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MEERKAT: FIRST LIGHT

Ken Tapping, 2nd August, 2016

For the last few days a fascinating image has been circulating around the astronomical community. It shows more than 1,300 starlike dots on a plain, uniform background. However, the level of detail in that image is such that one can magnify each “dot”, revealing it to be a galaxy. Some of the dots show themselves to be bright blobs emitting jets of material. These are probably giant black holes. The bright blob is radio emission from the hot material as it spirals in and is swallowed.

Moreover, this image was obtained using a radio telescope. It is the first astronomical result obtained using “MeerKAT”, an array of dishes currently under construction in South Africa’s Karoo Desert. The array will eventually comprise 64 antennas; the image was obtained using the 16 antennas currently in operation.

Canada and the National Research Council (NRC) have more than a casual interest in MeerKAT. Working with Nanowave Technologies, a Canadian company, we are providing the key elements for the radio receivers used on MeerKAT. On top of that, our research and expertise in the use of carbon-fibre composite materials in antenna construction have been used in the design of the dishes making up the array. MeerKAT will for a while be the most sensitive radio telescope in the world. However, its 64 dishes will be just part of a far bigger radio telescope – the Square Kilometre Array, or SKA.

For some years it has become clear that to tackle the research problems facing us in astronomy, we will need a radio telescope about 100 times more sensitive than existing instruments. It is unlikely that we will be able to do better than doubling the sensitivity of radio telescope receivers so we need to take a different approach; we will make an antenna big enough to collect about 100 times more signal. It is not possible or reasonable to try making a single big dish with a signal collecting area of one square kilometre. It is better to make up that collecting area using thousands of small

dishes. It’s something like the compound eye of a fly, which builds its images of the world through several thousand lenses. Moreover spreading the dishes out over thousands of kilometres will give us more power to resolve extremely fine detail in the cosmic radio sources. Imagine that MeerKAT image with orders of magnitude higher sensitivity and showing much finer detail. Achieving this within a reasonable budget requires the antennas to be precise but inexpensive. This is why NRC is pioneering the use of cost-effective, carbon-fibre composite materials in antenna construction.

The SKA will be located in the Southern Hemisphere, where there is enough interference-free real estate to accommodate this huge instrument. That location will also give us a clear view of the centre of our own galaxy, which is a major research interest.

MeerKAT will form part of the South African section of the SKA. The other major part of the SKA will be located in Western Australia, where an array of radio telescopes known as Australian Square Kilometre Array Pathfinder (ASKAP) is being commissioned. The MeerKAT and ASKAP radio telescopes are critical development platforms for the new technologies needed to make a cutting edge instrument like the SKA a success.

Obtaining a picture containing those thousands of previously undiscovered galaxies is a measure of the quality of the equipment calibration and the data processing. Scaling up to an array of thousands of dishes will bring a tsunami of data. NRC’s established expertise in high-speed number crunching raises another possible Canadian contribution to the Square Kilometre Array.

Mars and Saturn lie low in the southwest after dark. Mars is the bright one; Saturn is fainter and to Mars’ left. The Moon will be New on the 2nd and will reach First Quarter on the 10th.

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