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A CELL PHONE ON MARS

Ken Tapping, 9th September, 2014

”That radio telescope could pick up a cell phone if it were on Mars”. This is one of the things we say to visitors to the site when showing them our 26m radio telescope. That “dish” is now quite elderly and not very big by modern standards, although the equipment on it is certainly state-of-the-art. The big challenge for radio astronomy is due to cell phones, and the multitude of other radio devices we use, being much closer to us than Mars. Considering the sea of manmade radio emissions we live in today it is remarkable that radio astronomical observations are still possible. The cosmic radio emissions we study may have taken thousands, millions or even billions of years to reach us, and are incredibly weak compared with any of the signals we produce, deliberately or accidentally. What can we do to see those cosmic whispers amid the roar of the radio noise we produce? How do we cope with a situation that gets more challenging by the day?

The first level of protection is through legislation. Canada, as a member of the United Nations, participates in the work of a UN agency called the International Telecommunication Union. Through that organization we agree internationally what radio frequencies will be used for TV, radio, radar, emergency services and so on, and of course radio astronomy. We also agree on the protection mechanisms to ensure that legitimate users of the radio spectrum don’t get interfered with by others, or by poorly designed electronics. For example, put a portable FM radio alongside a computer, tune the radio between stations and listen to the changing noises as you do things with the computer, like saving files, accessing the internet and so on. Computers are pretty good transmitters, but without firm rules setting how much emission they can produce, the situation would be far worse. However, because Mother Nature sets the power of cosmic radio emissions, we have to deal with them as they are, which is very weak. That makes radio astronomy the most vulnerable activity involving radio. On the positive side it sets an immovable benchmark for clean radio and electronic devices. These days we live surrounded by radio signals, phone signals, wi-fi, blue-tooth emissions and all the other familiar radio services. Collision avoidance radars and other electronic devices are going into cars, and we walk around with one or more radio devices on our persons. The individual signals might be weak, but together they add up. This growing roar of millions of devices all whispering at legal levels is getting to be a problem. What we can do is not clear. We, along with our partners in Industry Canada are working on it. On the upside we are getting better at identifying and evaluating potential problems. At our observatory we have devices we use to check interference levels, and we are working on means to locate interference sources.

One new tool in identifying interference sources has come through the new technology of “software-defined radio”. Instead of processing the signals from the antenna using conventional electronics, the signals are digitized and fed to a fairly powerful computer. This technology means we can detect many different types of signal and with the click of a mouse button we decode them. This information may then be passed to Industry Canada. Of course such high-speed digital electronics is kept in a screened, metal box because of the interference it would otherwise cause. Doing the science of radio astronomy is challenging enough; we do not need the additional challenge of dealing with radio interference. However, when forced to face such problems, we can come up with some really innovative stuff. Unfortunately though you can never get back to where you would have been with no interference.

Venus lies very low in the predawn sky; Jupiter is higher. Saturn and Mars lie close together in the sunset twilight. Saturn is now the one on the right. The Moon reaches Last Quarter on the 15th.

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