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Computer Sciences Corporation

INTERNATIONAL ULTRAVIOLET EXPLORER OBSERVATORY OPERATIONS

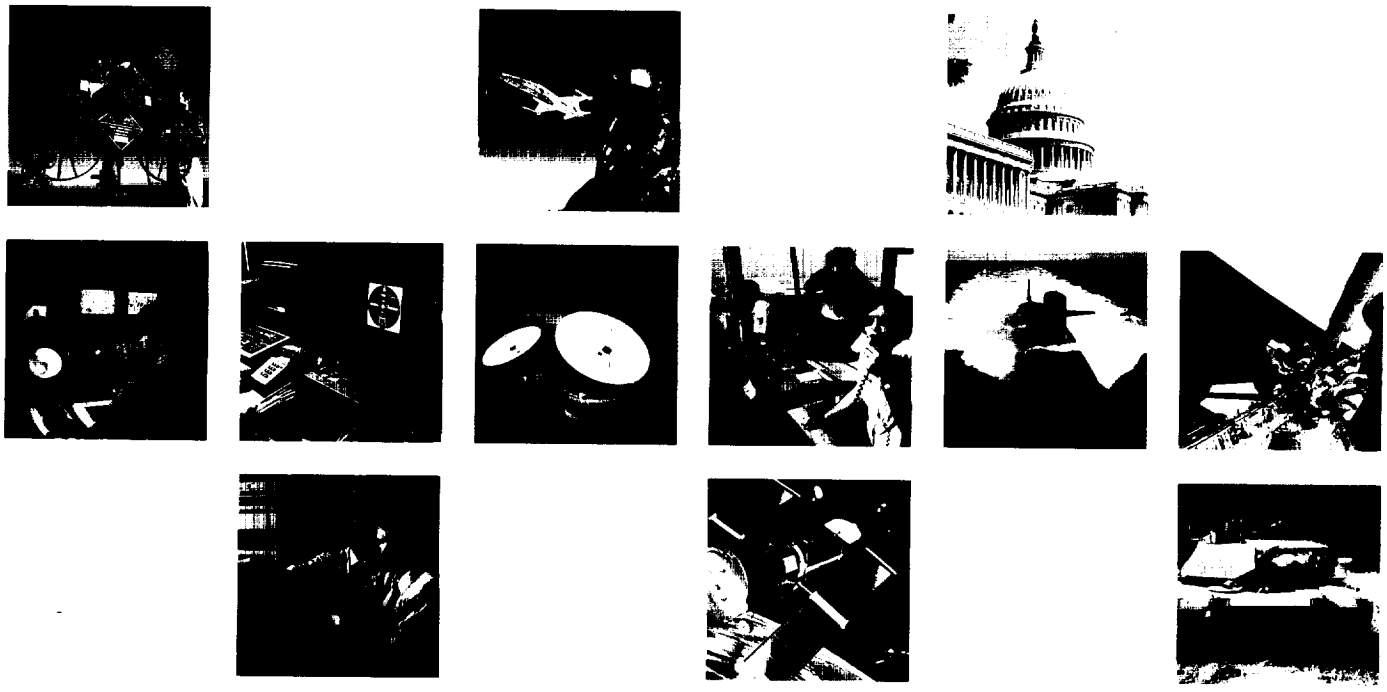
FINAL REPORT

CSC

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Goddard Space Flight Center
Greenbelt, Maryland

CONTRACT NAS5-31230

September 1996



SCIENCE OPERATIONS OF THE

INTERNATIONAL ULTRAVIOLET EXPLORER

(IUE) OBSERVATORY

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Prepared for

GODDARD SPACE FLIGHT CENTER

By

COMPUTER SCIENCES CORPORATION

Under

Contract NAS5-31230

PREFACE

This volume contains the Final Report for the Science Operations of the International Ultraviolet Explorer (IUE) Observatory contract, NAS5-31230. The nominal period of performance for this contract is October 10, 1991, to October 9, 1996. Under the terms of a pre-contract agreement, however, work began on August 27, 1991, immediately after the expiration of the predecessor IUE Observatory Operations contract.

This report summarizes the activities of the IUE Observatory from the start of the pre-contract work period and is arranged in sections according to the functions specified in the Statement of Work (SOW) of the contract. Routine activities have been summarized briefly whenever possible; statistical compilations, reports, and more lengthy supplementary material are contained in the Appendices.

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LIST OF ABBREVIATIONS

AAS	-	American Astronomical Society
ABG	-	Gyro Body Angles
AIPS	-	Astronomical Image Processing System
ADP	-	Astrophysics Data Program
ATR	-	Assistant Technical Representative
C&SA	-	Calibration and Systems Analysis
CCD	-	Charge Coupled Device
CCIL	-	Control Center Interactive Language
CCR	-	Configuration Change Request
CDA	-	Condensed Data Archive
CDMS	-	Command and Data Management System (UIT)
CGRO	-	Compton Gamma Ray Observatory
CP-R	-	Control Program for Realtime (Sigma-9 operating system)
CPU	-	Central Processing Unit
CRAB	-	Computer Resources Advisory Board
CSC	-	Computer Sciences Corporation
CTR	-	Contractor Task Report (projects cost estimates for a task)
CU	-	University of Colorado
DAC	-	Data Analysis Center
DASS	-	Data Accounting Software Support
DBMS	-	Data Base Management System

DCL	-	Digital Command Language
DEC	-	Digital Equipment Corporation
DEP	-	Dedicated Experiment Processor (UIT)
DIDL	-	Double Precision Version of Interactive Data Language (IDL)
DMC	-	Data Management Center
DN	-	Data Number (digital pixel value from camera)
DOC	-	Data Operations and Control
DR	-	GSFC Discrepancy Report
DSDM	-	Digital System Development Methodology
DTUTF	-	Digital Tape Unit Test Facility
ECIO	-	Experiment Computer Input/Output
ECOS	-	Experiment Computer Operating System (UIT)
EDS	-	Experiment Display System
EPROM	-	Eraseable Programmable Read Only Memory (UIT)
ESA	-	European Space Agency
ETC	-	Eastern Training Center
EUVE	-	Extreme Ultraviolet Explorer
FAX	-	Telefacsimile
FES	-	Fine Error Sensor
FITS	-	Flexible Image Transport System
FN	-	Flux Number (photometrically corrected digital pixel value)
FPM	-	Flux Particle Monitor

FSS	-	Fine Digital Sun Sensors (ACS)
FST	-	A prefix used by the NDADS Fstage/FStore system in naming the associated database and application software
FUSE	-	Far Ultraviolet Spectroscopic Explorer
GBF	-	GSFC Browse File
GHRS	-	Goddard High Resolution Spectrograph
GMT	-	Greenwich Mean Time
GO	-	Guest Observer
GOTL	-	Guest Observer Target List
GSA	-	General Services Administration
GSFC	-	Goddard Space Flight Center
HLCL	-	High Level Command Language
IADAF	-	Interactive Astronomical Data Analysis Facility
IDL	-	Interactive Data Language
IGSE	-	Instrument Ground Support Equipment (UIT)
IR	-	Infrared
I/O	-	Input/Output
IPC	-	Image Processing Center
IPL	-	Image Processing Log
IPS	-	Image Processing Support, or Image Processing Specialist
IRAF	-	Interactive Data Reduction and Analysis Facility
IRAS	-	Infrared Astronomical Satellite
ITF	-	Intensity Transfer Function

IUE	-	International Ultraviolet Explorer
IUEDAC	-	International Ultraviolet Explorer Data Analysis Center
IUEAIMS	-	IUE Automated Information Management System
IUESIPS	-	IUE Spectral Image Processing System
JCL	-	Job Control Language
JPL	-	Jet Propulsion Laboratory
JSC	-	Johnson Space Center
KSC	-	Kennedy Space Center
LAN	-	Local Area Network
LASP	-	Laboratory for Astronomy and Solar Physics
LBLS	-	Line-by-line Spatially Resolved Spectral File
LED	-	Light-emitting Diode
LWLA	-	Long Wavelength Large Aperture
LWP	-	Long Wavelength Prime Camera
LWR	-	Long Wavelength Redundant Camera
LWSA	-	Long Wavelength Small Aperture
MEHI	-	Merged High Dispersion Spectral File
MELO	-	Merged Low Dispersion Spectral File
MSFC	-	Marshall Space Flight Center
NASA	-	National Aeronautics and Space Administration
NEWSIPS	-	Image processing system for the IUE Final Archive
NOAO	-	National Optical Astronomy Observatory
NRA	-	NASA Research Announcement

NRAO	-	National Radio Astronomy Observatory
NSESCC	-	NASA Space & Earth Sciences Computer Center
NSSDC	-	National Space Science Data Center
OBC	-	On-board Computer
OCC	-	Operations Control Center
OD	-	Operations Director (GSFC)
PDL	-	Program Design Language
PHCAL	-	Photometric Calibration Program Identification
PI	-	Principal Investigator, or Photometrically Corrected Image
POCC	-	Payload Operations Control Center
POD	-	Project Operations Director
POT	-	Preplanned Operations Tape
PPARC	-	Particle Physics and Astronomy Research Council (formerly SERC)
PPMR	-	Production Processing Modification Report
PPV	-	Post Production Verification
PROC	-	Procedure
PROM	-	Programmable Read Only Memory (UIT)
PS	-	Payload Specialist
Pt-Ne	-	Platinum-Neon (wavelength calibration lamp)
PW	-	Photowrite
QC	-	Quality-Control
RA	-	Resident Astronomer

RAD	-	Rapid Access Device (disk on Sigma computers)
RI	-	Raw IUE Image (Unprocessed)
RIA	-	Raw Image Archive
S/C	-	Spacecraft
SCAMA	-	Switching, Conferencing, and Monitoring Arrangement
SCRIPTS	-	Observing Specifications
SDAS	-	Science and Data Analysis System of STScI
SEC	-	Secondary Emission Conduction Vidicon Tube (Camera)
SEID	-	Spacelab Experiment Interface Device (UIT)
SERC	-	Science and Engineering Research Council of the UK
SI	-	Scientific Instrument
SMR	-	Software Modification Report
S/N	-	Signal to Noise Ratio
SOC	-	Science Operations Center
SPAN	-	Space Physics Analysis Network
SPS	-	Senior Image Processing Special
STScI	-	Space Telescope Science Institute
SWLA	-	Short Wavelength Large Aperture
SWP	-	Short Wavelength Prime Camera
SWR	-	Short Wavelength Redundant (Camera)
SWSA	-	Short Wavelength Small Aperture
TC	-	Transfer Characteristic
TFLOOD	-	Tungsten-flood

THDA	-	Camera Head Amplifier Temperature
TOC	-	Telescope Operations Center
TOCS	-	Telescope Operations Command Station
TS&O	-	Telescope Scheduling and Operations
TSSF	-	Tape Staging and Storage Facility
UC	-	Users' Committee
UIT	-	Ultraviolet Imaging Telescope
US1	-	NASA IUE Observing Shift 1
US2	-	NASA IUE Observing Shift 2
UV	-	Ultraviolet
UVC	-	UV Image Converter (Camera)
UVF	-	UV Flood Lamp
UVFLOOD	-	UV Flood Lamp
UVS	-	Ultraviolet Spectrometer (Voyager)
VILSPA	-	Villafranca del Castillo, Spain
VIPS	-	VILSPA Image Preprocessing System
WAVECAL	-	Wavelength Calibration
WNRC	-	Washington National Records Center
WPS	-	NASA Wallops Flight Facility, Wallops Island, Virginia
XDS	-	Xerox Data Systems

INTRODUCTION

The fundamental operational objective of the International Ultraviolet Explorer (IUE) program is to support competitively selected astronomical research programs. Through the IUE program, researchers make IUE observations, have their scientific data reduced in a meaningful way, and receive data products in a form amenable to the pursuit of scientific research. The IUE Observatory is key to the program since it is the central control and support facility for all science support functions within the IUE project.

In carrying out the operation of this facility, CSC coordinated and performed a number of complex functions. These functions included telescope scheduling and operation (until termination of IUE telescope operations at GSFC in September, 1995), data processing (including Final Archive reprocessing), data distribution, and scientific data analysis. In support of these critical-path activities, CSC also provided a number of ancillary activities, including scientific instrument (S/I) calibration, system analysis, software support, and management and maintenance of a near-site computer cluster and facility.

SECTION 1 - IUE OBSERVATORY PROJECT MANAGEMENT

CSC IUE Observatory Project Management provided the overall project oversight, control, and administration necessary to operate, coordinate, and monitor the diverse elements of the IUE Observatory, including all onsite and offsite activities.

1.1 INTERFACES AND PROCEDURES

Project management established, implemented, and maintained interfaces and the procedures governing them in the areas of CSC interfacing with NASA, CSC interfacing with Guest Observers and other scientists, CSC interfacing with external agencies and enterprises as they relate to the project, and CSC internal interfacing.

1.2 OBSERVATORY STATUS REPORTING PROCEDURES

Project management established and implemented all necessary reporting procedures and compiled, produced, and distributed the quarterly technical progress reports. Project management approved all financial reports issued by CSC in relation to the project, coordinated the generation of unscheduled (i.e., as-needed) reports, and compiled this Final Report. A compilation of contract highlights taken from the quarterly technical progress report transmittal letters is contained in Appendix A.

1.3 PARTICIPATION IN MEETINGS

Project management participated in regularly scheduled and as-needed formal and informal meetings relating to the project work. The CSC IUE Deputy Project Manager or his representative participated in the weekly NASA/CSC IUE Project Meetings, and project management coordinated the participation by technical personnel in those and other meetings, such as the IUE Three-Agency Coordination meetings and the IUE Users' Committee meetings.

1.4 OVERALL COORDINATION

Project management provided the overall coordination required to ensure the maintenance of smooth interfaces and efficient working relationships among the various elements of the CSC IUE Project, thus ensuring that the overall objectives of the project were met. The coordination of project activities was facilitated through management meetings and frequent informal contact.

A compilation of commendations received by CSC IUE Project personnel is contained in Appendix B. Additionally, CSC IUE personnel were recipients of two NASA group awards during the period of this contract: The GSFC Productivity Improvement and Quality Enhancement Award in May, 1994, and the NASA Group Achievement Award in May, 1996.

SECTION 2 - OPERATIONS AND PLANNING

The Operations and Planning (O&P) group provided the functions of management, IUE telescope scheduling, telescope operation, science data management, and long-range planning in support of the IUE science program. It also provided expert technical advice to the IUE Project in the analysis of the feasibility of Guest Observer proposals and special requests. The routine telescope scheduling and operations functions ended on September 30, 1995, when IUE telescope operations at GSFC were terminated by IUE Three-Agency agreement.

2.1 MANAGEMENT

The Task Leaders and Technical Supervisors established, implemented, and maintained plans, configuration control, and procedures for O&P functions. They also implemented formal and informal interfaces with other IUE Observatory task areas, with the IUE Operations Control Center (OCC), with the European Space Agency (ESA), with the United Kingdom's Science and Engineering Research Council (SERC), which was subsequently renamed the Particle Physics and Astronomy Research Council (PPARC), and with other outside support facilities.

The Technical Supervisors, the Task Leaders, and the Project Manager participated as appropriate in meetings with NASA IUE Project staff members and, as requested by the NASA IUE Project, in meetings with IUE Guest Observers and with ESA and SERC/PPARC representatives. CSC personnel attended the weekly NASA/CSC Project Meetings and attended the IUE Three-Agency Coordination Meetings and IUE Users' Committee Meetings as those meetings were scheduled. Regular status reports and formal, written technical progress reports were provided as appropriate. Additional reports and meetings were accommodated as requested.

2.2 TELESCOPE SCHEDULING

Until the end of routine IUE telescope operations at GSFC on September 30, 1995, CSC provided extensive pre-visit planning and consultation with Guest Observers in order to develop efficient telescope-time schedules. CSC generated all necessary pre-visit observatory planning aids for telescope operations. Computer-compatible target lists and target availability printouts were generated and maintained, skymaps were generated and distributed to Guest Observers, and preplanned observation tapes were generated and provided to the IUE Operations Control Center (OCC) prior to the beginning of each month.

CSC generated, distributed, and maintained observing schedules and other pertinent scheduling information. Records relating to scheduling and spacecraft use were maintained by the staff member responsible for scheduling. Such records include instances of deviations from the scheduled assignments to accommodate target-of-opportunity programs or emergency spacecraft maintenance.

2.3 TELESCOPE OPERATIONS

CSC provided safe and efficient telescope operations by performing command and control functions with the IUE SI, monitoring the SI for anomalous behavior, supporting Guest Observers in planning and interpretation functions, and maintaining effective interfaces between the Telescope Operations Center (TOC) and other IUE support facilities.

Until the end of routine IUE telescope operations at GSFC on September 30, 1995, CSC operated the TOC for the two NASA shifts each day of the year with a staff of Resident Astronomers and Telescope Operators in support of Guest Observer programs, discretionary time programs, and calibration, maintenance, and engineering test programs. As necessary, the scientific instrument was operated during VILPSA shifts which ESA was unable to support due to contingency situations.

CSC provided support to Guest Observers by providing documentation on how to use IUE, contacting the Guest Observers in advance of their visits to answer questions and provide advice on the current status of the observatory, assisting the Guest Observers in performing target identification and deriving appropriate exposure-time estimates, and providing quick-look data analysis.

CSC provided reviews of proposed observing programs for feasibility and schedulablility, total number of shifts required, etc., for the annual IUE Peer Review meetings. Staff members were present at these meetings to answer technical questions posed by the Peer Review Committees.

CSC provided support for the maintenance, analysis, and enhancement of the SI control software including procedures, observer support, and data handling as needed to enhance SI efficiency, to eliminate potential or present hazards, and to work around hardware failures.

The technical staff made a continuing effort to identify areas of possible improvement, particularly to increase throughput, to decrease the possibility of errors and/or hazardous situations, to enhance on-line documentation of observational parameters, and to provide increased capabilities.

CSC provided support for the maintenance, analysis, and enhancement of the scientific data handling system and the Experiment Display System (EDS) interface support system of the command and control computers. CSC led the effort which replaced the aging EDS units with modern, commercial-off-the-shelf PC and workstation components. The new system, referred to as the Telescope Operations Control Station (TOCS), was put into routine use in February, 1992. The maintenance of the software for this system was documented in the CSC document "IUE Science Operations Control Center (SOCC) Telescope Operations Control Station (TOCS) Software Maintenance Guide," CSC/TM-95/6022 (NASA DOC#510-3SMD/0192).

CSC continued to maintain effective interfaces between the TOC and the other major areas of the IUE Observatory as well as with outside support facilities such as the OCC and VILSPA. These interfaces included participation in the IUE Three-Agency Coordination Meetings.

CSC provided quality assurance for all aspects of telescope scheduling and operations. This quality assurance included reviews of telescope-time schedules before distribution, spot-checks of the accuracy of skymaps, verification of the accuracy of handover information, and reviews of the information stored in image header records, scripts, observatory logs, and other TOC records.

A statistical summary of IUE science observing usage at GSFC is contained in Appendix C.

2.4 SCIENCE DATA MANAGEMENT

CSC provided science data management services in support of the distribution of the scientific output products of the IUE astronomical observatory. This support consisted of efforts in several functional areas including data product handling and monitoring, data base maintenance and operation, and data distribution.

All production IUE magnetic tapes were logged in, labeled, staged, stored, and distributed as required. Quick-look and processed Photowrite films received from the IUE Hardcopy Facility (HCF) were logged in to the appropriate Guest Observer data receipts and distributed.

CSC personnel produced and distributed observatory logs containing pertinent information about all IUE images acquired, according to formats and schedules established in conjunction with IUE Project personnel. The observatory logs were generated in appropriate output formats, including magnetic tape files, line printer output, Xerox 1200 Copier bound and unbound output, and microfiche, according to the type of log.

The IUE Observatory Browse File was maintained by CSC on a routine basis until the Browse File was decommissioned by NASA in 1992. Browse File maintenance specifically consisted of receiving, mounting onto viewgraph frames, labeling, and placing into the Browse File processed film sheets, and performing periodic checking on the order and completeness of the Browse File.

The IUE data base was maintained and operated by CSC. Daily entry and quality control of observation information, image processing information, and product completion dates were performed. Additionally, information concerning IUE observing proposals was entered into a computer data set as proposals were received at the observatory. The Guest Observer target lists were entered in cooperation with telescope operations personnel as part of the preparation for each new IUE observing episode.

CSC generated regular and special IUE data base reports as scheduled or otherwise required.

Guest Observer data packages for local Guest Observers were held at GSFC for direct retrieval. Guest Observer data packages for non-GSFC Guest Observers were staged and shipped once a week. Archive data tapes, photowrite film sheets, receipt forms and associated printouts were

staged and delivered to NSSDC in accordance with established schedules. Completed observatory log products were sent to ESA and SERC/PPARC in accordance with the standard log generation/distribution schedule. Magnetic tape shipments to, and recalls from, the Washington National Records Center (WNRC) or the Building 2 storage area were made as necessary.

The observatory petty cash fund was used to obtain GSFC-authorized supplies for the IUE Observatory.

A compilation of IUE data production statistics is contained in Appendix D.

2.5 LONG-RANGE PLANNING (LRP) ACTIVITIES SUPPORT

CSC supported the Long Range Planning effort of the IUE Observatory in the areas of mission documentation planning, operations augmentation planning, retroactive data enhancements planning and analysis, and data base preservation and utilization planning. The support included participation in NASA Long-range Planning Working Group and NASA/ESA/SERC Long-Range Planning Committee meetings.

CSC continued to define the material needed to fully document the acquisition and processing of IUE science data over the course of the mission. CSC identified existing documentation and information essential for future analysis and interpretation of IUE data.

CSC continued its planning for implementation of new or modified IUE operational capabilities as they become necessary due to changing spacecraft constraints and operational status in order to maintain IUE's observing flexibility and efficiency.

CSC evaluated various alternatives for the recalibration and reprocessing of the IUE data archives. Analyses of the scientific and efficiency trade-offs of various processing algorithms for such reprocessing were conducted in coordination with the IUE Final Archive Definition Committee. Prototype processing algorithms were defined, implemented, and evaluated in support of these studies, for both low- and high-dispersion images.

CSC analyzed technical and cost trade-offs for the modernization of the IUE archives and enhancement of the data base content needed to better document IUE data for its long-term use. Particular attention was paid to the identification and standardization of certain "core data items", relating to individual IUE spectra, which are critical to the IUE Final Archive reprocessing effort.

SECTION 3 - PROCESSING AND ANALYSIS

The Processing and Analysis (P&A) group provided the functions of management, image processing, image processing software and analysis support, instrument calibration, Regional Data Analysis Facility (RDAF)/IUE Data Analysis Center (IUEDAC) operation, meeting and travel support, and implementation of long-range plans.

3.1 MANAGEMENT

The Task Leaders and Technical Supervisors established, implemented, and maintained plans, configuration control, and procedures for P&A functions. They also implemented formal and informal interfaces with other IUE Observatory task areas, with the IUE Operations Control Center (OCC), with ESA, with SERC/PPARC, and with other outside support facilities.

The Technical Supervisors, the Task Leaders, and the Project Manager participated as appropriate in meetings with NASA IUE Project staff members and, as requested by the NASA IUE Project, in meetings with IUE Guest Observers and with ESA and SERC/PPARC representatives. CSC personnel attended the weekly NASA/CSC Project Meetings and attended IUE Three-Agency Coordination Meetings and IUE Users' Committee Meetings as those meetings were scheduled. Regular status reports and formal, written technical progress reports were provided. Additional reports and meetings were accommodated as requested.

3.2 IMAGE PROCESSING CENTER (IPC) OPERATIONS

CSC operated the IUE IPC to provide routine production processing of current IUE images, approved archival-image reprocessing, special processing in support of preparation for the IUE Final Archive, and special tests for IPC and other observatory areas. The IPC operated the IUESIPS processing system for all newly acquired data, and, beginning in May, 1993, the NEWSIPS system for Final Archive Processing. All necessary processing calibration files were maintained and verified. Operations-level interfaces with relevant observatory groups and outside facilities were maintained by the IPC.

Routine quality assurance operations were performed on all image processing output products, including Guest Observer and archive tapes, and all IPC records. Completed output products were transferred to the science data management group for appropriate tracking and distribution. The impact of approved observing programs on image processing activities was assessed as necessary, and priority processing was coordinated as appropriate.

3.3 IMAGE PROCESSING SOFTWARE AND ANALYSIS SUPPORT

CSC continued to provide monitoring, maintenance, enhancement, and change control of the IUE Observatory image processing software (both IUESIPS and NEWSIPS). The support provided

by CSC included the performance monitoring of all IUE production image processing software and schemes, the creation and maintenance of standard production and special schemes, and the continued maintenance of an interface with ESA and SERC/PPARC personnel.

Guest Observer support was provided through the preparation and distribution of documentation describing image processing software and standard procedures and through consultation with Guest Observers and the provision of special services as approved by GSFC.

CSC provided analysis and development support through the scientific analysis of IUE data and the development of new techniques relative to the goal of enhancing the usefulness of the reduced data generated by the IUE image processing operation. In conducting these efforts CSC worked in close cooperation with the IUE Final Archive Definition Committee (FADC). Areas addressed include thermal effects, intensity transfer function (ITF) studies, image registration techniques, wavelength calibration, and new methods of spectral extraction.

CSC developed techniques to respond to the findings of the analyses described above and developed and implemented prototype processing algorithms and corresponding calibration files for the IUE Final Archive reprocessing effort for both low and high dispersion images.

CSC provided software system development to implement the NEWSIPS image processing system for the IUE Final Archive effort, based on the prototype algorithms. The NEWSIPS system was developed and implemented by CSC on both the DECstation (Ultrix) and Alpha (Open VMS) platforms. CSC implemented the necessary plans and configuration control procedures to successfully test and operate NEWSIPS. CSC performed analyses and developed procedures and techniques to ensure adequate NEWSIPS processing throughput, including development of means of efficiently using multiple-CPU processing configurations. CSC also developed effective means of transferring the output data to the archive facilities and directly supported the archiving of IUE data through the GSFC Space Science Data Operations Office (SSDOO).

3.4 SI CALIBRATION AND SYSTEMS ANALYSES

CSC provided scientific instrument (SI) calibration and systems analysis functions, as well as implementation of long-range plans. CSC continued maintenance of the IUE instrument calibration including photometric calibration, geometric calibration, wavelength calibration, and calibration of the target acquisition system. In support of these activities, CSC planned, conducted, and analyzed the necessary observations. Data bases on the variation of dispersion constants, on records of wavelength calibration data products, and on maneuvering, maneuver errors, and telescope focus were updated and maintained. CSC performed analyses and created, tested, and implemented the new SI calibrations required for the NEWSIPS Final Archive processing system.

CSC performed analysis of IUE systems to enhance the scientific operation of IUE and other astronomical missions. CSC provided analysis to maintain and enhance the performance of the IUE maneuver and guidance systems as these apply to the target acquisition process.

Maneuvering records were maintained by the Telescope Operations Center staff and analyzed as needed to enhance the performance of the attitude control systems.

CSC continued to provide analysis of the performance of the components of the scientific instrument (telescope, FES, spectrographs, and cameras). Scientific analyses of data and operations were provided as appropriate. These activities included collaboration with Guest Observers, analysis and publication of scientific data, and participation in professional meetings and Three-Agency Coordination Meetings.

3.5 GSFC IUE REGIONAL DATA ANALYSIS FACILITY (RDAF) / IUE DATA ANALYSIS CENTER (IUEDAC) SUPPORT

CSC operated the GSFC IUE Regional Data Analysis Facility (RDAF), eventually renamed the IUE Data Analysis Center (IUEDAC) and hereafter referred to as such in this document, to provide IUE users ready access to reliable, uniform software and tools for analyzing IUE data. CSC activities included facility operation, software maintenance, analysis and software development, facility maintenance and supplies support, DAC software distribution, and LASP Cluster backup support.

CSC operated the GSFC IUEDAC 8 hours per day, 5 days per week (excluding holidays). Normal scheduling of users was provided on a continuing basis as requests were received, with careful coordination of the visitors' schedules and need for terminal time, disk storage space, tape input/output, instruction and advice. User support in the form of training, supervision, advice, scientific consultation, software development, documentation, and data input/output operations was provided. Special assistance was provided to several long-term visitors, and support for remote users was provided.

Appendix E summarizes GSFC IUEDAC usage since October 1991 in terms of user logon time and the number of users. Appendix F reports the number of archived IUE images requested each year through various facilities, including the IUEDAC.

CSC maintained effective interfaces between the IUEDAC and the other major areas of the IUE Observatory and outside facilities such as the NSESCC, the NSSDC, and other data analysis facilities.

CSC provided implementation and maintenance of IUEDAC science research tools and data bases. Change control was provided according to established procedures involving IUEDAC User Problem Reports, Software Modification Reports, and Software Review Meetings. These activities encompassed facility-generated tools, user-generated tools, tools provided by the RDAF at the University of Colorado, and access to data archives and other data bases.

CSC developed and implemented research tools to allow IUE archive data from the NSESCC facilities to be accessed from the IUEDAC. User support and training in the use of the data retrieval system were also provided.

Data bases supported include the IUE Merged Log, the IUE Representative Standard Star Catalog, the GSFC Catalog of IUE Fluxes, and various IUE calibration tables.

CSC supported the installation, maintenance, and update of IUEDAC augmentations as appropriate. CSC provided analysis and development of new research tools, procedures, and data bases to extend the capabilities of the RDAF. Studies were performed to evaluate the utility of potential enhancements, as were the development and verification of implementations of approved enhancements. IUEDAC enhancements were facilitated by the development and maintenance of effective working relationships and interfaces with other data analysis facilities.

CSC provided routine facility maintenance and equipment repair as appropriate. Minor IUEDAC supplies and spare parts were procured as needed through the IUEDAC petty cash fund. All such expenditures were made with GSFC approval.

3.6 IUE ASTROPHYSICS DATA SYSTEM (ADS) NODE SUPPORT

CSC provided support for the development and operation of the NASA Astrophysics Data System (ADS) by operating an ADS node at the IUEDAC. CSC provided system support for the IUE ADS node and its associated software, as well as user training and assistance, until September 30, 1994, when NASA funding for ADS node support was terminated.

3.7 MEETING AND TRAVEL SUPPORT

CSC provided specified meeting and travel support for the IUE Observatory, including those activities necessary to support the travel of Guest Observers to the IUE Observatory and to coordinate the organization and implementation of the meetings of the IUE Peer Group to evaluate research proposals, the GSFC IUE Three-Agency Coordination Meetings, IUE Long-Range Planning Working Group and Committee Meetings, meetings of the IUE Users' Committee, and special workshops.

For the Users' Committee and Three-Agency Meetings, technical meeting records were compiled and published, and for the IUE Peer Review meetings, clerical support was provided. In support of the Peer Review process, logistical support for the receipt, acknowledgment, and categorization of proposals was provided, and a computerized data base of proposers was maintained, with updates added for each new observing episode. Statistical reports summarizing institutional and principal-investigator involvement with IUE by episode are contained in Appendices G and H.

3.8 IMPLEMENTATION OF LONG-RANGE PLANS

P&A personnel supported the implementation of new capabilities and operational and procedural changes developed under the Long-Range Planning effort as they applied to P&A activities, including activities related to the preparation of the IUE Final Archive.

SECTION 4 - ANALYSIS TOOLS AND DATA BASE SUPPORT

The Analysis Tools and Data Base Support (AT&DBS) group provided the functions of management, science software support, data base support, and implementation of long-range plans.

4.1 MANAGEMENT

The Task Leaders and Technical Supervisors established, implemented, and maintained plans, configuration control, and procedures for AT &DBS functions. They also implemented formal and informal interfaces with other IUE Observatory task areas, with ESA, with SERC/PPARC, and with other outside support facilities.

The Technical Supervisors, the Task Leaders, and the Project Manager participated as appropriate in meetings with NASA IUE Project staff members and, as requested by the NASA IUE Project, in meetings with IUE Guest Observers and with ESA and SERC/PPARC representatives. CSC personnel attended the weekly NASA/CSC Project Meetings and attended IUE Three-Agency Coordination Meetings and IUE Users' Committee Meetings as those meetings were scheduled. Regular status reports and formal, written technical progress reports were provided, as appropriate. Additional reports and meetings were accommodated as requested.

4.2 SCIENCE SOFTWARE SUPPORT

CSC provided maintenance, enhancement, and change-control for IUE software including the observatory scheduling software and the data accounting software and data base. CSC completed the new data base software and procedures needed to support the IUE Final Archive effort. The new data base is central to the Final Archive reprocessing effort and will facilitate the long-term access to and use of the data by the science community. Complementing these activities, the AT&DBS group continued to provide computer programming and other technical advice and support as needed.

4.3 DATA BASE SUPPORT

CSC continued to provide maintenance and enhancement for the IUE Observatory data accounting data bases. CSC transitioned the IUE science data base from the IUE Automated Information Management System (IUEAIMS) on the IBM mainframe to the INGRES relational data base system residing on the DECstation platform. Coordination of IUE data exchange between NASA, ESA, and SERC/PPARC was an important function provided by CSC as part of its data base support.

4.4 IMPLEMENTATION OF LONG-RANGE PLANS

CSC supported the implementation of long-range plans developed by the observatory. These activities included the creation of the new IUE data base, utilizing the INGRES relational data base system, suitable for supporting the needs of the IUE Final Archive.

SECTION 5 - PHOTOGRAPHIC AND SYSTEMS SUPPORT

The Photographic and Systems Support (P&SS) group provided the functions of management, IUE Hardcopy Facility operation, facility maintenance and systems support, and implementation of long-range plans.

5.1 MANAGEMENT

The Task Leaders and Technical Supervisors established, implemented, and maintained plans, configuration control, and procedures for P&SS functions. They also implemented formal and informal interfaces with other IUE Observatory task areas and with other outside support facilities as appropriate.

The Technical Supervisors, the Task Leaders, and the Project Manager participated as appropriate in meetings with NASA IUE Project staff members and, as requested by the NASA IUE Project, in other meetings. CSC personnel attended the weekly NASA/CSC Project Meetings. Regular status reports and formal, written technical progress reports were provided. Additional reports and meetings were accommodated as requested.

5.2 HARDCOPY FACILITY (HCF) OPERATIONS

CSC continued operation of the IUE HCF at the GreenTec facility until August, 1992, when the HCF was decommissioned at GSFC direction. The HCF operation was discontinued because the widespread availability of digital image display capability among the IUE users rendered the HCF photographic products essentially obsolete. The HCF comprised film-writing units and ancillary hardware, as well as photographic processing equipment. While the HCF was in operation, CSC provided production services and quality assurance of the HCF output products, including quick-look (SOC) photowrite film sheets, processed photowrite film sheets and contact prints, and non-IUE photowrites as requested by GSFC.

5.3 FACILITY MAINTENANCE AND SYSTEMS SUPPORT

CSC provided scheduled and unscheduled facility maintenance support for the photowrite and photolab systems during the period of HCF operation. Typical unscheduled equipment maintenance support consisted of identifying anomalies and making preliminary diagnoses, interfacing with GSFC technicians, making minor adjustments and repairs, installing specified hardware replacement parts and, as necessary, interfacing with manufacturer's representatives.

CSC continued to provide systems support in various aspects of the IUE Observatory in order to ensure its effective operation. CSC used its experience with IUE science operations, system design, and software to support ongoing and future astronomical program analysis and planning. Specific areas supported include UIT software/hardware development and operation, FUSE

operations requirements analysis, gamma-ray astronomy mission planning and data analysis, design of lightweight optics for future space missions, and astronomical infrared-source cataloging.

5.4 IMPLEMENTATION OF LONG-RANGE PLANS

P&SS personnel supported the implementation of new capabilities and operational and procedural changes developed under the Long-Range Planning effort as they apply to P&SS activities.

SECTION 6 - SYSTEMS MANAGEMENT SUPPORT

CSC provided systems management support for all IUE Observatory computer systems, including monitoring the performance of the systems, planning and analyzing system capacities, performing system backups, and resolving problems.

6.1 SYSTEM PERFORMANCE MONITORING

CSC provided system monitoring at the GreenTec facility to assure the adequate performance of the computer systems and their components and to allow system capacity planning.

6.2 SYSTEM BACKUPS

CSC performed appropriate backups for all disks associated with the IUE computer systems at GreenTec according to a regular schedule. Backup strategies were periodically evaluated and adjusted as necessary to accommodate changing situations.

6.3 PROBLEM RESOLUTION

CSC analyzed system problems at the GreenTec facility and worked with GSFC personnel to either resolve the problems or arrange for and supervise problem resolution/system repair by outside parties, as appropriate.

SECTION 7- SYSTEMS ENGINEERING SUPPORT

CSC provided systems engineering support to the IUE Observatory, including studies and analyses for new and existing computer systems.

7.1 HARDWARE/SOFTWARE FEASIBILITY STUDIES

CSC provided support in the form of sustaining engineering to perform system planning studies and hardware and software feasibility analyses to evaluate alternatives for changes to the IUE computer systems. Many of these analyses, such as the studies for efficiently utilizing multiple DEC AXP (Alpha) platforms at GSFC for NEWSIPS production processing, were crucial for the successful implementation of systems supporting the IUE Final Archive effort.

7.2 PERFORMANCE EVALUATION

CSC evaluated the performance of the IUE Observatory's computer systems on an ongoing basis and made recommendations for configuration changes, component replacement/addition, or system tuning, as appropriate.

APPENDIX A - QUARTERLY PROGRESS REPORT TRANSMITTAL LETTERS

APPENDIX A - QUARTERLY PROGRESS REPORT TRANSMITTAL LETTERS

Contained herein are copies of the transmittal letters which accompanied the submission of the Quarterly Progress Reports for the contract. These are reproduced in order to present, as a unified set, the contract highlights appearing in the letters.

Computer Sciences Corporation
System Sciences Division

January 13, 1992

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-61C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for September 1991 - December 1991, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

CSC personnel members on Task 0121 accomplished a revised photometric calibration of the FES reference point at (-16, -208). This work was presented to the Three Agencies, who recommended the publication of these results in a refereed journal. A preliminary report, also presented at the same meeting, described the first attempt to scale the second order light contribution in the long wavelength cameras. A contamination on the order of one percent was estimated for most sources; however, for very hot and unreddened stars this contamination could be higher, on the order of several percent.

On Task 0131 IUE, in conjunction with ROSAT and ground-based observatories, participated in an intensive campaign to monitor the rapid variability of the BL Lacertae object PKS 2155-304. This program involved observations of the galaxy almost every day in November, including an intensive period of continuous monitoring covering more than 4 days and a double-shift high-dispersion exposure. Operations staff made special efforts to assist other tasks in promptly reducing each day's observations to aid the GOs in planning the program. This assistance was crucial in recognizing the feasibility of the high-dispersion exposure. Quality spectra of these objects well sampled in time are of fundamental importance because BL Lac objects have featureless spectra. The only clues to their nature lay in the study of their continuum variations. These observations resulted in the highest quality UV light curve of a BL Lac object produced to date.

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Also on Task 0131 CSC, in collaboration with the cognizant GOs, carried out a wide range of other interesting observations in combination with other space missions and ground-based observers. Task members responded to a rare (approximately once every 15 years) outburst of the Luminous Blue Variable AG Car to support observations of this object in conjunction with HST. Task members worked closely wit
h
OCC to ensure that the S/C remained power positive while observing this target, which was at a beta of 117 degrees. IUE also observed the comet P/Hartley in collaboration with HST, and P/Faye for the first time to complement intensive ground-based monitoring of the activity of its nucleus. IUE, along with HST and ground-based telescopes, observed the FK Comae star HD 32918, which is one of the most active members of its class. In addition, and simultaneously with the Voyager spacecraft and ground-based observatories, IUE obtained observations of two Be-shell stars in order to study the phase dependence and possible origin of observed variations in the winds of these stars.

On Task 0141 much of the database software for use by the IUE Final Archive system was completed. Programs allowing IPC operators to specify the types of images to be processed and input parameter were completed. Database software associated with the Final Archive pipeline was completed, including programs to select the next available image to be processed, inserting the initial CDIs into the Processing Information File (PIF) for that image, and ingesting output parameters from the PIF at the end of the pipeline were created. Reports to be used by the IPC staff for monitoring the Final Archive system were created.

On Task 0142, anomalies in the performance of the two long wavelength cameras were diagnosed using the newly developed software tools in NEWSIPS. These anomalies, which occurred in the 1983-5 time frame, have gone undetected until the availability of these tools.

CSC Task 0143 personnel began operations of the first stage of the Final Archive Processing System during this report period. The Core Data Item Verification System began full operations on October 9, 1991. Data base entries for 7958 IUE images were verified during the remainder of the report period.

CSC personnel on Task 0151 completed testing of the IDL Version 2 RDAF software and implemented the new procedure libraries on the IUE VAX on December 2, 1991. This marks the culmination of more than 12 months of software development, conversion, and testing. A common RDAF IDL Version 2 software package is now available which can run on

UNIX, ULTRIX, or VMS platforms and is compatible with both Tektronix-style graphics terminals and X-window displays. Several new IDL routines, as well as improvements to the majority of existing routines, were also incorporated into the new release.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

April 17, 1992

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-61C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for January 1992 - March 1992, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

During the Peer Review on March 3, 1992, Task 0113 personnel typed evaluation sheets for 232 proposals in 12 hours, ensuring the successful completion of the Peer Review process in two and one-half days. This is a new record for efficient operation of the Peer Review meeting.

On Task 0121, a preliminary NEWSIPS flux calibration was obtained deriving the inverse sensitivity curves for both SWP and LWP cameras using a total of about 350 images processed through the NEWSIPS prototype software. These curves, based on the white dwarf observations and flux models, when compared with the inverse sensitivity curves derived from flux calibration standards taken from OAO-2 and TD-1 observations, yield accuracies of 4+/-2% between the two systems for the region around 2400 Angstroms. Likewise, 733 images of standard stars processed through the NEWSIPS software were used to derive the low dispersion sensitivity degradation correction ratios for the SWP camera. These are important achievements for the absolute flux calibration of the Final Archive.

CSC, in collaboration with the cognizant GOs, responded to the occurrence of a naked-eye nova by obtaining a series of observations of Nova Cygni 1992, the brightest nova in ten years. In addition, Task 0131 members responded quickly in order to commence observations of Supernova 1992A. The observations of this supernova were especially challenging since the relevant Guest Observer was attending the American Astronomical Society meeting in Atlanta, Georgia, at the time. Operations staff worked closely with the GO and members of other tasks to coordinate the observations,

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promptly reduce the data, and send the spectra to the GO. The GO presented the results to the astronomical community during the course of the meeting.

Under Task 0141, the database software and several enhancements for the IUE Final Archive Pipeline system were completed and delivered to the Image Processing Group. The delivered database software allows the Final Archive Pipeline to run in a highly automated fashion.

CSC began system testing of the NEWSIPS processing system on February 1, 1992. On the VAX system, 53 images were processed in support of operational and compatibility tests. Task 0143 members provided VAX output files to Task 0142 for comparison with the NEWSIPS prototype system. The system was found to be fully compatible on February 24. On March 12 the IPC began pipeline processing tests on the DECstation. Task members processed 16 images and performed compatibility tests between the VAX and DEC systems. The processing outputs were found to be nearly identical on the two systems.

On Task 0151, several new RDAF routines were written for reading and writing the proposed FITS Image extension. A joint proposal by VILSPA & GSFC/CSC personnel was submitted to the IAU FITS committee for acceptance of the FITS Image extension, to be used in the IUE Final Archive. These routines fulfill the requirement that read/write software exist before acceptance by the IAU FITS committee.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

July 17, 1992

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-61C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for April 1992 through June 1992, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention. Task 0131 personnel installed the hardware and software implementing an advanced remote observing system on the new TOCS. This system allows the transfer of raw science images from the TOCS to a remote site without the use of magnetic tapes, and greatly expands the number of potential remote sites. Operations personnel developed documentation and guidelines for the managers and users of the remote stations. The new system is currently in use, and will be refined during the next report period.

Also on Task 0131 CSC, in collaboration with the cognizant GOs, took part in several interesting and difficult observations during the report period. IUE observed Comet Shoemaker-Levy on several occasions during this period. These observations involved blind offsets to a moving target at high beta. Task members, in coordination with ROSAT and ground based observatories, also participated in an intensive monitoring campaign to study the Seyfert galaxy NGC 3783. This object was observed every four days to produce an evenly sampled light curve characterizing the continuum and emission line variations of the galaxies spectrum, providing important information on conditions in active galactic nuclei. IUE also detected Ne IV lines in Nova Cygni 1992 confirming the GO's earlier predictions, followed the interesting eclipsing variable TU Mon through an eclipse, and performed "drift scan" observations across the HII region NGC 346 in the Small Magellanic Cloud. The last observations, in which the S/C moves across the nebula in a predetermined direction at a

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constant rate while the camera is exposing, required considerable preparation and real-time support from the TOC staff.

The data base portions of the Post Production Verification (PPV) system on Task 0141 were completed and delivered to the Image Processing Center (IPC). In this delivery, the database selects and retrieves the next image and associated information for PPV using operator-specified selection criteria. After the verification process, the database records the verfication status and any comments.

Also on Task 0141, two CDIVS enhancements were delivered to IPC. The first enhancement allows the system to automatically select the appropriate THDA values from a database table for early images whose image labels do not contain this data. The second enhancement allows senior level CDIVS operators to access, modify, and enter homogeneous coordinates and object names.

On Task 0143, CSC began operating the fully automated NEWSIPS pipeline processing system on April 16, 1992. Extensive testing was performed in conjunction with Tasks 141, 142, and 144 to ensure full compatibility of the output data files with those produced with the prototype software. In addition, staff members ensured that correct processing output values were recorded in the data base and in the Processing Information File. Output files were backed up to 4mm tape. Every effort was made to demonstrate the productivity of the system for the NASA Senior Review of the IUE Project. The IPC processed about 2300 images in the 5 weeks before the review.

On Task 0152 a study was performed to determine ways to improve the execution time of ADS user queries. It was found that by creating index tables and using various INGRES optimization techniques, a typical coordinate-based query of the IUE merged log could be reduced from 7 minutes to less than 5 seconds. The results of the study will be to generate new versions of the IUE merged log and FES tables.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

October 16, 1992

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-61C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for July 1992 through September 1992, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention. Task 0121 personnel improved and verified the correction factor stated by Panek (1982), which relates the true area of the large apertures to the area of the enclosing rectangle. The ongoing radial velocity study of IUESIPS high-dispersion data has confirmed that on average radial velocities derived from LWP images are approximately 15-16 km/s greater than those determined from SWP images. Furthermore, the same study has shown that for high-dispersion data taken before April 1, 1988, when the dispersion constants were updated, only weak correlations between processing date and radial velocity exist.

Using the operational flexibility of IUE, Task 0131 personnel responded to the identification of an interesting new source detected by the Compton Gamma Ray Observatory. Within hours of the source identification, TOC personnel activated a target of opportunity program to obtain UV spectra of the rapidly evolving outburst simultaneously with gamma-ray observations. The object is believed to be a low-mass X-ray binary consisting of a late-type primary star and a compact companion accreting matter from the primary. IUE also provided improved coordinates for the system based on FES data.

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Also on Task 0131, CSC experience prevented major time losses to GO programs during the report period. On two occasions task members conducted emergency service observing when GOs were not present in the TOC due to miscommunications among collaborators. Operations personnel also instituted a real-time schedule change when a GO requested observations of a target at high beta, and which was earth-occulted, during a shift. The TOC staff contacted a local GO and used the shift to obtain observations of his program, resheduling the high-beta observations for a more appropriate time.

On Task 0132, CSC scheduled weekly observations of two targets of opportunity during the months of August and September. Task members updated the Proposal Instruction Package to incorporate changes to the submission process which will streamline the feasibility review process.

On Task 0142, the final version of the 1992 LWP ITF was constructed, along with the associated calibration files. This new LWP ITF yields a significant improvement in the median cross-correlation coefficient for science images as compared to the 1984 LWP ITF.

CSC continued to process SWP low-dispersion images on Task 0143 through the NEWSIPS partial processing software. The implementation of Release 1.1 and the post-production verification bypass capability provided significant enhancements to the production environment. Task members processed and performed post-production verification of 3384 images on the NEWSIPS system.

A record number of RDAF users was supported by Task 0151 this period, with almost 70 non-local users using the facility each month. Part of this increase is due to an increasing number of users who use the RDAF for transferring IUE data sets back to their home institution. By transferring files via network connections, users can avoid reading and storing magnetic tapes and generally have faster access to their data.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

January 15, 1993

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for October 1992 through December 1992, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention. On Task 0221, all SWP low-dispersion calibrations for use in NEWSIPS have been derived and delivered to members of the Enhancements task and implemented into the prototype NEWSIPS system. These include wavelength calibration, absolute flux calibration, small-to-large aperture and trail-to-point source flux calibration ratios, large-aperture point-source and trail-mode sensitivity degradation corrections, and the temperature-dependent sensitivity correction factor.

The new scheme by which updates to the PHCAL database are handled in an automated, electronic fashion is now in routine use and has resulted in a substantial savings of time and task resources.

On Task 231, CSC, in conjunction with the cognizant GOs and VILSPA, participated in a number of major monitoring programs during the report period. IUE observed six O stars over 6 contiguous days to determine the origins of the variability detected in the stellar winds of these objects. GOs observed the eclipsing binary V711 Tau for 6 consecutive days in order to spatially resolve the chromospheric structure of this object, a fundamental step in understanding the properties of the star's outer atmosphere, followed the premain sequence star AB Aur for 60 consecutive hours as part of an international observing program dedicated to this object, monitored the carbon-poor star TU Mon through an eclipse, and observed the active galaxy Markarian 509 in collaboration with ROSAT and CGRO. IUE also made a series of observations of four novae during this period.

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CSC experience and the TOCS support software prevented losses of GO observing time on a number of occasions during the report period. In one instance the staff compared a GO's target coordinates to the HST Guide Star catalog data and identified a 15" error in the GO's values. On another occasion the operations personnel used the offline software to alert a GO to a target misidentification, thus preventing a significant time loss to the GO's program. In a third instance staff members used IUE's remote observing capabilities to allow a distant astronomer to begin a shift when his local colleague was late for an observing shift due to miscommunication among collaborators. TOC staff also conducted temporary service observing for a another GO whose original flight to Washington was cancelled due to bad weather until the observer arrived on a later flight.

On Task 243, CSC has made excellent progress in performing CDI verification of IUE low-dispersion images. Of the 30,960 low dispersion images obtained at GSFC up to January 1, 1990, 25,361 images (82 percent) have been verified. The verification of low-dispersion images should be completed during the next report period.

CSC worked with LASP personnel to provide the capability of transferring output files electronically to the IBM during IUESIPS production processing. This will permit a timely handling of data to be written to the mass storage device, thus making the data more accessible to Guest Observers and RDAF users. This was done on an experimental basis, with no official deliveries or reporting involved, but so far has operated smoothly.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

April 16, 1993

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for January 1993 through March 1993, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention. On Task 0231, CSC, in collaboration with the cognizant GOs and VILSPA, participated in major monitoring programs during the report period. IUE observed three B supergiant stars for 6 consecutive days to study the behavior of discrete absorption components in the stellar winds. This program was executed so efficiently that the GOs obtained significantly more spectra than they had expected. IUE also observed two Seyfert Galaxies for 5.5 consecutive days in order to study the nature and inter-relationship of their continuum, emission, and absorption line regions. These observations were obtained in conjunction with ROSAT, HST, and ground based observatories. CSC also participated in a campaign to intensively monitor two BL Lacertae galaxies in order to determine the location of the relavistic plasma that produces synchrotron emission in these objects, and monitored several M supergiants and long-period eclispsing binary stars.

In conjunction with the cognizant GOs, Task 0231 personnel participated in interesting and difficult solar system observations. IUE obtained the first ultraviolet observations of the near-earth asteroid Himalia, and observed the planet Venus and the moon. These observations were very challenging since the targets moved very rapidly and were often at high β angles. Task members worked closely with the Guest Observers and OCC in preparing for and executing these observations to accomplish accurate pointing and ensure S/C safety.

The IUE Final Archive Database was built into a DEC distributed relational database called ULTRIX/SQL which is based on the INGRES relational database. The ULTRIX/SQL database system came bundled with the DECSTATIONS that were purchased to process the Final Archive. Task 0241 personnel found out that DEC was no longer supporting

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ULTRIX/SQL and that INGRES was offering a conversion license with a significant discount but for a very short time. Task members worked closely with NASA LASP personnel and INGRES personnel to ensure that the conversion license was purchased before the discount offer lapsed, saving the IUE project a significant amount of money. The conversion package has arrived and will be installed in coordination with operating system and FORTRAN compiler upgrades.

The review of IUE articles on Task 0242 for object and image numbers is complete for years 1978-1992. The bibliographic database is being populated with this information. The bibliographic database was implemented in the IUEDAC search capabilities, allowing investigators to search on image numbers or target ID to obtain bibliographic information.

Task 0244 personnel delivered Release 2.1 of NEWSIPS on February 13, 1993 to VILSPA and February 16, 1993 to IPC to comply with a request from the ATR for early delivery.

On Task 0243, CSC made excellent progress testing the NEWSIPS Release 2.1 software. The new version of the software provides the full production system which will perform all processing steps for all SWP low-dispersion images. The software was received, configured, and tested on both the VAX and the DECstation. Forty images were processed on both systems for compatibility testing. The VAX-processed images were delivered to Task 242 to test that the output is compatible with the prototype NEWSIPS system. An IPC task member compared DEC-processed and VAX-processed images to examine machine-dependent differences. Forty operations tests were designed to test the capabilities and software fixes of the delivered software. About three-fourths of the operations tests have been completed. Software modification reports were written to request fixes and enhancements. The required changes are small, and the system should be soon ready for full production processing.

On Task 0251, the IUE Bibliographic Reference database, which contains information on published journal articles related to IUE data, was made available on the IUE VAX. The database was converted from INGRES tables on the IUE Sun workstation to disk files compatible with the existing IDL database search routines. A new routine called IUEREF was also created to allow users to search the new database in a manner similiar to that used in the existing IUE merged log search routine.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

July 16, 1993

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for April 1993 through June 1993, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention. CSC, using the operational flexibility of IUE on Task 0231, obtained extremely important observations of Supernova 1993J in the galaxy M81. SN 1993J is the second brightest supernova in twenty years, surpassed only by the well known supernova 1987A. IUE responded quickly to the announcement of this bright supernova's discovery, making the the first observations of the object by any satellite within 24 hours of its detection. The rapid IUE response proved crucial in confirming that SN 1993J is a rare type II supernova, and provided the first direct evidence that red supergiant stars become supernova. The timely observations also provide a unique opportunity to study the interaction of the explosion's expanding shock wave and the previously emitted normal stellar wind.

Also on Task 0231, the operations staff continues to expand the support of the very popular remote and service observing modes. During May 1993, the Observatory conducted 55 percent of all observing in one of these modes. A total of 25 days in May, or some 81 percent of the days, involved at least some service or remote observing. This support provides considerable assistance to GOs in making maximum use of the available program support resources.

Task 0241 personnel provided database support to other IUE Project members. A special database report was generated for IUE Enhancements personnel to help their analysis of NEWSIPS data results. A task member updated and generated a report on the science efficiency for both VILSPA and GSFC shifts since the appearance of the FES streak anomaly. This report was generated to support TOCC staff at the June AAS meeting in Berkeley.

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On Task 0242 writing of the NEWSIPS image processing manual for low-dispersion data was completed. The document is being reviewed.

CSC on Task 0243 completed the testing of the Final Archive processing system and began production processing on May 20, 1993. Full compatibility testing was completed for Release 2.1 for both the prototype-to-VAX tests and VAX-to-DEC tests. Task members performed acceptance testing of Release 2.2 by making comparisons against the output from Release 2.1. Staff members also performed extensive operations tests. The Goddard SWP low-dispersion Pilot Verification images were processed successfully. This release provides the full production system which handles all types of SWP low-dispersion images.

On Task 0244 updated Wavecal calibration tables were provided through the beginning of 1993 to IPC for the IUESIPS system. Additionally, NEWSIPS Release 2.2 was delivered to IPC, allowing full production of the IUE Final Archive to begin on May 20, 1993.

Task 0251 staff members worked with LASP personnel in reorganizing disk space allocation on IUE and the new IUEDAC workstation. Accounts used by former IUE project personnel were deleted, and IUEDAC user account quotas were increased from 30,000 to 40,000 blocks. New accounts were also created for storing additional data base tables, solar flux and intensity spectra, and backup save sets of the [IUERDAF] account.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

October 15, 1993

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for July 1993 through September 1993, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 231 CSC, in conjunction with the cognizant GOs, participated in several major multiwavelength monitoring campaigns during the report period. IUE, in coordination with ROSAT, ASTRO-D, EUVE, and ground-based observatories, obtained essential data on the low-mass X-ray binary Her X-1 over a three day period. IUE also monitored the RS CVn star HR1099 in conjunction with EUVE, HST, and the VLA and other ground-based observatories, catching this object in an unusually active state and detecting a number of large stellar flares during the campaign. IUE also coordinated observations of the flare star EV Lac with EUVE and ground instruments. The IUE data is necessary to place the EUVE observations in the proper context. The observatory also monitored the Lyman alpha emission of Uranus and the auroral activity of Jupiter. IUE is now in the unique position of investigating auroral activity on three of the giant outer planets.

In addition, on Task 231 CSC experience and the offline support software prevented major losses of GO time during the report period. A Telescope Operator noticed a 30-degree error in coordinates supplied by a GO. The error was corrected, thus preventing a substantial time loss to the GO's program. On another occasion, an RA noticed that all of a GO's coordinates differed from the Guide Star Catalog values displayed on the EDS. After correcting the coordinates, the observations were successfully obtained. Without this adjustment, the observations would not have been possible and a large amount of observing time would have been lost.

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Staff members on Task 252 reformatted the IUESN1 system disk after an increasing number of disk errors impacted computer operations. The reformatting was done with a minimum of downtime and no files were lost in the process. In addition, updated versions of the IUELOG, IUEFES, and IUEPROG tables and associated documentation were completed this quarter.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

January 14, 1994

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for October 1993 through December 1993, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 0331 CSC, in conjunction with VILSPA and the cognizant GOs, participated in a very intensive monitoring campaign of the active galaxy NGC 4151. The observations extended over 19 days, including 9 days of almost continual coverage. During this time 282 images of the target were collected at Goddard Space Flight Center. The observations were at least in part simultaneous with observations done by GRO, ASCA, Rosat, and ground-based observations.

Also on Task 0331, CSC conducted a number of interesting observations of transitory sources. Monitoring of Nova Sgr 1993 continued, as well as observations of the newly discovered Nova Cas 1993. Task personnel are providing maximum flexibility to the Nova Cas program by performing service observing for these shifts and adjusting observing plans in real time as the satellite monitors unusual brigthening in this object.

CSC continues to perform IPC image processing, Core Data Item Verification, NEWSIPS image processing, and Post-Production Image Verification on Task 343 on a daily basis, with no major outstanding problems.

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301.572.4900

At the request of NSSDC, staff members on Task 0351 continued testing IUE file access from the NSSDC Data Archive System known as NDADS. Many of the suggestions made by staff members have now been incorporated by NSSDC into a new version of the NDADS software. The new NDADS software produces more informative e-mail messages describing the status of IUE data requests. Staff members also tested the new NSSDC Proprietary Data Distribution System known as PDDS. Staff members concluded that the system was not yet ready for implementation and have made several suggestions for improvements.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

April 15, 1994

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for January 1994 through March 1994, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

Preliminary analysis by Task 0321 personnel of the SWP high-dispersion wavelength calibration for NEWSIPS is complete. The four Chebyshev coefficients used to define the wavelength linearization were fit as a function of order number with a low-order polynomial. This new parameterization of the wavelength calibration for NEWSIPS will provide significant improvement in the wavelength calibration.

Task 0331 and 0332 personnel scheduled and carried out timely observations of Nova Cas 1993 as that object began to fade suddenly. The IUE observations gave unique insight into the dust formation process in novae, and indicate that the dust grains formed in this nova are larger than typical interstellar dust grains.

The IUE Final Archive poster presentations by Task 0342 personnel at the 183rd Meeting of the AAS generated much support and enthusiasm for the development of the NEWSIPS algorithms in the general astronomical community as the NEWSIPS data are characterized by a higher S/N than previously processed with IUE data and open a new wavelength regime shortward of Ly α that was not commonly accessible to IUE users.

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The DECstation 5000/200 systems used in the processing pipeline were upgraded from Ultrix 4.1 to Ultrix 4.3a along with DECnet upgrades and the installation of DEC FORTRAN 77. Version 4.3a of Ultrix allows the configuration of a second swap space, allowing the adoption of the configuration used by VILSPA and improving performance significantly. Task personnel worked with Task 0341, 0343, and 0344 personnel to install and test INGRES upgrades, IDL, and other applications. Together, these upgrades will increase the throughput of the IUE final archive production image processing. They will also improve maintainability of the systems and restore compatibility with VILSPA.

On March 1, 1994, a new set of IDL routines and data sets was implemented by Task 0351 personnel in the Y library on the IUE VAX. The new programs, which have been in development for several months, support both IUESIPS and NEWSIPS data sets. Overall, approximately 140 routines were modified, and 23 new routines were added. A memo summarizing the changes was made available to users.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

July 18, 1994

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for April 1994 through June 1994, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 321, a set of fiducial order locations and coefficients that map the spectral motion with time and THDA were generated for SWP high-dispersion images. This is in preparation for the processing of wavelength linearization images through the NEWSIPS prototype system.

CSC personnel on Task 331, in conjunction with the cognizant GOs, participated in several major multiwavelength projects. In coordination with the ASCA X-ray satellite and radio and optical ground-based telescopes, IUE monitored the nucleus of the active galaxy PKS 2155-304 for 10 contiguous days. These observations, which were all done remotely by the GOs, will be used to investigate the properties of the accretion disk believed to power this object. In collaboration with HST, IUE also observed an eclipse in the binary system HR 2554. The resulting spectra provide extensive coverage of critical phases of this phenomenon, and provide new insight into the structure of the components' atmospheres.

Also, CSC personnel extensively observed the planet Jupiter in preparation for the July impact of the fragments of comet P/Shoemaker-Levy 9. The data included both Jupiter's aurora and atmosphere. These spectra provide a baseline for comparison to observations taken during and after the collisions. A number of these observations were coordinated with observations by the Hubble Space Telescope.

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On Task 344, the NEWSIPS Pipeline 2.4 was successfully tested on LWP04074 and compared to the output from the Prototype system on the VAX on June 30, 1994. All the LWP low-dispersion calibration files and associated software changes were packaged and delivered to VILSPA on July 1, 1994.

On Task 346, two new Hewlett-Packard 4M laser printers were installed on a rib of the local ethernet backbone, and print queues were created on IUEGTC to access them. Almost simultaneously, the last QMS printer ceased functioning and the remaining laser printer queues on serial lines were reconnected to the HP printers. The printers were registered with the GSFC CNE and are pending approval as TCP/IP nodes on the GSFC LAN. Task personnel modified and tested several packages on the VAX cluster (e.g. IDL, TeX) for compatibility with the new printers. Task personnel also developed documentation describing the use of the new printers with the modified packages (especially TeX) and distributed it through e-mail and hard copy.

A new subroutine called PLATFORM was completed by Task 351 personnel, which will return all the system-specific commands needed by the IUEDAC IDL routines. PLATFORM will help make IUEDAC routines more portable since only one routine will need to be modified for adding any new system-dependent calls. PLATFORM was also written to allow the IUEDAC to support Alpha workstations running OpenVMS.

Task 351 staff members also continued to support a large number of users (66) during the quarter. In response to the increased usage, five more accounts were created on the IUE VAX, bringing the total number of user accounts to 65.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

October 14, 1994

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for July 1994 through September 1994, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 331, IUE participated extensively in observations of Jupiter during the impact of comet Shoemaker-Levy 9. CSC staff, in conjunction with the cognizant GOs and in coordination with other ground and space based instruments, acquired 344 spectral images in support of impact observation programs. IUE obtained spectra of Jupiter's aurora and the Io torus, and made albedo measurements of Jupiter's disk. These observations included spectra of the impact regions. The GOs' preliminary report is that there were significant changes in the UV reflectivity of the impact sites. Overall reflectivity decreased by as much as 50 percent. Additional absorption features appeared. Auroral activity was also observed to be abnormally low, which may be attributable to the interaction between cometary dust and the Jovian magnetosphere. During the impact period, task members assisted media representatives covering the event and hosted a live television broadcast to Japan.

Also on Task 331, IUE observed the RS Cvn system UX Aries on 17 out of 22 consecutive days during August and September. UX Aries has a 6.4 day orbital period, and these observations cover the wide range of time scales on which activity occurs in this system. By studying the variation of UV emission with orbital phase, the investigators will learn more about the geometry of the active regions on the primary star.

A prototype to assign preliminary homogeneous coordinates and object names was developed by CSC personnel on Task 341, for targets in the new GSFC GO target list. This work was done as part of the planning for processing current images with NEWSIPS. Results of the study were presented at the IUE Three-Agency Meeting. At this meeting, it was reconfirmed that VILSPA will retain final responsibility for assigning homogeneous data.

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On Task 343, the CDIVS staff completed verification of all available Goddard SWP high-dispersion images that are on optical disks. With the prior completion of verifications of all low-dispersion images that are on various optical disks it is estimated that about 75 percent of all Goddard images now have been verified in the Ingres database. Hence this provides another source of astronomical science and spacecraft engineering data that can be used in research pursuits.

On Task 344, the NEWSIPS Pipeline 2.4.1 was successfully tested and compared to the output from the Prototype system on the VAX on September 30, 1994. This release provides the full capability of processing SWP and LWP low-dispersion data. The partial high-dispersion system was successfully implemented on the DECstation. This system processes SWP high-dispersion images through the GEOM program. The processing time for this system is roughly 34-40 minutes per images, which improves the VAX/VMS high-dispersion prototype system processing time by a factor of 4. Currently, 117 SWP wavecal images have been processed through this system on the DECstation.

On Task 351, the IUE VAX 8350 was upgraded to an Alpha 3000/400 workstation. The upgrade represents the first major hardware improvement for IUEDAC users since the RDAF first migrated from a PDP 11/44 to a VAX almost ten years ago. The new workstation represents an increase in cpu power of almost two orders of magnitude and should save the project money due to the lower hardware maintenance costs.

A significant amount of software development was completed by staff personnel, on Task 351. The newly written routines include the following: mgex,w_search, delcrcc, addicom, vecfits and stdstars. In addition, new versions of more than 100 existing routines were implemented this quarter to allow support for the OpenVMS operating system, and to simplify the conversion of the IUEDAC software to other platforms.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

January 13, 1995

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for October 1994 through December 1994, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 431, a number of exciting planetary observations were carried out during this report period. Two fragments from Comet Machholz 2 were observed under challenging conditions. Quality spectra were obtained showing several faint emission lines. In other programs, molecular hydrogen emission was observed from Saturn, and IUE looked at the Moon in order to study the reflected solar Lyman-alpha profile.

Also on Task 431, notable target of opportunity programs included monitoring of an extremely rare Eta Carina type outburst from the Wolf-Rayet like star, HD5980, monitoring the blazar OJ 287, and a campaign to observe the gravitationally lensed quasar PG 1115+080.

The IUE Project has been working to port the NEWSIPS and the supporting software to run on specific nodes of the LASP Alpha cluster. Use of this cluster will significantly speed up the Final Archive processing, allowing IPC to process as many as 300-500 images a night. The DASS task provided the tools that will allow the pipeline to be run in an automated fashion. Task 0441 personnel wrote the software to build PIFs and copy them to a staging area on the cluster; to copy raw images from IUEGTC optical disks to the staging area; ingest PIFs from images processed on the Alphas; and create and transmit BOLs to NSSDC for those images. All of these functions are incorporated in alphamnu, a menu written using the Ingres forms system. For this effort twelve new routines were written and seven existing routines were modified. A new Ingres report was also written to inform IPC of the status of images that had problems in processing.

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On Task 443, CSC started Final Archive production processing under Release 2.4.1. Under this new version SWP low-dispersion images continue to be processed, and additionally LWP low-dispersion pilot verification images have been processed. This has added to the overall capability of the Final Archive system of allowing the scientific community to access more, varied, and improved IUE data to continue and expand astronomical research.

The capability of automatically queueing user requests for NEWSIPS processing was implemented. Any user can now use this capability to have specific images processed with relative ease and hence will be able to take quicker advantage of the improved results as generated by NEWSIPS.

Staff members on Task 451 modified 12 existing programs, implemented 15 experimental programs, updated three database tables, and developed five new procedures during the past quarter. The newly written routines including the following: MULDIRFF - allows IUEDAC database files to be stored in (and searched from) multiple directories, KURUCZ91 - allows access to the latest (as yet unpublished) Kurucz model atmospheres, BOXCAR - extracts fluxes from either IUESIPS or NEWSIPS spatially-resolved spectral files using a box-car slit extraction, IUEPROG - allows users to search the database table of IUE programs IDs, and GFILTER - applies a 1- or 2- dimensional Gaussian filter to arbitrary vectors or arrays.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

April 14, 1995

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for January 1995 through March 1995, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 431, during the period January 1995 - March 1995, a planetary program spanning the current lifetime of IUE was completed. The program involved obtaining IUE spectra of the four Galilean moons of Jupiter. The primary goal is to better understand the surface evolution of the satellites – the surfaces are influenced by the Jovian magnetosphere, which is modified appreciably by volcanism on Io. The IUE data will provide an important foundation for upcoming Galileo and HST observations.

During March IUE obtained many coordinated observations for the Space Shuttle's Astro-2 mission, in particular supporting WUPPE and HUT. The IUE high-dispersion mode will be used to complement the voluminous lower resolution WUPPE and HUT data.

On Task 441, the system for running NEWSIPS processing on the LASP Alpha cluster was made operational in January. Several enhancements were made to the tools which run the processing in an automated manner. These include setting up batch jobs to run NEWSIPS processing for each image chosen, using FTP protocol rather than DEC NGT protocol copy to speed copying wherever possible; submitting a batch job to copy problem images to the DECstation for verification; and copying the processing output files directly to the NSSDC staging area.

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On Task 443 CSC staff completed LWP high-dispersion image verification for those images on optical disk. Essentially all low-dispersion and SWP and LWP high-dispersion images that are on optical disks have been verified.

IUE Final Archive staff completed NEWSIPS processing of both SWP and LWP low-dispersion Set 1 (pre-1990) images. CSC accomplished this goal by streamlining operational procedures, increasing disk space, and automating file transfers on the DECstations and IUE Alpha computers.

Very truly yours,

B E Turner for P M Perry

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

July 14, 1995

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for April 1995 through June 1995, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 421, LWR low-dispersion calibrations for the Final Archive are being completed significantly ahead of the schedule presented at the IUE Three-Agency Coordination Meeting in May.

Supported by Task 431, IUE took advantage of the equinoctial view of Saturn's northern and southern polar aurorae afforded by the May 22 ring-plane crossing in order to study the aurorae and seasonal variations in Saturn's atmosphere. The new IUE data will be analyzed in conjunction with IUE observations from the last ring-plane crossing in 1980.

Jupiter's North Aurora was also studied in a separate observing program. This new data, when combined with archived IUE spectra, will help in better understanding long-term changes in the chemistry, composition, and temperature of the Jovian upper stratosphere, ionosphere, and aurorae.

On Task 442, the Final Archive prototype processing system was ported from the MicroVAX 3600 to the new DEC ALPHA machine, decreasing the time required to process test images by a factor of 20.

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On Task 443, CSC has completed the processing of available SWP low dispersion Part 2 (post-1990) images. Many of these images were priority processed upon request for IUE Guest Observers and archival data users, thus making the improved data available as quickly as possible for their research analysis.

CSC implemented the capability to request and retrieve raw images from NDADS, using the FSTAGE utility. This allows NEWSIPS processing to be performed on the IUE Alpha for images which have been verified but which are not on our optical disk platters; this involves nearly all the IUE data taken after 1991. Production processing on the IUE Alpha is now done routinely using this capability.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

October 13, 1995

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for July 1995 through September 1995, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

IUE observed Comet Hale-Bopp, which was at 6-7 AU. This comet is brighter than most other distant comets observed previously by IUE, and presents a unique opportunity to study water outgassing cometary grain reflectivity in the UV when a comet is far from the Sun. Additional data will be obtained by VILSPA as part of Episode 19.

IUE observations of Jupiter extended a baseline of data on that planet going back to the early 1980s. The new observations are part of an effort to study the Jovian equatorial Lyman-alpha bulge, the polar aurorae (in conjunction with HST/FOC images), and any long-term effects from the 1994 Shoemaker-Levy impact events.

Task 431 personnel made extensive efforts to plan and carry out the final disposition of IUE Telescope Operations hardware, software and documentation. In coordination with the ATR, the staff discarded material no longer important to the mission history, packed other materials for storage in a government facility, and collected those documents requested by other Observatory sections. Other documents were prepared for microfiching to complete long standing sequences of these records. A task member made backup tapes of all relevant Telescope Operations software.

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On Task 443, CSC has completed processing available LWP low dispersion Part 2 (post-1990) images through the NEWSIPS system. Many of these images were priority processed upon request for IUE Guest Observers and archival data users, thus making the improved data available as quickly as possible for their research analysis. Staff members processed 12,254 images, a record number.

Task members worked with VILPSA personnal in developing new versions of several IUEDAC programs that will allow US and European IDL users to read 19th episode IUESIPS disk files on VMS computers.

Staff members completed the assembly and installation of a Sparc 1 workstation at no cost to the project. The hardware was obtained from various projects located at GSFC which were planning to excess their older computer equipment.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

January 15, 1996

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for October 1995 through December 1995, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

Final testing of the SWP high-dispersion wavelength calibration for NEWSIPS was completed by Task 521 personnel. Residual errors were found to be less than one pixel.

Task members completed an analysis of SWP high-dispersion large-aperture resolution data reprocessed with NEWSIPS. The average spectral resolution was 0.21Å or 5.6 pixels and showed no dependence on either wavelength or order number. The spatial resolution showed a strong dependence on order number and sample position.

CSC task members on Task 529 began work on the IUE Archive Support task, October 30, 1995 by familiarizing themselves with the current operating procedures and software. At the beginning of the training period, a GSFC Final Archive tape backlog of 31 tapes existed. Within 5 weeks task members reduced the backlog to zero. Task members were then able to begin archiving VILSPA Final Archive data. Although the process for archiving VILSPA data is longer, significant progress in reducing that backlog has been made, archiving 25 percent of the available VILSPA Final Archive data in 13 working days.

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TO: D. K. WEST FROM: P. M. PERRY DATE: 01/15/96

On Task 543, CSC delivered a major enhancement to the Post-Processing Verification system. The software will now read, display, and track the status of high-dispersion pMidas and FITS files. Previously the system handled only low-dispersion images.

Task members continued to process SWP and LWP low-dispersion images through the NEWSIPS system at a record rate. A total of 12,254 images was processed during this report period, equalling the previous record.

On Task 544, all components of the NEWSIPS high dispersion system have been coded into the MIDAS NEWSIPS production environment and the system runs to end-to-end. Compatibility has been demonstrated for all modules through the geometric correction step.

User support on Task 551 this quarter (about 46 users/month) represents a drop of about 20 percent. Though IUE telescope operations at Goddard ended last quarter, the continued high level usage of the data analysis center demonstrates the ongoing popularity of the IUE archive, and the important role the IUEDAC plays in supporting both archive users and 19th episode observers.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

April 12, 1996

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for January 1996 through March 1996, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

On Task 521, the LWP high-dispersion wavelength calibration for NEWSIPS is complete. The average residual wavelength error is approximately 0.3 pixels. Problems with the wavelength accuracy in IUESIPS data for the region around Mg II have been eliminated with this new calibration.

Under Task 529, the backlog of VILSPA Final Archive tapes was eliminated and most of the data are now available to the community. After this backlog was eliminated, task members accumulated no backlog of Final Archive data, keeping current as data arrived from the Project.

On Task 542 final modifications were applied to the GEOM modules and the code was delivered to the Software Task on March 11, 1996. The task finalized work on "Delivery 4" of BASISMOD, which encompasses all SWP high dispersion modifications. This version of the software was delivered to the Software Task on February 27, 1996. At this time, all development of the NEWSIPS high-dispersion modules is complete and prototype code delivered, except for the spectral extraction code which is awaiting the VILSPA delivery of calibration files.

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301.794.4460

TO: D. K. WEST FROM: P. M. PERRY DATE: 04/12/96

Personnel on Task 543 tested and implemented NEWSIPS Release 2.4.4, which includes modifications to the handling of sky background images and to the extraction when SWET finds only two nodes. Both changes provide higher quality processed data for the IUE Final Archive. In addition, output files produced on the DECstations are now copied directly to the NSSDC computers. This capability reduces the amount of tape handling and manpower required to maintain the IUE archive, thus making this activity more efficient.

CSC has nearly completed Core Data Item Verification of all NASA IUE images. Only 1 percent of the images remain to be verified, most of which are problem images which require special handling. The verifications insure that IUE archival users will have access to an accurate, useful database of observations.

Task 544 delivered the NEWSIPS SWP High Dispersion, Version 3.0 Processing System on GORGON on February 8, 1996 and on the LASP cluster on February 12, 1996.

On Task 551, IUEDAC usage increased this quarter with an average of 50 remote users supported per month. The IUEDAC software was also distributed to two remote users interested in installing the software on unix platforms.

Task members provided special assistance to several groups this quarter. Staff members assisted IUE users at VILSPA who were interested in analyzing NEWSIPS low-dispersion data. The DAC aided EUVE project staff who were interested in creating an EUVE spectral atlas similar to the ones compiled by the IUE project. Task personnel also provided a listing of IUE white dwarf spectra to STIS personnel who were evaluating potential calibration sources for the future STIS instrument, and forwarded information on FITS reading and writing software to University of Maryland researchers.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

Computer Sciences Corporation
System Sciences Division

July 15, 1996

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Donald K. West
Code 684.1
Building 21, Room G-59C

Subject: Contract NAS 5-31230

Dear Dr. West:

Enclosed is the Progress Report for April 1996 through June 1996, as required by the terms of the subject contract. Please note that a glossary of acronyms is included for your convenience.

I would like to bring several task highlights to your attention.

Under Task 529, IUE archive production work was smoothly moved from the TETHYS platform to the NDADS system. Software, tools, and documentation were all updated and made ready for the move. Subsequent enhancements were made as experience within the NDADS environment was gained.

Task 541 members led and participated in an internal working group that reviewed the current NEWSIPS pipeline processing system running on one LASP cluster Alpha and developed and updated requirements for processing high-dispersion images with the system. The pipeline had to be made more efficient and expanded to accommodate the required throughput for high-dispersion processing. The throughput requirements demanded more than the single Alpha used for low-dispersion processing. At the direction of NASA IUE Project management and in association with IPC task members, task members successfully negotiated with UIT team members to utilize the UIT Alphas. This will allow the IUE Project to complete processing the high-dispersion data.

On Task 542 a new method of determining the high dispersion slit heights was developed, tested, and implemented. This new method, based on empirical order widths in IUE images, represents an important improvement in the signal-to-noise ratio and photometric accuracy for high dispersion data, and is also the last algorithm development issue for the IUE Final Archive.

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TO: D. K. WEST FROM: P. M. PERRY DATE: 07/15/96

Under Task 544, the NEWSIPS SWP High Dispersion, Release 3.0 Processing System was delivered June 18, 1996 on GORGON and June 21, 1996 on the LASP cluster. These new deliveries provided full processing capability for SWP high-dispersion including calibrations.

On Task 551, special assistance was provided to a number of groups this quarter. Several routines were written and/or modified for N. Evans and her graduate student from York University for analyzing LWP high-dispersion images stored as MIDAS MSK files. A new version of BINS was developed for R. Shubert from JPL which allows binned fluxes to be specified in units of photons/cm2/sec/kev. A power-law fitting routine was written for visitor R. Sambruna from HEASARC. Assistance was provided to E. Pian from STScI in evaluating the effect of different extraction techniques on recent streak-contaminated LWP spectra. Assistance was also provided to M. Haken from the University of Maryland who needed IUE satellite positions for an upcoming 19th episode observing run.

Very truly yours,

COMPUTER SCIENCES CORPORATION

Dr. Peter M. Perry
Project Manager

APPENDIX B - STATEMENTS OF COMMENDATION

APPENDIX B - STATEMENTS OF COMMENDATION

Reproduced herein are copies of commendations for CSC staff members working under this contract. These commendations were received during the contract reporting period and are presented in chronological order.

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland
20771

NASA

y to Attn of 684

April 2, 1992

Mr. George Meyerson
President, System Sciences Division
Computer Sciences Corporation
4061 Powdermill Road
Calverton, MD 20705

Dear George:

I am pleased to write this letter to commend the outstanding performance of the CSC personnel who have supported the International Ultraviolet Explorer (IUE) Project over the past year.

The team supporting the operation of the IUE, which is widely regarded the most productive telescope in the solar system, has been headed by Terry Teays; the team consists of Resident Astronomers (R.A.s) Richard Arquilla, Ronald Pitts, Mario Perez, Lloyd Rawley, Cathy Mansperger, Mike Carini, Jeff Newmark, Martin England, and Telescope Operators (T.O.s) Scott Snell, Andy Groebner, Charles Loomis, Tom Walker, Daryl Weinstein, and Jim Caplinger. Bruce McCollum provided a very capable support in scheduling observations, many of which have complex requirements.

The IUE peer review for the 15th guest observer year has just been completed successfully thanks largely to the capable and dedicated help of the CSC workers. Terry Teays competently orchestrated the overall efforts. All of the R.A.s performed technical feasibility review, as well as Cathy Imhoff, Jerry Bonnell, Bruce McCollum and Terry Teays himself. During the review, Lloyd Rawley, Cathy Mansperger and Mike Carini provided technical support, while Corrie Eby, Dot Appleman and Rita Clarke rendered administrative support. The last three people, along with Mona Drexler, stayed very late the first night to complete typing up all of the panels' comments for use the following morning.

The installment of the new Experiment Display System (EDS or also known affectionately as the TOCS), which was a monumental task, involved many CSC personnel. Ron Pitts, with advice and consent from Terry Teays, has been the central figure in bringing it to fruition; he has been involved in every aspect of it, and, in particular, he wrote the all-important user interface. Other CSC people who were heavily

involved were Ben Gianni and Ed Pease (communications interface software), Len Smith and Kevin Hassett (systems engineering), Yuri Frankel (programming), Gwyn Fireman (image display and remote observing software), Jeff Newmark (Xenix system support), Tom Walker (HST Guide Star Catalog software), and Terry Teays (management, trouble shooting, trouble discovering). All of the R.A.s and T.O.s took part in the testing of the new system. The numerous details that had to be coordinated for construction were handled by Denise Taylor.

The Fine Error Sensor (FES) scattered light studies have been continued by Mike Carini assisted by Daryl Weinstein. He conducted tests to confirm that going into shadow with a cool telescope tube helped to keep down the level of scattered light. This solution was first proposed by Scott Snell.

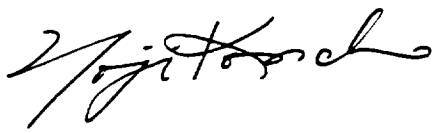
The one-gyro control system work has continued to be the domain of Rich Arquilla. The loss of the Particle Flux Monitor has been partially ameliorated by Rich Arquilla's idea of using the GOES-7 satellite electron flux data to predict the radiation levels for the IUE. The analysis which provided this correlation was carried out by Andy Groebner.

CSC support for the IUE Final Archive was coordinated by Joy Nichols Bohlin; Howard Bushouse and Michelle De La Pena also played key roles in this important effort. Rich Wasatonic contributed significantly to the Post Processing Verification work. Cathy Imhoff led the task on the production processing of the data for the Final Archive.

CSC staff also assisted us greatly in the completion of the proposal for the NASA Headquarters Senior Review of several ongoing NASA astrophysics projects. Terry Teays contributed an important section on IUE operations, Nancy Oliversen on the IUE Regional Data Analysis Facility, Cathy Imhoff on data processing and distribution, and Joy Nichols Bohlin on the Final Archive. Barry Turnrose developed statistical figures describing productivity of the IUE and Denise Taylor rendered assistance during the editing and formatting of the text. Jerry Bonnell masterfully produced excellent computer images for the cover of the document that highlight IUE's accomplishments.

It gives me pleasure to compliment you and the CSC managers for the IUE Project, Peter Perry, Barry Turnrose and Dawn Stone. Your capable management has made it possible for your good people to do their very best.

Yours cordially,



Yoji Kondo
NASA IUE Project Scientist

UNIVERSITY OF NEVADA RENO

Department of Physics/220
College of Arts and Science
Reno, Nevada 89557-0058
(702) 784-6792
FAX: (702) 784-1398

August 5, 1992

Dr. Yoji Kondo
NASA/GSFC
Greenbelt, Maryland
20771

Dear Dr. Kondo,

I was recently a guest observer at IUE and I wanted to express my thanks for all the support I received from your staff. I arrived a couple of days early to become familiar with the data reduction techniques, and everyone including Jerry Bonnell, Randy Thompson, Jenn Gagliardi, and Lyla Taylor took time to patiently help. The atmosphere in the RDAF room was comfortable and easy to work in.

During my observing shift I had the pleasure of working with RA, Martin England and TO, Daryl Weinstein. They gladly answered all my questions and made the experience an enlightening one.

I must also comment on the efforts of Bruce McCollum. He certainly went out of his way to make sure my observing program was a success. His last minute shuffle to schedule my double shift was very much appreciated.

I came away with such a positive feeling that I wanted to let you know how much I enjoyed working at IUE. Here's to the next 15 years!

Sincerely,

Melodi Rodrigue

From: STARS::HRSSHORE "Have Theory. Will Travel. (301)286-3748" 22-DEC-1992 1.
To: IUESOC::TEAYS
CC: HRSSHORE
Subj: Cuedos for the IUE staff

Hi Terry:

I just wanted to thank you and the staff for what turned out to be a successful set of remotely conducted observations of N LMC 1992 on 19 Dec. The remote session was arranged with ASU, with Sumner Starrfield and Scott Austin working from there by telnet, and with me working from home by phone (I was out of town and was able to return earlier than I expected). Mario and Jim handled the shift extremely well. There were many unexpected difficulties, including the return of the streak to the LMC and a problem at lower betas, but Mario and Jim performed well and very professionally. At one point, with about 3 hrs left, the ASU site had to shut down because of a fire alarm and I had to conduct the shift by phone from home. The script generation program worked, the procedures could be discussed by phone, and the data are of high quality (as always, of course).

So I hope you will be able to place this in Jim's and Mario's record somehow. They came through a hard session with flying colors and in the "best tradition of the corps" (so to speak!)

Cheers,
Steve Shore

Applied Research Corporation

8201 Corporate Drive Landover, MD 90785

11 March 1993

Dr. Yoji Kondo
Code 684.0
Goddard Space Flight Center
Greenbelt, MD 20771

Dear Yoji:

I would like to commend the members of the IUE observatory staff who assisted me on my recent IUE observing run. Specifically, Resident Astronomers Richard Arquilla, Mike Carini, Martin England and Lloyd Rawley, and Telescope Operators Andy Groebner, Charles Loomis, Scott Snell, and Tom Walker.

They made a challenging observing run, consisting of 6 consecutive sets of US1+US2 shifts, a relatively simple matter. Their performance was flawless, and their efficiency exceeded my expectations (they cycled through the targets much faster than their VILSPA counterparts). Because of their efforts, I was able to obtain considerably more data than I had anticipated, always a pleasant surprise.

I would also like to praise the RDAF staff members, Lyla Taylor and Randy Thompson, who were very accommodating, and enabled me to process the enormous mass of data I accumulated in an extremely short time.

I hope you appreciate the dedication of these hard working contractors.

Sincerely,

Derck Massa

cc: Terry Teays
Code 684.9

om: IUESOC::TEAYS "Terry Teays, IUE Observatory" 29-MAR-1993 16:27:16
: IUEGTC::TEAYS
:
bj: shore.txt

om: STARS::HRSSHORE "Have Theory. Will Travel. (301)286-3748" 29-MAR-199
: IUESOC::TEAYS
:
bj: A long delayed note

ar Terry:

rst, many thanks for the RU Cam material and I hope we can discuss it
ter this week. The past month hasn't allowed much time for this
estion, and I know how swamped you've also been.

a more important note, though, I wanted to put in writing what I'd
ntioned a while ago to you about this year's IUE Peer Review. The
ole operation was really great. Even with the hassles of the last
nute arrangements at the hotel (which was a terrible place that I
pe doesn't get used again), the staff worked with enormous efficiency
d skill. Corrie and Rita and the IUE crew (Llyod, you, and etc.)
de for faster turn-around and easier procedures than in any year
ve been involved. I was really impressed!! Having been sorry that
ere wer no laptops available for the rooms, I was amazed at how
st, and accurate, the operation was.

e staff evaluations of feasibility were, in many cases, useful and
all cases professional, free from any comments on proposed science,
d careful. And don't think for a minute that people were not aware
how much work had gone into them!

as not to belabor the point, I just wanted to say, as a participant
is year, thanks to you and to the staf for a job very well done.

eers
eve

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland
20771

NASA

Reply to Attn of: 684.1

February 16, 1994

Mr. George Myerson
President, Systems Sciences Division
Computer Sciences Corporation
4061 Powder Mill Road (7th Floor)
Calverton, MD 20705

Dear Mr. Myerson:

On behalf of the IUE Project, I wish to express my congratulations and thanks to members of the IUE CSC team who coordinated and supported the IUE Project exhibit at the 183rd meeting of the American Astronomical Society, which was held January 11-14, 1994, at the Marriot Crystal City, Virginia. The exhibit featured the remote observing capability recently developed by the Project, and data analysis software tools that have been developed at the IUE Data Analysis Center. In addition, the New Spectral Image Processing System (NEWSIPS) software was demonstrated at the exhibit, which highlighted the substantially improved results that are now being realized with this new calibration system. The design and development of the exhibit was an ambitious effort which provided important exposure of IUE's unique capabilities to the scientific community. An observing program in real time was actually conducted at the exhibit booth during the meeting, in which a guest astronomer was able to conduct an observing session while interacting via ethernet with the IUE Science Operations Center at Goddard. The setup for the remote operations workstation was an especially difficult challenge, and Dr. Ronald Pitts applied his critical technical expertise to the task.

The following list of CSC personnel played key roles in this effort, they include: Dr. Thomas Meylan, Dr. Ronald Pitts, Dr. Terry Teays, Dr. Mike Carini, Dr. Cathy Imhoff, Gwyn Fireman, Randy Thompson, Dr. Joy Nichols, Andrew Johnston, Pat Lawton, Dr. Richard Arquilla, and Jim Caplinger.

I wish to express my congratulations to you and to your staff of dedicated and enthusiastic scientists, managers and support personnel which have enabled IUE to maintain the very favorable reputation which the Project has with the scientific community and general public.

Sincerely,

Andrew G. Michalitsianos
IUE Deputy Project Scientist

›m: IUEGTC::TEAYS "TERRY TEAYS, CSC, CENTER FOR SCIENTIFIC RESEARCH"
TURNROSE,IUESOC::ARQUILLA,IUESOC::WALKER,IUESOC::GROEBNER,TORTE::MICHALI

›j: Accolades

›m: STARS::HRSSHORE "Steve Shore: Have Theory, Will Travel 219.237.4401"
TEAYS

›j: Hi

Terry: Just noticed you on and wanted to say hello from
›sierville. Just one thing -- do you know when the senior
'iew will take place?

›e all's well. ALso I wanted to send you, formally, my sincere thanks for
of the work that Tom Walker and Andy Groebner are doing to help set up
remote observing facility here. It has been a tremendous effort, mainly
'king through system-guts because of Alpha VMS problems, and they've been
t wonderful about it all. They deserve much more, but at least some
't of commendation is surely in order. You have a hell of a staff, as I
'e said many times, but this is above and beyond!

:ers
:ve

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, MD 20771

1995 March 30

/ to Attn of:

Mr. Milton E. Cooper
President
Systems Group
Computer Sciences Corporation
3170 Fairview Park Drive
Falls Church, VA 22042

Dear Milt,

It was a pleasure to make your acquaintance at the Goddard Memorial Dinner last Friday. The National Science Club Science Award that I received honored the entire IUE team and the CSC support staff has played a crucial role in the success of the IUE. As you may be aware, for the past seventeen years the IUE has been the most productive telescope on or off this planet, having accounted for more than three thousand refereed scientific articles. I might note that producing one thousand refereed papers (only) would be considered quite a feat for any telescope by the scientific community.

I would like to take this opportunity to honor those CSC employees who currently support the project. I will first list the workers who support the IUE as their primary responsibility and then will attach a list that includes everybody who is involved in the project. Their functions fall roughly in four categories: (A) those who schedule and operate the telescope, Resident Astronomers and Telescope Operators; (B) those developing and completing the voluminous Final Archive, which contains more than 100,000 valuable ultraviolet spectra; (C) on-site observatory support personnel; (D) Data Analysis Center workers that provide easy access to the IUE archive; and (E) the managers who have administered and kept the capable team together despite the difficulties arising from budgetary situations at NASA.

(A) Resident Astronomers; Richard Arquilla, Michael Carini, Martin England, David Kaufman, Lloyd Rawley, Edward Rosenthal, Terry Teays, and James Younger. Telescope Operators; James Caplinger, Andrew Groebner, Charles Loomis, Mark Schlegel, Scott Snell, and Thomas Walker.

(B) IUE Final Archive; Nepolia Dunn, Michelle de la Pena, Matthew Garhard, Catherine Imhoff, Karen Levay, Joy Nichols, and Myron Smith.

(C) On-site observatory support; Dot Appleman and Mona Drexler.

(D) Data Analysis Center; Thomas Maylan, Lyla Taylor, and Randy Thompson.

(E) Project management; Peter Perry, Dawn Stone and Barry Turnrose.

The CSC IUE staff is a unique scientific asset and is testament to your organization's successful scientific partnership with NASA. The large IUE user community that numbers in excess of 2,000, comprising a substantial fraction of all working astronomers today, thinks highly of the support they have received from the CSC staff. I might note that easily more than one half of the Hubble Space Telescope guest observers first learned to use ultraviolet spectra for research with the IUE.

All the best,

Yoji Kondo
NASA IUE Project Scientist

CSC IUE OBSERVATORY STAFF

Appleman, D.	Proposal and Grants Data Base Support
Arquilla, R.	Telescope Operations Center (TOC) Leader and Resident Astronomer
Bradley, R.	Data Analysis Center (DAC) User Assistant
Caplinger, J.	Telescope Operator and Final Archive Calibration
Carini, M.	Resident Astronomer and DAC Scientist
Coleman, S.	Senior Image Processing Specialist
Coulter, B.	Final Archive Development and Calibration
Crabb, S.	Data Base Software
Curtin, R.	Data Base Assistant/Facility Coordinator
de la Pena, M.	Final Archive Development and Calibration
Drexler, M.	Iue Science Operations Center Secretary
Dunn, N.	Final Archive Software
Eby, C.	Final Archive Calibration
England, M.	Resident Astronomer and Final Archive Development
Fireman, G.	Systems Support and Final Archive Verification S/W
Garhart, M.	Final Archive Calibration
Greenlee, V.	Data Management Center
Groebner, A.	Telescope Operator and Final Archive Development
Imhoff, C.	Resident Astronomer for Image Processing
Jackson, J.	Administrative Assistant
Johnston, A.	Computer System Administration and Support
Kaufmann, D.	Resident Astronomer
Kelley, R.	Final Archive Software
Levay, K.	Data Base Leader and Final Archive Development
Loomis, C.	Telescope Operator and Final Archive Calibration
Marochnik, L.	Core Data Item Verification
Martz, A.	Final Archive Software and Software Configuration
McCollum, B.	Science Observations Scheduler
Meylan, T.	DAC Leader
Nichols, J.	Final Archive Leader
Orem, B.	Final Archive Software
Perry, P.	Project Manager
Pitts, P.	Bibliographic Data Base
Proctor, D.	Observation Scheduling and Operations Assistant
Ramsburg, S.	Project Control Specialist
Rawley, L.	Resident Astronomer
Rosenthal, E.	Resident Astronomer and Calibration
Rudd, H.	Final Archive Software
Schlegel, M.	Telescope Operator
Smith, M.	Final Archive Development and Calibration
Snell, S.	Telescope Operator
Stone, D.	Technical Supervisor
Taylor, L.	DAC User Assistant
Teays, T.	Resident Astronomer
Thomas, C.	Image Processing Specialist
Thompson, R.	Senior DAC Coordinator
Turnrose, B.	Technical Supervisor
Walker, T.	Telescope Operator and Final Archive Software
Wasatonic, R.	Core Data Item Verification
Younger, J.	Resident Astronomer

National Aeronautics and
Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771

y to Attn of: 683.2

April 10, 1995

Dr. Barry Turnrose
Computer Sciences Corporation
10000A Aerospace Road
Lanham-Seabrook, MD 20706

Dear Dr. Turnrose:

I have known Dr. Peter Chen since his initial employment with CSC in 1983, when he was assigned to work on the software effort for the Ultraviolet Imaging Telescope (UIT) at NASA Goddard Space Flight Center (GSFC). At that time, I was the electronics design engineer for the UIT Instrument Development Team (IDT). My principal responsibility was to engineer the detail design of the Dedicated Electronics Processor (DEP), as well as all its unique interfaces to both the Spacelab Avionics and the UIT instrument subsystems. Dr. Ron Parise, Dr. Peter Chen and I worked closely, not only in developing the software that met the subsystems requirements, but also all subsystems and systems testing and integration activities. Soon after Dr. Chen was hired, Dr. Parise was selected as the ASTRO-1 Payload Specialist and Dr. Chen assumed full responsibility for developing all flight software and related tests. In short, Dr. Chen became the UIT software person supporting system development, integration, environmental testing, system calibration, as well as mission operations during ASTRO-1 and ASTRO-2 missions.

Dr. Chen not only is a very hard and diligent worker, but an innovator of first order too. Right before the ASTRO-1 Mission, Dr. Chen was instrumental in simplifying the interface between the Huntsville Science Operations Center and the UIT Ground Support Equipment (GSE). Flight data that was being recorded on a very bulky MINC computer disk system was recorded instead on a parallel PC and a compact EXABYTE 8mm tape recorder. This made it much easier to catalog and analyze the engineering data. Another example of Dr. Chen's creative work was his investigation of the feasibility of using a CCD camera rather than a film camera for UIT. In connection with this effort, Dr. Chen developed a concept for General Purpose CCD Controller. He published a refereed paper on this concept and in June 1994 the extract was published as a NASA Tech Brief publication.

Dr. Chen is very creative. He has collaborated with Dr. Randy Kimble on a winning NASA Headquarters proposal to develop radiation hard UV imaging detectors based on Intensified Charge Injection Devices (ICID). In addition, with several colleagues he has been pushing the concept of developing a lightweight, super-conductors suspended, moon base UV telescope. Dr. Chen's relentless efforts have led to a winning proposal by Dr. Andrew Smith and Dr. Chen to develop lightweight UV optics. Most recently, with Dr. Ronald Oliversen, Dr. Chen collaborated on a winning proposal to develop the concept of a lightweight lunar telescope.

On a personal note, it is always a pleasure to work with Dr. Chen--as a colleague and as a human being. He is always pleasant, courteous and engaging. I am proud to be associated with Dr. Chen as an aerospace technologist, and as a person with whom I have shared many happy and memorable occasions. Dr. Chen deserves to be recognized and commended for his superior work, driving vision and unrelenting efforts to always look for ways of doing things better. His work reflects well on him, as well as on CSC, and both Ted Stecher (the UIT Principal Investigator) and I are happy to acknowledge his many contributions to the Laboratory for Astronomy and Solar Physics (LASP) and to the Goddard Space Flight Center.

Joseph Novello

Joseph Novello, Head
Small Payloads Section
Laboratory for Astronomy & Solar Physics

Concurrence:

Theodore P. Stecher

Theodore P. Stecher
Principal Investigator, UIT
Laboratory for Astronomy & Solar Physics

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

Winter 1996 Vol. 43 No. 12

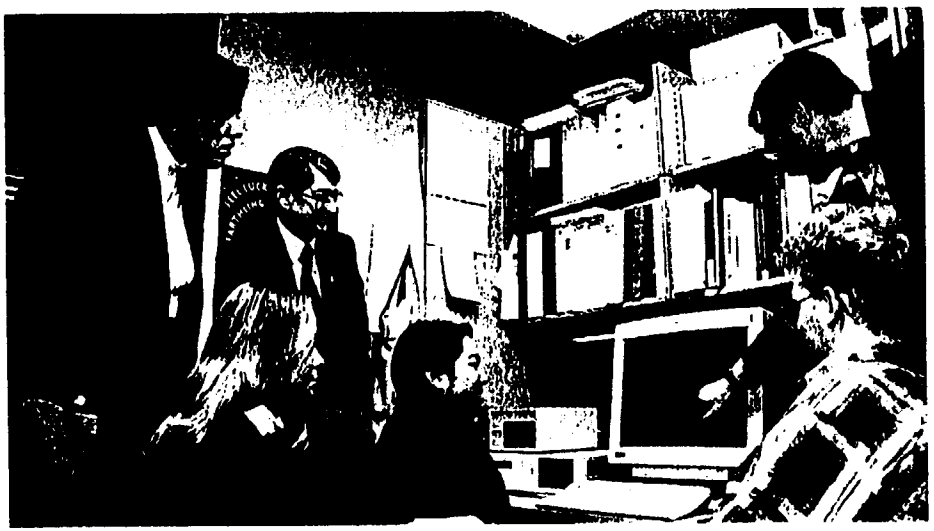
International Ultraviolet Explorer Education Project

Area high school and college students are part of a program that allows for the continuation of certain IUE operations.

Shown here in the photo from left are Isabel Rahe (seated), a junior at Stone Ridge High School; Katherine Keilty, a senior at Catholic University of America; Dr. Terry Teays, Computer Sciences Corporation, Code 681, Program Instructor; Patricia Chow, a senior at Walter Johnson High School; Professor Fred Bruhweiler, Catholic University of America and David Kolesar, a freshman at Catholic University of America.

According to Dr. Yoji Kondo, the IUE Project Scientist, Code 684, the program provides hands on experience for young students, who also earn extra credit for their work at Goddard.

This program demonstrates a new approach, in which students operate a spacecraft and obtain valuable data for scientific analysis. It will make possible timely observations of exciting pheonomena like Comet Hale-Bopp, which may become the brightest comet of the century.



Marc DeBord

IUE Student Operations

In October IUE science operations were turned over to the European Space Agency. NASA through Goddard continues to provide limited satellite operation support. IUE was launched in January 1978 and still is one of the most productive telescopes in the world.

May 1996 Vol. 5 No. 1

CSC

SYSTEMS GROUP

COMMUNITY

Spirit!

Finding Their Own Space

A lot of young adults seek space, but students David Kolesar, Isabel Rahe, Katherine Keilty and Patricia Chow found it through an innovative CSC-NASA partnership in which they learned to operate a NASA satellite and analyze the data it collects. The students, taught by Terry Teays, director of SSD's Center for Scientific Research, have spent five hours each week since November perfecting their skills.

Recently, their dedication paid off as they demonstrated what they learned for Joseph Rothenberg, director of NASA's Goddard Space Flight Center in Greenbelt, Md. Not only was their demonstration an unqualified success, the experience helped the students solidify their college and career plans.

Capturing a Star, Building a Future

At a time when most teenagers are excited to be driving a car, 17-year-old Patricia Chow is flying a spacecraft – the International Ultraviolet Explorer (IUE) satellite. Chow, with three other students, is part of a NASA-CSC pilot program that trains high school and college students in how to operate a satellite and analyze the data it collects. In a recent demonstration of the program, Chow and her fellow students, Isabel Rahe, Katherine Keilty and David Kolesar, showed their newly gained expertise to Joseph Rothenberg, director of NASA's Goddard Space Flight Center in Greenbelt, Md.

"Using the satellite, we're going to take an image and put it on screen," explained Chow, a 17-year-old senior at Walter Johnson High School in Montgomery County, Md. "I hope [Rothenberg] is impressed. When he asks questions, I hope I can answer."

The picture they took was an image of a spectrum, an array of ultraviolet wavelengths, of the star HD83953. HD83953 is a hot, rapidly rotating star (called a Be star in astronomical parlance) that is between five and 15 times larger than the sun. The students pointed IUE at the star and obtained a spectrum with each of the satellite's two cameras. Much to Chow's and the other students' relief, they were able to get the spectra with little fuss and were able to answer all of Rothenberg's questions.

"I like the concept of students learning from operating the IUE control rooms at Goddard," Rothenberg told *Spirit*. "So far, the operations are working out very well."

Although the students made the exercise look easy, it actually was the culmination of months of work, said Terry Teays, director of SSD's Center for Scientific Research, the instructor for the program. He and his students have been spending at least five hours a week on this project since November, on evenings and Saturdays. Teays conducted one or two science classes for the students each week and worked with them in the operation and control room as they practiced steering the satellite. The goal of the program was to give talented students a taste of what science means outside the classroom.

"I believe it is the first time an astronomical observatory was operated by students," said Dr. Yoji Kondo, the IUE project scientist who conceived of the program. "We wanted the students to attain their scientific goals, and we wanted to interest them in scientific and engineering work," he told *Spirit*.

IUE turned out to be the perfect learning tool. It is a guest observer facility dedicated to astronomical research that is jointly operated by NASA, the European Space Agency (ESA), and the British Particle Physics and Astronomy Research Council. According to Teays, IUE is "the most productive satellite in the solar system," and yields the data upon which many astronomers base their Ph.D. studies. Launched in 1978 for a three-year stint of stargazing, IUE is still operating. In fact, at 19 years of age, it is older than most of the students participating in this program.

Despite its longevity and usefulness, IUE has had its budget cut. Ironically, these cuts opened the window for this program. NASA was unable to support IUE's scientific operations, although it was able, for a time, to fund its operation and control center. ESA took NASA's satellite time for the remainder of this fiscal year, but it could not use the satellite

continued on page 4

Five Years of *Spirit!*

"In [illegible] social responsibility rests on each of us," read *Spirit*'s debut issue. The [illegible], which celebrates its fifth anniversary with this issue, began with the goal of telling the stories of those Systems Group employees who took on the responsibility of making their communities better places to live. In the past five years, *Spirit* has fulfilled that goal, showing that Systems Group employees are outstanding citizens on both corporate and individual levels. It also has served an equally important purpose in bringing together a large group of diverse employees through the common bond of good deeds.

When the newsletter began, skeptics pointed out that it might be difficult to find enough good news to keep such a newsletter going. But that didn't seem to be the case. Instead, issue after issue reported on CSC employees quietly going to great lengths to help others. Although it took staff a bit of work to uncover some of the stories (often because story subjects were too modest to disclose them), the well of employees' good works never seemed to dry up.

To continue in this tradition, *Spirit* looks to its readers for support. If you or your co-workers donate your time to improving the many communities in which CSC resides, please tell us about it. If you've been inspired to act by a story in *Spirit*, we'd also like to know about that. If you have a question as to what constitutes a *Spirit* story, we'd like to hear from you.

Capturing a Star

continued from page 1

Above right:
Rahe and Kolesar smile at their success in capturing an image of their star; Dr. Fred Bruhweiler (Kolesar and Keilty's advisor at of the Catholic University of America), Rothenberg, Kondo and Teays look on.

Above:
The students position the satellite under Teays' guidance.

for the eight hours each day when it is not visible from the ESA control center in Madrid. Where others saw downtime, Kondo saw an opportunity to put the satellite to good use when it was simply parked. He designed an educational program that helped high school and college students use a spacecraft to learn the practical applications of science. He looked to Teays, who had trained other satellite operators, as the right person to give the direct, personal instruction the students needed.

"He is very enthusiastic, very intelligent and good at teaching. He enjoys it. I cannot overemphasize how much of a contribution he's made. Unless you work with such good people, nothing happens," said Kondo.

To prepare them for their demonstration, Teays had the students participate in an international campaign to study RZ Cassiopeia, a binary star comprising two stars that circle one another. One of the stars is an early-type star, which is hot; the other is a late-type star, which is cool. During an international campaign, satellites as well as ground-based stations throughout the world observe and take spectrum images of a star throughout its cycle; in this case, as the two stars in the binary eclipse one another. These spectra can be quite wide, potentially ranging from radio to X-ray wavelengths. The spectra the students collected as part of this campaign, as with all of their spectra and accompanying data, were placed in the IUE archive. The archive, which now contains about 100,000 spectra, is what many of the country's astronomers use for their research.

Teays, a Ph.D. in physics, uses the IUE archive's spectra for his own research on distortions in the pulsation of certain stars, called the Blazhko effect. He has used the satellite to take images of the stars he is studying and consults the archive to see long-term variations. This commitment to science extends to the students in this program, whom he believes gain more than just knowledge of physics or astronomy.

"What they learn is science. They know how to analyze data," he said. "They can take that skill anywhere."

According to the students, the ability to analyze data was only a small part of what they learned. Kolesar, a freshman at Catholic University said, "This is giving me experience in the real-world applications of physics. In high school, [physics] was just concepts." Keilty agreed, "It's one thing to know the theories, but another to actually see what's real." On a more practical note, Chow added, "This has gotten me more interested in pursuing this field. It's pointed me to where I want to take my life." "Dr. Teays was incredible," said Rahe, a junior at Stone Ridge Country Day School. "He taught us so much, and it was fun."

Teays said he was pleased with his charges' performance for Rothenberg, which he called their "final exam." "The shift ran quite smoothly," he reported.

Although Teays and his students believe theirs was a productive educational experience, the future of the program is unclear at best. Neither NASA or ESA will have the funds to continue operating IUE next year. Kondo and Teays would like to continue and perhaps expand the project, but they will have to find another satellite to use. Teays is hopeful.

"It's extremely important that practicing scientists give their time to the education of the new generation of scientists," he said. "Who better to convey the excitement and the reasons why we do this?"

APPENDIX C - GSFC IUE SCIENCE OBSERVING TIME STATISTICS

APPENDIX C - GSFC IUE SCIENCE OBSERVING TIME STATISTICS

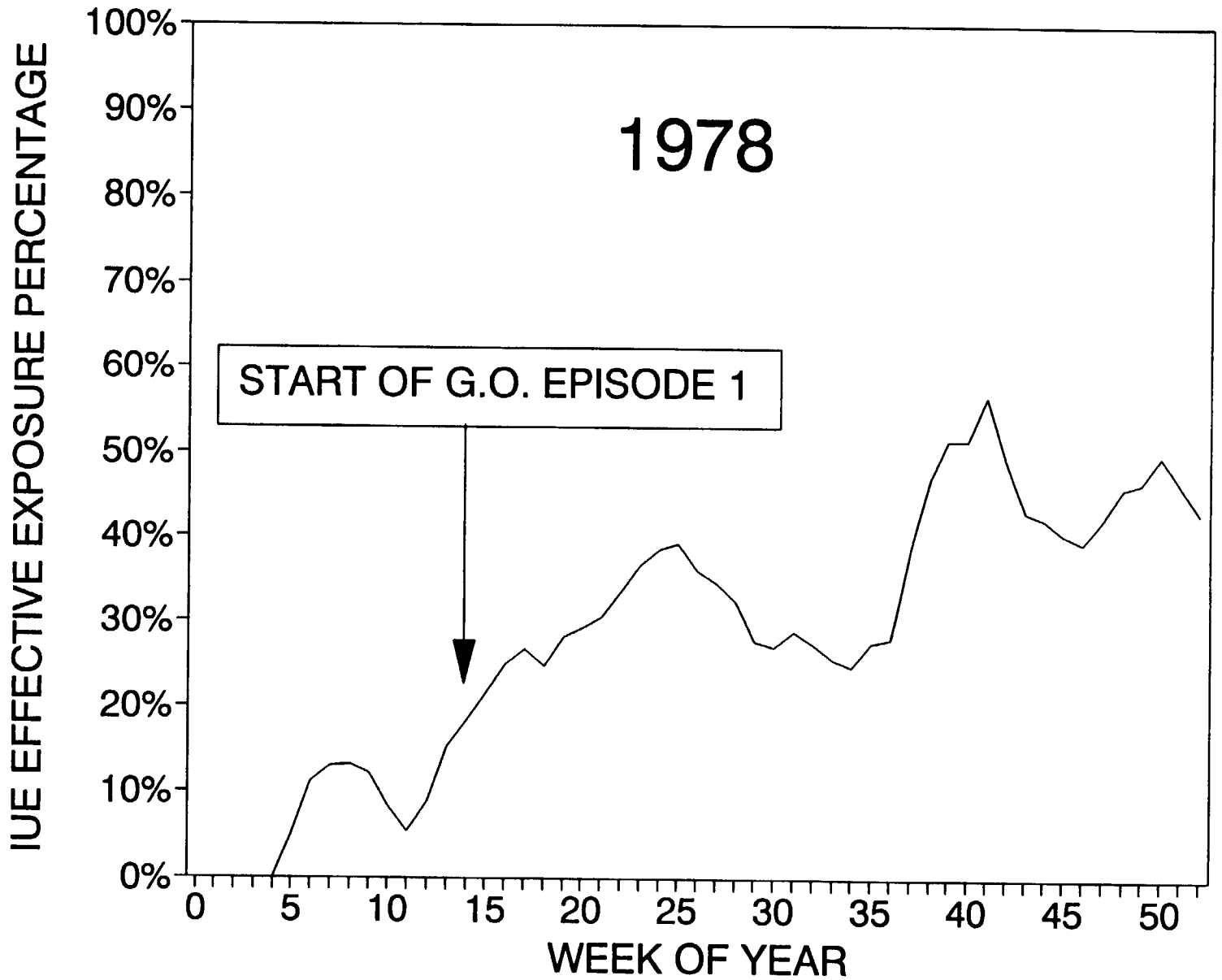
Presented herein are plots of GSFC IUE science observing time expressed in terms of the percentage of the total available GSFC IUE time each week actually used to obtain exposures. Note that because the data are based on actual exposure times, and not simply "time on target," they represent time actually spent collecting photons and do not include any setup or other operational overhead time. Each plotted point represents the sum of the individual GSFC exposure times for a given week, divided by the total amount of IUE time available to GSFC for the week (112 hours), and has been smoothed such that each data point is an average of the previous two weeks, the current week, and the following two weeks.

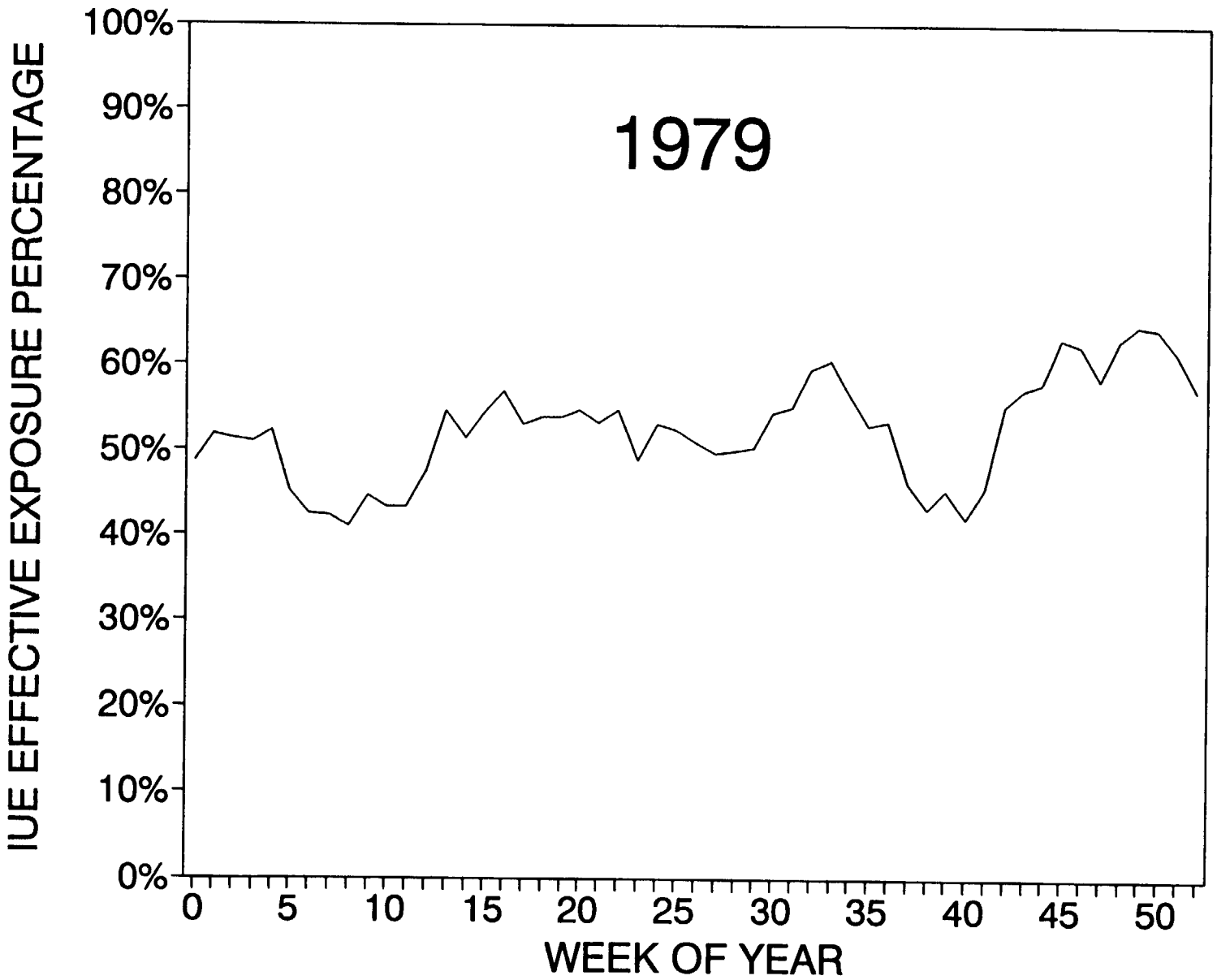
The smoothed weekly percentages are plotted separately for each calendar year. The first IUE observing episode began on April 3, 1978, which is marked by the notation on the graph for 1978; data for prior weeks in 1978 pertain to the observations obtained during the IUE Commissioning Period. The low percentage of use apparent in August 1985 was caused by the loss of a stabilizing gyro on the satellite; the graph shows that the normal scientific usage was quickly regained following implementation of the two-gyro/Fine Sun Sensor control system. IUE science operations at GSFC were terminated on September 30, 1995; the data for the 1995 graph accordingly ends at that time.

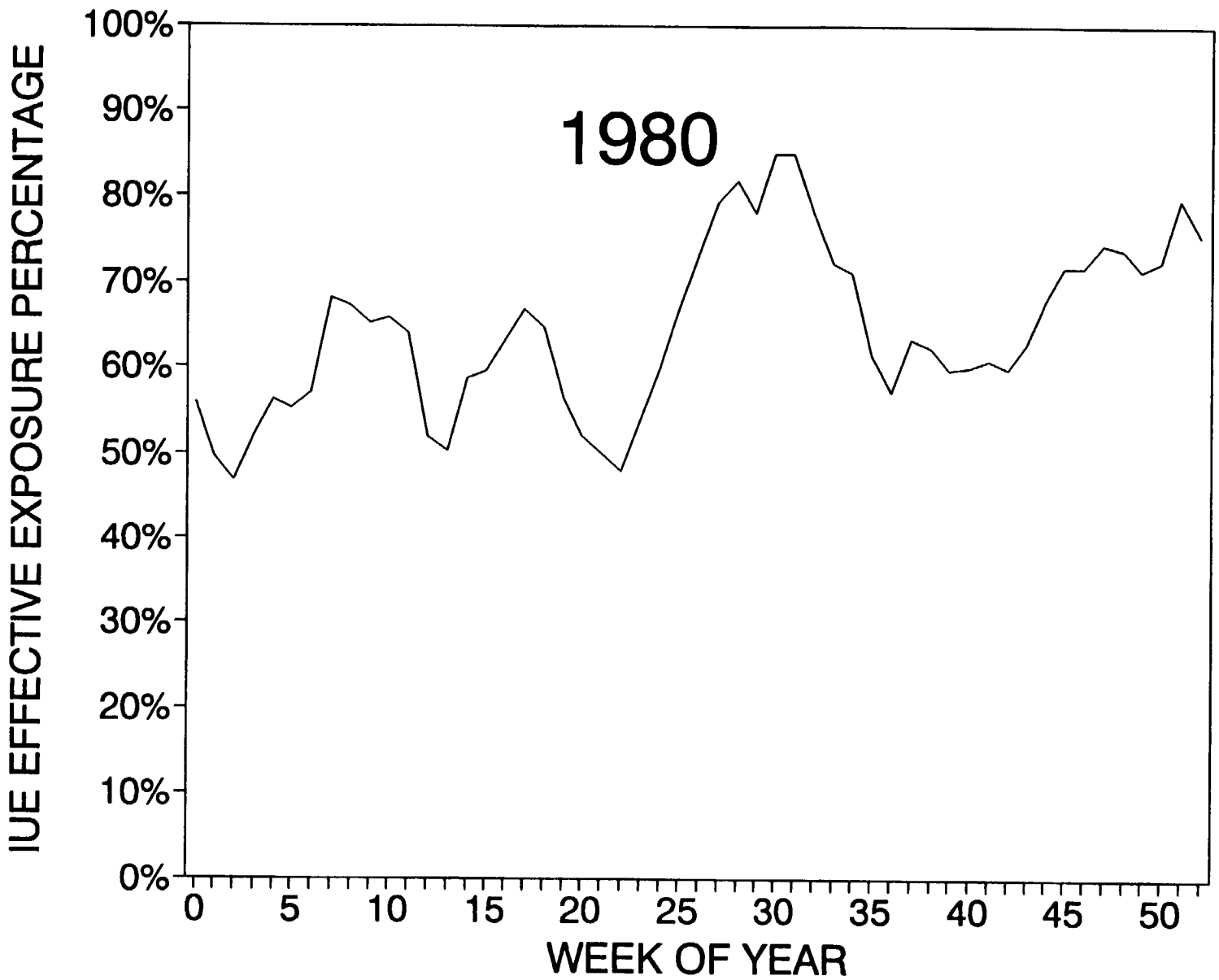
Following the individual-year plots is a bar chart indicating the yearly mean exposure percentages, from which the long-term efficiency trends over the entire life of the IUE can be seen at a glance.

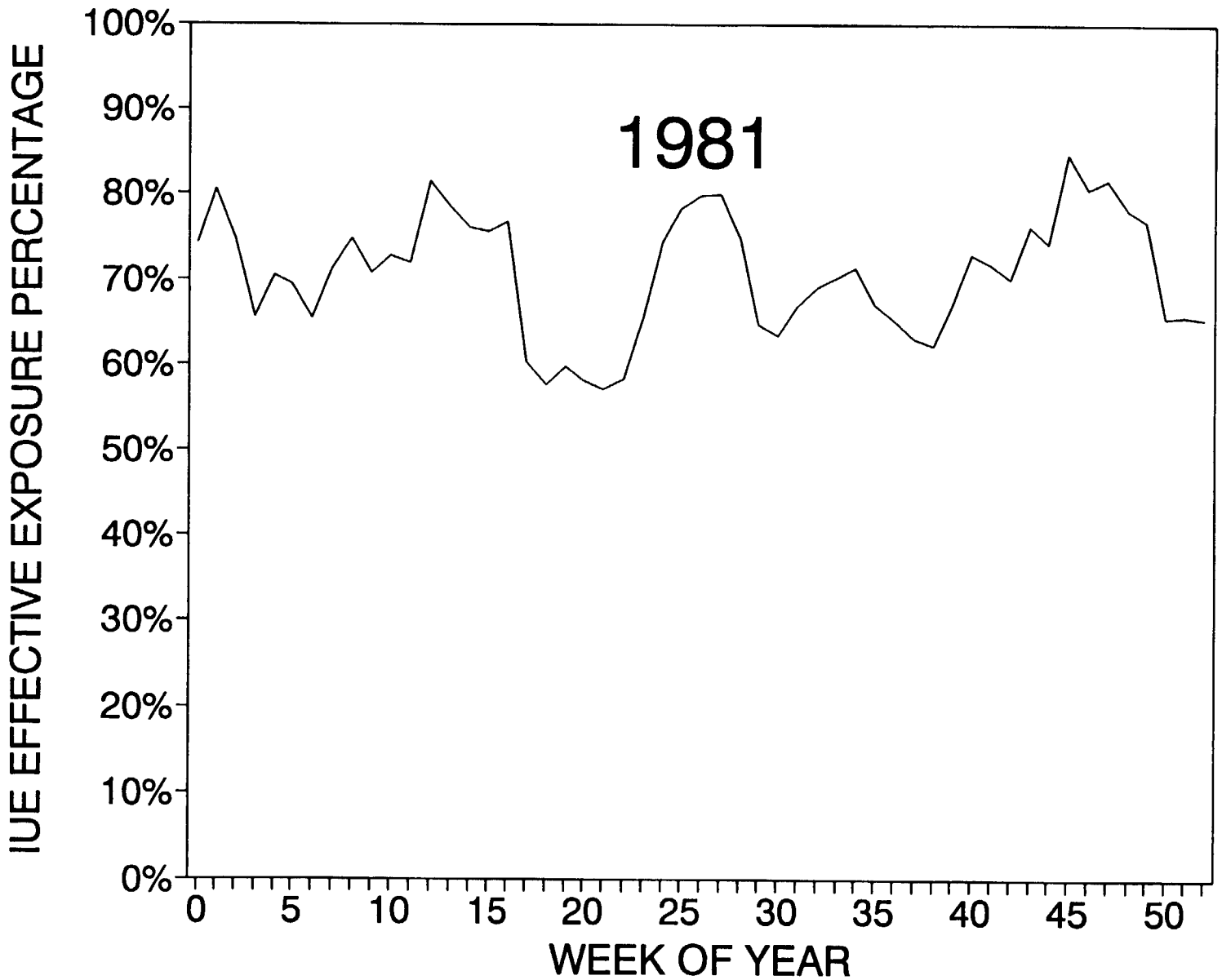
The following factors may affect the accuracy and interpretation of the statistics used to prepare the graphs:

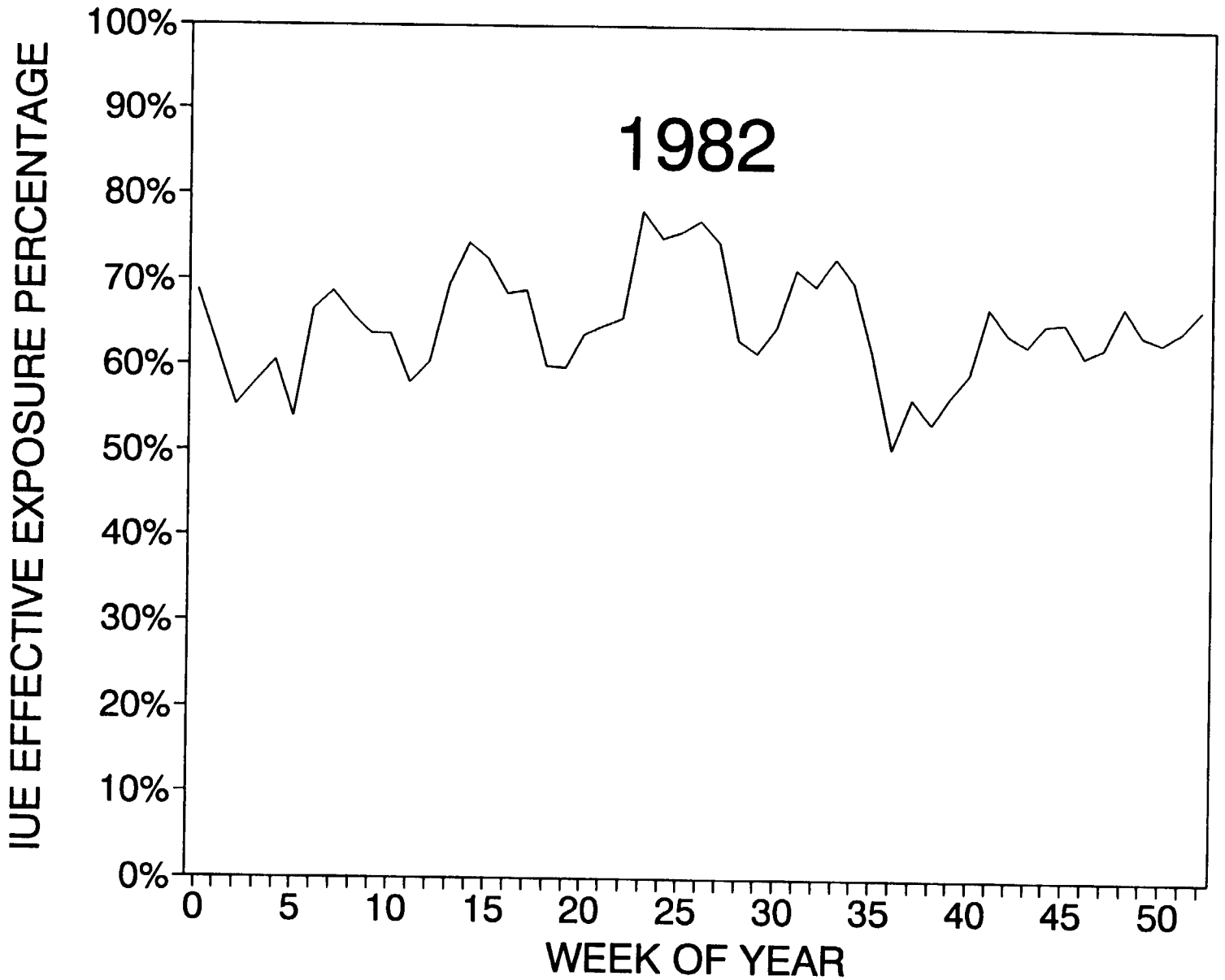
- The amount of any parallel exposure time (overlapping exposures of two cameras) is included in the data
- There may be missing or incorrect exposure times in the accounting data base from which the information has been drawn
- Multiple exposures may imply an exposure stop time which was too early.

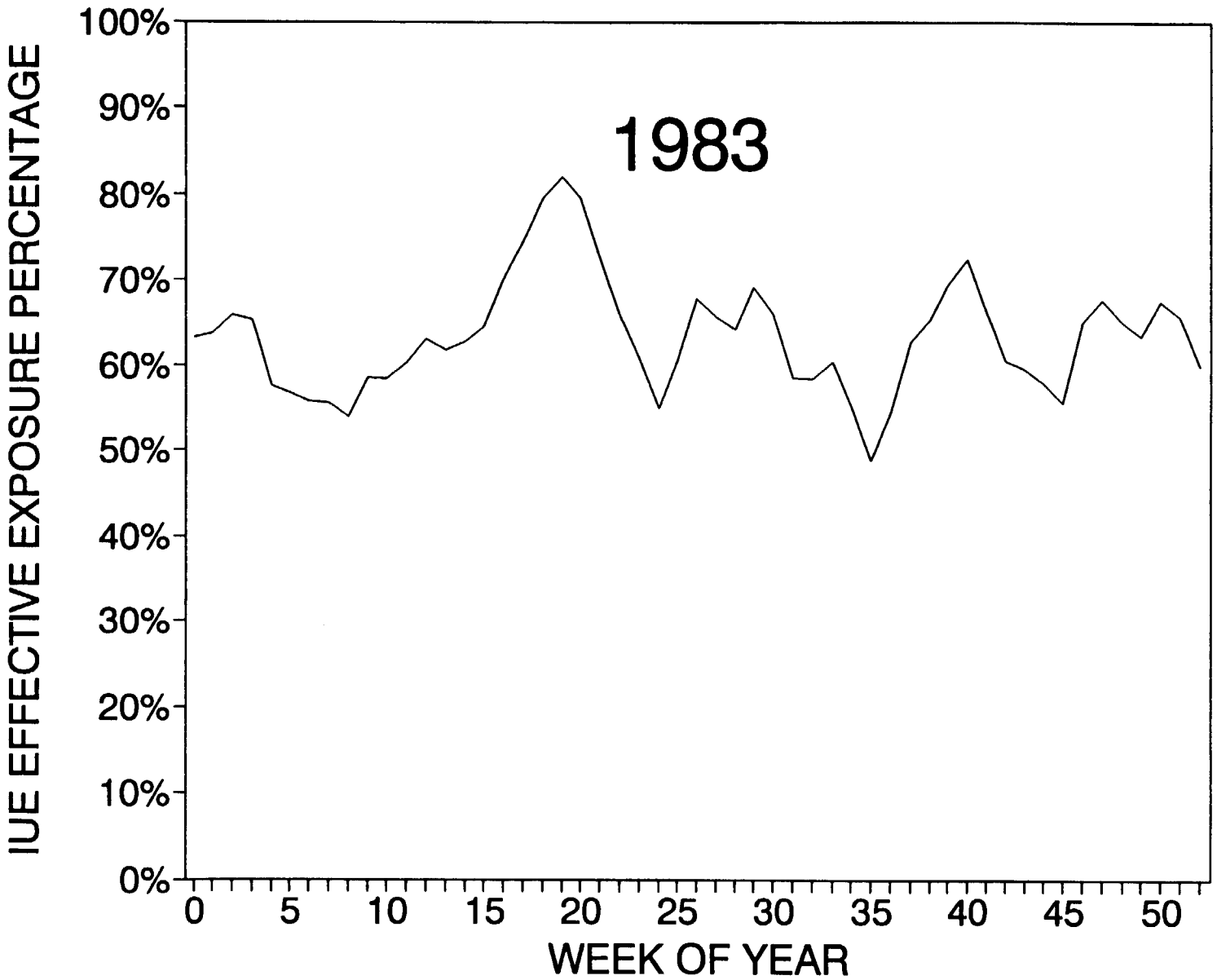

1978
START OF G.O. EPISODE 1
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

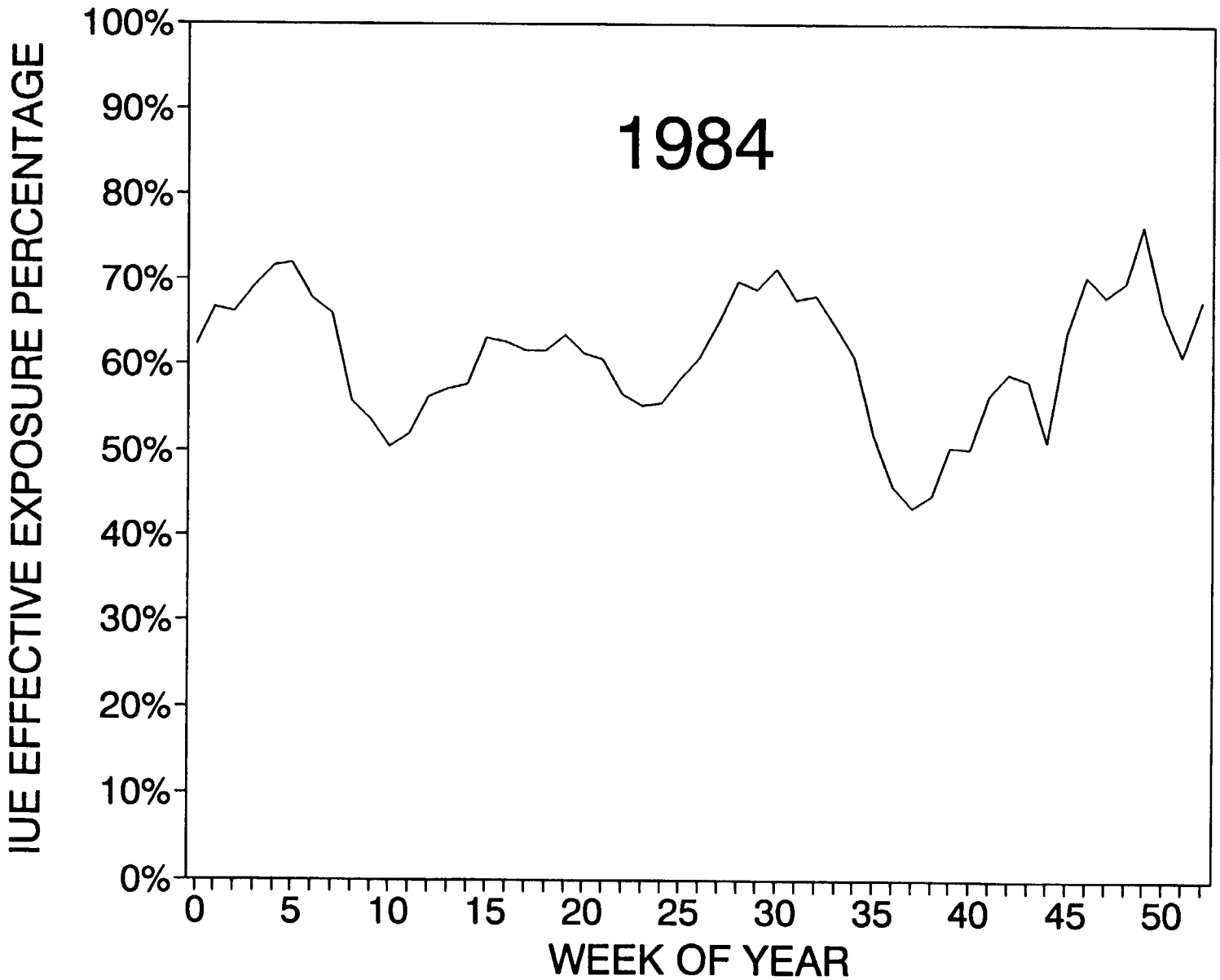

1979
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

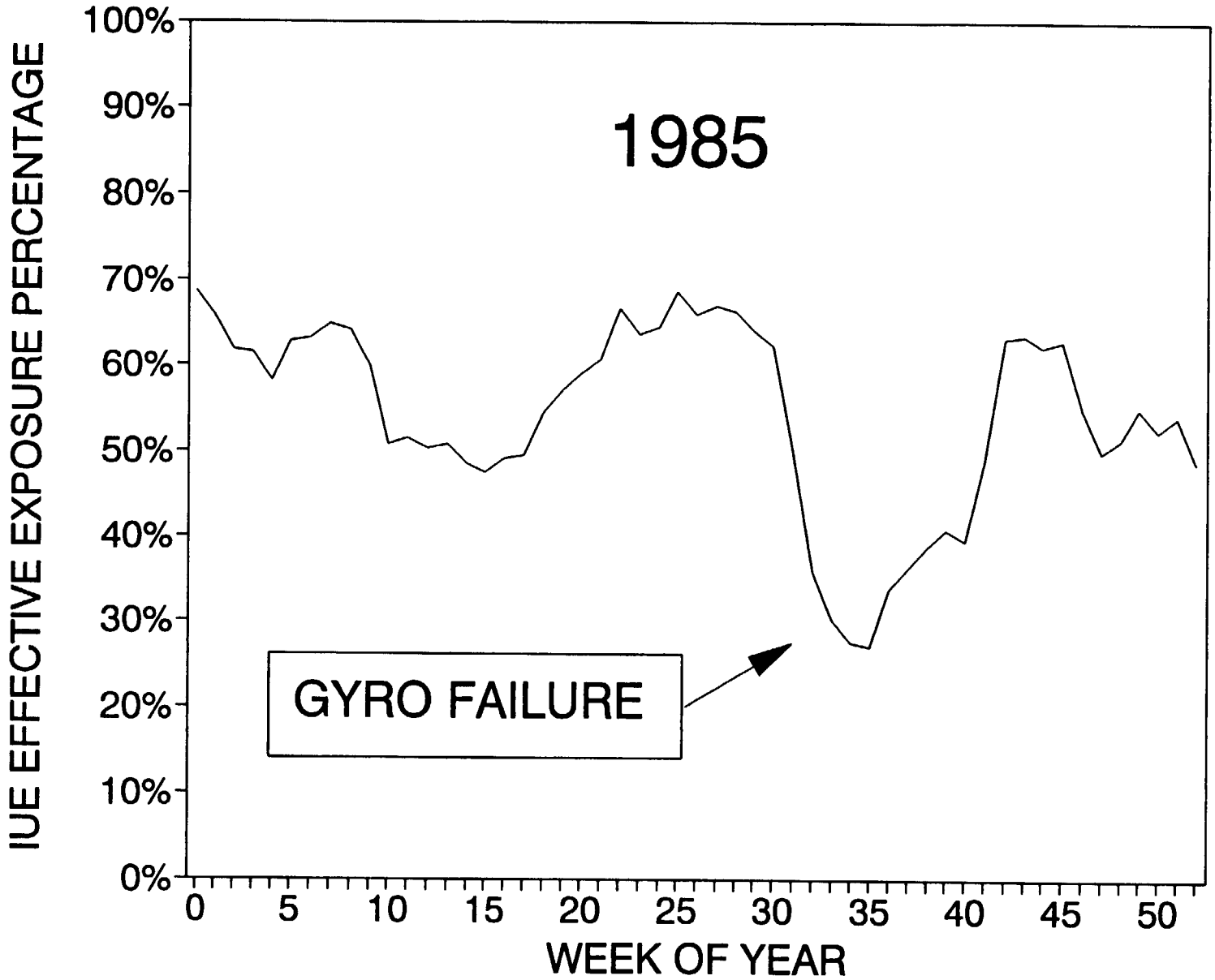

1980
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

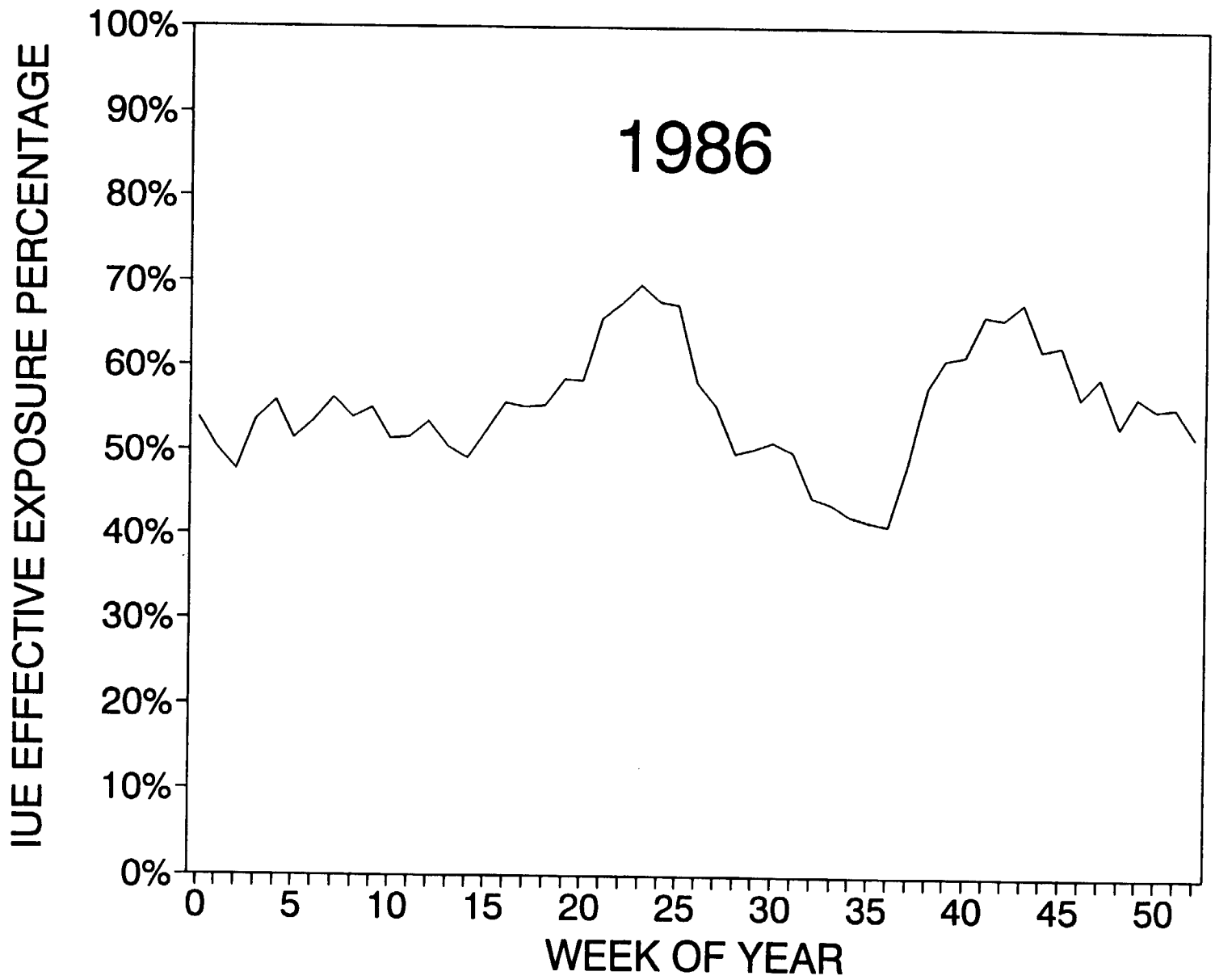

1981
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

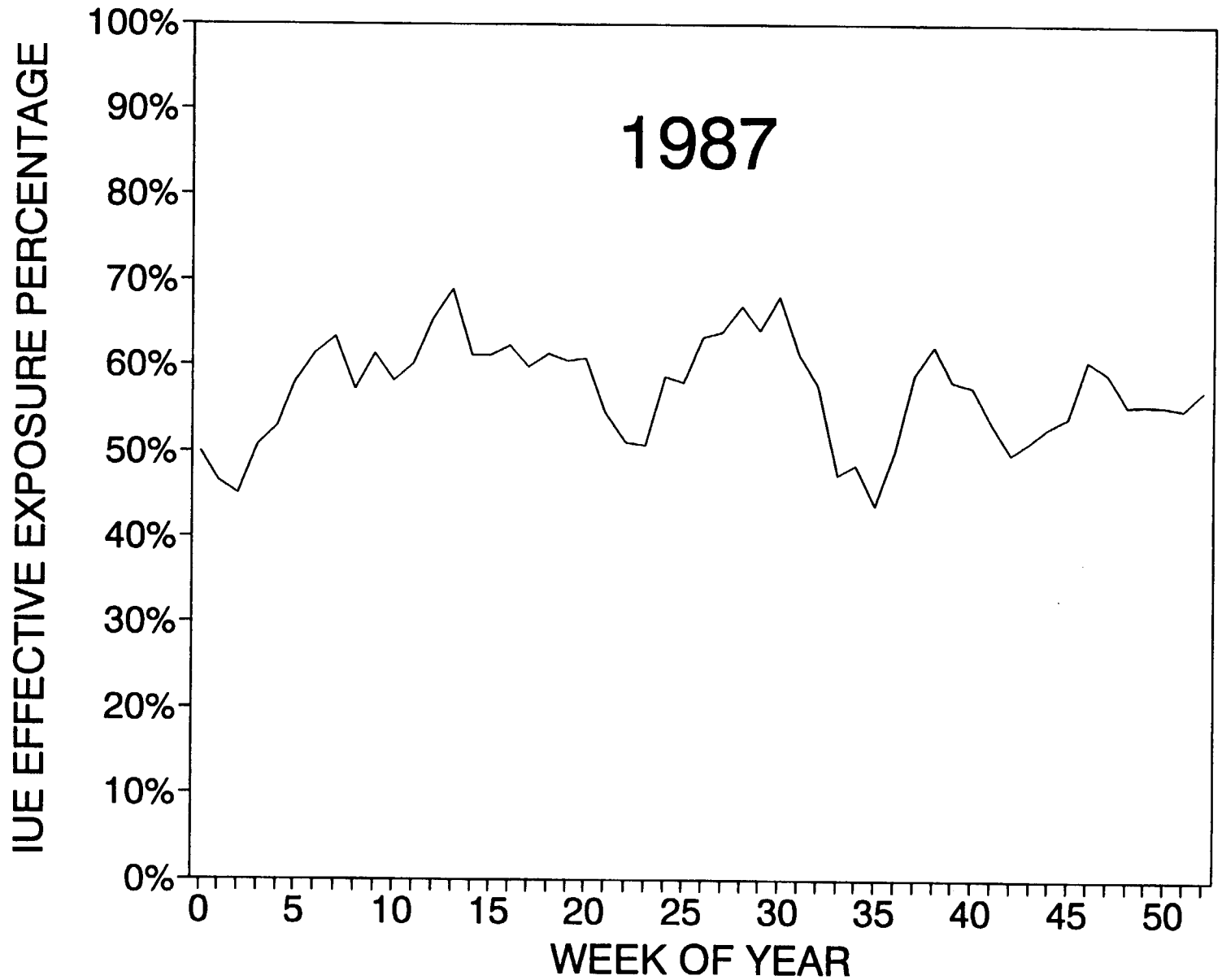

1982
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

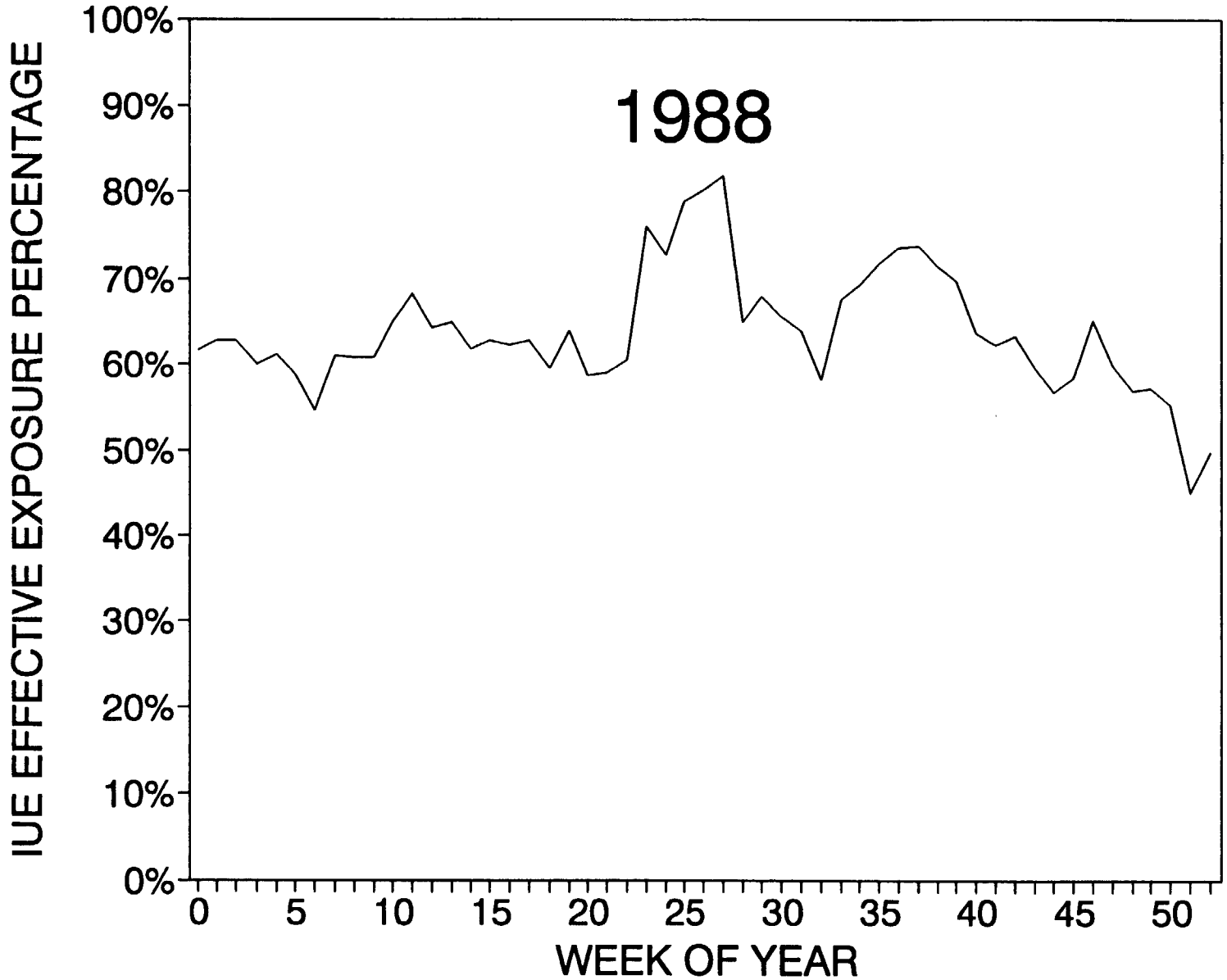

1983
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

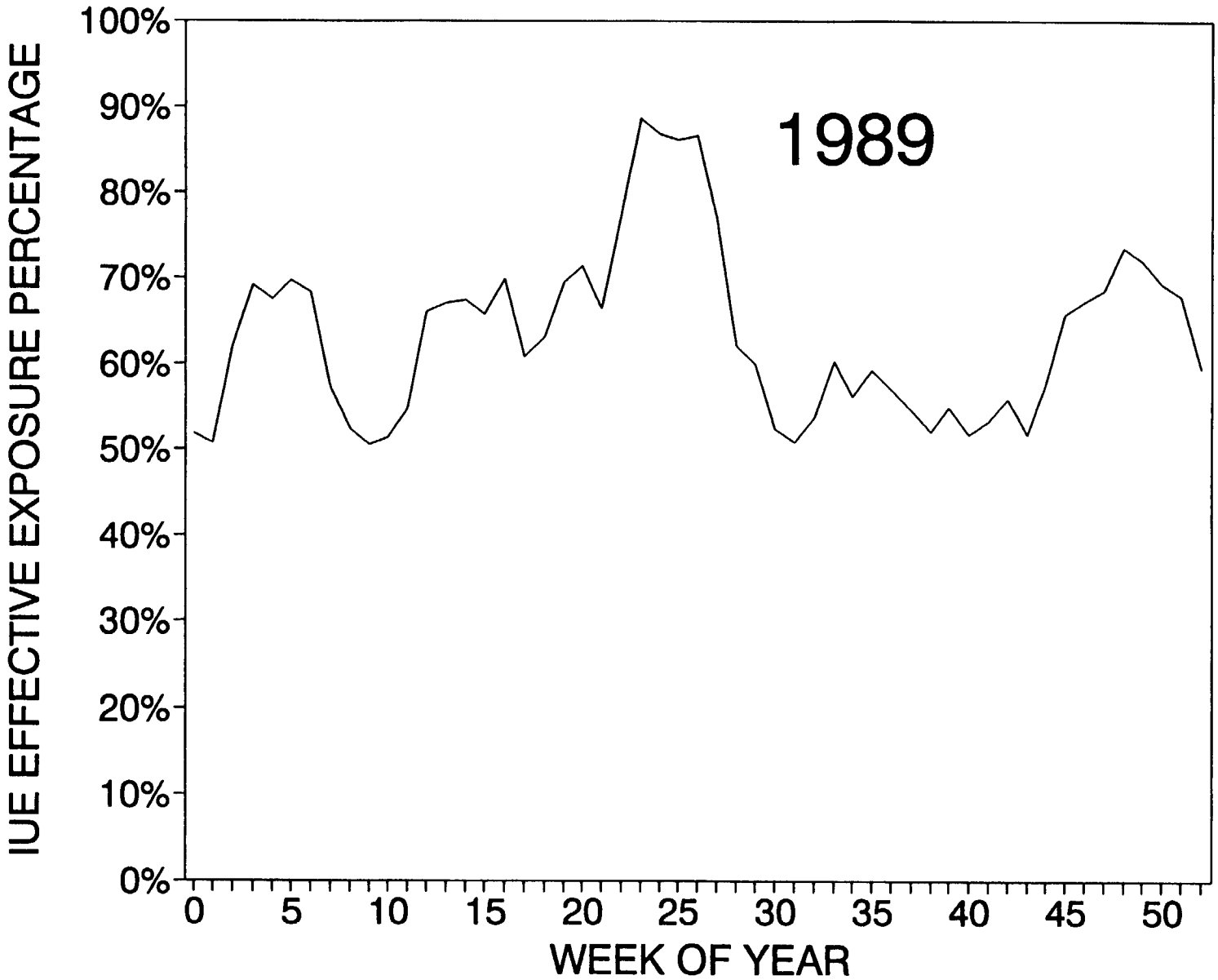

1984
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

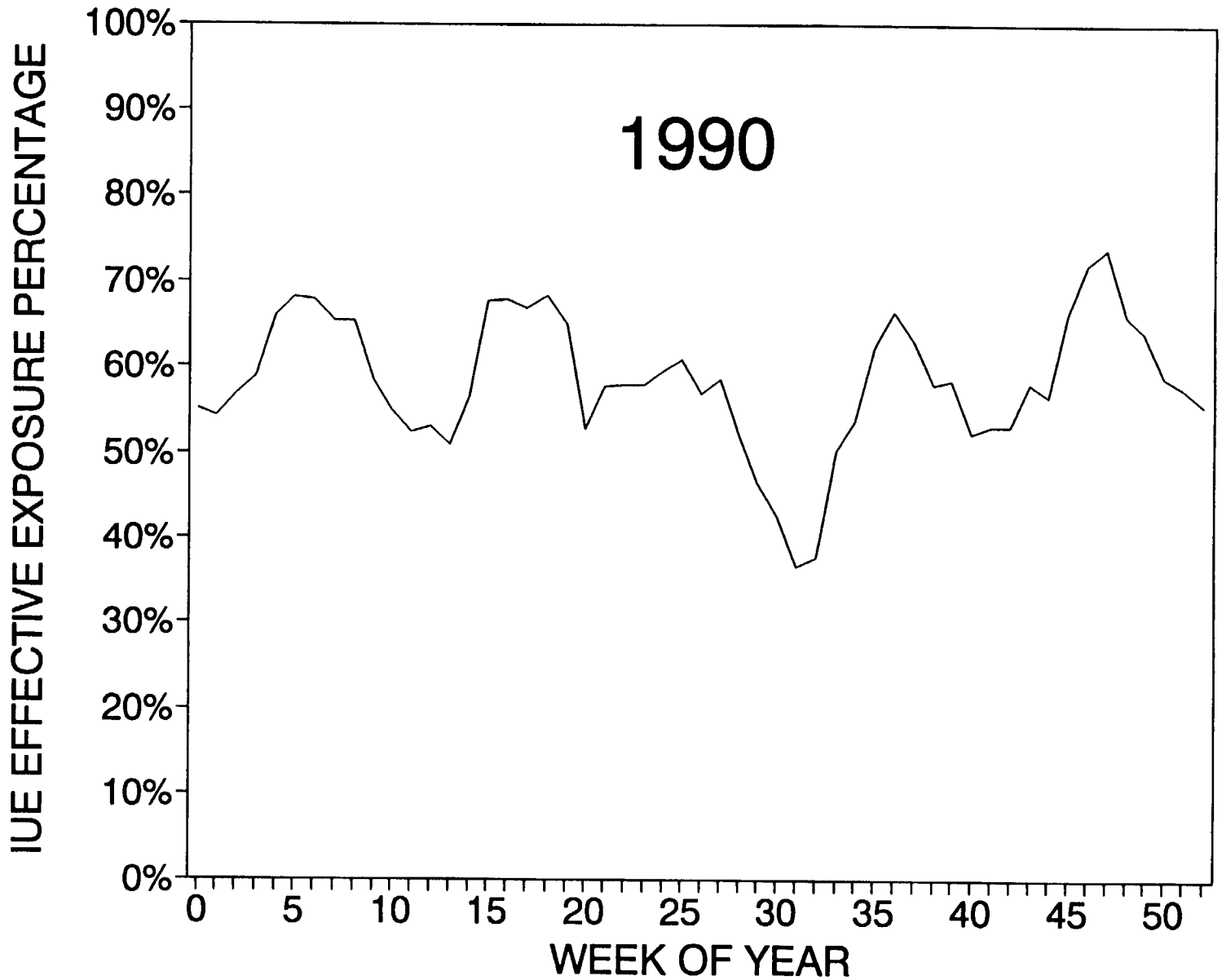

IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1985
GYRO FAILURE
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

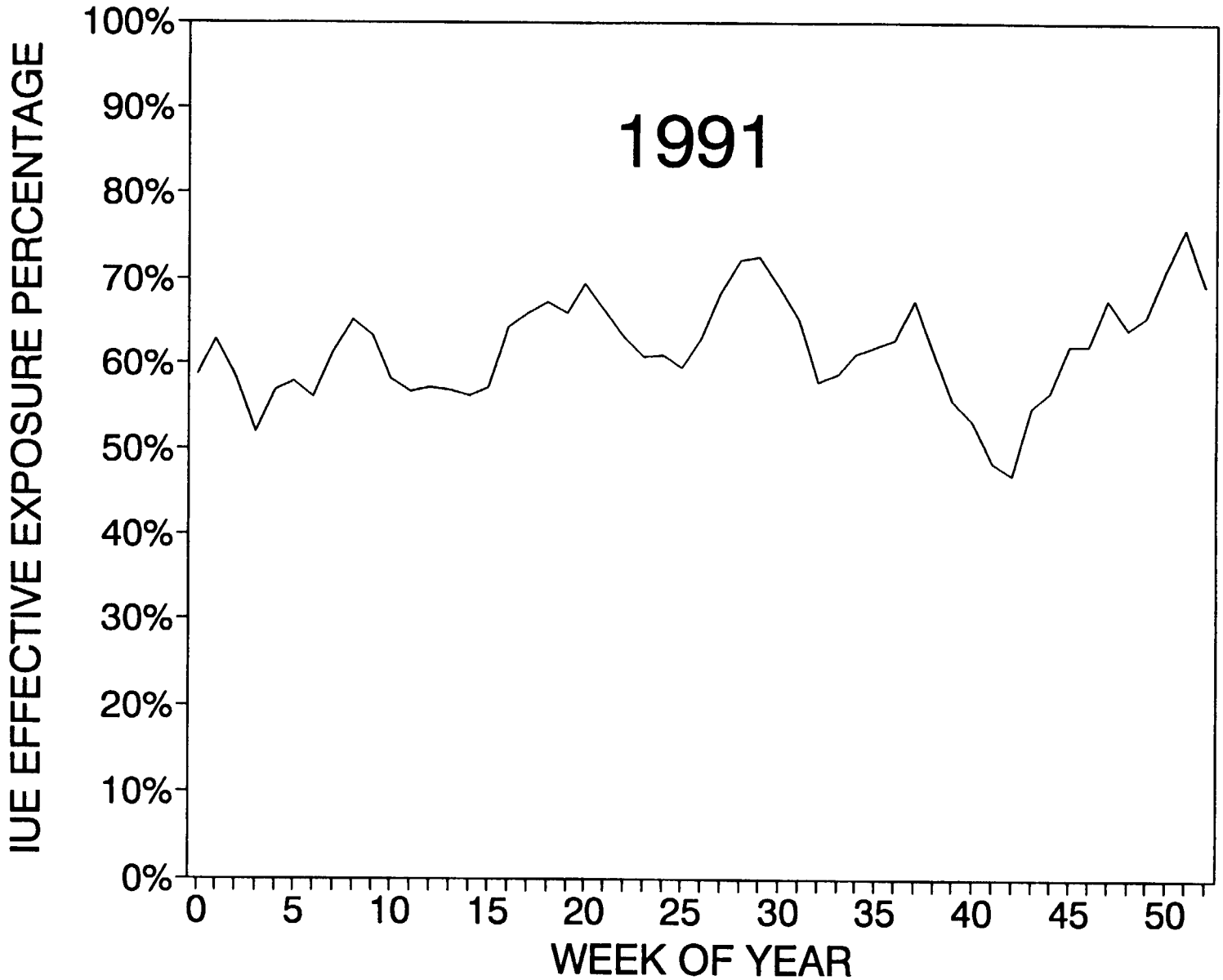

1986
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

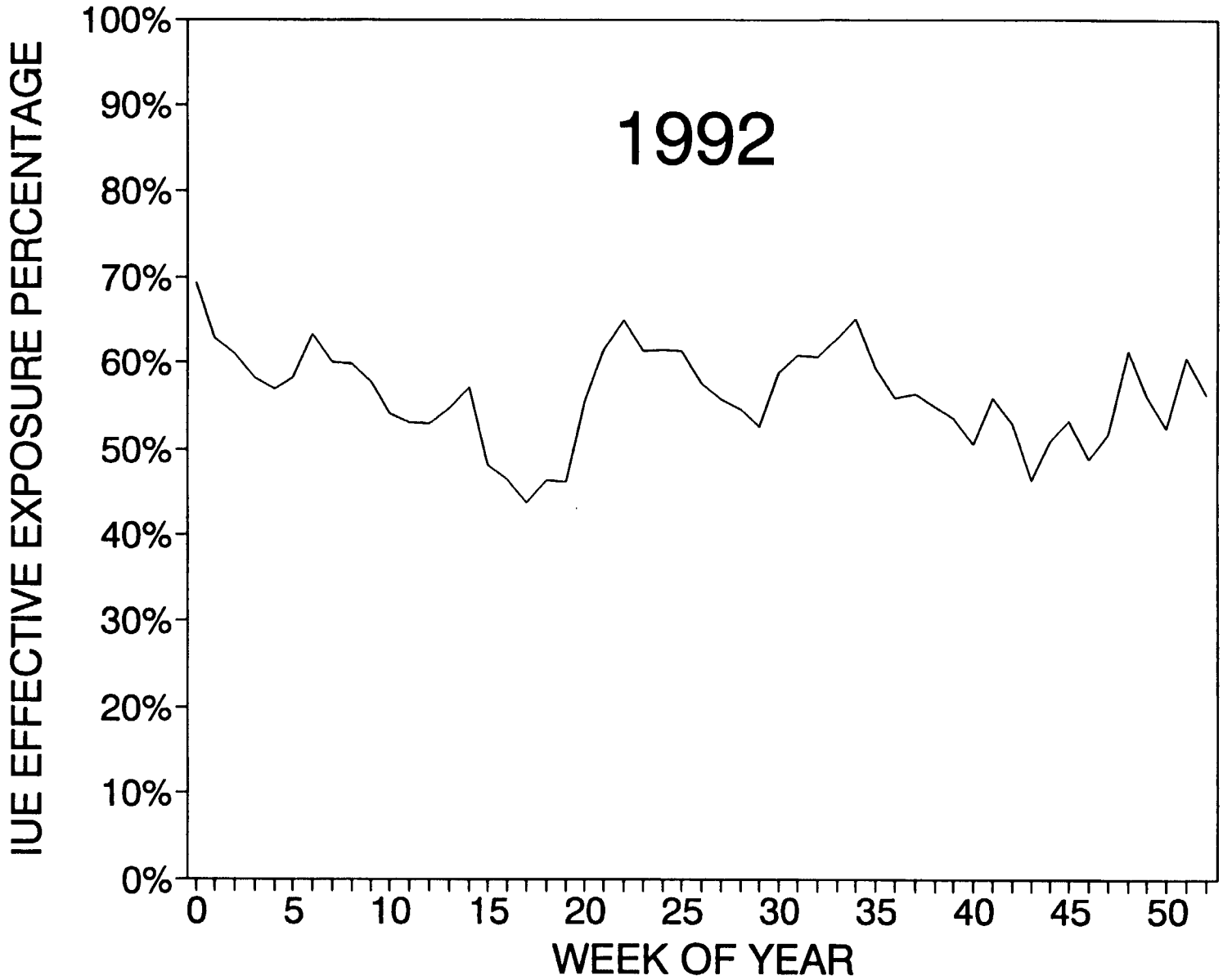

1987
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

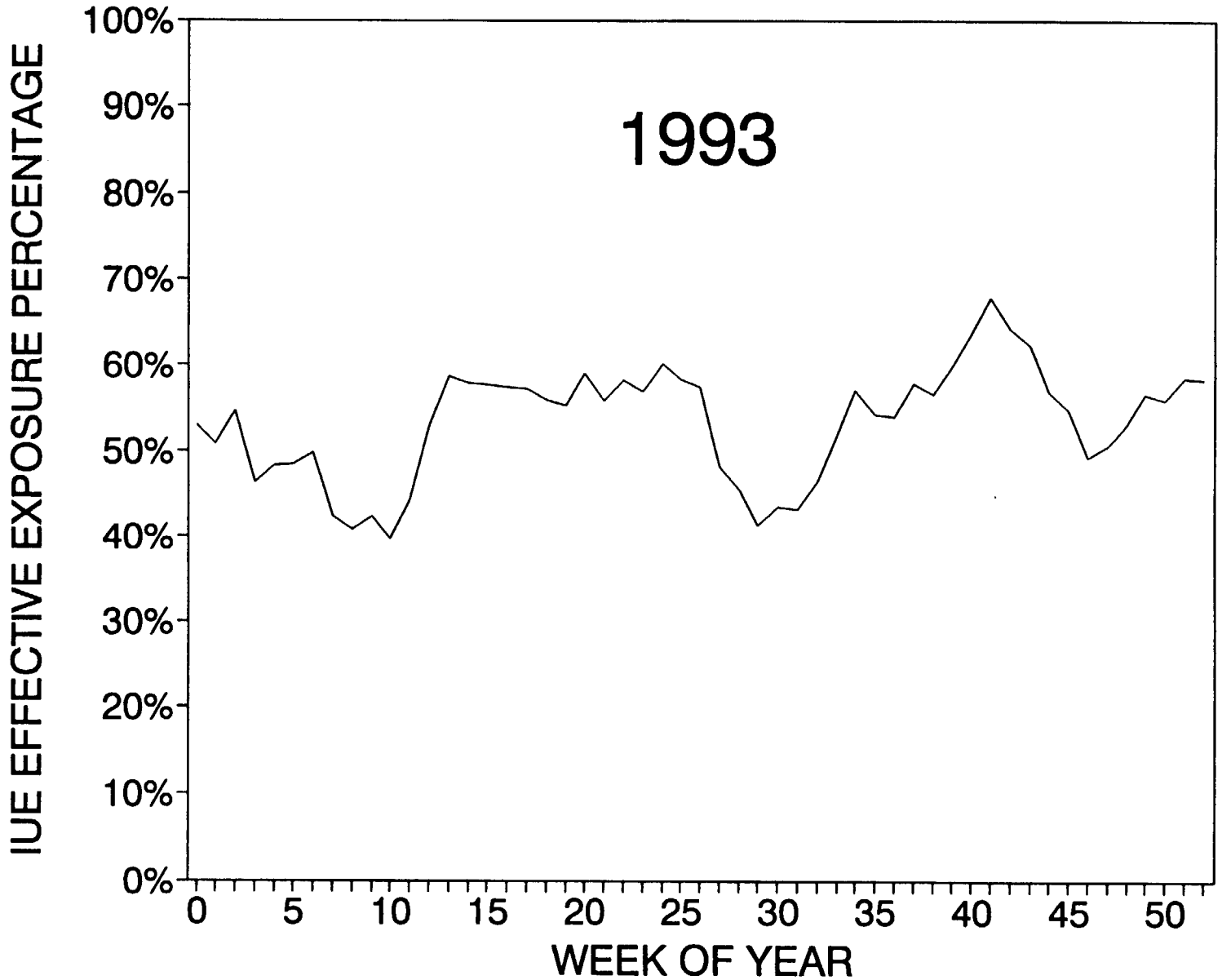

1988
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

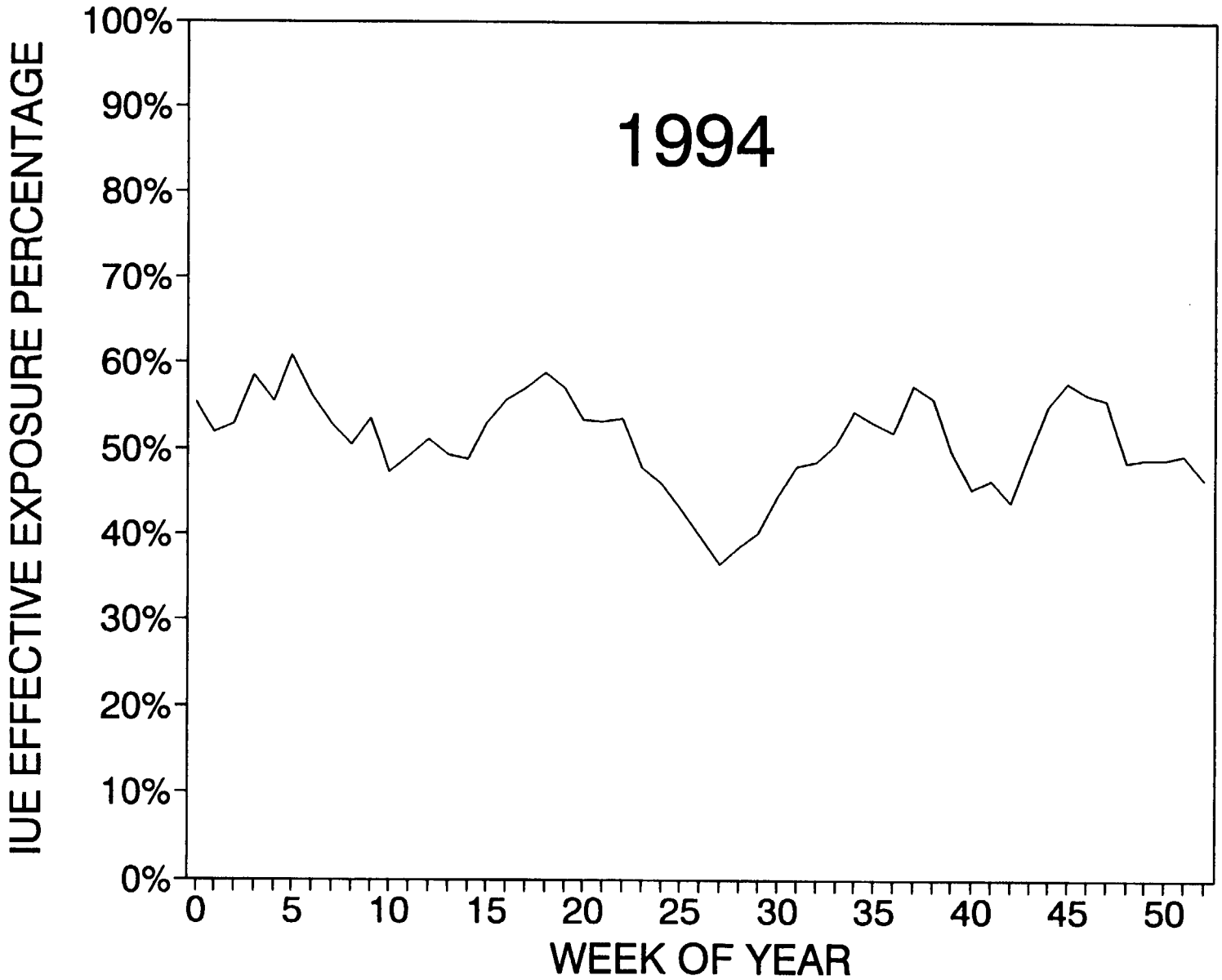

IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1989
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

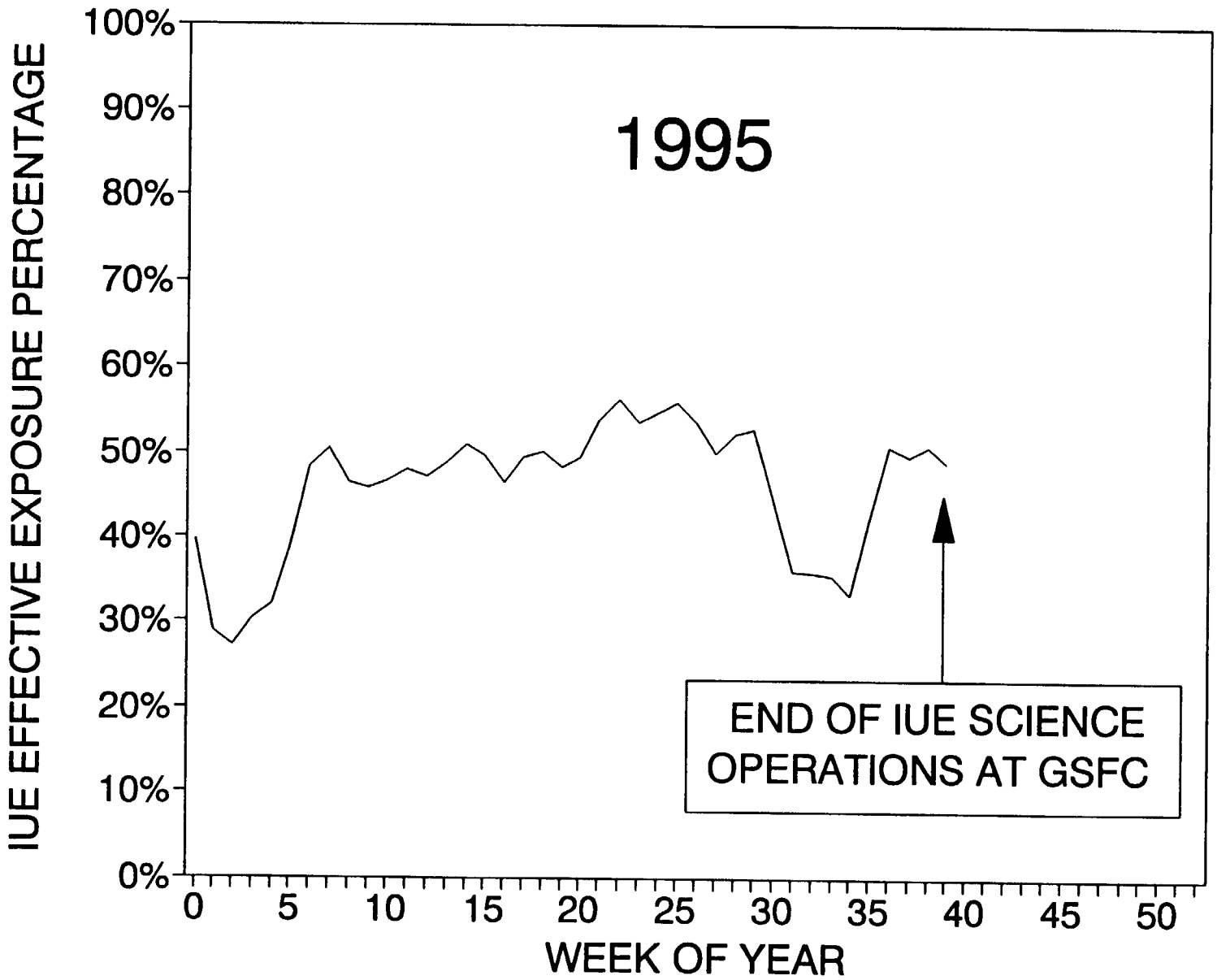

1990
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR


1991
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR


1992
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

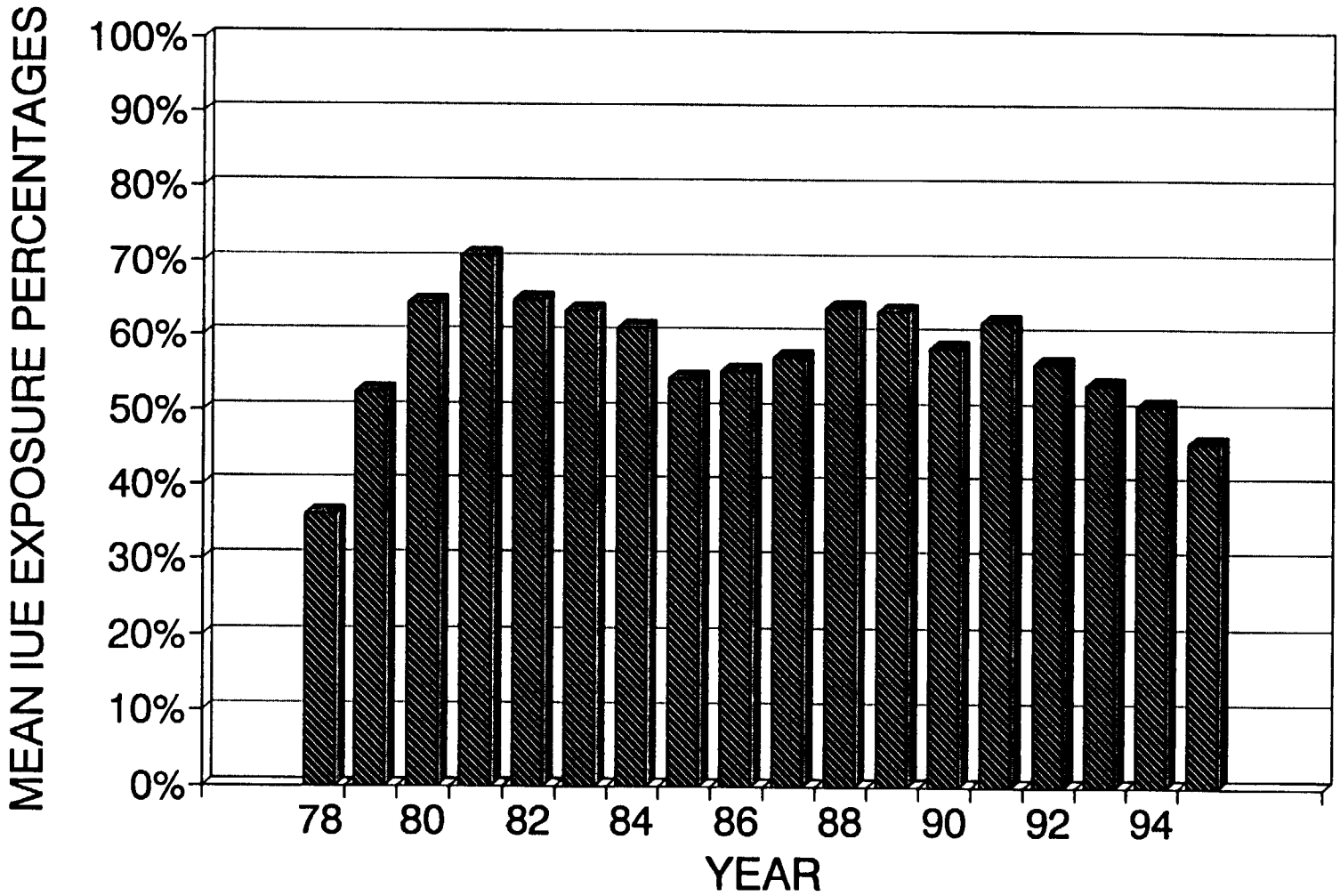

1993
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR


1994
IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR


IUE EFFECTIVE EXPOSURE PERCENTAGE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1995
END OF IUE SCIENCE
OPERATIONS AT GSFC
0
5
10
15
20
25
30
35
40
45
50
WEEK OF YEAR

OBSERVATORY SCIENCE EFFICIENCY

YEARLY GSFC MEANS



APPENDIX D - GSFC IUE DATA PRODUCTS SUMMARY

APPENDIX D - GSFC IUE DATA PRODUCTS SUMMARY

The following tables present summary statistics of IUE image acquisition and processing at GSFC as calculated from information obtained from the IUE data base. In both of the tables ("Summary of IUE Data Acquired at GSFC" and "Summary of IUE Data Processed at GSFC") data entries in the rows labeled "Since 8/27/91" represent activity associated with the current contract. For completeness, activity associated with earlier periods and Grand Totals are also shown. In these tables, separate columns are provided for low- and high-dispersion images from each of the four cameras (Short Wavelength Prime - SWP, Short Wavelength Redundant - SWR, Long Wavelength Prime - LWP, Long Wavelength Redundant - LWR) and for Fine Error Sensor (FES) images.

In the table "Summary of IUE Data Acquired at GSFC," note that the low-dispersion entries include nulls, floodlamp exposures, and other cases for which a dispersion is not specified. Also, note that the data for low-dispersion double-aperture images and images with multiple exposures in the large aperture are listed for completeness but have already been included in the general data for low-dispersion images presented at the top of the table.

The portion of the table "Summary of IUE Data Processed at GSFC" which is labeled "IUESIPS" refers to data processing/reprocessing accomplished using the various versions of the IUE Spectral Image Processing System (IUESIPS). The entries for "GO Tapes Produced" and "Archive Tapes Produced" are not dispersion-specific. The bottom portion, labeled "NEWSIPS," refers to IUE Final Archive processing, using the NEWSIPS software, accomplished during the current contract period. These NEWSIPS processing figures are also part of the data presented in the graph described below.

The graph entitled "NASA IUE Final Archive Processing" summarizes the status of images (for each of the various cameras and dispersion modes) in terms of processing, or readiness for processing, for the IUE Final Archive as of September 1, 1996. The category "Processed" denotes images that have completed NEWSIPS processing. The category "Data Ready" denotes images which are available for processing in that they have successfully undergone Core Item Data Verification (CDIV). The category "Data Questions" denotes images that have undergone CDIV but for which outstanding CDI questions remain to be resolved. The final category "Data Unverified" denotes images for which CDIV has not yet been attempted.

SUMMARY OF IUE DATA ACQUIRED AT GSFC

LOW DISPERSION IMAGES

	SWP	SWR	LWP	LWR	Total
Since 8/27/91	5935	0	4648	89	10672
Prior to 8/27/91	18299	31	9181	7691	35202
Grand Total	24234	31	13829	7780	45874

HIGH DISPERSION IMAGES

	SWP	SWR	LWP	LWR	Total
Since 8/27/91	3790	0	3059	32	6881
Prior to 8/27/91	9752	23	4921	5107	19803
Grand Total	13542	23	7980	5139	26684

FES IMAGES

Since 8/27/91	107
Prior to 8/27/91	938
Grand Total	1045

LOW DISPERSION DOUBLE-APERTURE IMAGES *

	SWP	SWR	LWP	LWR	Total
Since 8/27/91	349	0	469	2	820
Prior to 8/27/91	2093	2	737	1412	4244
Grand Total	2442	2	1206	1414	5064

* These images are included in the "LOW DISPERSION IMAGES" listing

LOW DISPERSION IMAGES WITH MULTIPLE EXPOSURES IN LARGE APERTURE *

	SWP	SWR	LWP	LWR	Total
Since 8/27/91	391	0	420	0	811
Prior to 8/27/91	1112	0	881	385	2378
Grand Total	1503	0	1301	385	3189

SUMMARY OF IUE DATA PROCESSED AT GSFC

IUESIPS

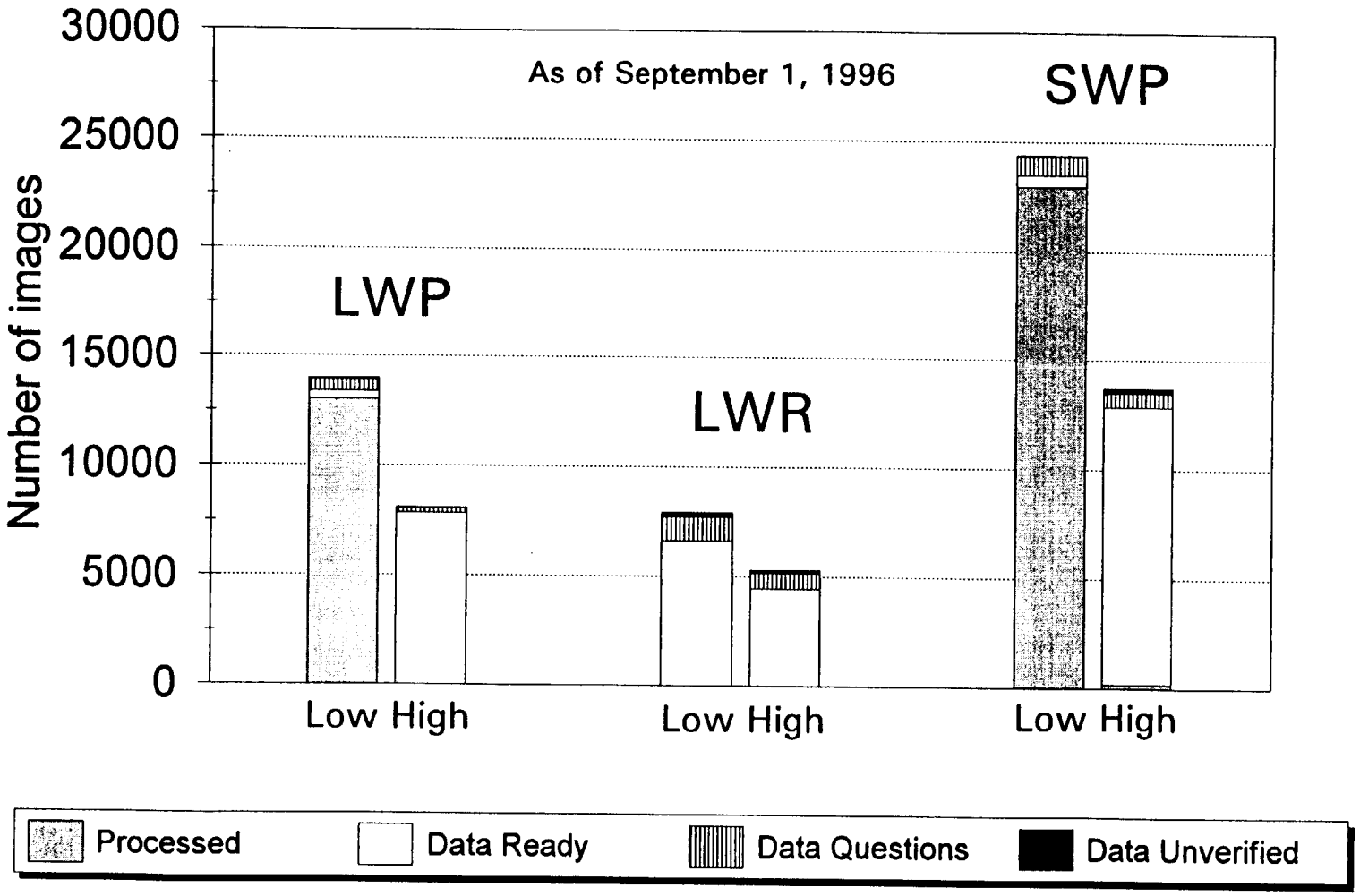
	LOW DISPERSION IMAGES					HIGH DISPERSION IMAGES					FES IMAGES
	SWP	*SWR*	*LWP*	*LWR*	*Total*	*SWP*	*SWR*	*LWP*	*LWR*	*Total*	
Since 8/27/91	6486	0	4686	422	11594	4572	0	3150	145	7867	112
Prior to 8/27/91	18855	31	9606	8132	36624	10471	25	5472	5784	21752	941
Grand Total	25341	31	14292	8554	48218	15043	25	8622	5929	29619	1053

	GO TAPES PRODUCED	ARCHIVE TAPES PRODUCED
Since 8/27/91	4288	1155
Prior to 8/27/91	16765	7768
Grand Total	21053	8923

NEWSIPS (AS OF SEPT. 1, 1996)

	LOW DISPERSION IMAGES					HIGH DISPERSION IMAGES				
	SWP	*SWR*	*LWP*	*LWR*	*Total*	*SWP*	*SWR*	*LWP*	*LWR*	*Total*
Total	22944	0	13036	0	35980	211	0	0	0	211

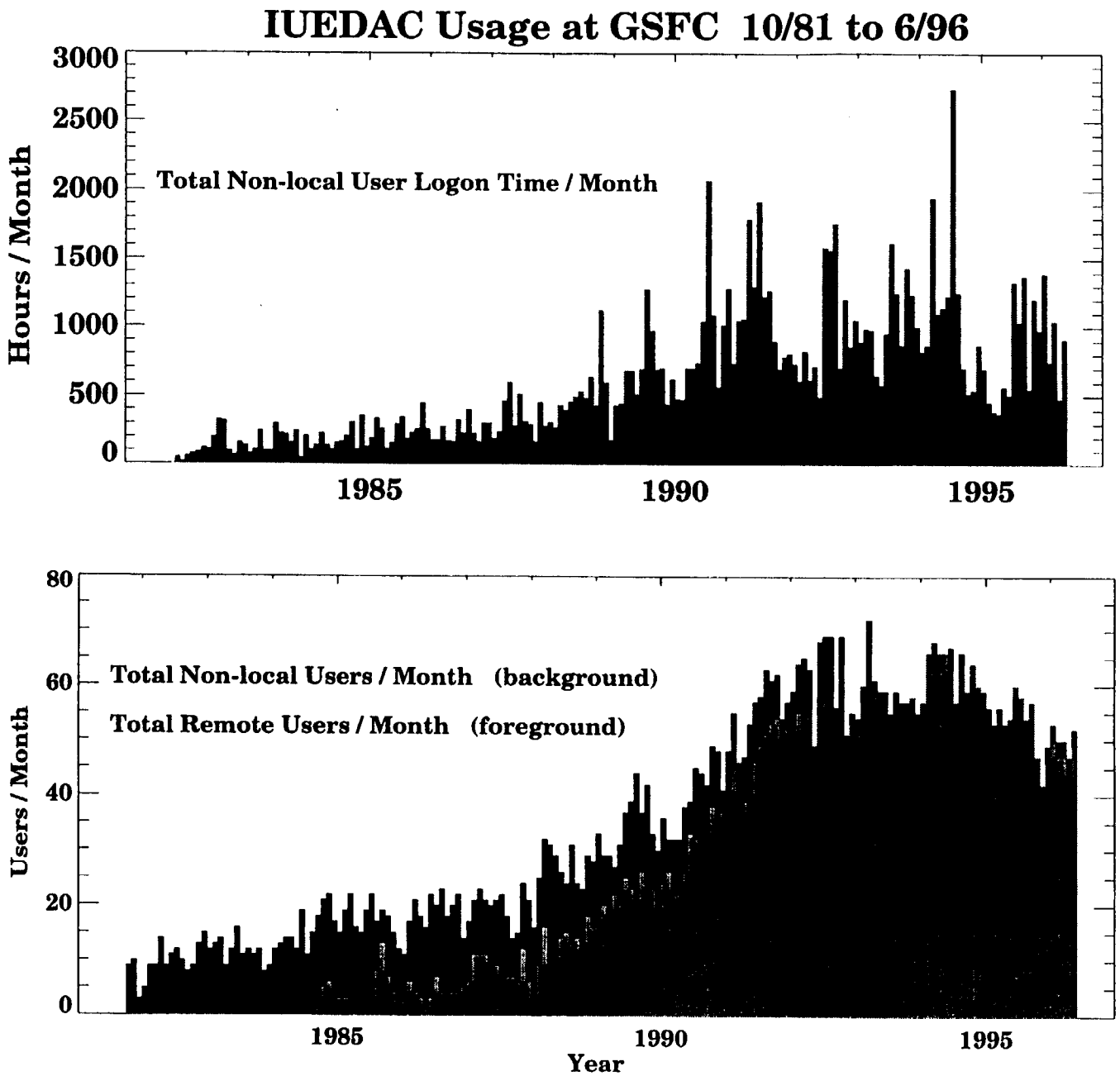
NASA IUE Final Archive Processing



APPENDIX E - GSFC IUEDAC USAGE

APPENDIX E - GSFC IUEDAC USAGE

The graphs presented herein show usage of the IUEDAC at GSFC over the period October 1981 to June 1996 in two ways. The upper panel plots the number of non-local-user logon hours per month. The bottom panel plots the total number of non-local users each month (black histogram in the background) as well as the number of users who accessed the GSFC IUEDAC remotely each month (gray histogram in the foreground). In cases where none of the black background histogram is visible, all of the non-local users were remote users.


IUEDAC Usage at GSFC 10/81 to 6/96
Hours / Month
3000
2500
2000
1500
1000
500
0
Total Non-local User Logon Time / Month
1985
1990
1995
Users / Month
80
60
40
20
0
Total Non-local Users / Month (background)
Total Remote Users / Month (foreground)
1985
1990
1995
Year

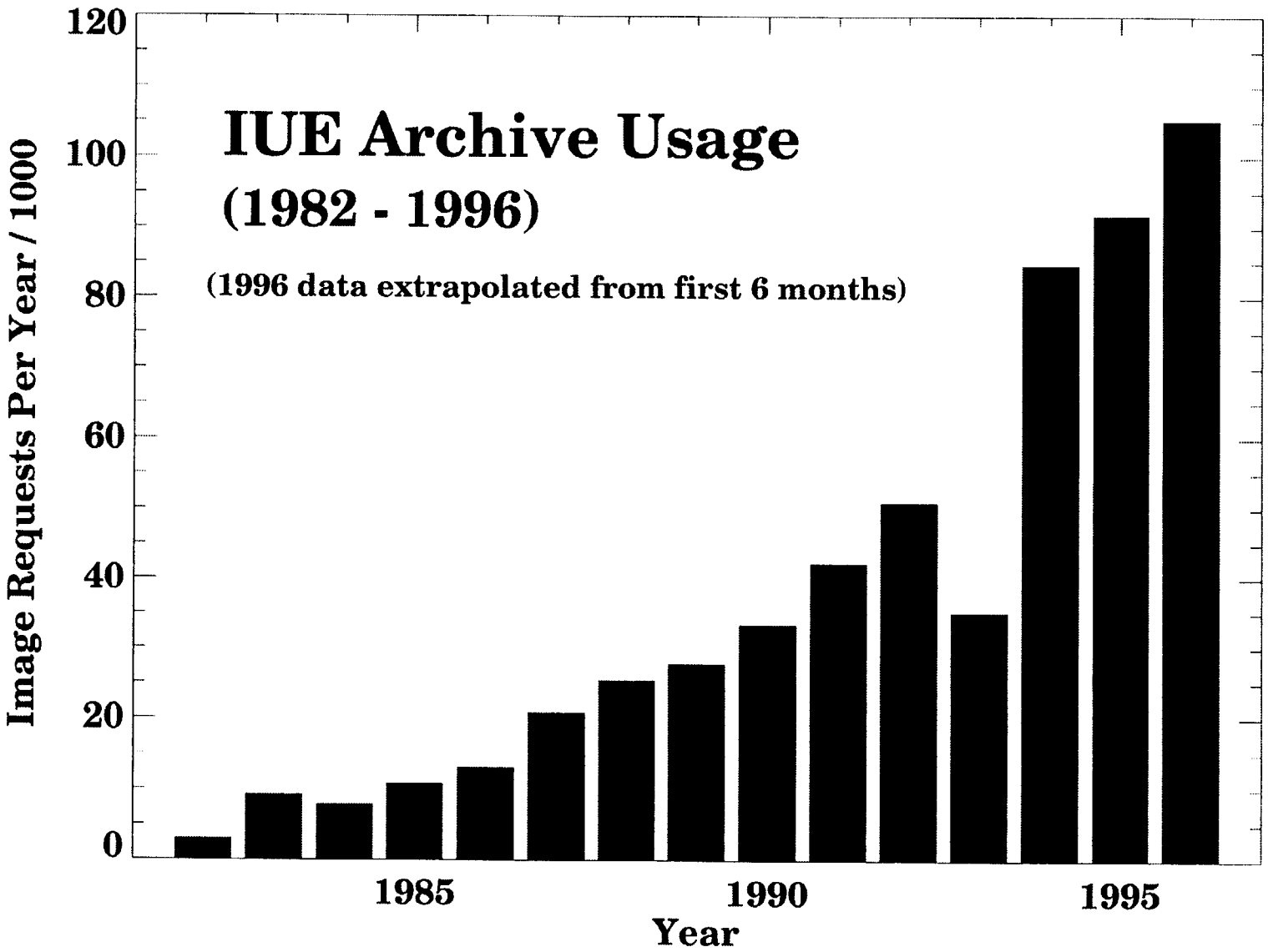
APPENDIX F - IUE ARCHIVE IMAGE REQUESTS

APPENDIX F - IUE ARCHIVE IMAGE REQUESTS

Since December, 1991, archived IUE data in the United States have been obtained primarily from an optical disk jukebox system maintained by the Space Science Data Operations Office (SSDOO), known as the NASA Data Archive and Distribution Service (NDADS). Prior to this date, most data was requested from a magnetic tape archive maintained by the National Space Science Data Center (NSSDC) on an IBM computer at Goddard Space Flight Center (GSFC). (Note that this archive has still been maintained on an IBM 9021 computer by the IUE project.) A tape archive was also available at the IUE Regional Data Analysis Facility in Boulder, Colorado; however, this facility however was closed in September, 1992. The data shown are based on the total number of requests from these three archives. Note that since the end of 1992, archive usage has been determined solely from the "number of entry ID's" statistics provided by SSDOO.

Archived data are accessed by several groups including the SSDOO, the IUE Data Analysis Center (IUEDAC), the IUE Image Processing Center (IPC), and various local and remote users. Because of increasing difficulty in distinguishing requests from these various groups, the statistics have been combined. The requests by IPC, which are primarily requests for raw image files, are included in the access statistics and represent both user requests for reprocessed data and data requests for Final Archive processing.

The attached bar graph shows the number of images (not data files) requested in the United States each year since July, 1982. The 1996 total was extrapolated from the requests made during the first 6 months of this year (i.e., the 6-month total was simply multiplied by 2 to approximate the yearly total). The results show that the demand for archived IUE data in the United States has been higher than ever before. Since July 1982, over 500,000 IUE images have been requested. The average request rate for the first half of 1996 has been more than 8,000 images per month.


IUE Archive Usage
(1982 - 1996)
(1996 data extrapolated from first 6 months)
Image Requests Per Year / 1000
120
100
80
60
40
20
0
1985
1990
1995
Year

APPENDIX G - IUE RESEARCH INSTITUTION STATISTICS FROM PROPOSER DATA BASE

APPENDIX G - IUE RESEARCH INSTITUTION STATISTICS FROM PROPOSER DATA BASE

The following table list the current and previous research institutions which have sponsored IUE Principal Investigators (PIs) for NASA* IUE observing programs. The table is arranged alphabetically by institution name (foreign institutions are cited by country only). The time period covered is April, 1978, through September, 1996 (IUE Observing Episodes 1 through 19). The numerical entries in the columns corresponding to each episode represent the number of accepted programs sponsored by the various institutions during that episode. The total numbers of programs for each institution over all 19 episodes are also listed, in the last column.

* *Note: During IUE Episode 19, NASA and ESA/PPARC programs were conducted in a combined manner from the VILSPA ground station. The statistics available for this episode and entered into this table therefore reflect both US and European Episode-19 programs; entries for Episodes 1-18 reflect only US programs.*

IUE RESEARCH INSTITUTION STATISTICS: OBSERVING PROGRAMS 1978 - 1996

NON US	INSTITUTION / COUNTRY	EP 1	EP 2	EP 3	EP 4	EP 5	EP 6	EP 7	EP 8	EP 9	EP 10	EP 11	EP 12	EP 13	EP 14	EP 15	EP 16	EP 17	EP 18	EP 19	TOTAL
	A.A.T.	1																			1
	AEROSPACE CORPORATION						1			1	1				1						4
	AIR FORCE SP.						1														1
	APPLIED RESEARCH CORPORATION							2	2	6	4	4	2	2	1	3	4	2	2	2	36
	ARECIBO OBSERVATORY							1								1					2
***	ARGENTINA	1				1					1			1							4
	ARIZONA STATE UNIVERSITY			1	1	1	1	2	3	4	3	5	3	4	6	3	4	4	2		47
	ARS				1																1
***	AUSTRALIA										1										1
***	AUSTRIA		1		1	1															3
	BALL STATE UNIVERSITY																2				2
	BOSTON UNIVERSITY									1											1
	BOWLING GREEN UNIVERSITY			1		1	1	2		1											6
***	BRAZIL															1				1	2
	BRIGHAM YOUNG UNIVERSITY			1																	1
	CAL TECH	3	8	6	5	5	6	2	1		1										37
	CAL TECH - JPL	1	4	4	4	3	1	1	3												21
***	CANADA	4	8	6	4	6	3	3	3	1	2	4	4	4	4	1	2	2	3	1	65
	CARNEGIE INSTITUTE				1																1
	CASE - WESTERN RESERVE				1	2	1														4
	CATHOLIC UNIVERSITY						3	4	6	3	3	3	2	5	3	3	3	1	3	2	44
	CLEMSON UNIVERSITY					1															1
	COLUMBIA UNIVERSITY	1								5	5		2	2	2	2	1	1	1	1	23
	COMPUTER SCIENCES CORPORATION		8	7	10	14	19	15	19	14	13	18	12	16	11	11	11	4	11	2	215
***	CZECHOSLOVAKIA																			2	2
	DARTMOUTH COLLEGE						1	1	2	2	1			1							8
	DOE/NM - LANL			1	1	1		2	1	1		3	3		1	1				1	16
	ELEC-MAG-APS.				1																1
	FLORIDA INTERNATIONAL UNIVERSITY																		1	1	2
***	FRANCE																			14	14
	FRANKLIN & MARSHALL COLLEGE							1													1
	GEORGE MASON UNIVERSITY				1	1	3	1		1	2	1		1	2						13
	GEORGIA STATE UNIVERSITY					1	1	1		1			1			1	1		2	1	10
***	GERMANY	1		1																21	23
	HARVARD CFA - SAO	3	10	12	13	16	16	18	13	9	10	10	7	12	11	9	8	3	1		181
	HARVARD COLLEGE OBSERVATORY																		1		1
	HARVARD UNIVERSITY														1			1			2
	HOWARD UNIVERSITY	1	1	1	1				4												8
	HUGHES - STX										2	1	1		1		3		3	1	12

IUE RESEARCH INSTITUTION STATISTICS: OBSERVING PROGRAMS 1978 - 1996

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	IMAD-AD-DEAN, INC.						1	1		2		1									5
***	INDIA						1													1	2
	INDIANA UNIVERSITY				1	1	2	2	6	4	3	3	4			1			1		28
	INST ASTRONOM										1										1
	INSTITUTE FOR SPACE OBSERVATION										1					1				1	3
	IOWA STATE UNIVERSITY				1	1			1	2	1		2	1	2	2	2				15
***	ISRAEL		1																	1	2
***	ITALY																			11	11
***	JAPAN	1			1	2		1	1											1	7
	JOHNS HOPKINS UNIVERSITY	1	6	5	3	4	4	6	7	6	7	8	5	5	6	4	5		1	2	85
	LEHIGH UNIVERSITY		1	1	1	1	1	1	1		2					1					10
	LOCKHEED - PARL	1		1	1		3	1	1					1							9
	LOUISIANA STATE UNIVERSITY			1	2	3	3	2		2	1	2	2	3		3	2		2		28
	LOWELL OBSERVATORY													1							1
	LUNAR & PLANETARY INSTITUTE																			1	1
***	MEXICO	1	1	2			1		1	1	2	1		1	1	2	2		2	2	20
	MICHIGAN STATE UNIVERSITY							1		1											2
	MIDDLEBURY COLLEGE									1		1		1							3
	MIT			2	2	1	1			1	2		1	1			1	2	2		16
	NASA - AMES							1						1							2
	NASA - GSFC	17	15	10	12	12	15	14	11	8	10	5	10	13	6	15	8	3	7	3	194
	NASA - JSC	2																			2
	NASA - MSFC							1	2	1	1	1									6
	NAVAL RESEARCH LABORATORY		2				1														3
	NEW YORK UNIVERSITY		1	2	2	2	2	2	2												13
	NM INSTITUTE OF TECHNOLOGY							1	1		1	1	3								7
	NO SPONSOR			1																	1
	NORTHWESTERN UNIVERSITY												2	2	1	2					7
***	NORWAY																			1	1
	NSF - NOAO - KPNO		1				1	2	3	2	3	1	2	3	1	1					20
	NSF - NOAO - NSO							3	2	1	1										7
	NSF - NOAO - SAC PEAK						1														1
	NSF - NRAO						1														1
	NSF HAO - NCAR							1									1				2
	OHIO STATE UNIVERSITY	1	1	5	1		2			1	2			1	1	1		1	1	1	19
	PENN STATE UNIVERSITY			1	2	2	3	2	2	3		1		1	2	1					20
	PLANETARY SCIENCE INSTITUTE																1			2	3
	PRINCETON UNIVERSITY	1	1	2	3	2	1	1	1	1		1									14
	RICE UNIVERSITY		1	1		2	1	2	2	2	2	1	2	1	1		1				19

IUE RESEARCH INSTITUTION STATISTICS: OBSERVING PROGRAMS 1978 - 1996

NON US	INSTITUTION / COUNTRY	EP 1	EP 2	EP 3	EP 4	EP 5	EP 6	EP 7	EP 8	EP 9	EP 10	EP 11	EP 12	EP 13	EP 14	EP 15	EP 16	EP 17	EP 18	EP 19	TOTAL
	RUTGERS UNIVERSITY			1	1																2
	S M SYSTEMS				1		1		1												3
	SASC			1	1					1											3
	SETS, INC.													1							1
	SOUTHWEST RESEARCH INSTITUTE															1	2				3
***	SPAIN																			14	14
	SRI ASSOCIATES																	1			1
	ST SCI							2	3	7	3	7	6	5	4	6	5	2	3	2	55
	STANFORD UNIVERSITY		1	1	1																3
	SUNY - OSWEGO													1							1
	SUNY - STONY BROOK	1	1	1	1	1	3	1	3	1	1	2	1	1			2	1		2	23
***	SWITZERLAND																			5	5
	TENNESSEE STATE UNIVERSITY - CEIS												1	2	3	2	4		3		15
	THE CITADEL		1		1		1	2	1						2		1			2	11
***	THE NETHERLANDS																			6	6
	TUFTS UNIVERSITY							1	1												2
	U ALABAMA												1	1		1					3
	U ARIZONA	2	2	2	5	3	8	7	8	8	9	10	6	2	2	3	4	1	2		84
	U CHICAGO		1	1		1	4	5	7	4	3	2	4	2	1	1	1				37
	U CINCINNATI														1						1
	U COLORADO	2	6	10	17	17	25	30	30	39	42	29	18	23	12	14	11	4		2	331
	U DELAWARE		1	1	1		3	1	3		1			1	1		2				15
	U DENVER		1														2	1	1	1	6
	U GEORGIA					1	1	1				1	1	1							6
	U HAWAII			1	2	5	3	4	3	3		3	3	4	3	2	3				39
	U ILLINOIS		1	1	1	2	2	1		1	1	3		1		1	2		2		19
	U IOWA											2								1	3
	U KANSAS														1				1		2
	U KENTUCKY					1	1	1	1												4
	U MARYLAND		4	2	3	3	2	3	4	3	2	1	1	1	1	1	1		1	3	36
	U MASSACHUSETTS								1												1
	U MICHIGAN		1			2	3	1	1	1	1	4	3	4	3	2	3	2	2		33
	U MINNESOTA		1	2	3	3	2	2	1					1	2						17
	U MISSOURI - ST. LOUIS					1	1	1													3
	U MONTANA	1																			1
	U NEBRASKA		1	1		1				2											5
	U NEVADA															1					1
	U NEW ORLEANS													1							1
	U NORTH CAROLINA							1								1					2

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NON US	INSTITUTION / COUNTRY	EP 1	EP 2	EP 3	EP 4	EP 5	EP 6	EP 7	EP 8	EP 9	EP 10	EP 11	EP 12	EP 13	EP 14	EP 15	EP 16	EP 17	EP 18	EP 19	TOTAL
	U PENNSYLVANIA			1									1		1	1	1		1		6
	U PITTSBURGH		1	1		1	1	1	1				1		2	1	2				12
	U ROCHESTER			2	1			1													4
	U TEXAS	4	3	2	3	4	2	1	3		2	1	1	1	1	3					31
	U TOLEDO		1	2	2	3	2	2	2	1	1	2	3	2			2				25
	U VIRGINIA			1		2		2		1	1	2		1	1						11
	U WASHINGTON	1	3	4	4	8	13	11	9	7	8	14	5	5	4	4	4	1	3	2	110
	U WISCONSIN	2	7	4	4	3	7	6	5	4	2	4	2	4	3	2	3		1		63
	UC BERKELEY		1	3	4	4	7	2	5	1		1	3	4	3	2	2		1		43
	UC DAVIS									2											2
	UC LA	1	3	3	3	2	2	4	4	8	3	6	1	5	1	3			2		51
	UC SAN DIEGO			2	3	3	2	1								1	1				13
	UC SANTA CRUZ		1		3		1	1							1						7
***	UNITED KINGDOM												1							19	20
	USC		2	1	2			2	1	4	2	4	3	3	1	1	1	2	4	2	35
	USRA															2	1		4	3	10
***	USSR	1	1																		2
	VALPARAISO UNIVERSITY										1	1									2
	VANDERBILT UNIVERSITY				2	1		1	1	2	1		1								9
	VILLANOVA UNIVERSITY		1		1	1	4	1	3	3	2	4	7	4	7	5	8	2	3	1	57
	WASHINGTON STATE UNIVERSITY		1	1				1	1												4
	WELLESLEY COLLEGE							1										1		1	3
	WESLEYAN UNIVERSITY							1						1	1						3
	WESTERN CONNECTICUT						1														1
	WESTERN KENTUCKY	1	1	1		1															4
	WHEATON COLLEGE		1		1	1	1	1	1	1	1		1		2						11
	YALE UNIVERSITY						1														1
	TOTALS	57	120	128	148	162	207	205	205	193	176	179	145	166	129	131	130	42	80	143	2746

APPENDIX H - IUE PRINCIPAL INVESTIGATOR STATISTICS FROM PROPOSER DATA BASE

APPENDIX H - IUE PRINCIPAL INVESTIGATOR STATISTICS FROM PROPOSER DATA BASE

The following table lists the number of NASA* IUE observing programs for all current and previous IUE Principal Investigators (PIs) over the period April, 1978 through September, 1996. The table is arranged alphabetically by PI and sponsoring institution and contains PI name, PI institution (more than one if the PI has moved), number of accepted observing programs for each PI (at each institution) by episode, and the total number of accepted observing programs per PI, per institution.

* *Note: During IUE Episode 19, NASA and ESA/PPARC programs were conducted in a combined manner from the VILSPA ground station. The statistics available for this episode and entered into this table therefore reflect both US and European Episode-19 programs; entries for Episodes 1-18 reflect only US programs.*

IUE PRINCIPAL INVESTIGATOR STATISTICS: OBSERVING PROGRAMS 1978 - 1996

NON US	PI NAME	INSTITUTION / COUNTRY	EP 1	EP 2	EP 3	EP 4	EP 5	EP 6	EP 7	EP 8	EP 9	EP 10	EP 11	EP 12	EP 13	EP 14	EP 15	EP 16	EP 17	EP 18	EP 19	TOTAL
	A'HEARN, M	U MARYLAND		1	1	1	2	2	2	2	1	2	1	1	1	1	1	1		1	1	22
	ADELMAN, S	THE CITADEL		1		1		1	2	1						2		1			2	11
***	AGRAWAL, P	INDIA						1														1
	AHMAD, I	IMAD-AD-DEAN, INC.						1	1		2		1									5
	AKE, T	COMPUTER SCIENCES CORPORATION				1	2	1	3		1	2	2	1	2	1	2					18
	ALLEN, M	U COLORADO													1							1
	ALLER, L	UC LA		1	1	1	1	1	1		1		1			1	1			1		11
	ALTNER, B	APPLIED RESEARCH CORPORATION							1	1	3	1	1					1				8
	ALTNER, B	COMPUTER SCIENCES CORPORATION													1							1
	AMBRUSTER, C	U COLORADO										1										1
	AMBRUSTER, C	VILLANOVA UNIVERSITY											1	2	1	1		2		1		8
	ANDERSON, C	U WISCONSIN															1					1
	AUER, L	DOE/NM - LANL							1				1	1		1	1					5
	AUER, L	PENN STATE UNIVERSITY				1																1
	AYRES, T	U COLORADO				3	3	5	4	4	2	4	4	2	2	1	2	1	1			38
	BAAN, W	ARECIBO OBSERVATORY							1													1
	BAGNUOLO, W	GEORGIA STATE UNIVERSITY																1				1
	BAIRD, S	CLEMSON UNIVERSITY					1															1
	BALACHANDRAN, S	SETS, INC.													1							1
	BALACHANDRAN, S	U NORTH CAROLINA															1					1
	BALBUS, S	U VIRGINIA											1									1
	BALICK, B	U WASHINGTON																		1		1
	BALIUNAS, S	HARVARD CFA - SAO					3	1	2	1	1	2	1			1	1					13
	BALLESTER, G	U MICHIGAN																1				1
	BARKER, E	U TEXAS														1	2					3
***	BARKER, P	CANADA				1	1	2														4
	BARKER, T	WHEATON COLLEGE		1		1	1	1	1	1	1	1		1		2						11
	BARRY, D	USC		1					1													2
***	BARSTOW, M	UNITED KINGDOM																			1	1
	BASRI, G	UC BERKELEY						1		2	1		1	1	2	1	1					10
***	BATES, B	UNITED KINGDOM																			1	1
	BAUER, W	WELLESLEY COLLEGE																	1		1	2
	BEAVERS, W	IOWA STATE UNIVERSITY				1																1
	BEGELMAN, M	U COLORADO							1													1
	BELL, R	U MARYLAND		1						2	2											5
***	BELTON, M	CANADA			1																	1
	BERGSTRALH, J	CAL TECH - JPL								1												1
	BERNAT, A	NSF - NOAO - KPNO		1																		1
	BERRIMAN, G	U ARIZONA										1										1

IUE PRINCIPAL INVESTIGATOR STATISTICS: OBSERVING PROGRAMS 1978 - 1996

NON			EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	
US	PI NAME	INSTITUTION / COUNTRY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	TOTAL
***	BEUERMANN, K	GERMANY																			1	1
	BIANCHI, L	ST SCI																			1	1
	BJORKMAN, K	U WISCONSIN													1					1		2
	BLACK, J	HARVARD CFA - SAO	1																			1
	BLAIR, G	ELEC-MAG-APS.				1																1
	BLAIR, W	HARVARD CFA - SAO					1	1	3													5
	BLAIR, W	JOHNS HOPKINS UNIVERSITY								1		3	2	1	1	1		1			1	11
***	BLONDEL, P	THE NETHERLANDS																			1	1
***	BOCCHINO, F	ITALY																			1	1
	BOGGESS, A	NASA - GSFC	2	3	1	3	2	2	1	1	1	1										17
	BOHANNAN, B	U COLORADO									1	1										2
	BOHLIN, R	NASA - GSFC		2																		2
	BOHLIN, R	ST SCI									2											2
	BOHM, K	U WASHINGTON			1	1	1	2	1	1	1	1	2	1	1	1						14
	BOHM-VITENSE, E	U WASHINGTON	1	1	1	1	3	3	6	2	2	4	8	2	1							35
	BOHM-VITENSE, E	U WASHINGTON														2	1	1				4
***	BOLTON, C	CANADA											1									1
	BOND, H	LOUISIANA STATE UNIVERSITY				1	2	2	1													6
	BOND, H	ST SCI								1	1	1	2	2	1		1					9
	BONNELL, J	COMPUTER SCIENCES CORPORATION															1					1
	BOOKBINDER, J	HARVARD CFA - SAO													2	1	1	1				5
	BOOKBINDER, J	U COLORADO										2	3									5
	BOPP, B	U TOLEDO			1		2		1	1		1	1	1	1			1				10
	BOTHUN, G	HARVARD CFA - SAO					1															1
	BOWYER, C	UC BERKELEY			1	3	3	6	2	2					1	1	1	1				21
	BOYD, P	USRA																		1		1
***	BRISSENDEN, R	AUSTRALIA										1										1
***	BROMAGE, G	UNITED KINGDOM																			2	2
***	BROSCH, N	ISRAEL																			1	1
	BROWN, A	U COLORADO										4	1		2	2	3	1	2		1	16
	BROWN, D	U WASHINGTON						1	2	2	1		1	1	1							9
	BROWN, R	U MONTANA	1																			1
	BRUGEL, E	U COLORADO						1	1		1	3	2	2	1		1					12
	BRUHWEILER, F	CATHOLIC UNIVERSITY						3	4	6	3	3	3	2	4	1	2	3	1	1	2	38
	BRUHWEILER, F	COMPUTER SCIENCES CORPORATION			1	1	1															3
***	BRUZUAL, G	ARGENTINA					1															1
***	BUES, I	GERMANY																			1	1
	BURKS, G	U COLORADO																1				1
***	BURLEIGH, M	UNITED KINGDOM																			1	1

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NON US	PI NAME	INSTITUTION / COUNTRY	EP 1	EP 2	EP 3	EP 4	EP 5	EP 6	EP 7	EP 8	EP 9	EP 10	EP 11	EP 12	EP 13	EP 14	EP 15	EP 16	EP 17	EP 18	EP 19	TOTAL
	BURSTEIN, D	ARIZONA STATE UNIVERSITY								1	2	1	2		1	2						9
	BUSS, R	JOHNS HOPKINS UNIVERSITY																1				1
***	CACCIARI, C	ITALY																			1	1
	CAILLAULT, J	U GEORGIA											1									1
	CALDWELL, J	SUNY - STONY BROOK		1	1	1	1	3	1	2	1											11
***	CALOI, V	ITALY																			1	1
	CALZETTI, D	ST SCI																		1		1
	CARDELLI, J	U WISCONSIN									1		1		2	1	1	2				8
	CARINI, M	COMPUTER SCIENCES CORPORATION																		1		1
	CARNEY, B	U NORTH CAROLINA							1													1
	CARONE, T	U ARIZONA												1								1
	CARPENTER, K	NASA - GSFC												3			2	1		1		7
	CARPENTER, K	OHIO STATE UNIVERSITY			1																	1
	CARPENTER, K	U COLORADO									1	1	1									3
***	CARRASCO, L	MEXICO			1																	1
	CASEY, S	NASA - GSFC															1					1
	CASH, W	U COLORADO				1						1										2
	CASSINELLI, J	U WISCONSIN		1					1													2
***	CASTRO-TIRADO, A	SPAIN																			1	1
	CAULET, A	NASA - GSFC												1	1							2
	CHAKRABARTI, S	UC BERKELEY													1							1
	CHAMBERS, K	ST SCI												1								1
	CHAPMAN, R	NASA - GSFC		1			1	1	2	1												6
	CHENG, K	CATHOLIC UNIVERSITY																		1		1
	CHENG, K	NASA - GSFC																1				1
	CHU, Y	U ILLINOIS															1	2		1		4
	CHU, Y	UC BERKELEY			1																	1
	CLARKE, J	NASA - GSFC									1	1										2
	CLARKE, J	NASA - MSFC								1												1
	CLARKE, J	U MICHIGAN											3	2	3	3	1					12
***	CLAYTON, G	CANADA					1															1
	CLAYTON, G	U COLORADO															2	2	1			5
	CLAYTON, G	U WISCONSIN											1									1
	CODE, A	U WISCONSIN		2	2	1		1														6
	COHEN, J	CAL TECH			1	1	2					1										5
	COHEN, M	NASA - AMES							1													1
	COHEN, M	UC BERKELEY								1												1
	COHEN, R	UC SAN DIEGO						1	1								1	1				4
	COMBI, M	U MICHIGAN															1	1	1			3

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	CONTI, P	U COLORADO	1	1	1	1	1	2		1	1	1	1	2	1	3	1	2				20
	CORCORAN, M	NASA - GSFC													2							2
	CORDOVA, F	DOE/NM - LANL			1	1	1		1	1	1											6
	CORDOVA, F	PENN STATE UNIVERSITY														1						1
***	COURVOISIER, T	SWITZERLAND																			1	1
	COWIE, L	MIT				1																1
	COWIE, L	PRINCETON UNIVERSITY			1																	1
	COWIE, L	ST SCI									1											1
	COWLEY, A	ARIZONA STATE UNIVERSITY							1	1			1	1		1	1	1				7
	COWLEY, A	U MICHIGAN					1															1
	COWLEY, C	U MICHIGAN						1														1
	CRENSHAW, D	COMPUTER SCIENCES CORPORATION									1	1	1			1						4
	CRENSHAW, D	NASA - GSFC													1							1
	CROTTS, A	COLUMBIA UNIVERSITY															1	1	1		1	4
***	CROWTHER, P	UNITED KINGDOM																			1	1
	CUNTZ, M	NSF HAO - NCAR																1				1
	CURIEL, S	HARVARD CFA - SAO														1						1
	CURRIE, D	U MARYLAND																			1	1
	CZYZAK, S	OHIO STATE UNIVERSITY			1																	1
	DALGARNO, A	HARVARD CFA - SAO		1																		1
***	DALTABUIT, E	MEXICO	1																			1
	DANKS, A	APPLIED RESEARCH CORPORATION											1	1	1							3
	DANKS, A	HUGHES - STX														1		1				2
	DANLY, L	ST SCI											1	1	1	2	1	1		1		8
	DAVIDSEN, A	JOHNS HOPKINS UNIVERSITY		1																		1
	DAVIDSON, K	U MINNESOTA		1	2	1	1	1							1							7
	DAVIS, M	UC BERKELEY												1								1
	DAWSON, D	FRANKLIN & MARSHALL COLLEGE							1													1
***	DE BOER, K	GERMANY																			1	1
	DE BOER, K	U WISCONSIN		1																		1
***	DE LA REZA, R	SWITZERLAND																			1	1
***	DE MARTINO, D	SPAIN																			4	4
	DEAN, C	S M SYSTEMS				1		1														2
	DELAND, M	HUGHES - STX																		1		1
***	DELEUIL, M	FRANCE																			1	1
	DINERSTEIN, H	U TEXAS										1										1
***	DOAZAN, V	FRANCE																			1	1
	DOHERTY, L	U WISCONSIN	1	1																		2
	DOMINGUE, D	LUNAR & PLANETARY INSTITUTE																			1	1

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	DONN, B	NASA - GSFC	1																			1
	DOSCHEK, G	NAVAL RESEARCH LABORATORY		1				1														2
	DOWNES, R	APPLIED RESEARCH CORPORATION								1												1
***	DOYLE, J	UNITED KINGDOM																			1	1
	DRAKE, S	HUGHES - STX										1		1								2
	DRAKE, S	SASC									1											1
***	DRECHSEL, H	GERMANY																			1	1
	DRECHSEL, H	U COLORADO																1				1
***	DREIZLER, S	GERMANY																			1	1
	DRESSEL, L	APPLIED RESEARCH CORPORATION															1	1				2
	DRILLING, J	LOUISIANA STATE UNIVERSITY			1	1	1	1	1		2		1	1	1		2	1		2		15
***	DUERBECK, H	GERMANY																			1	1
	DUFOUR, R	RICE UNIVERSITY		1	1		2	1	2	2	2	2	1	2	1	1		1				19
	DUNCAN, D	CAL TECH								1												1
	DUNCAN, D	ST SCI										1										1
	DUPREE, A	HARVARD CFA - SAO	2	4	7	4	2	2	3	3	2	2	2	1	2	2	1	2	1	1		43
	DURRANCE, S	JOHNS HOPKINS UNIVERSITY							1													1
	EATON, J	INDIANA UNIVERSITY							1	3	2	2	2	2								12
	EATON, J	TENNESSEE STATE UNIVERSITY - CEIS												1	2	3	2	3		2		13
	EATON, J	VANDERBILT UNIVERSITY				2	1															3
	EBBETS, D	ST SCI							1													1
***	ECHEVARRIA, J	MEXICO								1												1
	EDELSON, R	U IOWA																			1	1
	EDELSON, R	NASA - GSFC															1	1				2
	EDELSON, R	U COLORADO											1		1							2
	ELVIS, M	HARVARD CFA - SAO								1	1	1										3
***	ENGVOLD, O	NORWAY																			1	1
***	EVANS, N	CANADA				1						1	1	3	3	2	1	2	2	3	1	20
	EVANS, N	COMPUTER SCIENCES CORPORATION							2	2	4											8
	FABBIANO, G	HARVARD CFA - SAO		1																		1
	FABER, S	UC SANTA CRUZ							1													1
	FANG, L	HARVARD CFA - SAO						1														1
	FEIBELMAN, W	NASA - GSFC				1	1	1	3	2	2	1	2	2	2		2			2	2	23
	FEKEL, F	NASA - GSFC				1		1														2
	FEKEL, F	TENNESSEE STATE UNIVERSITY - CEIS																1		1		2
	FEKEL, F	VANDERBILT UNIVERSITY							1	1	2	1		1								6
	FELDMAN, P	JOHNS HOPKINS UNIVERSITY		2	2	1	1	1	1	2	2	1	1	1	1	1	1	1				19
	FELTZ, K	NO SPONSOR			1																	1
	FERLAND, G	OHIO STATE UNIVERSITY										1										1

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	FERLAND, G	U KENTUCKY					1	1	1	1												4
***	FERNANDEZ-CASTR	SPAIN																			1	1
	FESEN, R	NASA - GSFC					1	1														2
	FESEN, R	U COLORADO							4	2	3	2		1								12
***	FESTOU, M	FRANCE																			1	1
	FICH, M	U WASHINGTON								1												1
	FILIPPENKO, A	UC BERKELEY												1		1						2
	FISCHEL, D	NASA - GSFC	1																			1
	FITZPATRICK, E	PRINCETON UNIVERSITY											1									1
	FITZPATRICK, E	U COLORADO								1	2	2										5
***	FONTAINE, G	CANADA											1									1
***	FREIRE FERRERO, R	FRANCE																			1	1
***	FRIEDJUNG, M	FRANCE																			2	2
	FRIEDMAN, S	JOHNS HOPKINS UNIVERSITY																			1	1
	FRIEND, D	U WISCONSIN									1											1
	FRISCH, P	U CHICAGO		1	1					1	1	1		2	1							8
	FULLERTON, A	U DELAWARE																1				1
***	GAENSICKE, B	GERMANY																			2	2
	GAGNE, M	U COLORADO																			1	1
	GALLAGHER, J	HARVARD CFA - SAO		1																		1
	GALLAGHER, J	U ILLINOIS						1														1
	GARMANY, C	U COLORADO						1	2	3	3	3	3	1	1							17
***	GARRISON, R	CANADA	1																			1
	GASKELL, C	SUNY - STONY BROOK										1										1
	GASKELL, C	U MICHIGAN											1		1							2
	GELLER, M	HARVARD CFA - SAO		1	1	1	1															4
	GEORGE, I	USRA																1			1	2
***	GERBALDI, M	FRANCE																			1	1
***	GHISELLINI, G	ITALY																			1	1
	GIAMPAPA, M	HARVARD CFA - SAO			1	2	1															4
	GIAMPAPA, M	NSF - NOAO - NSO							3	2	1	1										7
	GIAMPAPA, M	NSF - NOAO - SAC PEAK						1														1
	GIBSON, D	NM INSTITUTE OF TECHNOLOGY							1	1												2
	GIES, D	GEORGIA STATE UNIVERSITY															1			2	1	4
	GILRA, D	S M SYSTEMS								1												1
	GLASSGOLD, A	NEW YORK UNIVERSITY			2	2	2	2	2	2												12
***	GONZALEZ-RIESTRA	SPAIN																			2	2
	GRADY, C	APPLIED RESEARCH CORPORATION																1	1	1	1	4
	GRADY, C	CATHOLIC UNIVERSITY													1	2	1					4

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	GRADY, C	COMPUTER SCIENCES CORPORATION							1	1	1	1	2									6
	GRANDI, S	UC LA				1																1
	GREEN, J	U COLORADO																2				2
	GREEN, R	CAL TECH		1																		1
	GREEN, R	NSF - KPNO										2			2							4
	GREEN, R	NSF - NOAO - KPNO							1	1												2
	GREEN, R	U ARIZONA			1	2	2	3			2											10
	GREENSTEIN, J	CAL TECH	1	1																		2
	GREGORY, S	BOWLING GREEN UNIVERSITY			1		1															2
	GRINDLAY, J	HARVARD CFA - SAO			1																	1
	GUINAN, E	VILLANOVA UNIVERSITY				1		1	1	1	2		2	2	2	4	2	3	2	2	1	26
	GULL, T	NASA - GSFC		1		2																3
	GUNN, J	PRINCETON UNIVERSITY				1																1
	GURMAN, J	NASA - GSFC									1											1
***	GURSKY, H	GERMANY	1																			1
	GURSKY, H	HARVARD CFA - SAO		2	1																	3
	HACKNEY, K	WESTERN KENTUCKY		1			1															2
	HACKNEY, R	WESTERN KENTUCKY	1		1																	2
	HACKWELL, J	AEROSPACE CORPORATION										1				1						2
	HAISCH, B	LOCKHEED - PARL						3	1	1					1							6
	HALL, D	JOHNS HOPKINS UNIVERSITY																1				1
	HALLAM, K	NASA - GSFC			1	1	2	1	1		1											7
	HALPERN, J	COLUMBIA UNIVERSITY									4	2			1		1			1		9
	HANSON, M	U COLORADO													1							1
	HAPKE, B	U PITTSBURGH		1																		1
	HARDORP, J	SUNY - STONY BROOK								1												1
	HARPER, D	U CHICAGO							1	1												2
	HARRINGTON, J	U MARYLAND		2		1	1		1													5
	HARRIS, W	U MICHIGAN																1	1	2		4
	HARTMAN, R	NASA - GSFC																		1		1
	HARTMANN, L	HARVARD CFA - SAO				1	1	2	1													5
***	HASSALL, B	UNITED KINGDOM																			1	1
	HAZARD, C	U PITTSBURGH								1												1
	HEAP, S	NASA - GSFC	2		2							1		1	1	1	1					9
	HECHT, J	AEROSPACE CORPORATION						1														1
	HECHT, J	NASA - GSFC				1																1
	HECKMAN, T	JOHNS HOPKINS UNIVERSITY														1						1
	HELFER, H	U ROCHESTER			1	1																2
	HENDEN, A	SASC				1																1

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***	HENRICHS, H	THE NETHERLANDS																			3	3
	HENRY, R	JOHNS HOPKINS UNIVERSITY							1	1			1									3
	HERBIG, G	UC SANTA CRUZ		1		1																2
***	HESSER, J	CANADA		1																		1
***	HILL, G	CANADA	1																			1
	HILL, J	SASC			1																	1
***	HIRATA, R	JAPAN					1															1
	HOARD, D	U WASHINGTON																			1	1
	HOBBS, L	U CHICAGO					1	2	1		1			1								6
	HOBBS, R	NASA - GSFC					1															1
	HODGE, P	U WASHINGTON				1	2	2		1		1	2		2		1	1				13
	HOLBERG, J	U ARIZONA						2	2	1	2	3	4	1	1	2	2	3	1	2		26
	HOLLIS, J	NASA - GSFC							1	1										1		3
	HOLM, A	COMPUTER SCIENCES CORPORATION		2	2	2	3	3		1	1		1	1	1					1		18
	HOLT, S	NASA - GSFC		1																		1
	HONEYCUTT, R	INDIANA UNIVERSITY						1														1
	HORNE, K	ST SCI									1						2	1				4
***	HOWARTH, I	UNITED KINGDOM												1								1
	HOWELL, S	PLANETARY SCIENCE INSTITUTE																1			2	3
	HRIVNAK, B	VALPARAISO UNIVERSITY										1	1									2
	HU, E	INST ASTRONOM										1										1
	HU, E	ST SCI							1													1
	HUANG, M	VILLANOVA UNIVERSITY																1				1
	HUCHRA, J	HARVARD CFA - SAO				1	1	1	1	1	1											6
	HUENEMOERDER, D	MIT																	1			1
	HUENEMOERDER, D	PENN STATE UNIVERSITY							1		1				1							3
	HUGGINS, P	NEW YORK UNIVERSITY		1																		1
	HUMPHREYS, R	U MINNESOTA				1										1						2
***	HUTCHINGS, J	CANADA	1	1	2				1	1						1						7
	HUTTER, D	APPLIED RESEARCH CORPORATION									1											1
	HUTTER, D	COMPUTER SCIENCES CORPORATION												1								1
	IMHOFF, C	COMPUTER SCIENCES CORPORATION					2	2	2	1			1		1	1		1	1			12
	IMHOFF, C	HARVARD CFA - SAO			1																	1
	IMHOFF, C	U ARIZONA	1	1		1																3
	JACKSON, W	HOWARD UNIVERSITY	1	1	1	1				3												7
	JACKSON, W	UC DAVIS									2											2
	JANES, K	BOSTON UNIVERSITY									1											1
***	JEFFERY, C	UNITED KINGDOM																			2	2
	JENKINS, E	PRINCETON UNIVERSITY	1				1	1	1	1	1											6

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***	JOHNSON, D	UNITED KINGDOM																			1	1
	JOHNSON, H	INDIANA UNIVERSITY				1	1	1	1	3	2	1	1	2			1					14
	JOHNSON, H	LOCKHEED - PARL	1		1	1																3
***	JORDAN, S	GERMANY																			2	2
	JUDGE, P	U COLORADO												1	2	1						4
***	JUGAKU, J	JAPAN	1			1	1		1	1												5
	JURA, M	UC LA		1									1		1							3
	KAFATOS, M	SRI ASSOCIATES																	1			1
	KAFATOS, M	GEORGE MASON UNIVERSITY				1	1	3	1		1	2	1		1	2						13
	KAITCHUCK, R	BALL STATE UNIVERSITY																2				2
	KALER, J	U ILLINOIS				1	1	1			1		1									5
	KALLMAN, T	MIT				1																1
	KALLMAN, T	NASA - GSFC								2												2
	KAMP, L	NASA - GSFC	1																			1
	KAROVSKA, M	HARVARD CFA - SAO													1	1						2
	KAZANAS, D	NASA - GSFC																		1		1
	KEEL, W	NSF - NOAO - KPNO						1														1
	KEEL, W	U ALABAMA												1	1		1					3
	KENYON, S	HARVARD CFA - SAO								2		2	2	1	1	1		1	1			11
***	KEPLER, S	BRAZIL															1					1
***	KEPLER, S	CANADA														1						1
	KINNEY, A	ST SCI											1			1	1	1				4
	KIPLINGER, A	ARS				1																1
	KIRSHNER, R	HARVARD CFA - SAO									1	1	2	2	1		1	1				9
	KIRSHNER, R	HARVARD COLLEGE OBSERVATORY																		1		1
	KIRSHNER, R	HARVARD UNIVERSITY														1			1			2
	KIRSHNER, R	U MICHIGAN		1			1	1	1													4
	KLINGLESMITH, D	NASA - GSFC	3																			3
	KOCH, R	U PENNSYLVANIA			1									1		1	1	1		1		6
***	KOENIGSBERGER, G	MEXICO									1	1								1	1	4
	KOESTER, D	LOUISIANA STATE UNIVERSITY										1	1	1	2		1	1				7
	KONDO, Y	NASA - GSFC		1	1	1	1	1	1	1												7
	KONDO, Y	NASA - JSC	1																			1
***	KOUBSKY, P	CZECHOSLOVAKIA																			1	1
***	KRAUTTER, J	GERMANY																			1	1
	KREIDL, T	LOWELL OBSERVATORY													1							1
	KRISS, G	U MICHIGAN						1														1
	KRON, R	U CHICAGO								1												1
	KUHI, L	UC BERKELEY			1		1															2

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	KUIN, N	HUGHES - STX										1										1
	KURT, V	USSR		1																		1
	LAMB, S	U ILLINOIS		1	1				1				1		1							5
	LAMBERT, D	U TEXAS		1	1	2	2	1		1												8
	LAMERS, H	U COLORADO													1							1
	LANDSMAN, W	HUGHES - STX											1					2		2	1	6
	LANDSMAN, W	NASA - GSFC									1											1
***	LANDSTREET, J	CANADA			1	1																2
	LANE, A	CAL TECH - JPL	1	1	2	1	1															6
	LANG, K	JOHNS HOPKINS UNIVERSITY									1											1
	LANG, K	TUFTS UNIVERSITY							1	1												2
	LECKRONE, D	NASA - GSFC	2											1								3
***	LEIBOWITZ, E	ISRAEL		1																		1
***	LEIGHLY, K	JAPAN																			1	1
	LESH, J	U DENVER		1																		1
***	LESTER, J	CANADA		2			2															4
	LEUNG, K	U NEBRASKA									1											1
	LEVREAULT, R	WESLEYAN UNIVERSITY													1	1						2
	LEWIS, B	ARECIBO OBSERVATORY - NAIC															1					1
	LIEBERT, J	U ARIZONA				1	1	1	2	1		1	1				1					9
	LIEN, D	MICHIGAN STATE UNIVERSITY							1													1
	LINNELL, A	MICHIGAN STATE UNIVERSITY									1											1
	LINSKY, J	U COLORADO	1	1	5	4	8	9	10	10	11	2	1	2	1	1	2					68
	LITTLE-MARENIN, I	WELLESLEY COLLEGE							1													1
	LIVENGOOD, T	NASA - GSFC																1	1	1		3
	LIVENGOOD, T	U MARYLAND																			1	1
***	LLOYD, C	UNITED KINGDOM																			1	1
	LUTTERMOSER, D	COMPUTER SCIENCES CORPORATION																		1		1
	LUTTERMOSER, D	IOWA STATE UNIVERSITY														1	1	1				3
	LUTTERMOSER, D	U COLORADO													1							1
	LUTZ, J	WASHINGTON STATE UNIVERSITY		1	1				1	1												4
***	LYNAS-GRAY, A	UNITED KINGDOM																			1	1
	MACALPINE, G	U MICHIGAN								1	1			1								3
	MADEJSKI, G	USRA															1					1
***	MADORE, B	CANADA					1															1
	MAGALHAES, A	U WISCONSIN													1	1						2
	MALKAN, M	U ARIZONA							1													1
	MALKAN, M	UC LA								2	4	2	2	1	1		1			1		14
***	MANNHEIM, K	GERMANY																			1	1

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	MANSPERGER, C	COMPUTER SCIENCES CORPORATION															1					1
	MARAN, S	NASA - GSFC		1		1	1	1	1	1			1		1							8
***	MARASCHI, L	ITALY																			1	1
	MARGON, B	U WASHINGTON						2	1	1												4
***	MARLBOROUGH, J	CANADA		1	1																	2
***	MARSH, T	UNITED KINGDOM																			1	1
	MARSH, T	ST SCI												1	1							2
	MARTIN, D	COLUMBIA UNIVERSITY										1		1								2
***	MAS HESSE, J	SPAIN																			2	2
	MASSA, D	APPLIED RESEARCH CORPORATION									2	1	2	1	1	1	2	1	1	1	1	14
***	MASSEY, P	CANADA				1	1	1														3
	MASSEY, P	NSF - KPNO											1	2								3
	MASSEY, P	NSF - NOAO - KPNO							1	1	1	1										4
	MATHIS, J	U WISCONSIN								1												1
	MATILSKY, T	RUTGERS UNIVERSITY			1	1																2
	MATSON, D	CAL TECH - JPL		2	2	2	2															8
	MAUCHE, C	DOE/NM - LANL											2	2								4
	MCALPINE, G	U MICHIGAN										1										1
	MCCLINTOCK, J	MIT			2																	2
	MCCLUSKEY, G	LEHIGH UNIVERSITY		1	1	1	1	1	1	1		2					1					10
	MCCOLLUM, B	COMPUTER SCIENCES CORPORATION															1	2		1		4
	MCCRAY, R	U COLORADO										1										1
	MCGRATH, M	JOHNS HOPKINS UNIVERSITY														2	3					5
	MCGRATH, M	ST SCI																1	1			2
	MCNAMARA, D	BRIGHAM YOUNG UNIVERSITY			1																	1
	MEIER, D	CAL TECH		1																		1
	MEYER, D	NORTHWESTERN UNIVERSITY												1	1	1	1					4
	MEYLAN, T	COMPUTER SCIENCES CORPORATION															1					1
	MICHALITSIANOS, A	NASA - GSFC		1	1	1		1	1	2		1	1		2	1						12
	MILLER, H	GEORGIA STATE UNIVERSITY					1	1	1		1			1								5
	MILLER, J	UC SANTA CRUZ						1														1
***	MOEHLER, S	GERMANY																			2	2
***	MONIER, R	FRANCE																			3	3
***	MONTESINOS, B	SPAIN																			2	2
	MOORE, R	CAL TECH						2														2
	MOOS, H	JOHNS HOPKINS UNIVERSITY	1	3	3	2	3	3	3	3	3	3	3	3	3	1						37
***	MOREELS, G	FRANCE																			1	1
	MORRISON, N	U COLORADO		1																		1
	MORRISON, N	U TOLEDO			1		1	2			1							1				6

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	MORTON, D	A.A.T.	1																			1
	MUKAI, K	USRA																		1		1
	MULLAN, D	U DELAWARE		1	1	1		1		3												7
	MURTHY, J	JOHNS HOPKINS UNIVERSITY																1				1
	MUSHOTZKY, R	NASA - GSFC															1	1				2
***	NAPIWOTZKI, R	GERMANY																			1	1
	NEFF, J	NASA - GSFC												1		1						2
	NEFF, J	PENN STATE UNIVERSITY															1					1
	NEFF, J	U COLORADO											1									1
	NEFF, J	IOWA STATE UNIVERSITY									1											1
	NELSON, J	CAL TECH - JPL		1																		1
	NELSON, R	CAL TECH - JPL						1	1	1												3
	NICHOLS, J	COMPUTER SCIENCES CORPORATION																		3		3
	NICHOLS-BOHLIN, J	COMPUTER SCIENCES CORPORATION				1		1	1			1	3	1	2	1	1	1				13
	NICHOLS-BOHLIN, J	ST SCI								1	2											3
	NICOLAS, K	NAVAL RESEARCH LABORATORY		1																		1
	NOUSEK, J	PENN STATE UNIVERSITY						2	1													3
	NOYES, R	HARVARD CFA - SAO				1	1															2
***	NUSSBAUMER, H	SWITZERLAND																			1	1
***	O'BRIEN, P	UNITED KINGDOM																			1	1
	O'CONNELL, R	U VIRGINIA					1															1
	OKE, J	CAL TECH	1	2	1		1	1	1													7
	OLIVERSEN, N	COMPUTER SCIENCES CORPORATION						1	1	2	1	1										6
	OLSON, E	U ILLINOIS					1					1	1									3
	OWEN, T	SUNY - STONY BROOK	1																			1
	PAGE, T	NASA - JSC	1																			1
	PANEK, R	COMPUTER SCIENCES CORPORATION			1	2	1	3														7
***	PARATHASARATHY,	INDIA																			1	1
	PARISE, R	COMPUTER SCIENCES CORPORATION					1															1
	PARSONS, S	COMPUTER SCIENCES CORPORATION							1	1				1				1		1		5
	PARSONS, S	NASA - GSFC					1	3														4
	PARSONS, S	U TEXAS	1		1																	2
***	PASTORI, L	ITALY																			1	1
	PATTERSON, J	COLUMBIA UNIVERSITY									1	1				1						3
	PATTERSON, J	HARVARD CFA - SAO					1	1														2
	PEERY, B	HOWARD UNIVERSITY								1												1
***	PEIMBERT, M	MEXICO		1	1												1					3
***	PENA, M	MEXICO													1		1	1		1	1	5
	PENNINGTON, R	U MINNESOTA								1												1

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***	PEREIRA, C	BRAZIL																			1	1
	PEREZ, M	COMPUTER SCIENCES CORPORATION														1		1				2
	PERRY, P	COMPUTER SCIENCES CORPORATION		1	1																	2
	PESCE, J	ST SCI																			1	1
	PETERS, G	USC		1	1	2			1	1	4	2	4	3	3	1	1	1	2	4	2	33
	PETERSON, B	OHIO STATE UNIVERSITY									1	1			1	1	1		1	1	1	8
	PETERSON, D	SUNY - STONY BROOK																			1	1
	PHILIP, A	INSTITUTE FOR SPACE OBSERVATIONS										1					1				1	3
	PHILIP, A	WESLEYAN UNIVERSITY							1													1
***	PIRO, L	ITALY																			1	1
	PITTS, R	COMPUTER SCIENCES CORPORATION								1		2										3
	PLAVEC, M	UC LA	1		2	1	1	1	3	1	3	1	2		3		1					20
	POLIDAN, R	NASA - GSFC													2	1	4	1	1			9
	POLIDAN, R	U ARIZONA							2	3	1	2	3	2								13
	PORTER, A	NSF - KPNO														1	1					2
***	PRANGE, R	FRANCE																			1	1
	PRAVDO, S	CAL TECH				1																1
***	PREVOT, M	FRANCE																			1	1
	PTAK, R	BOWLING GREEN UNIVERSITY							1													1
	PUETTER, R	UC SAN DIEGO				1	2															3
***	PURTON, C	CANADA		1																		1
***	RAHE, J	GERMANY			1																	1
***	RAKOS, K	AUSTRIA		1		1																2
	RAMSEY, L	PENN STATE UNIVERSITY								1	1		1			1						4
***	RAUCHE, T	GERMANY																			3	3
	RAYMOND, J	HARVARD CFA - SAO				3	2	5	5	5	3	2	1	2	2	1	2		1			34
	REICHERT, G	COMPUTER SCIENCES CORPORATION								1	1	2	2	2	1							9
	REICHERT, G	NASA - GSFC						1														1
	REICHERT, G	USRA															1			1	1	3
***	REIMERS, D	GERMANY																			1	1
	REMILLARD, R	MIT										1		1	1							3
	RICH, R	COLUMBIA UNIVERSITY												1	1	1						3
	RIEGLER, G	CAL TECH - JPL								1												1
***	RINGWALD, F	UNITED KINGDOM																			1	1
	ROBINSON, R	COMPUTER SCIENCES CORPORATION														2						2
	ROBY, S	SUNY - OSWEGO													1							1
	RODRIGUE, M	U NEVADA															1					1
***	ROEDER, R	CANADA	1																			1
	ROMANISHIN, W	NASA - GSFC							1													1

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	ROUSSEL-DUPRE, D	DOE/NM - LANL																			1	1
	RUBIN, R	NASA - AMES													1							1
	RUDY, R	AEROSPACE CORPORATION									1											1
	RUDY, R	U ARIZONA						2														2
	RUMPL, W	COMPUTER SCIENCES CORPORATION						1														1
	RUMPL, W	NASA - GSFC			1																	1
	SAAR, S	HARVARD CFA - SAO											1		1	1	2	1				6
***	SAHADE, J	ARGENTINA	1									1			1							3
	SANNER, F	U TEXAS		1																		1
	SAPAR, A	USSR	1																			1
	SARGENT, W	CAL TECH		2	2	1	1	3														9
***	SASSELOV, D	CANADA												1								1
	SAVAGE, B	U WISCONSIN	1	2	2	3	3	6	5	4	2	2	2	2		1						35
	SAVEDOFF, M	U ROCHESTER			1																	1
***	SCHARTEL, N	SPAIN																			1	1
	SCHIFFER, F	COMPUTER SCIENCES CORPORATION		1																		1
	SCHMIDT, E	U NEBRASKA		1	1		1				1											4
	SCHMIDT, G	U ARIZONA								1												1
	SCHMIDT, M	CAL TECH	1	1																		2
	SCHMIDTKE, P	ARIZONA STATE UNIVERSITY															1		1			2
***	SCHMUTZ, W	SWITZERLAND																			2	2
	SCHULTE-LADBECK,	U PITTSBURGH																1				1
	SCHULTZ, A	COMPUTER SCIENCES CORPORATION													1					1		2
	SCHWARTZ, R	U MISSOURI - ST. LOUIS					1	1	1													3
	SEAB, C	U NEW ORLEANS													1							1
***	SELVELLI, P	ITALY																			1	1
	SEMBACH, K	MIT																1	1	2		4
	SHAW, J	U GEORGIA					1	1	1					1	1							5
	SHEMANSKY, D	U ARIZONA								1	2	2	2	2	1							10
	SHIPMAN, H	U DELAWARE						1	1			1						1				4
	SHORE, S	CASE - WESTERN RESERVE				1	2	1														4
	SHORE, S	COMPUTER SCIENCES CORPORATION								3					1	1		2				7
	SHORE, S	INDIANA UNIVERSITY																		1		1
	SHORE, S	NM INSTITUTE OF TECHNOLOGY										1	1	3								5
	SHRADER, C	COMPUTER SCIENCES CORPORATION														1	1		1			3
	SHRADER, C	USRA																		1	1	2
	SHRADER, C	COMPUTER SCIENCES CORPORATION												1	1							2
	SHULL, J	U COLORADO		1	1	1	2	3	4	5	3	2	2		3	1	1					29
	SIAH, J	VILLANOVA UNIVERSITY																1				1

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	SIEGMUND, O	UC BERKELEY																1		1		2
	SILVIS, J	CATHOLIC UNIVERSITY																		1		1
	SIMON, T	NASA - GSFC										4										4
	SIMON, T	U HAWAII			1	2	5	3	4	3	3		3	3	4	3	2	3				39
	SION, E	VILLANOVA UNIVERSITY		1			1	3		2	1	2	1	3	1	2	3	1				21
	SITKO, M	NSF - NOAO - KPNO								1	1											2
	SITKO, M	U CINCINNATI														1						1
	SITKO, M	U MINNESOTA				1	2	1	2													6
	SKILLMAN, E	U MINNESOTA														1						1
	SKINNER, T	U COLORADO									1	2	3									6
***	SKOPAL, A	CZECHOSLOVAKIA																			1	1
	SKUMANICH, A	NSF HAO - NCAR							1													1
	SLETTEBAK, A	OHIO STATE UNIVERSITY			1	1		1														3
	SMITH, A	NASA - GSFC	1									1										2
	SMITH, G	HARVARD CFA - SAO							1													1
	SMITH, G	UC SANTA CRUZ														1						1
	SMITH, H	UC SAN DIEGO			1	1																2
	SMITH, M	COMPUTER SCIENCES CORPORATION												2	1		1	2	1	2	2	11
	SNEDEN, C	U TEXAS				1			1													2
	SNOW, T	U COLORADO		1	1	3	3	4	2	3	5	4	2	1	2	2		1				34
	SOBIESKI, S	NASA - GSFC	1																			1
	SODERBLOM, D	HARVARD CFA - SAO					1	2	2													5
	SODERBLOM, D	ST SCI											1		1							2
	SOFIA, S	NASA - GSFC		1																		1
	SOIFER, B	CAL TECH			1	1																2
	SONNEBORN, G	COMPUTER SCIENCES CORPORATION						1	2	3	1	2	1									10
	SONNEBORN, G	NASA - GSFC													1	2	3	2	1		1	10
	SPARKE, L	U WISCONSIN																1				1
	SPINRAD, H	UC BERKELEY		1																		1
	STARRFIELD, S	ARIZONA STATE UNIVERSITY			1	1	1	1	1	1	2	2	2	2	3	3	1	3	3	2		29
	STECHER, T	NASA - GSFC	1	1																		2
	STEINMAN-CAMERO	CAL TECH							1													1
	STENCEL, R	U COLORADO		1	2	4						2	1		2	1	2					15
	STENCEL, R	U DENVER																2	1	1	1	5
	STERN, R	CAL TECH - JPL				1																1
	STERN, S	SOUTHWEST RESEARCH INSTITUTE															1	2				3
	STERN, S	U COLORADO												3								3
***	STICKLAND, D	UNITED KINGDOM																			1	1
	STOCKE, J	U COLORADO									1	1		1								3

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	STONER, R	BOWLING GREEN UNIVERSITY						1	1		1											3
	STROM, S	U MASSACHUSETTS								1												1
	STURCH, C	COMPUTER SCIENCES CORPORATION						1														1
	SUN, W	NASA - GSFC												1								1
	SWANK, J	NASA - GSFC									1											1
	SZKODY, P	U WASHINGTON		1	1	1	2	3	1	1	3	2	2	1	1	1	2	2	1	2	1	28
***	TATUM, J	CANADA		1																		1
	TEAYS, T	COMPUTER SCIENCES CORPORATION											4	1	2	1	1					9
***	THEISSEN, A	GERMANY																			1	1
	THEJLL, P	U DELAWARE													1							1
	THONNARD, N	CARNEGIE INSTITUTE				1																1
	THORSTENSEN, J	DARTMOUTH COLLEGE													1							1
	THUAN, T	U VIRGINIA			1		1		2		1	1	1									7
***	TJIN A DJIE, H	THE NETHERLANDS																			1	1
	TOMASKO, M	U ARIZONA	1	1																		2
	TORRES-DODGEN, A	U COLORADO							1													1
***	TORRES-PEIMBERT,	MEXICO						1				1	1			1		1				5
	TRAUGER, J	CAL TECH			1	1	1															3
	TREMAINE, S	MIT					1	1														2
	TURNSHEK, D	ST SCI								1		1	1									3
	TURNSHEK, D	U ARIZONA				1																1
	TURNSHEK, D	U PITTSBURGH					1	1	1					1		2	1	1				8
	TWAROG, B	U KANSAS														1				1		2
	TWEEDY, R	U ARIZONA																1				1
	TYTLER, D	COLUMBIA UNIVERSITY										1										1
	UNDERHILL, A	NASA - GSFC	1	2	2		1	1	1													8
	URRY, C	MIT									1	1										2
	URRY, C	ST SCI											1	1	1	1	1	1	1	1		8
***	VALLS-GABAUD, D	FRANCE																			1	1
	VAN BUREN, D	U COLORADO									1											1
	VANDEN-BOUT, P	U TEXAS	2																			2
***	VENN, K	GERMANY																			1	1
	VENNES, S	U DELAWARE														1						1
***	VERDUGO, E	SPAIN																			1	1
***	VIOTTI, R	ITALY																			1	1
***	VIOTTI, R	ITALY																			2	2
	VRTILEK, S	HARVARD CFA - SAO												1				1				2
	VRTILEK, S	NASA - GSFC											1									1
	WADE, R	NSF - KPNO													1							1

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	WADE, R	U ARIZONA								1	1											2
***	WAELKENS, C	THE NETHERLANDS																			1	1
	WAGENER, R	APPLIED RESEARCH CORPORATION										1										1
	WAGENER, R	SUNY - STONY BROOK											2	1	1							4
	WAITE, J	NASA - MSFC							1	1	1	1	1									5
	WAKKER, B	U ILLINOIS																		1		1
	WALBORN, N	NASA - GSFC							1													1
	WALDRON, W	APPLIED RESEARCH CORPORATION							1													1
	WALDRON, W	U DELAWARE						1														1
	WALKER, A	STANFORD UNIVERSITY		1	1	1																3
	WALLERSTEIN, G	U WASHINGTON		1	1									1								3
	WALTER, F	SUNY - STONY BROOK																2	1		1	4
	WALTER, F	U COLORADO							1	1	3	3	2	1								11
	WAMPLER, E	UC SANTA CRUZ				2																2
	WEAVER, H	UC BERKELEY				1																1
	WEBB, J	COMPUTER SCIENCES CORPORATION													1							1
	WEBB, J	FLORIDA INTERNATIONAL UNIVERSITY																		1	1	2
	WEEDMAN, D	PENN STATE UNIVERSITY						1		1	1											3
	WEGNER, G	DARTMOUTH COLLEGE						1	1	2	2	1										7
	WEGNER, G	PENN STATE UNIVERSITY			1	1	2															4
***	WEISS, W	AUSTRIA					1															1
	WEISTROP, D	APPLIED RESEARCH CORPORATION										1										1
***	WELCH, G	CANADA		1	1																	2
	WELTY, D	U CHICAGO													1	1	1	1				4
***	WESEMAEL, F	CANADA							2	2	1	1	1		1							8
	WEST, D	NASA - GSFC	1																			1
	WHEELER, J	U TEXAS															1					1
	WHITNEY, B	HARVARD CFA - SAO													1	2						3
	WHITTLE, D	U VIRGINIA													1	1						2
	WILKES, B	HARVARD CFA - SAO											1		1		1	1				4
	WILLIAMS, R	U ARIZONA			1																	1
***	WILLIS, A	UNITED KINGDOM																			2	2
	WILLS, B	U TEXAS		1			2	1		2			1	1	1							9
	WILLSON, L	IOWA STATE UNIVERSITY					1			1	1	1	2	2	1	1	1	1				12
	WILSON, A	U MARYLAND			1	1																2
	WING, R	OHIO STATE UNIVERSITY	1	1	2			1														5
	WINGET, D	U TEXAS										1										1
	WINKLER, P	MIDDLEBURY COLLEGE									1		1		1							3
	WITT, A	U TOLEDO		1		2			1	1			1	2	1							9

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	WOLFE, A	U PITTSBURGH			1																	1
	WOLFF, R	COLUMBIA UNIVERSITY	1																			1
	WOODGATE, B	NASA - GSFC			1																	1
	WOODWARD, C	U ROCHESTER							1													1
	WOOTTEN, H	NSF - NRAO						1														1
	WORDEN, S	AIR FORCE SP.						1														1
	WORDEN, S	UC LA		1																		1
	WORRALL, D	UC SAN DIEGO			1	1	1	1														4
	WRAY, J	U TEXAS	1																			1
	WU, C	COMPUTER SCIENCES CORPORATION		4	2	3	4	5	2	3	3	1	1	1	1	1	1	1	1			34
	WYSE, R	JOHNS HOPKINS UNIVERSITY											1									1
	YORK, D	PRINCETON UNIVERSITY		1	1	2	1															5
	YORK, D	U CHICAGO						2	3	4	2	2	2	1								16
	YUSEF-ZADEH, F	NORTHWESTERN UNIVERSITY												1	1		1					3
	ZHENG, W	JOHNS HOPKINS UNIVERSITY																		1		1
	ZINN, R	YALE UNIVERSITY						1														1
	ZOLCINSKI, M	WESTERN CONNECTICUT						1														1
	ZUCKERMAN, B	UC LA								1												1
			57	120	128	148	162	207	205	205	193	176	179	145	166	129	131	130	42	80	143	2746

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