# MHAS-Observer

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

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## President's Message

Greetings all,

Just a reminder to those of you reading this in September. The annual Great Lakes Association of Astronomy Clubs (GLAAC) will holding its annual Astronomy At The Beach event (online this year) On Sept. 25 and 26. We will be holding a live radio telescope broadcast on Friday night at 8:00pm. Check here:https://www.glaac.org/ or their FB page for a schedule.

MHAS has joined an organization called The Astronomical League:https://www.astroleague.org/

This is a large organization of amateur astronomers in the U.S. The league has many programs and benefits for astronomy clubs. MHAS members can join them through us for only $7.50 per year and that includes their newsletter.

With October's cool weather and earlier nights, I am increasing my efforts to bring our 12-inch nighttime telescope up to speed so that members can do evening observing and astrophotography. Consider this another benefit for becoming a member!

I'm putting together a list of items and projects that will need funding. From the lowest dollar amount on up, for anyone that would like to sponsor/adopt a specific project. This list will also give everyone an idea of just how much it will cost to make the observatory functional.

Unfortunately for reasons beyond our control, the first Saturday open houses have been temporarily suspended. We hope to resume them as soon as possible.

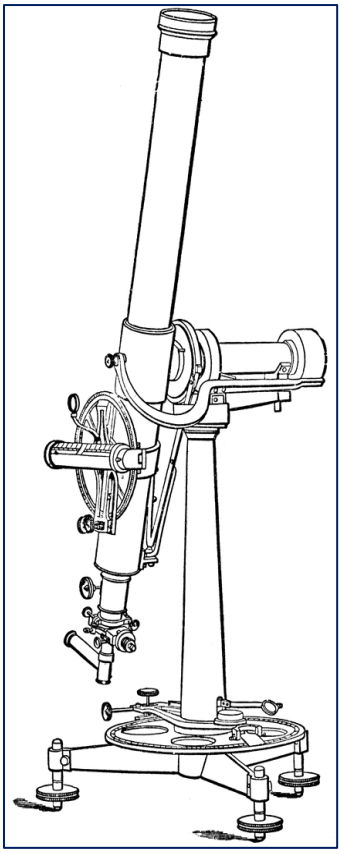
With your continued contributions and participation, we are moving forward to make this facility prosper and be a valuable, historic landmark in Michigan.

*Marty Kunz*

## Corona Virus Update

With the relaxation of social distancing restrictions, we can now allow our members back in to MHO. We can have up to ten people present at a time. And don't forget your mask and please maintain 6-foot social distancing.

Note that members may come out any Saturday at 10 AM.



McMath – Pierce Solar Observatory

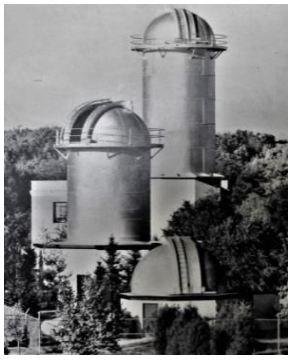
Robert McMath (1891-1962)

**History Corner—Jim Shedlowsky**

## Another "McMath Telescope" gets recycled/repurposed

In 2017 the McMath – Pierce Solar Telescope at the US National Observatory at Kitt Peak Arizona was decommissioned as the prime instrument for the National Solar Observatory. For 55 years, since its dedication as the McMath Solar Telescope in 1962, it was **the largest Solar telescope in the world**. But its history goes back another three decades to when three Amateur astronomers decided to build a private observatory back in Lake Angeles, Michigan.

Robert McMath, one of this trio (along with his father Francis and Judge Henry Hulbert) was the technical mastermind behind this enterprise which began in 1930 as the McMath – Hulbert Observatory (MHO), which was established to take time lapse movies of astronomical objects for educational outreach purposes. Their earlier efforts had received the attention of the University of Michigan who encouraged their novel approach to astronomy. In 1931, Robert was challenged by Dr. Heber Curtis, the Director of the Astronomy Department at



McMath – Hulbert Observatory
(Circa 1950)

the U of M, to devise a system to take time lapse movies of the **Sun**, a feat which had never been done previously in that "pre computer" era. His successful accomplishment of this daunting task resulted in a device called the Spectroheliokinematograph, and produced unprecedented movies of solar phenomena which so impressed the scientific world that it changed the course of Robert's life.

Over the next 37 years he would guide the McMath – Hulbert Observatory as its director, to grow and become one of the world's most prominent innovators and contributors in Solar Astronomy and its complex technology.

The MHO at Lake Angelus, Michigan ceased operations in 1979 and today has been repurposed as a home for the **McMath Hulbert Astronomical Society** for ongoing STEM and outreach activities……as well as basic maintenance and upkeep of that facility.

By 1954, Robert, who by now was known and respected in the scientific and astronomy world for his technical accomplishments as well as his business acumen, was named by the National Science Foundation to head a commission to assess the astronomical needs of the country. He became the first president of AURA (Association of Universities for Research in Astronomy) which was incorporated in 1957… to locate, construct and operate the Kitt Peak Observatory complex in Arizona, the nation's first national observatory.

It was no surprise that the plans for Kitt Peak included a recommendation for construction of the world's largest Solar telescope. Dr McMath (by this time Robert was a Professor of Astronomy with an honorary PhD), had spent many years at the MHO in Michigan, with the dream of constructing such an instrument using the experience and technological advancements pioneered at MHO. This unique facility was dedicated in 1962 as the Mcmath Solar Telescope incorporating many cutting-edge features into an unusual architecture resembling an upside down V shape which is visible for 60 miles atop Kitt Peak. It is the most striking structure

amongst the 26 research telescopes atop Kitt Peak.

During its long career (it was rededicated in 1990 as the McMath – Pierce Solar Telescope), this instrument made many contributions to our knowledge of our sun, but after more than 50 years of scientific operations, its technology has been replaced by a bigger and more advanced instrument in Maui. The facility with its spectacular 100 foot tall structure and advantageous location on Kitt Peak is in the process of a major transformation into an astronomical outreach facility named the **Windows on the Universe Center**. With a 4.5-million-dollar grant from the National Science Foundation, this significantly enhanced visitor center will provide a powerful new attraction to the Kitt Peak National Observatory. It will include a state of the art virtual visualization theater which can present programming from any NSF funded astronomy facility, a digital planetarium, and exhibits explaining astronomical topics and the various the various tools and technologies used in its pursuit. It will also maintain several of the current heliostats to provide live solar viewing. The center will coordinate and conduct all public outreach activities such as tours, workshops, observing programs and the like.
Thus, with this unique and spectacular new publicly sponsored facility,….the name and legacy of Robert McMath lives on, and returns to its roots of outreach. After all,…. outreach was the reason that McMath began his "Astronomy Odyssey" in 1930 when, as an interested **amateur** astronomer he started the McMath – Hulbert Observatory at his home in Lake Angelus, Michigan.

## Introduction to Radio Astronomy—The SuperSID Program; Part 1

One of the active ongoing radio astronomy projects at the observatory is a program called SuperSID. SuperSID is a project that detects radio waves from very low frequency (VLF) super powered radio stations operated by the world's navies to communicate with submarines under the sea and surface ships too.

VLF signals are found in the frequency range of 15 to 40 kiloherz (kHz). You may recall that human hearing runs in the range of about 20 Hz to 20 kHz, but the energy that your ears detect is in the form of sound vibrations in the air. VLF transmitters emit *electromagnetic* or radio waves on these frequencies.

Since VLF frequencies and audible sound frequencies are in a similar range, a receiver for VLF can be developed using a sound card in a computer. Connect an amplified VLF signal to the sound card on your PC and with appropriate software you can receive VLF signals from one or more of the several dozen stations operated by navies around the world.

VLF signals have wavelengths on the order of 7.5 to 20 km. These long wavelengths have the ability to penetrate conductive materials such as seawater better than the shorter wavelength radio signals. For example, the AM broadcast band wavelengths run from around 175 to 570 m (0.175-0.570 km). And FM wavelengths are even shorter, centered at 10 m (0.01 km). The world's navies take advantage of these properties of VLF to communicate with submerged vessels.

VLF waves are propagated by two mechanisms around the vast distances of the globe. The first is by a means called "ground wave propagation" and the second is called "skywave propagation".
Groundwave propagation is the means by which radio frequency (RF) waves are conducted near the ground by diffraction. This allows RF waves to reach over-the-horizon distances longer than line-of-sight propagation where the receiver and transmitter are in direct view of each other. As the wavelength of the signal increases, groundwave propagation distance increases. This effect is noticeable in the AM band as the lower frequency (longer wavelength) stations can be received further away from the transmitter than the higher frequency stations at the same transmitter power. The conductivity of the soil along the signal path also affects groundwave propagation with higher conductivity improving propagation. Seawater is the best conductor on the earth's surface and "seawave" propagation is even better than the best groundwave propagation.

Skywave propagation is caused by the highest levels of the atmosphere called the "ionosphere". The ionosphere ranges from 50 to 300 miles above the earth's surface. During the day, the air molecules in the ionosphere are ionized by the sun, which means that the electrons and nuclei of the atoms are separated by the ultraviolet and x-ray radiation from the sun. At night, weaker cosmic rays ionize the air molecules and cause the layers of the ionosphere to form at a higher altitude.

There are several identified layers of the ionosphere and they are labelled D, E, and F. The layers take different forms during the day and night. The lowest D- and E-layers exist only during the day and then disappear after sundown. The highest F layer is split into F1- and F2-layers during the day and these then combine into a single F-layer at night.

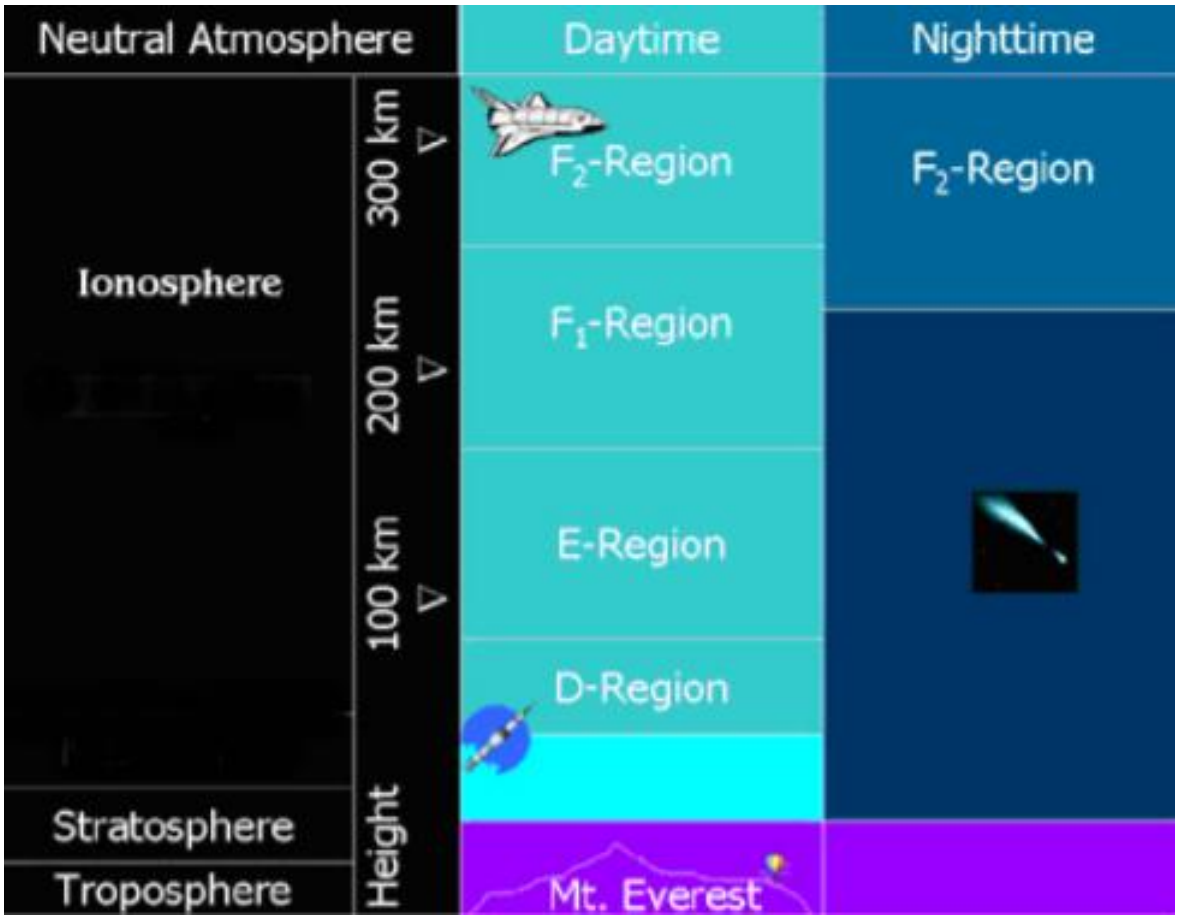
Because these layers have free electrons available, radio waves below 30 MHz or so can bounce between the earth's surface and the ionosphere and can propagate half way around the world or more.

The D-layer of the ionosphere is formed during the day from the intense ultraviolet and x-ray radiation from the sun. The ionization density of about

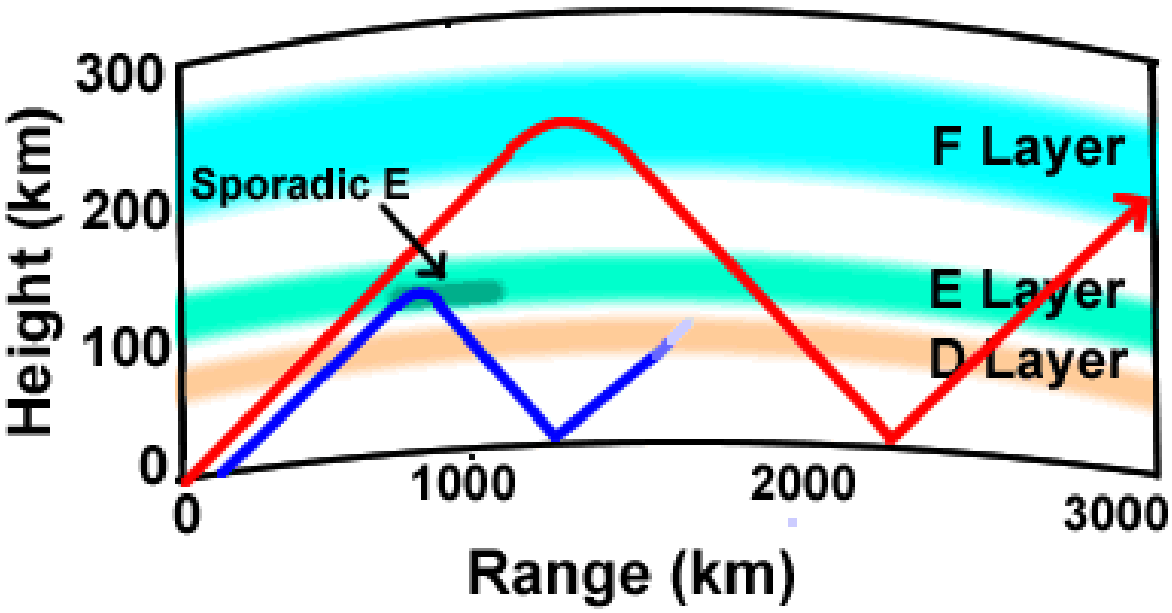
1000 electrons/cm$^3$ of the D-layer is normally not enough to reflect the VLF waves. The waves pass through the D-layer are reflected by the highly ionized E- and F-layers. While, the density of the D-layer is not not enough to reflect the VLF waves, the D-layer is partially ionized and this partially ionized D-layer attenuates the signal to some extent. Reflected radio waves during the day are normally reflected off the E-layer of the ionosphere.

During a solar flare, the sun puts out a greatly increased amount of X-rays and the D-layer becomes much more strongly ionized, causing VLF radio waves to be reflected much more strongly. If a receiver is monitoring a continuous signal such as that from a navy VLF station when the flare happens, the received signal level spikes up quickly and then decays over a period of maybe and hour or two. The shape of the signal strength follows the X-ray flux level from the solar flare fairly closely.

Next month we'll continue with a discussion of what solar flares are and how the SuperSID program monitors and logs results from the active sun.




Layers of the Ionosphere During the Day and Night




Reflection of Radio Waves Between the Ionosphere and the Earth's Surface During the Day (Blue Line) and Night (Red Line)

The 4m Daniel K. Inouye Solar Telescope, on Maui Island in Hawaii, the World's Largest Solar Telescope*

*By Ekrem Canli - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=61643518

# 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)

## MHAS Officers

**President**
Marty Kunz

**Vice-President**
Jim Shedlowsky

**Secretary**
Ken Redcap

**Treasurer**
Tom Hagen

**Appointed Positions**

**Dir-Membership**
Ken Redcap

**Dir-Communications & Website**
Tom Hagen

**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 at Open Houses and Board of Directors Meetings. We are open to the public at the Open House Meetings.**

**MHAS Board Monthly Meetings / Teleconferences:**
1st Sunday of Each Month @ 2 PM
The next board meeting is scheduled for October 4, 2020 and will be via teleconference. MHAS paid members are invited to participate in this meeting.

## 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

Name_____

Address_____

Email_____

Phone_____

Date_____

Dues_____Donation_____

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