MHAS-Observer

Newsletter of the McMath-Hulbert Astronomical Society, Lake Angelus, Michigan

Contents

President's Message

Greetings all,

Scientific research can be achieved by amateurs using modest equipment such as the telescopes at the observatory. One such opportunity occurs on Jan 23, 2021 at approximately 11:30pm. An asteroid named (333) Badenia will pass in front of a dim star in the constellation of Taurus the Bull, near the bright star Beta Taurus. (See diagrams on next page for more information.)

As the asteroid passes in front of the star, the star will disappear for a brief moment and then reappear. With careful timing and precise position coordinates the size of part of the asteroid can be determined. Using multiple observers stationed across the asteroid's path a "shadow gram" can be created to "see" the actual shape of it. An analogy would be like holding an object above a piece of notebook paper to see its shadow. Then highlighting the lines on the paper that are in the shadow of the object. Each highlighted line would represent when an observer sees the star disappear.

Certain conditions have to be met for this to see the shape of an asteroid. For starters the shadow of the asteroid needs to be available to the observer, asteroids travel in front of stars quite often but not in the same location, it happens all over the world. For any one location, this type of event will happen a few times a year. The star should be bright enough to be seen by the observer's telescope (not too faint). The asteroid on the other hand should be much fainter than the star, even too dim to be seen with the telescope is best. Some asteroids are fairly bright and if they are brighter or similar in brightness to the star then you will not see when the star disappears. With thousands of asteroids in the solar system, most of them have not had their size measured directly. Estimates of their sizes are determined by their brightness and distance but not to a high degree of accuracy. Having many amateur astronomers take these measurements is the most practical way professional astronomers can determine their sizes. For more information go to the International Occultation Timing Association's (IOTA) home page at https://occultations.org/.

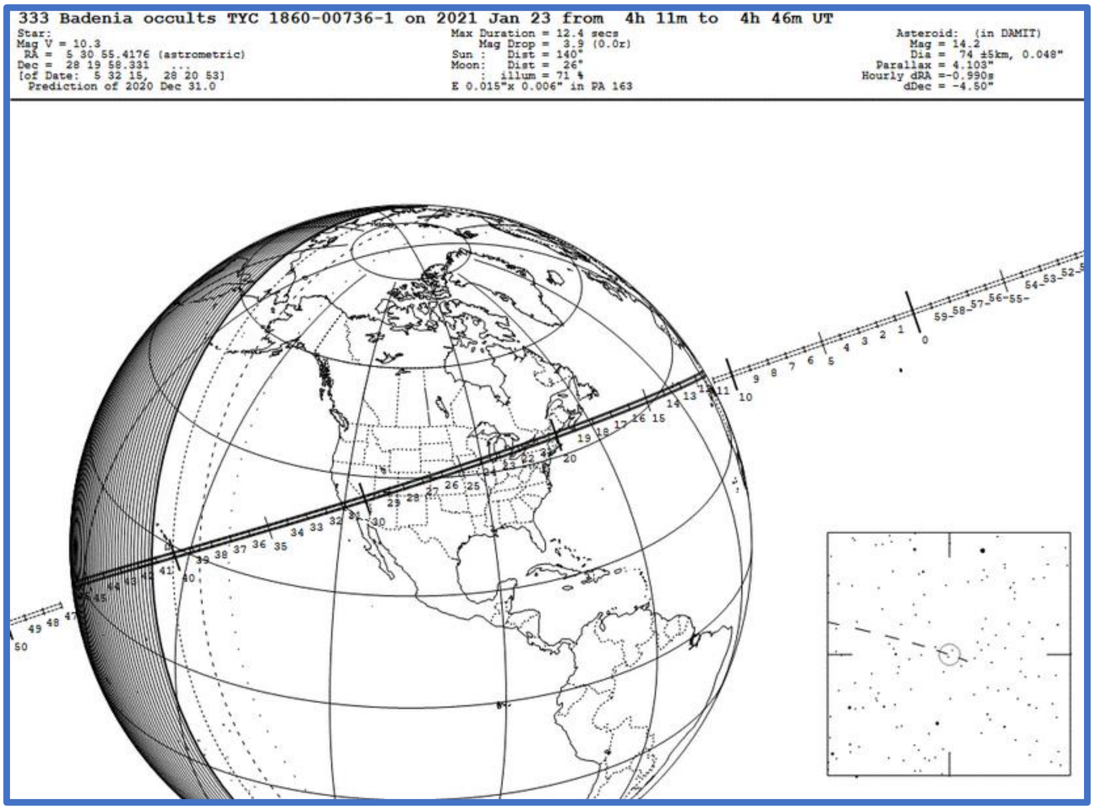
I know this event occurs in the previous month for this newsletter but it is still after our publication date. The list of events for this year was just recently released so I'm including it here. I can now look for future events and publish them much sooner. For updates check out our Facebook page also.

Marty Kunz

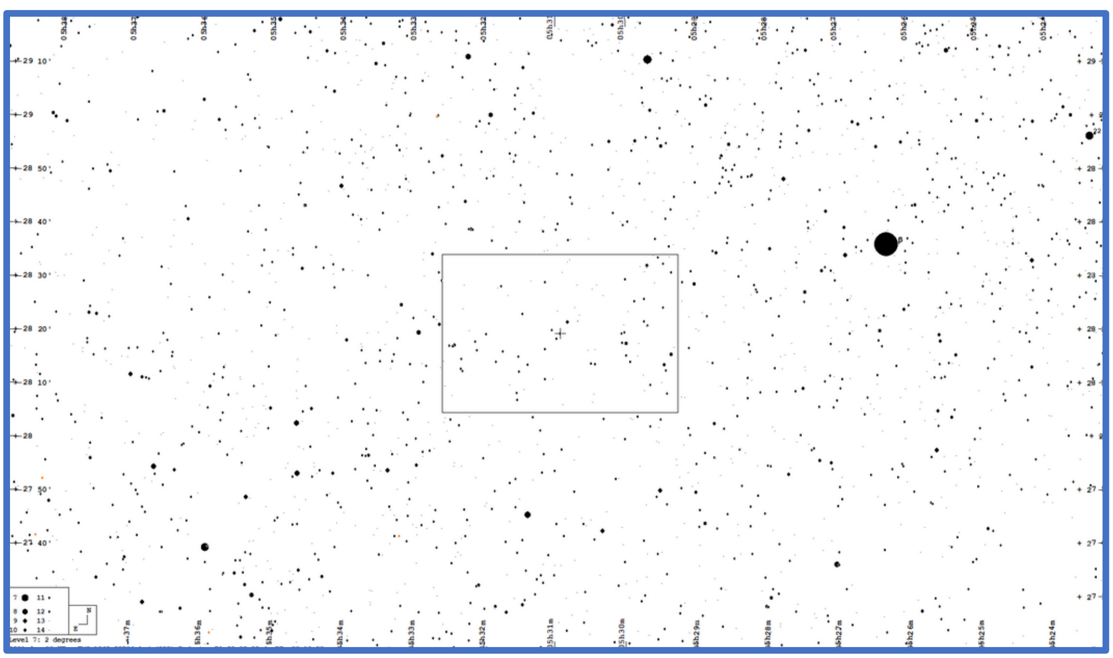
Corona Virus Update

With the most recent restrictions due to the increase of the Covid infection rate, we unfortunately have to restrict access to MHO again.

We at MHAS are all hoping we can resume normal operations and visits this year with the coming of vaccination. And at the time of this writing there appears to be a decrease in infection rates.



333 Badenia Occultation Path, 1/23/21



333 Badenia Occultation Field of View, Note β–Taurus, Brightest Star in Field

History Corner—Jim Shedlowsky: To Be Continued…..

Jim's taking a break this month as he did the snowbird thing and will be in Arizona for the next few months. Once he's settled in, look for another article next month!

Introduction to Radio Astronomy—Amateur Pulsar Detection; Part 3

Last month we discussed how pulsars were first discovered in 1967 by radio astronomers Anthony Hewish and Jocelyn Bell in 1967 at the Mullard Radio Observatory in Cambridge England. Like many scientific breakthrough discoveries, this was pretty much accidental and which turned out to be the first confirmation of the existence of neutron stars.

Note that the existence of neutron stars was first proposed by astronomers Walter Baade and Fritz Zwicky in 1934, shortly after the discovery of the neutron by James Chadwick in 1932.

Early on, the Cambridge team discovered many other pulsars and today over two thousand are known to astronomers.

And today even amateur radio astronomers are getting into pulsar detection. This is far and away the most challenging area that amateurs are working in. Amateur radio astronomers detect pulsars by prior knowledge of where the pulsar is in the sky, their periods, and how much dispersion there is of the pulsar's signal in the frequency domain by the interstellar medium. This dispersion is caused by the many free electrons in the signal path between us and the pulsar.

The amateur first points his dish at a known pulsar location and accumulates data for a fairly long period of time. The data is taken over the widest frequency band that the amateur's system can handle. The amateur also uses as large an antenna as possible. Antennas may take several forms, from dish antennas, corner reflectors, or arrays of Yagi antennas ganged up in parallel to increase sensitivity to the pulsar's signal.

An absolute requirement is the need for a very low noise, high gain radio frequency preamplifier for the signal. This amplifier is mounted as close as possible to the antenna output to get the highest possible noise figure for the receiving setup. The noise figure is the critical parameter for a receiving setup and amateurs strive to get the highest gain antenna and the lowest noise figure for their setup.

Typical receive frequencies for pulsar detection are around 400 MHz or 600 MHz. There are reserved frequencies for radio astronomy at 408 MHz and 611 MHz. 611 MHz by the way corresponds to TV Channel 37 in the USA and you will never find a television broadcast station on Channel 37!

Once an acceptable hardware setup is built, amateurs then configure receivers using software defined radios operating on computers. Software defined radio is a more recent development and in the last 15-20 years, a lot of economical equipment has become available for amateurs and has made possible sophisticated signal processing capability. This processing capability is absolutely necessary for pulsar detection with the typical small receiving systems used by amateur radio astronomers.

There is a small number of amateur radio astronomers using modest antennas around the world, possibly as few as 50 total. One active amateur is Steve Olney of Australia. Mr. Olney uses a quad yagi array and monitors the brightest pulsar in the sky in the constellation Vela. Unfortunately, this pulsar is not visible in the medium to higher northern latitudes. The brightest pulsar visible from our latitude is in the constellation Camelopardalis which is near the north celestial pole.

The difference in brightness between the Vela and Camelopardalis pulsars is fairly large. Brightness of radio objects of point source type is measured in Janskys which are units of energy flux density in the units of watts per square meter per Hertz of bandwidth. This is a very weak signal for amateurs to attempt to detect! The Vela pulsar has a brightness of around 5 Jansky at 400 MHz and the Camelopardalis pulsar has a brightness of only about 1.5 Jansky. So, for us in the northern hemisphere, pulsar detection is a tough job.

Probably the best place to start when figuring out how to detect a pulsar is of course the Web. Mr. Olney of Australia has a website that walks you through the process from the very beginning. See this link:

Hawkesbury Radio Astronomy Observatory

There's a wealth of information on how to detect pulsars on this site and I've found it to be a great starting resource on my effort to detect a pulsar.

Another site maintained by Mr. Olney is:

Neutron Star Group

There's more good information on this site, although I have found that some of the links don't work and the site could use some maintenance.

In a nutshell, the process amateurs use to detect pulsars starts with software that professional radio astronomers use to detect pulsars. Since the pulsar signals are so weak, they fall below the noise floor for most amateurs using antennas of small aperture. For example, the dish we have at MHO is a

3-meter dish and we someday hope to detect a pulsar with it.

In order to pull the pulsar signal out of the noise, an averaging technique is called “folding” is used. This works by first recording the apparent noise from the pulsar for a long period of time (often hours).

Now as amateurs, we are looking to detect a known pulsar which means that we know where is is in the sky, and what the period and pulse width of the signal is. Also known ahead of time is the dispersion with respect to frequency of the pulses. With this information we can “pre-set” the folding parameters of the software to detect the already known signal characteristics of the pulsar in question. This process is kind of like shooting a gun at a target in a pitch-black cave! We point the gun in the right direction, set the tilt right, and bingo, we get a bullseye hit every time. Now it would be possible to get a bullseye in this situation. That would be like actually discovering an unknown pulsar, but it would certainly be a very improbable event were we to do so.

The Cambridge group that discovered the first pulsar used strictly analog techniques as they didn’t have the computing power available to us amateurs today. Their antenna was 4.5 acres in size and they were actually able to see the pulses in the time domain on their paper strip chart recorders whereas amateurs today operate in the frequency domain.

So, maybe someday we’ll detect that pulsar in Camelopardalis at MHO with our tiny dish, and we’ll certainly let you know when we do!

MHAS 3m Dish Antenna, Repurposed from a C-Band Satellite TV Receiving System (1980’s Vintage)

MHAS Contact Information:

MHAS Website

http://www.mcmathhulbert.org/solar/

MHAS Facebook Page

Click on the button below to get to the MHAS Facebook Page.

Address:

McMath-Hulbert Astronomical Society
895 N. Lake Angelus Rd.
Lake Angelus MI 48326

Email: info@mcmathhulbert.org

Phone: 248-494-8256 (Google Voice, leave message if nobody picks up)

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Dir-Educational Activities
Tom Hagen

Dir-Finance
TBD

Dir-MHO Preservation
TBD

Dir-Buildings Security
TBD

Dir-Social Activities
Marty Kunz

Dir-History
Jim Shedlowsky

ALCOR
Austin Sabatino

Scheduled Meetings

All MHAS members are welcome to join us on Saturday Work Days and Board of Directors Meetings. We are temporarily unable to hold Open Houses for the public.

MHAS Board Monthly Meetings / Teleconferences:

Board meetings are scheduled on the 1st Sunday of Each Month @ 2 PM and will be via teleconference. MHAS paid members are invited to participate in this meeting. For an invitation, email us at info@mcmathhubert.org.

Space Pirates Radio!

MHAS President Marty Kunz hosts an astronomy internet show called “Space Pirates Radio" on the website www.astronomy.fm. The show airs every Wednesday night at 9 PM Eastern and features current information about space mission developments, astronomy news, and a “what’s in the sky today” report. Set your alarm today!

Join MHAS

Membership in MHAS is $25/year. Join with us on our mission to preserve and promote the McMath-Hulbert Solar Observatory. Just drop us a line at info@mcmathhulbert.org and we’ll get you signed up! Or use the application form on the next page, print it out, and return it to us via email or USPS.

McMath-Hulbert Astronomical Society

Membership/Donation Form

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Annual membership is $25. Checks should made out to “MHAS” or “McMath-Hulbert Astronomical Society”. You can also pay using PayPal on our website.

Bring to meeting or mail to:
MHAS
McMath-Hulbert Solar Observatory
895 N. Lake Angelus Rd.
Lake Angelus, Mi. 48326