ERIM
FORMERLY WILLOW RUN LABORATORIES, THE UNIVERSITY OF MICHIGAN

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MEMORANDUM TO: VLA File

FROM: A. Klooster A.K.

SUBJECT: VLA Laboratory Measurement of Fourier Transform Using π Shift of Reference Beam

An experiment designed to demonstrate one method of measuring the Fourier transform of an optical spatial input signal is described below. Two intensity scans of the VLA processor output plane were recorded using the Gamma Scientific microphotometer PMT scanner. The input signal was a rectangular aperture 2 mm wide and point source (reference beam), which were separated by 15 mm. A π phase shift for the second scan was achieved by rotation of an optical flat behind the input aperture.

A copy of the microphotometer scans is shown in Figure 1. The scan labeled I_1 represents the intensity of the interference between the Fourier transform of the input aperture and the off-axis reference beam at a fixed but unknown phase of the reference beam. Scan I_2 is the same as I_1 except the effective phase of the reference beam has been shifted by π radians.

Let

$$B(x) = \text{F.T. of input aperture}$$
$$R(x) = R^{ej(\omega x + \delta)} = \text{reference field}$$

Then

$$I_1 = B^2 + 2BR \cos(\omega x + \delta) + R^2$$

and

$$I_2 = B^2 - 2BR \cos(\omega x + \delta) + R^2$$

$$I_1 - I_2 = 4BR \cos(\omega x + \delta)$$

When this subtraction is performed B(x) appears as the modulation function of a fixed frequency cosine wave.

Selected data points from the scan labeled I_2 were subtracted from the scan of I_1 and plotted on the graph labeled Figure 2. Note that the phase of the signal over the first sidelobe has a π shift with respect to the mainlobe. This result is expected if B(x) is a sinc function.

The test results indicate the validity of this light amplitude measurement technique. A similar test will be performed using the photosensor array when it is operational.

AK:sd

cc: C. Aleksoff
I. Cindrich
J. Fienup

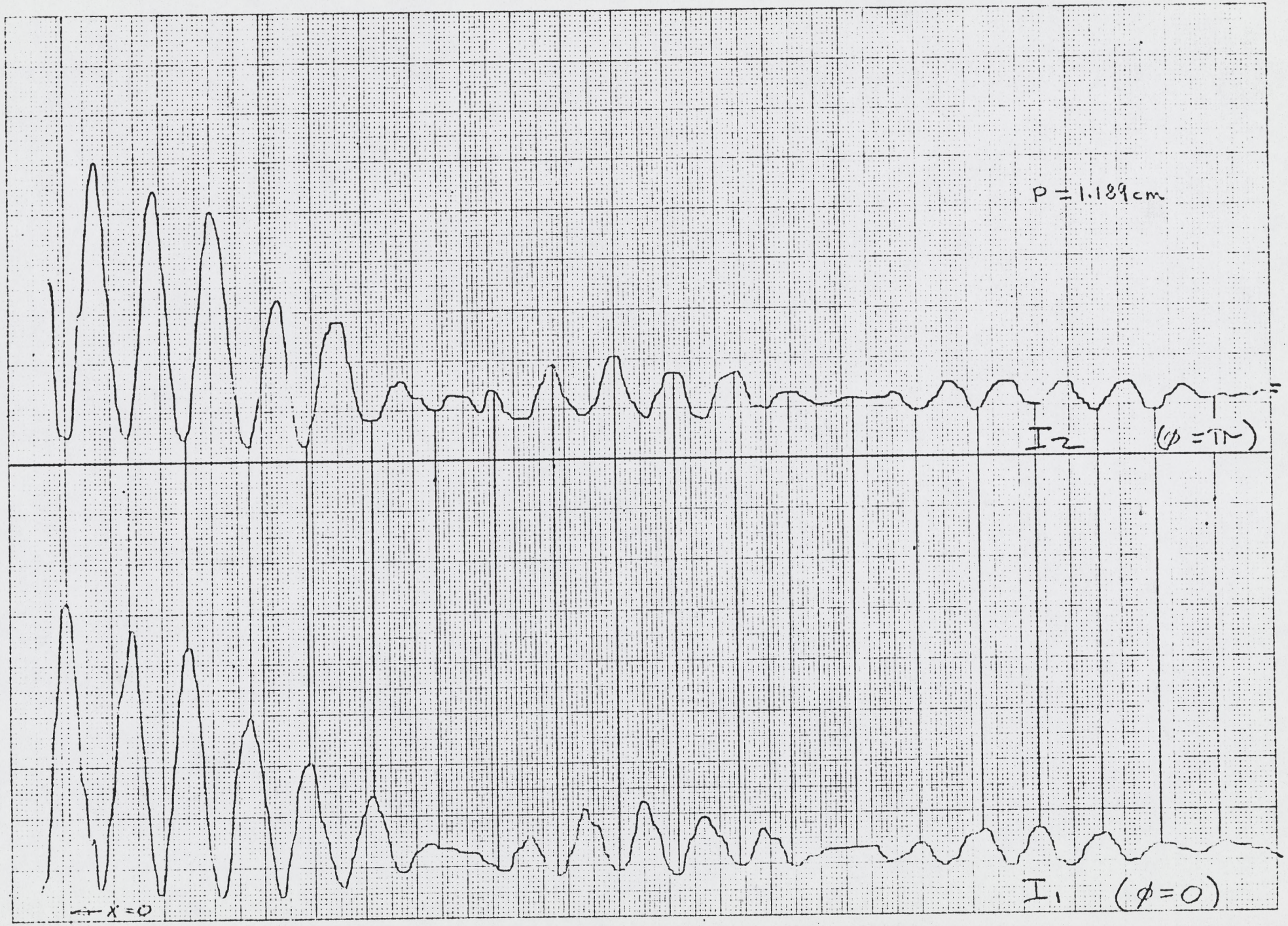

FIGURE 1.

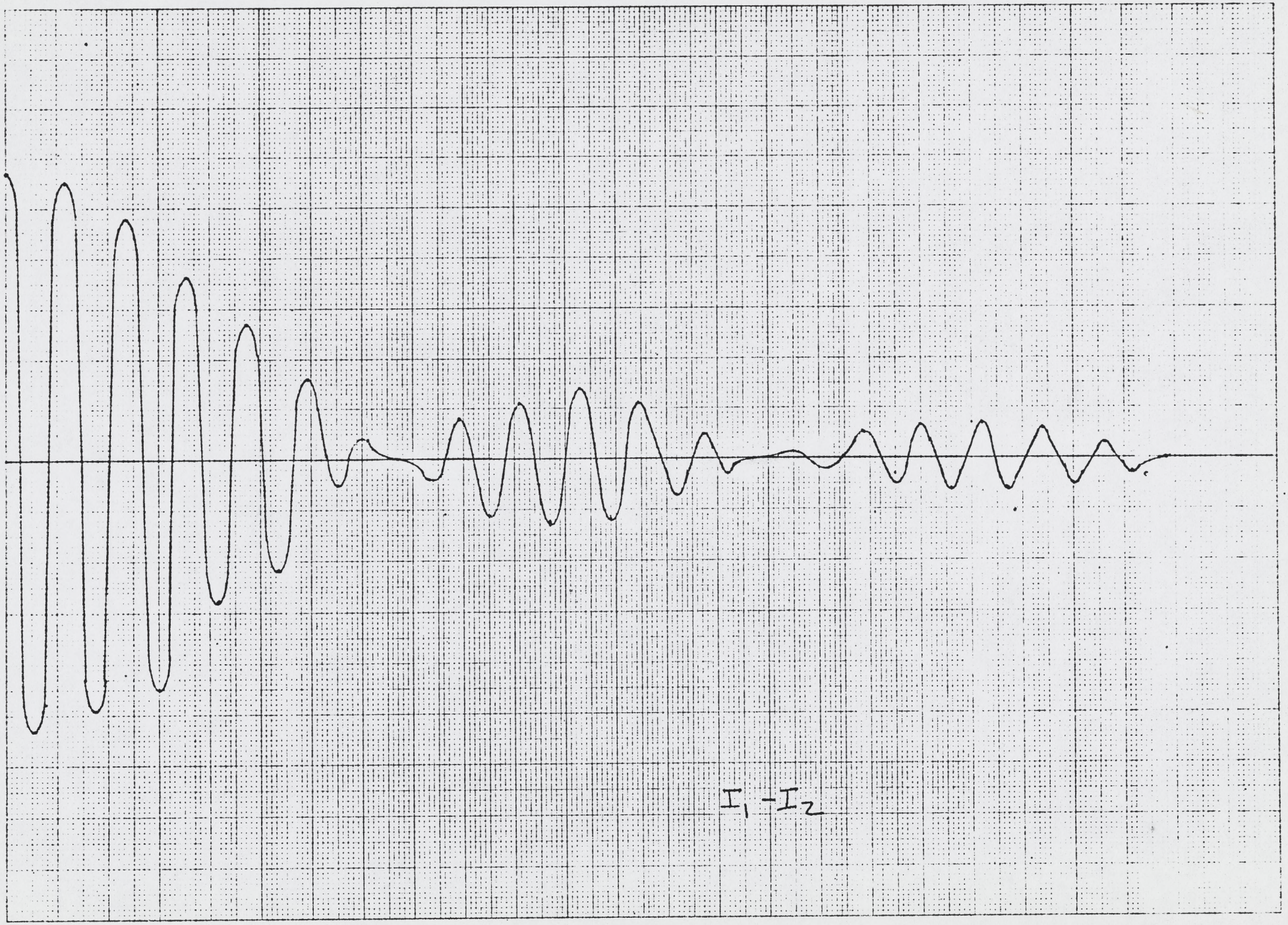

FIGURE 7.