Commission J
1999-2002 Triennium Report

Scientific Highlights

From the largest scales of cosmology to the smallest scales in stellar-mass black hole systems, radio astronomy has made important contributions to our understanding of astrophysical systems. In cosmology, spectacular results from the cosmic microwave background experiments have been reported. The first and second Doppler peaks in the fluctuation spectrum, and probably even higher order peaks, have been detected, giving us our strongest evidence to date that the universe is flat. This, combined with data from supernova photometry, has led to the remarkable conclusion that a significant amount of dark energy controls the dynamics of the universe. Pulsar astronomy has surged forward as the number of known pulsars exceeded 1000 for the first time, and new examples of the rare systems, such as binary neutron stars, are found. New insights into the generation and extraction of energy in black hole systems were made with the demonstration of interactions between the accretion disk and the radio jet in the galactic microquasars. The detection of radio afterglows in gamma ray bursts has helped to eludicate the developing picture that these high energetic systems may be the result of massive star explosions in other galaxies.

Technical Developments

The most recent triennium has seen great progress in the development of new radio astronomy facilities and the expansion of existing ones. The Giant Metrewave Radio Telescpoe (GMRT) consisting of 30 steerable parabolic dish antennas, each of 45-m diameter, has been constructed in western India and is operation in bands ranging from 150 MHz to 1.4 GHz. The GMRT represents an important step forward in sensitivity at these low frequencies. In April 2002 mm-VLBI reached a milestone with the detection of fringes at 147 GHz, representing the highest angular resolution astronomical observations ever made. The stations involved were at Haystack Observatory, Steward Observatory, the MPIfR and IRAM. At NRAO in the United States the Green Bank Telescope is now in operation and progress continues on the Enhanced VLA. The Submillimeter Array, a US-Taiwan project, is nearing completion on the summit of Mauna Kea in Hawaii. Five antennas (of the planned complement of eight) are in operation as an interferometric array; the array is expected to be fully operational an the end of 2003. The Atacama Large Millimeter Array (ALMA), a telescope planned to operate in the millimeter and submillimeter bands, has entered construction phase. Its 7000 square meter collecting area and its site high in the Andes mountains will provide unprecedented sensitivity and resolution at these wavelengths. The European and North American partners are developing prototype antennas, and in the following year will consider funding of the full construction phase of the project. Design and development efforts continue on the Combined Array for Research in Millimeter-wave Astronomy (CARMA), a 23-antenna millimeter array planned in the northern hemisphere to complement ALMA. Studies of three sites in eastern California are in progress. Work on the Allen Telescope Array, a planned 350-element centimeter-wave telescope to be sited at Hat Creek Observatory in California, continues with antenna design nearly complete and array prototyping under way. Construction is expected to begin in 2003 with the goal of completion in 2005. Construction of the Large Millimeter Telescope on Sierra Negra in Mexico continues. Instrumentation is under development and includes an array receiver, a correlator, and bolometer cameras. Completion in expected in

2004. A Dutch-US consortium has formed and is engaged in the design and development of LOFAR, an array that is expected to improve the sensitivity and resolution of low frequency radio astronomy by two orders of magnitude. Development of concepts and designs for the Square Kilometer Array continues as an international effort with active groups in Australia, Canada, China, Europe and the United States.

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