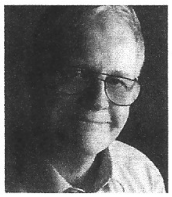
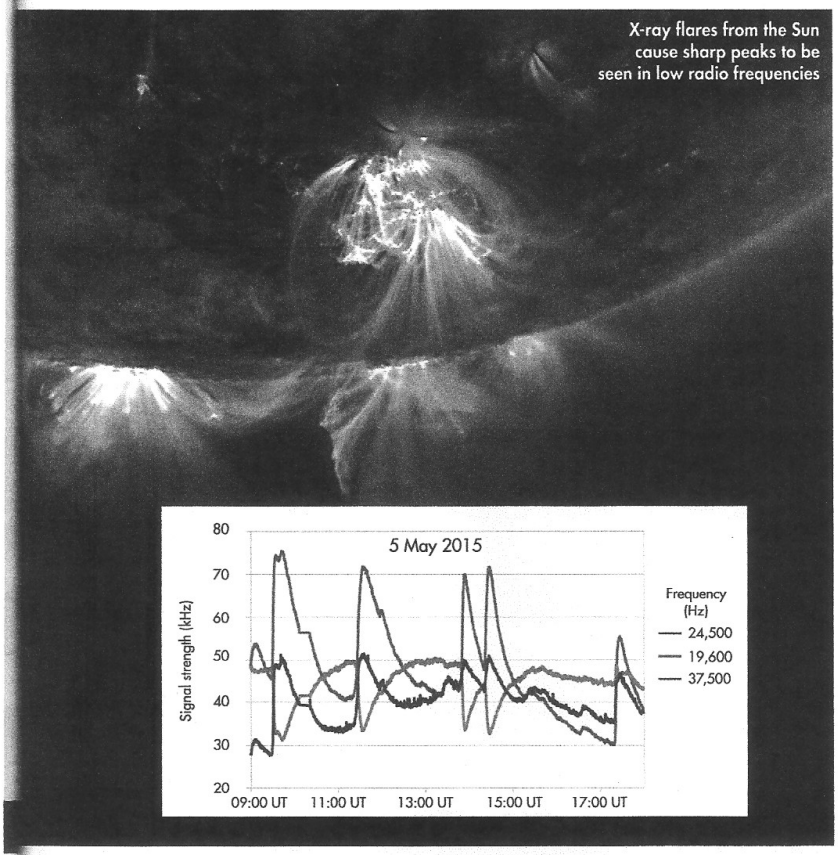


With Paul Hyde

How to

Study ionospheric disturbances

A simple aerial can help you spot X-ray flares on the Sun



X-ray flares from the Sun cause sharp peaks to be seen in low radio frequencies

PAUL HYDE X 2, NASA/SOLAR DYNAMICS OBSERVATORY

Sudden ionospheric disturbances (SIDs) are rapid changes in the Earth's ionosphere caused by X-ray flares erupting on the Sun. These flares release massive amounts of X-ray and ultraviolet radiation and, around eight to nine minutes later, this wall of energy slams into our atmosphere, modifying the way it reflects signals from low-frequency (15 to 30kHz) radio stations. The result is a distinctive 'shark's fin' change in the received signal strength, which reveals that a flare event has occurred.

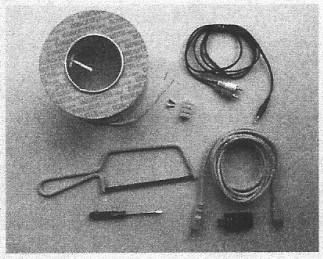
An SID detector is easy to build, being nothing more than a simple loop aerial connected to the microphone socket of a computer. If this sounds confusing, remember that all a microphone does is convert changes in air pressure (sound waves) into tiny electrical signals that are amplified by the sound card in your computer. In contrast, an aerial converts changes in electromagnetic fields to tiny electrical signals, and at these low frequencies your sound card can act as a perfectly good receiver. Unfortunately, the performance of computer microphones is very variable. There is also a very small risk of damaging the computer from static electricity. An alternative is to use a low-cost external USB sound card.

Fashioning the aerial

Make the aerial from bell wire looped around a few times: the dimensions are not critical but it should be at least 1m². That's quite a size, but it can be hung on the wall of your observatory or in the loft, away from sources of radio interference such as computer monitors and plasma televisions. Larger is always better, even if this means fewer turns of wire, so go for the biggest area you can.

Bell wire consists of two PVC-coated wires, usually with a stripe marking one of the cores. Buy a 100m reel, choosing a product with solid copper wire rather than copper-coated aluminium. Decide on a size for your loop and make a wooden cross to help you wind it. You can then remove the frame if wanted ▸

TOOLS AND MATERIALS



TOOLS
A small screwdriver and hacksaw for creating the wooden frame.

MATERIALS
A 100m reel of Bell Wire, mono or stereo audio lead with a 3.5mm jack at one end, 5m USB 2.0 extension lead, 4m of 12x32mm (or similar) timber for the frame.

HARDWARE
A computer running Windows XP, 7 or 8 and an external USB sound card.

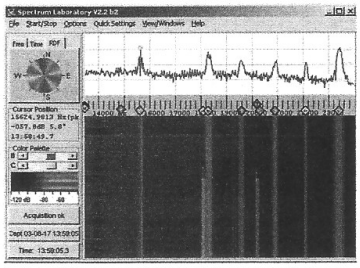
SOFTWARE
The Spectrum Lab freeware (www.qsl.net/dl4yhf/spectra1.html) and the configuration file included with this month's Project Resources.

▸ and simply drape the loop in its final location, or perhaps enclose it in plastic mini trunking for a tidier finish. The loop is directional and the best results will probably be achieved with the winding aligned north to south.

Linking the two

Finally, you will need an audio cable with a standard 3.5mm plug on one end to connect the loop to the microphone socket on the sound card. The easiest solution here is to buy a ready-made cable and cut off the unwanted connector. Plug in the sound card to your computer and wait for any driver installation to complete, then adjust the configuration settings in the Sound tab of Windows' Control Panel. For the final setup, move the sound card to the aerial and use a USB extension cable to connect it to the computer.

The software you'll need to see and record SIDs is Spectrum Lab, available from **www.qsl.net/dl4yhf/spectra1.html**, which is shown below.



Spectrum Lab will run under Windows XP, 7 and 8. Download and install the latest version and then use **File> Load Settings From** to load the RAG_SIDv1.usr configuration file, included in this month's project resources.

Select the external USB sound card as the source using Spectrum Lab's Options and Audio Settings tabs. You should now see several very-low frequency stations appear in the Waterfall window. Then use the View, Watch List and Plotter options to display the Plotter chart, which will reveal the sudden changes in signal levels caused by X-ray flares – a sure sign that it's time to get your solar telescope out.

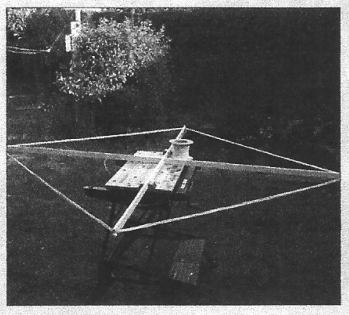
Paul Hyde is the coordinator of the BAA's radio astronomy group

PROJECT RESOURCES

Download the Spectrum Lab configuration files, plus guides to setting it up and interpreting SIDs at **http://bit.ly/howto124**

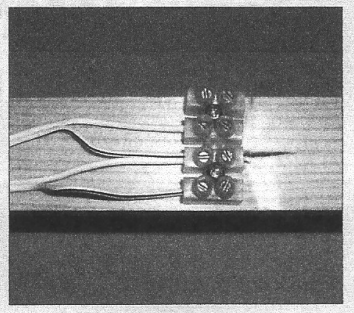
PAUL HYDE X 6

STEP-BY-STEP GUIDE



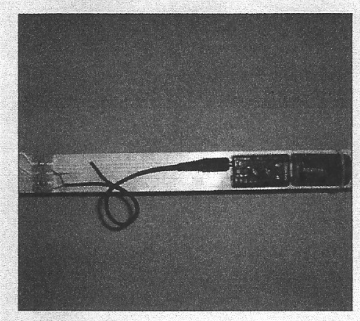
STEP 1

Cut notches at each end of a temporary wooden frame to hold the bell wire in place. Avoid twisting the wire and keep the windings taught, but don't overstretch it. Use tie wraps or insulating tape at 100mm intervals to bundle the wires together.



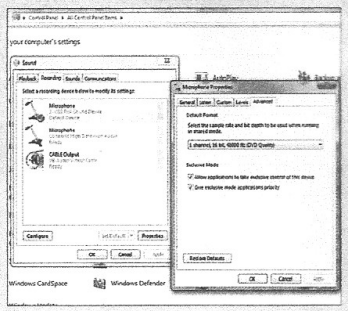
STEP 2

Screw a four-way terminal block to one leg of the wooden frame and connect the bell wire cores so as to create a single, continuous loop. Make sure you connect the wires as shown above or you will lose half your signal.



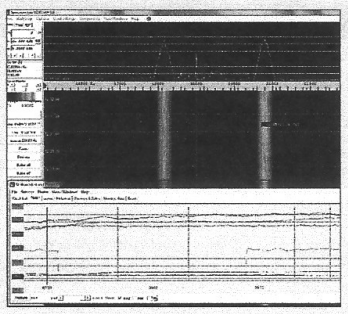
STEP 3

Remove 10cm of insulation from the left-hand channel of the audio lead and connect the centre (red) wire to one end of the loop and the braid to the other. Only add the USB sound card once you have set it up on the computer (Step 4).



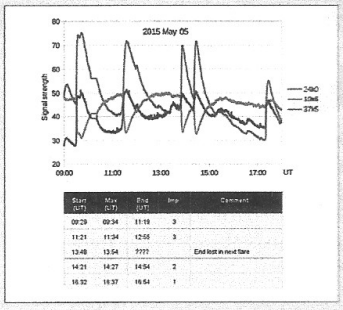
STEP 4

It's better to install the sound card with it plugged into your computer directly. Once done, check its microphone (recording) settings: the Sample Rate should be 48,000Hz or higher, the Level should be set to maximum and AGC switched on.



STEP 5

Install the Spectrum Lab software and adjust the scales for the aerial and sound card as necessary; each will be different. The Plotter window is the one used for day-to-day observing. Adjust each signal to fall two-thirds up the chart by modifying its Watch List entry.



STEP 6

For detailed analysis use a spreadsheet to show the imported daily text files that are saved in the Spectrum Lab system folder. Refer to the files in this month's Project Resources (see left) for advice on how to measure and report SIDs to the BAA.