The Elmer Project Part II

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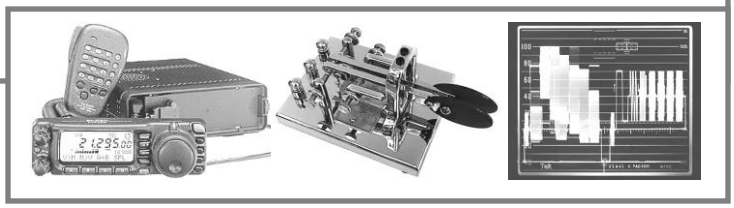
Radiate, Propagate, Communicate!



Edited by Nelson Derks, AC5UP

It's not unusual for me to use the cliché "…this isn't rocket science" regarding some of the concepts in Amateur Radio. Most of it isn't. But, mark your calendar, because this month it *is* Rocket Science! And what a golden opportunity to scare off the feint of heart... We're going to start at http://science.msfc.nasa.gov/ssl/pad/solar/default.htm and I can assure you the NASA in this URL doesn't signify Norm And Sam's Automotive. We're talking Celestial Dynamics, The Solar Wind and their effects on HF propagation.

I had planned to slide into this topic with a few clever paragraphs on choosing an HF antenna. Fuhgetaboutit! There are tons of articles on antennas and chances are your choice will be affected more by your QTH and budget than anything else. If you're like me, you're never exactly finished playing with your antennas, anyway, so how's this for a quick segue: Even a rusty coat hanger will *radiate*; let's see what it takes to make it *propagate*…

With a little luck, the graphics will be readable and save us both the work of describing every concept in detail. The first lesson is that nothing in our solar system is stationary. Everything moves, and moves quite a bit. Let's say you have a 40 Meter sked every morning with an OM near Waukegan, WI. Some days it works, some days it doesn't. That's called Condx. We'll try again tomorrow. Sure, nothing changes as far as the distance from here to there, but it's too far for Ground Wave propagation and we're always dependent on Sky Wave, regardless of the time of day. There's a reason why I chose 40, as I recall a QSO between myself and an OM in Sapulpa on 40 that started at 20 over 9 and ended when we dropped below the noise floor about five minutes later. Probably 25 miles between us, and the RF path was almost straight up and down. Two Meter FM simplex (using a rusty coat hanger?) could have been more reliable.

Let's get back to our 40m sked with the Niner up in Wisconsin... In the 24 hours between Q's everything changed. The Sun rotates on a 27 day cycle relative to the Earth and we'll be seeing the Sun's surface about 13.33 degrees from where it was yesterday. The solar flares or surface anomalies that may have helped (or hurt) us earlier are now at a different angle. The distance from the Earth to the surface of the Sun is approximately 93 million miles in a slightly elliptical orbit. That puts the circumference path at better than 584 million miles per year, and it takes 365.25 days for one pass. Divide that, and your QTH is at least 1.6 million miles away from where it was yesterday relative to the Sun. You say you never go anywhere…? Don't worry, you'll be back in a year and we'll leave the light on for you. To finish the thought, if the circumference of the Earth is 25,000 miles at the Equator and rotates once every 24 hours, that's a ground speed near 1,000 miles per hour. The point here is that band conditions change constantly because our relationship to the Sun changes constantly.

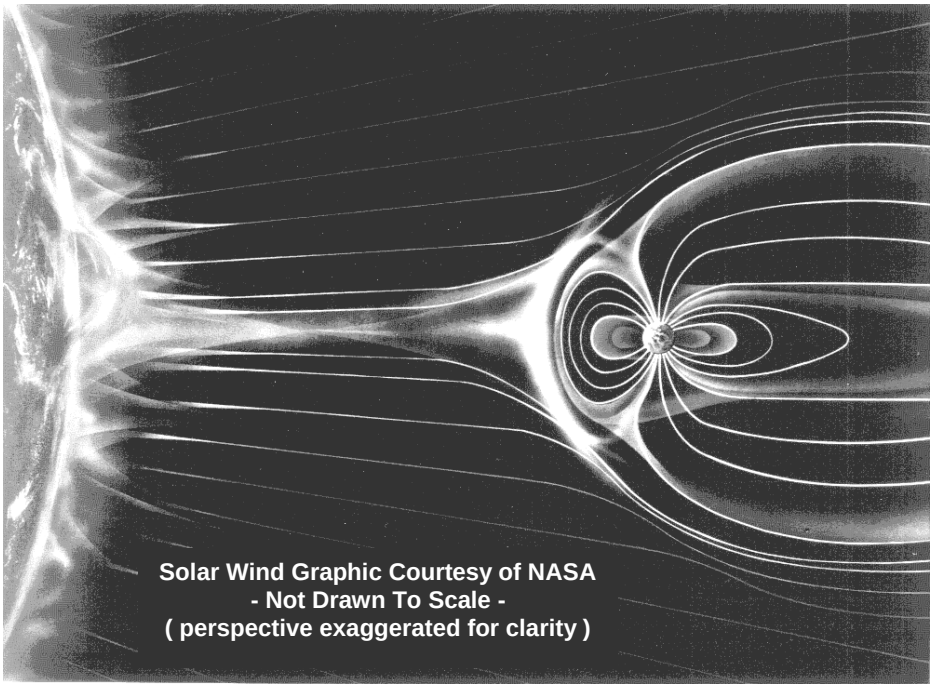
In case you're wondering why I reference everything to the surface of the Sun, it's because HF propagation is so dependent on it. The numbers are staggering. Every day the Sun ejects countless ionized particles into our Solar System, and it takes plenty of kick to launch those particles to an escape velocity against the tremendous solar gravity. Darn good thing it does, as these particles form the upper layers of our Ionosphere that can reflect our radio signals between Broken Arrow, Sapulpa, and beyond. At the speed of light, the 93 million miles between the Sun and Earth is an eight-minute trip. Ionized particles don't travel quite that fast, but the magnetic pulse from a solar flare can. Things really *move* out there…

So, imagine you're an ionized particle whizzing through space. Not a lot on your mind, you're just looking for a good time. Then you see this Big Blue Marble. If you're like most particles, you're very attracted to the magnetic flux. The Earth is just one giant Dust Bunny when it comes to solar dust. The particles try to line up like the old science experiment with a bar magnet under a sheet of paper and iron filings on top, but the Solar Wind does affect the pattern. Some particles might be blown back into space by a gust of Solar or Cosmic wind while others eventually fall through. Want to see this in action? Do a web search on "Aurora Borealis" or "Northern Lights" to see how pretty the pictures are. For HF band conditions to remain good, a steady stream of ionized particles must replenish the upper layers without distorting the lines of flux.

Astute readers know all too well the meaning of the previous sentence. A large solar flare or CME (Coronal Mass Ejection) can release so much ionized material that our ionosphere can be "blown out" or warped by a magnetic pulse so strong that you wish 40 Meters relied more on Ground Wave. In early February of 2001, the Sun flipped its magnetic field and that's considered a sign the current solar cycle has peaked. Normally we'd be celebrating the excellent band conditions. But, for the next few months, a series of enormous solar flares and CME's gave us HF conditions so poor that the dregs of the past cycle started looking good. The solar indexes were high enough for good DX, but the field angles were so bad that the HF bands shut down. It happens.

Take a moment to study the graphic on the next page. The Sun is to the left and sending a huge amount of both energy and ionized particles into our magnetosphere. Notice how the lines of magnetic flux are compressed on the sunny side and elongated on the shady side. Interesting perspective, Ehhh? If you learn anything from this article, the key point is that the

Earth (that little orb inside all those lines of flux) is rotating. As time progresses through Day / Night cycles relative to any point on Earth, the angles of reflectance change constantly relative to the ellipses of the flux field. That's a concept that helped me understand Grayline propagation and the seasonal variations on the HF bands. Notice how the lines of force are parabolic on the compressed side and relatively straight on the elongated side. Think that would change the reflected angle? You bet it does, and the DX signals we chase are constantly going through angular changes. When a big CME "dents" the parabolic shape of the F Layer, the reflection angle bounces your signal out into space instead of the Coaxial Islands. (IOTA RG-8)



So, what does this mean to you? RF is an electromagnetic wave affected by both the density of the ionized layers and the shape of the magnetic flux. The high ionospheric density on the sunny side favors the higher frequencies. The longer wavelengths of the lower bands tend to respond better to the densities found toward the shady side. That's why the upper HF bands work best during the day and the lower bands tend to play at night. As we go through the daily and seasonal cycles, your QTH will see the full variety of densities and reflectance angles. This explains why there is no "Best DX" antenna for any given band or mode. When you're dealing with reflected sky wave signals, the polarity and incoming wave angle are whatever they want to be at the moment. That's why a simple vertical can outperform a more sophisticated (but horizontally polarized) Yagi on some days. The trick to making a rare Q is often being on the right band, on the right antenna, and at the right time for the season of the year.

What does the season have to do with it? The Earth's axis is tilted about 30 degrees. In the Northern Hemisphere, we see the sun more squarely in the summer and much less so in the winter. In the Southern Hemisphere the opposite is true, and this effect is most pronounced at the poles. That's why you're more likely to work LU's and VK's in the spring and fall than in June or December. The overlap in seasonal conditions is beneficial on both sides of the path. This also explains why working Antarctica can be a challenge… The Ham population is greatest during the Antarctic summer, and that's our winter, an unlikely time to find a favorable path that far south. It can be done, but the odds tend to favor the middle to upper HF bands like 20 through 15 Meters.

Which leads us to another point… Those with a flexible attitude toward band usage tend to have more interesting logs than the OM's who set up camp on one band, only. We're all creatures of habit to some degree and many of us grow into a favorite band or mode. Nothing wrong with that, unless you're a 160 Meter devotee who works nights and makes plans for serious DX'ing during your two week vacation in July. It's not gonna' happen. As a general rule, the long days of late spring through early fall favor the higher HF bands while the lower bands perform best during the long nights of the cool months. Spring and fall tend to be the most interesting DX seasons. Adjust your operating style with the seasons, be flexible, don't ignore a band out of habit or decide it's a bad radio day based on your first impression in the morning. Band conditions change throughout the day and the clever DX'er checks them regularly. It's all in the odds, averages, and "luck".

With all this to consider, it's easy for the casual operator to just work 'em whenever they hear 'em. Here are a few tips if you fit that description (and many of us do!).

• You're having a great conversation with the regular group on 14.2xx when some LID starts calling "CQ Contest" 300 Hz up! The testosterone kicks in and you give 'em the old heave-ho. It's possible the calling station couldn't hear the OM who's been on the key for the past five minutes, but they hear you now. Band conditions do change; give them the benefit of the doubt.

• *Really* listen before you transmit, and in more ways than the example above. When I'm in the mood for Serious Radio (it can happen), I take the time to scan through several bands and modes to get a feel for what's out there. My habits include a quick check of WWV as an indicator of which frequencies are good into Boulder, but not as the definitive indicator of which band is open. I've worked plenty of RU's when WWV was weak, and missed plenty of IOTA's because I settled on one band.

• Remember to take a spin through the Beacon frequencies, especially if you're a fan of Ten or Six Meters. You can increase your odds of working a rare one when you're handy at more than one mode. In future issues, Clif Sikes, **N5UW** will tell us he's had excellent results with CW as his "Serious DX" mode, and I'll tell you RTTY has been good for me when polar distortion makes 'phone hard to deal with.

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For more info about propagation, visit the Magnolia DX Association web page at http://www.mdxa.org/ and check the links. (especially the real-time MUF map!)

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— 73 and Good DX!