LUNAR OCCULTATION AND PROVISIONAL IDENTIFICATION

OF MSH 21-23

BY

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The radio source MSH 21-23 was observed by means of a lunar occultation on June 18, 1965. The observation was made at the National Aeronautics and Space Administration's Data Acquisition Facility (latitude 35° 12' 0".05 North, longitude 05^h 31^m $29^s.294$ West). The occultation has provided a possible optical counterpart to the radio source, as well as position and diameter measurements.

The observation was made with a switched type receiver employing gain modulation and an 85 foot parabolic antenna tracking the center of the moon. The receiving frequency was 403 Mc/s with an intermediate frequency of 30 Mc/s, bandwidth of 5.0 Mc/s and RC integration time of 3 seconds. Digitized records of the disappearance and reappearance of the source are presented in figures 1a. and 1b. respectively. In addition the reappearance phase was observed at 137 Mc/s with a bandwidth of 2.5 Mc/s.

The data has been restored (as previously discussed[1]) and a gaussian curve fitted to the resulting brightness distribution. Analysis of the fit provides the best values for the position of the intensity peak and the source diameter along the scan. The diameter and position angles are given in Table 1.

TABLE 1

PHASE	TIME OF OCCURRENCE U.T.	POSITION ANGLE	DIAMETER	RESTORING BANDWIDTH USED
Disappearance 403 Mc/s	$11^h46^m13^s.3 \pm 4^s.3$	6°	$4''.0 \pm 2''.2$	$4''.0$ $2''.3$
Reappearance 403 Mc/s	$12^h24^m34^s.3 \pm 3^s.9$	122°	$3''.2 \pm 2''.2$	$3''.2$ $1''.7$
137 Mc/s		122°	$4''.8 \pm 2''.0$	$2''.8$

The position of the source has been computed from the Universal Times (corrected for integration effects[2]) corresponding to the intensity peaks of the restored brightness distributions. There are two possible positions for the source corresponding to these times.

Position 1: R.A. (1965.5) = $21^h15^m26^s.74 \pm 0^s.06$

DEC. (1965.5) = $-21^o30'0''.0 \pm 0''.9$

Position 2: R.A. (1965.5) = $21^h 14^m 43^s.02 \pm 0^s.06$

DEC. (1965.5) = $-21^o 07'23''.0 \pm 0''.9$

In calculating these positions, it has been assumed that the difference in Universal and Ephemeris Time is 35.0 seconds.

The ambiguity in position can be resolved by considering the positions given in the Howard and Maran catalogue[3]. Since position 2 lies within the quoted error limits of the catalogue and position 1 lies considerably outside, the source is assumed to be at position 2.

TABLE 2

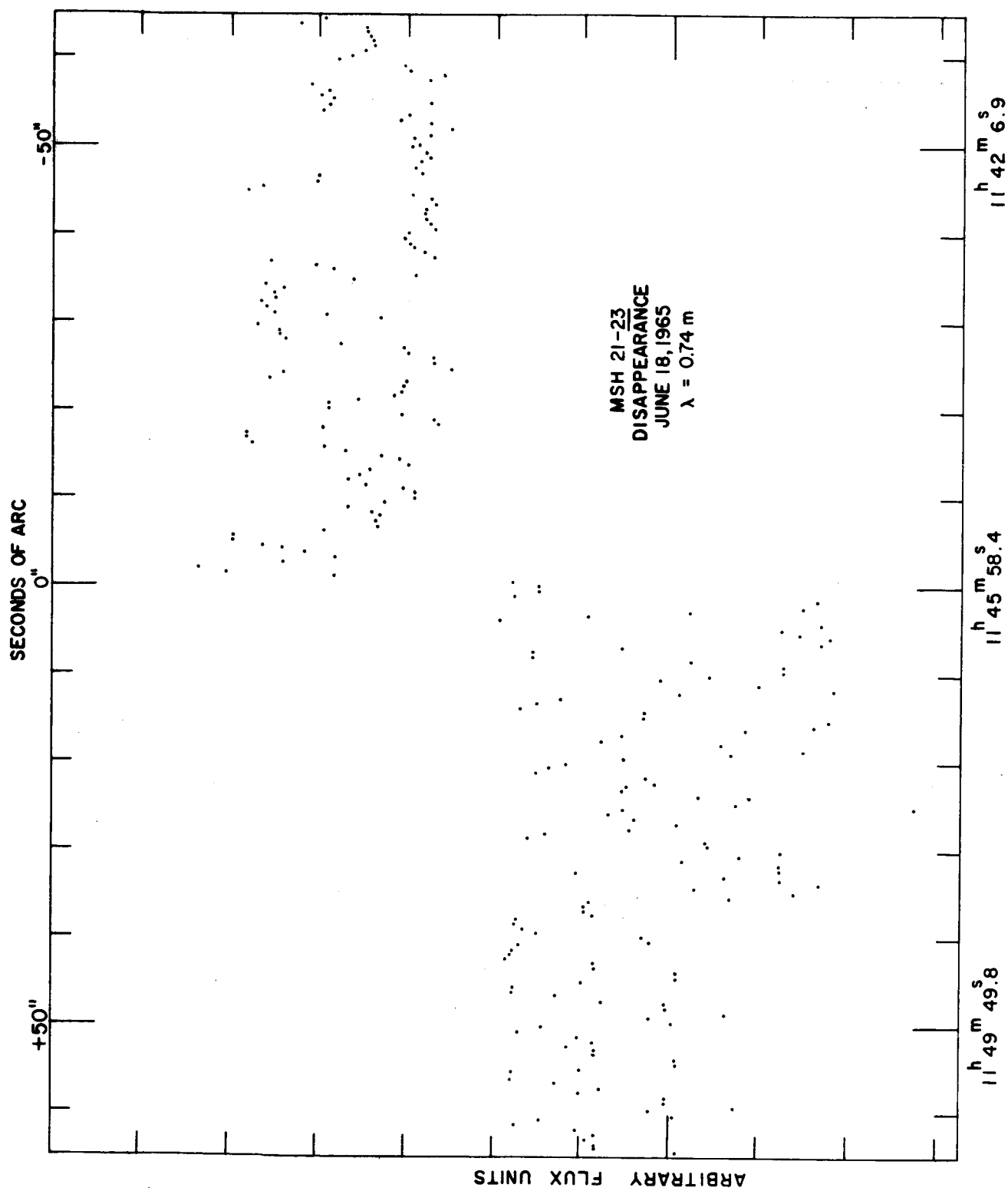|	R.A. (1950.0)	DEC.(1950.0)
Position 1	$21^h14^m33\overset{s}{.}92 \pm 0\overset{s}{.}06$	$-21°33'32\overset{.}{.}4 \pm 0\overset{.}{.}9$
MSH	$21^h13\overset{m}{.}6 \quad\pm 0\overset{m}{.}3$	$-21°11' \quad \pm 5'$
BGM	$21^h13^m41^s$	$-21°8'\ 0''$
Position 2	$21^h13^m50\overset{s}{.}20 \pm 0\overset{s}{.}06$	$-21°11'15\overset{.}{.}4 \pm 0\overset{.}{.}9$

The radio position of the source was located on the National
Geographic Society - Palomar Observatory Sky Survey Plates from
comparison with a number of 8th magnitude stars in the area.
The optical positions were obtained from the Smithsonian
Astrophysical Observatory Star Catalogue. The radio position
was found within the error limits of the plate measurement to
coincide with the position of a faint object. Since in some
cases the optical and radio positions have not coincided exactly,
an area ten times the radio diameter was examined for other possible
objects. The probability of the identification was increased
when no other optical objects were found in the area.

Figures 3a and 3b are 5x enlargements of the area containing
the source on the red and blue survey plates respectively. In
red light, the image is extremely faint showing a slightly
irregular shape. In blue light, although still faint, the image
is very much brighter than the red, definitely showing a blue
color excess. The image appears to be nearly stellar when
compared with other images in the region. The exact nature

of the object is not clear from the limited optical evidence.
However, the object has several characteristics similar to a
quasi-stellar source; such as color excess, near stellar
appearance, and radio emission. Also, the angular diameter
is small, though it appears to be larger than the average quasi-
stellar source. More optical evidence will be needed to identify
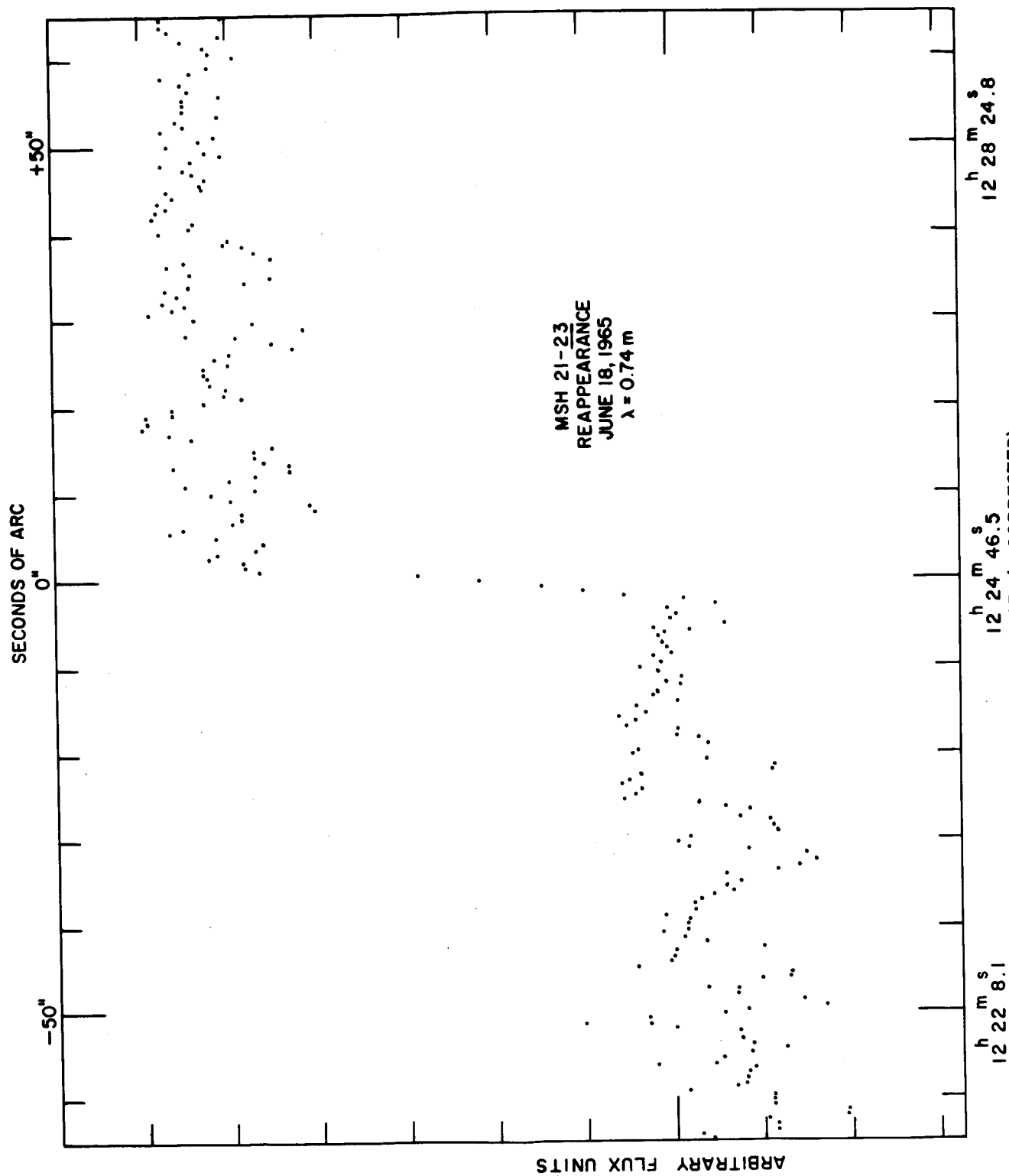this source.

REFERENCES

1. Brown, L. W., Nature, 210, 1102 (1966)

2. Howard, W. E., Astron. J., 66, 521 (1961).

3. Howard, W. E., and S. P. Maran, Ap. J. Supp., X, 173 (1965).

SECONDS OF ARC

MSH 21-23
DISAPPEARANCE
JUNE 18, 1965
λ = 0.74 m

−50"

0"

+50"

ARBITRARY FLUX UNITS

11^h 42^m 6.9^s

11^h 45^m 58.4^s

11^h 49^m 49.8^s

UNIVERSAL TIME (τ CORRECTED)
FIGURE 1a—DIGITIZED DATA-DISAPPEARANCE

SECONDS OF ARC

MSH 21-23
REAPPEARANCE
JUNE 18, 1965
λ = 0.74 m

+50"

0"

-50"

ARBITRARY FLUX UNITS

^{h} ^{m} ^{s}
12 28 24.8

^{h} ^{m} ^{s}
12 24 46.5

^{h} ^{m} ^{s}
12 22 8.1

UNIVERSAL TIME (τ CORRECTED)
FIGURE Ib−DIGITIZED DATA−REAPPEARANCE

MSH 21-23
DISAPPEARANCE
JUNE 18, 1965
RESTORING BEAMWIDTH = 3".7
$\lambda = 0.74$ m

ARBITRARY FLUX UNITS

SECONDS OF ARC

+50" 0" -50"
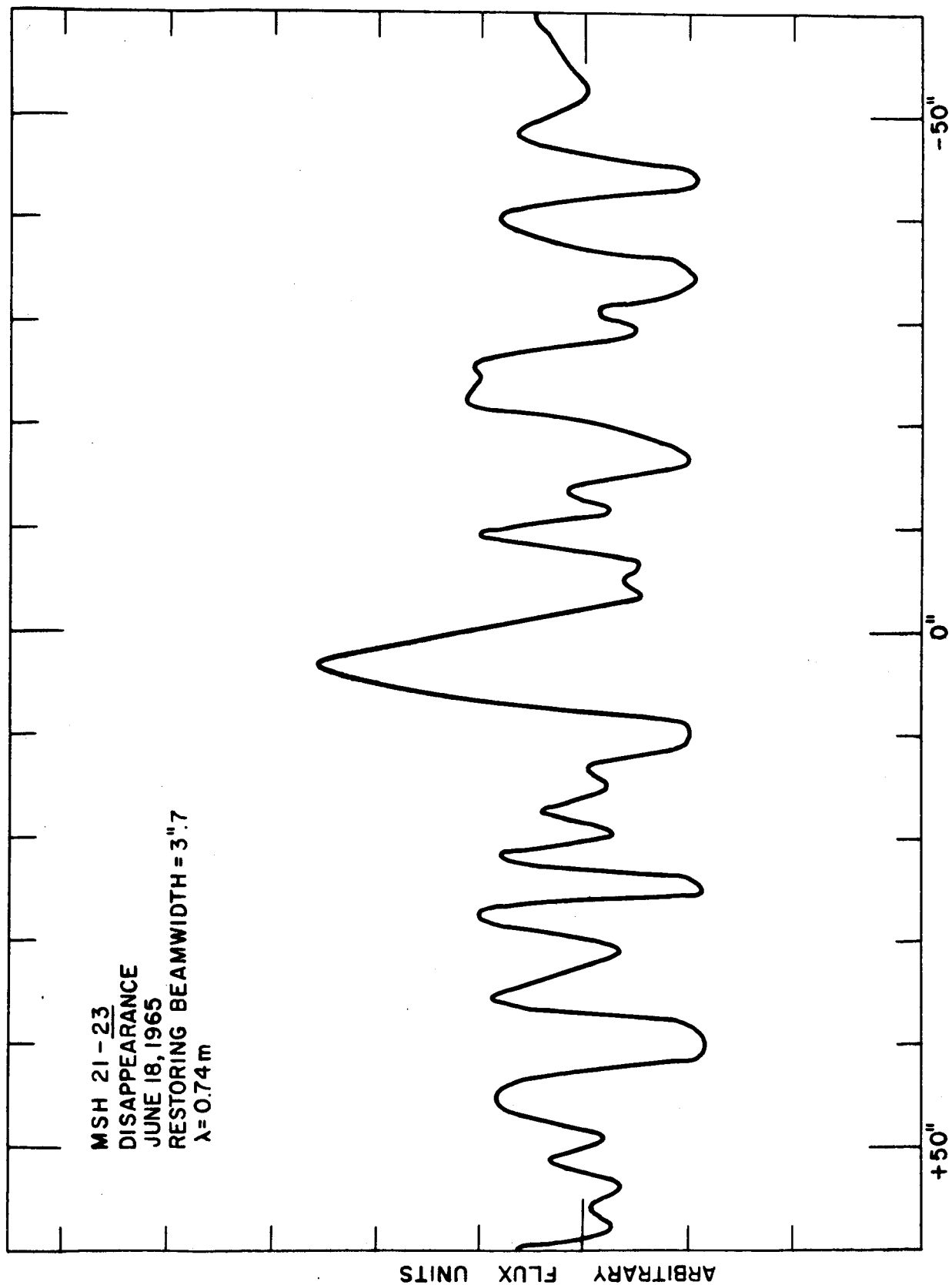
FIGURE 2a—RESTORED BRIGHTNESS DISTRIBUTION—DISAPPEARANCE

MSH 21-23
REAPPEARANCE
JUNE 18, 1965
RESTORING BEAMWIDTH =
  3".7; λ=0.74; SOLID
  3".8; λ= 2.2m; DASHED LINE

ARBITRARY FLUX UNITS

-50"

O"

+50"

SECONDS OF ARC
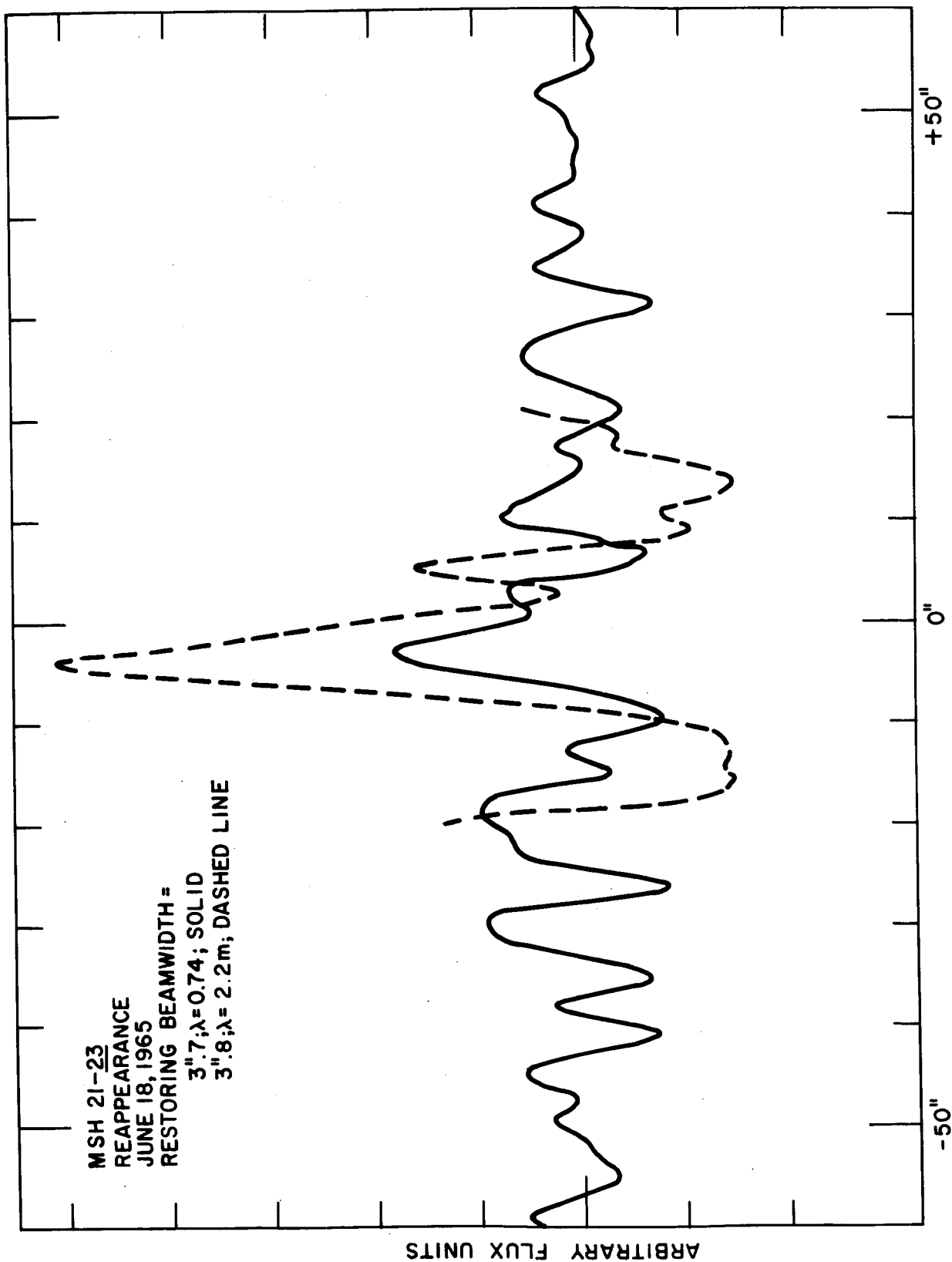
FIGURE 2b— RESTORED BRIGHTNESS DISTRIBUTION—REAPPEARANCE

DISAP

N

REAP

190208

190206
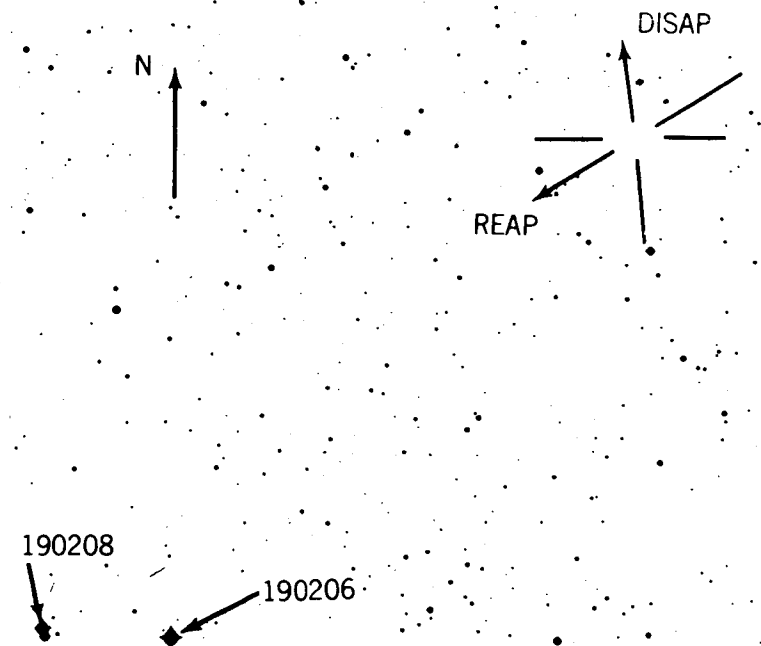
Figure 3a – 5X Enlargement of National Geographic
Palomar Survey: Red Plate
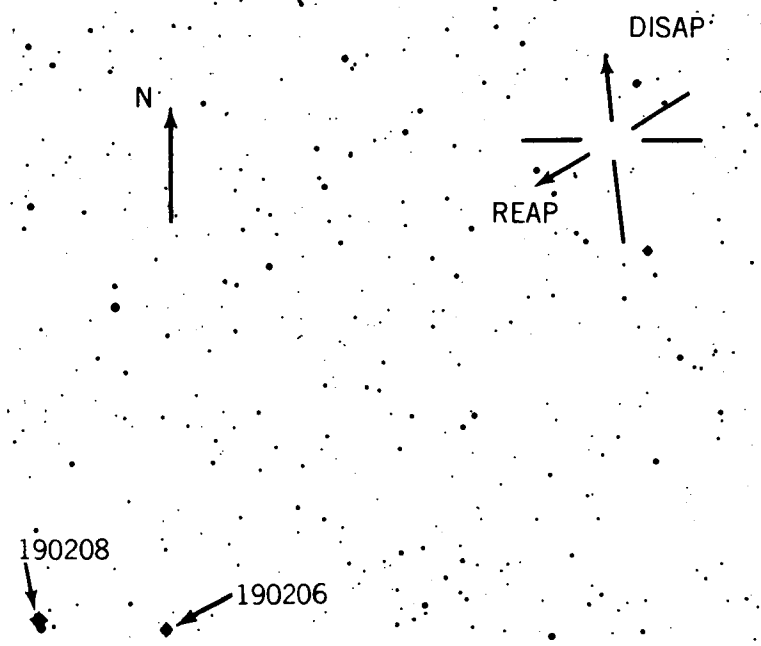
DISAP

N

REAP

190208

190206

Figure 3b – 5X Enlargement of National Geographic
Palomar Survey: Blue Plate