Rappahannock Astronomy Club

Minutes, July 15, 2015, Meeting

In attendance:

Bart & Linda Billard
Don Clark
Ron Henke
Glenn Holliday
Jerry Hubbell
Scott Lansdale
Lauren Nicholson
Tim Plunkett
Tom Watson
Adam, Zachary, & Noah Zwierko

President Ron Henke called the meeting to order shortly after 7 p.m. Thirteen members were present.

Program

Glenn Holliday's program was "New Planetary Science from Dawn, Rosetta, and New Horizons." He said these latest planetary missions were revealing new science about minor planets, overturning things we thought we knew. With Dawn and New Horizons, NASA has become the first space organization to send probes to all the planets in the solar system and to the largest minor planets. Dawn was the first to orbit an asteroid and is now the first to orbit two different deep space objects. (Glenn explained that for NASA deep space object means beyond the Moon.) Rosetta, a European Space Agency (ESA) craft, was the first mission to orbit a comet and it is hoped will be the first to make two landings on one.

Glenn made a brief digression to talk about NASA's Messenger mission, which ended April 30. He said Brenda Conway did two programs on it in prior years. The time limit on the mission was a result of the need to use fuel to maintain Messenger's orbit of Mercury. Because Mercury is so close to the Sun, the Sun's gravity varies significantly in the vicinity of Mercury where Messenger orbited. The variation caused disturbances in the orbit that required regular use of fuel to correct. As the fuel was running out, NASA adjusted the orbit as low as possible to Mercury. Glenn said Messenger unexpectedly found Mercury's magnetic field varies in response to solar activity. He also showed an image of hollows formed in the floor of impact craters that are evidence for geologic activity.

The Dawn spacecraft was not the first use of an ion engine in space but was the first long-range mission to use one. The ion engine was the key to entering and leaving orbit around more than one target (along with the low mass of the targets). Glenn said the targets, Vesta and Ceres, represent 10 percent and 33 percent, respectively, of the entire asteroid belt mass. Vesta is not spherical, but Ceres is, making the latter a minor planet. Vesta is differentiated, with a metal core, indicating melting and cooling. Vesta's water is gone, similar to large moons. Ceres is still in its original primitive state—a uniform rocky body with an ice layer accumulated on the surface and a dust layer on top. It is similar to Kuiper Belt objects. Vesta is considered a protoplanet, but Ceres is not because it is undifferentiated. Their similarity in origin from our Sun's original accretion disk and difference in evolution were factors in their selection as targets for Dawn. Adam Zwierko asked how we know Vesta's core is iron, and Glenn explained it is inferred from density measurements.

Among the new Dawn mission findings, Glenn listed the closest best pictures of Vesta, showing streambeds and an unexpected mountain at its south pole. Dawn is still getting started at Ceres, where four orbit distances are planned. It had some problems after shifting from the first, outermost distance. NASA is still analyzing what happened and adjusting the mission schedule. However, it has already produced a photographic map of the entire asteroid and imaged an unexpected bright spot, actually several spots in closer images, inside a crater. A leading hypothesis suggests it is reflective ice. Someone asked about the minimum size a body has to reach before gravitation makes it spherical. No one was sure, but Glenn pointed out it is somewhere between Vesta and Ceres.

Glenn told us Rosetta's trip to rendezvous with comet 67P/Churyumov-Gerasimenko spanned 2004 to 2014 and included three flybys of Earth and one of Mars for gravity assists. The Mars flyby allowed it to get pictures from 250 km above the surface. The second Earth flyby in 2007 led to it temporarily getting a minor planet designation, $2007VN_{84}$, when it was mistaken for a near-Earth asteroid. Rosetta also flew by two asteroids on the trip. It entered orbit around the comet last September.

Rosetta carried the landing probe Philae, which landed on the comet November 12, 2014. The three landing feet on Philae carried anchors to be driven into the comet's crust and secure the probe, but they failed to penetrate. Glenn told us Philae bounced at least twice before coming to rest at an angle in the shadow of a cliff face. Its solar panels could not receive enough light for continuous operation, and the probe performed initial experiments before going to sleep with low battery charge. He said the landing mishap provided the interesting information that the comet's crust was unexpectedly hard. Philae woke up June 13, 2015, and sent results of another experiment on July 9, but communications are still intermittent.

Glenn said the comet had a surprisingly odd shape. The two lobes joined by a narrower neck suggest two smaller objects collided and stuck together. An image of a crack in the neck suggests the two lobes are weakly connected and may break apart as the Sun warms the comet. He showed illustrations of a number of significant findings from Rosetta. One shows much of the surface is shaped into dunes, suggesting piles of soft material although Philae landed on hard ice and bounced. As the comet neared the Sun, some of the gas and dust that is becoming the comet's coma was released in jets at specific locations, instead of uniformly sublimating all over the surface as scientists expected. In June, the comet was close enough to the Sun for the jets of gas to continue after sunset at their locations. In July, Rosetta saw a sudden outburst of dust from the comet. Glenn said the water cycle on comet 67P is not what we thought. The Sun sublimates ice to water vapor, which subsequently breaks up into hydrogen and oxygen. Spectroscopy showed ultraviolet emission from water vapor characteristic of electron absorption instead of photon absorption. The conclusion is that the water vapor is ionized by the sunlight, and the resulting free electrons drive more splitting of the water than the sunlight photons do.

If Philae can generate enough electricity and establish reliable communication, scientists plan to command it to drill into the comet to get a measurement of its composition. Ultimately, ESA plans for Rosetta to complete its mission with a landing attempt on the comet surface. Glenn said it would probably be in late 2016.

New Horizons launched in January 2006, achieving the fastest launch speed of any spaceship. It took only 13 months to fly by Jupiter for a gravity assist, and its current final speed is second only to Voyager 1. Glenn said it turned off communications with Earth on July 13 to facilitate collection of science data during the flyby of Pluto the next day. It has now begun to download data from the flyby and will do so into next year to get it all. New Horizons is powered by a plutonium thermoelectric generator that will support science for another 11 years. Its next Kuiper Belt object target was found in a survey by the Hubble Space Telescope.

Glenn said photos of Pluto and Charon from New Horizons began to surpass Hubble's resolution when it neared Pluto in June. He said Charon is unexpectedly brighter than Pluto and has a dark spot at its north pole, while Pluto has a bright spot at its north pole that was shown to be twinkling in photos taken 30 minutes apart. The first color photos were returned on June 27. Glenn said Pluto and Charon are remarkably different in color, as well as reflectivity. Until 1990, they were thought to be of similar composition. More recent studies of eclipses showed Pluto is more rocky and Charon more icy.

Because of a software problem that caused New Horizons to enter a safe mode on July 4, science data were lost until July 8 while the probe was oriented to communicate with Earth for troubleshooting. Afterward, new photos revealed more details of Pluto, including geological features. A more accurate diameter was determined for Pluto, revealing its diameter is larger than Eris. Therefore, it is less dense than thought and consequently less rocky and more icy. New Horizons detected traces of Pluto's atmosphere while still farther away than the orbit of Charon. That means they share an atmosphere.

Glenn's last New Horizons image of Pluto was returned July 13, just before the closest approach began. There was also an image of Pluto made by Rosetta the day before, and he said Google added Pluto to Google Earth using New Horizons images. Glenn said that because he was giving the presentation the day after closest approach, "We should check the web now for exciting new updates since I started talking." Lauren Nicholson was able to download a new image on her phone and confirm his prediction. His presentation with bibliography is on the club website monthly programs page.

Old Business

- Treasurer's Report—Tim reported receiving three dues payments, two of them including Astronomical League dues. The club currently has 19 paid memberships this year and 1 paid through 2016.

- Update on the next Newsletter Status—Linda said the new issue is nearly done except for two articles Jerry Hubbell and Terry Barker are working on.
- Communications Committee/Website—Glenn said the website was unsuccessfully attacked for about 5 hours on July 4. It was a brute force break-in attempt.
- Support or Awards for Science Fairs—Ron said he did not have anything new to report on the University of Mary Washington STEM idea.
- Astronomy on the Mall—Ron and Jerry took telescopes and Lauren stopped by later. There was more discussion than observing because of the weather, but Ron found it was a good experience discussing astronomy with quite a few people.
- Shiloh Schools Outreach (Northumberland)—Scott had nothing new to report. Ron said all the planets will have set by the time we get there on November 7 and suggested considering alternatives. Should we pick another Saturday when we could view the Moon or come up with a suitable target list?
- Club Picnic—Ron said the picnic would be at Scott's on August 8, starting at 3 p.m. Scott would supply meat, beverages, and paper products. Attendees should provide desserts or potluck dishes. An email was sent out and RSVPs are needed by July 29 so Ron can give Scott a head count. A star party was planned if weather permits. Ron and Jerry told us some people from Voice of America who talked with them at the Mall event would be attending to see some amateur astronomy equipment.

New Business and Astronomy News

- Field Trip—Ron said he had talked with someone at the Mall event about Cherry Springs, PA, one of the darkest sites east of the Mississippi. He thought it might be a possible field trip destination. It is about a 6-hour drive. Lauren said there is also a Dark Sky Park a little farther on in Ohio.
- Shenandoah Park Events—Ron heard from Kirstin Hendershot at Shenandoah Park about events planned in August and September where our participation would be welcome. The August event is during the week of the 12th and 13th (Perseid meteor shower peaks), and the September event on the 27th, a Sunday. He plans to go to the August event. He said he asked about regular events at the park and got a positive response. He asked us whether we were interested in the possibility of a couple of weekend star parties there in the spring and fall and the response was positive. Ron said he would tell her that at least one member with a telescope would go in August but September was doubtful, and that we would like to arrange a couple of star parties a year.

Next Meeting

The next meeting is the club picnic on Saturday, August 8, 2015, at Belmont Observatory.