MILLIMETER ARRAY MEMO NO. 3

# Fiber Optic Links in a Millimeter Wave Array

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## Initial Conclusions

1) Phase stability of fiber-optic links has been studied by T. Cole of CSIRO and G. Lutes at JPL. Papers by these authors are attached to NRAO VLBA #228. The effective length changes with temperature due to changes in the refractive index and, surprisingly, the coefficients of 1 to 20 x $10^{-6}$ $C^{-1}$ are in the same range as coaxial cables. The time delay coefficient of a 1 km, 10 x $10^{-6}$ $C^{-1}$ fiber or cable, is thus 1 cm/°C or 33 ps/°C. A length correction system is certainly needed for LO distribution and may be needed in a simple form for IF transmission.

2) An important part of the phase stability problem is in the devices for modulating and demodulating the LO reference signal on a microwave or optical carrier frequency. Here the microwave devices have an inherent advantage in the fact that they are reciprocal; i.e., a diode mixer can be used both for modulation and demodulation and its phase instability can then be corrected by a round-trip measurement system.

3) The prices of coaxial cables and optical fibers are comparable and will not be a large portion of a compact (∿ 1 km) array cost. Prices for optical fibers per T. Dunne of Corning Glass (607-974-9000) are \$750/km for single mode fiber with < ½ dB per km loss plus ∿ \$4000/km for the armor sheath for direct burial. A ½" Heliax coaxial cable is ∿ \$5000/km and has 50 dB/km loss at 400 MHz.

4) In view of the above statements, it appears that coaxial cables should be used for LO distribution and optical fibers for wideband IF transmission. In any case, it is not particularly a crucial or costly area to warrant detailed examination at early stages of the array development.

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