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Configuration of Antennas in the First Phase of GMRT

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It is generally agreed that as the first phase of GMRT, we will try to get 4 to 6 antennas working by the middle or end of ‘91. A further question that has to be discussed is the configuration of these antennas. While logistically it might be easy to have all the antennas in the central square, this may not be the best configuration. For realistically testing the performance of the electronics (including the optical fibre link), and for understanding the problems of the ionosphere, it would be better to have the antennas on one of the NE or NW arms going out to say 10km and uniformly sampling the space in between. The astronomical projects that are possible are also quite dependent on the configuration of the antennas. The purpose of this note is to point out the pros and cons for the 2 possible configurations and recommend further discussion on the subject.

It is logistically the simplest to have all the antennas in the central square. The first antennas will come in the central square, laying the optical fibre is simple, and problems like power,communication, security and so forth are easily taken care of.Since the baselines are small, ionospheric phase fluctuations over the array should be small and it should not be too difficult to keep the system phased. If 4 antennas are within 1km, using them in the phased array mode, one gets an antenna of 90m effective diameter and synthesised beam of about 3.3X(in metres) arc mi In this configuration, the only astronomical activity possible with the telescope are those that need collecting area and not angular resolution. Such a “single dish” would be useful for of pulsars, inteplanetary scintillation and maybe even lunar occultation. But even for these observations, the system is not attractive for frequencies less, than 327 MHz since the collecting area is too small and confusion is a problem. 610 and 1400 14Hz would be the most popular bands in this configuration.

The other possibility is to put all the antennas on one of the arms, giving a maximum baseline of about 10 km with the antennas spaced such that the available baselines nearly uniformly cover the 10 km spacing. With such an array, phased array observations will be difficult since near the solar maximum, ionospheric phase fluctuations over the array could be severe, though at high frequencies (610 and 1400 MHz), phasing may be possible. The synthesisecl beam for the array would be about 0.3X (in metre) arc Thin which is small enough that the contusion limit is low even at the longest wavelengths. The astronomical activity with this array would be mainly flux measurements at the longer wavelengths where not too much is known. More important than the astronomical work is fact that this array enables one to realistically debug the instrument. The longest baseline is close to the real thing for studying the behaviour of the optical fibre link, local oscillator phase stability, any synchronisation problems and so forth. The software too has to have the accuracy of the full array software. The study of the ionosphere over this baseline will very useful in planning the strategy for analysis when the full array is ready. While the full array is being built, the preliminary array can be used for a number of necessary and useful things like establishing flux scales at 150 and 30 MHz, establishing calibration sources and maybe even make a start at tackling the non’-isoplanaticity problem.

From the discussion it should be clear which way my preference lies, but a formal discussion, taking into account the problems of different groups, should be initiated. One thing that has to pointed out is that if only 4 antennas are available in the first phase, there are no compromise solutions like putting 3 in the central square and 1 a little way away - they do nobody any good. Some compromise is possible if the electronics is available for 6 antennas as was talked about once but I do not know what the current thinking is.