Commission J

1996 – 1999 triennium report

Commission J has had an active triennium with some exciting technical and scientific achievements and some important developments in international collaboration. However, our observations have continued to be plagued by man-made of interference and various measures have been taken to deal with the problem. Commission J together with Commission 40 of the International Astronomical Union, arranged a meeting of the directors of most of the world's radio astronomy observatories at the IAU General Assembly in Kyoto in 1997. This resulted in the 'Kyoto declaration', a pledge to work together to better inform the public, and fellow scientists and engineers in the communications industry, of our work and the problems of interference, to make efforts to devise techniques to mitigate the effects of interference and to intensify participation in the regulatory processes conducted through IUCAF and by the ITU.

In another forum, the OECD Megascience Forum, a working group for Radio Astronomy identified the conflicting interests of radio astronomy and satellite communications as a serious challenge for the current regulatory mechanisms. This was acknowledged at Ministerial level and Ministers endorsed the formation of a small, informal, one-year Task Force with participation from industry, astronomy, regulatory bodies and governments to investigate the problem and look for solutions,

International meetings

Conference support in the last triennium is confined very strongly to 1999, there being only one sponsored conference before then: 'Radio Emission from Galactic and Extragalactic Compact Sources' in Socorro, New Mexico, USA, in April, 1997. In 1999 we have co-sponsored Commsphere'99, held in Toulouse, France in January, and we will sponsor a workshop on 'Radio Methods for studying Turbulence' at the University of Illinois in Urbana-Champaign, USA immediately before the General assembly, and a conference on the 'Early Universe' in St Petersberg just after the GA. Finally we support a timely conference on 'The Universe at Low Radio Frequencies' in Pune, India in November 1999.

Technical developments

One of the most exciting development of the last triennium was the successful launch, on February 12, 1997, of the Japanese VSOP satellite, bearing an 8m antenna and associated VLBI receivers.. The satellite, renamed HALCA on launch, is in an orbit with apogee 21,400 km. It is now routinely possible to make VLBI observations, at wavelengths of 18 and 6 cm, with baselines up to 3 times the Earth's diameter using HALCA and the ground VLBI arrays. Among other important technical developments in VLBI was the opening of the JIVE correlator in October, 1998; full operation is expected before the end of 1999.

At millimetre/submillimetre wavelengths, significant progress in array receivers has been demonstrated by several groups, eg Edinburgh, MPI Bonn, Caltech and UMass and Chicago. SCUBA, the first in a new generation of submillimetre arrays built at the Royal Observatory, Edinburgh in collaboration with Queen Mary and Westfield College, London, became available at the James Clerk Maxwell Telescope in 1997. It consists of two arrays of bolometers – 37 pixels in the wavelength range 750 – 850 micron and 91 pixels in the range 350 – 450 micron.

Another important technical achievement was the launch of the US submillimetre wave satellite, SWAS in late 1998. Observations with the SWAS indicate abundant interstellar water but no oxygen line indicating a low abundance. A similar satellite, instrumented for astronomy and aeronomy observations, is under construction by a consortium led by Sweden. It will be launched in 2000.

Towards the other end of the wavelength range, 21 cm, a new large 13 beam focal plane array on the Parkes telescope is facilitating large surveys at this wavelength as well as being used to detect pulsars at a great rate.

Scientific results

It was at the beginning of the triennium that detections of CO and dust at redshifts of 4.69 with both the Nobeyama and IRAM interferometers were reported. (Redshift signifies both distance and epoch and $z=4.69$ implies that the radiation left the quasar when the Universe was only about 7% of its current age). A second detection of CO at a redshift greater than 4 was reported more recently by IRAM scientists. These and recent Scuba results put into question whether the epoch of galaxy formation was at $z\approx2$ as has been discussed, or significantly earlier.

Molecular maser research has been prominent during the past few years. 22 GHz water masers in the accretion disc surrounding the central black hole in the galaxy NGC 4258 have been known for some time and their position – rotational velocity measurement has shown the central mass to be some 35 million times that of the Sun. New observations with the US VLBA have detected and located the core of an active galactic nucleus relative to the black hole – the positional offset is consistent with theoretical predictions. Masers, methanol this time, are also being used to delineate discs around newly forming stars according to results from the Australia telscope and the European VLBI network and VLBA observations of SiO masers show them to lie in rings around evolved stars.

Finally, another result of note is the role played by the VLA in the detection of a gamma-ray burst at radio wavelengths. This detection and the measurement of radio brightness variations helped astronomers begin to measure a size limit to the object and together with its redshift, determined optically, to begin to understand the physics of gamma-ray bursters

New instrumental projects

Such considerations as high redshift CO and the epoch of galaxy formation referred to above are important scientific drivers for a large millimetre/submillimetre array. Three arrays were being discussed in 1996 but the US and Europe have formally agreed to co-operate to build a single large array, the Atacama Large Millimetre Array (ALMA), on the mountain Chajnantor, at an altitude of 5000 m in the Chilean Andes. The project is in a study/prototyping phase until the end of 2001 when it is hoped that full production of the 64-telescope array will be built. The individual antennae are to be 12m in diameter (total collecting area 7000 m^2) and their wavelength range will be 3.5 mm to 350 micron. It seems likely that the third group, from Japan, will also become partners in ALMA.

Another large array under discussion is the ‘Square Kilometre Array’. This instrument is intended for observations, among other things, of hydrogen in the early universe and so will be required to operate at wavelengths where communications are already dominant. It will rely upon interference mitigation technology and must, presumably, be built in a remote, relatively interference-free part of the Earth.

Meanwhile the construction of the Smithsonian millimetre array continues apace, the Green Bank telescope has made significant progress, despite some manufacturing problems and a 50 m diameter millimetre telescope (LMT) is being constructed in Mexico, as a joint project between the Mexican Instituto National de Astrofisica and the University of Massachusetts.

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