	REPORT DOCUT	MENTATION	PAGE		
	JTIC	15. RESTRICTIVE	MARKINGS	<u>E</u> ILE	COP
2. SECURITY CLASSIFICATION AUTHORITY	LECTER	3. DISTRIBUTION	for public	REPORT	
26. DECLASSIFICATION / DOWNGRAD	PR 1 7 1989	distribu	tion is unli	mited.	
A PERFORMING ORGANIZATION REPORT	D ^{CS}	5. MONITORING	organization ri	EPORT NUMBER(S	•)
a. NAME OF PERFORMING ORGANIZATION	66. OFFICE SYMBOL	7a. NAME OF M	ONITORING ORGAI	NIZATION	
Univ of Arizona	(ir applicable)	AFOSR/NP			
ic. ADDRESS (City, State, and ZIP Code)		76. ADORESS (C) Building	ty, State, and ZIP 410, Bolli	Code) Ing AFB DC	<u></u>
Tucson, AZ 85721		20332-64	48		•
3a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDEN (IFICATION NUMBER			
AFOSR	NP NP	AF0SR-85-0101			
3c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS				
Building 410, Bolling AFB DC 20332-6448	· ·	ELEMENT NO. 61102F	NO. 2311	NO. Al	ACCESSION N
11. TITLE (Include Security Classification)	• •				the contraction of the second
(U) A DEEP OPTICAL INFRARED	SURVEY		•		
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky		La part of arm	007 (V	and he need	COUNT
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT FINAL FROM	COVERED 1 Feb 850 31 Jul	14. DATE OF REPO 88 March	ORT (Year Month, 7, 1989	Day) 15. PAGE	COUNT
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT FINAL 16. SUPPLEMENTARY NOTATION	COVERED 1 Feb 850 31 Jul	14. DATE OF REP B8 March	ORT (Year Month, 7, 1989	Day) 15. PAGE	COUNT
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT IFINAL 16. SUPPLEMENTARY NOTATION 17. COSATI CODES	COVERED 1 Feb 850 31 Jul 18. SUBJECT TERMS	14. DATE OF REPO B8 March	ORT (Year Month, 7, 1989 se if necessary an	Day) 15. PAGE	COUNT
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT FINAL 16. SUPPLEMENTARY NOTATION 17. COSATI CODES FIELD GROUP SUB-GROUP	COVERED 1 Feb 850 31 Jul 18. SUBJECT TERMS Astronom	14. DATE OF REPO B8 March (Continue on rever	ORT (Year Month, 7, 1989 Se if necessary an CCD	Day) 15. PAGE	COUNT ck number)
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT 13b. TIME FINAL 16. SUPPLEMENTARY NOTATION 17. COSATI CODES FIELD GROUP 03.02 19. ABSTRACT (Continue on reverse of recessed	COVERED 1 Feb 850 31 Jul 18. SUBJECT TERMS Astronomy 19. And identify by block	(Continue on rever y, Infrared,	ORT (Year Month, 7, 1989 Month, se if necessary and CCD to carry ou	Day) 15. PAGE d identify by blo	COUNT ck number) cy survey a
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT IFINAL 13b. TIME FROM_ 16. SUPPLEMENTARY NOTATION 17. COSATI CODES FIELD GROUP SUB-GROUP 03.02 19. ABSTRACT (Continue on reverse if necessed This grant was awarded to de the near-infrared wavelength after which funding would be strategy consists of placing (CCD) at the focus of a tran Juffaced Astronom Devices, (jhd)	COVERED 1 Feb 850 31 Jul 18. SUBJECT TERMS Astronomy Venobioently necess of 2000. The gr sought from oth a near infrared sit telescope on J. J. J	(Continue on rever y, Infrared, ant was also er sources t array with Kitt Peak, Defect	ORT (Year Month, 7, 1989 se if necessary and CCD to carry ou to cover an o finish the a silicon ch Arizona. Ke tors: Che	Day) 15. PAGE d identify by blo it a deep sk n ititial op e survey. T harge:couple 7 Words: C	COUNT ck number) ay survey a perating per he survey ed readout
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT IFINAL 13b. TIME FROM	COVERED 1 Feb 850 31 Jul 18. SUBJECT TERMS Astronomy We hop definity he cless of 2000. The gr sought from oth a near infrared sit telescope on T_{in} from oth a near for a cless M_i CY GNG	(Continue on rever y, Infrared, argotrardware ant was also er sources t array with Kitt Peak, Detect 21. ABSTRACT S UNCI	ORT (Year Month, 7, 1989 Se if necessary and CCD to carry ou to cover an o finish the a silicon ch Arizona. Ke tors: Chce SECURITY CLASSIFIE	Day) 15. PAGE d identify by blow it a deep sk h ititial op e survey. Thargetcouple 7 Words: CATION	COUNT ck number) sy survey a berating pe the survey ed readout
12. PERSONAL AUTHOR(S) Dr Marcia J. Lebofsky 13a. TYPE OF REPORT FINAL 13b. TIME FROM	COVERED 1 Feb 850 31 Jul 18. SUBJECT TERMS Astronom We top define he dess of 2000. The gr sought from oth a near infrared sit telescope on <i>J. J. J. C.Y. GWS</i>	14. DATE OF REPO B8 March (Continue on rever y, Infrared, aff go Mardware ant was also er sources t array with Kitt Peak, D De Tec s 21. ABSTRACT S UNCI 226. TELEPHONE (201)	ORT (Year Month, 7, 1989 se if necessary and CCD to carry ou to cover an o finish the a silicon ch Arizona. Ke tors: Chc SECURITY CLASSIFIE ASSIFIED E(Include Area Cod 2) 767-4906	Day) 15. PAGE d identify by blow it a deep sk h ititial op e survey. Thargetcouple words: CATION Ke) 220. OFFICE S AFOSI	COUNT ck number) ck number) cy survey a berating pe the survey ed readout che survey ed readout
12. PERSONAL AUTHOR(S) DT Marcia J. Lebofsky 13a. TYPE OF REPORT 13b. TIME FROM	COVERED 1 Feb 850 31 Jul 18. SUBJECT TERMS Astronom Veropidentify necess of 2000. The gr sought from oth a near infrared sit telescope on <i>J. J. M. Craces</i> <i>M. Craces</i> CT IS RPT. DIIC USER	14. DATE OF REP B8 March (Continue on rever y, Infrared, array With Kitt Peak, Defect s 21. ABSTRACT S UNCI 22b. TELEPHONE (20) Until exhausted.	ORT (Year Month, 7, 1989 ccD to carry ou to cover an o finish the a silicon ch Arizona. Ke tors: Che SECURITY CLASSIFIE Elinclude Area Cod 2) 767-4906	Day) 15. PAGE d identify by bloc at a deep sk h tittal op e survey. Thargelcouple floords: floords: AFOS cation	COUNT ck number) ck number) cy survey a berating pe he survey ed readout cmpled che survey ed readout

.

· · · · ·

The state of the

Final Technical Report for Grant No. AFOSR-85-0101

Marcia J. Lebofsky University of Arizona March 7, 1989

APOSR . TR. 89-0435

¹ This grant was awarded to develop the necessary hardware to carry out a deep sky survey at the near-infrared wavelength of 2µm. The grant was also to cover an initial operating period after which funding would be sought from other sources to finish the survey. The survey strategy consists of placing a near-infrared array with a silicon charge-coupled readout (CCD) at the focus of a transit telescope on Kitt Peak, Arizona/ A similar survey at optical wavelengths was also planned. The optical survey uses optical CCDs and is funded separately. The infrared survey will use the same data reduction facilities, and will "piggy-back" on the optical survey for many of the needed support services. The performance of the infrared array and the 72-inch diameter of the transit telescope should insure that a survey of 12 square degrees will reach a limiting magnitude of $K(2.2\mu m) = 17$ or .10 mJanskys. Such a survey should reveal much about the local structure of the galaxy such as the first accurate and unbiased measurement of the cool M-dwarf star density. The survey may also have cosmological implications because it should be capable of detecting luminous galaxies at redshifts of 0.7 and higher.

The progress in implementing this survey has included all of the steps up to actually carrying out the survey. A 32x32 array was obtained from Rockwell International, and shown to be more than adequate for the purposes of this project. A set of readout electronics was built which permits the array to be clocked in synchronism with the rate at which the sky sweeps past a transit telescope. The readout electronics and computer interface were tested using the array mounted at the Cassegrain focus of the University of Arizona's 90-inch telescope on Kitt Peak, and demonstrated the performance level needed to achieve the survey goals. The remaining work under this grant consisted of taking the array and its readout electronics, and repackaging them to meet the constraints of the transit telescope. These constraints consist of a special dewar and electronics package which must not exceed a diameter of 8 inches because the dewar and electronics must not protrude into the light beam. A major complication in assembling the survey hardware arose from the constraint placed by the operating temperatures of the two array types. The optical CCDs must operate at a temperature no lower than 140°K while the infrared array operates best at a temperature near 77°K. A thermal design for the dewar was generated. The actual dewar required some tuning in the form of optimizing the sizes of thermal straps connecting the various arrays to the cold bath, but the final performance has all arrays operating at their optimum temperatures, and the dewar requires a liquid nitrogen refill only once every 24 hours.

The other component of readying this survey consisted of modifying the optical survey data reduction path to include the infrared data. Routines specific to the infrared data stream have been added to the survey data reduction computer (a Data General MV10000). Routines have also been added to permit co-adding of data taken on different nights to permit reaching the ultimate survey goal of K=17. The database query routines have also been

modified to include the additional infrared data.

The optical portion of this survey has been operating nightly for a year, and the transit survey concept has been verified. When the Arizona "monsoon" season arrives in July, the optical CCDs will be removed from the transit telescope. They will then be placed in the dewar described above and aligned with the infrared array to insure that the survey track will be parallel to both arrays. The dewar will then be placed on the transit telescope, aligned, and data-taking will commence. Limited funding from the National Science Foundation has been obtained to continue the survey.

Accesion For	
NTIS CRA&I N	
DTIC TAB	
Unarrow and D	
Justification	
By Distribution /	····
Avera Consty Council	
Dist Spears	
A-1	