Tab settings for Selectric typewriter:
Green: any 10-pitch element [set on "10", left back of typewriter]
Read the numbers below on the 10-scale on front of typewriter.

red: any 12-pitch element (the numbers refer to those on the 12-scale on front of typewriter)

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78- Santa Cruz, California

~~First edition~~ April 1978
Amended ~~Second edition~~ April, June 1980

This memo was mailed to people who had already received the earlier edition (April '78).

June 30, 1980

TO: Users of Lick Observatory Technical Rep
"Everything You Always Wanted to Ask St
Afraid To"

FROM: Marilyn Oreck
Lick Observatory Publications

Attached are a number of revised pages to Tech
Changes from the original text are identified
left margin. The old pages in your copy of th
replaced by these revised ones. Pages 33a&b a
completely new and should be inserted in the a

Revisions or additions, June 1980

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UNIVERSITY OF CALIFORNIA

LICK OBSERVATORY TECHNICAL REPORTS

NO. 26

EVERYTHING YOU ALWAYS WANTED TO ASK STEVE GRANDI

BUT WERE AFRAID TO

S. A. Grandi

8K Special Tape
32K Special Tape
SDRS Changes
IBM-SDRS

Santa Cruz, California

First edition April, 1978
Second edition April, June 1980

REVISIONS

Revisions to Technical Report No. 26 are in the form either of changes made within the original text or of entirely new pages added. In the former case, an arrow in the left margin will indicate the line(s) that have been changed. In the latter case, when a new page has been inserted, the title of that page will be added to the Table of Contents with an arrow next to it in the margin.

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LICK OBSERVATORY TECHNICAL REPORT NO. 26

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8K SPECIAL TAPE

This writeup describes the scanner reduction and analysis programs present on the 8K Special Tape, also known as the Koski Special Tape.

The programs may be used by bootstrapping the 8K Special dectape or disc and typing GO. This will load the Selector, which lists a menu of available programs and which branches to the one chosen. The Selector may be entered from a program by: 1) entering "-1" to an appropriate input parameter; 2) hitting control-C to exit to the monitor, and typing GO; or 3) hitting control-C and then typing "X CALL (1,1)".

A terse description of the use of each program is included in this write-up. These instructions are quite brief and should be considered as introductory guides only.

A map of the Programs and Names on the tape follows this introduction. There are several programs of dubious utility (such as program 8 called "Bicycle Gears") which are physically present on the tape, but I have not documented them. The 8K Special Tape contains the Focal system SCN 78-A which is a revision of SCN 75-C allowing it to run on a 40K PDP-8 without a DF 32 disc.

Alan Koski wrote, or adapted, most of the programs on the 8K Special Tape. Mark Phillips wrote Superdeblend (as well as its excellent documentation). I apologize to the program authors whom I have failed to mention - ignorance is my only excuse.

PROGRAM MAP - 8K SPECIAL TAPE

PROGRAM NUMBERS				PROGRAM
1	___	___	___	Selector
2	___	___	___	2048 Channel Scan Transfer
9	___	___	___	Fast Intensities
12	___	___	___	Precision Unredshifter
13-15	___	___	___	Plot, Batch Plot
16	___	___	___	Line Unreddener
17	___	___	___	4096 Channel Plot, 4096 Channel Batch Plot
18	___	___	___	Widen by Gaussian
19-20	___	___	___	Chunk Plot
21	___	___	___	4096 Channel Batch Plot/Widen by Gaussian
22	___	___	___	Plot R,L, (R+L)/2
23	___	___	___	Plot (same as program 15)
25-27	___	___	___	Lines
28	___	___	___	Wavelength Tables for Lines
29-30	___	___	___	Lines
33	___	___	___	X Name (72-73)
35	___	___	___	8K IBM Tape Handler
36	___	___	___	X Name (78-79)
40-41	___	___	___	Subtract Two Scans
43	___	___	___	Slow Scan Unreddener
45	___	___	___	Widen Single Line by Gaussian
46-47	___	___	___	X Name (98-101)
48	___	___	___	Widen Single Line by Gaussian
50	___	___	___	IBM Response Curve Fixer
61	___	___	___	X Name (128-129)
63	___	___	___	Plot Overlay Positions
64-65	___	___	___	Adder
66	___	___	___	X Name (138-139)
70-74	___	___	___	Grapher
75-76	___	___	___	Super Deblend
77	___	___	___	X Name (160-161)
78-79	___	___	___	Super Deblend
90	___	___	___	X Name (186-187)
91-97	___	___	___	Super Deblend

X NAME MAP

NUMBER				CONTENTS
1	___	___	___	SUPERTINC, DTIM (PPUL), FILT 2/73
2	___	___	___	10 OCT '74 LOGB, SHOV, MOVE
3	___	___	___	POLY, FLIP
4	___	___	___	PAIR, SCRN, ETAP, DMUL (TMUL)
5	___	___	___	TTTT 15 DEC 1974
6	___	___	___	TTTP DEC 72
7	___	___	___	10 OCT '74 FIND, SIG, SEEK
72	___	___	___	12/5/74 IBM, ISOR
73	___	___	___	TTTT DEC 72
78	___	___	___	LOGB, NUDG 17 APR '75
79	___	___	___	PAIR, SCRN, ETAP, DMUL
98	___	___	___	POLY, FLIP
100	___	___	___	LOGB, NUDG 17 APR '75
101	___	___	___	6/73 TINC/TNC2, DTIM/PPUL, FILT
128	___	___	___	TTTT DEC 72
129	___	___	___	4/73 POLY, FLIP
138	___	___	___	LOGB, NUDG 17 APR '75
160	___	___	___	LOGB, NUDG 17 APR '75
161	___	___	___	4/73 POLY, FLIP
186	___	___	___	LOGB, NUDG 17 APR '75
187	___	___	___	PAIR, SCRN, ETAP, DMUL (TMUL)

2048 - CHANNEL SCAN TRANSFER

This program copies sequences of 2048-channel scans. The program asks "GET: 1ST/LAST SCAN" whereupon the user enters the first and last scan number of the sequence to be copied. The program then asks the dectape "UNIT" to be copied from, and asks "STORE AS SCANS" expecting the first scan number on the target unit. The program calculates and prints the last scan number and then asks the target "UNIT. To escape back to the Selector, enter -1 for the first scan number.

FAST INTENSITIES

This program will measure emission line strengths from reduced data scans. The program asks a scan number (enter -1 to escape back to the Selector). Next, the program asks for the dispersion of the scan, taking as a prompt value the position of switch 1,7 (the top position of 1,7 corresponds to 0.625 Å/channel, the next position down corresponds to 1.25 Å/channel, etc.). Hitting escape will approve the prompt value, otherwise the correct value may be typed in. The program then asks for a redshift z. The lambda zero and scale factor of the scan are taken from the scan's ID record.

The scan is then plotted on the CRT, and the user should point to the line to be measured using the joystick. A segment of the scan containing the identified line is plotted on the CRT, and the user is allowed to change the scale of the plot. For example, if the value of SC = 100, making SC = 200 will make the emission lines 1/2 as tall while making SC = 50 will make the lines twice as tall; setting SC = -1 (or hitting escape) ends the process and enables the cursor. The user should then place the cursor on the intersection of the left wing of the emission line and the continuum and press 3,11. An

asterisk will be plotted, and the user should repeat the process for the right wing. Another asterisk will be plotted, the computer will think (thinking time is proportional to the width of the emission line) and finally will print the first moment wavelength of the emission line (in the rest frame of the object) and line flux (in the rest frame of the Earth) with the units 10^{-15} ergs sec^{-1} cm^{-2}.

Other lines in the same segment of the scan may then be measured; or, if switch 3,11 is pressed without moving the cursor, the whole scan is re-plotted. If switch 3,12 is held down while pressing 3,11, the program asks for a new scan.

A more versatile version of Fast Intensities is available on the 32K Special Tape.

PRECISION UNREDSHIFTER

This program will change the redshift of a scan to an arbitrary accuracy in Δz. However, to process a 2048 channel scan takes $\sim$4 minutes. There is a program on the 32K Special Tape that will change a scan's redshift almost instantaneously but with incremental values of Δz.

This program will process either 2048 or 4096 channel scans. Scan numbers are 2048 channel scan numbers when processing 2048 channel scans and 4096 channel scan numbers when processing 4096 channel scans. Entering a negative scan number will return to the Selector. The scan is plotted on the CRT, then the program asks for the lambda-zero value, the current z and the desired z. The program prints $\Delta z = (1 + z_{old})/(1 + z_{new})$ and then starts crunching the numbers. After an interminable wait, the unredshifted scan is plotted, the new lambda-zero is printed and the program asks where the new scan is to be stored.

PLOT

This program will plot 2048 channel scans on the calcomp plotter. The calcomp pen should be placed on the far right border of the plot paper. Switch 3,7 should be turned on if it is desired to have the scan number and the plot scale printed on the bottom of the plot. The program will ask "PTS/CH:" (points/channel). A value of 1 indicates a horizontal scale of 100 channels/inch, a value of 0.5 indicates a scale of 200 channels/inch, etc. Acceptable choices for PTS/CH are 0.25, 0.5, 1, 2, 3, ...

The program asks for a scan number (-1 will cause an exit to the Selector) and then asks for a plot scale. The plot scale (PS) is defined such that F_ν = (height of plot in 0.01 inches) * PS * 10^{-SF} ergs sec^{-1} cm^{-2} Hz^{-1} where SF is the scale factor of the scan. Therefore doubling the plot scale will halve the height of the data on the plot. Alternatively, the program can be made to calculate the scale factor by entering - size. Size is the desired height (in 0.01 in.) of the peak data point in the scan. Thus entering -800 would cause the peak channel to be 8 in. high. If this option is used, the resultant plot scale is printed out.

The program then asks for an offset value, the placement (again in 0.01 in.) of zero on the calcomp plot. For example, offset = 0 will place zero on the bottom line of the resultant plot. Therefore SCALE = -500, OFFSET = 500 will place the plot in the upper half of the calcomp paper. An offset of -500 will cause the zero level to be placed 5 inches below the bottom of the plot.

The resultant scaled scan is plotted on the CRT (the CRT is not erased automatically) and the program asks whether to plot on the calcomp. If yes, → the program asks "NEW PG?" If yes, the calcomp pen will be advanced (based on → the PTS/CH specified). Finally, the scan is plotted and the program loops back → to ask for another scan.

Two features of the program should be noted. First, hitting escape for scan number, scale or offset will cause the previous values to be used. Second, if SW 2,1 is all the way up, the scan will be converted to a log flux scan.

BATCH PLOT

This program, an extension of PLOT, plots a series of 2048 channel scans. The program asks the first and last scan numbers of the series, the points per channel, the plot scale, the offset and whether the plotter should space forward one plot before plotting the first scan in the series. Generally, one would enter a negative number for the plot scale, indicating to the program that the individual plots should be scaled to a certain size. As in PLOT, having switch 3,7 up will cause the plot scale and scan numbers to be printed on the bottom of the plot. A log of the plots made is printed on the teletype.

LINE UNREDDENER

This program will apply reddening corrections to emission line measurements. The formulae are from Miller and Mathews 1972, ApJ 172, 593. Basically, $I(\lambda) = F(\lambda)\ 10^{cf(\lambda)}$ where I is the unreddened flux, F is the observed flux, $c = A_{H\beta}/2.5$ and $A_{H\beta}$ is the total extinction at Hβ.

The program first asks if c is known. If it is not, then the program asks the lambda of 2 lines (Hα and Hβ for example), their observed ratio and their theoretical ratio. The value of c is calculated and the series repeats (enter -1 for lambda to quit). The user must do any necessary averaging.

When c is known or calculated as above, the program asks which line will be used as the denominator in the intensity ratios (usually Hβ λ4861). The program then asks for a wavelength, an observed ratio and calculates the corrected ratio. Enter -1 for the wavelength to exit back to the Selector.

WIDEN BY GAUSSIAN

This program will convolve a gaussian with a scan. The gaussian can have FWHM between 0.2 and 34 channels, in steps of 0.2. The program widens, then stores the widened scan. If 3,7 is set, the program will widen a scan by a range of FWHM and store them all away. The program finally asks if chunk plots are desired and if so, a transfer is made to the chunk plot program.

CHUNK PLOT

This program allows specified portions of a scan to be plotted. If switch 3,7 is up, the scan will not be arbitrarily scaled. In other words, if 3,7 is flat, the normal relation between plot scale and flux scale will not be true.

The center of the chunk to be plotted should be indicated with the joystick, and a 256 channel section containing the indicated center will be displayed on the CRT (the programs works with blocks of 128 channels, so the indicated center of the chunk will not necessarily be in the center of the CRT). The scale and offset can now be changed to reflect what you want to plot. Setting -1 for the scale will indicate the end of changing the scale or offset. Hitting escape will cause the previous value of the scale or offset to be used. Minus offsets are handled correctly.

An automated scan scaling feature is available which is designed for plots of emission line profiles. -1 should be entered immediately for the scale, and when the question "SIZE?" is asked, "Y" should be entered. ("N" should be typed if the scale and offset were entered as above). The peak and continuum levels (or top and bottom of the desired data) should be marked with the cursor. The program then asks for a size which will be the height (in 0.01 inches) of

the peak-continuum distance on the plot. The scaled data is shown on the CRT with the calculated scale factor. The offset may be changed by hitting altmode for the scale. Otherwise enter -1 for the scale to go on.

The program now allows you to mark the horizontal limits of the desired chunk with the cursor, (mark the leftmost limit first, then the rightmost) and then asks for points/channel (1 point/channel means 100 channels/inch; 2 points per channel means 50 channels/inch). Finally, the program asks for "N" which is an ID number (always extended to 9 digits) to be printed on the bottom of the plot. Entering -1 for N will disable the printing. After the plot is completed, the program asks for the next scan; enter -1 to quit.

4096 - CHANNEL SCAN BATCH PLOT

This program plots a sequence of 4096-ch scans. The first and last scans (4096-channel scan numbers), the points per channel (0.25, 0.5, 1, 2 ...), the common plot scale (or a size value entered as a negative number - see the PLOT write up) and a common offset value are entered and the program goes from there. Each plot is displayed on the CRT as it is being plotted.

PLOT <R>, <L>, <R+L>/2

This program plots the left channel, the right channel and the average of the two on the same plot. The lower scan plotted is the right channel, the next is the left channel and the upper scan is the average. The 3 plots have the same scale.

The program asks for a sequence of 4096 channel scan numbers (1,5 is an acceptable scan number - although the value printed in the log will be rounded off) and then asks whether the data is raw or scrunched. If the data is scrunched, the right and left channels will be aligned in wavelength and

adjusted to the same flux scale. If scrunched data is to be plotted, switch 1,7 must be set to indicate the dispersion. The uppermost position on switch 1,7 indicates 0.625 Å/channel, the second highest position indicates 1.25 Å/channel, the next position indicates 1.875 Å/channel, etc. The program finally asks for a "SIZE X" parameter. A value of 1 indicates a normal (vertical) sized plot, a value of 0.5 indicates a half-sized plot, etc.

On the bottom of each plot, a small line is drawn that indicates the scan number plotted. Scan 1 will have a line plotted 0.1 inches from the lambda-zero line while scan 11 will have a line plotted 1.1 inches from the lambda-zero line.

LINES

This program finds peaks of emission or absorption lines and calculates redshifts, lambda-zeros and positions of lines on a plot.

The program asks "Do you want to find peaks?". If you answer "Y", the program asks for a scan (from unit 7) and plots it on the CRT with the cursor. Place the cursor on a line which you wish to find the peak of and hit switch 3,11. The display is blown up horizontally and the program gives the user a chance to change the vertical scale. Entering a larger value for SC will make the emission lines shorter while entering a smaller SC will increase the size of the line. Enter -1 for SC to continue.

The user should now place the cursor on the profile of the line. If switch 3,6 is flat, the program will integrate the line profile above the cursor to determine the first moment wavelength. If switch 3,6 is set, the program will integrate below the cursor (for an absorption line). If a peak is not found near enough to the center of the CRT (which is based on the initial identified position) the program will not record the peak. Otherwise, the program will print out a code number (starting with 100), a peak location in

channels and ask for a wavelength. The program maintains a table of commonly used wavelengths; to enter one of these wavelengths, the user should enter an index number from the following table rather than the complete wavelength. This table will be printed on the CRT unless switch 3,7 is set.

INDEX	WAVELENGTH	ID	
1	3345.83	[Ne V]	
2	3425.87	[Ne V]	
3	3868.76	[Ne III]	
4	3967.47	[Ne III]	
5	4101.74	Hδ	
6	4340.47	Hγ	
7	4363.21	[O III]	
8	4471.48	He I	
9	4685.68	He II	
10	4861.33	Hβ	
11	4958.92	[O III]	
12	5006.85	[O III]	
13	5517.66	[Cl III]	
14	5537.60	[Cl III]	
15	5577.35	[O I]	
16	5754.57	[N II]	
17	5875.63	He I	
18	6300.32	[O I]	
19	6363.81	[O I]	
20	6548.06	[N II]	
21	6562.82	[Hα]	
22	6583.39	[N II]	
23	6678.15	He I	
24	6716.42	[S II]	
25	6730.78	[S II]	
26	7065.19	He I	
27	3651.00	Night Sky	Hg I
28	4046.56	"	Hg I
29	4077.83	"	Hg I
30	4358.33	"	Hg I
31	5460.73	"	Hg I
32	5577.35	"	[O I]
33	5769.60	"	Hg I
34	5790.65	"	Hg I
35	5891.44	"	Na I
36	6300.32	"	[O I]
37	6363.81	"	[O I]

To stop finding peaks, the user should hit switch 3,11 without moving the cursor. The program gets the dispersion from switch 1,7, but the user is given a chance to correct it (hit escape if the value is correct as printed). The program asks for a redshift (z); enter -1 if you wish to have the program calculate it. The program then asks for the lambda zero; again, enter -1 if you wish to have the program calculate it. The program lists the residuals for each line (in channels) on the CRT and prints the fitted (or entered) values of z, $\sigma(z)$, λ_0 and $\sigma(\lambda_0)$(in both channels and angstroms).

Then the program asks: "Different Solution?", if "Y" is typed, different values of λ_0 or z may be entered. Otherwise, the program asks "Delete Lines"; if "Y" is entered, lines can be deleted (via their code numbers) from the fit. The program then asks "Add Lines?"; if "Y" is entered, the program returns to the identify-peaks procedure. If any lines are added or deleted, the program goes back for another attempt at a fit. Finally, a list of residuals is printed.

The program then asks "PTS/CH". If a positive number is entered, a list of (mostly) emission lines is displayed on the CRT with the distance (in inches) from the lambda zero line where the line should appear on a plot with the computed z and λ_0 and the entered PTS/CH. The program then asks "TTY?". If "Y" is entered, the list is printed out. Finally, the program asks "More Lines?". If Y is entered, a wavelength may be entered and the position of the line on the above-defined plot will be printed out. Enter -1 to quit.

If, at the beginning of the program, the user answered "N" to "Do You Want To Find Peaks?", the program asks "Do You Want To Enter Channel Numbers and Wavelengths?". Answering "Y" to this question enables the user to type in previously determined peaks and determine values of λ_0, and z and plot positions of lines. If "N" is entered at this point, the program expects a dispersion (from switch 1,7), a value for z and λ_0 in order to list line positions (various questions will be asked along the way - such as "Delete Lines?" - which are rather meaningless to this application).

8K IBM TAPE HANDLER

This program manipulates an 8K format 9-track IBM tape. The menu of options is listed on the CRT. These options are:

-1: Exit to 8K Special tape Selector

1: Rewind IBM tape

2: Erase 4 feet of tape (IBME)

3: Write EOF mark

4: Read IBM tape until EOF found

5: Count records and scans until EOF found

6: Advances N records

7: Backspaces N records

8: Writes a scan (2048 Channels) into the next 5 records on IBM tape

9: Reads next 5 records on IBM tape with a 2048 Channel scan

SUBTRACT 2 SCANS

This program subtracts a 2048 channel segment of a 4096 channel scan from another 2048 channel scan. This program can be used, for example, to subtract a composite elliptical galaxy spectrum from a Seyfert 2 galaxy scan.

→ The program calls the 2048 channel scan "A" (2048 channel scan number) and
→ the 4096 channel scan "B" (4096 channel scan number). (Enter -1 for the scan numbers to return to the Selector.) Scan A is displayed on the top, scan B is displayed on the bottom. The user should mark with the cursor the same points (emission lines or absorption lines) on both scans. Scan A should be marked first. Both x and y coordinates are significant. Finally, hit 3,11 twice to end the sequence.

The program then plots on the CRT scan A, the 2048 channel portion of B that "lines up" with A, and A-B. Also listed on the CRT are the parameters of the subtraction: intensity ratio I(B/A) and channel shift S (in channels).

The program now allows you to vary S and I: giving a starting value, an increment, the number of steps (<21) and "SIZE X" on the CRT (1 is "full sized", 0.5 is "half sized"). Scan A is plotted on the CRT, then A-B for each case is plotted. If 3,7 is flat, the relevant parameter is printed on the CRT with each iteration. Holding switch 3,11 down at the end of an iteration will terminate the sequence. Finally, the user should enter the best value of the varied parameter.

When the user is satisfied with the subtraction, -1 should be entered for "VARY <I/S>" and the program asks for a scan number in which the subtraction is to be saved. The program asks "Return?" and an answer of "Y" will allow the user to try different subtraction parameters with the same data.

SLOW SCAN UNREDDENER

This program will unredden a scan. The program takes ∿8 minutes per 2048 channel scan. After asking for the scan number and unit number, this program lists the λ_0 contained in the scan's ID record. An opportunity is given to change this value (hit escape if the printed λ_0 is correct). The program asks for a value of E(B-V) (E(B-V) = 0.72c) and then thinks for a long time. The unreddened scan is plotted on the CRT, and the program asks where it should be stored. An opportunity is given to plot the unreddened scan on the calcomp, and finally the program asks whether a new value of E(B-V) should be tried.

WIDEN SINGLE LINE BY GAUSSIAN

This program will convolve a single emission line with a gaussian of FWHM = 1, 1.2, 1.4, 1.6, ..., 34 channels. The program asks for a scan number, (enter -1 to exit) then plots the scan on the CRT. The user can then vary the scale (enter -1 to continue). Next, the cursor should be used to mark the line to be broadened. The scan is expanded vertically, and once again an opportunity is given to adjust the vertical scale. The user should mark 2 continuum points to which a line is fit. If this line is acceptable, the user should respond "Y" to "OK?". Next the user should mark the wings of the emission line with the cursor (the left wing should be marked first).

Now a series of broadenings may be specified. The user enters the first FWHM value, a step value and the last value (the program lists the maximum upper limit). The resultant profiles are plotted on the CRT. The individual profiles are labeled by the FWHM of the convolved gaussian and by the peak value (divided by 1E6) of the profile. As displayed (and stored) all the profiles are scaled to the same height. Finally, the computed profiles can be stored on dectape.

IBM RSCV FIXER

This simple program modifies a response curve generated by the IBM SDRS-program by adding the appropriate ID information (λ_0, dispersion and flux scale) to enable it to be used with the S^4 programs.

PLOT OVERLAY POSITIONS

This program plots a sky survey overlay from positions generated by the IBM OVERLAY program (see L.O.T.R. #18). X and Y coordinates of the SAO stars are

entered in mm (entering 0 for both coordinates will terminate the data entry). Entries may be deleted (by use of the entry index) and other entries added before the plot is made.

ADDER

This program enables several scans of the same object, with differing values of λ_0, to be combined into one composite scan. The program is set up for scans with dispersion of 1.25 Å/channel. For each scan (2048 channel scan numbers), the user must supply a value of λ_0 ($\lambda_0 \geq 3000$ Å) and a weight (which might be based on exposure time or a qualitative determination of "noise"). Also, for each scan, the user can specify with the cursor (left then right) the position to be included in the sum. The scan containing the largest flux levels (Hα in emission, for example) should be entered first, since all succeeding scans are scaled to this first scan before adding. Each succeeding scan is scaled according to its overlap with the previously entered scans. If no overlap is present, an error message is printed.

The resulting composite scan will have a λ_0 = 3000 Å and will be either 2*2048 or 3*2048 channels long.

GRAPHER

This program is designed to plot data arrays on the calcomp plotter. These arrays, which can be stored or retrieved from a dectape, consist of up to 129 elements. Up to 55 arrays may be present, plus one symbol array. Each array occupies 4 blocks on the DF 32 disk and dectape (blocks 0-3 of the dectape are reserved for the symbol array).

The first step in using Grapher is to load the symbol array. For each point to be plotted, the symbol array contains a code to determine the symbol to be plotted: . , +, x,□, or a blank. The program lists the appropriate codes as well as the codes to end entry or to read a symbol array from the data tape. Finally, the user is given the opportunity to save the symbol array on the tape.

Next, data arrays may be entered (see the CRT for instructions). The program will ask for data arrays (with increasing index numbers) until the user types "N" to the question "OK?". Entered data may be positive or negative, and the special entries 1E99 and -1E99 are used to indicate no entry and end of entry, respectively.

The program now enters an endless series of questions, to which "Y" or "N" should be answered (to escape back to the Selector, type control-C and then type G).

Answering Y to "ANOTHER PLOT?" will cause a plot to be set up. The user must provide, for the X and then the Y axis, the array to be plotted, the size in inches, the minimum and maximum values on the axis and the interval between tick marks. The calcomp pen must be placed at the initial position (which will become the lower left corner of the graph) on the right edge of the calcomp paper as seen by the operator. The length of the Y axis must be less than or equal to 10 inches. The last plot may be replotted by answering Y to "REPEAT PLOT?".

The other questions in the sequence are: "ADD ANOTHER ARRAY?", "CHANGE SYMBOL ARRAY?", "CHANGE ARRAY?", "STORE ARRAY ON TAPE?", "RETRIEVE ARRAY FROM TAPE?", and "AUTOPLOTTING". Elements in the symbol and data arrays are referred to by their index numbers. Arrays are referred to on the data tape by their first block number. Each array is four blocks long, so acceptable starting block numbers are 4, 8 ..(blocks 0-3 are reserved for the symbol array). To recall the symbol array off tape, restart the program.

The Autoplotting option automatically plots a single array against a sequence of arrays.

Superdeblend (by Mark Phillips)

Superdeblend is an improved version of the original deblend program written by Alan Koski. The basic purpose of the program is to obtain individual relative intensities of emission lines which are blended together. This is accomplished by the creation of a synthetic blend from input line profiles. The synthetic blend is then altered by varying the strengths of the component lines until the best match to the observations is obtained. Superdeblend can also be used to obtain information concerning the widths and profiles of blended emission lines.

Superdeblend occupies programs 75 - 97. The program utilizes nearly the entire disc storage area (records 0 - 27). In spite of the fact that it has been designed with efficiency in mind, Superdeblend is still a very slow program and the user must show a good deal of patience.

Superdeblend has the following limitations:

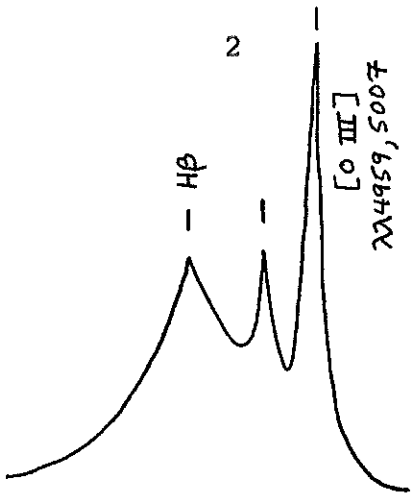
(1) The maximum number of lines which can be synthesized in a blend is 18.

(2) The maximum number of channels which the blend can occupy is 1024.

(3) Two different profiles can be used as input line profiles. Each input profile can occupy no more than 512 channels.

(4) Two different redshift systems can be defined.

Perhaps the best way to explain the program is by illustrating its use in the following example. Suppose one has observed a QSO with broad Hβ and narrow [O III] λλ4959, 5007 emission lines. The spectrum might appear as below:



We would like to use Superdeblend to obtain the relative strengths of these lines. Clearly the Hβ and [O III] lines have different profiles. Careful measurement has revealed that the redshifts of the peaks are also different, with z(Hβ) = 0.13 and z([O III]) = 0.10.

Before using Superdeblend, one must choose appropriate input line profiles. In this example, we are lucky to have obtained high-quality observations of Hα which can be used to synthesize Hβ. By even more good fortune, this QSO has strong [Ne V] λ3426 emission which we can use to synthesize the [O III] lines. Of course, in many cases things are not nearly so convenient, and one must show a little imagination to obtain the best results. Consult your local Superdeblend pundit for a few tricks of the trade.

To start, select program number 76 with the calling program. The following will then be typed out:

```
PROGRAM-SUPER DEBLEND

PROFILE 1:
  SCAN: ____
```

The program is now asking for the number of the scan which contains one of the input line profiles. Let's assume that the observations of Hα are in scan 18, and so we type that number. The program then types out the dispersion of the scan in Å/channel as selected with switch 1,7. (The top position of this switch corresponds to 0.625 Å/ch, the next one down to 1.25 Å/ch, the next to 1.875 Å/ch,

the next to 2.50 Å/ch, etc.) The program next asks ANG/CH: ____. If the preceeding "selected" dispersion was correct, then the user should hit ALT MODE. If however, switch 1,7 was incorrectly set, then type in the correct value at this point.

Scan 18 is then displayed on the CRT screen, and we are asked to mark the line center (of Hα) with the cursor (using switch 3,11). The program then displays on the CRT a 1024-ch segment of the scan centered on Hα, and types SC = nnn : ____ at the bottom. This is the plot scale, which can now be modified. The object is to find an adequate scale for defining the continuum (which is the next step). To change the scale, just type in a value. The scan segment will then be plotted at this new scale, and SC = nnn : ____ will again be typed at the bottom. When the desired scale has been found, entering a -1 for the scale will cause the program to proceed.

The cursor is now displayed again, and we are asked to mark the continuum. When the desired number of continuum points have been marked, the user should then push switch 3,11 again without moving the cursor. The question 2ND ORDER? : ___ will then appear. If "N" is typed, a linear fit to the continuum points will be computed and displayed. If "Y" is entered, a second order polynomial fit will be performed. (Make sure you have entered at least three points if the 2nd order fit is chosen!) After the continuum fit has been displayed, the user is asked OK? :___. A response of "N" will cause the scan segment to be redisplayed and allow the scale to be changed and the continuum points to be reentered for a new fit. If "Y" is typed, the user is told to MARK WINGS. Using the cursor, the left and then the right wings of the profile should be marked (only the x-position is used). The program then pauses a few moments while the emission-line flux is calculated. This value is then printed out (multiplied up by a factor of 10^{15}). The laboratory wavelength of the line

(= 6563 for Hα) and the redshift (= 0.13) are then requested.

The program next types:

```
PROFILE 2:
  SCAN: ___
```

The same procedure can now be repeated for the second input profile, which is [Ne V] λ3426 in our case. However, if a second input profile is not needed to synthesize the blend, then a response of -1 for the scan number is required here to move on to the next portion of the program.

Next in Superdeblend, the observed blend which is to be synthesized is isolated. The program asks SCAN: ____, and the scan number of the observed spectrum should be entered. The blend is then centered and a continuum computed on the CRT in exactly the same manner as was done for the input line profiles. When the user is asked to mark wings, the region of the blend which is to be synthesized should be marked. The blend is then finally displayed, with the continuum subtracted, at the top of the CRT.

We are now ready to enter the individual parameters of the component lines of the blend. First, however, the system redshifts are requested. The computer types SYSTEM 1: Z = : ____. In our case there are two redshift systems. Thus we define system 1 to be the redshift of the hydrogen lines, z = 0.13. After entering this, we are asked SYSTEM 2: Z = :___, to which we respond with the redshift of the [O III] lines of z = 0.10. If there is only one redshift system, then any response to this question is alright.

The program now types the following:

```
                        PROFILE          Z              BRD
LINE  WAVELENGTH    <1> OR <2>   <1>  OR <2>     DOP
 1       : ___
```

The user is now expected to type in the parameters for the lines which make up the blend. For the example considered here, the entries would be something

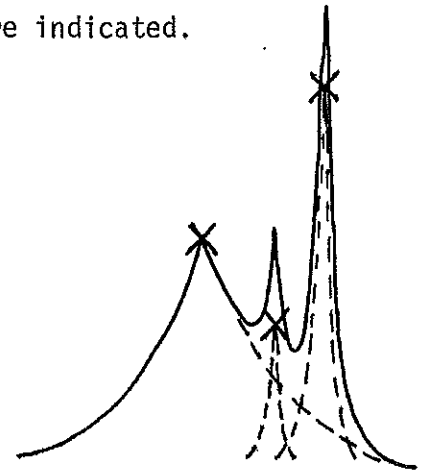
like the following:

LINE	WAVELENGTH	PROFILE <1> OR <2>	Z <1> OR <2>	DOP	BRD
1	:4861	:1	:1	.741	:(Alt Mode)
2	:4959	:2	:2	1.447	:(Alt Mode)
3	:5007	:2	:2	1.461	:(Alt Mode)
4	:-1				

The portions of the above which are underlined are where entries must be made by the user. In the first line, the wavelength for Hβ is entered, followed by the appropriate input profile number (of Hα) and redshift system. The broadening of the line is the final parameter. The broadening is defined as the width of the line divided by the width of the input profile used to synthesize the line. The program computes the doppler broadening (equal to the wavelength of the line divided by the wavelength of the input profile), prints out the value, and then asks for a final value. If this Doppler value is the amount of broadening desired, then one should hit "Alt Mode." If, however, another value of the broadening is desired, it can be entered here. The second and third lines correspond to the [O III] λλ4959, 5007 transitions. Thus, the input profile is 2, and the redshift system is also 2. To end this part of the program, a -1 should be entered for the wavelength of a line.

At the same time that the line parameters are input, initial estimates of the individual line intensities are also made on the CRT. Upon entering all of the parameters for the first line, the cursor will appear on the CRT. Using the tracing of the observed blend which has been displayed, the user should mark a point corresponding to that line. Both the x- and y-positions of the cursor are used. The x-position plus the wavelength tells the computer what each channel of the 1024-ch segment of the observed blend corresponds to in wavelength. The y-position provides an estimate of the intensity of the line, since the program takes the height of the point above the continuum and scales the input line profile in intensity to obtain a line with that height. In the

example shown below, good estimates of the line intensities would be made if points were marked where the x's are indicated.



When the parameters of the second line (and all others that follow) are entered, the cursor will be displayed in roughly the correct x-position automatically, since the computer now knows the approximate absolute wavelength scale. Each time a line is entered, the program uses the x-position of that line, along with the preceeding lines, to better define the wavelength scale zero-point.

Another feature should be mentioned at this time. The user will notice that when the cursor is displayed for each line, the y-position is below the continuum zero-line. If the cursor is moved in the x-coordinate only, and a point is then marked, the line will be included in the synthesized blend, but at a very small intensity. This feature can be used if one desires to enter the parameters of a line, but initially does not want to make the line strong enough to be visible in a blend.

Once the parameters of the final line have been entered, the program scales and broadens the appropriate input profile for each one of the lines. Each line is then traced on the CRT screen. Finally, the individual lines are summed together to form a synthetic blend. The CRT then displays the observed blend at the top, the synthetic blend in the middle, and the difference between the

synthesis and the observations below. This subtraction is used to determine how good the synthetic blend matches the observed blend. At the very bottom of the screen the line parameters are displayed for reference. For the QSO we have been taking as an example, the following parameters might be listed:

LINE	1	2	3
LA	4861	4959	5007
I R	4.1	48.9	16.2
BRD	.74	1.45	1.46

The wavelength of each line is given in the row marked "LA". In the second row, "I R" stands for intensity ratio. This is defined as the intensity of the input profile divided by the intensity of the particular line. In our example, we find that I(Hα)/I(Hβ) for the synthetic blend is 4.1. Note that as I R increases, the line will become weaker in strength. For [O III] λλ4959, 5007, the values of I R are, of course, in units of the intensity of [Ne V] λ3426. Finally, the last row lists the broadening of each line.

The next thing which appears on the CRT is

CHANGE LINE #(-1,0,N) : ___.

At this point in the program, one can vary the parameters of individual lines to obtain a better fit. This is accomplished by typing the individual line number, N. A number of options which effect all of the lines as a whole can also be called. This is done by typing a 0 (zero). Finally, one can get a Calcomp plot and a table of line parameters for the current synthetic blend if a -1 is typed. Let us consider each of these sets of options in turn.

N : If an individual line number is typed, the following is written out on the DecWriter:

LINE N OPTION(B,D,I,L,P,Z): ___.

The computer then waits for one of the option codes to be entered. The options are

B : Change the broadening of line N,
D : Delete line N,
I : Change the intensity ratio of line N,

L : Change the wavelength of line N,
P : Change the input profile of line N,
Z : Change the redshift of line N.

If the B, I, L, or Z options are chosen, the computer next asks a series of questions:

FROM:___ STEP:___ #<21:___ SIZE X:___ .

If, for example, the I option has been chosen, a typical reply to these questions would be

FROM:4.0 STEP:0.5 #<21: 7 SIZE X: 1 .

These entries would cause the following to take place. A synthetic blend with the intensity ratio of line N equal to 4.0 is created, subtracted from the observed blend, and the result is displayed at the top of the CRT, just below a tracing of the observed blend. Next a synthetic blend with the intensity ratio of line N equal to 4.5 is constructed, subtracted from the observed blend, and the result is displayed just below the first subtraction. This procedure continues for a total of seven times, with intensity ratios of 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, and 7.0 used. Since a SIZE X (size times) parameter of 1 was entered, each of the subtractions is displayed at the same scale as the observed blend. If SIZE X = 2 was entered, the scale of the subtraction would be enlarged by a factor of two. If the user does not desire to see all seven subtractions, switch 3,11 should be held down until the program terminates. When this is done, or when the program terminates on its own, the computer types I:___ (or B, L, or Z). The user should then enter the value which gives the best subtraction. The program then generates a synthetic blend with this value for line N, and displays it along with the observed blend and the subtraction. The next option is then requested.

If the D option is chosen, the program will delete line N from the synthetic blend and type

LINE N GONE!
DELETE LINE (-1,N) :___ .

The program is now asking if the user would like to delete any other lines. To delete another line, just enter the number of the particular line at this point. To end, simply enter a -1, and the new synthetic blend (minus the deleted line(s)) will be displayed. Although these lines are deleted from the blend, they are not lost forever. The parameters and profiles of the lines continue to be stored, and the lines may be reinstated at some further point in time (see below).

If the P option is entered, the computer types

CHANGE TO PROFILE # :____ .

The user should then enter the desired input profile number (1 or 2). A synthetic blend with this new profile for line N is then computed and displayed.

O: If a 0 (zero) is typed in answer to the question CHANGE LINE # (-1,0,N) :___, the following is typed out:

LINE 0 OPTION (A,RB,RL,S,SC;(1,2):B):___ .

This is how options which effect the entire blend can be called. The available ones are:

A : Add a line. The selection of this option will return the user to the portion of the program where line parameters are initially entered. Additional lines can thus be added to the synthetic blend in this manner.

RB : Repeat all broadenings. This option causes the synthetic blend to be rebuilt again from scratch, using the input profiles and broadening, and scaling them by the appropriate amounts. The use of this option will be considered later.

RL : Reinstate lines. This option allows lines which have been previously deleted to be reinstated to the synthetic blend. The intensity, broadening, redshift, wavelength, and profile of the lines will be the same as when they were deleted.

S : Shift. This allows the synthetic blend to be shifted as a whole with respect to the observed blend. This option works similarly to the B, I, L, and Z options. The user is asked

FROM:___ STEP:___ #<21:___ SIZE X:___ .

The shift should be entered in units of channels.

SC : Change scale. This option allows one to permanently change the scale of the plots of the observed blend, synthetic blend, and subtraction. When

SC is entered, the computer types
CHANGE SCALE: SIZE X:___ .
Again, if a 2 is entered for SIZE X, the scale of all three plots will be enlarged by a factor of 2.

(1,2):B : This option allows one to change the broadening of all of the lines with the same input profile. If this option is chosen, the program asks
PROFILE:___ FROM:___ STEP:___ # 21:___ SIZE X:___ .
The user must specify which input profile (1 or 2), and then give the range of broadenings to try (as with the other options). (This option has been known to cause a spurious line to be generated in the blend. Try "RB" if this happens).

-1 : When a -1 is entered as the line number to change, a listing of the parameters of the individual lines of the synthetic blend is generated. The table gives the line number, wavelength, intensity ratio, broadening, redshift. In the final column, the intensity ratio is converted into an absolute intensity in ergs sec^{-1} cm^{-2} (multiplied by a factor of 10^{15}). After the table has been typed, the program asks PLOT?:___. If "Y" is entered, the program instructs the user to zero the Calcomp, and then asks N:___ . The user may then enter a 9-digit identification number which will be plotted by the Calcomp, along with the scans. (If a -1 is given, no identification number will be plotted.) The observed and synthetic blends, and the subtraction of the two, are then plotted on the Calcomp just as they appear on the CRT. After the plot is completed, the program asks RETURN TO SUBTRACTION?:___ . If a "Y" is entered, the program displays the results of the last deblend, and then asks which line to change. If an "N" is typed, the program then allows the user to save the subtraction as a scan. When this has been accomplished, the program then branches back to the point where another blend can be analyzed, using the same input line profiles. If one answers "N" to the question PLOT?:___ , the program skips the Calcomp plot and then asks if the user would like to return to the subtraction.

Miscellaneous Information:

There is an additional feature of Superdeblend which should be mentioned at this time. Once the individual lines have been input and the actual "deblend" portion of the program has been entered, there is a bail-out procedure for when mistakes are made (by the user!). For example, say that you wanted to vary the intensity ratio of a line, but instead of typing an "I", you type a "B". If it is too late to delete the B, just hit control-C and then type G (return). This will direct the program back to the display routine, and the question CHANGE LINE # (-1,0,N):___ is again asked. This is a valuable bail-out procedure, and should be remembered.

Another point which should be emphasized is that Superdeblend requires scanner data which is in a flux-reduced form. The program reads the lambda-zero and the flux scale of the scans from which the input line profiles are obtained. If your data is not in a flux-reduced format, you should use the M D option of the utilities program on the SDRS tape to "fudge" a lambda-zero and a flux scale (see page 49 of this writeup).

Superdeblend is especially slow when there are many lines in the synthetic blend. Some users have found that if a large number of lines are to be "deblended" (e.g., 15 or so), it is wise to work initially with small groups (e.g., 5) and then combine all of the lines in the end. This is easily accomplished through the use of the "D" (delete) and "RL" (reinstate lines) options. To be more specific, one might start by inputing the first five lines, and then varying the parameters until a reasonably good fit is made. The "D" option should then be used to delete these five lines, and then the "A" option should be called to enter the next five lines. When these lines have been satisfactorily synthesized, they should be deleted also and the last five lines considered. Finally, when these have been fit, the "A" option should be used to recall the other ten lines. The fifteen lines together should then be varied to obtain the final "deblend."

In the course of using Superdeblend, it is wise to use the "RB" (repeat broadening) option occasionally. Because the data is stored in discrete channels, shifting the lines around can artificially broaden or narrow the profiles. Although this effect is small, it sometimes can become a source of problems. Therefore, one should make it a practice to use the RB option regularly. This will cause the synthetic blend to be built again from scratch, using the latest values of the line parameters.

As a last word of advice, if you have never used this program before, it would probably be to your benefit to have one of the local Superdeblend "experts" to help you along the first time. Hopefully this write-up explains the basic workings of the program, but there are many subtle points in technique which can not be covered.

32K SPECIAL TAPE

This writeup describes the scanner reduction and analysis programs present on the 32K Special Tape. Programs on this tape are accessed in the same way as programs on the 8K Special Tape.

I have included in this writeup a map of Programs and Names and a brief description of the use of each program. Once again, I must stress that these instructions are introductory guides only.

Except for several programs written by Howard French, I have written (or adapted) all the programs on the 32K Special Tape.

One general note about the programs on this tape:
All dectape scans accessed by these programs are assumed to be in 8K Focal format and are assumed to follow the 8K scan numbering convention. However, both the Dec - IBM and raw data archive programs have switch selectable options to convert to the 32 K scan numbering convention.

PROGRAM NUMBERS	PROGRAMS
1	Selector
3,4	Unredshift/F_ν to F_λ/New λ_0/Truncate
5	2048 Channel Scan Transfer
6	Raw IBM to Dec
7	Plotter
8	Least Squares Fit Subroutine
9	Plotter
10	Scan Scaler
11-13	Data Plotter
15	Precession
16-17	Write Archive Tape
18-19	Read Archive Tape
20	Write Archive Tape
21	Check Archive Tape
23-24	Fast Intensities
25	F_ν to F_λ
26	F_λ to F_ν
→ 30-32	Dec to IBM
33-34	IBM to Dec
35	IBM Log
36	Spectral Index
37-38	Line Broadener
→ 40	Spectral Index
→ 43	32K to 8K Dectapes
51-60	5-Level Atom

X NAME MAP-32K SPECIAL TAPE

NUMBER	CONTENTS
1	POLY 10/12/77
2	IND, SEEK, SCRNCH 3/13/78
3	DTIM, TINC, LOGB 9/20/77
4	TIME, SWEP, POSN, TIMC 1/22/78
5	CORL, FLIP 8/29/77
6	ZAP, MPX, BIT, NZ 1/31/78
7	IND, SEEK 4/2/78

UPDATE TO 32K SPECIAL TAPE
APRIL 1980

Since the first edition of Lick Observatory Technical Report No. 26, three of the programs on the 32K Special Tape have been updated. The latest version of the 32K Special Tape is dated (in the selector display) March 28, 1979.

PLOTTER: Two new switch options have been incorporated. Setting switch 3,5 suppresses the preliminary plot on the CRT and causes the CRT not to be erased between final plots. Setting switch 3,6 suppresses the plotting of zero lines on the calcomp. These two options are useful for plotting several scans on the same page.

SPECTRAL INDEX: The program now allows you to subtract the previously fit power law from the scan being processed and to save the result on tape. After displaying the power-law fit on the CRT, the program asks you, "DO SUBTRACTION? ⟨Y/N⟩." If yes, the program asks you to mark with the joystick the left and right limits of the area to be subtracted. After a long wait, the result will be plotted on the CRT and the user will be asked where to store the result.

BROADEN A LINE: The old version of this program automatically centered the isolated line profile on the first moment peak of the isolated profile. However, this procedure is not always desirable; for example, strong [O III] lines can move the first moment peak far off the peak of the desired Hβ profile. For this reason, switch 3,7 can now be set to enable manual peak finding of the isolated line profile with the joystick.

UPDATE TO 32K SPECIAL TAPE
JUNE 1980

1) A new program, "32K TO 8K DECTAPES", has been included on the 32K Special Tape as program #43. It allows a user to copy Dectapes/floppies in 32K format (such as are produced by 32K-SDTS) into 8K format. The program asks for "# SLITS <1,2>" to determine if it is a raw data tape (slits = 2) or reduced data tape (slits = 1). Note that for the 32K input dectapes, scan numbers can range from 0-22 for raw data tapes and 0-45 for reduced data tapes; while for 8K output dectapes, scan numbers can range from 0-17 for raw data tapes and 0-35 for reduced data tapes.

2) A new parameter, the number of ID records per scan, is requested in "DEC TO IBM" and "IBM LOG" if 2 slits per scan is specified. If 2 ID records per scan is specified the IBM tape is equivalent to the IBM tapes produced by 32K - SDTS. The old versions of "DEC TO IBM" and "IBM LOG" can be simulated by specifying 1 ID per scan.

3) A new switch option has been added to "IBM TO DEC" and "IBM LOG". If switch 3.7 is engaged, the test for the presence of the proper scan number in ID word 23 is not performed.

4) Revised atomic constants have been inserted into "5-LEVEL ATOM." See a program listing for references.

5) Programs 30 and 43 on the program tape are now in use: 30 for another piece of "DEC TO IBM" and 43 for "32K TO 8K DECTAPES."

UNREDSHIFT, F_ν TO F_λ, NEW λ_0, TRUNCATE

This program is designed to "pretty up" scans in order to make more appealing plots. The program first asks for the scan length (1, 2 or 3 2048 channel chunks), the first scan number on unit 7 and the λ_0 of the scan. Enter -1 for the scan length to return to the Selector. If the user answers "Y" to "UNREDSHIFT?", the program asks for old and new values of the redshift. Because the Focal scrunch function limits redshift changes to one part in 4096, the unredshift process can only be done in discrete steps. The program will print the actual $\Delta z = (1 + z_{old})/(1 + z_{new})$ applied to the scan. Also printed is the new λ_0 of the scan.

The program will next ask "F-NU to F-Lambda?" and, if "Y" is answered, will convert the scan to a relative F_λ scale. Note that absolute flux information is not preserved in this operation.

Finally, an opportunity is given to both change the λ_0 of the scan and to truncate data beyond a certain λ. Both of these functions require the user to enter the dispersion ($\mathring{A}$/channel) of the scan.

After displaying the final version of the scan on the CRT, an opportunity is given to store it on tape (enter -11 to bypass the storage).

2048 CHANNEL SCAN TRANSFER

This program copies sequences of 2048 channel scans from one dectape to another. Enter -11 for a scan number to return to the selector. Otherwise, the program is used exactly as the 2048 channel scan transfer program on the 8K Special Tape.

RAW IBM TO DEC

This simple program copies a 4096 channel raw data scan from an IBM-SDRS input tape (created by Dec-IBM) to a Dectape. No error checking is done on the IBM tape.

PLOTTER

This program will plot a 2048, 4096 or 6144 channel scan on the calcomp. A border drawing option is also included in the program (set switch 3,7). The program first asks for the scan length (enter -1 to exit to the Selector) and first scan number and then displays the scan on the CRT. Next the program asks for the points per channel ("PTS/CH"), scale (or -size) and offset (these parameters are explained in the description of "Plot" on the 8K Special Tape.) The scaled plot is shown on the CRT, and the computer asks "⟨C⟩ALCOMP, ⟨R⟩ESCALE, ⟨N⟩EW SCAN". Typing "R" will cause the program to again ask for points/channel, scale and offset. After a plot has been completed, the program asks "PG?"; typing "Y" will cause the Calcomp to space over the plot. Finally, the program will again ask "CALCOMP, RESCALE, NEW SCAN". To exit to the Selector, enter -1.

If switch 2,1 is all the way up, the scan will be put on a log flux scale before plotting.

If the border option was selected, the program will ask for the location of the upper and right borders and the tick mark intervals. The lower border is the zero flux line (which is set by the scan's offset) and the left border is the λ_0 line. The location of the upper border is given in 0.01 in. and the location of the right border is given in either Å or channels. The program will ask for "LAMBDA ZERO" - if zero is entered, the program will ask for the right border in channels. If a positive value is entered, the program then asks for

the dispersion (Å/ch) and the location of the right border in Å. The plot will be truncated at the location of the right border, but the borders themselves will not be plotted unless "Y" is entered to the question "DRAW BORDERS?" (Thus a convenient way to truncate a plot is provided.). The tick mark intervals should be entered in units of 0.01 in. Tick marks will be placed at the entered intervals starting at the λ_0 line and the zero flux line (enter a very large interval to eliminate the tick marks entirely).

SCAN SCALER

This program is designed to divide two scans and measure their relative flux calibrations. For example, this program will tie together emission line flux measurements made on two overlapping scans.

The program asks for the scan number (enter -1 to return to the Selector), λ_0 and scale factor for the "bluer" scan; then the same data is requested for the "redder" scan. The scans are aligned, divided and displayed on the CRT and the joystick is enabled. The right and then the left edges of the desired division should be marked, whereupon the scale factor (red scan divided by blue scan) will be printed.

DATA PLOTTER

This program is designed to make file plots of reduced scanner data. The plots are scaled to fit in a 8-1/2 by 11 inch notebook, and the program prints adhesive labels to be placed on each plot. The data to be plotted may reside on an IBM-SDRS output tape or on Dectape.

The user first tells the program the input medium (IBM or Dectape) then the user should enter up to 26 characters that will be printed on the label for each scan (for example: "GRANDI 3, 4, 5 March 1978"). Next, all the instructions to the program are entered. For each sequence of scans, a dectape number

(if using dectape), a first and last scan number (2048 channel scan numbers), a dispersion (Å/channel) and an option must be entered. Option 1 is to plot a single 2048 channel scan. Option 2 is to plot an average of the right and left channel scans, Option 3 is to plot (on the same page) both the right and left channel scans, Option 4 is to plot the right, the left and their average on the same page. Options 2, 3, and 4 treat scans in pairs - so entering 0 as the first scan and 1 as the last scan will result in only one plot.

Finally, after all the instructions are typed (-1 should be entered to terminate), the program allows modifications and deletions of instruction entries. The adhesive labels should now be placed in the teletype and the calcomp prepared. If the input medium is IBM tape, no further operator intervention is required; if the data is on dectape, tape changes will be directed by the program via the CRT.

PRECESSION

This program performs precession calculations. It was stolen from the Scanner Data Taking System.

WRITE ARCHIVE TAPE

This program is designed to create archive quality IBM tapes containing raw or reduced scanner data. The archive tape is organized as a series of files, each of which contain several dectape images. Presumably, each file corresponds to one night of observing, but this is optional.

Data scans are written as 4096 channel scans with their associated ID records. A scan identification number is written in word 23 of the first ID

record. The sum of the contents of all channels in both 2048 channel portions of the 4096 channel scan are written in the second ID record as words 23-30 (see L.O.T.R #17, A-2). Thus the latter portions of any comments will be lost when archiving raw data scans, and the standard star name will be lost from the second 2048 channel scan in each pair of reduced scans.

To use the write archive tape program, the tape drive heads and rollers should be cleaned, a good quality IBM tape should be mounted and the program should be called from the 32K Special Tape. The program will ask for "SLITS/SCAN? <1/2>" (switch 3,7 should be set if 32K raw data tapes are being copied) and the first file to be written on the tape. File 1 is the first file on the tape and if file 1 is the first file to be written, the program will type "INITIALIZING NEW TAPE" and erase the first 40 feet of tape.

The program then asks "END OF IBM TAPE? <Y/N>". An answer of "Y" will end the input and cause the IBM tape to be rewound (slowly - to keep the tape under the proper tension). An answer of "N" will initiate the transfer of another file of several dectapes to the IBM tape. The program will now ask for a tape name which is used only to annotate the teletype output. The program then proceeds to copy the entire dectape to the IBM tape (while typing a log on the teletype). If bad segments are found on the IBM tape during this process, either "3 BAD SEGMENTS - - ERASING PIECE OF TAPE" or "1"/"2 BAD SEGMENTS FOUND" will be printed (I would suggest starting over with a new tape if this happens). If the physical end of the IBM tape is reached during the copying process, the program will type "END OF IBM TAPE -- CURRENT FILE WILL BE LOST" and the program will place a second EOF mark after the end of the preceeding file.

After the dectape has been copied, the teletype will beep to indicate that the dectape may be rewound and replaced. Meanwhile, the IBM tape is rewound over the just written data and the data is read checking for parity errors, wrong length

records and check-sum errors. Finally, the program asks (on the CRT) "NEW FILE? <Y/N>". If "N" is entered, the program will ask for the next dectape name. If "Y" is entered, the program will again ask "END OF IBM TAPE?".

READ ARCHIVE TAPE

This program is used to transfer scans from an archive IBM tape (created by the write archive tape program) to dectape. The archive tape (without a write ring) should be mounted on the tape drive and the program called from the 32K Special Tape. The program first asks for "SLITS/SCAN" and then goes into a loop transferring sequences of scans. These sequences are defined by an IBM file number (enter -1 to escape to the Selector), a first and a last IBM scan number and a first 4096 channel dectape scan number. The program will type a log of the scans transferred and will check for parity errors, wrong length records, wrong ID numbers, check sum errors and unexpected EOF marks.

CHECK ARCHIVE TAPE

This program is designed to check that the data on an IBM tape is still readable. An archive tape should be read periodically (every 1 to 2 years) if only to redistribute the tape tension. To use the program, mount the archive tape (without a write ring) and call the program from the 32K Special Tape. No further operator intervention is required. The program will list the number of scans found in each file of the tape and check for parity errors, wrong length records, wrong ID numbers, check-sum errors and unexpected EOF marks.

FAST INTENSITIES

This program (written by Howard French) will measure emission and absorption line intensities and equivalent widths. Switch 3,6 should be set before using the program if absorption lines are to be measured and switch 3,7 should be set (also before using the program) if equivalent width measurements are desired. The program asks for a 2048 channel scan number (reduced scans only), dectape unit number, dispersion (Å/Channel), data format of the Scan (F_ν or F_λ), and redshift or radial velocity (in km/sec). The scan will be displayed on the CRT and the user is given an opportunity to change the scale of the display. If the value of SC printed on the CRT is 100, entering 50 will make emission lines twice as tall while entering 200 will make them one half as tall. Enter -1 for SC to continue.

The program will then ask (on the CRT) "MARK STANDARD LINE" and the user should point with the cursor to the standard line. (Hβ for example). The scan will be blown up on the CRT and the user may again adjust the scale on the exploded display. The program will then ask "MARK CONTINUUM" and the user should mark two or more points through which a straight line continuum may be fit. Holding switch 3,12 down while hitting the cursor button will cause the program to jump back to the display of the entire scan. Hitting the cursor button without moving the joystick will indicate the last continuum data point. After the fitted continuum is displayed on the CRT, the program will ask "MARK WINGS" and the user should mark the left and right limits of the line being measured. The program will finally print the rest wavelength, the intensity (in units of 10^{-15} ergs/(cm^2 - sec) and, if switch 3,7 had been set, the equivalent width of the standard line.

The entire scan is now displayed and the user is asked to mark a line to

be measured with the cursor. As before, the scale should be set, the continuum fitted and the wings marked. After a line is measured, another line may be measured using the same continuum. Or, if switch 3,12 is held down while the cursor button (switch 3,11) is pushed, the whole scan will be displayed once again.

If, while the entire scan is being displayed, the cursor button is hit without moving the corsor from its initial position, the program will ask (on the teletype) "SPECIFIC LINES?" If "N" is entered, the program will ask for a new scan number (enter -1 to escape to the selector). If "Y" is entered, the program asks for a rest wavelength (enter -1 to quit) and then will mark this wavelength on an exploded portion of the scan and jump to the line strength measurement loop. This feature of the program facilitates measurements of upper limits of weak or non-existent lines.

A simpler line measurement technique is invoked if switch 3,5 is set. If this technique is used, the user should respond to "MARK CONTINUUM" by first placing the cursor on the intersection of the left wing of the emission line and the continuum and then on the intersection of the right wing of the emission line and the continuum (the same method used in the 8K Fast Intensities program). Finally, the user should hit the cursor button again without moving the joystick and the program will print out the line strength. Unlike switches 3,7 and 3,6 switch 3,5 can be changed while using the program.

ABSOLUTE F_ν TO F_λ AND ABSOLUTE F_λ TO F_ν

These two programs (written by Howard French) allow F_ν scans to be changed to F_λ scans, and vice versa, while preserving absolute flux scales and ID information. Word 2 of a reduced scan ID area will be set to contain 1 if the scan is in F_λ format and 0 if the scan is in F_ν format.

Both programs ask for the dispersion (in Å/channel), the scan (enter -1 to exit to the Selector) and unit number for the original scan and the scan and

unit number where the modified scan is to be stored. The original and new flux scales are printed on the teletype.

The F_ν to F_λ program has a batch mode which is invoked by answering "Y" to the question "BATCH?". The program will ask for a sequence of input scans and the locations where the modified scans are to be stored (if the unit number for the input and output scans is the same, the program will type "REALLY?" - "Y" should be typed if the directions are correct).

DEC - IBM

This program creates input tapes for the IBM-SDRS program (see the revised version of L.O.T.R.#15 and the IBM-SDRS section of this L.O.T.R.). 4096 channel scans (raw data scans) are written on IBM tape as one 16 channel ID record, followed by two 2048 channel records. Only the right channel ID information is written on IBM tape, the left channel information (comments) is not. 2048 channel scans (reduced data scans) are written as one ID record followed by one 2048 channel record. Word 23 of the ID record contains the IBM record number for both 2048 and 4096 channel scans.

The first file on the IBM tape is file 1. The first scan in an IBM file is scan 0. "SLITS/SCAN" = 1 for 2048 ch. scans, = 2 for 4096 ch. scans. If switch 3,7 is flat, 8K Focal scan numbers are assumed (4096 ch. scans range from 0-17). If 3,7 is set, 32K Focal slot numbers are used .

The program first asks for the IBM file to be written on, the first IBM scan to be written in this file, the slits/scan, and (2 digits each) the day, month and year of the tape. If the first IBM scan is not zero, the program will space the IBM tape forward and count any parity errors. "WRONG ID NUMBER ON LAST SCAN" means that there is something wrong with the data already on the tape. If an EOF is detected "FIRST IBM SCAN TOO LARGE" is printed.

Instructions to the program are entered all at once before any scans are copied. Each instruction entry consists of a dectape number (enter -1 to terminate), and the first and last scan of a sequence to be copied. After all the instructions are entered, an opportunity is given to delete, modify and add (but not insert) entries. The program now commences to copy scans--the program keeps the user advised via the CRT on which dectape to mount. A log of the copied scans is printed on the teletype.

To decrease the IO requests used by the IBM-SDRS program, the data on the IBM tape should be arranged by setup. Specifically, the first scans in a setup should be the end quartz followed by the beginning quartz and then the data scans.

At the end of the data transfer, the program asks "CHECK DATA?". Typing "Y" will cause the tape to be read counting records and checking for parity errors. Remember that the first scan in a file is scan 0, so "SCANS IN FILE" should equal the last IBM scan number +1. Parity errors are not necessarily fatal since the IBM program does a lot of rereads. A non-integral number of scans indicates something is definitely wrong. Try again, then call for help!

The program performs various tests. "DATA ON IBM TAPE IS WRONG" (after which the program quits) means that a test to check that a record is read the same as it is written has failed. This is usually a hardware problem with the tape drive. This test is made before any data is written.

"ERROR ON IBM TAPE" means that a scan as written on the IBM tape and subsequently read are not identical. This test is made only when a new dectape is mounted.

"END OF TAPE" means that the IBM tape is filled up. An EOF is written and data copying is stopped.

"UNSUCCESSFUL WRITE ATTEMPT, TRYING AGAIN" means that 3 successive write attempts have failed. Be suspicious of the final result on IBM tape.

"M BAD SEGMENTS FOUND ON IBM TAPE" means that m records had to be re-written due to bad spots on the IBM tape. Data should be OK.

IBM - DEC

This program copies 2048 channel scans from IBM tape (such as those produced by the IBM-SDRS program) and puts them on dectape. The IBM scans must consist of a 16 channel ID record (with the IBM scan number as word 23) followed by a 2048 channel record.

Information is entered into the program in a similar manner as DEC-IBM. Each data entry consists of a first and last IBM scan number, a dectape number and a first dectape scan number (the program will list the last dectape scan number). As in the DEC-IBM program, the program directs the mounting of dectapes via the CRT.

The program checks for parity errors on the IBM tape, wrong length records, incorrect scan numbers in the ID record, and attempting to read an EOF mark.

IBM LOG

This program will print a log of scans written on IBM tape by DEC-IBM or IBM-SDRS. The program asks for the IBM file to be searched and the number of slits/scan. The program checks for a full range of tape errors.

SPECTRAL INDEX

This program will measure the spectral index α (in the power law expression

$F_\nu = \kappa\nu^{-\alpha}$) from a single or a composite F_ν scan (such as those produced by the Adder program on the 8K Special Tape). The program asks for the scan length in units of 2048 channels, the first scan number, the lambda zero, the dispersion (Å/channel) and the redshift, z. The scan will be displayed on the CRT, and the user may adjust the vertical scale of the display by typing a new value for "SC" (enter -1 to continue). The program will ask "MARK CONTINUUM" and the user should mark with the cursor the continuum points to be fit by the power law. Hit the cursor button without moving the joystick to terminate data entry. All the data points will be typed out (the wavelengths will be rest wavelengths and the flux will be in F_ν units $*10^{-SF}$ (SF is the scale factor of the scan)) and then the value of α and its R.M.S. error will be printed. The power law will be displayed on the CRT as a series of points superimposed on the scan. The program will then ask "SAME SCAN? <Y/N>": entering "Y" will allow the user to remeasure the same scan.

BROADEN A LINE

This program was written to broaden (or shrink) an emission line. For example, the program can be used to isolate the profile of He I λ5876 and to put it on the velocity scale of Hα so the line profiles may be directly compared.

The program asks for a scan number (enter -1 to exit to the Selector), λ_0, dispersion (Å/channel) and redshift z. The scan will be displayed on the CRT and the user may change the vertical scale by entering a different value of "SC". (Enter -1 to continue). The program will now print "MARK LINE" and the user should point to the line to be broadened with the cursor. The CRT scale will be expanded horizontally and once again the user is given the chance to change the vertical scale by changing "SC". Next, the program will print "MARK CONTINUUM" whereupon the user should mark with the cursor several continuum points which

will be fit with a straight line. To terminate the entry of continuum points, the cursor button should be hit without moving the cursor. The program will now print "MARK WINGS", and the user should mark with the cursor the left and then the right extents of the emission line.

The program now determines and prints the rest wavelength that corresponds to the first moment of this emission line and its velocity scale (km sec^{-1} $channel^{-1}$). The line profile is now displayed on the CRT and the user is given the opportunity to save this profile in one of 4 blocks of a dectape scan (-1 should be entered for the scan number if the profile is not to be saved). As stored on tape, each profile occupies a block of 512 channels with the first moment peak at channel 255*N where N is the block number (1, 2, 3, or 4).

The program will now ask for the wavelength corresponding to the new velocity scale of the emission line (enter -1 to process a new scan). The new broadened profile will be displayed along with the original profile, the velocity scale will be printed and the scan and record where the broadened profile is to be stored will be requested (enter -1 for the scan if the profile is not to be stored).

Since the Focal Scrunch function does not interpolate when one channel is expanded into several channels, line profiles that are significantly "broadened" will resemble a stairstep. Therefore, when two lines of differing wavelengths are to be compared, it is preferable to "shrink" the redder than to "broaden" the bluer profile

5 LEVEL ATOM

This program will solve the level population and line strength problem for the common 5-level atoms encountered in nebular astrophysics. The ions currently included in the program are: C III, N II, O I, O II, O III, Ne III, Ne V, S II, S III, Ar III, Ar IV and Fe XI.

To use the program, it should be called off of the 32K Special Tape and an ion selected from the menu displayed on the CRT. The program will then go into a loop asking for the electron temperature (enter -1 to quit) and the electron density. The program will then print out the relative population in each of the five levels (it is of course assumed that no higher levels are populated) and the relative line strengths for the 10 emission lines interconnecting the five levels. The emission lines are identified both by their wavelength and by their lower and upper levels (level 1 is the lowest energy state, level 5 is the highest). The relative line strengths may be turned into absolute line emissivities (ergs sec^{-1} cm^{-3}) by multiplying them by the number density of the emitting ion.

Also included in the program is a 3-level atom solver which may be of some use to somebody.

If more ions are to be added to the program (consult a listing!), an explanation of the variables used in the program is necessary. Variables A1, A2, ..., A0 are Einstein A values for the 10 transitions interconnecting the five levels of the ion. A1 corresponds to the transition between levels 2 and 1, A2 to 3-1, A3 to 3-2, A4 to 4-1, A5 to 4-2, A6 to 4-3, A7 to 5-1, A8 to 5-2, A9 to 5-3 and A- to 5-4. C1, C2, ..., C0 are collision strengths: C1 corresponds to the transition between levels 1 and 2, C2 to 1-3, C3 to 1-4, C4 to 1-5, C5 to 2-3, C6 to 2-4, C7 to 2-5, C8 to 3-4, C9 to 3-5 and C0 to 4-5. W1, W2, ..., W5 are the statistical weights of levels 1, 2, ..., 5 respectively. T2, T3, T4 and T5 are energy differences (in Å): T2 corresponds to the transition between levels 1 and 2, T3 to 1 and 3, T4 to 1-4 and T5 to 1-5.

SDRS CHANGES

Several changes to the SDRS programs have been made (chiefly by Alan Koski) that deserve to be documented. A tape with these changes may be identified by the phrase "2/78 Scanner Data Reduction System" which is displayed on the CRT by the program Selector.

The changes to SDRS include:

1) The deadtime for the discriminator-amplifier used in the scanner has been changed from 51 nsec to a more realistic 25 nsec.

2) Burstein's Lambda Calibrator has been modified so that the correct calibration coefficients are printed on the teletype even if they are large enough to cause an overflow when stored on dectape. Note that if any of the coefficients have magnitudes $\gtrsim 8 \times 10^6$, then PDP-8 Scrunch will not work correctly.

3) Log List-Raw Data has been modified to correctly print out the slit code "S".

When reducing data from the 24-inch scanner, it is sometimes useful to modify the Log List-Raw Data program to list the RA, Dec and object name for all scans and not just for scans with a trailing N in their slit codes. To make this modification, remove "I (M-28)3.9" from line 3.50 of program 32.

UTILITY PROGRAMS

The SDRS utility programs have been somewhat modified from their write-ups in L.O.T.R. #2. Therefore, I will give a brief description of the use and effect of each command.

C = CLEAR: This function erases the scan buffer.

A = ADD: This program gets a scan and adds it to the buffer. The program asks "M,D" whereupon the user may enter constants to multiply and divide the scan before it is added into the buffer. Thus, entering 1,1 for "M,D" will cause the scan to be added to the buffer unadulterated, while 1,2 will cause the scan to be divided by 2. Note that M,D does not cause a change in the flux scale of a scan so large effective multiplications ($M/D \gtrsim 10$) will cause overflows, while large effective divisions will result in a loss of significance.

The ADD option will add correctly if the buffer contents and the scan on tape have different flux scales, but the program will not align scans with different lambda zeros. The ID information in channels 2045-2047 are restored after the ADD is completed.

MD = M,D BY +CONSTANT: This option allows the user to multiply or divide the scan buffer by positive constants. It is used in the same way as the M,D entries in the ADD option described above. If M and D are both set equal to 1, a special option is invoked to inspect or modify the flux scale, the lambda-zero and the lambda-high of the scan buffer. First, the flux scale is printed. If the flux scale is to be changed, a new value should now be typed in; otherwise escape should be hit. The same procedure is repeated for lambda-zero and lambda-high.

M = MINUS: This program gets a scan from the tape and subtracts it from the scan in the buffer. The result is stored back in the buffer. Again, M,D constants are asked for by the program, as described above. The M function will not align scans in wavelength or reconcile different flux scales before subtracting: the SD and MD functions must be used before the M function in

these cases. After the subtraction is complete, the program restores to the result the flux scale, lambda-zero and lambda-high of the scan originally in the buffer.

D = DIVIDE: This program gets a scan from the tape and divides it into the scan in the buffer. Once again, the D function will not align the scans in wavelength before dividing. After the division has been performed, the flux scale of the scan in the buffer will correctly reflect the division but the values of lambda-zero and lambda-high will have been destroyed.

A special feature of the divide function is that if the escape key was hit when "SCAN" is asked for, the scan in the buffer will be divided by the same scan used in the previous division. Thus repeated division by the same scan is facilitated.

F = FIXUP: This program will fix-up bad points in a scan and truncate scans. The program asks "SIZE:" which will set the maximum vertical height on the CRT of the data to be displayed (full scale is 1024). Thus for example, by setting SIZE to 800, high points which need to be fixed-up will not be lost on the top edge of the screen.

The scan is displayed in four chunks. Picking off a point with the cursor and switch 3,11 causes the point to be set equal to its neighbor. Pressing 3,11 without moving the cursor causes the next section of the scan to be displayed. Pressing both 3,11 and 3,12 will fix up lots of points in a row -- the program asks "L, M or R?". L or R will set all points to the left or right of the cursor to 0. M will enable the cursor, and after another position is marked will cause all points between the two marked positions to be set equal to the point next to the first marked position.

S = SAVE: This option will save the scan in the buffer on tape.

P = CRT PLOT: This program will plot the scan in the buffer on the CRT. After the scan is plotted, the user must hit return to restart the program. A plot scale, such as is used for calcomp plots, is printed on the teletype.

SD = SHIFT DATA: This option will shift the scan left or right by any number of channels (to the nearest thousandth). A positive channel shift corresponds to a shift to the right. Entering 0 for the channel shift will cause the program to enter a "lazy person" mode: the program will ask for the current lambda-zero (LL), the desired lambda-zero (LZ) and dispersion (DL) and will calculate the channel shift. The ID information in the buffer is not totally preserved after a shift. Partial channel shifts of scans containing negative numbers give odd results—use of the PC command should cure this problem. User's note: When you are adding 2 scans with different lambda-zeros, start with the scan with the largest lambda-zero, shift it to the other scan's lambda-zero, then add in the other scan.

PC = PLUS CONSTANT: This program adds a constant (in the range -8388607 to 8388607) to every channel in the buffer. The PC operation does not affect the flux scale of the buffer, so overflows or underflows can occur.

CC = PLOT ON CALCOMP: This program will plot the buffer on the calcomp. The entries for scale and offset are the same as in other calcomp programs—such as Plot on the 8K Special Tape. Answering Y to "DOTS?" will cause the plotter to make individual dots for each channel instead of connecting them with lines.

Q = QUIT: This option causes an exit to the Selector.

IBM-SDRS PROGRAM CHANGES

The IBM-SDRS program has continued to evolve since the publication of the revised version of L.O.T.R. #15. Use of IBM tapes written under 32K Focal has increased program efficiency, several new commands have been included, and various other changes have been made.

NEW COMMANDS

1) FLAMBDA

*FLAMBDA D1 D2

will convert disk scans D1 through D2 from F_ν to F_λ. A new flag has been created in the reduced scan ID area to record whether a scan is F_ν or F_λ: Word 2 of the ID area is 0 for a F_ν scan and 1 for a F_λ scan (see L.O.T.R. #2, A-3).

Probably the most efficient way to use this feature would be to create a response curve, hit the response curve with *FLAMBDA, and then use this new response curve to flux the data.

FOR EXAMPLE:

```
*ADD        9
*SFLUX      8                    create R channel response curve
            0
*STORE      7
*ADD       10
*SFLUX      8                    create L channel response curve
            0
*STORE      8
*FLAMBDA    7    8               change response curves to F_λ
*ADD        7
*SFLUX                               flux R channel data
            9   11   13   15   17
```

2) SWRITE

*SWRITE S1 S2

will copy disk scans S1 through S2 to the output tape. This command simplifies long *WRITE commands. For example

*SWRITE 1 32

replaces

*WRITE 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

*WRITE 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

*WRITE 31 32

PROGRAM CHANGES

*PROCESS and *NEON will now handle an arbitrary number of raw data scans. Previously 14 scans was the limit.[1]

Word 3 of the reduced scan ID record now contains the dispersion (Å/Channel) multiplied by 1000.

The system B flux calibration system has been updated to include the revised standard star calibrations (see Stone, R.P. 1977 Ap.J., 218, 767). Also the code numbers for the standard stars have been changed. These numbers are listed in the table on page 54. Note that only the 8 stars marked with asterisks in the table can be used for system A flux calibrations (the code numbers for system A standard stars are the same as for system B stars). The system A flux calibration has not been changed to reflect the revised Stone numbers.

→[1] See "Update," page 53a

UPDATE TO IBM-SDRS
APRIL 1980

1. Despite the claim on the previous page, *PROCESS will properly handle only 16 scans. The program will appear to work correctly for over 16 scans, but extinction corrections will be performed only for the first 16.

2. *ZERO can now handle wavelengths as well as channels. For example:

*ZE 31003100 will zero the scans in slit buffers 1 and 2 to λ3100.

3. 40 scans are now available instead of the previous 32 in the disc buffer area (accessed with *ST).

4. Whenever *SKY is executed, the peaks of the night sky lines are found and a least-squares fit for λ_0 is performed.

5. A new and vastly improved system A flux calibration system has been installed. The new *RF command is used as follows:

```
*RF     SC1 SC2 SC3 ....
        SS1 SS2 SS3 ....
        OB1 OB2 OB3 ....
```

where SCn is a standard star code number from the list on page 54; SSn is the disc buffer containing the scan of standard star SCn; and OBn are the object scans to be fluxed.

Up to 5 standard stars may be included, and up to 15 scans may be fluxed. Note that all the standard stars may now be used in a system A calibration, not just those shown with an asterisk in the standard star table. After *RF is finished, the resulting response curve is placed in slit buffer 1. If there are no entries on the first and second cards, the response curve is assumed to be in slit buffer 1.

*RF does the following: For each standard star, a smooth representation of the standard star flux is created from the Stone calibration and is divided by the line-zapped standard star scan. The resulting response curves are shifted so their atmospheric bands line up and they are then averaged. Before the response curve is applied to an object scan, it is again shifted to line up the atmospheric bands.

6. JCL changes: The SPACE parameter on the FT04F001 card must be changed to SPACE=(4352,(84,2)). To prevent virgin output tapes from being ignored by the sytem, change the LABEL parameter on the FT10F001 card to LABEL=(,BLP).

7. A "hoked up" point at λ8600 has been added for all the standard stars in a largely futile attempt to improve the far-red response curves.

STANDARD STAR LIST

CODE NUMBER		STAR
1		BD +8 2015
2		BD +25 3941
3	*	BD +28 4211
4	*	BD +33 2642
5	*	BD +40 4032
6	*	FEIGE 15
7	*	FEIGE 25
8	*	FEIGE 34
9	*	FEIGE 56
10		FEIGE 92
11		FEIGE 98
12		FEIGE 110
13	*	HILTNER 102
14		HILTNER 600
15		HZ 15
16		KOPFF 27
17		HD 37129
18		HD 46150
19		TRUMPLER 183
20		ETA HYD
21		HD 182487

* AVAILABLE FOR USE BY *AFLUX

USING THE PROGRAM

The IBM-SDRS program is now permanently stored on the disk, so an object deck is no longer required. A JCL listing is included in this writeup that shows the necessary control cards. The user must substitute his own tape names in the MESSAGE cards and (in two places each) on the FT10F001 and FT11F001 cards. The IBM-SDRS command cards go after the //SYSIN DD * card.

A description of the programs used to make IBM-SDRS input tapes and to read IBM-SDRS output tapes is contained in the writeup on the 32K Special Tape.

A library of command cards is kept in the card file in the data analysis room, to the right of the Monroe Calculator. Please keep the cards in order!

IBM tapes that are produced by 32K versions of the scanner data taking system (SDTS) differ in format from tapes produced by the DEC-IBM program. These 32K-SDTS tapes include the second slit ID record and have sequence numbers in word 0 rather than word 23 of the first ID record. Such IBM tapes may be read by IBM-SDRS if the following command is included as the first card of the input deck:

```
*32K
```

Remember that IBM-SDRS considers scans to be 4096 channels long, while area-scanner output may have scans up to 32768 channels long; so IBM scan numbers used in IBM-SDRS input commands will differ from those used by SDTS.

A TYPICAL RUN

Suppose your IBM tape contained data (taken with the red tube) as follows:

IBM SCANS	OBJECT
0-2	end-quartz
3-5	beginning-quartz
6	He Hg Ar
7-8	BD +28 4211
9-13	NGC 4151
14-16	NGC 1068
17-18	BD +33 2642

One way to reduce this data might be (comments in parentheses):

```
*QUARTZ      3   5   0   2
*STORE       1   2   3   4
```

(sums up all 6 quartz scans)

(save Σ Quartz right slit in disk scan 1, Σ Quartz left slit in disk scan 2, Σ Quartz (beg.)/Σ Quartz (end) right and left slits in disk scans 3 and 4)

```
*LAMBDA      1   2
RT 4/25-6/77  3455214.   1835184.   4242553.   -5213489.
LF 4/25-6/77  3450661.   1849558.   4031673.   -4818583.
```

(read in lambda coefficients for this setup)

```
*SCRUNCH     0   0   1   2
```

(scrunch the quartz divisions to place any glitches on the reduced wavelength scale)

```
*STORE       0   0   5   6
```

(save them in disk scans 5and 6)

```
*NEON        6   6
```

```
*STORE        7   8
```

(process and store He Hg Ar scans - one can measure instrumental resolution from these scans)

```
*PROCESS      7   8
*STORE        9  10
```

(do BD +28 4211)

```
*PROCESS      9  13
*STORE       11  12
*SKY         13
```

(do NGC 4151 - saving sky)

```
*PROCESS     14  16
*STORE       14  15
*SKY         16
```

(do NGC 1068)

```
*PROCESS     17  18
*STORE       17  18
```

(do BD +33 2642)

```
*ADD          9  17
*ZERO       120 120
*SFLUX        3   4
              0
*ZERO       120
*STORE       19
```

(create a right-slit response curve and save it in disk scan 19. The standard star scans and the resultant response curve are zeroed below $\sim\lambda 3600$ - red tube data is essentially worthless shortward of this wavelength)

```
*ADD         10  18
```

```
*ZERO       120 120
*SFLUX        3   4
               0
*ZERO       120
*STORE       20
    (create a left-slit response curve)
*ADD         19

*SFLUX
              5   7   9   11   14   17
    (flux all the right-slit data)
*ADD         20
*SFLUX
              6   8  10   12   15   18
    (flux the left-slit data)
*ADD         19
*ADD         20
*SFLUX
             13  16
    (create a composite response curve by adding disk scans 19 and  20 and
    then flux the sky scans)
*SWRITE       5  20
    (write out the results)
*END
```

If you don't care about keeping the slits separate, the following sequence will combine the left and right slits of NGC 1068 and store their sum in disk scan 9. The sky sum is stored in disk scan 10.

```
*PROCESS    14   16
*ADD        -2
*STORE       9
*SKY        10
```

JCL LISTING

```
//SDRS JOB (3022,60,20,0),GASKELL,MSGLEVEL=1,TIME=60
***MESSAGE     **********
***MESSAGE     PLEASE MOUNT TAPE ASC001  NO RING
***MESSAGE     PLEASE MOUNT TAPE SC0512       RING
***MESSAGE     **********
//GO EXEC PGM=SDRS1
//STEPLIB DD DSN=#3506.KIBRICK.SDRS,UNIT=2314,VOL=SER=42,DISP=OLD
//FT03F001    DD DSN=&DISK,UNIT=SYSDA,SPACE=(4352,(64,2))
//FT04F001    DD DSN=&SCRATCH,UNIT=SYSDA,SPACE=(4352,(68,2))
//FT05F001 DD DDNAME=SYSIN
//FT06F001 DD SYSOUT=A
//FT10F001    DD LABEL=(,NL),VOL=SER=SC0512,DSN=SC0512,
// DISP=(NEW,PASS),DCB=(RECFM=VS,LRECL=8196,BLKSIZE=8200),
// UNIT=(2400,,DEFER)
//FT11F001    DD LABEL=(1,NL,,IN),VOL=SER=ASC001,DSN=ASC001,
// DISP=(OLD,PASS),DCB=(RECFM=VS,LRECL=8196,BLKSIZE=8200,BUFNO=1),
// UNIT=(2400,,DEFER)
//SYSIN DD *
//
```