WHAT'S UP?

Hello. In the last *What's Up?* we looked at equipment we can use for viewing the night sky – binoculars and telescopes. These devices magnify the visible light that pass through them. What we define as "visible" light is just one type of *electromagnetic radiation*. Everything from an electron to a supergiant star (and everything else there is) that has a temperature above *absolute zero* emits electromagnetic radiation – including you! The full range of wavelengths is called the *electromagnetic spectrum*. This spectrum ranges from *gamma* radiation (with the shortest wavelengths) to *radio* radiation (with the longest wavelengths). All of this radiation is "light". Because our eyes are only sensitive to a small section of the spectrum, we don't think of these other wavelengths as light, but they are – just light that we can't see. What does this have to do with astronomy? A lot of what we know about the universe is the result of the information conveyed to us in these non-visual wavelengths. Telescopes that can collect and focus short-wavelength light (gamma, x, and ultraviolet light) operate in space, above our atmosphere. They have to be placed there because the Earth's atmosphere blocks these rays (except for a portion of ultraviolet rays) from reaching the surface. That's a good thing too, because these short-wavelength rays are harmful to us. The wavelengths of light that do penetrate the atmosphere and reach the ground are the long-wavelength rays. Of these, radio waves are the longest.

In 1932, while investigating the cause of interference in communication signals for Bell Telephone Laboratories, Karl Jansky discovered that some of the radio waves detected with his antenna was not from any Earth-based source. Radio astronomy was born. Because radio waves are longer than visual waves and radio waves pack a lot less energy in each photon of the light, these *radio telescopes* (also known as antennas) have to be much bigger than optical telescopes. Extraterrestrial radio waves are at such low energy levels that, according to Sue Ann Heatherly of the Green Bank Observatory in West Virginia in 2004, "If you gathered all the radio energy collected by all the radio telescopes in the world from 1932 to the present, the energy would be less than that of a falling snow flake." These are REALLY tiny signals that we are collecting. Because of the small energy levels, radio telescopes are often deployed in sets that allow astronomers to combine the radio light that each telescope collects, allowing the array to act like one gigantic telescope. One of these arrays, called the *Very Large Array* (VLA) is located in New Mexico. Many years ago when I was working near there, I had the opportunity to visit the VLA site. Standing next to one of these telescopes was an awesome experience. They are huge. The array consists of 27 antennas in a Y-shaped arrangement. Each antenna is 82 feet in diameter. The antennas sit on rail cars that can be moved along tracks to modify the total size of the array as needed for a given research purpose. In its widest configuration, the signals received are combined to give the resolution of a single antenna 22-miles across. Radio telescopes don't have to be as large as these, though. In fact, you can have one in your own backyard.

NASA's *Radio Jove* project (https://radiojove.gsfc.nasa.gov/index.html) allows students, teachers, and the general public to learn about radio astronomy by building their own radio telescope. What would you be able to detect? Primarily, radio emissions from Jupiter and the Sun. One of Jupiter's largest moons, Io, has a lot of volcanic activity. Io's volcanos spew sulphur-containing compounds onto its surface and into its atmosphere and surrounding space. These materials have an electric charge and are swept into giant Jupiter's magnetic field. As the particles travel along the magnetic field lines, radiation with wavelengths in the radio part of the spectrum are emitted. It is these radio waves that you can pick up with your backyard antenna. Additionally, occasional bursts of material from the Sun's surface generate radio waves that can be detected. My friend Steve has been interested in radio astronomy for a long time and built an antenna that he could couple to his shortwave radio and listen in on the Jupiter-Io interactions. I asked him if he had any words for the *What's Up?* readers. He told me:

"What I like about radio astronomy is it's possible to build your own telescope. An optical telescope is a precision scientific instrument, which is beyond the casual amateur. Certainly, beyond my level of skill and dedication. The Radio JOVE antenna on the other hand most anyone can build. The electronic components come as a kit and require a bit more expertise and attention to detail, not to mention skill at soldering electronic components. In the end radio feels a bit like magic. You build the antenna, position it (in a not so precise way) then tune to a particular frequency and you can hear a signal from another world."

But wait…there's more! With just an FM radio, you can detect meteors as they streak through the atmosphere. The heat generated as a meteor passes through the atmosphere heats the air and ionizes (knocks electrons off of) the air. Radio waves can reflect off these patches of ionized air. The result is that radio waves from a far away transmitter can bounce down to us. This is the same effect that allows short wave radio waves to travel so far around the world. But short wave radio uses the ionosphere to bounce the waves back down. By tuning your radio to an unused FM frequency, you will here short, sporadic bursts of noise (sometimes even a long enough burst to make out a word or two). You can find more information about this at a website maintained by Embry-Riddle Aeronautical University (http://mercury.pr.erau.edu/~prcphysics/observatory/meteors.htm).

You can reach me at astroblog@comcast.net with any questions and comments you have. This is What's Up? Installment #41.
Until next time, Keep looking up! *Barry*