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BIG SKY ASTRONOMY

Ken Tapping, 4th September, 2018

In the past, most radio astronomy consisted of pointing the instrument at the right place in the sky. Most cosmic objects change little over a human lifetime. Radio emissions from supernova explosions last for months or more and the emissions from the supernova remnant may be observable for millennia. Even pulsars, producing their regular pulses of radio emission, keep doing so for centuries or longer. However, over the last few years we have realized that some cosmic events need not only that we look at a particular position, we need also to be doing it at precisely the right time, to the millisecond (thousandth of a second). This happened on 24 July, 2001. The radio telescope was the 63-metre diameter radio telescope at Parkes, Australia. It picked up a very short, millisecond pulse of radio emission. The characteristics of the emission showed this pulse originated a very long way away. The Parkes radio telescope can "see" a patch of sky just a few percent of the size of the Full Moon, so the chance of the telescope being pointed at the right piece of sky at the right moment was minute. Were these pulses, now called "fast radio bursts" common or was this observation an amazing coincidence?

Even today, most radio telescopes in the world are single-antenna instruments, which see a tiny patch of sky, where to make an image one has to wave the antenna around, scanning the area. There are also radio imagers, which produce pictures of what we would see if we could see radio waves. Unfortunately most of these instruments can still only image tiny pieces of sky. The Synthesis Radio Telescope at our observatory is unique in that it can image a bigger piece of sky, maybe a few times the diameter of the Full Moon. Making a full image can take two weeks of observations. However, now we are entering the age of "wide field imagers", such as the CHIME (Canadian Hydrogen Intensity Mapping Experiment) radio telescope now being commissioned, also at our observatory. This radio telescope can image most of the sky above the horizon, and as the Earth's rotation carries the sky past the telescope, it can image all the sky that is ever visible from our part of the world. Its primary purpose is to map structure in the young universe, but it will also be a front-line instrument for detecting of "fast radio bursts". Some time ago, during test observations, CHIME picked one up.

So far a number of fast radio bursts have been detected, by radio telescopes around the world. All we know at the moment is that since the pulses are short, the sources have to be small, and because they lie a long way away, they have to be very powerful. With so little information, there are currently more theories to explain the fast radio bursts than the number of observations.

The discovery of fast radio bursts underlines how much we might be missing by using instruments that can only see a tiny bit of sky at a time, like being forced to observe through a keyhole rather than being able to open the door. Fortunately, advances in image processing techniques and the almost explosive improvement in video processing electronics are changing the game completely. We are now entering the age where modern radio telescopes will keep an eye on large patches of sky as a routine part of their observations. In addition to finding out how many fast radio bursts occur each day, we will be keeping an eye open for anything odd occurring anywhere in the sky the radio telescope can see. We have always been able to go out on a clear night and explore the whole sky, just using our eyes. Now, for the first time in the history of radio astronomy, we will be able to get the same view of the radio universe.

Mars is now receding from us, but still justifies getting out the telescope. The red planet lies low in the Southeast after dark. Saturn is in the South and Jupiter very low in the Southwest. The Moon will be New on the 9th.

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