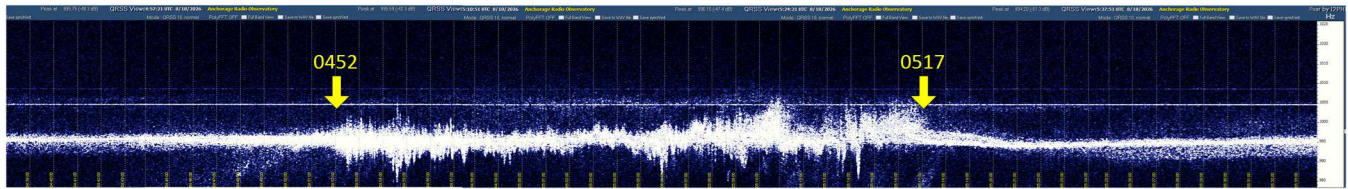


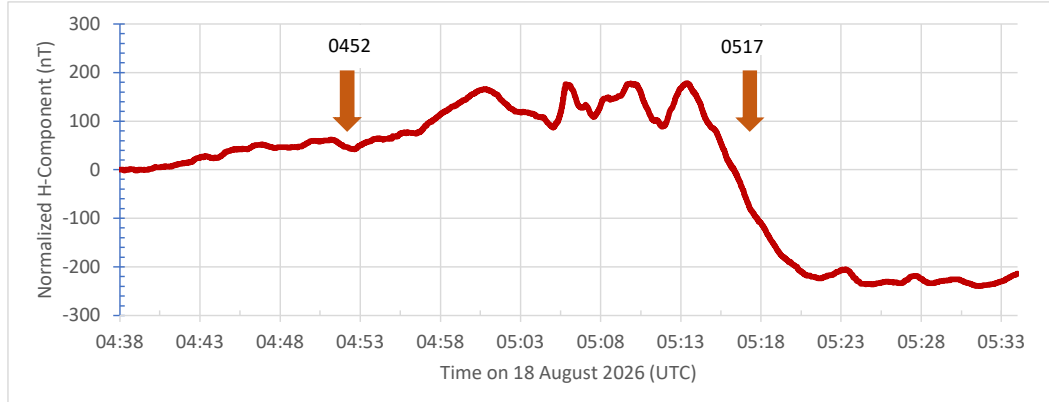
Geomagnetic Disturbance and Aurora Radio Reflections

Whitham D. Reeve



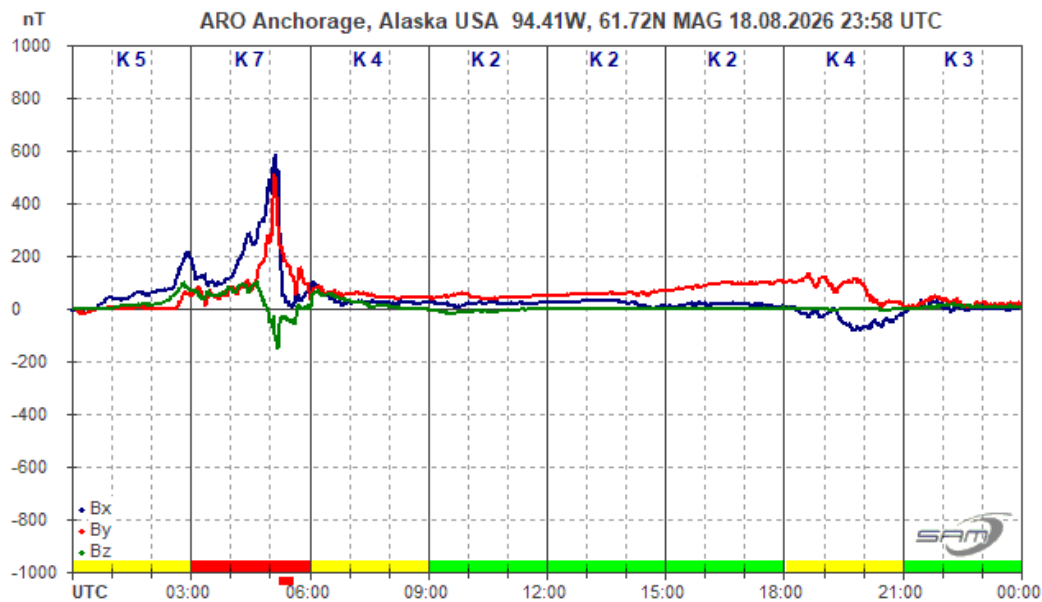
The image above shows aurora radio reflections of the 15 MHz WWVH time-frequency transmitter received at Anchorage, Alaska on 18 August 2026. The image was produced from eight 13 minute Argo images that were spliced together. Argo is a software application used as a narrowband audio signal processor. In this case, it displays demodulated audio spectra as a horizontal waterfall with frequency on the vertical scale and time on the horizontal scale. The Doppler frequency shifted variations are approximately ± 10 Hz. The faint middle trace is spurious. The plot spans about 1 hour from 0438 to 0534 UTC (8:38 to 9:34 pm local). The major part of the activity is from 0452 to 0517, or 25 minutes, and is bracketed by yellow arrows.

Data from the SAM-III Magnetometer at Anchorage for the same time period is shown below. This plot shows the horizontal (H) component, which is the vector sum of the X (north-south) and Y (east-west) magnetic components. It is produced from 1 second data and has been normalized to the value at the beginning of the plot. The magnetic deflection is approximately ± 200 nT between the beginning and end of this plot and 100 nT between the arrows.



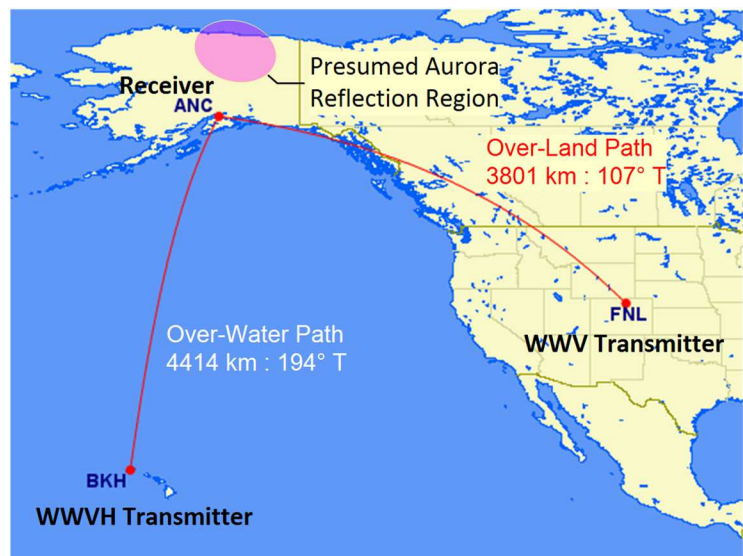
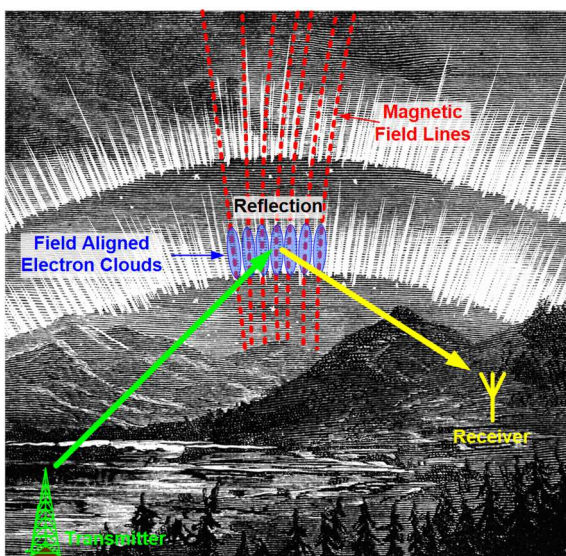
The full 24-hour magnetogram, which displays the X-, Y- and Z-components for 18 August, is shown below. Note that the total deflections of the X- and Y-components are approximately 600 nT between 0000 and 0600 UTC. The derived H-component is approximately 850 nT. It is noted from this and many previous observations that rapid increases in the X- and Y-components (and H-component) lead to Doppler frequency shifts in the received HF signals. The increasing H-component indicates that the Auroral Electrojet enhanced the observed ground magnetic field. These shifts are not seen as often for magnetic bays or decreases in the magnetic components.

The aurora radio reflections described here correlate well with the solar time and type of magnetic activity described in https://www.reeve.com/Documents/Articles%20Papers/Reeve_AuroraRadioObsrv.pdf.



Visible and radio aurora are different manifestations of similar physical processes. Radio aurora is caused by increased ionization of atoms and molecules that enables reflection of radio waves. Visible aurora is caused by atomic and molecular excitations that produce light at certain wavelengths; see left image below. The increased ionization often results from magnetic connection events between the solar wind interplanetary magnetic field and Earth's magnetic field. When the fields merge charged particles enter the magnetosphere and cause the aurora phenomena.

It was stated above that the signals in question originated at WWVH in Hawaii. This is because the propagation geometry from WWVH is far more favorable for aurora radio reflections than the WWV station in Colorado, which transmits on the same frequency; see right image below.



Annotated images for reference. Underlying image sources: Left: <https://thegraphicsfairy.com/polar-lights-images/> ; Right: <http://www.gcmap.com/mapui?P=FNL-anc-bkh> .