hrs.
12 Su **PERSEID** Meteors: **favorable!** View pm 11th & am 12th
13 Mo Dbl.Shadow Tr., 0348hrs., I & G
Occultation of Venus by the Moon; near 1340 hrs.
16 Th Merc. morning planet in E., 8″
17 Fr ● **NEW MOON** 0855 hrs.
24 Fr Neptune @ Opposition,0600h. mag.+7.8, size 2.3″, 29AU
☽ First Quarter Moon 0654 hrs.
31 Fr ○ Full Moon (**2nd**) 0659 hrs.

September 2012
HIGHLITE: Northern Lights in AZ ?
08 Sa ☾ Last Quarter Moon 0616 hrs.
12 We Epsilon (ε) Eridanids Meteors peak near 0600hrs; favorable
14 Fr Zodiacal Lt. in E., am, next 2 weeks before twilight
15 Sa ● **NEW MOON** 1911 hrs
Alert For aurora activity before, during & after Equinox
22 Sa **Autumn Equinox** 0749 hrs.
☽ First Quarter Moon 1241 hrs.
29 Sa Uranus @ opposition, 0000hrs. mag. +5.7, size 3.7″, distance 19.1 AU from Earth
○ Full Moon 1241 hrs.

October 2012
HIGHLITE: Meteor Showers (3)
03 We Venus/Regulus Appulse—one of the best for 2012; E., 0500hrs
08 Mo ☾ Last Quarter Moon 0034hrs
Draconids Meteors: 0300 to dawn
10 We **S. Taurids** Meteors: favorable!
13 Sa Zodiacal Lt., E., am, next 2 wks.
15 Mo ● **NEW MOON** 0503 hrs.
21 Su **Orionids** Meteors: v. favorable!
☽ First Quarter Moon 2033 hrs.
29 Mo ○ Full Moon 1250 hrs.

November 2012
HIGHLITE: LEONID Meteor Shower
06 Tu ☾ Last Quarter Moon,1736hrs.
12 Mo **N. Taurids** Meteors, 0400h.
13 Tu ● **NEW MOON** 1509 hrs.
17 Sa **Leonid Meteors!** First of 2 Pks., 0200hrs.; v. favorable
19 Mo 2nd **Leonid** pk. possible 2400h.
20 Tu ☽ First Quarter Moon 0732 hrs.
27 Tu Venus/Saturn Conjunction! E., am, 0630hrs., 0.6° separation
28 We ○ Full Moon 0747 hrs.

December 2012
HIGHLITE: GEMINID Meteor Shower
02 Su JUPITER @ Opposition, 1900 h.
04 Tu Merc. morning planet in E., 7.4″
06 Th ☾ Last Quarter Moon 0832 hrs.
13 Th ● **NEW MOON** 0142 hrs.
GEMINIDS Pk: 0500 hrs.; Very Favorable for 2012
19 We ☽ First Quarter Moon 2220 hrs.
21 Th Solstice (Winter) 0412 hrs.
22 Fr **Ursid** Meteors Pk., 0100 hrs.
28 Fr ○ Full Moon 0322 hrs.

*Times/Dates= ARIZONA MountainStandardTime (UT-7hrs), NO DST; **updates/ details,** see**:** http://skycalendar.blackskies.org;
Abbr: Tr=Transit; Pk=Peak; Merc=Mercury; E=East W=West; S=South; N=North; J, Jup.=Jupiter; V=Venus; "=arc seconds; h., hrs.=hours (24 hour time system); MP=Minor Planet; MS=Moon Set; wks=weeks; Lt=Light; pm=evening; v.= very am=morning; mag.=magnitude; **meteor shower dates reflect predicted Peak Morning, but Moon may still be present; I=Io; Eu=Europa; G=Ganymede; C=Callisto; UT=Universal Time; **bold text=**possibly a promising/worthy event or activity; G_Elong=Greatest Elongation; dbl= double; AU=Astronomical Unit; *compiler*: Doug Snyder (C/2002 E2, MP15512); V2.0.2012