

# Rappahannock Astronomy Club

## Minutes, April 17, 2013, Meeting

In attendance:

- Benjamin Ashley
- Terry Barker
- Bart & Linda Billard
- Scott Busby
- Don Clark
- George Clarke
- Joe Fordham
- Joe & Sherry Francis
- Glenn Holliday
- Melvin McDaniel
- Tim Plunkett

Vice President Ben Ashley began the meeting shortly after 7:00 p.m. Thirteen members were present.

## Program

Glenn Holliday presented "The Adventures of Voyager Across the Solar Heliopause." He said he saw stories about new findings from Voyager a few months ago and remarked that it might be a good subject for a program. Not long after he agreed to do a program on Voyager for this meeting, it was back in the news again. Voyager 1 is part of the Grand Tour fleet of four probes made possible by the planetary alignment that occurred in the 1970s. The four craft were Pioneer 10 and 11, which practiced on Jupiter, and Voyager 1 and 2, which covered all four of the outer planets. The fleet made dozens of first discoveries, and the two Voyager craft are still doing astronomy after almost 40 years.

Pioneer 10 was launched in March 1972 and was the first craft to enter the asteroid belt and first to reach Jupiter. Besides demonstrating the feasibility of crossing the asteroid belt, it discovered unexpected clouds of helium in interplanetary space and hydrogen clouds around Io and Europa, and found that Jupiter is exothermic, emitting more heat than it receives from the Sun. Pioneer 10 was last heard from in January 2003 when its power source became too weak. The launch of Pioneer 11 was in April 1973. It flew by Jupiter and was the first craft to reach Saturn, discovering new rings and moons of that planet. It also discovered Saturn is exothermic. Pioneer 11 was last heard from in November of 1995.

Voyager 1 was launched in September 1977, a month later than Voyager 2, but it was able to overtake its sister craft. It flew by Jupiter and Saturn, performing a gravitational slingshot maneuver over Titan to investigate that moon. The maneuver took Voyager 1 out of the plane of the ecliptic, so it could not visit the other outer planets. Voyager 1 discovered new rings of Jupiter and volcanoes on Io. It took the Family Portrait of the solar system planets from beyond Neptune. Although it can no longer send images, Voyager 1 continues to send daily science data back to Earth.

Voyager 2 also flew by Jupiter and Saturn. It remains the only craft to visit Uranus and Neptune. A gravity slingshot maneuver over Triton ruled out a visit to Pluto. Voyager 2 discovered new moons of Jupiter and studied the unusual magnetic field of Neptune, finding the field has a tail like a comet. Voyager 2 determined that features on Jupiter and Neptune are storms. It also continues to send science data back.

Glenn discussed the gravitational slingshot maneuvers that helped make the Grand Tour missions possible. The theory is relatively old, with the first use in 1965. The technique appeared in the *Star Trek* series 2 years later. The potential increase in speed is dramatic, allowing the trip from Jupiter to Saturn to be reduced to 2 years. He noted that the slingshot maneuver is the only technology known with a chance to save the Earth one day from the Sun's red giant phase. In a table about where they are going, Glenn showed current speed ranging from 11 km/sec for Pioneer 11 to 17 km/sec for Voyager 1. Pioneer 10 is 108 astronomical units (AU) from the Sun headed in the direction of Aldebaran. It will take 2 million years to arrive. Pioneer 11 is 88 AU from the Sun headed toward somewhere in the constellation Aquilla, and will take twice as long as Pioneer 10 to arrive. Voyager 2 is 101 AU out headed toward Sirius with about

496 thousand years to go, and Voyager 1 is 124 AU from the Sun headed in the direction of the star Gliese 445 with 40,000 years to go. Glenn also included the New Horizons probe in the table. It is 26 AU from the Sun and due to arrive at Pluto in 2 years. The table did not include its speed, but Glenn said it is the fastest.

Joe Francis asked about news reports suggesting that unexplained acceleration of the Voyagers might be related to dark energy. Glenn said some acceleration has been measured, but that a recent more mundane explanation has been proposed and is gaining acceptance. Taking into account the directional distribution of thermal radiation produced by the radioactive power sources of the spacecraft appears to be sufficient to explain the acceleration.

The scientific data the Voyagers are now sending back relate to refining our models of the heliosphere, the region where the solar wind has influence. The probes have found and passed the termination shock region where the solar wind drops from supersonic to subsonic velocity. The models had a heliosheath of subsonic solar wind particles beyond the termination shock, ending in a heliopause and a bow shock between the solar wind and galactic particles. Although the Voyagers found the termination shock appeared as expected, the bow shock is not as expected: "the solar wind ends not with a bang but a whimper." The solar wind and galactic magnetic fields interact in ways we didn't know before. The heliosheath is also asymmetrical. Last August, Voyager 1 reached a stagnation region where galactic particles are distinguishable by their direction of flow parallel to the heliopause.

These results introduced the final topics of when or whether Voyager 1 has left the solar system and what is in store for it after leaving. Glenn noted that it may have "left the solar system" a number of times. It passed beyond Neptune's orbit in 1989, found the Termination Shock in 2004, and encountered an unexpected region with no solar wind in 2010. The stagnation zone is also a region of "magnetic foam," with each bubble the size of Earth's orbit. In 2012 it found a sudden increase in cosmic rays and also found the magnetic highway, with galactic particles flowing along parallel to the heliopause. Glenn noted that Voyager is still influenced by the Sun's gravitation, and will not reach the Oort Cloud until it has traveled 2,000 AU. The questions of definition of "leaving" become murky. Does the Oort Cloud end at 50,000 AU? Does it continue and mingle with a Proxima Centauri Oort Cloud?

Glenn closed with a discussion on what Voyager 1 might encounter after leaving the solar system, although he noted that its power will run out long before then, and it will not send back any data. He described the messages the four craft carry in case they encounter other civilizations. The Pioneers carry plaques with diagrams indicating where it came from and showing a man and a woman to scale in comparison to the spacecraft. The Voyagers also carry recordings, including some music from Earth.

## Old Business

- Treasurer's Report—Tim Plunkett said he had no new dues payments or expenditures to report. The number of 2013 paid club members remains 20, with one member paid through 2014. He said the projector purchase will show up in the next month's report.
- Status of Club Loaner Equipment—Ben had no changes to report for the status of loaner equipment. Glenn said he brought the club Personal Solar Telescope in case a member wanted to check it out.
- Star Parties, Events, and Meetings—Terry Barker reported on the March 21 outreach at Kate Waller Barret Elementary School. They had fires going for the event. It was not as dark as it might be, but the fires allowed nice breaks to get warm. Linda Billard and Ben reported on the England Run Library outreach held on March 23 (on the same night as the Stafford Elementary School Outreach). It started early while it was still bright. People had a chance to see the Moon and Jupiter very early. There were 40–50 visitors, and quite a few stayed the whole evening. Some brought telescopes and got help with them. The event was well-appreciated. The Caledon star party scheduled for April 6 was cancelled because of forecasted overcast conditions. Ben reported on the outreach for the Boy Scouts of Aquia at Flying Circus Bealton. He noted it was a good dark location with convenient amenities. The conditions were poor for a few hours, with many fast-moving clouds and very bad seeing. It got better around 10–11 p.m. The seeing was good late, and Ben left around 3 a.m. The Belmont star party the next night was successful. Melvin McDaniel, Scott Busby, Linda, Bart, and Ben were there with 2 guests. Ben and Melvin stayed the latest. Melvin said the Sun was coming up when he got home.

## News/New Business/Announcements

- RACLUB *StarGazer* Newsletter—Linda said that material for the April quarterly issue was essentially complete except for reports on tonight's program and Jerry's trip this week.
- Upcoming Star Parties and Outreach Requests—On April 20, Glenn is helping with the Girl Scout Spring Fling event in Northumberland County. He said he will be camping there that weekend, which helps lessen the impact of the travel distance. It also serves as a Scout Leader development event. Our next Caledon date is May 4. Ben said his Post Oak Middle school contact has asked about trying again for May 10 or 17 starting at 8 p.m. Linda and Bart were interested in participating with Ben, and he said he would let his contact pick one of the dates. The next pending outreach dates are in the fall. Wilderness Elementary School has an Observe the Moon Night on a Tuesday, October 15, at 6:30 p.m. Ben was inclined to say we should try to support it because it is close to Astronomy Day. We also have a request for Hartwood October 25. It is the next occurrence of the event we were unable to support last fall. November 9 is the planned date to return to Northumberland Shiloh Schools for a repeat of the event we had there last fall. Jane Towner is the contact again this year.
- Website Committee—Glenn mentioned that the committee has a long-term plan worked out. Linda added that a design idea is finished, but that she delayed discussing it at the meeting so committee members could look at it first and possibly have Terry put together something with it that works enough to better demonstrate it. Ben asked what we know about usage of the website by nonmembers. Glenn said that people we see at Caledon events often say they were steered there by our website.

## Next Meeting

The next meeting is on Wednesday, May 15, 2013, at the Heritage Center in Fredericksburg.