WEYMOUTH ASTRONOMY

Sky Watcher

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9 March 2018

Trips / Events

Ideas for trips and events always welcome!

events@weymouthastronomy.co.uk

- 21 Mar CADAS—The International Space Station—Bill Combes
- 3 Apr WAS—Globular clusters: galactic fossils—Callum Potter
- 18 Apr CADAS—T'aint Rocket… - Bud Budzynski
- 1 May WAS—Debunking the Moon landing myth—Graham Bryant
- 16 May CADAS—Light pollution FAQ - Bob Mizon

Programmes for many local Societies will be available in the near future.

Check their websites for more details.

If you are interested in giving a talk or workshop, let the organisers know. They like to offer new titles in their programme line-up.

WAC Upcoming Events:

13 Apr—David Whitehouse - TBC

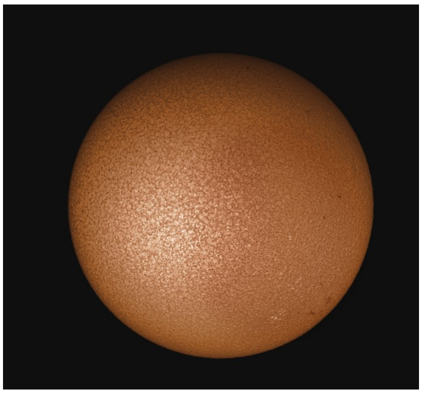
11 May—AGM + James Fradgely - Birth of the Solar System

8 June—Ask the Panel

13 July—Geoff Kirby - Quirky Astronomy

10 Aug—Summer Social

More to come!!



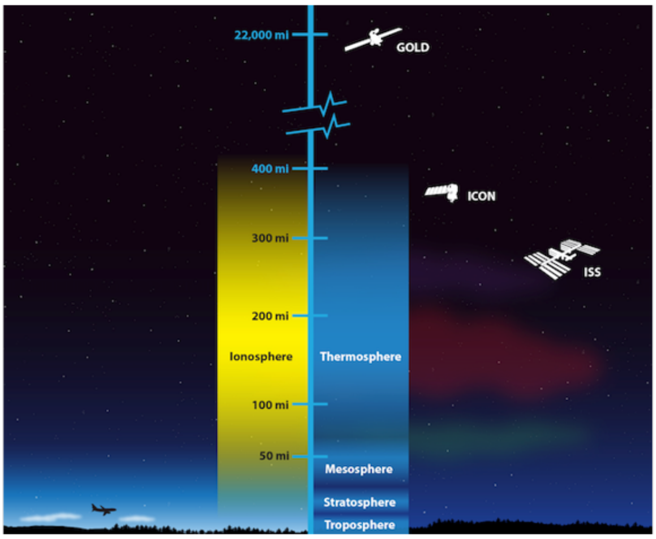
WAC News— What a remarkably blank sun! Checking with the BAA solar section, they too note how remarkably quiet even H-alpha has been. Currently the stats for the 2018 without sunspots is 31 days (47%). An interesting link was presented on Spaceweather.com regarding the increase in cosmic rays. Cosmic rays are bad–and they're getting worse. That's the conclusion of a new paper just published in the research journal *Space Weather*. The authors, led by Prof. Nathan Schwadron of the University of New Hampshire, show that radiation from deep space is dangerous and intensifying faster than previously predicted. Galactic cosmic rays come from outside the solar system. They are a mixture of high-energy photons and sub-atomic particles accelerated toward Earth by supernova explosions and other violent events in the cosmos. Our first line of defense is the sun: The shielding action of the sun is strongest during Solar Maximum and weakest during Solar Minimum–hence the 11-year rhythm of the mission duration plot above. Cosmic rays will intensify even more in the years ahead as the sun plunges toward what may be the deepest Solar Minimum in more than a century. Stay tuned for updates. The problem is, as the authors note in their new paper, the shield is weakening: "Over the last decade, the solar wind has exhibited low densities and magnetic field strengths, representing anomalous states that have never been observed during the Space Age. As a result of this remarkably weak solar activity, we have also observed the highest fluxes of cosmic rays. Solar Minimum, now expected in 2019-2020. "Our previous work suggested a ~ 20% increase of dose rates from one solar minimum to the next," says Schwadron. "In fact, we now see that actual dose rates observed by CRaTER in the last 4 years exceed the predictions by ~ 10%, showing that the radiation environment is worsening even more rapidly than we expected." Check out spaceweather.com 6 March for more information. Until next month! ~SK

What is the Ionosphere? by Linda Hermans-Killiam

High above Earth is a very active part of our upper atmosphere called the ionosphere. The ionosphere gets its name from ions—tiny charged particles that blow around in this layer of the atmosphere. How did all those ions get there? They were made by energy from the Sun!

Everything in the universe that takes up space is made up of matter, and matter is made of tiny particles called atoms. At the ionosphere, atoms from the Earth's atmosphere meet up with energy from the Sun. This energy, called radiation, strips away parts of the atom. What's left is a positively or negatively charged atom, called an ion.

The ionosphere is filled with ions. These particles move about in a giant wind. However, conditions in the ionosphere change all the time. Earth's seasons and weather can cause changes in the ionosphere, as well as radiation and particles from the Sun—called space weather. These changes in the ionosphere can cause problems for humans. For example, they can interfere with radio signals between Earth and satellites. This could make it difficult to use many of the tools we take for granted here on Earth, such as GPS. Radio signals also allow us to communicate with astronauts on board the



This illustration shows the layers of Earth's atmosphere. NASA's GOLD and ICON missions will work together to study the ionosphere, a region of charged particles in Earth's upper atmosphere. Changes in the ionosphere can interfere with the radio waves used to communicate with satellites and astronauts in the International Space Station (ISS). Credit: NASA's Goddard Space Flight Center/Duberstein (modified)

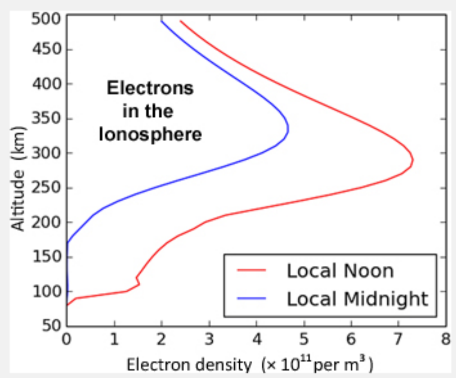
Ionosphere (*more!)*

International Space Station, which orbits Earth within the ionosphere. Learning more about this region of our atmosphere may help us improve forecasts about when these radio signals could be distorted and help keep humans safe.

In 2018, NASA has plans to launch two missions that will work together to study the ionosphere. NASA's GOLD (Global-scale Observations of the Limb and Disk) mission launched in January 2018. GOLD will orbit 22,000 miles above Earth. From way up there, it will be able to create a map of the ionosphere over the Americas every half hour. It will measure the temperature and makeup of gases in the ionosphere. GOLD will also study bubbles of charged gas that are known to cause communication problems.A second NASA mission, called ICON, short for Ionospheric Connection Explorer, will launch later in 2018. It will be placed in an orbit just 350 miles above Earth—through the ionosphere. This means it will have a close-up view of the upper atmosphere to pair with GOLD’s wider view. ICON will study the forces that shape this part of the upper atmosphere. Both missions will study how the ionosphere is affected by Earth and space weather. Together, they will give us better observations of this part of our atmosphere than we have ever had before.

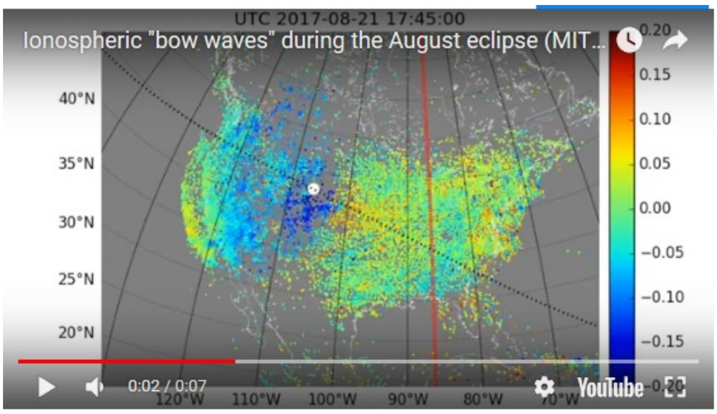
Solar Eclipse Made Bow Waves in Earth’s Atmosphere by Joe Rao

Even though the “Great American Eclipse” is now many months behind us, we are still learning new things about how the passage of the Moon’s shadow affected our atmosphere. Earth scientists are particularly interested in studying the electrified layers situated 80 to 1,000 km (50 to 600 miles) above the ground, known as the ionosphere. It experienced a drastic shock as the Moon’s umbra came along and briefly shut off its one source of energy: the Sun. Ultraviolet light from the Sun is what breaks apart molecules in the outermost layer of Earth’s atmosphere. Even though these molecules are few and far between at such high altitudes, when they’re ionized they have measurable effects, such as bouncing radio waves back to Earth. (We wouldn’t have radio reception if not for the ionosphere.) Yet during nighttime, without the Sun’s energy input, some layers of the ionosphere disappear altogether. During last summer’s solar spectacular, for the very first time, the effect of the change in sunlight, in the form of ionospheric bow waves, was observed. This phenomenon had long been suspected but never actually observed.



The density of electrons in the ionosphere varies dramatically between day and night.
Dieter Bilitza et al / Journal of Geodesy (2011)

While total solar eclipses are far from unique celestial events — occurring on average about once every 18 months somewhere on Earth — last August’s coast-to-coast totality path across the contiguous U.S. was the first such circumstance since 1918. It was this unusual shadow trajectory that allowed researchers at MIT's Haystack Observatory and the University of Tromsø, Norway, to make definitive observations of eclipse-induced bow waves. The teams made use of the U.S.-owned Global Positioning System (GPS), a constellation of satellites that can locate a receiver anywhere in the world — as well as provide accurate, high-resolution data on the total electron content of the ionosphere. Last August, during totality’s 4,000-kilometer, 91-minute trek across 14 states, researchers studied ionospheric electron content data collected by a vast network of more than 2,000 of extremely sensitive receivers in place across the nation.



The result? The eclipse generated clear ionospheric bow waves in electron content disturbances resulting from totality, observed most clearly over the central and eastern U.S. Bow waves are observed whenever an object shoots through a medium more quickly than waves in that medium can travel. A speedboat, for example, will build up water along its bow that moves more quickly than waves within the water can travel. Likewise, when a jet flies, it builds up invisible pressure waves in front of it. As the jet flies faster and faster, the pressure waves can’t get out of the way of each other. Eventually, when the jet reaches supersonic speeds, the waves compress together into a single bow wave. All those in a narrow path below the jet’s flight path will be able to hear the sonic boom as it passes overhead. https://youtu.be/8vivMEVBwys

During the solar eclipse, it was the Moon’s shadow that moved at supersonic speeds. In an article published last December in the journal Geophysical Research Letters, Haystack’s Shunrong Zhang and his colleagues wrote: “The eclipse shadow has a supersonic motion which [generates] atmospheric bow waves, similar to a fast-moving river boat, with waves starting in the lower atmosphere and propagating into the ionosphere. [Such] study of wave characteristics reveals complex interconnections between the Sun, Moon, and Earth's neutral atmosphere and ionosphere.” No doubt scientists are already looking forward to repeating this fascinating experiment at the next total solar eclipse that will pass over the United States on April 8, 2024. While the Moon’s shadow will not go coast-to-coast, its 3,400-km- long path, nearly 80 km wider than 2017’s path of totality, will pass over the central and eastern U.S., from Texas to Maine.