VERY LONG BASELINE INTERFEROMETRY BY 45m RADIOTELESCOPE

Hisashi HIRABAYASHI, Makoto INOUE,
Hiroyuki IWASHITA, and Masaki MIRIMOTO
Nobeyama Radio Observatory
Tokyo Astronomical Observatory
University of Tokyo
Nobeyama, Minamimaki, Minamisaku,
Nagano 384-13, Japan
and
Masato TSUBOI
Faculty of Science, University of Tokyo,
Hongo, Tokyo 113, Japan

VLBI (Very Long Baseline Interferometry) has become a very important tool for radio astronomy revealing very compact structures such as cores and jets of quasars and radio galaxies or active star forming regions.

The 45m radiotelescope of Nobeyama Radio Observatory is a general purpose type radiotelescope and VLBI activity has been aimed since the beginning. The case of joining 45m radiotelescope to international VLBI network was studied by Hirabayashi (1979).

The radiotelescope has been working since March 1983. Its surface accuracy is 0.2mm rms and pointing accuracy is about 0.001 degree. Thus the telescope has high performance especially in mm wave region. The low noise frontends installed are for 1.4/1.6, 5, 22. 40, 80, 100, and 120, GHz bands.

For VLBI purpose, one Mk III terminal was installed in March 1983. A hydrogen maser of VLG-11 series type by Maser Lab of Center for Astrophysics, Smithsonian Institution, has been operating since March 1982 as a primary frequency standard for radiotelescopes and for time keeping.

In November 1983, 45m radiotelescope was connected to a 10m element antenna of 5-element supersynthsis interferometer to form an ad-hoc two element interferometer at 22 GHz for a preliminary VLBI test experiment. Frequency conversion and phase-locked oscillator systems were independent from each other but with a common hydrogen maser frequency standard. Radio sources 3C84 (continuum) and W49 (maser line) were observed and signals from both antennas were recorded onto different tracks of a single tape using the Mk III terminal. Fringes were detected successfully for both sources using K-3 processor of Kashima Branch, Radio Research Laboratories (RRL).

In December 1983, 3C84 (continuum) and W3 (OH) (maser line) were observed with Nobeyama-Haystack baseline at 22 GHz using MK III facilities. Fringes of 0.00029 arcsec were detected for both sources using both processors of RRL K-3 and Haystack Mk III, and the feasibility of 45m radiotelescope for VLBI were verified and clock difference and coordinates of the telescope site were estimated.

In February 1984, with Nobeyama, Haystack and Owens Valley stations, 3C345 and NGC4278 were observed and this was in conjunction with the US VLBI Network program at 22 GHz MK III session.

In December 1984, one hour test experiment was done for four radio sources with Nobeyama-Kashima baseline at 8 GHz with MK III mode E operation. Telescopes used were 45m radiotelescope and 26m antenna of Kashima with dual circular feeds. 8 GHz forntend were on loan from Kashima. In the second VLBI experimemt in December, 6-hours operation program were performed with the same

scheme as the first run to make VLBI polarimetry and preliminary result shows a linear polarization for BL Lac as an example.

45m radiotelescope has high pointing accuracy and high gain in mm wave region and mm wave VLBI is a very challenging field for 45m radiotelescope. 43 and 89 GHz VLBI experiments with US stations are under discussion. and hopefully, experiments will be done in 1985.

10, 22, 40, 80, 100, 120 GHz band frontends are set in the Coudé focus situated in the lower cabin of the radiotelescope. These receiving bands can be changed easily by moving some reflecting mirrors and/or dichroic mirrors, and all frontends are ready for observations.

Photograph 1. Aerial view of the 45m radiotelescope in front of control and receiving building.

Photograph 2. mm wave horns and frontends in the lower cabin of 45m radio telescope.

There is no problem for 22 GHz operation, but phase noise of local oscillator signal will become a severe problem in shorter wavelengths. Improvements of phase locked oscillators in mm wave is under consideration for future mm wave experiments.

Time keeping at Nobeyama Radio Observatory is done with monitoring Loran-C signal. But comparing the measurement accuracy of GPS receiver with that of Loran-C with weak signal level at Nobeyama site, we will install GPS receiver in Nobeyama since April 1985.

An 8 GHz (X-band) frontend is under construction to join in the geodynamic VLBI network. The frontend is designed to be attached to the 10 GHz band horn in the Coudé focus in the lower cabin of the 45m radiotelescope.

VLBI Mk II system is less expensive and still widely used in radioastronomy field. Two sets of Mk II system will be ready in 1985.

In November 1984, so-called "FX" digital spectrometer became operational with 45m radiotelescope. The feasibility of this digital spectrometer for VLBI processor was suggested by Hirabayashi and Chikada (1983). Installing extra tape recorder of Honeywell Model 96 is considered. This is for tape recorder back-up and may open the possibility of forming a new type Mk III processor with "FX".

Energetic cores of active radio sources can be seen more clearly at high frequencies and 45m radiotelescope, by its high accuracy and by unique location relative to other radiotelescopes, will produce new informations of those regions by VLBI.

REFRENCES

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