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mmVLBI – HIGH RESOLUTION IMAGING

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ABSTRACT Development of receivers and the new technique to perform global fringe fitting on Mk3 data have now made it possible to produce hybrid maps at 100 GHz.

INTRODUCTION

VLBI observations at 100 GHz started around 1982 and have proceeded since then with one observing session per year. The first 6 years of observations were devoted to finding suitable objects and only crude models of source structure could be made from the very limited data available. We started a new series of observations in 1988, where we instead aimed for producing hybrid maps.

OBSERVATIONS AND TECHNIQUE

The data we present here were obtained at 100GHz in March 1988, April 1989, and April 1990 with a global VLBI array consisting of: Onsala, Nobeyama, Owens Valley, Kitt Peak, Hat Creek, Quabbin (1988), and SEST (1990). The maximum baseline length was $2.5 \cdot 10^9 \lambda$, corresponding to an angular resolution (FWHM) of 50 μas. The Mk3 VLBI system was used to record data with as wide a bandwidth as possible. Data were in general recorded for 7 mins. once every hour. One IF channel was used to record data at 5GHz for fringe finding, clock and rate corrections.

It was soon evident that the standard technique to find fringes by baseline did not have sufficient sensitivity on the longer baselines to Onsala and Nobeyama. Therefore a new technique was developed (Bååth these proceedings) which allowed us to do global fringe fitting within AIPS.

The coherence time of the original data was about 10 secs., but the fringe fits were done over solution periods of 7 mins.. This was possible since the delays did not change significantly during that time, and the SNR was higher because the noise decreased more than the loss of coherence. After the fringe fit we did a selfcalibration on the phases over solution periods of 6 secs. in order to correct any residual fast phase fluctuations.

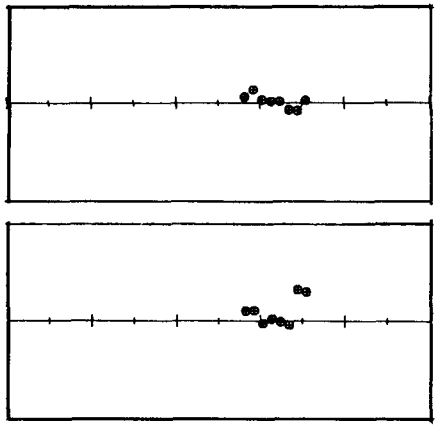

Fig. 1. Residuals for SEST from global fringe fitting. Horizontal axis is time, 0–24 hours. Upper panel shows single band delay (+/– 0.5 microsecs.). Lower panel shows rate (+/– 5 picosecs./sec.).

The new technique enabled us to detect fringes on the long, intercontinental baselines between the USA, Sweden, Japan, and Chile. We show in Fig. 1 the residuals from global fringe fitting for SEST, using Kitt Peak as reference station. The residuals show clearly that the solutions do connect, even though they were independently made. The standard baseline fitting technique failed to find any of these fringes. In Fig. 2 we show the correlated fluxes on the sources 3C446 and 3C279. The amplitudes were calibrated using the following formula:

$$S_{12} = \rho_{12} \times (SYS_1 \times SYS_2)^{1/2}$$

where ρ_{12} is the raw crosscorrelation function for the baseline 1-2; SYS_1 is the equivalent system temperature in Jansky, calculated on top of the atmosphere and corrected for elevation and shadowing.

The first paper showing an image at 100 GHz obtained with this technique has now been published (Bååth et al. 1990). Other papers are in preparation. We show here (Fig. 3) some examples of images obtained in 1988, 1989, and 1990. The small number of antennas and the high system temperatures makes mapping very difficult. The quality of the maps are therefore much lower than that achieved in the 1 – 10 GHz range. However, they represent the present state of the art in angular resolution and show interesting structure even at such a low dynamic range. The next generation mmVLBI arrays will contain more telescopes and we look forward to hybrid maps with higher dynamic range.

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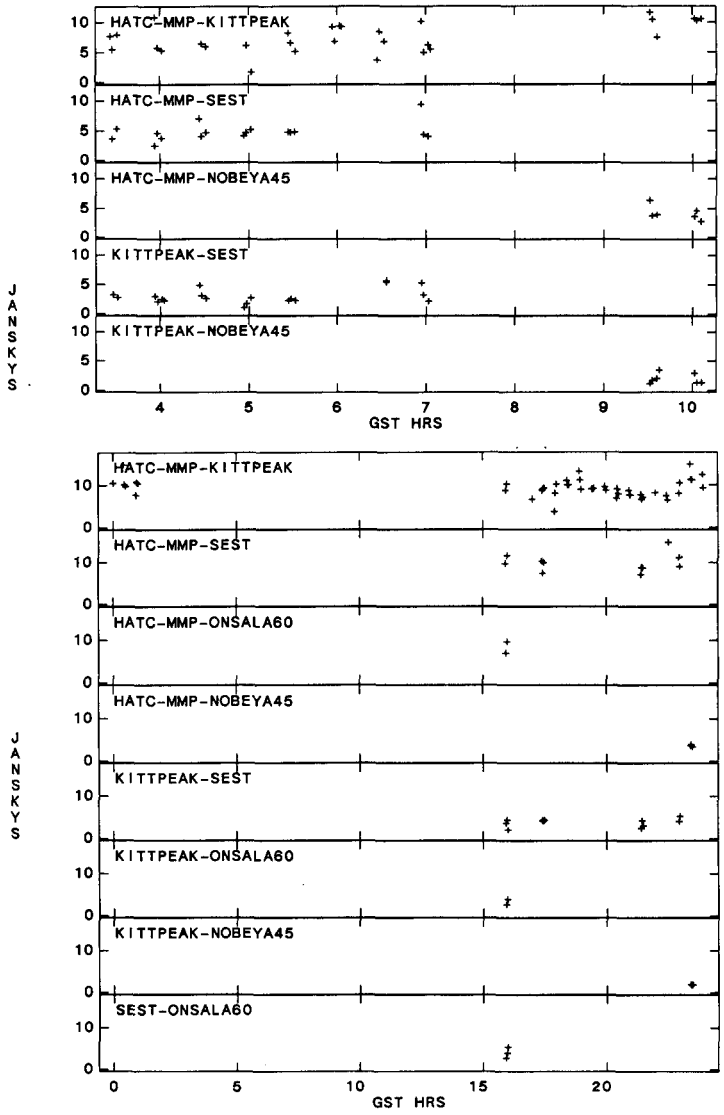

Fig. 2. Correlated fluxes on the sources 3C446 (upper) and 3C279 (lower) observed with a global VLBI array at 100 Ghz in April 1990.

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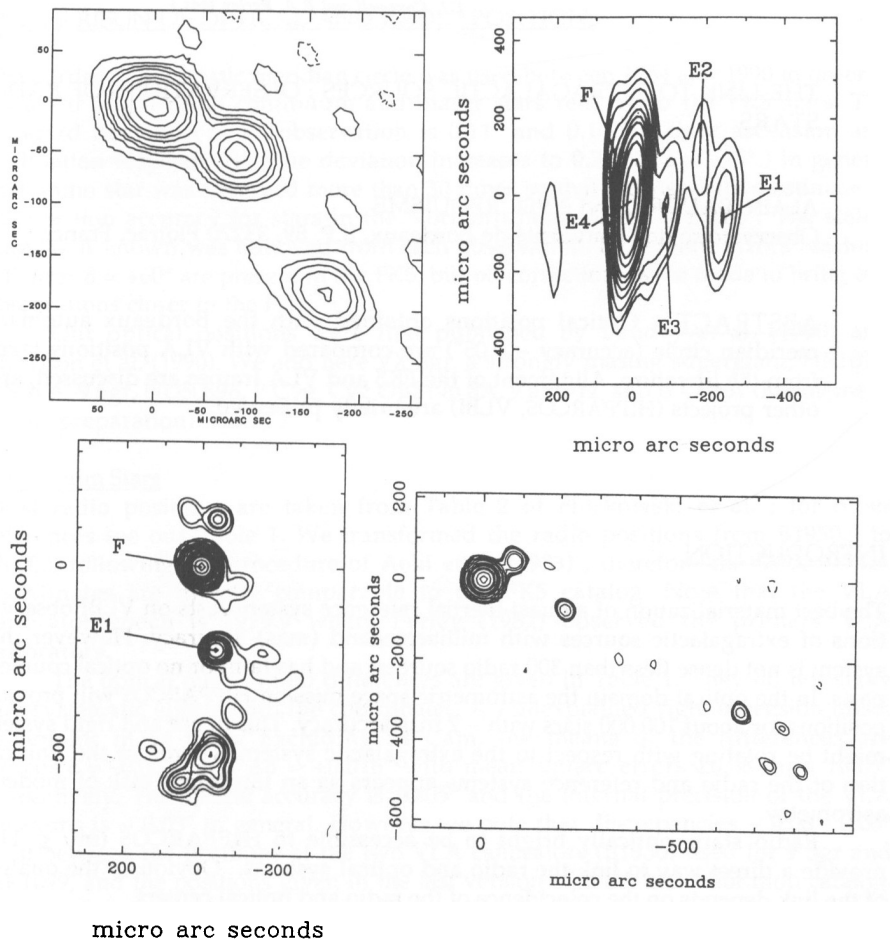

Fig. 3. Examples of maps from 100 GHz global VLBI: Upper left: A preliminary map of 3C446 (April 1990). Upper Right: 3C273 (April 1989). Lower left: 3C84 (March 1988). Lower right: 3C345 (April 1989).

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