

# Rappahannock Astronomy Club

## Minutes, April 20, 2016, Meeting

In attendance:

Terry Barker  
Bart & Linda Billard  
Don Clark  
Ron Henke  
Glenn Holliday  
Jerry Hubbell  
Paul Jacobs  
Scott Lansdale

Lauren Lennon  
Aiden O'Leary  
Payal Patel  
Tim Plunkett  
Ryan Rapoza  
Myron Wasiuta  
Tom Watson

The meeting began a little after 7 p.m. Twelve members and 2 visitors were present.

## Program

Bart Billard presented "Kepler Update: 2016." Although he had presented a program or update on Kepler nearly every year since 2009, he started with an overview of the mission for those who might need the background. Kepler is a space telescope designed to detect extrasolar planets by the dimming of their host stars caused if they pass in front from our point of view. It is a 0.95-m Schmidt camera with 21 pairs of CCDs totaling nearly 100 megapixels, so it can monitor more than 150,000 stars at once.

Extrasolar planets were first confirmed 21 years ago, but early ones tended to be similar in mass to Jupiter, the size best for early techniques. William Borucki and other scientists who helped develop the Kepler mission wanted to extend the capability to detect smaller planets like Earth and pushed the idea of using a space telescope to search many stars at once for transits. Eventually, Kepler was approved and launched May 6, 2009, into an orbit of the Sun trailing the Earth. The orbit and choice of target stars allowed Kepler to nearly continuously observe their intensity year-round, with short breaks to transmit data back to Earth and reorient the solar panels facing the Sun. Myron Wasiuta asked which constellation the target stars are located in, and Bart said they are in Cygnus in the area toward Lyra.

Goals of the mission aimed at detecting systems similar to the Earth-Sun system, meaning measuring stars' intensities with noise levels significantly less than 100 parts per million and observing long enough to catch four transits (at least 3-1/2 years). The large number of stars monitored provides a good statistical sample for estimating how many planets of various types could be found in the Milky Way. These goals were exceeded before problems with the reaction-wheel stabilization degraded the pointing precision needed for the original target region. However, data from the 4-1/2 years of observations are still being analyzed. Meanwhile, engineers devised a new way to stabilize the telescope if the telescope points parallel to the ecliptic so that sunlight pressure on the solar panels is balanced. The success of this adaptation led to approval of a new mission K2, with targets along the ecliptic plane in 75-day campaigns.

Bart showed two charts he found using the [NASA Exoplanet Archive](#), a relatively new website providing access to exoplanet data, charts, and tools for exploring the data. The first chart showed that the year 2014 had a very large number of transit discoveries. Bart explained the signals that are consistent with extrasolar planet transits become "candidate planets," but they require confirmation that they are not something else, like a variable star or a "blend" of a star with an eclipsing binary system in the background. Methods like radial velocity measurements or high-resolution imaging to detect blends use ground-based telescope follow-up observations and take time to schedule. Two papers introduced new methods for confirming candidates in systems where multiple planet transit signals are detected. The additional information available when more than one candidate is found allowed ruling out the other possible explanations with high confidence. The papers confirmed 750 candidates in such multiple-planet systems *en masse*. The second chart showed the distribution of candidate and confirmed Kepler planets by radius and orbital period. Bart said a video version in the Archive shows year-by-year results. It makes clear the need for longer observation time to find the planets that take longer to complete their orbit. Someone pointed out there were a number of planets whose "years" were less than a day long.

Bart then turned to a number of recent news items from the NASA Kepler News website. He said the first was an unfolding story of an emergency situation that has put the next K2 campaign in jeopardy, so he would begin with that item and based his update on that and others he had highlighted. Between routine contacts on April 4 and 7, the spacecraft had entered an emergency mode, which had never happened before and results in high fuel consumption. Kepler engineers were granted priority access to NASA's Deep Space Network to communicate with the spacecraft to restore it to a stable state over the weekend and return to normal network scheduling. During the next week, engineers downloaded diagnostic data and used a troubleshooting procedure tested first on the ground with a Kepler simulator. By April 14, they were testing the more suspect components. The next day, all but one had been tested. Bart said the fault detection sensitivity might be high enough that a chance coincidence could have precipitated the emergency. He had also seen a suggestion that one more fault detection in emergency mode could have ended the mission. The cause of the anomaly remains under investigation.

The next K2 campaign, on hold because of the emergency, involves using Kepler to detect planets in another way: Planets can boost a parent star's gravitational effect on bending the light from a distant star in the background to enhance the brightness. Predicted by General Relativity, this "microlensing" effect is especially suited to detecting planets far from their host stars—or even wandering planets—that are not detectable by radial velocity measurements and rarely transit. This campaign involves cooperation with ground-based telescopes on six continents and will target stars in the direction of the center of the galaxy. An interesting wrinkle is that Kepler will point along its orbit in the direction of Earth instead of away from it as in previous campaigns. Otherwise, the target region would be in the daytime sky for telescopes on Earth. The joint effort should allow some parallax measurements.

Bart described some results of research groups using Kepler data for studies of supernovae. Two groups analyzed Kepler data on hundreds of galaxies to find records of supernova explosions. The "steady gaze" of Kepler allowed them to find a supernova and work back to see the star's behavior leading up to the explosion. One study found two examples of type II (core-collapse) supernovae. The researchers were able to find a pulse of light at the beginning of the explosion. They concluded it represented the "shock breakout" as the shock wave that bounces back from the core collapse inside the star reaches the surface. The other study appeared in *Nature* last May along with a Swift team study in ultraviolet. They showed evidence for two mechanisms proposed as the triggers of type Ia supernovae. The Swift team study showed an ultraviolet pulse early in the explosion, evidence of the explosion reaching the white dwarf's companion, an ordinary star that would have contributed the material that built up on the white dwarf and triggered the explosion. The team using Kepler data found signatures of three type Ia supernovae that showed no evidence of ejecta interacting with a companion star, supporting the mechanism of merger of two white dwarfs as the trigger in these explosions.

The original Kepler mission field was largely populated by mature stars similar to the Sun or older. K2 samples star-forming regions, clusters, galaxies, and more. In addition, the science community can choose the most compelling science targets. One interesting discovery was a close-in Jupiter-sized planet sandwiched between two smaller companion planets. Theorists are reworking their models, and astronomers are searching for more "hot Jupiter" companions. Another highlight was the discovery of a mini-planet orbiting a white dwarf star. Its lopsided transit light curve, suggesting a comet-like tail, is evidence it is disintegrating and being vaporized because of the strong gravitational effects and intense starlight.

Bart concluded with a selection of exoplanet discoveries, including the eight Kepler discoveries that made a top-20 list chosen last year for the 20th anniversary of the first exoplanet discovery. Among them was Kepler-444, a system of five planets in orbital resonance that is nearly as old as the Milky Way. Another, Kepler-452b, is the first confirmed planet satisfying three criteria for similarity to Earth—its radius is 1.6 times Earth's, its orbit is in the habitable zone 5 percent larger than Earth's, and its star is Sun-like. A copy of Bart's presentation is available on the club website's [monthly programs](#) page.

## Old Business

- Treasurer's Report—Tim Plunkett did not have any new dues payments to report except that Don Clark paid the additional \$10 for 2 years because he had forgotten the recent increase in dues from \$15 to \$20.
- Stargazer and Communications Committee Update—Linda Billard said she had reminded everyone (except Scott Busby) from whom she was expecting articles, and she anticipated

having all the articles she needed shortly in order to have the newsletter ready by the end of the month. Glenn Holliday said the club website is doing fine. He brought up the Renaissance Faire, for which he said he would need club flyers. Ron said he would return the unused flyers from the Curtis Park outreach to Linda, and Linda said she still had about 75 copies she could give to Glenn. Glenn reiterated that he would welcome help from other club members who wanted to volunteer. He mentioned he would again be playing the part of Thomas Digges, an English astronomer before the invention of the telescope who was the translator of Copernicus' book on the heliocentric solar system.

- Stafford County Event Review—Ron said the event went very well, and some people stayed around until the last telescope was being put away. However, Scott Lansdale said he had noticed that some people coming to these events take a couple of looks through telescopes and leave without waiting for the move to a third object. Jerry suggested that having binoculars to pass around to people in line gives them something to do while waiting. He thought it had helped with past events at the Mall.
- Cub Scout Pack at Caledon—Ron said the night was unexpectedly successful, in spite of the forecasted cold weather and poor sky conditions.

## **New Business and Astronomy News**

- Astronomy at the Mall—Ron noted that the organizers had changed the location for the rain date to Catholic University.
- Northumberland, May 14—Ron said it was time to finalize details. Northumberland Preservation Inc. has announced the event in its newsletter. A band would play from 7 until 8 p.m., and they are having a potluck picnic. Someone suggested we could set up the solar telescope at about 6. Ron got a show of hands of members who planned to go.
- NOVAC at Sky Meadows May 7—(Scott said it was at Sky Meadows instead of Big Meadows.) Ron told us about the invitation from NOVAC for this upcoming event. He pointed out it was the week before Northumberland, and Glenn observed it was also a Caledon star party date. Ron did not think NOVAC was seeking volunteers to bring more telescopes.
- Ferry Farm, November 5—Ron has been in contact with the organizers of the Kenmore outreach event about their request for a follow-up. Based on November as the month they prefer, he was suggesting the 5th has objects of interest that we would be able to show. However, it is a Caledon date, so we would have to do something about the conflict. Ron asked Glenn, who responded that we could probably reschedule with Caledon for the event this far in advance.
- Need a New Vice President—Ron decided to move this item up in the agenda. He said he and his wife had just put their house on the market, and it is already under contract. He expected to be moving in early June, and May would be his last meeting as president. He thought it would be best to choose a new vice president (or president) so that person could start getting up to speed on ongoing outreach arrangements such as in the previous item. Nominations were needed this evening so that we could vote at the next meeting. Jerry Hubbell said he would accept a nomination as vice president with the understanding that he would be unable to accept a nomination as president later. Jerry nominated Myron, who said he has trouble making it to club meetings. He said he could try to accommodate if absolutely necessary.
- Embury Mill July 8—Ron said David Abbou was asking for help for this outreach, which is also a star party date. Scott said he might be able to help, and Lauren Lennon also said she might be able to.
- Stafford County September 10—Ron said some members were concerned about the background check requirement for volunteers. It came up just before the Curtis Park event but was not strictly enforced because of the short notice. Ron did not think that exception would work for September. He urged us to decide soon as a club whether we are willing to go along with the requirement or need to decline the second outreach in September.
- Westmoreland Park Invitation April 23—Glenn said we were invited this weekend. A picnic would be involved, and a couple of scout groups would like some astronomy activities.
- MSRO Update and Demonstration—Jerry said the mount controller replacement was now operational, and the dome shutter was remotely controllable. The telescope was getting a good workout, including imaging. He estimated he has spent 60 hours using the MSRO, some of it with Ron and Bart. This week he finished getting data submitted to the Minor Planet Center as a step in getting certification for the observatory. Myron thanked Jerry and others who helped get the

observatory operational so quickly. Groundbreaking was in October. He said he was serving as the Observatory Director and Jerry was the Assistant Director. Now that MSRO is operational, Myron said it is time for people to start using it. He described three ways to use MSRO. Someone could simply send a request as a guest observer for something he wanted observed for him/her. Alternatively, he/she could log on to watch or be guided through the process without wanting to go to a higher level. Finally some could become actual operators by going through some reading materials Jerry is preparing and then getting training.

For the latter two options, Myron said the first step is to download and install TeamViewer version 11. Once that is ready, the next step is to request a code number and password, which are used in TeamViewer to “connect to partner.” Myron showed the screen the user would see when he connected and proceeded with a demonstration. He showed the display from the webcam that serves as a video finder, then demonstrated using Maxim DL, which provides integrated control of the entire observatory. He opened the dome, slaved it to the telescope, and started the telescope tracking. A virtual hand controller showed the status of the telescope (tracking or slewing). Myron then showed how to use the Maxim DL camera controller to turn on the camera, start its cooler, and make exposures. The telescope is polar-aligned well, and it tracks well with Drivemaster. A few small glitches in right ascension tracking can be ironed out once a pier extension is added to allow the telescope to see down to the local horizon.

Ron said he spent about 5 hours one evening learning about how to operate the telescope and made the picture that is currently on the club website, with help from Jerry, Myron, and Bart. Myron said they were ready to start helping people, inviting us to email if interested. Tom Watson asked how fast the telescope. The answer was  $f/5.2$ .

Someone asked whether it would still be possible to contribute to MSRO through GoFundMe. Jerry said they were considering starting the GoFundMe account back up some time soon. He said they would need to purchase some equipment and software licenses for MSRO that were being used on loan so far.

Myron was able to continue the demonstration by pointing toward a star cluster and manually correcting with the video finder until an image could be “plate solved” using Pinpoint Astrometry in Maxim DL. Then he showed how to “synch” the telescope to the coordinates that were found. That allowed him to find a galaxy, NGC 2903, and make an image. As the meeting ended he pointed the telescope to the Hickson 44 galaxy group and set up a long sequence of exposures, demonstrating the Autosave feature.

## Next Meeting

The next meeting is on Wednesday, May 18, 2016, at the Central Rappahannock Heritage Center.