Rappahannock Astronomy Club

Minutes, January 21, 2015, Meeting

In attendance:

- Bart & Linda Billard
- Don Clark
- George Clarke
- Ron Henke
- Jerry Hubbell
- Lauren Nicholson
- Scott Lansdale
- Tim Plunkett
- Mike Spragins
- Myron Wasiuta
- One other visitor

President Ron Henke called the meeting to order shortly after 7 p.m. Ten members and 2 visitors were present.

Program

Ron presented the program “How Big Is the Solar System.” He noted that the solar system is defined by the Sun’s influence but that there is more than one way of defining “influence.” The talk looked at three of them. One is the extent of influence of solar winds, the heliosphere. The second is the extent of gravitationally held bodies, which includes the Oort cloud. The third is the theoretical extent of the influence of the Sun’s gravity, known as the Hill Sphere.

Ron described components of the heliosphere in the old model. The solar winds abruptly slow at the termination shock, resulting in a region of compression and a change in the magnetic field. It begins at about 75 to 90 astronomical units (AU) from the Sun. Beyond the termination shock is the heliosheath, at about 80 to 100 AUs. In it, the solar winds slow further and become more compressed. They also become turbulent from effects of interaction with the interstellar medium. Ron said the heliosphere finally ends in the heliopause, at about 100 to 120 AUs. Here the solar winds reach a standstill and can no longer push back against the winds of the interstellar medium. He said Voyager 1 reached the heliosheath in late 2010 and found that the velocity of particles in the solar wind had decreased almost to zero. He presented a plot of particles detected by Voyager 1 in the 12 months starting in late October 2011. It showed an abrupt drop in numbers in August 2012.

In another slide, Ron described the Interstellar Boundary Explorer (IBEX) satellite launched by NASA in 2008 in contract with Orbital Systems. Its objective is to discover the nature of the interactions between the solar wind and the interstellar medium by making a map of the boundary. Returning to his slide picturing the old heliosphere model, he pointed out it also showed the heliosheath stretches on one side into a tail. On the other side, the old model predicts a bow shock, like a wave forming in front of a moving boat. Ron explained the question mark after “bow shock” in the slide. IBEX found that there is no bow shock because the Sun and heliosphere are moving through the interstellar medium more slowly than originally thought. He said he tried without success to research whether that meant the solar system is orbiting the galaxy more slowly and asked our thoughts. Myron Wasiuta and Bart Billard agreed that the *relative* motion of the interstellar medium and the solar system is the reason there is no bow shock. That does not necessarily mean the solar system is moving more slowly through the galaxy. Jerry Hubbell wondered whether some sort of friction effect reduced the velocity difference so there is no shock. Myron mentioned that the star Mira moves through the interstellar medium at a very high speed and has a bow shock.

Another measure of the Sun’s influence is the most distant gravitationally held bodies: the Oort cloud. Ron said its name refers to Dutch astronomer Jan Oort, who postulated its existence in 1951. Interestingly, the Kuiper Belt was theorized a year later. Ron found quite a variation in estimates of distances to the start and end of the Oort cloud. He said he went with the NASA estimates of 5,000 to 100,000 AUs, respectively. For perspective, he said the Oort cloud reaches almost half way to Proxima Centauri, and that the Kuiper Belt is only 0.001 as far from the Sun as the Oort cloud. Ron mentioned some widely varying estimates of the number of objects and total mass in the Oort cloud, but he considered them too disparate to choose numbers to put in writing on a slide. The objects are believed to

have formed nearer the Sun and then thrown outward by the gravitational influence of the large planets early in the evolution of the solar system.

The Oort cloud is thought to be the source of long-period comets, and the Kuiper Belt is thought to be the source of short-period comets. Comets from the Oort cloud are thought to be caused by the perturbations of passing stars. Ron found the division into orbit periods as less than 200 years for short-period comets and more than 200 years for long-period comets did not make sense if the latter are from the Oort cloud. He illustrated with the orbit of Sedna, the planetoid with a diameter of about 1,100 miles discovered in 2003. With a sequence of 4 images, each zoomed out by 10 or more times the previous, he showed the inner solar system out to Jupiter, the outer solar system with Sedna's current position near its closest approach to the Sun showing in the corner, Sedna's entire orbit, and finally, the inner part of the Oort cloud, with Sedna's orbit a tiny loop in the center. The period of Sedna's orbit is about 10,000 years, so "more than 200 years" is a serious understatement for an Oort cloud comet.

The last definition Ron discussed for the Sun's influence as it relates to the size of the solar system is a theoretical range of influence for the Sun's gravity called the Hill Sphere. When an object orbits a more massive object, its satellites are unstable unless they orbit within the Hill Sphere. The Hill Sphere thus defines the volume of gravitational influence for the object that orbits the more massive object. Ron had the equation in his slide but denied being able to calculate it for the Sun's Hill Sphere. He remembered finding an answer that was little more than half the distance to Alpha Centauri, but left it out of the slide because he could not find the reference again. Incidentally, Ron found that the very inner part of the Oort cloud includes a torus (donut-shaped) region called the Hill Zone, named after a different Hill.

In summary, the solar system size could be the size of the heliosphere (about 120 AUs), the size of the Oort cloud (100,000 AUs or more), or the size of the Hill Sphere (even bigger). Jerry commented on the Oort cloud being outside the heliosphere. He wondered whether if the size of the solar system includes the Oort cloud, do we still consider particles there as part of the interstellar medium? Scott Lansdale asked which direction Voyager 1 left the heliosphere. Ron said it went more or less out the front and that Voyager 2 went out at more of an angle toward the side, but not toward the tail.

Old Business

- Treasurer's Report—Tim Plunkett gave the report for December, 2014. He noted receipt of four dues payments, with one including additional dues for the Astronomical League and a donation to the club. There were no expenditures. The club ended the year with 27 paid memberships and begins 2015 with 9.
- Loaner Equipment—Scott was continuing work on updating the list that he had assembled, and he was planning to send an email to those who have equipment asking for more details, perhaps a picture, and an indication whether any would prefer to pass the loaner on to a new custodian. He noted some of the names were no longer accurate. In discussion at the meeting, two updates were noted. Scott Busby has the Personal Solar Telescope (not Dave Bentz), and Ron Henke has the Orion Star Shoot Webcam (not John Ulrich).
- Update on the next Newsletter Status—Linda said the newsletter was coming along, with inputs from Jerry and Bart nearly ready and a review article she was working on. She expected to work on it over the next week or so.
- Star Parties, Events, and Meetings—Ron said he had attempted to contact Jane Towner via email to discuss a date for the Northumberland outreach but had had no response yet. He felt he should allow a few more weeks before attempting to call. He thought the date should preferably allow viewing of the Moon and some planets to provide more interest for the audience.

  Ron said we need to give John Bachman a decision on a date for a Stratford Hall outreach in order to fit in with their scheduling. He said October 8, 2016 has a half Moon, and darkness starting around 8:15. Venus sets at 8:19, Saturn at 9:46, and Mars at 11:22. Uranus and Neptune are up essentially all night. Ron said John Bachman gave him an attendance estimate of about 30 to 50 people, and asked whether we felt comfortable committing to the event this much in advance. Our consensus was that it was a reasonable date, and we should offer to do it.

  Ron said the schedule for 2015 star parties at Caledon is now available on the club website.

New Business and Astronomy News

- Next Club Meeting Program—Ron said Lauren Nicholson will present the program on the Sloan Digital Sky Survey, with the schedule changed to have the business meeting first. He said the schedule change has been announced on our website.
- Activities for 2015—Ron asked about desires for club activities in the coming year. Linda suggested scheduling a visit to Fan Mountain as we have talked about in recent meetings. Jerry said he would get some information about arranging it for us. Ron suggested finding a project to learn about and use an online remote telescope system such as Slooh. He also said he would like the club to do an outreach event on our own initiative as opposed to simply responding to requests. As an example, he suggested doing a demonstration on using online telescopes at the Library. Myron talked about observing reports from Sky & Telescope. He had an archive of reports on a thumb drive and said reading through them gives him ideas for interesting follow-up observing projects. Lauren said an outreach built around teaching constellations of the season and going back to myths about them has been popular for younger audiences and given some inspiration to go find out more. Scott suggested holding a weekend workshop where we could demonstrate different types of equipment. Linda suggested calling it an astronomy fair. Don Clark thought England Run Library offers a good venue. Linda and Jerry remembered doing a talk on constellations for children at the Headquarters Library and tried to remember the name of the Library youth coordinator they worked with.
- Club Website Status—Don reported on some administration he did for the club website. He said it was complete although there was an outage for a few hours while the change propagated through the internet. He had not realized he needed to allow for that.
- Myron Wasiuta's Webcam Image and Video Presentation—Myron showed some results from trying out a new webcam that came with a fisheye lens attachment. He said it gave him motivation to find some other things to do when the planets are not up. One was creating time-lapse videos, including an ISS pass video he called "Firefly Summer Night." A video at normal speed showed the Moon and caught an aircraft pass across it. He had a time lapse of comet Lovejoy made over a 30 minute period in which the comet's motion against the stars is visible. He also had some images from the webcam and from a new DSLR camera. A high resolution view of the crater Plato taken at f/50 with his C5 telescope showed how nice an image can be if seeing is good. He showed Hubble's Variable Nebula, which he recommended observing because it is possible to see changes over time.

Next Meeting

The next meeting is on Wednesday, February 18, 2015, at the Central Rappahannock Heritage Center.