Radioastronomy and the unquiet radio sky

This week's meeting of the World Radio Conference could make or break radioastronomy by making wise or foolish decisions about the reservation of radio-frequencies.

Westerbork. The easy way to gauge the seriousness of the damage done to radioastronomy by the general radio traffic in the sky is to stand in front of one of the pen recorders at this radioastronomy observatory in North Holland (a few kilometres south of Gröningen). You can quickly tell when people wake up and move about in this part of the world (soon after 06:00): the pen recorders quickly go off scale. Thus has radioastronomy been converted from a 24-hour-a-day business to one in which, like optical astronomers, observers are also compelled to stay up all night.

Westerbork is the site of the array of radiotelescopes originally built by the late Jan van Snort and still in service after nearly 30 years. The telescope is still widely used (not only by Dutch astronomers), but is busily rebuilding its equipment to make the frequency of its receivers more easily interchangeable. The hutted buildings are stacked with double-frequency receivers that will soon be bolted to each of the 14 dishes, and which will make it possible to switch from one frequency to another in a few hours, not a few days as at present.

By accident, the observatory has also been the cockpit of the fight against contamination of the radioastronomy spectrum waged by the research community against the commercial users of the radio spectrum over the past several years. And the accident is not really accidental. H. C. Kahlmann was the natural choice as chairman of the European Science Foundation's Committee on Radio Astronomy Frequencies. Everybody is hoping that the committee's report, published a few weeks ago, will have some effect on the current negotiations at the World Radio Conference, now under way at Geneva.

'Commercial' is the word that matters. One wag has calculated that if radioastronomy were to sell off its present allocation of protected radio frequencies to commercial interests at something like the prices for which frequencies have recently been auctioned in the United States, there would be enough cash to provide every radioastronomer with an income of $160,000 a year for the rest of time. And it would be a life of leisure; radioastronomy as a science would have to fold its tent.

There are also rumours, unconfirmed, that companies with interests in radiotelephony are seeking to make deals of unspecified character with particular observatories, or suborning individuals by offering them lush consultancies. These tales are a sign that radioastronomers appreciate how much they are asking of the real world by demanding that certain frequencies should be reserved for them alone. But they appear also to recognize that they are playing a poker game. In a strictly rational world, they would put the frequencies they wish to see reserved in some kind of order of priority — and would then find them whittled away from the bottom. Better to keep the pirates guessing.

What the Kahlmann report does instead is to give a thumbnail justification in scientific terms of the reasons why particular wavelength bands deserve protection. The tone of the document is far from defensive, which is right and proper. Recent years have enormously extended the number of particular frequencies at which the observation of emission from the sky can be of immense interest to astronomers at large. In the 1950s, there was only the 21 cm (1,420 MHz) line of hydrogen and, later, that of the molecular inversion of ammonia. Now there are not merely CO and a host of other molecular species, but the search for OH masers (at 1,665 MHz), the need for quiet bands in which to search for redshifted versions of the 21-cm emission from neutral hydrogen and the wish to learn a little more about quasars from the freedom to use measurements in the 15.40 GHz band. Will this year's World Radio Conference grant all these wishes, and on what terms?

The first thing to note is the magnitude of the claim that radioastronomy is making of the commercial world. The companies bidding to use the protected frequencies would not willingly contribute to research in astronomy the many hundreds of millions of dollars a year they would pay for the right to use the same frequencies. But that is also why the radioastronomers' demands are reasonable.

There is no method by which some latter-day Solomon could carry out an accurate cost–benefit analysis on behalf of radioastronomy and set that off against the commercial value of a free-for-all in frequency use. Nor would it make sense to let the market decide, presumably by inviting research councils and other grant-making agencies to bid for frequencies in competition with the companies. Even if they were able to get their bids in on time they would invariably bid too low, at least the first time around. Then some kinds of observations would be out of bounds until the next round of bidding, perhaps decades away.

The only acceptable route to a solution is that governments should openly acknowledge that the needs of radioastronomy, esoteric though they may be, are in some sense paramount. It will be ridiculous if a few years before the end of this century and millennium, one crucial window on the still largely unknown Universe will be closed or at least clouded by foolish decisions hastily taken. When most well-off governments are wringing their hands about the preservation or their cultural heritage, that would be a shabby business.

For what it is worth, there is no permanent protection from radio interference in long baseline interferometry, although the direct effects are rather less severe; to the extent that radio contamination is local or, at worst, regional, the comparison of signals from distant receivers can be used to cancel out the contamination. But in the processing of signals, there is no such thing as a free lunch. The signal-to-noise ratio of a combined signal is always degraded by manipulations meant to remove contamination.

So much will soon be apparent at Dwingeloo, a few miles down the road to Amsterdam from Westerbork. This is the site of the European very-long-baseline-interferometry (VLBI) correlator station, which now exists as a large hole in the ground near the steerable dish built here in the 1960s. The project has been on the boil since 1988, when the European Community (now Union) funded a feasibility study (and then declined to follow through).

Since then, arm-twisting (in which Nature played a part) has unlocked the funds for the building from the same source, while national governments have done their duty by their own people in contributing to the cost of the small core staff. The main telescopes in the club contribute up to 20 per cent of their time on VLBI work. The network stretches from the eastern Pacific to China and Japan, and has 16 regular participants. It may soon be possible to work with magnetic recording tape a few micrometres thick: that will make it possible to cram 24 hours of recording onto a single reel. And there is great excitement at the planned launch next summer by the Japanese Institute of Space and Astronomical Science of the first steerable radiotelescope in orbit, which will become another node in the network.

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