11:32:30 OCA PAD AMENDMENT - PROJECT HEADER INFORMATION 10/07/92

Active

Project #: E-21-623 Cost share #: Rev #: 10
Center # : Q5272-0A0 Center shr #: OCA file #:
Work type : RES
Contract#: NAS1-15370 Mod #: 15 Document : CONT
Prime #: Contract entity: GIT

Subprojects ? : N CFDA: N/A
Main project #: PE #: N/A

Project unit: ELEC ENGR Unit code: 02.010.118
Project director(s):
CALLEN W R JR ELEC ENGR (404)894-2919
GAYLORD T K ELEC ENGR (404)-

Sponsor/division names: NASA / LANGLEY RESEARCH CTR, VA
Sponsor/division codes: 105 / 001

Award period: 780421 to 921001 (performance) 921001 (reports)

Sponsor amount	New this change	Total to date
Contract value	0.00	66,795.00
Funded	0.00	66,795.00
Cost sharing amount		0.00

Does subcontracting plan apply ?: N

Title: HOLOGRAPHIC DATA STORAGE CRYSTALS EXPERIMENT FOR LDEF, PHASES I, II, III.

PROJECT ADMINISTRATION DATA

OCA contact: Ina R. Lashley 894-4820

Sponsor technical contact

MR. JAMES L. JONES, JR., MS 356
(804)864-3795

NASA
LANGLEY RESEARCH CENTER
HAMPTON, VA 23665-5225

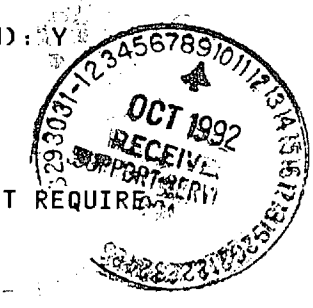
Sponsor issuing office

MR N G PRICE, MAIL STOP 126
(804)864-2422

NASA
LANGLEY RESEARCH CENTER
HAMPTON, VA 23665-5225

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): Y
Defense priority rating : N/A GOVT supplemental sheet
Equipment title vests with: Sponsor X GIT

Administrative comments -
MOD 15 AUTHORIZES A CHANGE IN THE CDRL WHICH CHANGES THE FINAL REPORT REQUIREMENT FROM "FORMAL" TO "INFORMAL".



SE772

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 05/23/94

Project No. E-21-623_____ Center No. Q5272-0A0_____

Project Director CALLEN W R JR_____ School/Lab ECE_____

Sponsor NASA/LANGLEY RESEARCH CTR, VA_____

Contract/Grant No. NAS1-15370_____ Contract Entity GIT_

Prime Contract No. _____

Title HOLOGRAPHIC DATA STORAGE CRYSTALS EXPERIMENT FOR LDEF, PHASES I, II, III.

Effective Completion Date 921001 (Performance) 921001 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	_____
Final Report of Inventions and/or Subcontracts	Y	_____
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	Y	_____
Other _____	N	_____

Comments_____

_____

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

NOTE: Final Patent Questionnaire sent to PDPI.

E 21-623

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

June 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 1
Monthly Financial Management Report
Contract No. NAS1-15370
"Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)"
Period Covered 21 April 1978 to 31 May 1978

Dear Sir:

The subject reports are forwarded in conformance with contract specifications. Should you have any questions or comments regarding this report, please contact me at the above address.

Sincerely,

W. R. Callen
Project Director

WRC/kkm

Distribution:
Addressee, 2 copies
cc J. Y. Taylor, Mail Stop 126, 1 copy

J. Samos, Mail Stop 139A, 1 copy (Monthly Technical Letter Only)

Cost Accounting Dept., Mail Stop 135, 1 copy (Financial Management Report Only)

Programs and Resources Div., Mail Stop 104, 1 copy (Financial Managment Report Only)

Henry S. Cassell III, ONRRR, 1 copy (Transmittal Letter Only)

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

June 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 1
Contract NAS1-15370
"Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)"
Period Covered 21 April 1978 to 31 May 1978

Dear Sir:

Activities during the first month of the subject contract included solicitations for bids from suppliers of the lithium niobate crystals to be used in our project. Responses were obtained from approximately six suppliers, but none would guarantee flawless quality crystals. We therefore have selected our normal supplier (also the lowest bidder), Crystal Technology, Inc., to provide the crystals, and the order has been placed. We feel that the crystals that we will obtain from this supplier will be quite suitable for the recording and testing of the holograms.

Next month's activity will include further coordination with the Engineering Experiment Station at Georgia Tech concerning the design of crystal holders for the LDEF.

New Technology Statement

A thorough review was conducted during the reporting period by the technical staff assigned to Contract NAS1-15370 to determine if any reportable items of new technology as defined in NASA PR Paragraph 9.107-6 resulted from the above described technical efforts. The engineering techniques applied to development of the holographic data storage crystals experiment were carefully reviewed, and no reportable items of new technology were discovered.

Respectfully submitted,

W. R. Callen
Project Director

WRC/kkm

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 4-21-78 to 5-31-78

TO: Mr. J. Y. Taylor
Long Duration Exposure Facility Project Office
National Aeronautics and Space Administration
Langley Research Center; Hampton, VA 23665

FROM: Georgia Institute of Technology
School of Electrical Engineering
Atlanta, Georgia 30332

3. CONTRACT VALUE
a. COSTS: $24,838
b. FEE: $ 0

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursement (No Fee)
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15370
c. SCOPE OF WORK: Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)
d. AUTH. CONTR. REP. (Signature):
DATE: 6/5/78

4. FUND LIMITATION
$11,000 $ 0

5. BILLING
a. INVOICE AMTS BILLED: $ 0
b. TOTAL PYTS REC'D: $ 0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	DURING MONTH — PLANNED b.	CUM. TO DATE — ACTUAL c.	CUM. TO DATE — PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Hours	-0-	-0-	-0-	-0-			800	800	800	
Direct Labor Dollars	-0-	-0-	-0-	-0-			9,750	9,750	9,750	
Overhead	-0-	-0-	-0-	-0-			6,630	6,630	6,630	
Materials & Supplies	-0-	-0-	-0-	-0-			7,000	7,000	7,000	
Other Direct Cost	-0-	-0-	-0-	-0-			1,278	1,278	1,278	
Total Estimated Cost	-0-	-0-	-0-	-0-			24,838	24,838	24,838	

Baseline Plan Identification (Col. 7b & 7d): Revision No. _____, Dated _____.

NASA FORM 533M MAR 73 PREVIOUS EDITION MAY BE USED.

RCS10PUBL00417

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

July 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 2
Monthly Financial Management Report
Contract No. NAS1-15370
"Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)"
Period Covered 1 June 1978 to 30 June 1978

Dear Sir:

The subject reports are forwarded in conformance with contract specifications. Should you have any questions or comments regarding this report, please contact me at the above address.

Sincerely,

W. R. Callen
Project Director

WRC:kkm

Distribution:
Addressee, 2 copies
cc: J. Y. Taylor, Mail Stop 126, 1 copy

J. Samos, Mail Stop 139A, 1 copy (Monthly Technical Letter Only)

Cost Accounting Dept., Mail Stop 135, 1 copy (Financial Management Report Only)

Programs and Resources Div., Mail Stop 104, 1 copy (Financial Management Report Only)

Henry S. Cassell III, ONRRR, 1 copy (Transmittal Letter Only)

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

July 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 2
Contract NAS1-15370
"Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)"
Period Covered 1 June 1978 to 30 June 1978

Dear Sir:

Activities during the second month of the subject contract included coordination with the Engineering Experiment Station at Georgia Tech concerning design and fabrication of the tray to hold the crystals during flight. It has been decided that the tray will be fabricated out of fiberglass with silicone rubber padding for the crystals. A preliminary design has been completed.

Next month's activity will include final design of the crystal holder.

New Technology Statement

A thorough review was conducted during the reporting period by the technical staff assigned to Contract NAS1-15370 to determine if any reportable items of new technology as defined in NASA PR Paragraph 9.107-6 resulted from the above described technical efforts. The engineering techniques applied to development of the holographic data storage crystals experiment were carefully reviewed, and no reportable items of new technology were discovered.

Respectfully submitted,

W. R. Callen
Project Director

WRC:kkm

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 6-1-78 to 6-30-78

TO: Mr. J. Y. Taylor
Long Duration Exposure Facility Project Office
National Aeronautics and Space Administration
Langley Research Center; Hampton, VA 23665

FROM:
Georgia Institute of Technology
School of Electrical Engineering
Atlanta, Georgia 30332

3. CONTRACT VALUE
a. COSTS: $ 24,838
b. FEE: $ 0

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursement (No Fee)
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15730
4. FUND LIMITATION: $ 11,000 $ 0
c. SCOPE OF WORK: Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)
d. AUTH. CONTR. REP. (Signature) DATE: 7/5/78
5. BILLING
a. INVOICE AMTS BILLED: $ 0
b. TOTAL PYTS REC'D: $ 0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT	CONTRACTOR ESTIMATE	CONTRACT VALUE	
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	a.	b.	
Direct Labor Hours	-0-	-0-	-0-	-0-			800	800	800	
Direct Labor Dollars	-0-	-0-	-0-	-0-			9,750	9,750	9,750	
Overhead	-0-	-0-	-0-	-0-			6,630	6,630	6,630	
Materials and Supplies	-0-	-0-	-0-	-0-			7,000	7,000	7,000	
Other Direct Cost	-0-	-0-	-0-	-0-			1,278	1,278	1,278	
Total Estimated Cost	-0-	-0-	-0-	-0-			24,838	24,838	24,838	

Baseline Plan Identification (Col. 7b & 7d): Revision No. _____, Dated _____.

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

August 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 3
Monthly Financial Management Report
Contract No. NAS1-15370
"Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)"
Period Covered 1 July 1978 to 31 July 1978

Dear Sir:

The subject reports are forwarded in conformance with contract specifications. Should you have any questions or comments regarding this report, please contact me at the above address.

Sincerely,

W. R. Callen
Project Director

WRC:kkm

Distribution:
Addressee, 2 copies
cc: J. Y. Taylor, Mail Stop 126, 1 copy

J. Samos, Mail Stop 139A, 1 copy (Monthly Technical Letter Only)

Cost Accounting Dept., Mail Stop 135, 1 copy (Financial Management Report Only)

Programs and Resources Div., Mail Stop 104, 1 copy (Financial Management Report Only)

Henry S. Cassell III, ONRRR, 1 copy (Transmittal Letter Only)

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

August 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 3
Contract NAS1-15370
"Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility (LDEF)"
Period Covered 1 July 1978 to 31 July 1978

Dear Sir:

Activities during the third month of the subject contract included the completion of the final design of the fiberglass mount to hold the crystals during flight. With regard to the crystal test facility, a number of angular selectivity scans were completed using both bounded beam and Fourier transform data page holograms.

Next month's activity will include the analysis of the holograms using the digital measurement system of the holographic test facility.

New Technology Statement

A thorough review was conducted during the reporting period by the technical staff assigned to Contract NAS1-15370 to determine if any reportable items of new technology as defined in NASA PR Paragraph 9.107-6 resulted from the above described technical efforts. The engineering techniques applied to development of the holographic data storage crystals experiment were carefully reviewed, and no reportable items of new technology were discovered.

Respectfully submitted,

W. R. Callen
Project Director

WRC:kkm

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 7-1-78 to 7-31-78

TO: Mr. J. Y. Taylor
Long Duration Exposure Facility Project Office
National Aeronautics and Space Administration
Langley Research Center; Hampton, VA 23665

FROM:
Georgia Institute of Technology
School of Electrical Engineering
Atlanta, Georgia 30332

3. CONTRACT VALUE
a. COSTS: $24,838
b. FEE: $ 0

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursement (No Fee)
c. SCOPE OF WORK: Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility(LDEF)

5. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15730

4. FUND LIMITATION: $11,000 $ 0

d. AUTH. CONTR. REP. (Signature): J. C. Cain DATE: 8/5/78

6. BILLING
a. INVOICE AMTS BILLED: $ 0
b. TOTAL PYTS REC'D: $ 0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT	CONTRACTOR ESTIMATE	CONTRACT VALUE	
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	a.	b.	
Direct Labor Hours	46	46	46	46			754	800	800	
Direct Labor Dollars	881	881	881	881			8,869	9,750	9,750	
Overhead	670	670	670	670			5,960	6,630	6,630	
Materials and Supplies	-0-	-0-	-0-	-0-			7,000	7,000	7,000	
Other Direct Cost	87	87	87	87			1,191	1,278	1,278	
Total Estimated Cost	1,638	1,638	1,638	1,638			23,200	24,838	24,838	

Baseline Plan Identification (Col. 7b & 7d): Revision No. _____, Dated _____.

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

September 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 4
Monthly Financial Management Report
Contract No. NAS1-15370
"Holographic Data Storage Crystals Experiment
for the Long Duration Exposure Facility (LDEF)"
Period Covered 1 August 1978 to 31 August 1978

Dear Sir:

The subject reports are forwarded in conformance with contract specifications. Should you have any questions or comments regarding this report, please contact me at the above address.

Sincerely,

W. R. Callen
Project Director

WRC:kkm

Distribution:
Addressee, 2 copies
cc: J. Y. Taylor, Mail Stop 126, 1 copy

J. Samos, Mail Stop 139A, 1 copy (Monthly Technical Letter Only)

Cost Accounting Dept., Mail Stop 135, 1 copy (Financial Management Report Only)

Programs and Resources Div., Mail Stop 104, 1 copy (Financial Management Report Only)

Henry S. Cassell III, ONRRR, 1 copy (Transmittal Letter Only)

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

September 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 4
Contract NAS1-15370
"Holographic Data Storage Crystals Experiment for the
Long Duration Exposure Facility (LDEF)"
Period Covered 1 August 1978 to 31 August 1978

Dear Sir:

Activities during the fourth month of the subject contract included the comparison of the previously recorded holograms with the theoretical predictions. The data from the angular selectivity scans was recorded on the digital measurement system and compared with the coupled wave theory of hologram formation. Overall agreement was obtained, which indicates that our system is performing properly.

Next month's activity will include the receipt of the crystals that will be included in the LDEF experiment.

New Technology Statement

A thorough review was conducted during the reporting period by the technical staff assigned to Contract NAS1-15370 to determine if any reportable items of new technology as defined in NASA PR Paragraph 9.107-6 resulted from the above described technical efforts. The engineering techniques applied to development of the holographic data storage crystals experiment were carefully reviewed, and no reportable items of new technology were discovered.

Respectfully submitted,

W. R. Callen
Project Director

WRC:kkm

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 8-1-78 to 8-31-78

TO: Mr. J. Y. Taylor
Long Duration Exposure Facility Project Office
National Aeronautics and Space Administration
Langley Research Center; Hampton, VA 23665

FROM:
Georgia Institute of Technology
School of Electrical Engineering
Atlanta, Georgia 30332

9. CONTRACT VALUE
a. COSTS: $ 24,838
b. FEE: $ 0

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursement (No Fee)
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15730
4. FUND LIMITATION: $ 11,000 $ 0
c. SCOPE OF WORK: Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility(LDEF)
d. AUTH. CONTR. REP. (Signature)
DATE: 9/5/78
5. BILLING
a. INVOICE AMTS BILLED: $ 1,637.16
b. TOTAL PYTS REC'D: $ 0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT	CONTRACTOR ESTIMATE	CONTRACT VALUE	
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	a.	b.	
Direct Labor Hours	141	141	187	187			613	800	800	
Direct Labor Dollars	1,925	1,925	2,806	2,806			6,944	9,750	9,750	
Overhead	1,463	1,463	2,133	2,133			4,497	6,630	6,630	
Materials and Supplies	-0-	-0-	-0-	-0-			7,000	7,000	7,000	
Other Direct Cost	86	86	173	173			1,105	1,278	1,278	
Total Estimated Cost	3,474	3,474	5,112	5,112			19,726	24,838	24,838	

Baseline Plan Identification (Col. 7b & 7d): Revision No. _____, Dated _____.

NASA FORM 533M MAR 73 PREVIOUS EDITION MAY BE USED.

RCS10PUBL00417

E-21-623

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

October 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 5
Monthly Financial Management Report
Contract No. NAS1-15370
"Holographic Data Storage Crystals Experiment
for the Long Duration Exposure Facility (LDEF)"
Period Covered 1 September 1978 to 30 September 1978

Dear Sir:

The subject reports are forwarded in conformance with contract specifications. Should you have any questions or comments regarding this report, please contact me at the above address.

Sincerely,

W. R. Callen
Project Director

WRC:kkm

Distribution:
Addressee, 2 copies
cc: J. Y. Taylor, Mail Stop 126, 1 copy

J. Samos, Mail Stop 139A, 1 copy (Monthly Technical Letter Only)

Cost Accounting Dept., Mail Stop 135, 1 copy (Financial Management Report Only)

Programs and Resources Div., Mail Stop 104, 1 copy (Financial Management Report Only)

Henry S. Cassell III, ONRRR, 1 copy (Transmittal Letter Only)

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-2901

October 5, 1978

National Aeronautics and Space Administration
Langley Research Center
Attn: Mr. Robert L. O'Neal, Mail Stop 158B
Contract NAS1-15370
Hampton, VA 23665

SUBJECT: Monthly Technical Letter Progress Report No. 5
Contract NAS1-15370
"Holographic Data Storage Crystals Experiment
for the Long Duration Exposure Facility (LDEF)"
Period Covered 1 September 1978 to 30 September 1978

Dear Sir:

Activities during the fifth month of the subject contract included a visit to Georgia Tech by Mr. Lenwood Clark from the LDEF Project Office. Mr. Clark viewed the flight hardware that has been constructed at the Engineering Experiment Station at Georgia Tech; he also viewed the tray provided by NASA for the Georgia Tech experiments. The holographic crystal test procedure and test apparatus in the School of Electrical Engineering were discussed. The crystals themselves had arrived from the supplier earlier in the month.

Next month's activity will include preliminary examination and testing of the crystals that will be included in the LDEF experiment.

New Technology Statement

A thorough review was conducted during the reporting period by the technical staff assigned to Contract NAS1-15370 to determine if any reportable items of new technology as defined in NASA PR Paragraph 9.107-6 resulted from the above described technical efforts. The engineering techniques applied to development of the holographic data storage crystals experiment were carefully reviewed, and no reportable items of new technology were discovered.

Respectfully submitted,

W. R. Callen
Project Director

WRC:kkm

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 9-1-78 to 9-30-78

TO: Mr. J. Y. Taylor
Long Duration Exposure Facility Project Office
National Aeronautics and Space Administration
Langley Research Center; Hampton, VA 23665

FROM:
Georgia Institute of Technology
School of Electrical Engineering
Atlanta, Georgia 30332

3. CONTRACT VALUE
a. COSTS: $ 24,838
b. FEE: $ 0

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursement (No Fee)
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15730
c. SCOPE OF WORK: Holographic Data Storage Crystals Experiment for the Long Duration Exposure Facility(LDEF)
d. AUTH. CONTR. REP. (Signature) | DATE

4. FUND LIMITATION: $ 11,000 $ 0

5. BILLING
a. INVOICE AMTS BILLED: $ 6,498.83
b. TOTAL PYTS REC'D: $ 5,112.42

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT	CONTRACTOR ESTIMATE	CONTRACT VALUE	
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	a.	b.	
Direct Labor Hours	62	62	249	249			551	800	800	
Direct Labor Dollars	774	774	3,580	3,580			6,170	9,750	9,750	
Overhead	588	588	2,721	2,721			4,089	6,810	6,810	
Materials and Supplies	-0-	-0-	-0-	-0-			7,000	7,000	7,000	
Other Direct Cost	25	25	198	198			1,080	1,278	1,278	
Total Estimated Cost	1,387	1,387	6,499	6,499			18,339	24,838	24,838	

Baseline Plan Identification (Col. 7b & 7d): Revision No. _____, Dated _____.

NASA FORM 533M MAR 73 PREVIOUS EDITION MAY BE USED.

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No Reports Issued 1979-1989

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

July 23, 1990

Ms. Mary G. Coburn
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665-5225

RE: NAS1-15370 Financial Management Report

Dear Ms. Coburn:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-15370 for the period ended June 30, 1990.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. R. Callen, Elec Eng., 0250
Dr. T. K. Gaylord, Elec Eng., 0250
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
File: E21-623/Q52720A0

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

September 18, 1990

Ms. Mary G. Coburn
NASA Langley Research Center
Financial Management Division
Mail Stop 126
Hampton, VA 23665-5225

RE: NAS1-15370

Dear Ms. Coburn:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-15370 for the period ended August 31, 1990.

If you have any questions or need any additional information, please feel free to call me at (404) 894-2629 or Tammy Putnal at (404) 894-6757.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosures

cc: Dr. William R. Callen, Elec Eng, 0250
Ms. Kathy Knighton, Elec Eng, 0250
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
ONR RR, Don Calder, 0490
File: E-21-623/Q52720A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Budget Bureau No. 104-R0011 | 08/31/90 | 23

NASA - LANGLEY RESEARCH CENTER
ATTN: MS. MARY G. COBURN
FINANCIAL MGMT. DIV. M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332-0259

3. CONTRACT VALUE
a. COSTS: $ 56.8
b. FEE: $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15370
4. FUND LIMITATION: $ 56.8 $ -0-
c. SCOPE OF WORK: HOLOGRAPHIC DATA STORAGE CRYSTALS EXP. FOR LDEF
d. AUTH. CONTR. REP. (Signature) DATE: 09-17-90
5. BILLING
a. INVOICE AMTS BILLED: $ 51,277.42
b. TOTAL PYTS REC'D: $ 45,272.06

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT	CONTRACTOR ESTIMATE	CONTRACT VALUE	
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	e.	b.	c.	a.	b.	
Direct Labor Dollars	.7	.7	24.4	24.4			1.3	25.7	25.7	
Fringe Benefits	.2	.2	3.3	3.3			.9	4.2	4.2	
Travel	0	0	.5	.5			1.1	1.6	1.6	
Other Direct Costs	0	0	5.3	5.3			.3	5.6	5.6	
Overhead (Indirect)	.5	.5	18.2	18.2			1.5	19.7	19.7	
Total Costs	1.4	1.4	51.7	51.7			5.1	56.8	56.8	

Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757

E-21-623/Q5272-0A0

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624: 2629
Fax: 404•894•5519

November 20, 1991

Ms. Mary G. Coburn
NASA Langley Research Center
Financial Management Division
Mail Stop 126
Hampton, VA 23665-5225

RE: NAS1-15370

Dear Ms. Coburn,

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-153709 for the period ending October 31, 1991.

If you have any questions or need any additional information, please feel free to call me at (404) 894-2629 or Tammy Putnal at (404) 894-6757.

Sincerely,

David V. Welch
Director

DVW/djt

Enclosures

c: Dr. William R. Callen, Elec Eng, 0250
Ms. Kathy Knighton, Elec Eng, 0250
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies) ✓ 1-mw
Don Calder, ONR RR, 0490
File: E-21-623/Q5272-0A0

E-21-623

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404·894·4624; 2629
Fax: 404·894·5519

December 12, 1991

Ms. Mary G. Coburn
NASA Langley Research Center
Financial Management Division
Mail Stop 126
Hampton, VA 23665-5225

RE: NAS1-15370

Dear Ms. Coburn:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-15370 for the period ending November 30, 1991.

If you have any questions or need any additional information, please feel free to call me at (404) 894-2629 or Tammy Putnal at (404) 894-6757.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosures

cc: Dr. William R. Callen, Elec Eng, 0250
Ms. Kathy Knighton, Elec Eng, 0250
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies) ✓ 1 to M. Wolfe
ONR RR, Don Calder, 0490
File: E-21-623/Q52720A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS: 11/30/91 · 20

NASA-LANGLEY RESEARCH CENTER
ATTN: MS. MARY G. COBURN
FINANCIAL MGMT. DIV., M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332-0259

DESCRIPTION OF CONTRACT

a. TYPE: COST REIMBURSABLE

b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15370

c. SCOPE OF WORK: HOLOGRAPHIC DATA STORAGE CRYSTALS EXP. FOR LDEF

d. AUTH. CONTR. REP. (Signature) | DATE: 12/12/91

3. CONTRACT VALUE

a. COSTS	b. FEE
$ 66.8	$ -0-

4. FUND LIMITATION

$ 66.8	$ -0-

5. BILLING

a. INVOICE AMTS BILLED	b. TOTAL PYTS REC'D
$58,383.12	$ 58,383.12

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL					
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	e.	f.	BALANCE OF CONTRACT g.	CONTRACTOR ESTIMATE c.	CONTRACT VALUE b.	
DIRECT LABOR DOLLARS	0	0	27.8	27.8			2.2	30.0	30.0	
FRINGE BENEFITS	0	0	4.4	4.4			1.0	5.4	5.4	
TRAVEL	0	0	.5	.5			1.6	2.1	2.1	
OTHER DIRECT COSTS	0	0	5.3	5.3			.5	5.8	5.8	
OVERHEAD (INDIRECT)	0	0	20.9	20.9			2.6	23.5	23.5	
TOTAL	0	0	58.9	58.9			7.9	66.8	66.8	

Questions pertaining to this report should be directed to:
Ms. Tammy Putnal (404) 894-6757

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

June 12, 1992

Mr. Neil Price
NASA Langley Research Center
Financial Management Division
Mail Stop 126
Hampton, VA 23665-5225

RE: NAS1-15370

Dear Mr. Price:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-15370 for the period ending May 31, 1992.

If you have any questions or need any additional information, please feel free to call me at (404) 894-2629 or Tammy Putnal at (404) 894-6757.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosures

cc: Dr. William R. Callen, Elec Eng, 0250
Ms. Sharon Austin, Elec Eng, 0250
OCA/CSD, 0420 (2 copies)✓
ONR RR, Michael D. Karp, 0490
File: E-21-623/Q52720A0

E21-623

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
USA
404•894•4624; 2629
Fax: 404•894•5519

February 8, 1993

Mr. Neil Price
NASA Langley Research Center
Financial Management Division
Mail Stop 126
Hampton, VA 23665-5225

RE: NAS1-15370

Dear Mr. Price:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-15370 for the period ending December 31, 1992.

If you have any questions or need any additional information, please feel free to call me at (404) 894-2629 or Peggy Faircloth at (404) 894-6759.

Sincerely,

David V. Welch
Director

DVW/psf

Enclosures

cc: Dr. William R. Callen, Elec Eng, 0250
Ms. Sharon Austin, Elec Eng, 0250
Ms. Mary Wolfe, OCA/CSD, 0420
ONR RR, Michael D. Karp, 0490
File: E-21-623/Q52720A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 12/31/92 — 23

TO:
NASA-LANGLEY RESEARCH CENTER
ATTN: MR. NEIL PRICE
FINANCIAL MGMT. DIVISION, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GA 30332-0259

3. CONTRACT VALUE
a. COSTS: $ 66.8
b. FEE: $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-15370
4. FUND LIMITATION: $ 66.8 — $ -0-
c. SCOPE OF WORK: HOLOGRAPHIC DATA STORAGE CRYSTALS EXP. FOR LDEF
d. AUTH. CONTR. REP. (Signature): [signature] — DATE: 02/08/93
5. BILLING
a. INVOICE AMTS BILLED: $ 65,291.99
b. TOTAL PYTS REC'D: $ 65,281.31

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED: DURING MONTH a. ACTUAL	DURING MONTH b. PLANNED	CUM. TO DATE c. ACTUAL	CUM. TO DATE d. PLANNED	8. ESTIMATED COSTS/HRS. TO COMPLETE: DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS: CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	0	0	30.6	30.6			(.6)	30.0	30.0	
FRINGE BENEFITS	0	0	5.2	5.2			.2	5.4	5.4	
TRAVEL	0	0	1.2	1.2			.9	2.1	2.1	
OTHER DIRECT COSTS	0	0	5.3	5.3			.5	5.8	5.8	
OVERHEAD (INDIRECT)	0	0	23.6	23.6			(.1)	23.5	23.5	
TOTAL	0	0	65.9	65.9			.9	66.8	66.8	
				Questions pertaining to this report should be directed to:						
				Ms. Peggy Faircloth			(404) 894-6759			
E-21-623/Q5272-0A0										

Baseline Plan Identification (Col. 7b & 7d): Revision No. _____, Dated _____.

NASA FORM 533M MAR 79 PREVIOUS EDITION MAY BE USED.

RCS10PUBL00417

HOLOGRAPHIC DATA STORAGE CRYSTALS FOR THE LDEF*

W. Russell Callen
School of Electrical Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332-0250
Phone: 404/894-2912, FAX: 404/853-9171

Thomas K. Gaylord
School of Electrical Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332-0250
Phone: 404/894-2931, FAX: 404/853-9171

SUMMARY

Crystals of lithium niobate were passively exposed to the space environment of LDEF. Three of the four crystals contained volume holograms. Although the crystals suffered the surface damage characteristic of that suffered by other components on the Georgia Tech tray, the crystals remained suitable for the formation of volume holograms.

INTRODUCTION

Lithium niobate is a significant electro-optic material, with potential applications in ultra high capacity data storage and processing systems. Lithium niobate is the material of choice for many integrated optical devices and holographic mass memory systems. The objective of the experiment is to test the spaceworthiness of electro-optic crystals for use in ultrahigh capacity space data storage and retrieval systems.

VOLUME HOLOGRAPHIC STORAGE

Volume holographic storage offers a unique capability for ultrahigh capacity data storage and processing systems. In addition to the potential storage of up to 10" bits in a single crystal, holographic storage is insensitive to point damage of the medium. Holographic storage is particularly suitable for processing of data in page-oriented form and can be used either in a read-write-erase mode or in an archival

*This work was performed under NASA Contract No. NAS1-15370.

storage mode. By using electro-optic beam deflectors, mechanical motion can be eliminated. The principal advantages of volume holographic storage are listed in Table 1.

To record the volume holograms in the lithium niobate, two plane waves, produced by the same laser, are interfered within the crystal, as shown in Fig. 1. The interference maxima and minima produce a corresponding refractive index variation in the photorefractive crystal, which produces the volume hologram. By passing one of these beams, the "object" beam through a data page mask prior to incidence on the crystal, digital data in page oriented format may be stored as a volume hologram. The data page may be displayed by subsequent illumination with the reference beam alone. This writing and reading process is shown in Fig. 2. By rotation of the crystal with respect to the laser beam, multiple pages of data can be stored. Figure 3 illustrates the data storage in a page-oriented optical phase holographic memory.

OPTICAL SYSTEM

Much of our effort centered on developing a precise system for writing and evaluating the holograms. Systems were developed for hologram formation with both helium-neon (λ = 632.8 nm) and argon (λ = 514.5 nm) lasers. The apparatus for the holography study with helium-neon lasers is shown in Fig. 4. This apparatus achieves page rotation by rotating the reference beam angle with respect to a stationary object beam and stationary recording crystals. The reference beam angle is controlled by a stepper motor that drives a rotating mirror. The angular rotation resulting from a single step is 19.6 mirroradians. [1]

LDEF EXPERIMENT

For the LDEF experiment, holograms were recorded in 10 mm x 10 mm x 2 mm samples of iron-doped lithium niobate, with the optic axis lying in the plane of the surface. The crystals were specified to be iron doped to .005 mole percent iron in the melt. The samples were flown as part of the overall Georgia Tech experiment, LDEF experiment S0050, "Investigation of the Effects of Long-Duration Exposure on Active Optical Components," with principal investigator M.D. Blue. Our experiment consisted of the materials shown in Table 2.

The diffraction efficiency (diffracted power divided by incident power) as a function of read beam angle for a typical plane wave hologram is shown in Fig. 5. This diffraction efficiency could be used to monitor the degradation of the hologram with time.

RESULTS

To date, no holograms have been observed remaining in any of the samples because of the long exposure time involved. Although the crystals were recovered intact, they

suffered the same surface damage characteristic of that of other optical components on the Georgia Tech tray. A very significant result is that the crystals still retained their photosensitivity. A recently recorded hologram from one of the LDEF crystals is shown in Fig. 6.

ACKNOWLEDGMENT

The authors express their appreciation to NASA for sponsoring this research, and to Mr. Mark Lehi Jones for the photographs shown in Fig. 6.

REFERENCE

1. J.E. Weaver, "Angular Addressing Properties of Volume Fourier Transform Holograms in Iron-doped Lithium Niobate," Ph.D. Thesis, Georgia Institute of Technology, 1979.

Figure Captions

Figure 1. Volume hologram recording (a) interfering beams (b) crystal recording (c) recorded holograms.

Figure 2. Writing and reading a data page hologram.

Figure 3. Data storage in a page-oriented optical holographic memory.

Figure 4. Hologram recording and reading apparatus (helium-neon laser) (reference 1).

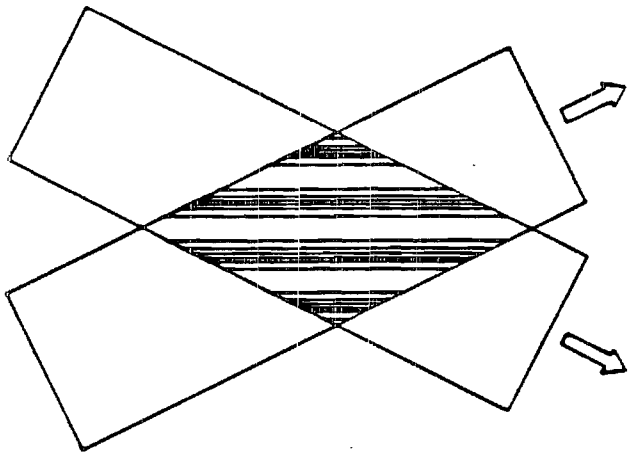
Figure 5. Diffraction efficiency versus angle (reference 1).

Figure 6. Hologram produced wiht LDEF crystal (a) object beam data page (b) hologram of object beam.

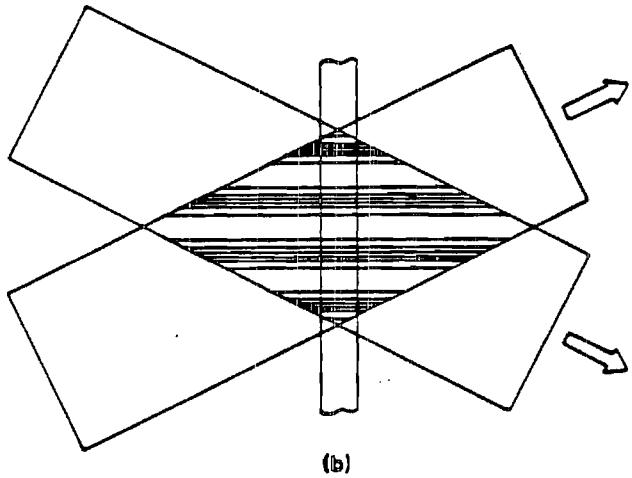
Table Captions

Table 1. Characteristics of volume holographic storage.

Table 2. LDEF samples.



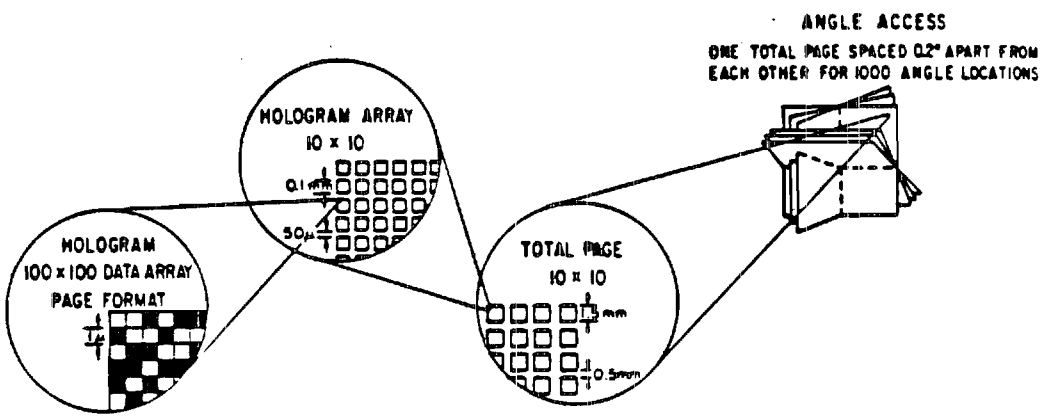
(a)



(b)

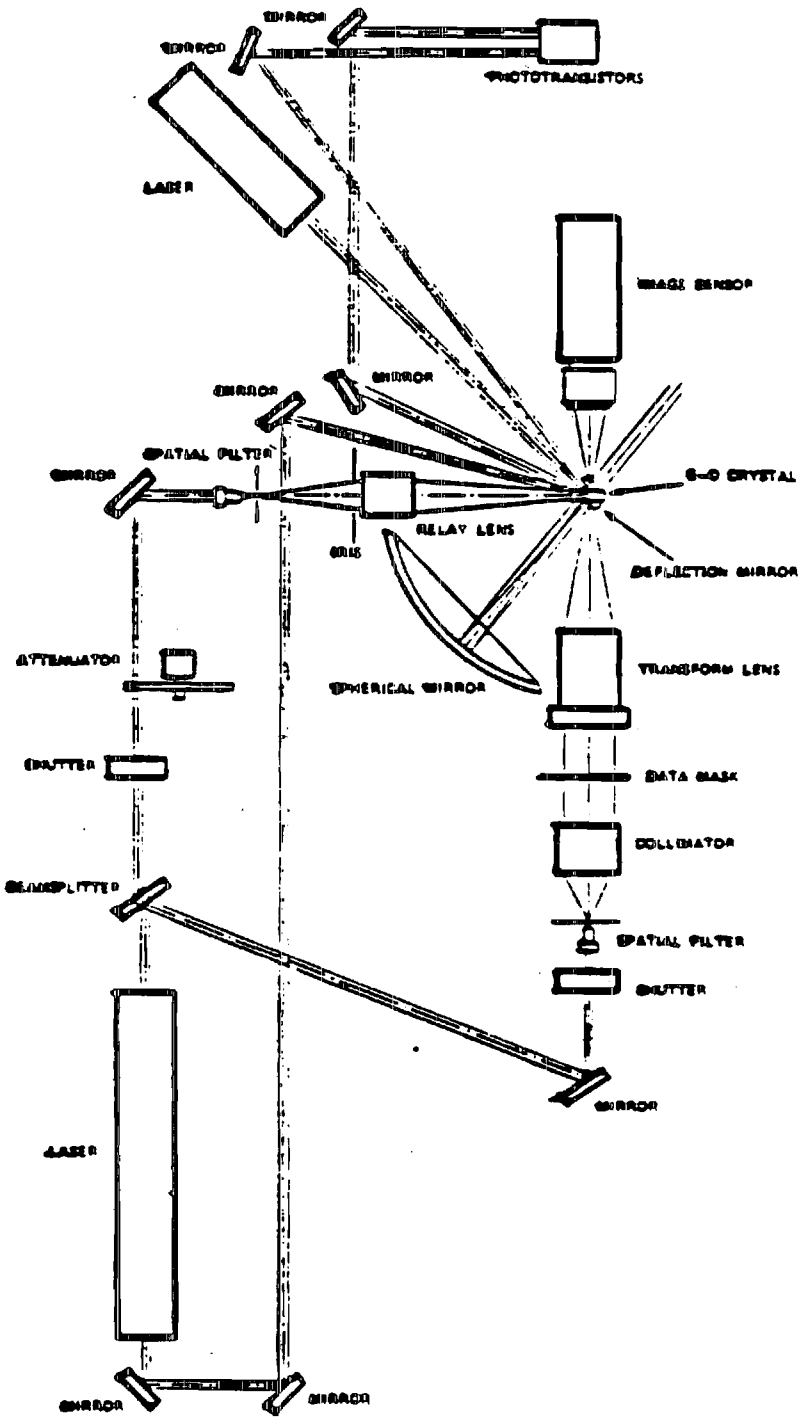
(c)

Fig. 1



10^4 bits x 10^2 x 10^2 x 10^3 = 10^{11} bits

Fig. 3



Optical System Diagram

Fig. 4

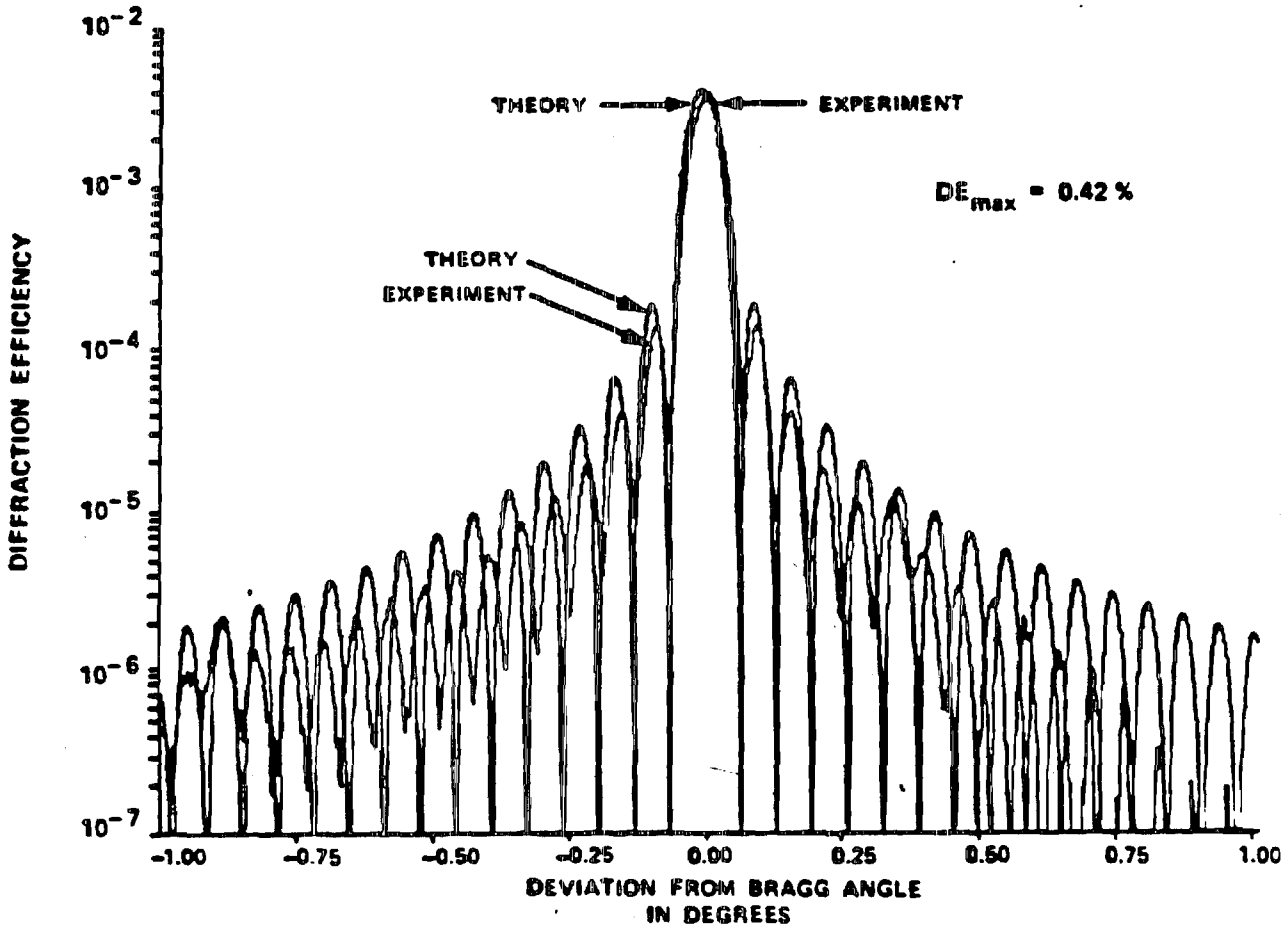

DIFFRACTION EFFICIENCY
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
THEORY
EXPERIMENT
DE_{max} = 0.42 %
THEORY
EXPERIMENT
-1.00
-0.75
-0.50
-0.25
0.00
0.25
0.50
0.75
1.00
DEVIATION FROM BRAGG ANGLE
IN DEGREES

Fig. 5

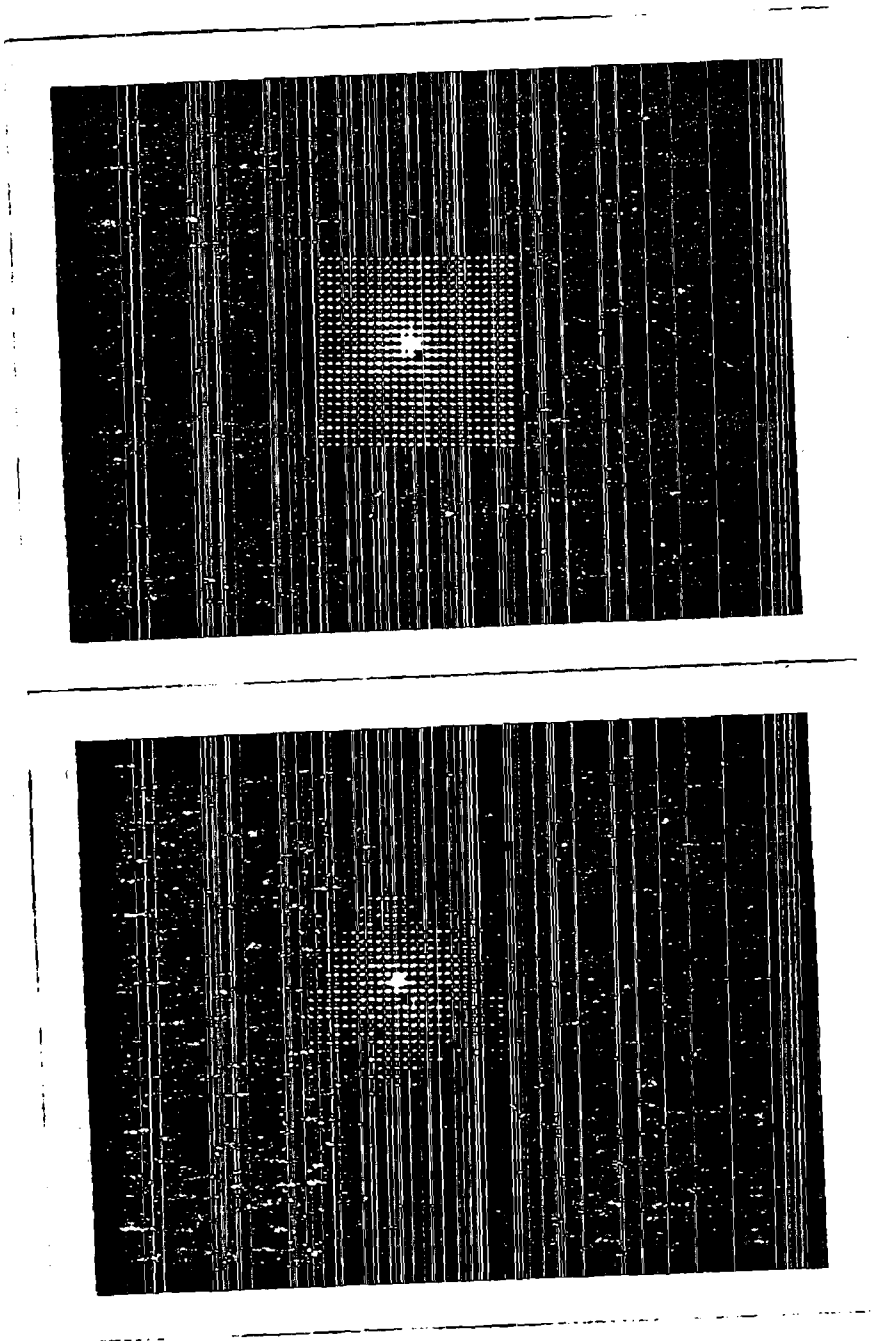


Fig. 6

VOLUME HOLOGRAPHIC STORAGE

HIGH INFORMATION CAPACITY

REDUNDANT

READ-WRITE-ERASE OR ARCHIVAL

NON MECHANICAL (ELECTRONIC & OPTICAL)

INHERENT TWO-DIMENSIONAL STORAGE

PROCESSING CAPABILITY

TABLE 1

TABLE —