Basic radio astronomy with simple equipment by Whitham D Reeve

Listening to the Sun's Radio Storms

Following on from his recent article on listening to radio storms on Jupiter, Whitham D Reeve explains how easy it is to tune into radio emissions from the Sun with a standard HF receiver and a simple piece of software.

The strongest extraterrestrial radio source we experience on Earth is our own Sun. Solar flares and other phenomena cause powerful radio emissions and *RadioUser* readers equipped with an HF receiver can easily listen to these outbursts.

This article follows on from my 2-part article *Listening to Jupiter's Radio Storms*, which appeared in the September and October 2009 issues of *RadioUser*. If you set up a radio telescope for listening to Jupiter as I described then, you already have one suitable for listening to the Sun's radio storms. Of course, it must be daylight at your location (although I have received solar bursts after sunset).

The Sun has an approximate 11-year cycle of activity, which is measured by the number of visible sunspots. The last cycle ended in the autumn of 2008. The current cycle is off to a slow start but as it progresses, listeners will hear more and more solar radio storms. The current cycle is predicted to peak between late 2012 and the middle of 2013.

Listening Frequencies

The Sun's radio bursts cover a very wide frequency range (from very low frequency radio waves to gamma and x-rays) but, as I explained in my previous article, the Earth's ionosphere blocks frequencies below around 15 MHz. Therefore, we must tune our receivers above this range. A good frequency to start with is **20.1MHz**, the same frequency we use for Jupiter. However, listeners also should try higher HF frequencies and, if equipped with the proper receiver and antenna, VHF and UHF frequencies.

When a solar radio storm occurs, the Earth's ionosphere is affected, which in turn affects signal propagation. This means the Sun's outbursts also can be detected indirectly by monitoring manmade signals that propagate long distances by ionospheric refraction. The signals to monitor are transmitted by high-power, very low frequency (VLF) transmitters located around the world and listeners can use VLF receivers to detect the Sudden Ionospheric Disturbance (SID). I will not cover this type of listening here – perhaps it might be a good subject for a future article.

Some of the Sun's radio bursts are so powerful that they drown out manmade interference but it is good practice to always tune to a quiet spot. When a burst occurs, the background noise level will quickly increase and then taper off slowly. Some listeners leave their receivers on all day with the volume low enough so that the normal background noise is not annoying but high enough to hear the change. When it sounds like a burst is occurring, you can change the receiver tuning to confirm its wideband nature. Manmade interference disappears when the receiver tuning is changed but the burst noise will remain.

Recording Solar Storms

The Radio-Sky Publishing software, Radio-SkyPipe (RSP), described in the previous article, is also used for charting solar radio storms. A free version with limited features is available and the PRO version is only $49.95 for home use. Both can be downloaded from the Radio-Sky website, where you'll also find a lot of interesting information on monitoring extraterrestrial signals.
www.radiosky.com/skypipeishere.html

The unpredictable nature solar bursts makes catching them exciting but because they are not predictable, it is not possible to preset RSP for timed audio recording as we do with Jupiter. Some listeners set up RSP to record audio everyday for a certain amount of time, hoping to capture the Sun. If you use this technique, be sure to have a large hard drive for file storage. Each minute of recording requires about 1 to 1.5MB, depending on how your soundcard is set up. Other listeners use a VHS video recorder with the record mode set to extended play to record the receiver audio output each day.

When unattended audio recordings are made, it can be quite time consuming to go back and listen for bursts that might have occurred. However, an RSP chart can be quickly reviewed at the end of the day and the signature shape of a solar burst is easy to spot. The chart trace will rise sharply and then fall slowly, the characteristic 'shark fin' shape. It is common to mistake a reverse shark fin as a solar burst. A reverse shark fin is caused by manmade interference; it rises slowly and ends abruptly.

Another way to determine if a solar burst has occurred is to look at the Space Weather Prediction Center's (SWPC) daily solar event reports. However, these reports do not always show all solar events that took place. The SWPC also will send you e-mail alerts when solar events occur (select Email Products in the left panel on the SWPC website).
www.swpc.noaa.gov

Results

I obtained my first chart recording of a solar burst on May 8th 2009 – see **Fig. 1**. I had the receiver running in the background and heard the sudden noise increase at 2107:44 UTC and the relatively slow tapering off over the next almost one minute. By lucky coincidence, I had RSP running during a predicted daytime Jupiter radio storm but I caught the solar burst instead.

The next day, I recorded another solar burst – see **Fig. 2**. By even luckier coincidence, I not only had RSP set up to chart but I also had it preset to record the audio in anticipation of another Jupiter radio storm. Again, I caught the Sun and not Jupiter. The audio recording can be heard on my website.
www.reeve.com/solar.htm

A useful way to find out about solar events after-the-fact is to visit NASA's Radio JOVE website data archives.
http://jovearchive.gsfc.nasa.gov

I was looking through the archive one day in August when I noticed two submissions for July 4th 2009 by Richard Flagg (a dedicated Jupiter and Sun observer in Hawaii). I went back to my RSP files for that date and found that I had also recorded two events at the same time, one of which is shown in **Fig. 3**.

Conclusions

The radio telescope you set up for Jupiter can be used for listening to the Sun without any changes. The only setback is that solar radio storms are not predictable. However, as the sunspot cycle increases over the next several years, listeners will have numerous chances to catch something on their charts and even on audio. Good luck and happy listening! ●

Further Reading

The British Astronomical Association Radio Astronomy Group
www.britastro.org/radio
The Stanford Solar Center
http://solar-center.stanford.edu
The Nancay Observatory in France
www.obs-nancay.fr/a_index.htm
A list of radio telescopes throughout the world can be found on Wikipedia.
http://en.wikipedia.org/wiki/List_of_radio_telescopes

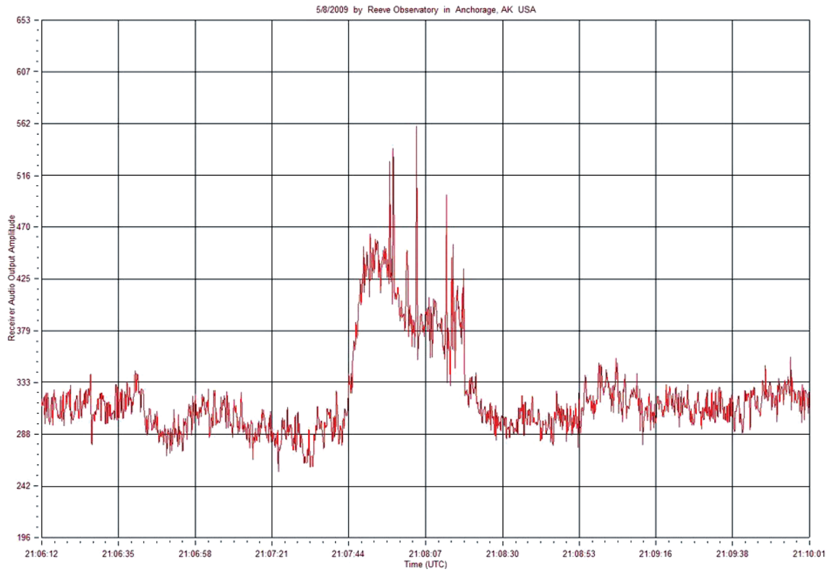

Fig. 1: The solar burst is the 'shark-fin' shaped event in the centre. The spikes were caused by tuning around the 20.1MHz centre frequency to verify the wideband nature of the burst. There were several stations in the tuning range and each one caused a spike as I tuned through it.

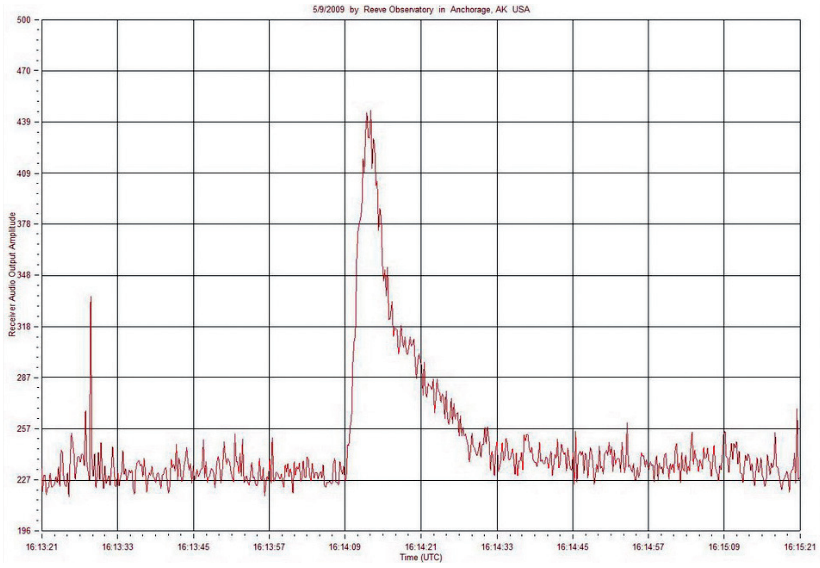

Fig. 2: The characteristic 'shark-fin shape is obvious in this May 9th 2009 RSP chart. The burst started at 0814:09 local time, almost 3 hours after sunrise.

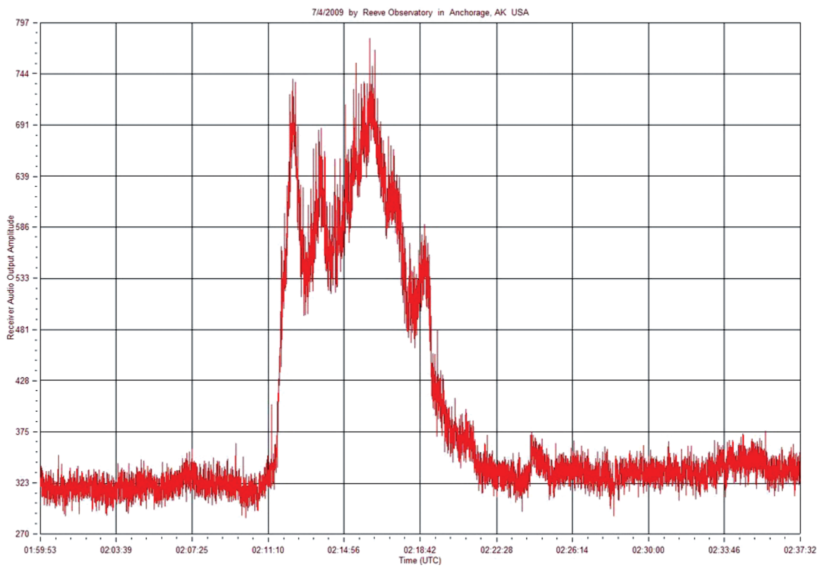

Fig. 3: The 'shark fin' shape of this event is not obvious but I was able to match its time to charts from Hawaii in the NASA Radio JOVE data archive. If it had been manmade interference, there would be no time correlation between Alaska and Hawaii. Note the time duration of almost 11 minutes.