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M. J. Hagyard and N. P. Cumings

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16. ABSTRACT

An atlas of all magnetic field observations made during the Skylab missions with the Real Time Solar Magnetograph system located at the Marshall Space Flight Center is presented. Also included are a description of the system and its operation; an outline of the data reductions performed; and a discussion of probable errors, noise, magnetic sensitivity, and system reliability.

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REAL TIME SOLAR MAGNETOGRAPH SKYLAB MISSION ATLAS

I. INTRODUCTION

The Real Time Solar Magnetograph (RTSM) system which is located at the Marshall Space Flight Center (MSFC) is designed to provide information on the states of linear and circular polarization of a narrow wavelength interval of the 525.022 nm (5250.22 Å) solar absorption line over an extended field of view with a spatial resoltuion of 2.5 sec of arc or better and with a time resolution on the order of a few seconds. The RTSM is the result of a joint effort between the Naval Research Laboratory (NRL) and the Marshall Center; Dr. Guenther Brueckner of NRL was responsible for the concept and design of this vector magnetograph, and members of the Space Sciences Laboratory (SSL) at Marshall have been responsible for the integration, testing, and operation of the system. The RTSM became operational on May 30, 1973, with the production of the first Polaroid pictures of the longitudinal magnetic field of a solar active region. The first calibrated digital data in the longitudinal mode were obtained on September 19, 1973; transverse measurements were initiated on October 25, 1973, and both longitudinal and transverse measurements were obtained through December 21, 1973; subsequently, only longitudinal data were taken for the remainder of the Skylab mission. This report contains an atlas of all observations which were made during the Skylab mission as well as auxiliary information concerning the RTSM instrument. Section II of this report describes the RTSM system and its operation; Section III provides a description of the data output of the RTSM; in Section IV we outline the computer reductions performed on the raw data and their interpretations, as well as appropriate analyses of errors, noise, magnetic sensitivity and overall system reliability. Finally, Section V contains the atlas of our observations with an accompanying description of terms employed in the atlas.

II. THE RTSM SYSTEM

A. Description

1. Optics. The RTSM is situated at the top of a 12.8-m tower of heavy structural steel, as shown in Figure 1. The main telescope, a 30.48-cm (12-in.) Ealing-Competition Associates f/13 Cassegrainian telescope, is

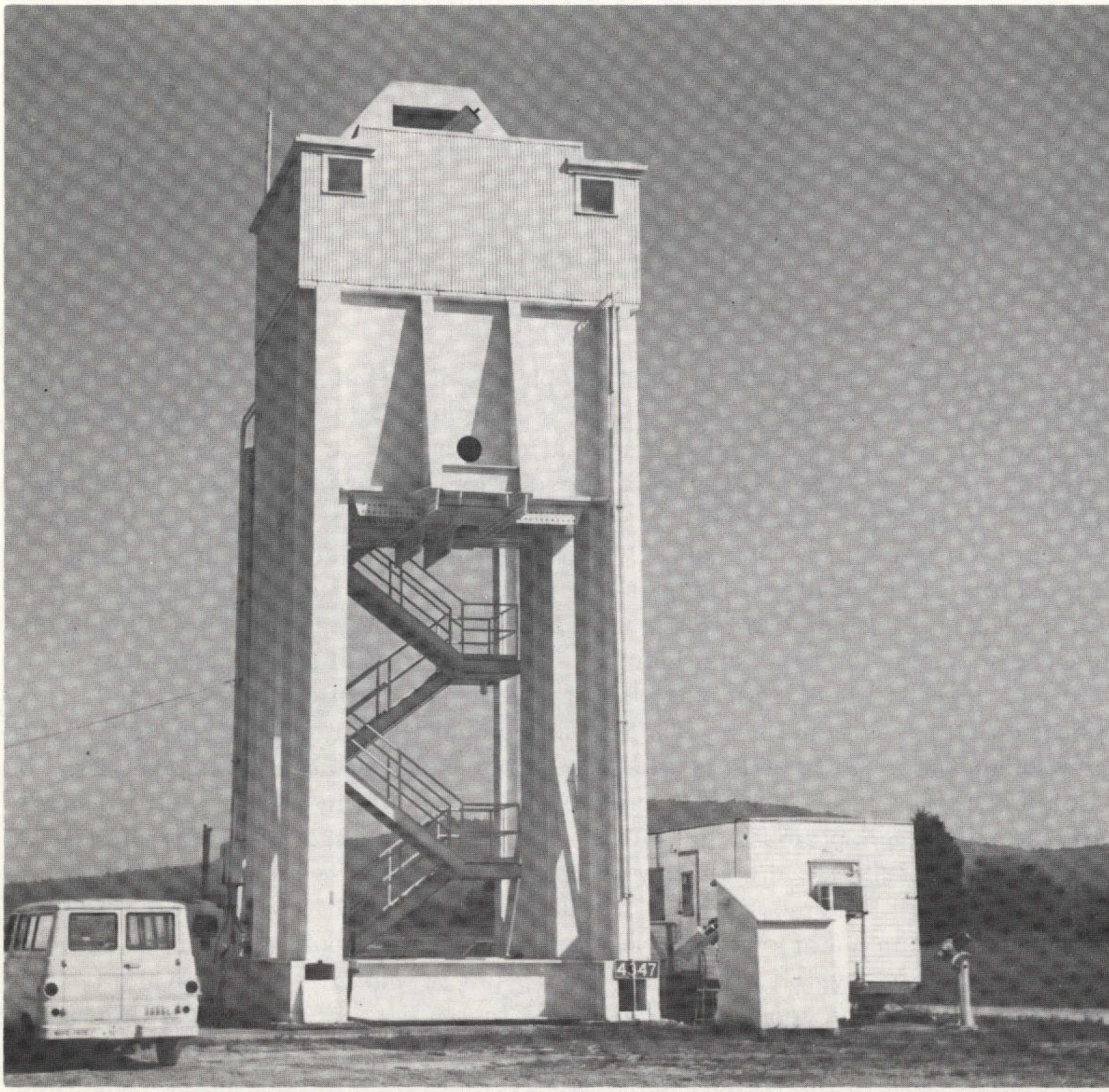

Figure 1. Real Time Solar Magnetograph.

mounted on a 1.5-m-high concrete pier on the southern portion of the platform. The telescope is driven at the solar rate using a variable-frequency drive setting on the telescope control console; this console is shown in Figure 2 together with the RTSM controls and display monitors. Attached to the front of the telescope is a full-aperture prefilter which has a half-width of 21 nm (210 Å) centered at 525 nm (5250 Å); approximately 10 percent of the incident solar energy is transmitted through this "heat rejection" filter.

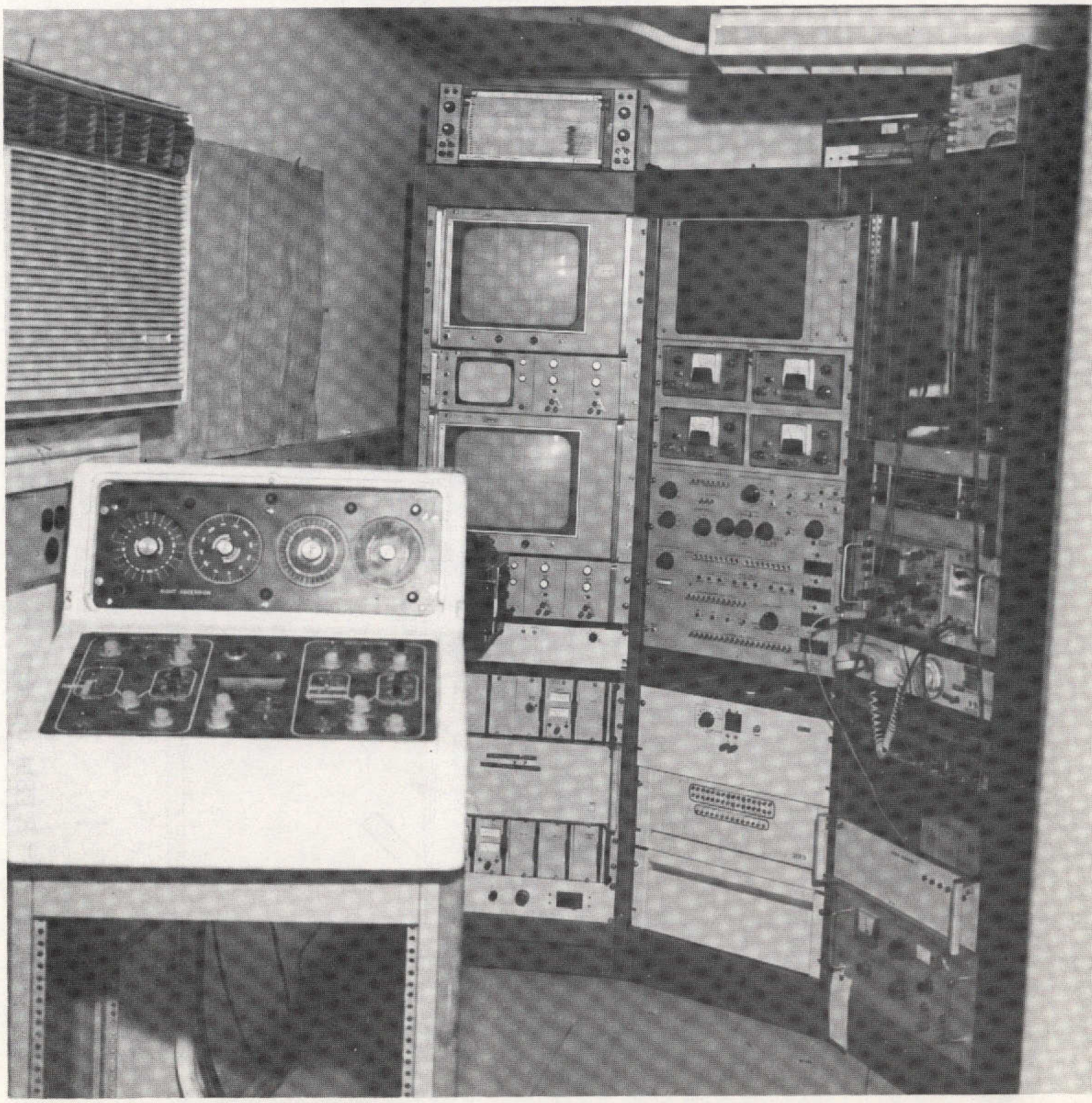

Figure 2. RTSM telescope console and display monitors.

The optical system, which is illustrated in Figure 3, is contained in a closed "optics box" which is bolted to the saddle of the Cassegrainian telescope; the design, construction, and alignment of this optical system were performed by NRL personnel. At the focal plane A of the telescope the 3.5-cm-diameter image of the sun is reduced to a maximum 5 × 5 arc min field of view by a square aperture stop; all light of the image around this aperture is reflected out through a port in the side of the optics box. The collimator lens B provides a collimated beam through the polarization optics (GH) and the

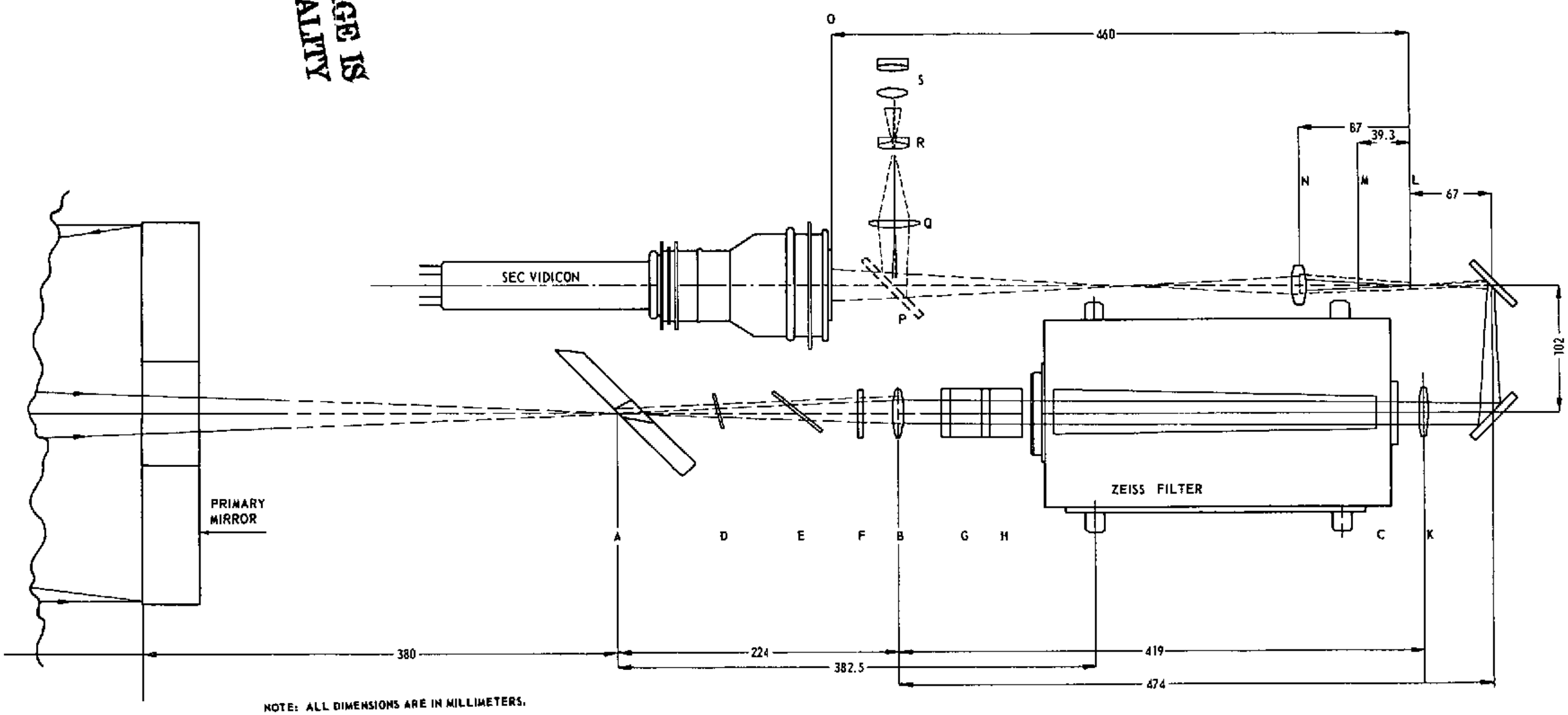

Figure 3. RTSM optical train.

Zeiss birefringent filter. The collimator K forms an image of A at L with a scale factor of unity. Two independent and interchangeable magnification lenses at M and N form an image of L at the fiber optics faceplate O of the Westinghouse SEC tube. The system N provides the full 5 × 5 arc min field of view to be imaged on the faceplate, whereas the system M produces a 2 × 2 arc min image at O. A removable mirror at P provides the operator the option of viewing the image through the eyepiece S.

A plane glass plate D, which is mounted so as to have two separate rotational axes, provides the capability of compensating for any instrumental polarization introduced by the telescope system. A removable tilting glass plate and quarter-wave plate, at E and F, respectively, are used to introduce artificial linear and circular polarization into the light beam for calibration purposes.

During the period May 30 to October 25, 1973, the polarization optics GH consisted of a single Lasermetrics KD*P light modulator which was switched between positive and negative quarter-wave retardance at λ 525 nm. From October 25 to December 21, 1973, this single KD*P modulator was replaced by a multicomponent polarization optics system designed by Isomet; Figure 4 is a schematic drawing of the components of this sealed package. Elements 1 and 3 are fixed quarter-wave retarders; element 2 is a KD*P light modulator which is regulated to a quarter-wave retardance (at λ 525 nm), and element 4 is another KD*P modulator which is regulated to provide positive and negative quarter-wave retardance and (positive) half-wave retardance.

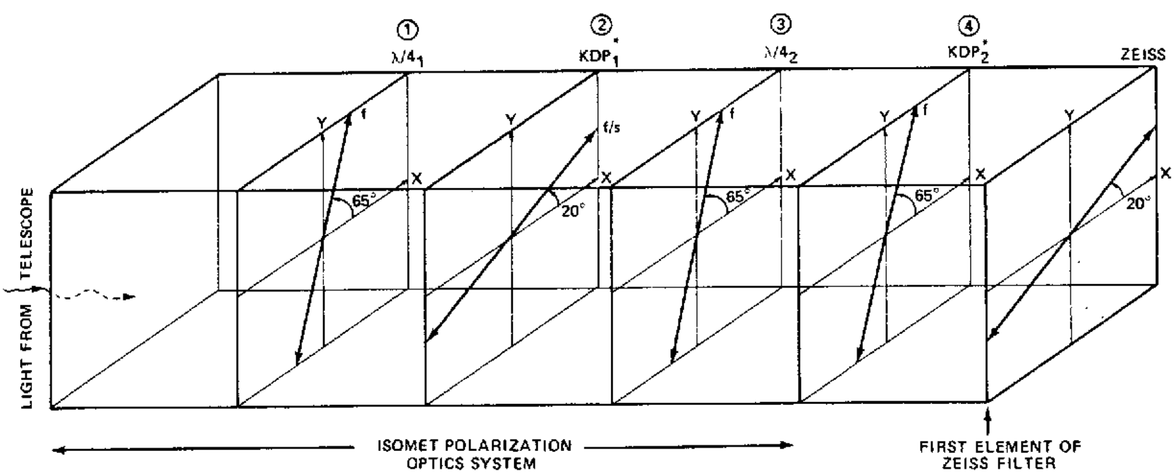

Figure 4. Schematic of Isomet polarization optics system.

In order to analyze the states of linear and circular polarization over a narrow wavelength interval of the 525.022 nm (5250.22 Å) solar absorption line, the RTSM system utilizes a specially built Zeiss birefringent filter designed to have a bandpass of 0.0125 nm (125 mÅ) at 525.022 nm. In December 1968, experimental verifications of the optical characteristics of the Zeiss filter were undertaken by members of SSL and Dr. William Livingston of the Kitt Peak National Observatory using the McMath solar telescope and spectrograph; the data obtained from these experiments were reduced and analyzed by members of SSL. Figure 5 indicates the results of a photoelectric scan of the filter transmission near the center of the Zeiss aperture; further results indicate that the transmission profile for the full aperture is quite similar to this and there are no appreciable changes in filter transmission characteristics as the filter is tuned over its entire range of 525.022 nm ± 0.80 nm. The theoretical transmission of a birefringent filter composed of N elements is given by

$$T = T_0 \prod_{k=0}^{N} \left[\cos\left(\frac{\pi \Delta\lambda}{2^k d} \right) \right]^2 ,$$

where T_0 is the transmission at the center wavelength (λ_0) of the bandpass, T is the transmission at a wavelength λ, $\Delta\lambda = \lambda - \lambda_0$, and d is a constant. If the final polarizing element of the filter is rotated through an angle δ, the transmission characteristics are then determined by the equation

$$T = T_0 \left[\cos\left(\frac{\pi \Delta\lambda}{d} + \delta \right) \right]^2 \cdot \prod_{k=0}^{N} \left[\cos\left(\frac{\pi \Delta\lambda}{2^k d} \right) \right]^2 .$$

By choosing $\delta = 0.85\pi$, a good fit to the experimental transmission profile is obtained, as is indicated in Figure 6. This analytical representation for the Zeiss filter has thus been adopted for use in computer programs for the reduction and interpretation of the RTSM data.

2. Electronics. The basic electronic system of the RTSM consists of the image tube, video preamplifier and amplifier, digitizing system, core memory, and automatic control and sequencing logic. The image tube is a standard 40-mm SEC vidicon with a fiber optics faceplate; its sensitivity and exposure time are controlled by the level and duration of the applied photocathode voltage. The vidicon target area is scanned in a 128 by 128 raster so that the optical image which is focused on the fiber optics faceplate at O is divided into 16 384 separate spatial elements. With the system N in the optical train, a spatial resolution of 2.34 sec of arc is obtained over the 5 × 5 arc min field of view, whereas the optical component M produces a resolution of 0.94 arc sec over a 2 × 2 arc min field.

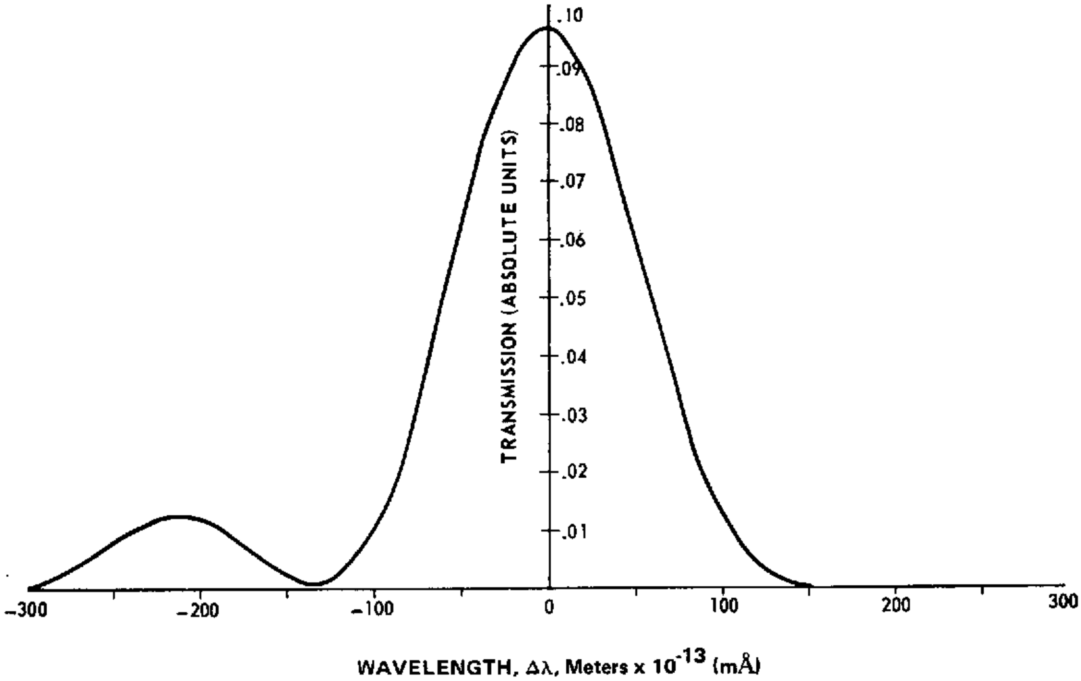

Figure 5. Transmission of center of aperture based on photoelectric data.

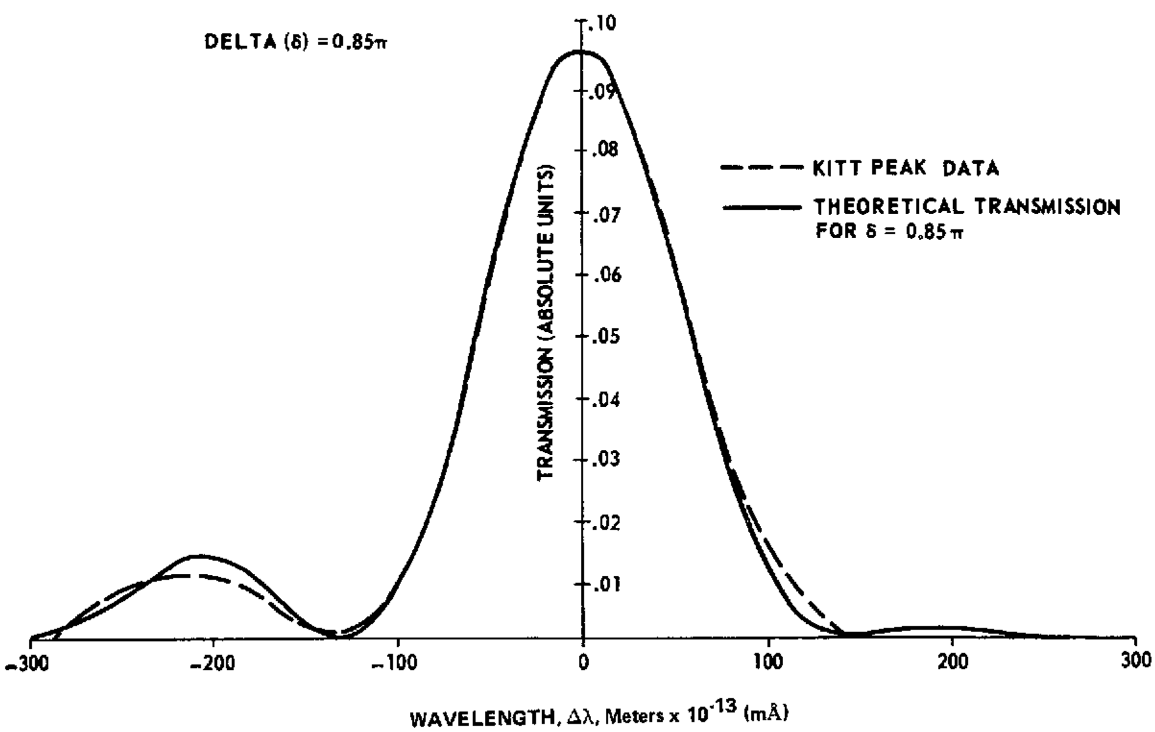

Figure 6. Comparison of experimental and theoretical transmission data.

In the digitizing system, the variable-gain video amplifier optimizes the signal voltage level from the vidicon in order to utilize the full 8-bit resolution of the analog-to-digital (a/d) converter. The magnetic core memory of the system is capable of storing two complete 128 × 128 digital images scanned from the vidicon. An adder associated with this memory allows additional data frames to be added to the two original frames up to a maximum of 255 frames; this "enhancement" process provides improved signal-to-noise capabilities for the system. As an example, in the "longitudinal" mode of operation where the light intensity over the field of view is analyzed for circular polarization, the two stored images in the core memory are the digitized intensities of right and left circular polarization, called the 1A and 1B frames, respectively. In the "enhanced" mode, several exposures of right and left circular polarization are digitized and added into the 1A and 1B images in the memory. The enhanced 1A or 1B image can then be displayed on an X-Y display monitor, or the subtracted image (1A-1B) can be selected for display; this subtracted picture provides a "quick-look" capability for observing the line-of-sight magnetic field patterns over the field of view. When the enhancement sequence is completed, the data frames 1A and 1B in the core memory are subsequently transmitted to a buffer storage unit located in the MSFC Computation Laboratory where the data are processed on the Univac 1108 computer and the reduced data are stored on magnetic tape.

B. Operation

The RTSM system was designed to incorporate a wide range of operational modes; an understanding of this flexibility in the operation of the system is thus fundamental to the interpretation and use of the data in this atlas. To initiate operation, the optimum settings of the RTSM electronics must be determined. The photocathode voltage can be varied to change the gain of the SEC vidicon tube; the gain itself must be set so that the tube operates close to its peak efficiency. The video preamplifier is designed to saturate before the combined incident light intensity and applied photocathode voltage can damage the vidicon. For optimum performance, the photocathode voltage is set just below the saturation level of the video preamp by increasing the photocathode high voltage until saturation is observed on an auxiliary oscilloscope and then by decreasing the high voltage slightly below this saturation level. It has been determined through experience and experimentation that the variable gain amplifier located on the control console clips the optimized signal at a setting of 3 of the step attenuator. The standard procedure which has thus evolved under conditions of normal solar intensity is to set the attenuator at step 3 and adjust the photocathode voltage until the video amplifier is operating just below the clipping level. Under conditions of low light intensity, the maximum high voltage setting of 7 kV is used and the attenuator setting is increased so that the amplifier is operating close to the optimum signal level.

Since the SEC vidicon target continues to integrate the incident light signal throughout the time interval that the photocathode voltage is applied, additional signal output can be obtained by increasing the time interval of the photocathode exposure. Under very low light level conditions the exposure time can be increased from the minimum value of 1/60 sec; automatic selection can be made for exposure times of 1/30, 1/15, 1/7.5, 1/3.75 and 1/1.875 sec.

To ensure that the a/d converter is converting only the video signal and not any dc offset from some other source into digital information, a ±dc voltage is used and is set at a given level with an a/d "bias" potentiometer (pot). This pot is adjusted so that, with the SEC tube voltage off, the lowest order bit of the a/d converter is converting the low level analog noise into a digital value. Since the noise level should be relatively constant, any increase in signal level at this bias setting can be interpreted as originating from the active vidicon tube and thus treated as real information.

Before initiating operation of the RTSM system, three other variable control settings must be determined: magnification, number of enhancements and number of "polarizations." The magnification setting provides the option, as previously mentioned, of viewing either the 5 × 5 arc min field ("low" magnification) or the 2 × 2 arc min field ("high" magnification). The selection is made by manually interchanging the two lens systems M and N using a switch on the outside of the optics box. Generally, the "low" magnification has been used in order to obtain data over a complete solar active region.

The number of exposures in each frame which provides the "enhancement" capability can be set at any value from 0 to 255. Experience has shown that enhancing in the range from 8 to 32 normally produces the best quality photographic magnetograms; the digital display of the 1A-1B picture also aids the operator in determining the optimum number of enhancements.

The SEC vidicon target retains approximately 15 percent of its original charge after it has been scanned by the electron gun beam. This residual charge can be reduced by rescanning the target before the next exposure, a process which is called "polarizing" the target. By setting a switch on the control console, the operator can select the number of times (up to 7) that the target is polarized.

III. RTSM DATA OUTPUT

A. Operational Modes

1. Normal Mode. In the normal operation of the RTSM system, three different data modes can be selected: longitudinal, transverse, or vector. When data acquisition is initiated, the system automatically sequences the voltage levels on the KD*P crystals, exposes the vidicon tube, and stores and transmits the data to the Univac 1108 computer interface. In the longitudinal mode, the polarization electro-optics are sequenced so that only right and left circularly polarized light intensities are alternately transmitted to the vidicon target and scanned; the data outputs are two 128 × 128 matrices, designated the 1A matrix (right circularly polarized intensity signals) and the 1B matrix (left circularly polarized intensity signals). In the transverse mode two separate operations take place: The KD*P voltages are first sequenced so that only light intensities with linear polarization states perpendicular and parallel to the first polarizing element of the Zeiss filter (which acts as a linear analyzer) are transmitted. The resulting data matrices are called the 2A and 2B intensity signals, respectively. In this transverse mode the KD*P crystals are next sequenced so that only light intensities with linear polarization states at 45 deg and 135 deg to the linear analyzer are transmitted, and these intensity signals are termed the 3A and 3B matrices. In the vector mode of operation, all six (1A, 1B, 2A, 2B, 3A, 3B) data matrices are acquired and transmitted to the MSFC computer facility.

2. Calibration Modes. In addition to the normal mode of operation of the magnetograph, various calibration modes have been incorporated into the control logic which provide auxiliary data necessary for the operation of the system and for the reduction and interpretation of the polarization data obtained in the normal mode.

a. Center Filter Mode. It has been determined theoretically that, with the Zeiss filter, optimum signals for linearly and circularly polarized intensities for the Fe 525 nm (5250 Å) line are obtained with the filter centered at line center and at 65×10^{-4} nm (65 mÅ) in the blue wing of the line, respectively. As a result, the filter's wavelength position must be changed between the longitudinal and transverse modes of operation. The Zeiss filter is tuned in wavelength by a stepping motor which is controlled by a selection of switches on the console from 1 to 1414, where each step interval corresponds to a wavelength change of 11.3×10^{-4} nm (11.3 mÅ). Before the filter can be tuned to the appropriate wavelength in the 525 nm (5250 Å) line, the switch setting for line center (525.022 nm) must be determined, and this is done in the "center filter" mode. In this mode, a quiet region of the sun (near sun-center) is selected and "longitudinal" data (matrices 1A and 1B) are obtained at consecutive switch settings and transmitted to the computer. At each filter switch setting, the average intensity over the field of view is calculated [the intensity of each matrix element ij is given by $(1A)_{ij} + (1B)_{ij}$] and a plot of intensity versus filter setting is generated and transmitted back to the magnetograph tower for display on a TV monitor. The setting for minimum intensity which is read from this plot thus provides the switch position for line center. A computer printout of the calculated average intensities and filter setting is also generated.

b. Instrumental Polarization Mode. This operational sequence was included in the RTSM system logic in order to measure and correct for any spurious polarization signals that might be introduced into the optical train by the telescope. In this mode, a nonmagnetic region of the sun is chosen and the "vector" mode is run, providing the six matrices of data which are transmitted to the Univac computer. The three quantities

$$(PO)_{ij} = \frac{(1A)_{ij} - (1B)_{ij}}{(1A)_{ij} + (1B)_{ij}} \quad ,$$

$$(UO)_{ij} = \frac{(2A)_{ij} - (2B)_{ij}}{(2A)_{ij} + (2B)_{ij}} \quad ,$$

$$(RO)_{ij} = \frac{(3A)_{ij} - (3B)_{ij}}{(3A)_{ij} + (3B)_{ij}} \quad ,$$

are calculated and averaged over all matrix points. The resulting average values $\overline{PO}$, $\overline{VO}$, and $\overline{RO}$ are then used in the data reduction of the normal mode data as outlined below.

c. Polarization Calibration Mode. In the normal mode of operation, linearly and circularly polarized light intensities are transformed by the a/d converter and memory adder into integer numbers having values in the range from 2^0 to 2^{15}; in order to interpret these numbers in terms of polarized intensities, the polarization calibration mode is implemented. In this mode, linearly and circularly polarized light beams are introduced into the optical path of the optics system by inserting a tilted glass plate and a tilted glass plate and quarter-wave plate, respectively. With the glass plate tilted at an angle of 40 deg, incident unpolarized light becomes partially linearly polarized, the degree of polarization being about 6 percent. With the quarter-wave plate inserted with its fast axis at 45 deg to the plane of polarization of the linearly polarized light, the light becomes partially (6 percent) circularly polarized. As shown in Section IV, the degree of circular polarization P_V of the incident light beam is proportional to the quantity S_V:

$$P_V = K_1 S_V$$

where

$$S_V = \frac{1A - 1B}{1A + 1B} \quad \text{(subscripts ij have been omitted)} \quad .$$

The calibration constant K_1 can thus be determined by operating the system in the longitudinal mode with the tilted plate and $\lambda/4$ plate inserted in the beam .

Similarly, the degree of linear polarization is proportioned to the quantity S_Q : $P_Q = K_2 S_Q$, where

$$S_Q = \sqrt{\left(\frac{2A - 2B}{2A + 2B}\right)^2 + \left(\frac{3A - 3B}{3A + 3B}\right)^2} \quad .$$

The calibration constant K_2 is determined by operating in the transverse mode with only the tilted plate in the beam. In the actual computer reductions, the values S_V and S_Q are averaged over the entire matrix.

B. Data Formats

1. Digital Data. The digitized data obtained in the normal mode undergo some computer reductions before being written on magnetic tape. In the longitudinal mode, the matrix $(P_V)_{ij}$ $(i, j = 1, 128)$ is recorded where

$$(P_V)_{ij} = K_1 \left[\frac{(1A)_{ij} - (1B)_{ij}}{(1A)_{ij} + (1B)_{ij}} - \overline{PO} \right] \quad .$$

In the transverse mode, the two matrices U_{ij} and R_{ij} are recorded where

$$U_{ij} = \frac{(2A)_{ij} - (2B)_{ij}}{(2A)_{ij} + (2B)_{ij}} - \overline{UO}$$

and

$$R_{ij} = \frac{(3A)_{ij} - (3B)_{ij}}{(3A)_{ij} + (3B)_{ij}} - \overline{RO} \quad .$$

In the vector mode, the three matrices $(P_V)_{ij}$, U_{ij} and R_{ij} are recorded on tape.

During the early part of the Skylab IV mission, it was determined that the matrix $(I)_{ij}$ should also be recorded in the longitudinal and vector modes, where

$$(I)_{ij} = \frac{1}{2} [(1A)_{ij} + (1B)_{ij}] \quad ;$$

consequently, approximately one-half of the magnetic tapes also include this matrix.

2. Photographic Data. In addition to the digital data, Polaroid pictures of the X-Y display monitor were obtained which depict the enhanced 1A, 1B or 1A-1B images. The 1A (or 1B) photographs show the intensity distribution over the field of view and thus indicate the locations of sunspots in the active regions. The 1A-1B photographs provide an indication of the longitudinal magnetic field distribution over the field of view and are useful for determining the general morphology of the line-of-sight magnetic field.

IV. DATA REDUCTION AND ANALYSIS

A. Data Reduction

The interpretation of the data output of the RTSM system is based on an analysis of the effects of the polarizing optics on the incident light beam for the different automatic sequences of exposures obtained in the longitudinal and transverse modes of operation. In the first part of this section, we outline this analysis for the two separate polarization optics: the single Lasermetric KD*P light modulator and the multicomponent Isomet electro-optical system.

1. Single KD*P Modulator. In Figure 7, the relative orientation of the KD*P crystal's fast axis and the linear analyzer's transmission axis is depicted (the linear analyzer is the first polarizing element of the Zeiss birefringent filter). The y-axis is in the vertically upward direction with respect to the bottom of the optics box, and the x-axis is parallel to the bottom of the optics box in such a direction that the z-axis lies in the direction of the propagation of the light beam through the optical system. The effect of alternating the voltage on the KD*P crystal to produce plus and minus $\lambda/4$ retardation on a beam of partially polarized light can be described in terms of the Stokes parameters and Mueller matrices. The Stokes parameters used in this discussion are defined in the coordinate system introduced by Unno [1]; this system is shown in Figure 8. In this system the Z_0-axis is parallel to the direction of propagation of light, and the magnetic field vector $\vec{B}$ at point Q lies in the X_0, Z_0 plane at an angle ψ to the Z_0 axis. The angles ϕ and ρ denote, respectively, the orientation of the linear analyzer transmission axis and fast axis of the KD*P $\lambda/4$ retarder with respect to the X_0-axis. The Mueller matrix for a linear analyzer with azimuth ϕ is given by [2]

$$M_a = \frac{1}{2} \begin{pmatrix} 1 & \cos 2\phi & \sin 2\phi & 0 \\ \cos 2\phi & \cos^2 2\phi & \cos 2\phi \sin 2\phi & 0 \\ \sin 2\phi & \cos 2\phi \sin 2\phi & \sin^2 2\phi & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} ;$$

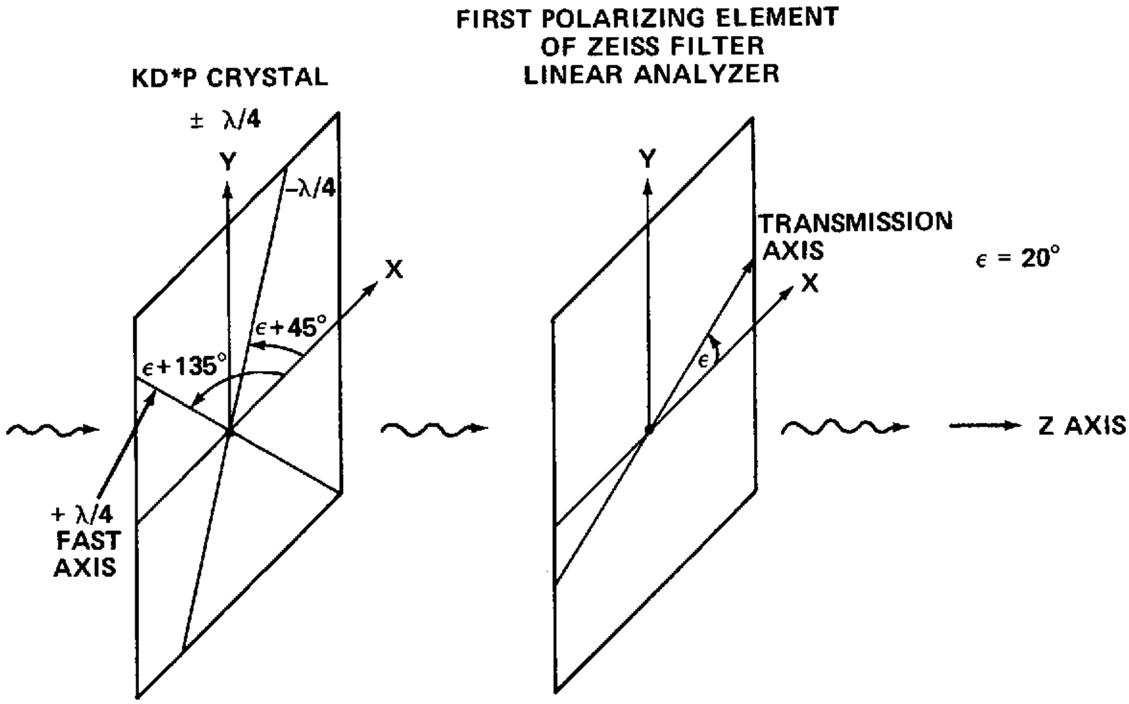

Figure 7. Optical orientation for single KD*P crystal.

similarly, for an ideal $\lambda/4$ retarder with azimuth ρ, the Mueller matrix is

$$M_{\lambda/4} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos^2 2\rho & \cos 2\rho \sin 2\rho & -\sin 2\rho \\ 0 & \cos 2\rho \sin 2\rho & \sin^2 2\rho & \cos 2\rho \\ 0 & \sin 2\rho & -\cos 2\rho & 0 \end{pmatrix} .$$

The effect of the KD*P $\lambda/4$ retardance and linear analyzer on a beam of light can be represented by a single matrix M given by

$$M = M_a \otimes M_{\lambda/4} .$$

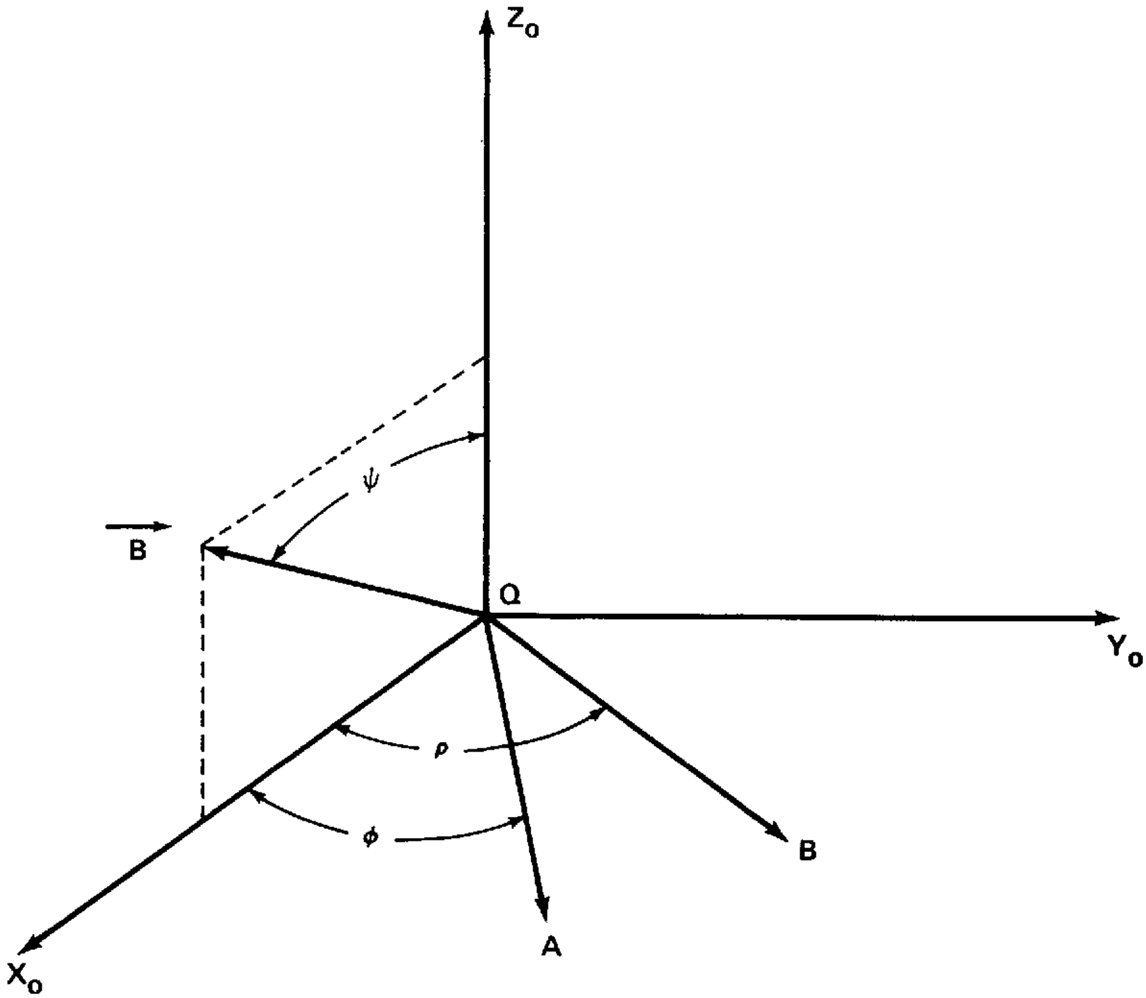

Figure 8. The coordinate system in which the Stokes vector is defined.

Since the angles ρ and ϕ are related via the equations

$$\rho - \phi = 135 \text{ deg}$$

and

$$\rho - \phi = 45 \text{ deg}$$

for the KD*P crystal voltage regulated for $+\lambda/4$ and $-\lambda/4$ retardance, respectively, the matrix M is given by

$$M = \frac{1}{2}\begin{pmatrix} 1 & 0 & 0 & \pm 1 \\ \cos 2\phi & 0 & 0 & \pm\cos 2\phi \\ \sin 2\phi & 0 & 0 & \pm\sin 2\phi \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

where the + sign is for the case of $+\lambda/4$ retardance. The emergent intensities of the Stokes parameters, I', Q', U', V', expressed as the column vector

$$\begin{pmatrix} I' \\ Q' \\ U' \\ V' \end{pmatrix} ,$$

can be calculated from the Stokes parameters I, Q, U, V, representing the state of partial polarization of the incident light intensity, using the relation

$$\begin{pmatrix} I' \\ Q' \\ U' \\ V' \end{pmatrix} = M \otimes \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} .$$

The resulting transmitted intensity I' is thus given by

$$I_{\pm}' = \frac{1}{2}(I \pm V) .$$

After the transmission of the intensities $I_{\pm}'$ through the Zeiss filter, the intensities incident on the SEC vidicon tube can be represented by

$$I_{1,2}(\Delta\lambda_i) = \int_{\Delta\lambda_i - \Delta}^{\Delta\lambda_i + \Delta} (I_{\pm}') \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda) \quad ,$$

where $\Delta\lambda = \lambda - \lambda_0$ (λ_0 representing the center of the Fe 525.022 absorption line), $\Delta\lambda_i = \lambda_i - \lambda_0$ (λ_i representing the wavelength at which the Zeiss filter is centered), $T(\Delta\lambda, \Delta\lambda_i)$ is the transmission profile of the Zeiss filter, and 2Δ represents the wavelength interval over which the filter transmission is nonzero; Figure 9 is a schematic representation of these terms. The digitized output signals 1A and 1B of the magnetograph system are thus proportional to the intensities I_1 and I_2, respectively.

In the computer reductions performed on the data $(1A)_{ij}$ and $(1B)_{ij}$, the resultant matrix $(P_V)_{ij}$ written on magnetic tape is thus proportional to (after the correction is made for the instrumental circular polarization $\overline{PO}$)

$$\frac{I_1 - I_2}{I_1 + I_2} = \frac{\int_{\delta_1}^{\delta_2} V(\Delta\lambda, \Delta\lambda_i) \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda)}{\int_{\delta_1}^{\delta_2} I(\Delta\lambda, \Delta\lambda_i) \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda)} \equiv \bar{P}_V(\Delta\lambda_i)$$

where $\bar{P}_V(\Delta\lambda_i)$ is the measured degree of circular polarization of the incident light averaged over the filter bandpass (subscripts i, j have been omitted), and $\delta_{1,2} = \Delta\lambda_i \mp \Delta$. The factor of proportionality K_1 is determined independently in the polarization calibration mode by introducing a known amount of circularly polarized light. Thus, for the periods of observations, September 19, 1973, to October 25, 1973, and December 21, 1973, to the

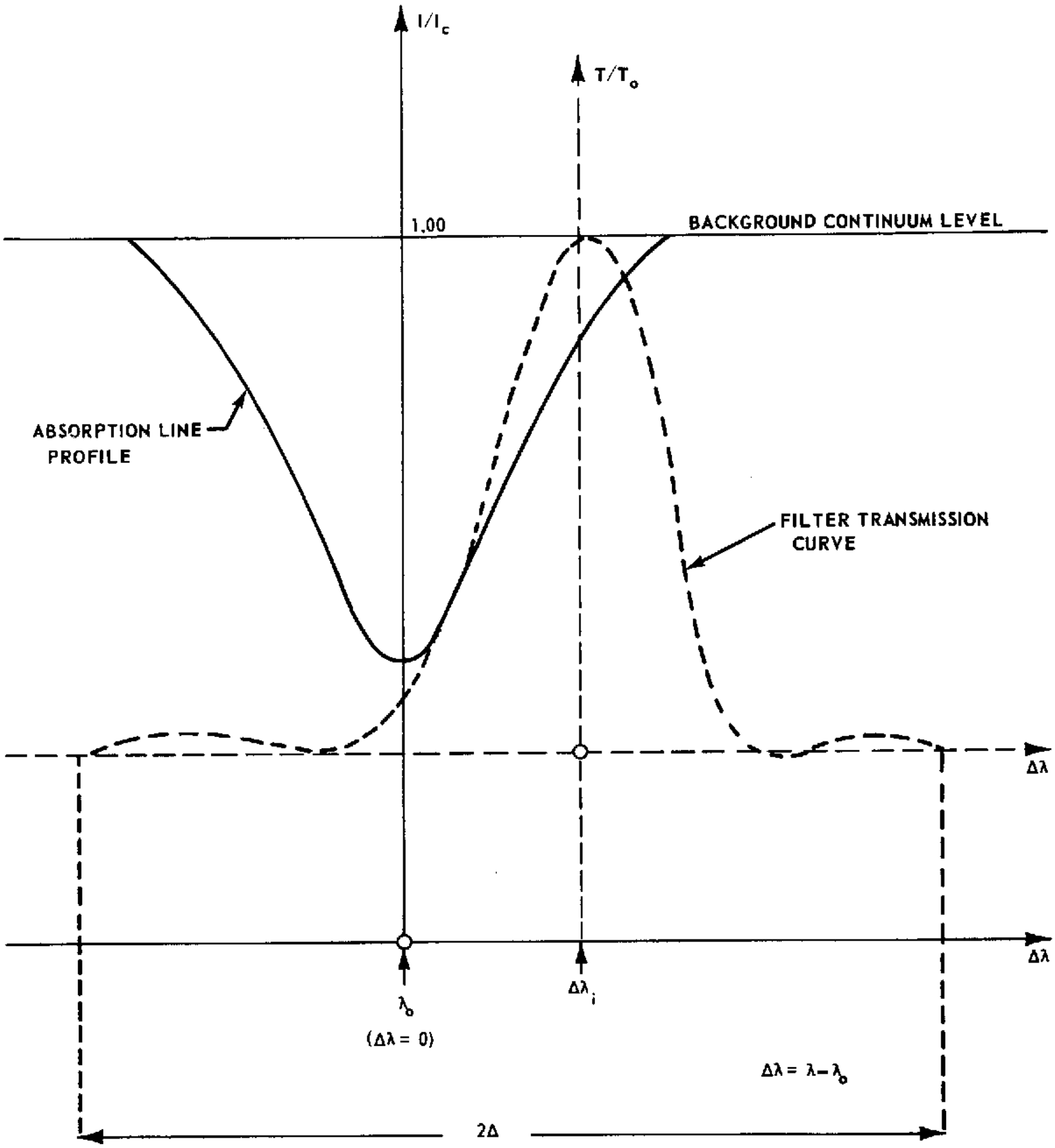

Figure 9. Schematic representation of filter "tuned" to a portion of an absorption line.

present date, the digital data recorded on tape are the averaged degrees of circularly polarized light $(\bar{P}_V)_{ij}$ which can be related to the line-of-sight magnetic field of the sun as outlined in part B of this section. For portions of these periods of observation, the taped records also include the matrix $1/2[(1A)_{ij} + (1B)_{ij}]$ which is proportional to

$$\bar{I}(\Delta\lambda_i) \equiv \int_{\delta_1}^{\delta_2} I(\Delta\lambda, \Delta\lambda_i) \cdot T(\Delta\lambda, \Delta\lambda_i)\, d(\Delta\lambda) \quad .$$

2. Multicomponent Electro-Optical System. The four elements of this polarizing optics package are depicted schematically in Figure 4. The two KD*P crystals are sequenced in the following manner:

	Sequence Number N	KD^*P_1	KD^*P_2
Longitudinal Mode	1	Off	$+\lambda/4$
	2	Off	$-\lambda/4$
Transverse Mode	3	Off	Off
	4	Off	$+\lambda/2$
	5	$+\lambda/4$	Off
	6	$+\lambda/4$	$+\lambda/2$

Again, the Mueller matrices and Stokes parameters are used to describe the effects of the six sequences of operation of the polarizing optics. Besides the matrices for the linear analyzer M_a and $\lambda/4$ retarder $M_{\lambda/4}$ given above, the matrix for a $\lambda/2$ retarder with azimuth ρ relative to the x_0, y_0, z_0 coordinate system is given by

$$M_{\lambda/2} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos 4\rho & \sin 4\rho & 0 \\ 0 & \sin 4\rho & -\cos 4\rho & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix} \quad .$$

The Stokes parameters of the light emerging from the multicomponent electro-optical package and linear analyzer are again related to the incident Stokes vector by

$$\begin{pmatrix} I_n' \\ Q_n' \\ U_n' \\ V_n' \end{pmatrix} = M_n \otimes \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} \quad n = 1, 2, \ldots, 6 \quad .$$

The six matrices M_n representing the six sequences of operation are given by:

$$M_n = M_a \otimes M_{KD^*P_2} \otimes (M_{\lambda/4})_2 \otimes M_{KD^*P_2} \otimes (M_{\lambda/4})_1 \quad .$$

Assuming that when a KD*P crystal is "off" it has no effect on the light, the six matrices are found to be given by:

$$M_{1,2} = \frac{1}{2}\begin{pmatrix} 1 & 0 & 0 & \pm 1 \\ \cos 2\phi & 0 & 0 & \pm\cos 2\phi \\ \sin 2\phi & 0 & 0 & \pm\sin 2\phi \\ 0 & 0 & 0 & 0 \end{pmatrix} ,$$

$$M_{3,4} = \frac{1}{2}\begin{pmatrix} 1 & \mp\cos 2\phi & \mp\sin 2\phi & 0 \\ \cos 2\phi & \mp\cos^2 2\phi & \mp\sin 2\phi \ \cos 2\phi & 0 \\ \sin 2\phi & \mp\sin 2\phi \ \cos 2\phi & \mp\sin^2 2\phi & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} ,$$

$$M_{5,6} = \frac{1}{2}\begin{pmatrix} 1 & \mp\sin 2\phi & \pm\cos 2\phi & 0 \\ \cos 2\phi & \mp\sin 2\phi \ \cos 2\phi & \pm\cos^2 2\phi & 0 \\ \sin 2\phi & \mp\sin^2 2\phi & \pm\sin 2\phi \cos 2\phi & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} ,$$

where use has been made of the relationships among the azimuth angles of the retarders and the linear analyzer. Thus, for the six separate sequences, the transmitted intensities are found to be:

$$(I')_{1,2} = \frac{1}{2}(I \pm V) \quad ,$$

$$(I')_{3,4} = \frac{1}{2}(I \mp Q \cos 2\phi \mp U \sin 2\phi) \quad ,$$

$$(I')_{5,6} = \frac{1}{2}(I \mp Q \sin 2\phi \pm U \cos 2\phi) \quad .$$

After transmission through the Zeiss filter, the intensities focused on the SEC vidicon are given by:

$$I_{1,2}(\Delta\lambda_i) = \int_{\delta_1}^{\delta_2} (I')_{1,2} \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda) \sim 1A, 1B \quad ,$$

$$I_{3,4}(\Delta\lambda_i) = \int_{\delta_1}^{\delta_2} (I')_{3,4} \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda) \sim 2A, 2B \quad ,$$

and

$$I_{5,6}(\Delta\lambda_i) = \int_{\delta_1}^{\delta_2} (I')_{5,6} \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda) \sim 3A, 3B \quad .$$

Thus, in the time period of October 25, 1973, to December 21, 1973, the actual data which should be recorded on tape are given by (omitting subscripts ij):

$$K_1 \left[\frac{1A - 1B}{1A + 1B} - \bar{P}O \right] = \frac{\int_{\delta_1}^{\delta_2} V(\Delta\lambda, \Delta\lambda_i) \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda)}{\bar{I}} \equiv \bar{P}_V(\Delta\lambda_i)$$

$$\left[\frac{2A - 2B}{2A + 2B} - \bar{U}O \right] = \frac{\frac{1}{K_2} \int_{\delta_1}^{\delta_2} - [Q \cos 2\phi + U \sin 2\phi] \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda)}{\bar{I}}$$

$$\equiv U(\Delta\lambda_i)$$

$$\left[\frac{3A - 3B}{3A + 3B} - \bar{R}O \right] = \frac{\frac{1}{K_2} \int_{\delta_1}^{\delta_2} [-Q \sin 2\phi + U \cos 2\phi] \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda)}{\bar{I}}$$

$$\equiv R(\Delta\lambda_i)$$

where

$$\bar{I}(\Delta\lambda_i) \equiv \int_{\delta_1}^{\delta_2} I(\Delta\lambda, \Delta\lambda_i) \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda) \quad .$$

Again, for this period of observation, some of the recorded data also include the matrix $1/2\ [(1A)_{ij} + (1B)_{ij}]$ which is proportional to $\bar{I}$. The degree of linear polarization averaged over the wavelength interval of the filter bandpass, $\bar{P}_Q(\Delta\lambda_i)$, can be obtained from the relation

$$\bar{P}_Q(\Delta\lambda_i) = K_2 \sqrt{U^2 + R^2} \quad .$$

Again, the factor of proportionality, K_2, is determined in the polarization calibration mode by introducing a known amount of linearly polarized light.

B. Data Analysis

The average degress of circular and linear polarizations, $\bar{P}_V(\Delta\lambda_i)$ and $\bar{P}_Q(\Delta\lambda_i)$, respectively, which are obtained for each of the 128 × 128 elements scanned over the field of view, can be related to the magnitude and orientation of the sun's magnetic field at each point, although such an interpretation is not without some ambiguities and is, moreover, dependent on the various assumptions which are made concerning the formation and transfer of the polarized radiation in the solar atmosphere. Figures 10 and 11 show the results of theoretical calculations of $\bar{P}_V(\Delta\lambda_i)$ and $\bar{P}_Q(\Delta\lambda_i)$ as functions of $|\vec{B}|$ and ψ for the solutions to the Unno transfer equations for the Stokes parameters as developed by Kjeldseth Moe [3] under the assumptions of a homogeneous magnetic field and a line formation mechanism of pure absorption; the penumbral model of Kjeldseth Moe and Maltby [4] was used for these calculations. For small values of $|\vec{B}|$, $\lesssim$ 0.05 W/m^2 (500 gauss), the longitudinal (B_L) and transverse (B_T) components of $\vec{B}$ can be calculated from

$$B_L \equiv B \cos\psi = C_1 \cdot \bar{P}_V$$

and

$$B_T \equiv B \sin\psi = C_2 \cdot (\bar{P}_Q)^{1/2} \quad .$$

Moreover, with the assumption of a homogeneous magnetic field, in the Unno coordinate system the Stokes parameter U is everywhere zero; thus, the orientation ϕ of the transverse field can also be calculated from the reduced magnetograph data; viz.,

$$\tan 2\phi = -R/-U \quad .$$

There is, of course, an ambiguity of 180 deg in the orientation of ϕ of B_T, but this is inherent in the transverse Zeeman effect.

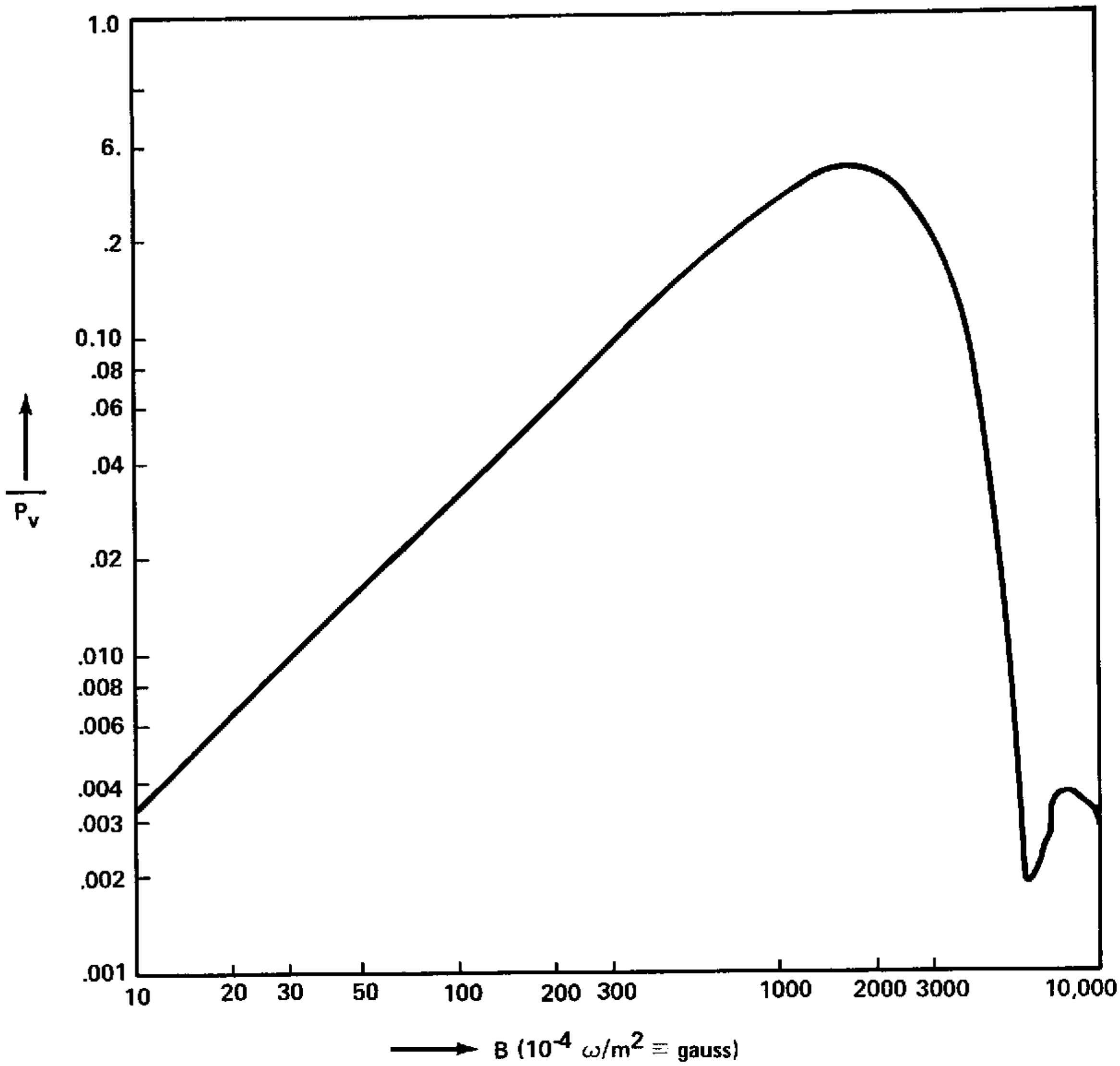

Figure 10. Kjeldseth Moe/Maltby penumbral model (ψ = 0 deg).

C. Discussion of Data Reliability

1. Instrumental Errors

a. Multicomponent Electro-Optical System. The RTSM system's optics box and electronics were delivered to MSFC in September 1972, and the integration and testing of these components together with the telescope system were immediately initiated in the SSL optics laboratory using an existing optical collimator system. It was quickly determined that the multicomponent electro-optical unit was not functioning properly, and the unit was subsequently

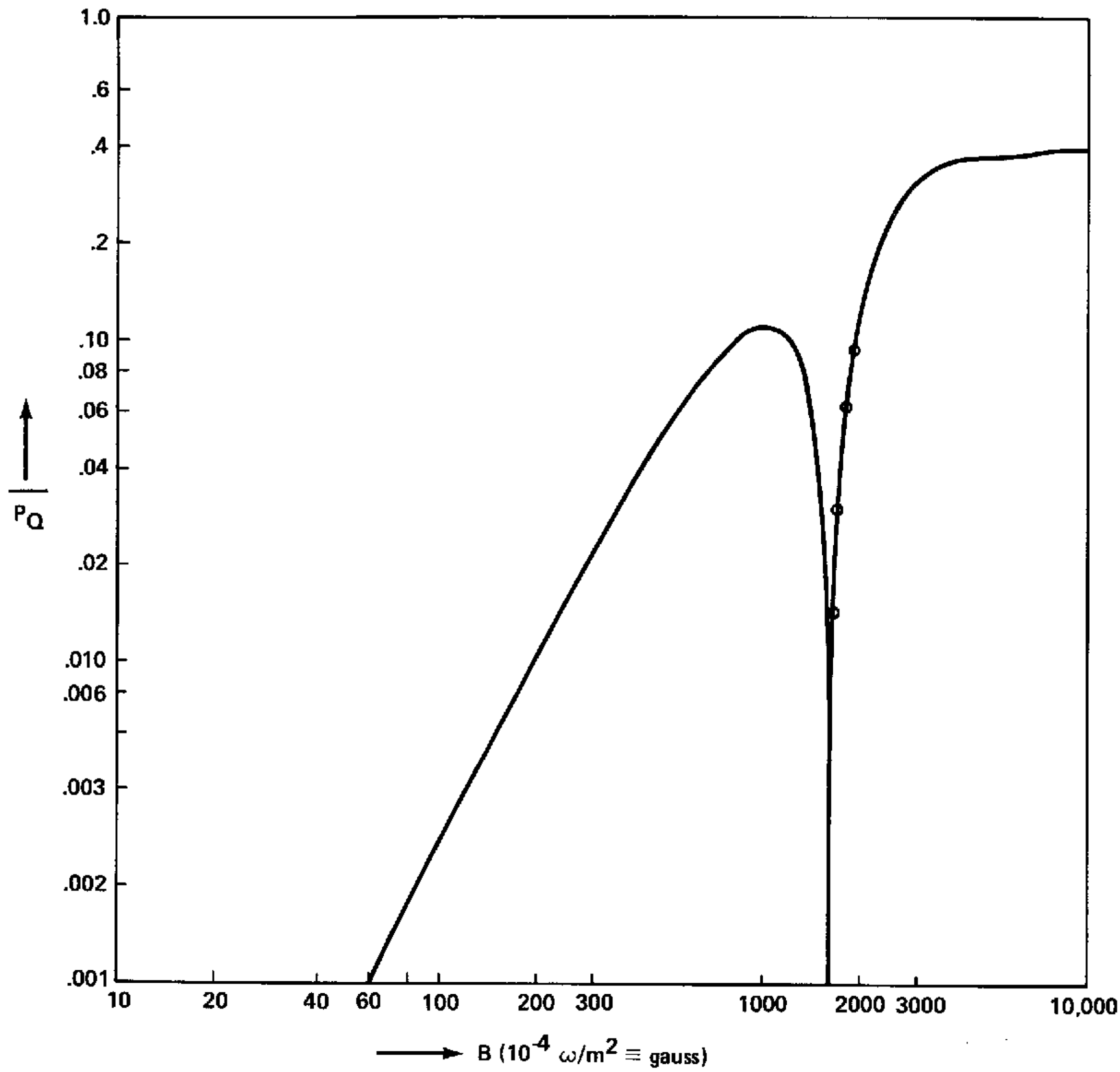

Figure 11. Kjeldseth Moe/Maltby penumbral model (ψ = 90 deg).

returned to the manufacturer for repairs. The repaired package was received in October 1973 and immediately installed in the magnetograph system, which had already been placed in operation in May 1973. After two months of operating the RTSM system with this repaired unit, it was determined that the optical quality of the total system was degraded compared to that achieved using the single KD*P crystal in the longitudinal mode. This degradation was thought to be caused by the scattering of light by the gold conducting grids on both sides of the two KD*P crystals. The decision was thus made to return to the use of the single KD*P crystal in the longitudinal mode. The multicomponent unit has since been sent to Lasermetrics where the gold grids are being replaced with conductive coatings on the crystals. In the process of the redesign of this unit it was determined that the two original fixed quarter-wave plates were not $\lambda/4$ retarders at the 525 nm wavelength: the first plate, $(\lambda/4)_1$, was $\lambda/4$ at 450 nm, and $(\lambda/4)_2$ was $\lambda/4$ at 486 nm. Upon evaluation of these effects on the Mueller matrices and Stokes parameters, it was determined that "cross-talk" was introduced between the measured circular and linear polarizations. Specifically, the resulting intensities of the six sequences of operation were determined to be (setting U = 0))

$$(I')_{1,2} = \frac{1}{2}[I - 0.3096 \cos 2\phi \pm 0.9513\ V] \quad ,$$

$$(I')_{3,4} = \frac{1}{2}[I \mp 1.000\ Q \cos 2\phi \mp 0.3088\ V] \quad ,$$

and

$$(I')_{5,6} = \frac{1}{2}[I \pm (-0.9945 \sin 2\phi + 0.0216 \cos 2\phi)\ Q \pm (-0.102)\ V] \quad .$$

If we denote the values of Q and V averaged over the filter bandpass by $\bar{Q}(\Delta\lambda_i)$ and $V(\Delta\lambda_i)$ (for a homogeneous magnetic field the angle ϕ is constant), then the data which are actually contained on magnetic tapes for the period October 25, 1973, to December 21, 1973, are:

$$\bar{P}'_V(\Delta\lambda_i) = \frac{0.9513\ V(\Delta\lambda_i)}{\bar{I}'} \quad ,$$

$$U'(\Delta\lambda_i) = \frac{1}{K_2'}\left[- 1.000 \frac{\bar{Q}(\Delta\lambda_i)}{\bar{I}} \cos 2\phi + 0.3088 \frac{\bar{V}(\Delta\lambda_i)}{\bar{I}}\right] \quad ,$$

$$R'(\Delta\lambda_i) = \frac{1}{K_2'}\left[(-0.9945 \sin 2\phi + 0.0216 \cos 2\phi) \frac{\bar{Q}(\Delta\lambda_i)}{\bar{I}} - 0.102 \frac{\bar{V}(\Delta\lambda_i)}{\bar{I}}\right] \quad ,$$

where

$$\bar{I}' = \int_{\delta_1}^{\delta_2} [I(\Delta\lambda, \Delta\lambda_i) - 0.3096\, Q \cos 2\phi] \cdot T(\Delta\lambda, \Delta\lambda_i) \cdot d(\Delta\lambda)$$

$$= \bar{I} - 0.3096\, \bar{Q} \cos 2\phi \quad .$$

Again, some of the recorded data include the matrix

$$\frac{1}{2}(1A + 1B) \sim \bar{I}' \quad .$$

If we write

$$\bar{I}' = \bar{I}\left(1 - 0.3096 \frac{\bar{Q}}{\bar{I}} \cos 2\phi\right) \quad ,$$

then

$$\bar{I}' = \bar{I}(1 - 0.3096\, \bar{P}_Q \cos 2\phi) \equiv \bar{I}(1 - \epsilon) \quad .$$

Since for field strengths less than or on the order of 0.1 W/m^2 (1000 gauss), $\bar{P}_Q \lesssim 0.10$, we have for the term $\epsilon = 0.3096\, \bar{P}_Q \cos 2\phi$:

$$|\epsilon| \lesssim 0.03 \cos 2\phi \leq 0.03 \quad ;$$

thus $\bar{I}' \approx \bar{I}$ to within this factor ϵ and

$$\bar{P}_V' \approx 0.9513\, \bar{P}_V \quad .$$

It thus appears that measurements for the degree of circular polarization for this period of operation are reasonably accurate. This conclusion is reinforced by longitudinal data recorded on October 25, 1973, on the same active region using both the single KD*P crystal system and the multicomponent unit; the numerical results for each case agree very well. The extraction of the degree of linear polarization $\bar{P}_Q$ and the field orientation ϕ from the recorded data $U'(\Delta\lambda_i)$ and $R'(\Delta\lambda_i)$, where

$$U'(\Delta\lambda_i) = \frac{1}{K_2'} [-(1.000\ \bar{P}_Q(\Delta\lambda_i) \cos 2\phi + 0.3088\ \bar{P}_V(\Delta\lambda_i)]$$

and

$$R'(\Delta\lambda_i) = \frac{1}{K_2'} [(-0.9945 \sin 2\phi + 0.0216 \cos 2\phi)\ \bar{P}_Q(\Delta\lambda_i)$$

$$(-0.102)\ \bar{P}_V(\Delta\lambda_i)] \quad ,$$

appears to present a formidable data reduction problem. However, in most cases, when data were taken, for sequences 1 and 2 the filter was tuned about 60×10^{-4} nm (60 mÅ) from line center in the blue wing, whereas for sequences 3, 4, 5 and 6, the filter was tuned to line center where the net circular polarization averages to zero for a symmetric filter profile. Thus, the recorded data are

$$\overline{P_V}'(\Delta\lambda_1) = 0.9513\ \bar{V}(\Delta\lambda_1)/\{\bar{I}(\Delta\lambda_1) \cdot [1 - \epsilon(\Delta\lambda_1]\} \quad ,$$

$$U'(\Delta\lambda_2) = \frac{1}{K_2'} [-(1.000 \cos 2\phi)\ \bar{P}_Q(\Delta\lambda_2)] \quad ,$$

and

$$R'(\Delta\lambda_2) = \frac{1}{K_2'} [(-0.9945 \sin 2\phi + 0.0216 \cos 2\phi)\ \bar{P}_Q(\Delta\lambda_2)] \quad ,$$

where $\Delta\lambda_1 \approx 60 \times 10^{-4}$ nm (60 mÅ) and $\Delta\lambda_2 \approx 0.0$ nm (0.0 mÅ), and where $\bar{P}_V(\Delta\lambda_2)$ is assumed to be zero. From the two values, U' and R' , $\bar{P}_Q$ and ϕ can easily be computed.

b. DC Restoration. In the early phase of the acquisition of digital data in the longitudinal mode, it was determined that information on the degree of circular polarization was being lost in the data obtained for large sunspot umbrae. The source of this problem was traced to the voltage levels sampled by the a/d converter which were dropping below the a/d zero-level voltage for umbral intensities; thus, all analog signals for umbral intensities in both left and right circularly polarized light were converted to zero digital values, so that the information on the relative differences between the 1A and 1B signals was lost, resulting in zero values for the degree of circular polarization. Moreover, for intensities slightly higher than umbral intensities, either the 1A or the 1B signal was converted to a zero digital value, resulting in an unrealistically high value for the degree of circular polarization. This situation is schematically illustrated in Figure 12 for a single scan line through a sunspot where the individual voltage level for each pixel is shown. The voltage drop below the zero level of the a/d converter was due to an electronic overshoot which did not damp out rapidly enough. In the a/d converter, all voltages below the zero level are interpreted as 0.0 volts and converted to a zero digital value.

In the original circuit design, the variable gain amplifier employed a diode to stabilize the circuit by damping the stronger voltage transients but this proved inadequate to damp the strong over-shoot in the umbral region. On February 5, 1974, an active dc restoration circuit was placed in operation to correct this problem. This circuit uses a transistor as a clamp between each pixel of data and is turned on and off by the same timing circuits which control the SEC vidicon scans. Subsequent examination of data for large umbral regions indicated that this problem has been corrected by this circuit.

c. X-Y Display. The digital logic controlling the display of the matrix $(1A)_{ij} - (1B)_{ij}$ on the X-Y display monitor was designed to provide an eight-scale greyscale with neutral intensity (grey) representing zero difference in 1A-1B, full-scale intensity (bright) representing the maximum positive difference, and zero intensity (black) representing the maximum negative difference. In the spring of 1974, after the completion of the Skylab mission, it was discovered that, because of an error in this digital logic circuit, the negative part of the greyscale display was inverted: the smallest negative difference in 1A-1B was displayed as zero intensity (full black) and increasing negative differences were displayed as increasing intensities. This problem has since been corrected, but all photographic data of the X-Y display during the complete Skylab mission contain this error. However, this "mistake" does have some inherent value: the weak negative fields surrounding the active regions appear very clearly in the Polaroid pictures.

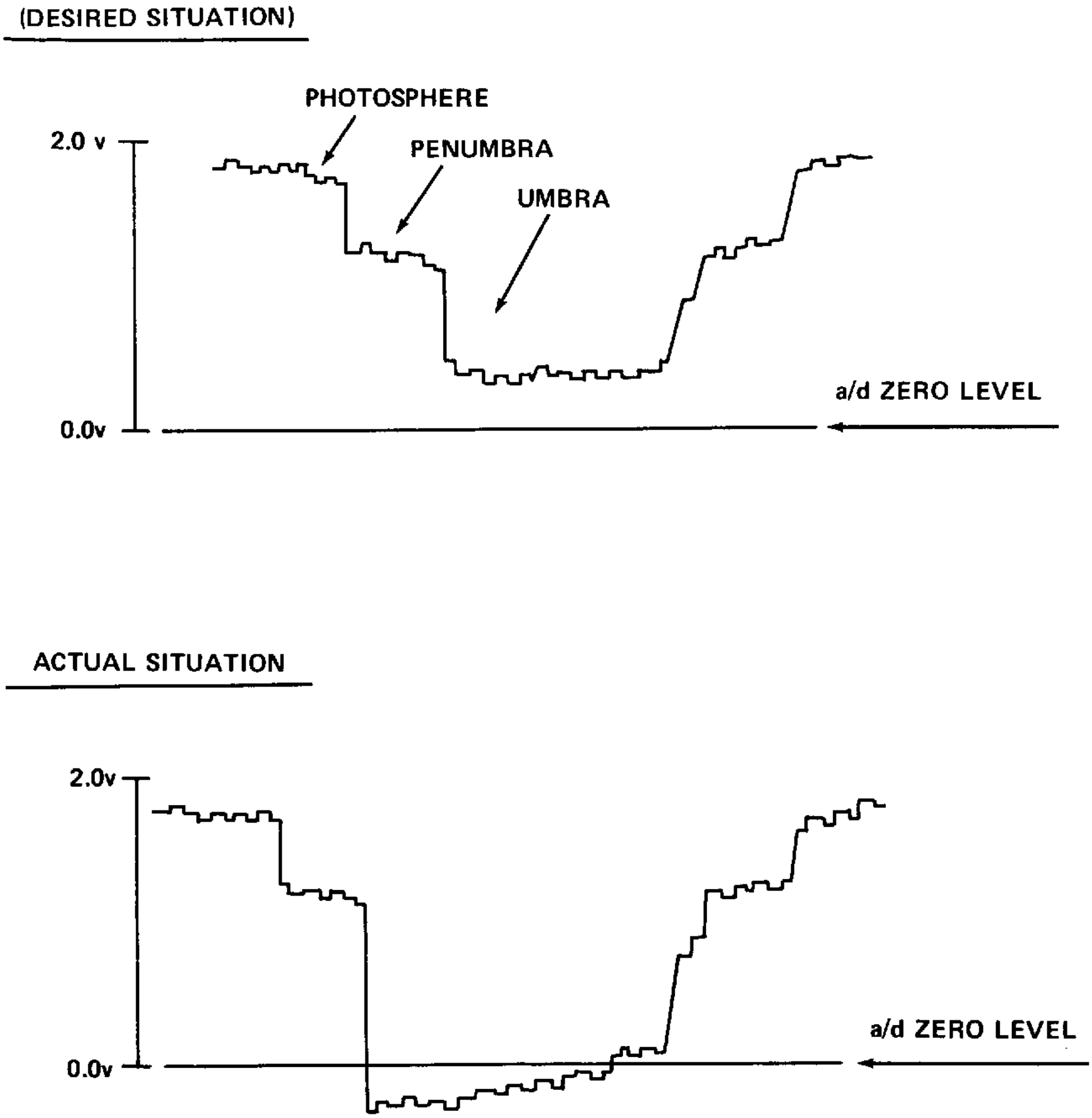

Figure 12. Schematic representation of electronic "over-shoot."

2. Magnetic Sensitivity. The magnetic sensitivity of the RTSM system is determined by the value of the minimum amount of degree of polarization which can be detected above the background noise level. An estimate of this value can be obtained for each set of data by averaging the absolute value of

$(P_V)_{ij}$ over a "quiet" region of the field of view. In addition, throughout the period of operation of the RTSM during the Skylab mission, specific tests were conducted to determine the noise level of the system as a function of various parameters. One such test was conducted on October 3, 1973 (and thus employing the single Lasermetrics KD*P crystal) where longitudinal data were obtained at different enhancement levels for a quiet region of the sun. Since a "polarization calibration" operation was performed during this test, absolute values for $(\bar{P}_V)_{ij}$ were obtained. The results are given below together with the corresponding values of the magnetic field which were determined from curves of $\bar{P}_V$, $|\vec{B}|$ for the Holweger photospheric model [5]; these field values indicate the magnetic sensitivity of the measurements.

Number of Enhancements	P_V	B_L (W/m^2)
0	0.0335	150×10^{-4}
1	0.0266	115×10^{-4}
2	0.0259	110×10^{-4}
4	0.0160	70×10^{-4}
8	0.0113	48×10^{-4}
16	0.0080	34×10^{-4}
32	0.0070	30×10^{-4}
64	0.0046	20×10^{-4}

Since the conclusion of the Skylab mission, the video preamplifier has been redesigned and a new SEC vidicon tube installed; as a result, the magnetic sensitivity has been improved. For example, for data taken on October 11, 1974, for 32 enhancements, the average background level of the degree of circular polarization was calculated to be 0.00246, which represents a longitudinal magnetic field sensitivity of about 10×10^{-4} W/m^2 (10 gauss). A similar value for the background level for linear polarization would indicate a transverse magnetic field sensitivity of about 140×10^{-4} W/m^2 (140 gauss). Further efforts are in process to improve these values even more.

V. RTSM SKYLAB MISSION ATLAS

The following atlas of all RTSM data obtained during the Skylab mission lists six entries for each magnetogram obtained:

Column 1	gives the date
Column 2	gives the universal time of the observation in hours, minutes and (when necessary) seconds
Column 3	gives the Boulder region identification number
Column 4	denotes whether the data are in "digital" form or are a polaroid "photo"
Column 5	denotes the mode of the data; i.e., whether the data are longitudinal ("long"), transverse ("trans"), or vector ("vector") magnetic field measurements
Column 6	indicates the field-of-view of the magnetogram where "LOW" denotes the 5 × 5 arc min field and "HIGH" denotes the 2 × 2 arc min field

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
May 30, 1973	15:24	117	Photo	Long	High
	15:26	"	"	"	"
	15:29	114	"	"	"
	15:39	117	"	"	Low
	15:40	"	"	"	"
	15:57	"	"	"	High
May 31, 1973	12:37	"	"	"	"
	12:40	"	"	"	"
	12:41	"	"	"	"
	12:58	"	"	"	"
	13:12	"	"	"	"
	13:24	"	"	"	"
	14:40	"	"	"	"
June 1, 1973	12:42	"	"	"	"
	12:49	"	"	"	"
	12:52	"	"	"	"
	12:55	"	"	"	"
	13:12	"	"	"	"
	13:17	"	"	"	"
	14:13	"	"	"	"
	14:29	"	"	"	Low
	14:32	"	"	"	High
	14:37	117	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 1, 1973	14:39	117	Photo	Long	High
	14:40	"	"	"	"
	14:41	"	"	"	"
	14:52	"	"	"	"
	14:55	"	"	"	"
	14:58	"	"	"	"
	15:04	"	"	"	Low
June 2, 1973	14:34	"	"	"	High
	14:55	"	"	"	"
	14:58	"	"	"	"
June 3, 1973	13:08	Small Spot Group in S.W.	"	"	Low
	14:25	"	"	"	High
	14:27	"	"	"	"
	14:30	"	"	"	"
	14:33	"	"	"	"
	14:36	"	"	"	"
	14:37	"	"	"	"
	14:40	"	"	"	"
	14:45	"	"	"	Low
	14:49	"	"	"	"
	14:53	"	"	"	"
	15:05	"	"	"	High
June 4, 1973	14:19	Plage	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 4, 1973	14:39	Plage	Photo	Long	High
	15:49	"	"	"	Low
	16:01	"	"	"	High
	16:02	"	"	"	"
June 6, 1973	21:37	Small Spot	"	"	Low
	21:40	"	"	"	"
June 8, 1973	13:14	131	"	"	"
	13:15	"	"	"	"
	13:21	"	"	"	High
	13:58	"	"	"	"
	15:15	"	"	"	"
	15:36	"	"	"	"
	15:38	"	"	"	"
	15:39	"	"	"	"
	15:41	"	"	"	"
	15:42	"	"	"	"
	15:43	"	"	"	"
	15:45	"	"	"	"
	15:46	"	"	"	"
	15:47	"	"	"	"
	15:48	"	"	"	"
	15:52	131	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 8, 1973	15:53	131	Photo	Long	High
	15:55	"	"	"	"
	15:57	"	"	"	"
	16:02	"	"	"	"
	16:04	"	"	"	"
	16:05	"	"	"	"
June 9, 1973	13:58	"	"	"	Low
	14:05	"	"	"	High
	14:10	"	"	"	"
	14:25	"	"	"	"
	14:49	"	"	"	"
	14:55	132	"	"	"
	15:09	Plage N15 W15	"	"	"
	15:12	"	"	"	"
June 10, 1973	16:42	131	"	"	"
	16:58	"	"	"	"
June 11, 1973	11:59	"	"	"	"
	12:11	"	"	"	"
	12:13	"	"	"	"
	12:16	"	"	"	"
	12:31	137	"	"	"
	12:39	"	"	"	"
	13:28	131	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 11, 1973	13:35	131	Photo	Long	High
	13:39	"	"	"	"
	14:09	"	"	"	"
	14:22	"	"	"	"
	14:36	"	"	"	"
	14:42	"	"	"	Low
	14:59	Plage & Spot	"	"	"
June 13, 1973	16:11	137 N13 E54	"	"	High
	16:15	137	"	"	"
	16:16	"	"	"	"
	16:23	"	"	"	"
	16:24	"	"	"	"
	16:59	131	"	"	"
	17:19	127	"	"	"
	17:37	"	"	"	"
	17:42	"	"	"	"
	17:49	132	"	"	"
	17:52	"	"	"	"
	17:54	"	"	"	"
	17:60	"	"	"	"
	21:23	137	"	"	"
	21:54	"	"	"	"
	22:03	137	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 15, 1973	11:48	137	Photo	Long	Low
	11:53	"	"	"	"
	11:57	"	"	"	High
	12:01	"	"	"	"
	12:13	"	"	"	"
	13:09	"	"	"	Low
	13:41	"	"	"	"
	13:47	"	"	"	"
June 16, 1973	11:39	"	"	"	"
	11:41	"	"	"	"
	11:55	"	"	"	"
	12:00	"	"	"	"
	12:05	"	"	"	"
	12:12	"	"	"	"
	12:27	"	"	"	"
	12:34	"	"	"	"
	12:38	"	"	"	"
	12:41	"	"	"	"
	12:43	"	"	"	High
	12:50	"	"	"	"
	12:52	"	"	"	"
	14:05	131	"	"	"
	14:07	"	"	"	"
	14:11	131	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 16, 1973	14:13	131	Photo	Long	High
	14:15	"	"	"	"
	14:16	"	"	"	"
	14:25	137	"	"	"
	14:27	"	"	"	"
	14:29	"	"	"	Low
	14:31	"	"	"	"
	14:33	"	"	"	"
	14:35	"	"	"	"
	14:37	"	"	"	"
	14:38	"	"	"	"
	14:40	"	"	"	"
	14:43	"	"	"	"
	14:44	"	"	"	"
	14:47	"	"	"	"
	14:50	"	"	"	"
	14:52	"	"	"	"
	14:56	"	"	"	"
	14:58	"	"	"	"
	15:04	"	"	"	"
	15:05	"	"	"	"
	15:10	"	"	"	"
	15:16	"	"	"	"
	15:24	137	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 16, 1973	15:29	137	Photo	Long	Low
	15:34	"	"	"	High
	15:42	"	"	"	"
	15:56	"	"	"	"
	16:07	"	"	"	Low
	16:09	"	"	"	"
	16:22	"	"	"	"
	16:31	"	"	"	"
	16:34	"	"	"	"
	16:41	"	"	"	"
June 17, 1973	11:45	"	"	"	High
	12:06	"	"	"	"
	12:12	"	"	"	"
	12:15	"	"	"	"
	12:19	"	"	"	Low
	12:25	"	"	"	"
	12:32	"	"	"	"
	12:35	"	"	"	"
	12:56	"	"	"	"
	13:36	"	"	"	"
	13:53	"	"	"	"
	14:47	137	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 17, 1973	15:02	137	Photo	Long	Low
	15:13	140	"	"	"
	15:23	Plage S15 E60	"	"	"
	15:28	137	"	"	"
	16:33	Plage S15 E60	"	"	"
	16:40	137	"	"	"
June 18, 1973	21:15	"	"	"	"
	21:41	"	"	"	"
June 20, 1973	12:19	147,149	"	"	"
	12:23	"	"	"	"
	12:30	"	"	"	"
	13:40	"	"	"	"
	13:45	"	"	"	"
	13:53	137	"	"	"
	13:57	"	"	"	"
	14:18	149	"	"	High
	14:21	147	"	"	"
	14:23	"	"	"	"
	14:37	Plage Disk Center	"	"	?
	19:17	147,149	"	"	Low
	19:23	"	"	"	"
June 21, 1973	12:05	"	"	"	"
	12:22	149,150	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 21, 1973	12:27	149,150	Photo	Long	Low
	13:09	137	"	"	"
	13:14	"	"	"	"
	13:19	"	"	"	"
	14:50	147,149	"	"	"
	14:53	150	"	"	"
June 22, 1973	12:16	147,149	"	"	"
	12:20	149	"	"	"
	12:24	150	"	"	"
	12:35	137	"	"	"
June 23, 1973	12:07	147	"	"	"
	12:13	149	"	"	"
	12:20	150	"	"	"
	12:35	137	"	"	"
	12:43	"	"	"	"
	12:47	"	"	"	"
	13:53	149	"	"	High
	13:58	147	"	"	"
	14:03	150	"	"	"
	14:29	Plage West of 147	"	"	Low
	14:30	"	"	"	"
	14:32	Plage West of 147	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 23, 1973	14:35	Plage West of 147	Photo	Long	Low
	14:38	"	"	"	"
	14:40	"	"	"	"
June 24, 1973	11:54	147	"	"	"
	11:59	149	"	"	"
	12:05	150	"	"	"
	12:24	149	"	"	"
	12:27	"	"	"	"
	12:31	"	"	"	"
	12:54	"	"	"	"
	12:55	"	"	"	"
	12:57	147	"	"	"
	12:58	"	"	"	"
June 25, 1973	11:15:00	147,149	Digital	"	"
	11:15:57	"	"	"	"
	11:16:01	"	"	"	"
	11:16:05	"	"	"	"
	11:16:15	"	"	"	"
	11:16:31	"	"	"	"
	11:16:37	"	"	"	"
	11:16:41	"	"	"	"
	11:16:45	"	"	"	"
	11:16:53	147,149	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 25, 1973	11:16:59	147,149	Digital	Long	Low
	11:17:03	"	"	"	"
	11:17:13	"	"	"	"
	11:17:35	"	"	"	"
	11:17:41	"	"	"	"
	11:17:47	"	"	"	"
	11:17:51	"	"	"	"
	11:17:55	"	"	"	"
	11:18:01	"	"	"	"
	11:18:05	"	"	"	"
	11:18:09	"	"	"	"
	11:18:13	"	"	"	"
	11:18:17	"	"	"	"
	11:18:23	"	"	"	"
	11:18:27	"	"	"	"
	11:18:31	"	"	"	"
	11:18:35	"	"	"	"
	11:18:39	"	"	"	"
	11:18:43	"	"	"	"
	11:18:49	"	"	"	"
	11:18:55	"	"	"	"
	11:19:03	147,149	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 25, 1973	11:19:09	147,149	Digital	Long	Low
	11:19:15	"	"	"	"
	11:19:19	"	"	"	"
	11:19:23	"	"	"	"
	11:19:27	"	"	"	"
	11:19:33	"	"	"	"
	11:19:37	"	"	"	"
	11:19:51	"	"	"	"
	11:19:55	"	"	"	"
	11:19:59	"	"	"	"
	11:20:03	"	"	"	"
	11:20:09	"	"	"	"
	11:20:11	"	"	"	"
	11:20:15	"	"	"	"
	11:20:21	"	"	"	"
	11:20:25	"	"	"	"
	11:20:29	"	"	"	"
	11:20:33	"	"	"	"
	11:20:39	"	"	"	"
	11:20:43	"	"	"	"
	11:20:49	"	"	"	"
	11:22:29	147,149	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 25, 1973	11:22:35	147,149	Digital	Long	Low
	11:22:39	"	"	"	"
	11:22:43	"	"	"	"
	11:22:47	"	"	"	"
	11:22:49	"	"	"	"
	11:22:55	"	"	"	"
	11:22:57	"	"	"	"
	11:23:01	"	"	"	"
	11:23:07	"	"	"	"
	11:23:13	"	"	"	"
	11:23:17	"	"	"	"
	11:23:21	"	"	"	"
	11:23:25	"	"	"	"
	11:23:29	"	"	"	"
	11:23:31	"	"	"	"
	11:23:35	"	"	"	"
	11:23:41	"	"	"	"
	11:23:49	"	"	"	"
	11:23:53	"	"	"	"
	11:23:57	"	"	"	"
	11:24:01	"	"	"	"
	11:24:05	147,149	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 25, 1973	11:24:07	147,149	Digital	Long	Low
	11:24:11	"	"	"	"
	11:53	147	Photo	"	"
	11:59	149	"	"	"
	12:08	150	"	"	"
	12:12	"	"	"	"
	12:30	149	"	"	"
	12:37	"	"	"	"
	12:40	150	"	"	"
	12:42	147	"	"	"
	14:51	S16 E24	"	"	"
June 26, 1973	13:58	147	"	"	High
	14:01	"	"	"	"
	14:05	"	"	"	"
	14:10	"	"	"	"
	14:14	149	"	"	"
	14:22	150	"	"	Low
	16:13	"	"	"	"
	16:20	"	"	"	"
	20:46	147,149	"	"	"
	20:52	150	"	"	"
June 27, 1973	15:30	147	"	"	High
	15:38	149	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
June 27, 1973	15:47	150	Photo	Long	Low
	16:38	147,149	"	"	"
	16:48	150	"	"	"
	18:14	147,149	"	"	"
June 28, 1973	18:26	150	"	"	"
June 29, 1973	12:22	158	"	"	High
	12:32	"	"	"	"
	12:52	147,149	"	"	Low
	12:56	150	"	"	"
	14:08	158	"	"	High
	14:24	"	"	"	"
	14:55	"	"	"	"
	15:55	157,159	"	"	"
	16:12	"	"	"	"
	20:01	"	"	"	"
	20:12	"	"	"	"
	20:54	158	"	"	"
	21:06	"	"	"	"
July 2, 1973	13:04	"	"	"	"
	13:15	157,159	"	"	Low
	13:18	"	"	"	"
	13:28	158	"	"	"
	21:59:29	158	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 2, 1973	22:00:00	158	Digital	Long	High
	22:00:01	"	"	"	"
	22:00:03	"	"	"	"
	22:00:05	"	"	"	"
	22:00:06	"	"	"	"
	22:00:07	"	"	"	"
	22:00:09	"	"	"	"
	22:00:11	"	"	"	"
	22:00:13	"	"	"	"
	22:00:15	"	"	"	"
	22:00:17	"	"	"	"
	22:00:19	"	"	"	"
	22:00:23	"	"	"	"
	22:00:25	"	"	"	"
	22:00:27	"	"	"	"
	22:00:29	"	"	"	"
	22:00:31	"	"	"	"
	22:00:35	"	"	"	"
	22:00:37	"	"	"	"
	22:00:39	"	"	"	"
	22:00:41	"	"	"	"
	22:00:47	158	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 2, 1973	22:00:49	158	Digital	Long	High
	22:00:51	"	"	"	"
	22:00:57	"	"	"	"
	22:00:59	"	"	"	"
	22:01:03	"	"	"	"
	22:01:05	"	"	"	"
	22:01:07	"	"	"	"
	22:01:09	"	"	"	"
	22:01:15	"	"	"	"
	22:01:17	"	"	"	"
	22:01:19	"	"	"	"
	22:01:23	"	"	"	"
	22:01:25	"	"	"	"
	22:01:27	"	"	"	"
	22:01:31	"	"	"	"
	22:01:33	"	"	"	"
	22:01:35	"	"	"	"
	22:01:39	"	"	"	"
	22:01:45	"	"	"	"
	22:01:53	"	"	"	"
	22:01:55	158	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 2, 1973	22:01:57	158	Digital	Long	High
	22:02:01	"	"	"	"
	22:02:05	"	"	"	"
	22:02:07	"	"	"	"
	22:02:09	"	"	"	"
	22:02:13	"	"	"	"
	22:02:15	"	"	"	"
	22:02:21	"	"	"	"
	22:02:23	"	"	"	"
	22:02:25	"	"	"	"
	22:02:31	"	"	"	"
July 3, 1974	14:34	"	Photo	"	Low
	15:17	157,159	"	"	"
	20:53	158	"	"	"
	20:58	"	"	"	"
	21:12	"	"	"	"
	21:15	"	"	"	"
	21:28:51	"	Digital	"	"
	21:29:33	"	"	"	"
	21:29:39	"	"	"	"
	21:29:45	158	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 3, 1973	21:29:51	158	Digital	Long	Low
	21:29:57	"	"	"	"
	21:30:03	"	"	"	"
	21:30:09	"	"	"	"
	21:30:47	"	"	"	"
	21:30:55	"	"	"	"
	21:30:59	"	"	"	"
	21:31:07	"	"	"	"
	21:31:13	"	"	"	"
	21:31:19	"	"	"	"
	21:31:23	"	"	"	"
	21:31:35	"	"	"	"
	21:31:41	"	"	"	"
	21:31:47	"	"	"	"
	21:31:53	"	"	"	"
	21:31:59	"	"	"	"
	21:32:05	"	"	"	"
	21:32:11	"	"	"	"
	21:32:17	"	"	"	"
	21:32:25	"	"	"	"
	21:32:31	"	"	"	"
	21:32:37	158	Digital	Long	Low

DATA	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 3, 1973	21:32:43	158	Digital	Long	Low
	21:32:49	"	"	"	"
	21:32:55	"	"	"	"
	21:33:01	"	"	"	"
	21:33:07	"	"	"	"
	21:33:15	"	"	"	"
	21:33:19	"	"	"	"
	22:14	"	Photo	"	"
July 4, 1973	12:11	"	"	"	"
	12:21	157,159	"	"	"
	12:25	"	"	"	"
	12:36	158	"	"	"
July 5, 1973	13:03	"	"	"	"
	13:12	157,159	"	"	"
	13:25	"	"	"	"
July 6, 1973	12:10	158	"	"	"
	12:16	"	"	"	"
	12:23	162	"	"	High
	12:28	"	"	"	"
	12:32	"	"	"	"
	12:43	162	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 6, 1973	12:52	157,159	Photo	Long	Low
	12:54	"	"	"	"
	13:06	158	"	"	"
	13:11	162	"	"	High
	13:25	"	"	"	"
	13:39	"	"	"	"
	13:48	"	"	"	"
	14:03	"	"	"	"
	14:12	"	"	"	"
	14:50	"	"	"	"
	15:24	"	"	"	"
	19:42+	"	"	"	"
July 7, 1973	20:09	158	"	"	Low
	20:18	157,159	"	"	"
	20:25	162	"	"	High
	20:28	"	"	"	"
July 9, 1973	15:03	158	"	"	Low
	15:23	157,159	"	"	"
	15:29	"	"	"	"
	15:40	"	"	"	"
	15:49	158	Photo	Long	Low

+ SEC vidicon scan reversed to give conventional disk orientation

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 9, 1973	16:08	162	Photo	Long	High
	16:13	"	"	"	"
	16:24	"	"	"	"
July 10, 1973	15:17	158	"	"	Low
	15:34	162	"	"	High
	15:40	"	"	"	"
	15:53	"	"	"	"
	16:02	158	"	"	"
	16:07	"	"	"	"
July 11, 1973	18:06	"	"	"	"
July 12, 1973	12:39	166	"	"	"
	17:17	Plage N20 E20	"	"	Low
July 13, 1973	13:16	168	"	"	High
	13:22	"	"	"	"
	13:28	"	"	"	"
	13:34	"	"	"	"
	14:13	"	"	"	"
July 17, 1973	20:50	171	"	"	"
	21:03	"	"	"	"
	21:16	171,172	"	"	Low
	21:24	"	"	"	"
	21:44	168	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 18, 1973	19:52	171,172	Photo	Long	High
	20:11	173	"	"	"
	20:30	174	"	"	"
July 20, 1973	19:56	173	"	"	Low
	19:58	Plage	"	"	"
July 21, 1973	13:53	171	"	"	?
	14:07	"	"	"	?
	14:13	"	"	"	?
July 22, 1973	15:22	173	"	"	High
July 24, 1973	19:00	175	"	"	?
	19:02	"	"	"	?
July 25, 1973	13:18	177	"	"	High
	13:31	"	"	"	"
	14:19:25	"	Digital & Photo	"	"
	14:26:13	"	Digital	"	"
	14:26:19	"	"	"	"
	14:26:25	"	"	"	"
	14:26:31	"	"	"	"
	14:26:37	"	"	"	"
	14:26:43	"	"	"	"
	14:26:49	"	"	"	"
	14:26:55	177	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 25, 1973	14:27:01	177	Digital	Long	High
	14:27:07	"	"	"	"
	14:27:13	"	"	"	"
	14:27:19	"	"	"	"
	14:27:25	"	"	"	"
	14:27:33	"	"	"	"
	14:27:39	"	"	"	"
	14:27:45	"	"	"	"
	14:27:51	"	"	"	"
	14:27:57	"	"	"	"
	14:28:03	"	"	"	"
	14:28:09	"	"	"	"
	14:28:15	"	"	"	"
	14:28:21	"	"	"	"
	14:28:27	"	"	"	"
	14:28:33	"	"	"	"
	14:28:39	"	"	"	"
	14:28:45	"	"	"	"
	14:28:59	"	"	"	"
	14:29:19	"	"	"	"
	14:29:39	"	"	"	"
	14:29:49	177	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 25, 1973	14:29:59	177	Digital	Long	High
	14:30:07	"	"	"	"
	14:30:17	"	"	"	"
	14:30:27	"	"	"	"
	14:30:35	"	"	"	"
	14:30:45	"	"	"	"
	14:30:55	"	"	"	"
	14:31:03	"	"	"	"
	14:31:13	"	"	"	"
	14:31:23	"	"	"	"
	14:31:31	"	"	"	"
	14:31:41	"	"	"	"
	14:31:51	"	"	"	"
	14:31:59	"	"	"	"
	14:32:09	"	"	"	"
	14:32:19	"	"	"	"
	14:32:27	"	"	"	"
	14:32:37	"	"	"	"
	14:32:47	"	"	"	"
	14:32:55	"	"	"	"
	14:33:05	"	"	"	"
	14:33:15	177	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 25, 1973	14:33:23	177	Digital	Long	High
	14:33:33	"	"	"	"
	14:33:43	"	"	"	"
	14:33:51	"	"	"	"
	14:34:01	"	"	"	"
	14:34:11	"	"	"	"
	14:34:21	"	"	"	"
	14:34:29	"	"	"	"
	14:34:39	"	"	"	"
	14:34:49	"	"	"	"
	14:34:57	"	"	"	"
	14:35:07	"	"	"	"
	14:35:17	"	"	"	"
	14:35:25	"	"	"	"
	14:35:35	"	"	"	"
	14:35:45	"	"	"	"
	14:35:53	"	"	"	"
	14:36:03	"	"	"	"
	14:36:13	"	"	"	"
	14:36:21	"	"	"	"
	14:36:31	"	"	"	"
	14:36:41	177	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 25, 1973	14:36:49	177	Digital	Long	High
	14:36:59	"	"	"	"
	14:37:09	"	"	"	"
	14:37:17	"	"	"	"
	14:37:27	"	"	"	"
	14:37:37	"	"	"	"
	14:37:45	"	"	"	"
	14:37:55	"	"	"	"
	14:38:05	"	"	"	"
	14:38:13	"	"	"	"
	14:38:23	"	"	"	"
	14:38:33	"	"	"	"
	14:38:41	"	"	"	"
	14:38:51	"	"	"	"
	14:39:01	"	"	"	"
	14:39:09	"	"	"	"
	14:39:19	"	"	"	"
	14:39:29	"	"	"	"
	14:39:37	"	"	"	"
	14:39:47	"	"	"	"
	14:39:57	177	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 25, 1973	14:40:05	177	Digital	Long	High
	14:40:15	"	"	"	"
	14:40:25	"	"	"	"
	14:40:33	"	"	"	"
	14:40:43	"	"	"	"
	14:40:53	"	"	"	"
	14:41:01	"	"	"	"
	14:41:11	"	"	"	"
	14:41:21	"	"	"	"
	14:41:29	"	"	"	"
	14:41:39	"	"	"	"
	14:41:49	"	"	"	"
	14:41:57	"	"	"	"
	14:42:07	"	"	"	"
	14:42:17	"	"	"	"
	14:45:33	"	"	"	"
	14:45:43	"	"	"	"
	14:45:51	"	"	"	"
	14:46:01	"	"	"	"
	14:46:11	"	"	"	"
	14:46:19	"	"	"	"
	14:46:29	177	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 25, 1973	14:46:39	177	Digital	Long	High
	14:46:47	"	"	"	"
	14:48	"	Photo	"	"
	15:24:21	"	Digital	"	"
	15:55:01	"	"	"	"
	15:55:49	"	"	"	"
	15:56:37	"	"	"	"
	15:57:25	"	"	"	"
	15:58:13	"	"	"	"
	15:59:01	"	"	"	"
	15:59:49	"	"	"	"
	16:00:37	"	"	"	"
	16:01:23	"	"	"	"
	16:02:13	"	"	"	"
	16:03:01	"	"	"	"
	16:03:49	"	"	"	"
	16:04:37	"	"	"	"
	16:05:25	"	"	"	"
	16:06:15	"	"	"	"
	16:07:05	"	"	"	"
	16:07:55	"	"	"	"
	16:08:43	177	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 25, 1973	16:09:33	177	Digital	Long	High
	16:10:21	"	"	"	"
	16:11:09	"	"	"	"
	16:11:59	"	"	"	"
	16:12:47	"	"	"	"
	16:13:35	"	"	"	"
	18:34:21	"	"	"	"
	18:36:27	"	"	"	"
	18:38:55	"	"	"	"
	18:39:15	"	"	"	"
July 27, 1973	21:21	"	Photo	"	"
	21:29	"	"	"	"
	21:38	"	"	"	"
	21:46	"	"	"	"
July 28, 1973	13:12	"	"	"	"
	13:24	"	"	"	"
	13:30	"	"	"	"
	13:38	"	"	"	"
	13:45	"	"	"	"
	13:55	"	"	"	"
July 29, 1973	12:55	177	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
July 29, 1973	13:09	177	Photo	Long	High
	13:18	"	"	"	"
	13:32	"	"	"	"
August 1, 1973	19:24	"	"	"	"
August 2, 1973	13:56	"	"	"	"
	14:15	"	"	"	"
	14:44	183	"	"	"
	15:20	"	"	"	"
	15:55	"	"	"	"
	19:29	177	"	"	"
	20:25	"	"	"	"
August 3, 1973	12:44	"	"	"	?
	13:06	183	"	"	High
	15:26	"	"	"	"
	15:52	"	"	"	Low
	16:02	177	"	"	?
	16:06	"	"	"	?
August 4, 1973	12:33	183	"	"	High
	12:53	185	"	"	"
	13:04	"	"	"	"
	13:12	185	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Aug. 4, 1973	13:21	183	Photo	Long	High
	13:29	177	"	"	"
	13:46	176	"	"	Low
	13:49	"	"	"	"
	13:53	"	"	"	"
	14:56	"	"	"	"
Aug. 5, 1973	14:01	185	"	"	High
	14:05	"	"	"	"
	14:09	"	"	"	"
	14:18	176	"	"	Low
	14:22	"	"	"	"
	14:30	183	"	"	High
	14:37	"	"	"	"
Aug. 6, 1973	15:52	185	"	"	"
	15:55	"	"	"	Low
	16:00	"	"	"	"
	16:03	"	"	"	"
	16:07	"	"	"	High
	16:10	"	"	"	"
	16:19	"	"	"	"
	16:23	185	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Aug. 6, 1973	16:27	185	Photo	Long	High
	16:38	183	"	"	"
	17:46	185	"	"	"
	18:05	"	"	"	"
	18:08	"	"	"	"
	18:14	"	"	"	"
	18:18	"	"	"	"
	18:24	"	"	"	Low
	18:51	"	"	"	"
	19:12	"	"	"	"
	19:50	"	"	"	"
	20:02	"	"	"	"
	20:15	"	"	"	"
	20:26	"	"	"	"
	20:36	"	"	"	High
	20:53	"	"	"	"
	21:00	"	"	"	Low
	21:12	"	"	"	"
	21:33	"	"	"	"
	21:53	"	"	"	"
Aug. 7, 1973	14:15	"	"	"	"
	14:18	185	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Aug. 7, 1973	14:25	183	Photo	Long	High
	14:35	"	"	"	"
	14:45	185	"	"	"
	15:03	"	"	"	"
	19:02	"	"	"	"
	19:08	"	"	"	"
	19:40	"	"	"	"
	19:56	"	"	"	Low
	20:29	186	"	"	High
	21:28	185	"	"	"
Aug. 9, 1973	14:46	"	"	"	Low
	15:04	"	"	"	High
	15:27	"	"	"	Low
	15:56	183	"	"	"
	16:01	"	"	"	"
	16:15	186	"	"	"
	16:26	184,185	"	"	"
Aug. 10, 1973	13:17	185	"	"	High
	13:20	"	"	"	"
	13:35	186	"	"	"
	13:41	186	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Aug. 10, 1973	13:51	183	Photo	Long	Low
	14:00	"	"	"	"
Aug. 11, 1973	12:19	185	"	"	"
	12:55	"	"	"	High
	13:15	183	"	"	Low
	13:36	186	"	"	High
	13:41	"	"	"	"
	14:43	"	"	"	Low
	14:49	Plage	"	"	"
	15:20	183	"	"	"
Aug. 12, 1973	14:14	186	"	"	High
	14:16	"	"	"	"
Aug. 18, 1973	16:07	193	"	"	?
	16:23	"	"	"	?
Aug. 19, 1973	14:07	"	"	"	?
	14:20	192	"	"	?
	14:39	193	"	"	?
	14:41	"	"	"	?
	14:48	"	"	"	?
Aug. 20, 1973	13:38	"	"	"	High
	13:46	193	Photo	Long	High

DATA	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Aug. 20, 1973	13:51	193	Photo	Long	Low
	14:03	"	"	"	"
Aug. 21, 1973	12:48	"	"	"	"
	12:52	"	"	"	"
	13:16	"	"	"	"
Aug. 22, 1973	12:34	"	"	"	"
	13:08	"	"	"	"
	13:11	"	"	"	"
	13:34	Plage, E Limb	"	"	High
	13:45	Plage, E Limb	"	"	"
	16:27	193	"	"	Low
Aug. 23, 1973	13:31	203	"	"	High
	14:01	193	"	"	Low
	14:14	"	"	"	"
Aug. 24, 1973	13:05	203	"	"	High
	13:16	"	"	"	"
	20:58	"	"	"	Low
Aug. 25, 1973	13:25	"	"	"	"
	13:34	"	"	"	"
	13:45	193	"	"	"
Aug. 26, 1973	13:03	"	"	"	"
	13:19	203	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Aug. 26, 1973	13:24	203	Photo	Long	Low
Aug. 27, 1973	12:43	"	"	"	"
	12:51	"	"	"	"
	12:56	208	"	"	"
	13:04	193	"	"	"
	13:34	206	"	"	"
	13:43	"	"	"	"
	20:23	208	"	"	High
Aug. 28, 1973	13:30	"	"	"	Low
	13:46	203	"	"	"
	13:48	"	"	"	"
	14:06	206	"	"	"
	14:16	193	"	"	"
	19:14	208	"	"	"
Aug. 29, 1973	12:57	"	"	"	"
	13:01	"	"	"	"
	13:15	203	"	"	"
	13:21	209	"	"	"
	13:37	S10 E22	"	"	High
	13:38	"	"	"	"
	14:46	206	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Aug. 30, 1973	12:43	209	Photo	Long	Low
	12:48	"	"	"	"
	13:04	211	"	"	"
	13:12	203	"	"	"
	13:21	208	"	"	"
	13:31	"	"	"	High
	13:42	"	"	"	"
	13:46	206	"	"	Low
	14:11	207	"	"	"
	19:29	209	"	"	"
	19:44	"	"	"	"
	19:51	"	"	"	"
	19:57	"	"	"	"
	20:04	"	"	"	"
Aug. 31, 1973	13:13	212	"	"	"
	13:18	209	"	"	"
	13:30	203	"	"	"
Sept. 1, 1973	13:08	212	"	"	"
	13:12	209	"	"	"
	13:17	208	"	"	"
Sept. 2, 1973	14:27	212	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	TYPE DATA	MODE	MAGNIFICATION
Sept. 2, 1973	14:38	215	Photo	Long	Low
	14:44	209	"	"	"
	14:52	210	"	"	"
	14:59	213	"	"	"
	15:05	211	"	"	"
Sept. 3, 1973	13:02	212	"	"	"
	13:07	209	"	"	"
	13:14	210	"	"	"
	13:20	215	"	"	"
	13:24	"	"	"	"
	13:27	"	"	"	"
	13:33	211	"	"	"
	13:36	"	"	"	"
	13:42	203,213	"	"	"
	13:47	"	"	"	"
	13:54	219	"	"	"
Sept. 4, 1973	13:34	"	"	"	"
	14:01	212	"	"	"
	14:06	215	"	"	"
	14:10	219	"	"	"
	14:14	209	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Sept. 4, 1973	14:18	210	Photo	Long	Low
	14:23	211	"	"	"
	14:29	203,213	"	"	"
	14:35	Plage	"	"	"
	15:05	212	"	"	"
	15:12	"	"	"	"
	15:17	"	"	"	"
	15:34	"	"	"	"
	15:50	"	"	"	"
	15:59	209	"	"	"
Sept. 5, 1973	13:40	219	"	"	"
	13:51	212	"	"	"
Sept. 8, 1973	13:06	"	"	"	"
	13:12	210	"	"	"
	13:20	209	"	"	"
	13:32	219	"	"	"
	13:46	215	"	"	"
Sept. 9, 1973	12:55	219	"	"	"
	12:59	"	"	"	"
	13:04	215	"	"	"
	13:15	212	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Sept. 9, 1973	13:24	209	Photo	Long	Low
	13:31	210	"	"	"
Sept. 10, 1973	12:52	219	"	"	"
	13:04	"	"	"	"
	13:15	"	"	"	"
	13:20	224	"	"	"
	13:26	215	"	"	"
	13:33	212	"	"	"
	13:42	"	"	"	High
	13:48	224	"	"	"
Sept. 12, 1973	13:34	219	"	"	Low
Sept. 14, 1973	20:39	226	"	"	"
	20:49	"	"	"	"
	20:45	"	"	"	"
Sept. 16, 1973	13:34	Spot S04 E10	"	"	"
	13:42	"	"	"	"
	13:53	"	"	"	"
	14:23	227	"	"	"
	14:35	"	"	"	"
	14:39	Plage SW227	"	"	"
	14:45	Plage SW227	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MODIFICATION
Sept. 16, 1973	14:48	226	Photo	Long	Low
	16:07	227	"	"	High
Sept. 18, 1973	13:19	228	"	"	Low
	13:32	226	"	"	"
	13:48	"	"	"	"
	13:51	227	"	"	"
Sept. 19, 1973	13:09	"	"	"	"
	13:12	"	"	"	"
	13:16	"	Photo/ Digital	"	"
	13:52	231	"	"	High
	14:05	226	"	"	Low
	14:30	232,233	"	"	"
	19:40	227	Photo	"	"
	20:25	"	"	"	"
Sept. 20, 1973	12:56	"	"	"	"
	13:01	"	"	"	"
	13:06	234	"	"	"
	13:12	"	"	"	"
	13:27	226	"	"	"
	13:39	228	"	"	High
	13:53	228	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Sept. 21, 1973	13:19	234,236	Photo	Long	Low
	13:28	"	"	"	"
	13:36	231	Photo/ Digital	"	High
	13:39:43	227	Digital	"	Low
	13:39:47	"	"	"	"
	13:40:00	"	"	"	"
	13:40:11	"	"	"	"
	13:40:19	"	"	"	"
	13:40:25	"	"	"	"
	13:40:33	"	"	"	"
	13:40:41	"	"	"	"
	13:40:49	"	"	"	"
	13:43	"	Photo	"	"
	13:56	228	"	"	"
Sept. 22, 1973	13:55	234,236	"	"	"
	14:06	"	Photo/ Digital	"	"
	14:14	227	"	"	High
	14:20	228	"	"	Low
	14:27	231	"	"	High
	14:30	234	"	"	"
	14:34	236	Photo/ Digital	"	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Sept. 22, 1973	14:37	234	Photo/ Digital	Long	High
Sept. 23, 1973	13:53	236	Photo	"	"
	14:41	234	"	"	"
Sept. 24, 1973	14:06	236	"	"	Low
	14:11	234	"	"	"
	14:17	227	"	"	High
	14:23	228	"	"	"
	14:40	231	"	"	"
	14:57	"	"	"	"
	15:00	234	"	"	"
Sept. 25, 1973	13:26	234,236	Photo/ Digital	"	Low
	13:30	"	"	"	"
	13:33	"	"	"	"
	13:41	241	"	"	High
	13:47	231	"	"	"
	13:56	245	"	"	"
Sept. 27, 1973	19:50	234,236	Photo	"	Low
	19:58	"	"	"	"
	20:20	NO5 E80	"	"	"
Oct. 2, 1973	20:57	247	Photo/ Digital	"	"
	21:10	241	"	"	"
	21:16	248	Photo/ Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Oct. 3, 1973	14:02	248	Photo/ Digital	Long	High
	14:10	247	"	"	Low
	14:16	241	"	"	"
	14:20	245	"	"	"
	14:28	"	"	"	"
	14:37	Plage	"	"	"
	14:47	Quiet	"	"	"
	15:17	247	Digital	"	"
	15:18:00	"	"	"	"
	15:18:15	"	"	"	"
	15:18:19	"	"	"	"
	15:18:25	"	"	"	"
	15:18:30	"	"	"	"
	15:18:40	"	"	"	"
	15:18:58	"	"	"	"
	15:19:00	"	Photo	"	"
Oct. 4, 1973	13:29	"	Photo/ Digital	"	"
	13:39	245	"	"	High
	13:49	241	"	"	"
	13:55	248	"	"	"
	15:09	247	Photo	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Oct. 5, 1973	13:08	247	Photo	Long	Low
	13:15	"	Photo/ Digital	"	"
	13:23	248	Photo	"	High
	13:28	241	"	"	"
	13:38	245	Photo/ Digital	"	"
	13:43	241	"	"	"
Oct. 6, 1973	13:55	247	Photo	"	Low
Oct. 7, 1973	13:35	248	Photo/ Digital	"	"
	14:03	247	"	"	"
Oct. 10, 1973	13:15	253	Photo	"	High
Oct. 17, 1973	13:50	255	"	"	"
	14:02	"	Photo/ Digital	"	"
	14:05	"	Digital	"	"
	14:06	"	"	"	"
	14:18	259	Photo	"	"
	14:37	"	Photo/ Digital	"	"
	14:40	"	Digital	"	"
	14:41	"	"	"	"
	20:08	255	"	"	Low
	20:10:00	"	"	"	"
	20:10:15	"	"	"	"
	20:11	255	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Oct. 17, 1973	20:14	255	Digital	Long	Low
	20:40	"	"	"	High
	20:41	"	"	"	"
	20:42	"	"	"	"
	20:44	"	Photo/ Digital	"	"
	20:47	"	Digital	"	"
	20:50	"	Photo/ Digital	"	"
	20:52	"	"	"	"
	20:55	"	Digital	"	"
	21:03	259	Photo/ Digital	"	Low
Oct. 18, 1973	13:16	255	Photo	"	High
	13:27	"	"	"	"
	13:30	"	Digital	"	"
Oct. 19, 1973	13:23	Plage E Limb	Photo	"	Low
	13:26	"	Digital	"	"
	13:32	"	"	"	"
	13:33	"	"	"	"
	14:22	"	Photo	"	"
Oct. 22, 1973	13:47	264	"	"	High
	13:54	"	Digital	"	"
Oct. 23, 1973	13:25	264	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Oct. 23, 1973	13:32	264	Digital	Long	High
	13:33	"	Photo	"	"
	13:42	265	"	"	"
	14:29	264	"	"	"
	19:22	"	Digital	"	Low
	19:23	"	"	"	"
	19:41	"	"	"	"
	19:44	"	"	"	"
	19:47	"	"	"	High
	19:48	"	Photo/ Digital	"	"
	19:51	"	"	"	"
	19:58	"	Digital	"	"
	19:59	"	"	"	"
	20:01	"	"	"	"
	20:02	"	"	"	"
	20:03	"	"	"	"
	20:04	"	"	"	"
	20:06	"	"	"	"
	20:07	"	"	"	"
	20:08	"	"	"	"
	20:10	264	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Oct. 23, 1973	20:12	264	Digital	Long	High
	20:13	"	"	"	"
	20:14	"	"	"	"
	20:15	"	"	"	"
	20:33	"	"	"	"
	20:42	"	"	"	"
	20:43	"	"	"	"
	20:45	"	Digital/ Photo	"	"
	20:46	"	Digital	"	"
	20:47	"	"	"	"
	20:48	"	"	"	"
	20:52	"	"	"	"
	20:54	"	"	"	"
	20:56	"	Photo	"	"
Oct. 24, 1973	13:20	"	"	"	Low
	13:23	"	Digital	"	"
	13:31	"	Digital/ Photo	"	"
	13:34	"	"	"	"
	13:43	265	"	"	"
	21:05	264	Digital	"	"
	21:06	"	"	"	"
	21:21	264	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Oct. 24, 1973	21:23	264	Digital	Long	Low
	21:24	"	"	"	"
	21:25	"	Digital/ Photo	"	"
	21:30	"	Digital	"	"
	21:31	"	"	"	"
	21:32	"	"	"	"
	21:33	"	"	"	"
Oct. 25, 1973	13:11	"	Photo	"	"
	13:36	"	Photo/ Digital	"	"
	13:59	"	Digital	"	"
	14:01	"	"	"	"
	14:03	"	"	"	"
	14:04	"	"	"	"
	14:05	"	"	"	"
	14:06	"	"	"	"
	14:10	"	"	"	"
	14:15	"	"	"	"
	14:16	"	Digital/ Photo	"	"
	16:00+	-	-	-	-
	18:41	264	Photo	Long	Low

+ Multi-component electro-optical unit installed in optics box

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Oct. 25, 1973	20:13	264	Digital	Long	Low
	20:14	"	"	Vector	"
	20:17	"	"	Long	"
	20:24	"	"	"	"
	20:25	"	"	Vector	"
	20:28	"	"	Trans	"
	20:30	"	"	Vector	"
	20:32	"	"	"	"
	20:34	"	"	"	"
	20:37	"	"	"	"
	20:40	"	"	"	"
	20:42	"	"	"	"
	20:46	"	"	"	"
	20:49	"	"	"	"
Oct. 26, 1973	13:35	"	Photo	Long	"
Nov. 16, 1973	16:01	280	Digital	"	"
	16:03	"	"	Trans	"
	16:05	"	"	Vector	"
	16:09	Plage	"	"	"
	16:47	280	Photo	Long	"
	19:22	280	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Nov. 16, 1973	19:23	280	Digital	Long	Low
	19:27	"	"	Vector	"
	19:31	"	"	"	High
	19:34	"	"	"	"
	19:39	"	"	"	"
	19:41	"	"	"	Low
	19:51	Plage	"	Long	"
	19:57	"	"	Vector	"
Nov. 21, 1973	20:19	280	Photo	Long	?
	20:21	"	"	"	?
Nov. 29, 1973	14:12	287	"	"	Low
	15:30	"	Digital	"	"
	15:31	"	"	"	"
	16:03	"	"	"	"
	16:05	"	"	"	"
	16:06	"	"	"	"
	16:08	"	"	Vector	"
	16:10	"	"	"	"
	16:13	"	Digital/ Photo	"	"
	16:16	"	Photo	Long	"
	16:37	287	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Nov. 29, 1973	16:38	287	Digital	Vector	Low
	16:40	"	"	"	"
	16:49	284	"	"	High
	16:51	"	"	Long	"
	16:52	"	"	"	"
	16:53	"	"	Trans	"
	16:54	"	"	"	"
	16:55	"	"	"	"
	16:57	"	"	"	"
	16:58	"	"	"	"
	16:59	"	"	"	"
	17:03	"	"	"	"
	17:08	"	"	"	"
	17:09	"	"	"	"
	17:16	287	Digital/ Photo	Long	"
	17:18	"	Digital	"	"
	17:19	"	"	"	"
	17:20	"	"	Trans	High
	19:32	"	"	Long	Low
	19:45	"	"	"	"
	19:47	287	Digital	Trans	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Nov. 29, 1973	19:48	287	Digital	Long	Low
	19:49	"	"	Trans	"
	20:20	"	"	Long	"
	20:21	"	"	Vector	"
	20:25	"	"	"	"
Nov. 30, 1973	14:06	"	Photo	Long	"
	14:07	"	"	"	"
	15:52	"	Digital	"	"
	15:55	"	"	"	"
	15:57	"	"	"	"
	16:00	"	"	Vector	"
	20:07	"	Photo	Long	"
	20:18	"	"	"	"
	20:22	"	Digital	"	"
	20:23	"	"	"	"
	20:25	"	"	Vector	"
	20:28	"	"	"	"
	20:31	"	Digital/ Photo	"	"
	20:38	"	Digital	"	"
	20:40	"	"	"	"
	20:46	287	Digital	Vector	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Nov. 30, 1973	20:47	287	Digital	Vector	Low
	20:49	"	"	"	"
Dec. 1, 1973	14:26	"	Photo	Long	"
	14:29	"	"	"	"
	16:26	"	Digital	"	"
	16:27	"	"	"	"
	16:28	"	"	Vector	"
	16:29	"	"	"	"
	16:31	"	"	"	"
	16:42	"	Photo	Long	"
	20:11	"	Photo/ Digital	"	"
	20:14	"	Digital	"	"
	20:15	"	"	"	"
	20:16	"	"	Vector	"
	20:17	"	"	"	"
Dec. 2, 1973	14:07	"	Photo	Long	"
	15:04	"	"	"	"
	15:21	"	Digital	"	"
	15:23	"	"	Vector	"
	15:24	"	"	"	"
	15:25	287	Digital	Vector	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Dec. 2, 1973	16:20	287	Photo	Long	Low
	16:24	"	Digital	Vector	"
	16:25	"	"	"	"
	16:26	"	"	"	"
	16:30	"	Photo	Long	"
	16:35	"	Digital	Vector	"
	16:36	"	"	"	"
	16:38	"	"	"	"
	16:39	"	"	"	"
	16:40	"	Photo	Long	"
	16:58	"	Digital	Vector	"
	16:59	"	"	"	"
	17:00	"	"	"	"
	17:12	"	"	Long	"
	17:13	"	"	Vector	"
	17:14	"	"	"	"
	17:15	"	"	"	"
	18:38	"	Photo	Long	"
	18:43	"	Digital	Vector	"
	18:44	"	"	"	"
	18:45	"	"	"	"
	18:48	287	Digital	Vector	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Dec. 2, 1973	18:49	287	Digital	Vector	Low
	18:56	"	"	"	"
	19:04	"	"	"	"
	19:08	"	"	"	"
	19:24	"	"	"	"
	19:25	"	"	"	"
	20:39	"	Photo	Long	"
Dec. 3, 1973	15:00	"	"	"	"
	15:12	"	"	"	"
Dec. 6, 1973	15:31	Plage	Digital	"	"
	15:34	"	"	Trans	"
	15:36	"	"	Vector	"
	15:43	"	"	Long	High
	15:44	"	"	Trans	"
	15:45	"	"	Vector	"
Dec. 14, 1973	17:29	Small Spot	"	Long	Low
	17:30	"	"	"	"
	17:31	"	"	Trans	"
	17:32	"	"	"	"
	17:33	"	"	Long	"
	17:35	Small Spot	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Dec. 14, 1973	17:36	Small Spot	Digital	Long	High
	17:37	"	"	"	"
	17:38	"	"	Trans	"
	17:39	"	"	"	"
	17:40	"	"	"	"
	17:43	Quiet	"	Long	Low
Dec. 19, 1973	14:10	300	Photo	"	"
	14:50	"	"	"	"
	15:04	"	"	"	"
	15:23	299	"	"	"
	16:37	300	Digital	"	"
	16:40	"	"	"	"
	16:41	"	"	"	"
	16:42	"	"	Trans	"
	16:44	"	"	Vector	"
	19:13	"	"	Long	"
	19:16	"	Photo	"	"
Dec. 20, 1973+	-	-	-	-	-
Dec. 21, 1973	16:58	300	Photo	Long	Low
	17:00	"	"	"	"
	21:26	300	Digital	Long	Low

+ Multi-component electro-optical unit replaced with single KD*P element

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Dec. 21, 1973	21:27	300	Digital	Long	Low
	21:28	"	"	"	"
	21:29	"	"	"	"
	21:30	"	Digital/ Photo	"	"
Dec. 22, 1973	16:10	"	Photo	"	"
	16:11	"	"	"	"
	16:20	299	"	"	"
	18:34	300	Digital	"	"
	18:35	"	"	"	"
	18:37	"	"	"	"
	19:02	"	"	"	"
	19:04	"	"	"	"
	19:05	"	"	"	"
	19:06	"	"	"	"
	19:07	"	"	"	"
	19:08	"	"	"	"
	19:09	"	"	"	"
	19:10	"	"	"	"
	19:11	"	"	"	"
	19:12	"	Digital/ Photo	"	"
	19:33	"	Digital	"	"
	19:34	300	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Dec. 22, 1973	19:35	300	Digital	Long	Low
	19:36	"	"	"	"
	21:06	"	Photo	"	"
Dec. 27, 1973	16:24	"	"	"	"
Dec. 28, 1973	17:10	Plage	Digital	"	"
	17:12	"	"	"	"
	17:32	Quiet	"	"	"
Jan 12, 1974	20:01	316	Photo	"	"
	20:08	"	"	"	"
	20:20	"	"	"	"
	20:27	"	"	"	"
Jan. 13, 1974	14:12	"	"	"	"
	16:10	"	Digital	"	"
	16:11	"	"	"	"
	16:25	"	"	"	"
	16:28	"	"	"	"
	16:29	"	"	"	"
	16:31	"	"	"	"
	16:33	"	"	"	"
	17:10	"	"	"	"
	17:11	316	Digital	Long	Low

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Jan. 13, 1974	17:12	316	Digital	Long	Low
	17:14	"	"	"	"
	17:17	"	Digital/ Photo	"	High
	17:43	"	Digital	"	"
	17:44	"	"	"	"
	17:46	"	"	"	"
	17:48	"	Digital/ Photo	"	"
	17:51	"	Digital	"	"
	17:52	"	"	"	"
	17:54	"	"	"	"
	17:55	"	"	"	"
	17:57	"	"	"	"
	17:58	"	Digital/ Photo	"	"
	18:05	320,321	Digital	"	Low
	18:07	"	Digital/ Photo	"	"
	18:11	314	"	"	"
	18:15	"	Digital	"	"
	18:23	Plage	"	"	"
	18:29	316	"	"	High
	18:30	"	"	"	"
	18:34	316	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Jan. 13, 1974	18:36	316	Digital	Long	High
	18:37	"	"	"	"
	18:38	"	"	"	"
Jan. 21, 1974	18:38	331	Digital/ Photo	"	Low
	18:41	"	Digital	"	"
	18:45	"	"	"	High
	18:46	"	Digital/ Photo	"	"
	18:55	"	Digital	"	"
	18:56	"	"	"	"
	19:01	"	"	"	"
	19:02	"	"	"	"
	19:08	"	"	"	"
	19:10	"	"	"	"
	19:12	"	"	"	"
	19:19	"	"	"	"
	19:20	"	"	"	"
	19:23	"	"	"	"
	19:25	"	"	"	"
	19:28	"	Digital/ Photo	"	"
	19:30	"	Digital	"	"
	19:32	"	"	"	"
	19:34	331	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Jan. 21, 1974	19:37	331	Digital	Long	High
	19:39	"	"	"	"
	19:40	"	"	"	"
	19:42	"	"	"	"
	19:43	"	Digital/ Photo	"	"
	19:45	"	Digital	"	"
	19:47	"	"	"	"
	19:57	"	"	"	"
	19:59	"	Digital/ Photo	"	"
	20:05	"	Digital	"	"
	20:07	"	"	"	"
	20:09	"	"	"	"
	20:13	"	"	"	"
	20:15	"	"	"	"
	20:18	"	Digital/ Photo	"	"
	20:22	"	Digital	"	"
Jan. 22, 1974	13:40	"	Photo	"	"
	13:43	"	"	"	"
	13:45	"	"	"	"
	13:50	"	"	"	"
	13:58	"	"	"	"
	14:17	331	Photo	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Jan. 22, 1974	14:23	331	Digital	Long	High
	14:25	"	"	"	"
	14:30	"	"	"	"
	14:31	"	"	"	"
	14:35	"	"	"	"
	14:45	"	"	"	"
	14:49	"	Digital/ Photo	"	"
	14:56	"	Digital	"	"
	15:01	"	"	"	"
	15:02	"	"	"	"
	15:04	"	"	"	"
	15:10	"	"	"	"
	15:16	"	"	"	"
	15:24	"	"	"	"
	15:29	"	"	"	"
	15:32	321	Digital/ Photo	"	"
	18:01	331	Digital	"	"
	18:03	"	"	"	"
	18:05	"	Digital/ Photo	"	"
	18:08	"	Digital	"	"
	18:10	321	Digital	Long	High

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Jan. 22, 1974	18:12	321	Digital	Long	High
	18:21	331	"	"	"
	18:23	"	"	"	"
	19:36	"	"	"	"
	19:38	"	"	"	"
	19:53	"	"	"	"
	19:57	"	"	"	"
	20:06	321	"	"	"
	20:08	"	"	"	"
	20:16	331	"	"	"
	20:27	"	"	"	"
Jan. 31, 1974	18:49	338	"	"	"
	18:50	"	"	"	"
	18:54	"	"	"	"
	18:55	"	"	"	"
	20:22	"	"	"	"
	20:23	"	"	"	"
Feb. 1, 1974	15:15	"	Photo	"	?
	15:22	339	"	"	?
Feb. 5, 1974*	-	-	-	-	-

* D.C. restoration circuit installed

DATE	UNIVERSAL TIME	REGION	DATA TYPE	MODE	MAGNIFICATION
Feb. 11, 1974+	-	-	-	-	-
Feb. 12, 1974	19:42	N08 E17	Digital	Long	Low
	19:44	346	"	"	"
	19:45	"	"	"	"
	19:47	"	Digital/ Photo	"	"
	19:49	"	Digital	"	"
	19:50	"	"	"	"
	20:05	"	Digital/ Photo	"	"
	20:08	"	Digital	"	"
Feb. 17, 1974	16:10	352	Photo	"	"
	16:44	"	Digital	"	"
	16:45	"	"	"	"
	16:46	"	"	"	"
	16:47	"	"	"	"
	16:48	"	"	"	"
	17:39	347	Photo	"	High
	17:45	352	"	"	Low
Feb. 20, 1974	15:07	352	Photo	Long	Low

+ New single KD*P crystal installed

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APPROVAL

REAL TIME SOLAR MAGNETOGRAPH SKYLAB MISSION ATLAS

By M. J. Hagyard and N. P. Cumings

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

Anthony C. DeLoach

ANTHONY C. DELOACH
Chief, Solar Science Branch

William C. Snoddy

WILLIAM C. SNODDY
Chief, Astronomy and Solid State Physics Division

Charles A. Lundquist

CHARLES A. LUNDQUIST
Director, Space Sciences Laboratory

R. ISE
Manager,
Skylab Program Office

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