NEW DEVELOPMENTS IN EUROPEAN VLBI

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ABSTRACT: Five major areas of development in European VLBI are reviewed: new telescope millimeter-wavelength VLBI; Mk2 and Mk3 correlators, the European Data Processing Facility for the 1990's and a 5 GHz receiver for the RADIOASTRON space VLBI program.

1. INTRODUCTION

The European Consortium for VLBI was established in 1980 with the member institutes listed in Table 1. The Consortium is governed by a Board of Directors consisting of the Institute Directors, which delegates the operation of the European VLBI Network (EVN) to the Program Committee which meets three times a year to select observing proposals, the Technical Working Group which coordinates instrumental developments in the EVN, and a network of "friends of VLBI" at each telescope to carry out the observing programs. Scheduling of the EVN observing sessions and coordination of the activities of the friends of VLBI during the sessions is the responsibility of the Chairman of the Program Committee. The Board of Directors recently appointed a Network Scientist to look into means for improving the scientific performance of the EVN, and a Project Manager to oversee efforts to develop new generation processing facilities.

In the seven years of its existence the EVN has seen observing time for VLBI more than double to about 65 days per year, the number of proposals more than double to about 80 per year, and the number of scientists involved in proposals also more than double to about 150 per year.

A number of initiatives have been undertaken in recent years to ensure a leading role for European VLBI in the next decade. These include a proposal for an advanced data processing facility, the construction of new large diameter telescopes, a proposal for equipping the millimeter-wave telescopes at Pico Veleta and Plateau de Bure with VLBI equipment, the agreement with the Space Research Institute in Moscow to construct two 5 GHz receivers for the RADIOASTRON space VLBI program (Kardashev and Slysh, these Proceedings), and the proposal for

M. J. Reid and J. M. Moran (eds.), The Impact of VLBI on Astrophysics and Geophysics, 469–473.

QUASAT, the European-led western proposal for space VLBI (Schilizzi, these Proceedings).

Table 1: Member institutes of the European Consortium for VLBI

Institute	Membership Status	Telescope Location	Telescope Diameter	Comment
Nuffield Radio Astronomy Lab, Jodrell Bank, UK	F	Jodrell Bank	76 m 26 m	
Paris Observatory, Meudon, France	A	Nancay	94 m	(equivalent diameter)
Netherlands Foundation for Radio Astronomy, Dwingeloo, NL	F	Westerbork	93 m	(phased array)
Max-Planck-Institut for Radio Astronomy, Bonn, FRG	F	Effelsberg	100 m	
Institute of Radio Astronomy, Bologna, Italy	F	Medicina Noto Sardinia	32 m 32 m $\geq$32 m	 new new
Chalmers Technical Univ Goteborg, Sweden	F	Onsala	26 m 20 m	
Technical University of Munich/University of Bonn, FRG	A	Wettzell	20 m	
Nicolaus Copernicus University, Torun, Poland	A	Torun	15 m 32 m	 new
Space Research Institute, Moscow, USSR	A	Simeis Suffa	22 m 70 m	 new

F : full member
A : associate member

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2. NEW TELESCOPES

Four of the telescopes in Table 1 are noted as "new". The Noto, and Suffa telescopes are currently under construction, and should be operational in 1989 and 1990 respectively. The engineering design study for the Torun telescope has been completed. The Sardinia telescope is approved as part of a long term development plan for southern Italy, the details of which are still under discussion. A further 32m telescope has been proposed at Cambridge as an extension of the MERLIN system, which at the same time provides crucial intermediate baselines between the current MERLIN and the EVN. These telescopes will add significantly to the overall sensitivity and U-V coverage of the EVN.

Two other developments in the area of telescopes are worth mentioning: the resurfacing of the 25m Mk2 telescope at Jodrell Bank and the outfitting of the 11m telescope at Nsukka (Nigeria) for VLBI. The Mk2 telescope at Jodrell now has overall surface accuracy of 0.6mm rms which will allow high aperture efficiency operation at 22 GHz. The Nsukka telescope will operate at 18 cm initially and provide important intermediate baselines from the EVN to Hartebeesthoek.

3. MILLIMETER-VLBI

Onsala and Effelsberg have conducted experimental observations at 43 GHz as a single baseline and also as part of global observations with US stations. A proposal to expand European facilities for mm-VLBI has been prepared by MPIfR and IRAM, and will be submitted in Summer 1987. It envisages hydrogen masers and broad-band recording systems at Pico Veleta in Spain and Plateau de Bure in France. Table 2 lists the European telescopes capable of participating in a mm-VLBI network.

Table 2: European millimeter-wave telescopes

Location	Diameter	λ min
Pico Veleta (Spain)	30 m	0.8 mm
Onsala (Sweden)	20 m	2.6 mm
Yebes (Spain)	14 m	2.6 mm
Metsaehovi (Finland)	14 m	2.6 mm
Plateau de Bure (France)	3 x 15 m	0.8 mm

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4. Mk2 AND Mk3 CORRELATION FACILITIES

An agreement between Bologna and Caltech will see the JPL/CIT 5-station Mk2 correlator move to Bologna late in 1987 following check out of the new Block II correlator at Caltech.

The MPIfR Mk3 correlator will be upgraded from 4 to 5 stations in 1987 and to the higher track density system by early in 1988.

Support has come for the tape density upgrade throughout the EVN from the Commission of the European Communities in Brussels via a grant from their Technology Stimulation Program.

5. EUROPEAN DATA PROCESSING FACILITY FOR THE 1990'S

To meet the obvious scientific challenges of the 1990's, the EVN will need to provide better image quality, higher spectral resolution, higher frequency capability, and be able to handle data from a space element. The European Consortium is seeking funding for an augmentation of the EVN facilities in the 1990's through the European Community's "Framework Programme of Technological Research and Development (1987-1991)".

The proposal has two major components: the Data Processing Facility (DPF) including the Data Playback System (DPS), and the Data Acquisition System (DAS). The current concept for the processing facility centers around a correlator capable of processing up to 256 Mbits/sec data in one polarisation from 16-stations simultaneously. The correlator is of the "X-F" type and will employ state of the art 2μ CMOS technology. A number of the possible correlation options are listed in Table 3.

The DAS and DPS will follow the US VLBA design for obvious compatibility reasons. The 24 acquisition terminals and 18 playback terminals envisaged are to be built in Europe.

The total cost is expected to be 16.4 MECU (18 M$), comprising 10.2 MECU for the DPF including the DPS, 4.6 MECU for the DAS and 1.6 MECU for contingency.

The NFRA in Dwingeloo will carry the overall project responsibility and will construct the DPF. The MPIfR in Bonn will manage the construction of the DAS and DPS.

6. 5 GHz RECEIVERS FOR RADIOASTRON

The European Consortium is jointly financing the construction of two space-qualified, coolable, 5 GHz receivers for RADIOASTRON. The NFRA in Dwingeloo is managing the overall receiver project and building the mixer/IF unit; the MPIfR is building the low noise amplifier. It is hoped that ESA/ESTEC will provide advice during the course of the project, as well as the use of environmental test facilities for testing the prototypes. The receiver project kickoff meeting took place in February 1987; delivery of the two flight units is expected in March 1990.

Table 3: Basic correlator configurations for the proposed European Data Processing Facility.

# Stations	# Pol	Continuum bandwidth (MHz) 2-Bit	1-Bit	# Spectral points per interferometer baseline
16	2	64	128	128
	1	128	256	256
12	4	64	128	128
	2	64	128	256
	1	128	256	512
8	4	64	128	256
	2	64	128	512
	1	128	256	1024
6	4	64	128	512
	2	64	128	1024
	1	128	256	2048

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