CR-203643

High Energy Astrophysics Program

Contract No.
NAS5-32490

Technical Report

for

April 1, 1995 through September 30, 1995

by

Universities Space Research Association
Mail Code 610.3
Building 26, Room 215
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Greenbelt, Maryland 20771

A Brief Summary of Task Activities under Contract NAS5-32490 During the Period of
April 1, 1995 through September 30, 1995
(individual project reports are attached on the indicated pages)
Summary notation and actual reports are sequentially listed by Task Number

SPACE SCIENCES

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SEMI-ANNUAL TECHNICAL REPORT FROM DR. STEPHEN A. DRAKE

CODE 668/LHEA:HEASARC RESEARCH SCIENTIST

1995 April 1 - September 30

WORK ACCOMPLISHED AND IN PROGRESS

(i) Science Related

I wrote as Principal Investigator (PI) 3 proposals and assisted in writing as Co-Investigator (Co-I) on 7 other proposals, all for the ASCA AO-4 Guest Investigator Program, the deadline for which was September 15 1995. These proposals will be reviewed in November 1995. Collaborators on these proposals include Rolf Mewe and Jelle Kaastra (SRON, Utrecht), Karel Schrijver and Robert Stern (LPARL), Andrea Dupree and Nancy Brickhouse (SAO), Jeremy Drake (CEA), Theodore Simon (U. Hawaii), and Nicholas White, K.P. Singh, Alex Antunes, and Michael Corcoran (GSFC). In addition, for the XTE AO-1 Guest Investigator Program, I wrote as PI one proposal and assisted in writing as Co-I on 2 other proposals, all for the deadline of April 27 1995. All of these XTE proposals were accepted and had observing time scheduled. Collaborators on these proposals include R. Stern, T. Simon, N. White, K.P. Singh, and M. Corcoran. Finally, for the ROSAT AO-6 Guest Investigator Program, I assisted in writing as Co-I on 4 proposals, all for the deadline of May 15 1995. The results of the AO-6 proposals were announced in August 1995, and targets were approved for 3 of the 4 proposals. Collaborators on the successful proposals include S. White (U. Maryland), R. Stern, T. Simon, N. White, K.P. Singh, and M. Corcoran.

I wrote in September 1995 a VLA proposal to obtain simultaneous radio data for 2 stars (Algol and HR 1099) for which we have confirmed XTE observing time (and have also requested ASCA observations for).

In July 1995 I reviewed 32 proposals submitted to the National Radio Astronomy Observatory (NRAO) for observing time on its facilities, and e-mailed my scores and comments back to NRAO on July 21.

The paper by KP Singh, myself, and Nicholas White on ASCA and ROSAT observations of Short-Period Algol Binary Stars was published in the June 1 1995 issue of ApJ. The paper by Bob Duncan [ATNF], Stephen White [U. Maryland], Jeremy Lim [Caltech], GJ Nelson [ATNF], myself, and Mukul Kundu [U. Maryland] on 'An Intense Radio Outburst from the Super-Massive Star Eta Carinae' was published in the March 10 1995 issue of ApJ. A paper by this same set of authors that included some newer data on Eta Carinae was published in the RevMexAA Conference Series. Two other papers of which I am a co-author are in press in ApJ and PASP, while four other papers of which I am either author or co-author are in conference proceedings that are in press.

In my other ongoing research, KP Singh, N. White, and I worked on:

(a) analyzing PSPC data on RS CVn and Algol binaries: we find that the X-ray emission of Algols is about a factor of 3 times weaker than that of RS CVn binaries of the same orbital period. We intend to use these data to examine the recent claim by Welty and Ramsay (1995, AJ, 109, 2187) that the Roche Lobe filling factor is an important factor that positively correlates with X-ray emission in active binary systems like RS CVn's and Algols.

(b) analyzing ASCA and EUVE spectra of the nearby active binaries AR Lac, Algol, and Capella. This project is also in collaboration with Martin Barstow [U. Leicester], and Jelle Kaastra and Rolf Mewe [SRON]. The latter 2 Dutch scientists visited the HEASARC from July 12 to 14 1995 and worked on this project with myself, K.P. Singh, and N. White.

(c) analyzing the ASCA X-ray lightcurves in hard and soft bands of the RS CVn binary AR Lac, using a 3-dimensional spatial deconvolution procedure: this work was done in collaboration with M. Siarkowski and P. Pres, the two Polish scientists who developed this technique. A paper was submitted to ApJ presenting this study and a referee's report was received. A revised version of this paper is in the process of being prepared.

(d) analyzing the ROSAT PSPC spectra of 5 active stars. We find evidence that one of these stars, actually a rather close binary containing an active giant and a white dwarf has an unusually soft X-ray spectrum that may indicate a contribution by an accretion region (in addition to the emission from the corona of the giant star).

(ii) Programmatic

I continued to monitor the WWW, anonymous ftp and Gopher services provided by the HEASARC to the scientific community. We are presently transferring data via ftp, http, and Gopher utilities at a rate of about 12.5 Gigabytes per month, while our data archive has reached a size in excess of 400 Gigabytes.

I continued to work closely with our BROWSE database creators Pat Tyler and Susan Humphrey to ensure quality control of the final product. The following 14 new databases and catalogs were made public in the period covered by this report:

Name	Description	Observatory	Updated
OPENCLUST	Catalog of Open Clusters	CATALOG	95.170
GLOBCLUST	Galactic Globular Clusters	CATALOG	95.139
MESSIER	Messier Catalog	CATALOG	95.160
DUERBECK	Galactic Novae Ref Catalog	CATALOG	95.163
CPSTARS	Gen Catalog of Ap & Am Stars	CATALOG	95.177
MARKARIAN	Markarian Galaxies Catalog	CATALOG	95.124
M31STARS	Field of M31 Bright Stars	CATALOG	95.125
ACRS	Astrographic Catalog of Refere	CATALOG	95.229
CABSCAT	Chromospherically Active Binar	CATALOG	95.206
EGRETSRC	EGRET Sources	CGRO	95.131
MPCRAW	Einstein MPC Raw Data	EINSTEIN	95.157
EUVELOG	EUVE Log of Spectrometer Point	EUVE	95.129
EXOHGLS	EXOSAT HGLS Database	EXOSAT	95.095
IRASZSURV	IRAS 1.2 Jy IRAS Redshift Surv	IRAS	95.187

A much larger number (about 40) of databases was also revised, updated, and/or corrected in this same time period.

I co-ordinated the installation of the Columbia University IPC Database and Analysis package OPED on the HEASARC's Legacy computer, working with Austin Tomaney (Columbia U) and Eric Gotthelf (GSFC). At the end of

September 1995, some data format issues remained to be solved before this installation was complete.

I researched the status of several gamma-ray burst datasets (GBD's) that the HUG Meeting in January had suggested might be added to the HEASARC's data holdings. A request to Edward Fenimore concerning the status of the Ginga GBD data was not answered. I did obtain a copy of the Ulysses GBD data from Kevin Hurley (UC Berkeley), but Jesse Allen (HSTX) and I discovered that it both contained bad data ('spikes') and was partially corrupted. These data were to be regenerated by Hurley's group but had not been received as of September 30, 1995.

I installed the SPEX X-ray and EUV Analysis package written by Rolf Mewe and Jelle Kaastra in Legacy's anonymous ftp area so that the user community could for the first time obtain their own copies of this important software.

NON-LOCAL TRAVEL

At the invitation of Dale Cary (Caltech), I attended the Solar Radio Telescope Workshop held in San Juan Capistrano, CA from April 17 through 20 1995 and chaired a group of radio astronomers which studied the uses of such a facility during the night, i.e., for non-solar observations. After the meeting, George Dulk (Meudon Observatory, France) and I prepared a short report summarizing our conclusions on this topic [See attached copy].

WORK PLANNED FOR NEXT SIX MONTHS

I have been asked to give a review talk on coronal abundances at the 6th Annual Maryland Astrophysics Conference on Cosmic Abundances that will be held in College Park, Md in early October 1995.

I will continue my research into the coronae of stars using hard X-ray, soft X-ray, extreme-ultraviolet, and radio observations as probes of their physical environments.

I will continue overseeing the anonymous ftp account on HEASARC's LEGACY computer, as well as the HEASARC's ADS node, and the request@legacy user hotline. I will continue monitoring our creation of BROWSE databases and catalogs.

I will co-ordinate the installation of the TOPBASE database of atomic database on our computers and its being made available to the external user community via a captive account and/or a WWW interface. This database will be a copy of the one installed at CDS in Strasburg, France, and will make it much easier for US users to access these important data.

UNIVERSITIES SPACE RESEARCH ASSOCIATION
GODDARD VISITING SCIENTIST PROGRAM

SEMI-ANNUAL TECHNICAL REPORT
1995 Apr 01 – 1995 Sept 30

Employee Name: Ian M George Activity: 5030-01A-39

1 Programatic Activities

1.1 CALDB Infrastructure & Access

Maintanence & development of the *OGIP Calibration Database* has continued. Unfortunately this activity has been adversely affected by the loss of the "CALDB-programmer", Ron Zellar, in late June. A replacement has been found (via HSTX) and is currently scheduled to start in 1995 Oct.

Datasets & documentation continue to be delivered to the "CALDB" by the various instrument teams and GOFs of current mission, as well as by HEASARC personnel (including myself) responsible for the restoration/conversion of data from old missions.

As of 1995 Sept 30, the total size of the CALDB was 1.3 Gbytes, dominated by 1164 data files (1.2 Gbyte) and 265 document files (54.4 Mbyte). The entire database has remained on-line throughout the quarter via the `legacy.gsfc.nasa.gov` computer, and available world-wide via anonymous ftp, WWW *etc.* The number of files taken from the database per month continues to be rather erratic, reflecting the erratic delivery of new files.

The major project for the next 6 months is to make the installation and maintenance of the CALDB as easy as possible at remote sites. The necessary groundwork was completed by Ron Zellar, prior to his departure, but a significant fraction of the 'nitty-gritty' development remains. Progress will be almost solely dependent upon obtaining good programmer support.

1.2 Software

Work has continued to develop calibration software tasks under the FTOOLS umbrella. Within the most recent FTOOLS distribution (v3.4; scheduled for release in 1995 Oct), I contributed the following task:

- `ftools/caltools/col2img` - Converts a 3-D collimator response dataset (X,Y,Energy) to an image with user-defined spatial & energy ranges for diagnostic/visualization purposes.

I continued maintenance of tasks previously delivered by myself, which included significant enhancements to the following:

- `ftools/heasarc/mathpha` - Added improved functionality regarding the treatment of the `AREASCAL` parameters, the 'anciliary' files and gave the user a higher degree of control over the error prescription they wished to use.

I also supervised OGIP programmers (Tripicco, Yusaf, Zellar) and members of the *XTE* GOF (Lochner) in the design and writing of several other tasks

With the loss of Zellar, I have also taken over responsibility of the tasks for which he was formally responsible, namely:

- `ftools/caltools/brcaldb` – interactive browser for the CALDB data holdings
- `ftools/caltools/crcif` – creates an empty Calibration Index File
- `ftools/caltools/mkcaldb` – create a Calibration Database
- `ftools/caltools/mkcaldir` – create a Caldb directory structure
- `ftools/caltools/mkcalinit` – create a `caldbinit` file
- `ftools/caltools/quzcif` – interrogates CALDB for location of a dataset
- `ftools/caltools/stcal` – stores one or more calibration files in the CALDB
- `ftools/caltools/udcif` – adds a calibration file to a CIF

1.3 FITS File Formats

Over this reporting-period I continued to serve as the secretary of the HEASARC FITS working Group (HFWG - formally known as the OGIP FITS Working Group), taking and distributing the minutes from the meetings along with maintaining the HFWG-related ftp and WWW areas within the HEASARC's on-line service.

2 Personal Research Activities

2.1 Scientific Research

During this reporting-period, Paul Nandra arrived at NASA/GSFC on a 2 year NRC position. Paul is a long-time collaborator of mine, and we hope that his presence within the LHEA will enable us to increase the number & variety of collaborations (also with Turner & Yaqoob) in the future. A number of research projects have already been started, including a complete analysis

of all the AGN observed by *ASCA* during the PV and AO-1 mission phases. A 'quick' paper reporting the results from a an *ASCA* observation of the quasar PG 1116+215 has already been submitted for publication.

In collaroration with Turner (USRA) & Netzer (Tel Aviv, Israel), a paper reporting the results from an *ASCA* observation of the Seyfert-1 Galaxy EXO 055620-3820.2 has been submitted for publication. We find the source spectrum to exhibit a complex structure below 2 keV, indicating that the continuum is attenuated either by an ionized absorber fully or partially covering the X-ray source, or a neutral absorber partially-covering the source. While the X-ray data alone do not allow us to distinguish between these models, consideration of the optical properties of this highly reddened nucleus suggests that partial-covering by neutral material is unlikely, as it implies an unusually large intrinsic optical flux. The partial-covering models leave a residual soft excess below 1 keV, and the possible origin of this soft emission is discussed. We also detect an iron *K*-shell emission line, which appears to be significantly broad, with an equivalent width (~300 eV) exceeding that predicted from the absorbing material along the line–of–sight. The line is consistent with emission from neutral iron, and we find a FWHM for the line of 31,000 – 77,000 km s^{-1}, similar to several other Seyfert spectra reported recently.

In collaboration with Turner (USRA), a paper reporting the results from serendipitous *ROSAT*& *ASCA* observations of the BL Lac Object EXO 055625-3838.6 has been accepted for publication. We find a simple powerlaw of photon index of $\Gamma \sim 2.5$ fits both (non-simulataneous) datasets absorbed by the 21cm column. We estimate that this BL Lac is unlikely to have contributed significantly to the HEAO-1 observation of the nearby bright Seyfert which is a member of the Piccinotti sample.

2.2 Proposal News

The results of several proposal evaluations were made public during this reporting-period. Happily, the following proposals for which I was Principle Investigator were awarded observing time:

1. CGRO Cycle-5
   The Orgin of the Continuum Emission in Seyferts ($15000 awarded)
2. XTE AO-1
   The Origin of the Continuum Emission in Seyferts (funding yet to be announced)
3. IUE 19th Year
   IUE Observations of 2 XUV-Bright Seyferts (no funding available)

A number of other proposals for which I was a co-Investigator were also successful.

2.3 Papers Published/Accepted
(in the 6 months ending 1995 Sept 30)

(NOTE: Due to the long turn-around time taken for papers submitted to refereed journals, most of the following scientific papers will have appeared in earlier annual & semi-annual reports as submitted/not accepted papers.)

2.3.1 Refereed Journals

1. **ASCA and ROSAT Observations of NRAO 140 and IX Per**
   Turner, T.J., George, I.M., Madejski, G.M., Kitamoto, S. & Suzuki, T.,
   1995. *Astrophys. J.*, **445**, 660.

2.3.2 Non-Refereed Journals, Conference Proceedings etc:

None

2.3.3 Other Articles

1. **Recent Updates to GRPPHA**
   Yusaf, R., George, I.M., 1995. *Legacy*, **6**, 40.

2.4 Papers Submitted, not yet accepted by Refereed Journals
(in the 6 months ending 1995 Sept 30)

1. **The X-ray Spectrum of the BL Lac Object EXO 055625-3838.6**
   George, I.M., Turner, T.J.,
   1996. *Astrophys. J.*, submitted.
2. **Complex Absorptionn in the Seyfert-1 Galaxy EXO 055620-3820.2**
   Turner, T.J., Netzer, H., George, I.M.
   1996. *Astrophys. J.*, submitted.
3. **Evidence for a Highly Ionized Iron Emission Line in the QSO PG 1116+215**
   Nandra, K., George, I.M., Turner, T.J., Fukazawa, Y.,
   1996. *Astrophys. J.*, submitted.

3 Non-Local Travel

None

4 Work Planned for the period 1995 Oct 01 – 1996 Mar 31

Below are the major activities pending my attention and scheduled to be worked on (though not necessarily completed) in the next 6 months:

- CALDB infrastructure/design *etc*
  - ensure the installation and maintenance of a CALDB at a remote site is as straightforward as possible (which will most likely entail a significant amount of platform-specific scripting).
  - supervise the CALDB-related training of the new (HSTX) "CALDB-programmer" (scheduled to start 1995 Oct, as replacement for Ron Zellar)
  - a large number of CALDB-related documents and on-line information sources (eg ftp, WWW) require review and up-dating.
- Software design, development and delivery:
  - **ftools/caltools/caldbool** - a tool to allow allow calibration datasets to be indicated as on-line or off-line within CIFs.
  - **ftools/einstein/sssbck** - a background-generator for the *Einstein* SSS instrument
  - **ftools/einstein/sssrmg** - a response matrix generator for the *Einstein* SSS instrument
  - **ftools/exosat/mermg** - a response matrix generator for the *EXOSAT* ME instrument (to be adapted from the XANADU VIMAT package)
- FITS file formats & the HFWG
  - continued review & development of file formats
  - continued maintenance of HFWG ftp & WWW pages
- Archival Data Restoration
  conversion to FITS format of the following datasets:
  - *EXOSAT* CMA PHA files and response matrices
  - *EXOSAT* TGS PHA files and response matrices
  - *Einstein* OGS PHA files and response matrices
  - *HEAO-1* A-2 PHA files and response matrices
- Personal Scientific Research
  - continued scientific analysis and publication of recently obtained *ROSAT*, *ASCA* and *IUE* (and potentially *XTE*) datasets

To: Crystal Wheatley
From: Dr. M. F. Corcoran
Activity: 5030-02A-39
Subj: Semi-Annual Technical report, 1 Apr 1995 - 30 Sep 1995
Date: 27 Oct 1995

PROGRAMMATIC ACTIVITIES ACCOMPLISHED

1) ROSAT public archive

a) Supervision of data ingest into the NDADS archive is continuing. In this period 157 US ROSAT datasets and 158 German/UK ROSAT data sets were released to the archive. An agreement was reached between the US, German and UK archives that REV2 data will only be archived as RDF version 3.4 or later. The need to re-FITS convert some REV2 data to this RDF version has delayed release of some of the REV2 data.

b) Public ROSAT data sets have been moved to the HEASARC jukebox attached to the legacy machine, using software implemented in the previous period. In this period this included all data released to NDADS.

c) the ROSAT archive data lists have been updated to reflect recent ingests.

d) Number of e-mail communications during this period: 534, including user comments, data release and archive maintenance communications.

2) ROSAT Results Archive

a) I continued development of the RRA screening software for the HRI data. 13 versions were released during this period. The latest verision, hvi2.5.4, incorporates comments from other users, the latest flag definitions, and includes fixes for all known bugs. HVI2.5.4 is the final production version.

b) The data transfer pipeline has been designed by myself, Sumant Krishnaswamy, and John Silverman (SAO). Silverman has written software to transfer data from the GSFC RSDC to the screening sights and to move screened data back to the RSDC. I've installed and tested this software at GSFC.

c) I've written an introduction to the RRA activities and made this available on the www (ftp://heasarc.gsfc.nasa.gov/rosat/data/qsrc/www/RRA.html). This includes the RRA operator manual (by D. Harris, SAO) and a detailed comparison of differences in source flagging between the various RRA checkers (compiled by me).

d) I've installed the PSPC software for RRA checking (written by T. Boller, MPE) and have tested it.

e) I've been training Mike Arida in RRA screening, since he'll be doing a portion of the screening at GSFC.

f) Number of e-mail communications during this period concerning Results Archive matters: 808

3) Rationalized FITS development for ROSAT

a) RDF 3.4 was released during this period. These included bug fixes and additional data output requested by MPE. RDF 3.4 represents the final archive format for ROSAT data.

b) Number of e-mail communications during this period concerning rationalized FITS development: 93

c) I've converted the PSPC aluminum calibration data to RDF format and made these data available via anonymous ftp from the legacy.gsfc.nasa.gov server.

3) OGIP FITS working group

a) The OFWG has continued roughly bi-weekly meetings to discuss FITS issues in the OGIP.

b) number of e-mail communications regarding FITS issues: 59

4) RGOF/HEASARC duties

a) The RGOF continued its series of bi-weekly meetings

b) number of e-mail communications regarding RGOF issues: approximately 266, including user questions and internal RGOF problems.

c) The 4th volume of ROSAT images on CDROM were created. These CDROMS were distributed at the June AAS meeting in Pittsburgh.

d) Provided RGOF support to M. Smith during this period, and remote support to H. Waite's analysis of HRI images of the Jupiter-Shoemaker Levy comet impact.

e) Provided technical support to the ROSAT AO6 peer review.

5) Software Development

a) I wrote and tested routines to convert German-formatted PSPC and HRI data to US data format. Conversion of the German data is done periodically on the legacy jukebox.

b) I developed the final version of the graphical user interface to allow for quick checking of source reliability as part of the quality checking phase of the RRA construction.

c) I wrote/tested software to convert the SASS-formatted Al calibration data to RDF format.

d) wrote software to generate optical sky maps for all archived ROSAT data. The skymap generation is ongoing.

TRAVEL

1) Attended the Jun 95 AAS meeting in Pittsburgh and presented a poster on recent X-ray observations of Eta Car.

PAPERS

PUBLISHED:

"First Detection of X-Ray Variability in η Carina", M. F. Corcoran, G. L. Rawley, J. H. Swank and R. Petre, ApJL, 445, L121.

"The Carina Nebula in X-rays", M. F. Corcoran, J. Swank, G. Rawley, R. Petre, J. Schmitt, and C. Day, Rev. Mex. Conf. Ser., 2, 97.

"The ROSAT PSPC Survey of Wolf-Rayet Stars", A. M. T. Pollock, F. W. Haberl, and M. F. Corcoran, in *Wolf-Rayet Stars: Binaries, Colliding Winds, Evolution*, ed. van der Hucht, K, and Williams, P. (Kluwer:Dordrecht), p. 512.

"ASCA X-ray Spectroscopy of WR 140 Near Periastron", A. M. T. Pollock, M. F. Corcoran, I. R. Stevens, P. M. Williams, and K. van der Hucht, in *Wolf-Rayet Stars:*

Binaries, Colliding Winds, Evolution, ed. van Der Hucht, K, and Williams, P. (Kluwer:Dordrecht), p. 510.

"ASCA Observations of Colliding Stellar Winds in Gamma Velorum", Stevens, I. R., Skinner, S. L., Nagase, F., Corcoran, M. F., Willis, A.J., Pollock, A. M. T., and Koyama, K., Ap&SS, 224, 569.

SUBMITTED:
"X-ray Variability in V444 Cygni - Evidence for Colliding Winds", M. F. Corcoran, I. R. Stevens, A. M. T. Pollock, J. H. Swank, S. N. Shore, and G. L. Rawley, ApJ, submitted.

PROPOSALS SUBMITTED/AWARDED

I was the PI on a successful XTE AO1 proposal to observe Eta Car ($16 K awarded).

I was PI on a ROSAT AO6 proposal to observe Eta Car with the HRI which was accepted as a priority "C" observation.

I've submitted a proposal to observe Eta Car with ASCA as part of the AO4 cycle.

I'm co-I on a proposal to observe 4U 1700-37 with ASCA (Vritilek PI).

PLANNED ACTIVITIES

1) Begin screening of data and population of ROSAT Results Archive.

2) Continue supervision of ROSAT Public Archive including ingest of WG data and ingest of REV2 data (the final archive product).

3) Continue guest observer support activities

5) Publish results of analysis of ROSAT observations of Sco OB1 and Cyg OB2 and ASCA observations of Gamma Vel, HD 153919 and Zeta Ori

Dr. Steven L. Snowden
26 October 1995

USRA Semi-Annual Technical Report
Task Number: 5030-02A-39
1 April – 31 September 1995

Code 666, Laboratory for High Energy Astrophysics
ROSAT Guest Observer Facility

Programmatic Work

I've continued to maintain the ESAS (Extended Source Analysis Software for the analysis of *ROSAT* PSPC observations of extended sources and the diffuse X-ray background) package which I've discussed in previous reports. I also have the responsibility for answering questions concerning the use of the software and the interpretation of the output. The response continues to be very positive with use being made of the software by GOs both at GSFC and at other institutions. I am continuing to improve the documentation and have added functionality to the package.

The reduction of *ROSAT* trend data (diagnostic information for both the PSPC and HRI in more useful format) continues in production mode in step with both the SASS reprocessing of old data and processing of new data. The processing is becoming considerably more automated but there has arisen a important secondary benefit derived from a close monitoring of the TREND status. Occasionally observations fall through cracks in the SASS bookkeeping and are missed. Since all observations for a given day must be processed before the TREND analysis can be completed, I've been able to identify a number of these missed observations and have forwarded the information to the appropriate people. At present, 896 days ($\sim$ 50% of the current total) have been processed.

Ian George, Jane Turner, and myself have started making progress in the spectral calibration of the PSPC. Using both ground and in-flight calibration data and observations of astrophysical sources, we are parameterizing the spatial and temporal variation of the gain. An FTOOL will be included in the next release which will correct an error in the SASS processing. During my September/October trip to Germany I had discussions with both Peter Predehl and Almudena Prieto about the status of their calibration work. Unfortunately, most of the work will need to be done here at GSFC.

We carried out a successful AO-6 review where I provided technical support at the peer review and attended the IUC meeting.

Scientific Work

In this half year, the two papers that had been submitted and resubmitted for publication (last report) have been accepted for publication. I've had three co-authored papers submitted for publication.

The September/October trip to Germany served many purposes. I was able to attend the high-energy astrophysics conference in Würzburg where I presented an invited review talk on the link between the soft X-ray background and the interstellar medium. While at MPE I had extensive discussions concerning the reprocessing of the all-sky survey data and who would do what, where. Discussions were also held on the scientific analysis which needs to be done and the papers which need to be written.

I continue organizing a monthly seminar where the graduate students associated with

the lab present progress reports on their work. This seminar seems to be working well with a reasonably good turn out by lab personnel. The graduate students are getting experience in presenting their work and the lab gets to hear what they are doing. It has also been used as a forum for one graduate student to give her thesis defence to a test audience.

Travel

The last half year saw two trips to Germany (one for the *ROSAT* International Users Committee meeting and one for the Würzburg meeting) and a trip to Northwestern University to give a seminar.

Plans for the Next Half Year

The focus of the next half year will again be on the spectral calibration of the PSPC. Trend processing will continue but with a smaller time committment. The preparation of documentation for the *ROSAT* project will also continue but at a reduced level.

I expect no travel in the next six months.

Scientifically, I have several papers on which I hope to make progress and I will work on the reprocessing of the *ROSAT* survey data.

Return-Path: <DHold>
Date: Thu, 26 Oct 1995 15:37:45 -0400
X-Sender: dhold@phoenix.gvsp.usra.edu
To: cwheat
From: DHold (David V. Holdridge)
Subject: 6 monthly report

>Return-Path: <TURNER@LHEAVX.GSFC.NASA.GOV>
>Date: Thu, 26 Oct 1995 13:58:45 -0400 (EDT)
>From: CONFUSED OF NEASDEN <TURNER@LHEAVX.GSFC.NASA.GOV>
>To: DHold@gvsp.usra.edu
>Subject: 6 monthly report
>
>
>6 Month Report for March 31 1995 - Sept 30 1995
>
>T.Jane Turner
>task number: 93-02-00
>
>Observing Proposals:
>_____
>
>
>ASCA AO4:
>---------
>
>I submitted the following ASCA observing proposals as PI, these were entitled
>
>"An ASCA observation of Spectral Variability in ESO198-G24"
>
>"ASCA OBSERVATIONS OF BRIGHT EMSS AGN "
>
>"ASCA/XTE OBSERVATION OF NGC2992: deconvolving the primary continuum
> and reprocessing components "
>
>"Simultaneous ASCA/XTE/IUE Observations of XUV-BRIGHT SEYFERTS "
>
>I am a co-i on ~12 other ASCA proposals for AO4
>
>XTE AO1:
>--------
>
>I was awarded XTE time as PI in AO1 with:
>
>"XTE Observations of XUV-Bright Seyferts"

>
>I was a co-i on a large number of other successful XTE proposals
>
>
>
>Project Support
>_____
>
>Within the most recent FTOOLS distribution (v3.4; scheduled for
>release in 1995 Oct), I contributed the fortran core of the task
>PCPICOR, converted to an ftool by OGIP programmer R.Yusaf (STX).
>
>
>PCPICOR is a task to correct for an error which occurs in the SASS
>telemetry data -> PI dataset processing. SASS currently misapplies the
>spatial gain correction in the PHA->PI conversion process. PCPICOR
>recalculates the correct PI values and repopulates the appropriate column
>in the output events file.
>
>
>
>I have continued working with visiting Guest Observers and at the moment handle
>~ 3 email queries per day on ROSAT issues. A significant
>amount of time is spent answering email and phone queries on data analysis
>issues and software problems.
>
>I am training a new ROSAT data tech, Mike Arida (STX), who will be able to
>help Guest Observers with their analysis.
>
>
>Scientific Interests
>----------
>
>Work In Progress:
>
>Analysis of ASCA observations of Mkn290.
>----------
>The ASCA data for Mkn290 have revealed a complex soft X-ray spectrum.
>The spectrum is well-described by a warm absorber, and the source spectral
>variability can be explained by a simple change in the ionization-state of
>this material, on a timescale of about 10,000 seconds. This is the only
>source seen to exhibit a rapid response in the ionized absorber to a change
>in the flux of the continuum source. Such a rapid response should yield
>tight new constraints on the location and density of the ionized
>reprocessing material.
>
>

>Papers Submitted, not yet accepted by Refereed Journals
>(in the 6 months ending 1995 Sept 30)}
>
>
>
>
>The X-ray Spectrum of the BL Lac Object EXO 055625-3838.6,
>George, I.M., Turner, T.J., 1996. ApJ, accepted.
>
>"A paper reporting the results from serendipitous ROSAT & ASCA
>observations of the BL Lac Object EXO 055625-3838.6 has been accepted for
>publication. We find a simple powerlaw of photon index of 2.5
>fits both (non-simulataneous) datasets absorbed by the 21cm column. We
>estimate that this BL Lac is unlikely to have contributed significantly to
>the HEAO-1 observation of the nearby bright Seyfert which is a member of
>the Piccinotti sample."
>
>
>
>Complex Absorption in the Seyfert-1 Galaxy EXO 055620-3820.2,
>Turner, T.J., Netzer, H., George, I.M, 1996. ApJ, submitted.
>
>"The first uncontaminated hard X-ray spectrum of the Seyfert 1 galaxy
>EXO055620-3820.2 shows complex structure below 2 keV, indicative of
>attenuation either by an ionized absorber fully or partially covering the
>X-ray source, or a neutral absorber partially-covering the source. While
>the X-ray data alone do not allow us to distinguish between these models,
>consideration of the optical properties of the source suggests that
>partial-covering by neutral material is unlikely, as the implied intrinsic
>optical flux would be unusually large. The full-covering ionized absorber
>model is the preferred explanation for EXO-055620-3820.2, from the point
>of view of its simplicity. In addition to the complex absorber, we find
>evidence for a full-covering screen of neutral material, which is
>consistent with the column implied by optical reddening. We also detect an
>iron K-shell emission line, which appears to be significantly broad and
>whose equivalent width of 300 eV exceeds that predicted to arise in the
>absorbing material, as for many other Seyfert spectra recently reported. We
>find a FWHM for the line of 31,000 -- 77,000 km/s."
>
>
>Evidence for a Highly Ionized Iron Emission Line in the QSO PG 1116+215,
>Nandra, K., George, I.M., Turner, T.J., Fukazawa, Y., 1996. ApJ, submitted.
>
>"We present an ASCA spectrum of the radio-quiet quasar PG 1116+215 (z=0.
>177),which shows evidence for line emission around the iron K-shell complex
>in the rest frame of the source. Such emission is common in Seyfert
>galaxies and is attributed to fluorescence in an accretion disk rotating
>around a central black hole. Unlike the Seyferts, however, the best-fit

>energy of the emission line in PG 1116+215 is higher than the 6.4 keV
>expected of neutral material. This implies that the accretion disk in this
>source is ionized. This may be expected, as the high ratio of UV/X-ray
>luminosity of this source indicates that it is radiating at a substantial
>fraction of the Eddington limit."
>
>
>
>Papers Published/Accepted
>(in the 6 months ending 1995 Sept 30)
>_____
>
>(NOTE: Due to the long turn-around time taken for papers submitted to
>refereed journals, most of the following scientific papers will have
>appeared in earlier annual & semi-annual reports as submitted/not accepted
>papers.)
>
>Refereed Journals
>----------
>ASCA and ROSAT Observations of NRAO 140 and IX Per
>Turner, T.J., George, I.M., Madejski, G.M., Kitamoto, S. & Suzuki, T.,
>1995. ApJ, 445, 660.
>
>
>
>Work Planned for the Next 6 Months
>_____
>
>We will refine the PCPICOR ftool to include corrections for temporal gain
>shift errors.
>
>We will analyze the ASCA observation of the Narrow Emission Line Galaxy
>NGC526A (scheduled for observation by ASCA in DEcember 1995).
>
>We will work on systematic analysis of AGN from the PV and AO1 phases of
>the ASCA mission (now public data).
>
>
>
>
David V. Holdridge
Project Manager
Universities Space Research Association
High Energy Astrophysics Program

Return-Path: <DHold>
Date: Tue, 31 Oct 1995 13:51:44 -0500
X-Sender: dhold@phoenix.gvsp.usra.edu
To: cwheat
From: DHold (David V. Holdridge)
Subject: semi-annual report for April 1995 to September1995

>Return-Path: <ebisawa@subaru.gsfc.nasa.gov>
>Date: Fri, 27 Oct 1995 18:07:07 -0400
>From: Ken Ebisawa <ebisawa@subaru.gsfc.nasa.gov>
>To: dhold@gvsp.usra.edu
>Cc: ebisawa@subaru.gsfc.nasa.gov
>Subject: semi-annual report for April 1995 to September1995
>
>Technical Report for the period from April 1995 to September 1995
>
>Ken Ebisawa, code 660.2, ASCA GOF
>
>////////////
>
>PROJECT WORK
>
># Helped ASCA observations for US guest observers.
>
># Answered questions from US ASCA guest observers regarding
> ASCA data analysis and calibration.
>
># With other members of the ASCA GOF, developed the ASCA GOF
> mosaic page, which is accessible through WWW.
>
>SCIENTIFIC RESEARCH
>
># Submitted two XTE AO1 observation proposals, and they were accepted.
>
># Submitted three ASCA AO4 proposals (pending).
>
># Analyzed ASCA Cyg X-1 data and preparing a publication.
>
># Analyzed ASCA Cen X-3 data and preparing a publication.
>
># Analyzed ASCA GRO1655 data with Y. Ueda et al., and the publication
> is being prepared by Y. Ueda.
>
># Submitted a paper 'On the spectral slopes of hard x-ray emission from
> black hole candidates' to PASJ letter. This is a collaboration with
> Lev Titarchuk and Sandip Chakrabarti.
>

>\# Participated in the 186th AAS meeting in June at Pittsburgh, and
> presented a poster paper with the title,
> "X-ray Spectroscopy of the Super-soft Source RXJ0925.7-475".
>
>\# Participate in the international meeting at Wurtzburg in Germany
> in September 25-29, and gave an oral presentation with the title
> "X-ray Spectroscopy of the Super-soft Source RXJ0925.7-475".
>
>SCIENTIFIC SERVICE WORK
>
>\# Participated in the XTE AO1 review as a panelist in July.
>
>////////////////
>
>WORK PLAN IN THE NEXT 6 MONTHS
>
>PROJECTS:
>\# Write following programs/tools for ASCA data analysis;
> addarf ftool,
> binary orbital motion correction ftool,
> light curve deadtime correction ftool,
> SIS pile-up correction tool,
> GIS blank sky background production tool.
>
>\# Participate in the ASCA calibration meeting and Astro-E
> software meeting in December at ISAS, Japan.
>
>SCIENCE:
>\# Submit Cyg X-1 paper and Cen X-3 paper to refereed journal.
>
>\# Work on ASCA RXJ0925.7-475 data and prepare publication.
>
>\# Work on ASCA GRS1915+15 data and prepare publication.
>
>\# Visit Marshall Space Flight Center to give a seminar in November.
>
>\# Participate in the 'Black Hole X-ray Transients' meeting
> in Jan 21-27, 1996 at Aspen, CO.
>
>\# Participate in the super-soft source workshop at MPE
> in Germany in the end of February 1996.
>
>\# Participate in the 'X-ray Imaging and Spectroscopy of
> Cosmic Hot Plasmas' meeting in March 11-14 in Japan.
>
>
>

Return-Path: <mukai@rosserv.gsfc.nasa.gov>
Date: Tue, 24 Oct 1995 16:09:24 -0400
From: Koji Mukai <mukai@rosserv.gsfc.nasa.gov>
To: cwheat@gvsp.usra.edu
Subject: Semiannual rereport, Apr-Sep 95

Technical Report 1995 April 1 - 1995 September 30
Koji Mukai (Task number: 93-03-00)

ASCA Matters:

There were few GOs visiting ASCA GOF at Goddard, but our e-mail helpdesk activity continued to occupy a significant fraction of our time. This also included troubleshooting of problems discovered by the processing team. In particular, I revised the program "mkfilter2" to make it more robust, which was necessary due to a problem in another program (mkfilter2 collects the critical information and stores it in an easy-to-use format).

NASA Research Announcement for the ASCA AO-4 cycle was released and, towards the Aug 15th deadline, generated a significant (though not overwhelming) amount of questions. Proposal review related activities have not started to demand our time yet, as of end of September.

On Sep 8th, people involved in ASCA, HST and XTE mission planning activities met at STScI in Baltimore to discuss how to handle coordinated observations among these 3 satellites. We exchanged information on satellite constraints, how mission planning is done, and discussed individual observations that are to be coordinated. We expect future coordinated observations to be carried out more smoothly as a result of this meeting.

Science:

There were several other proposal deadlines during this 6-months period, besides ASCA: XTE, ROSAT and HST. In chronological order, I was the PI of 3 XTE proposals (all accepted), 1 ROSAT proposal (accepted as type C target, so may or may not get done), and 3 ASCA proposals (review pending); I was a co-I on more than 10 proposals, with different degrees of contribution.

I attended IAU Colloquium 158, "Cataclysmic Variables and Related Objects," at Keele, UK, during 1995 June 26-30. I presented results from the ASCA observation of HT Cas, which was well received by the ~170 participants of the conference. Following the meeting, I spent an extra few days at Keele discussing collaborative projects with Drs. Naylor, Wood, Hellier and Ringwald, as well as Mr. Sommers; I also visited The Open University, UK, to discuss ASCA data on magnetic CVs with Drs. Norton and Beardmore,

and Mr. Taylor.

Mr. Ryuichi Fujimoto (ISAS) visited GSFC for 3 weeks in August for collaborative research into magnetic cataclysmic variables using ASCA data. We made a substantial progress, although we did not quite reach the point of drafting a paper; this was partly due to the limited quality of some of the datasets we looked at, and partly because we ran out of time.

Coming attractions:

ASCA AO-4 proposal review will be held in Laurel, MD, Nov 14-16; following the US-Japanese merging meeting at ISAS, Japan on Dec 4-5, there will be ASCA calibration and ASTRO-E software meetings at ISAS, which I am planning to attend. I will present a poster paper at the winter AAS meeting in San Antonio (mid Jan, 1996), as well as helping the booth activities.

James Lochner
LHEA Office of Guest Investigator Programs
Code 668.0
(Activity 5030-04A-39)

Semi-annual Report
April 1 - Sept 30, 1995

During this second semi-annual period, I continued concentrating my efforts to the development of the XTE GOF software and design. The major tasks included designing and implementing the response matrix tools for the PCA, implementing and testing the ASM Data Products, developing a plan for distribution of the ASM Products, implementing the interface with HEASARC's calibration database, and supporting the first XTE Announcement of Opportunity. In another area, I expanded the GOF's outreach program by mentoring a high school physics teacher during the summer.

Starting in May, 1995, I led a team consisting of myself, Keith Jahoda (PCA Team/GSFC), Tod Strohmeyer (PCA Team/USRA), and Ian George (HEASARC/USRA) to design and implement the software necessary to create response matrices appropriate for PCA observations. These response matrices must be compatible with the particular observation and compatible with the XSPEC spectral analysis package. We met weekly over the course of two months to clarify the necessary elements of the design and to discuss the individual software tools necessary to accomplish the task. Jahoda provided the tool to create fundamental response matrices; George provided the necessary modifications to existing tools to rebin the matrix to the appropriate channel binning; Strohmeyer supplied the necessary transformations for determining the position of the source in the instrument's field of view and the collimator response data for the instrument; George also provided the software for reading and interpreting the collimator response data. I wrote the tool for creating the accompanying effective area file, as well a number of smaller tools for reading certain information from the input pha file. Along the way, I also wrote a general purpose tool for transferring a column from one FITS file to another. Finally, I also developed the overall framework for tying these tools together into a perl script. By the end of this semi-annual period, all these tools were completed, tested on the standard mode PCA data, and delivered to the FTOOLS team for installation in the FTOOLS package. In the coming months, we will continue to test the tools, upgrade their interfaces to work with files installed in HEASARC's calibration database, and provide modifications as necessary.

I also continued to oversee the development of the calibration tools from the HEXTE team. These have been much slower in coming, but the HEXTE folks are now devoting their attention to these tools, and taking lessons from our experience with the PCA team. During separate visits to GSFC by Phil Blanco and Duane Gruber, we discussed the plan for the HEXTE response matrix builder and the construction of HEXTE background spectra. The HEXTE team is scheduled to deliver the first of their calibration tools early in the next semi-annual period.

On the homefront, Ian George and I continued to develop and exercise the interface between the GOF and the HEASARC's calibration database, CALDB. Having established a staging area for the delivery of calibration products from the GOF to the CALDB, we tested it through a number of pre-launch deliveries. In the coming months, these pre-launch deliveries will enable me to upgrade the GOF's calibration software to retrieve data files directly from the CALDB.

During this semi-annual period, I worked with Ron Remillard (MIT) on the implementation of the data products for the All Sky Monitor. These products provide light curves and auxiliary information in a user-friendly manner. Having established the FITS formats for these products, I assisted Dr. Remillard by providing guidelines for writing these data products in the FITS formats. Once his software ran successfully, we tested it on samples of outputs from the ASM analysis software. I also directed our GOF programmer, Brian Elza (STX), in the development of a tool to append MIT's weekly results onto master files containing the light curves from the beginning of the mission. Remillard and I had a number of meetings to discuss the pipelining of these products from their point of origin to their ultimate resting place in a publicly accessible archive. This entails interfacing not only with XSDC (Code 631) for the "definitive" versions of the products, but also with the SOF for the quicklook versions.

I also took up the interface with the HEASARC for making these products publicly available. Tom McGlynn (USRA) is heading this effort from the HEASARC side. The HEASARC agreed to receive the definitive products from XSDC and make them available via ftp and the World Wide Web. They also agreed to receive ascii quicklook results from the SOF, convert them to FITS files using the MIT tools, and update the quicklook light curves. More importantly, they offered to provide orbit-by-orbit source intensity results to the community via the Web. This is a welcome additional feature to the public data that the GOF does not have the resources to perform.

In the coming months, I will continue to oversee these various interfaces for bringing the ASM Data products to the public.

This semi-annual period also saw the deadline for the first XTE Announcement of Opportunity

for proposed XTE observations. During the month of April, I not only participated in writing a number of proposals, but I also assisted proposers by answering questions that came via the XTENRA email. Once the proposals were in, I performed my duties to support the peer review process, and subsequently followed up some accepted proposals to clarify the proposers intent.

I participated heavily in submitting proposals to XTE's AO-1. I was PI on a proposal to study Be-neutron star transients in the Small Magellanic Cloud. I was an active Co-I on four other proposals: one with Laura Whitlock (USRA) for examining the transients 4U0115 and V0332 ; another with Dr. Whitlock for two observations of Cir X-1; the third with Jean and Warren for Cyg X-1; and finally a proposal with Tom Bridgman (USRA) for variability studies of GX 339-4 and LMC X-3. I was also a Co-I on proposals for x-ray novae, the transient 4U1608-52, and SN 1987a. All of these proposals, except the one with Bridgman, were accepted to one degree or another.

During this past semi-annual period, I took an active role in the GOF's educational outreach effort by mentoring a high school physics teacher, James Humphreys (Elenor Roosevelt H.S.), under GSFC's Summer Teacher Intern Program during July and Aug. I provided him opportunities to learn about XTE, to see the PCA hardware and other hardware projects done in LHEA, and to talk with other scientists in the lab. Working with the HEASARC's database of x-ray data, he developed lesson plans illustrating the basics of x-ray timing analysis, along with the interesting physics of x-ray emitting objects. I gained a better understanding of how to package material for the educational community, and the realistic uses of the internet and the Web for making these materials available.

The most important event in the coming months is the anticipated launch of XTE. I expect to remain busy completing necessary software for providing calibrated observations to the instrument teams and guest observers, overseeing the delivery of ASM products to the public archive, writing appropriate documentation for such tasks, and beginning to support guest observers.

Return-Path: <zhang@xancus10.gsfc.nasa.gov>
From: William Zhang <zhang@xancus10.gsfc.nasa.gov>
Subject: Technical report
To: cwheat@gvsp.usra.edu (Crystal Wheatley)
Date: Fri, 27 Oct 1995 08:20:02 -0400 (EDT)
Cc: dhold@phoenix.gvsp.usra.edu (David Holdridge)
Content-Length: 6800

Crystal,

Here is my report covering the period from April 1 through Sept. 30.

Thanks,
Will Zhang

Semi-Annual Report: 1 April 1995--30 September 1995

This report briefly describes my activities under 5030-05A-39 covering calendar time from 1 April 1995 through 30 September 1995.

I. XTE/PCA Detector Characterization

XTE/PCA detector#6 was swapped off the XTE spacecraft in June 1995. In the past few months I have used it to study its xenon permeation rate as a function of temperature. From previous anecdotal evidence, we suspected that the permeation rate dependence on temperature is a real effect: the lower the temperature, the lower the permeation rate. With detector 6 available, I was able to perform a systematic study of this effect. I measured the permeation rates at 5 different temperatures: 0, 5, 10, 15, and 20 degrees centigrade, and found that the permeation rate at 0 C is approximately 20% of that at 20 C. The data and conculsion from this study will be incorporated into the XTE mission operation plan and the PCA calibration plan.

II. Preparation for XTE Launch

The XTE spacecraft has been ready for launch since July. It has been waiting for the completion of the Delta-II launch vehicle. Meanwhile we are checking the science analysis software and instrument monitoring software. Of particular interest to me is the timing software which corrects the raw XTE time for all kinds of effects to get the corresponding Universal Time (UTC). I actively participated in checking the mission operation software that sets the XTE spacecraft

clock and the corresponding ground software that does the necessary corrections.

III. Proposals to Goddard's Director's Discretionary Fund (DDF)

I initiated or actively participated in writing three DDF proposals. Due to some Goddard internal regulations, I could not be Principal Investigators on these proposals, but I did play major roles in creating the ideas and writing the proposals.

(1) Development of an All Sky Monitor Using Mylar Sheets Coated with Aluminum/Gold, (PI: Robert Petre). In it we propose a new technology to improve the signal/background ratios of monitoring existing sources and covering the entire sky almost 100% of the time, as compared to 1-10% of the time of past all sky monitors. This proposal is intended to be the first step toward writing a SMEX proposal that will be written in response to an official NASA AO expected to be released sometime next year.

(2) Big Balloon X-ray Collector (BBXRC), (PI: Elihu Boldt). In it we propose to construct a large balloon to get 100 square meters of soft X-ray collection area. If successful, it should enable us to study X-ray sources for very fast (less than 1 microsecond) time variability.

(3) Prototype Curved Focal Plane Detectors for X-Ray Astronomy, (PI: Keith Jahoda). In it we propose to use the microstrip detector technology to produce curved, either cylindrically or spherically, detectors which are necessary for the next generation of X-ray telescopes.

These proposals are being evaluated by the Goddard management. We expect to hear from them about the final outcome sometime in December.

IV. Visit of Dr. Peter Geltenbort

I invited Dr. Peter Geltnebort of the Institute of Laue-Langevin in France to visit the Laboratory for High Energy Astrophysics. Dr. Geltenbort is a recognized expert in designing and constructing a new generation of gas proportional counters called microstrip proportional counters. He gave a seminar here and discussed in detail about the new technology with LHEA members from both the X-ray astrophysics and the Gamma Astrophysics branches. I believe his visit significantly helped LHEA in utilizing this new technology for space flight purposes.

III. A Conceptual Design for LOBSTER Detectors

With the help of Dr. Geltenbort, I have put together a conceptual design for the detectors required by a SMEX mission named LOBSTER. LOBSTER is in its embryonic stage being conceived and developed by LHEA, the Los Alamos Nations Laboratory, the University of Melbourne in Australia, and University of Leicester in England. According to the current scheme of labor division, LHEA (PI: Nick White) is responsible for building the required detectors. There are many obstacles that we have to overcome in order to meet the stringent technical requirements and the tight budget. I believe the microstrip proportional counter technology provides the solution. My conceptual design based on this technology will be discussed and debated next February during a meeting of the LOBSTER collaboration.

IV. Writing XTE Proposals

Following is a list of approved XTE proposals that I have participated in writing. I list them according to the order of my own effort in their creation. I am the Principal Investigator of the first three proposals.

1. A search for coherent pulsations from 4U1820-30 (PI: Zhang, USRA)
2. A comprehensive timing and spectral study of 4U1608-522 (PI: Zhang, USRA)
3. Time lag measurements of the crab pulsar to infer the size of the x-ray emission region (PI: Zhang, USRA)
4. Search for a definitive black hole signature: relativistically trapped modes of disk oscillation (PI: Wagoner, Stanford)
5. Spectral and timing studies of expansion phases of X1636-536 (PI: Lapidus, Cambridge)
6. Microsecond temporal structure in the emission from Vela X-1 (PI: Orlandini, TeSRE)
7. Measuring the spin periods of LMXRB's: Aql X-1 (PI: Kelley, GSFC)
8. A search for the pulsar in SN1987A (PI: Marshall, GSFC)
9. Generic observation of all "bright" TOO's with very high time resolution and high telemetry rate (PI: Giles, USRA)
10. X-ray and radio fluctuations of the crab pulsar (PI: Jahoda, GSFC)
11. Study of very rapid phenomena in Sco X-1 (PI: van der Klis, Amsterdam)
12. A search for rapid temporal variations in x-ray bursting low mass binaries (PI: Strohmayer, USRA)
13. A search for microsecond variability from bright galactic x-ray sources (PI: Morgan, MIT)
14. Harvesting x-ray bursts from the galactic center region (PI: Strohmayer, USRA)
15. Pulse phase spectroscopy of the crab pulsar following

a glitch (PI: Jahoda, GSFC)
16. A search for pulsed 2-200keV emission from Geminga (PI: Jahoda, GSFC)
17. Radio and XTE fluctuations of the Crab pulsar (PI: Cordes, Cornell)

With the amount of XTE observing time that has been awarded to me and my collaborators, I expect my next year will be a very fruitful year in terms of scientific output. I also expect I will make significant progress in enhancing my stature in the astrophysics community.

Return-Path: <palmer@rosserv.gsfc.nasa.gov>
X-Sender: palmer@suncad.gsfc.nasa.gov
Date: Fri, 20 Oct 1995 11:25:31 -0400
To: cwheat@gvsp.usra.edu
From: palmer@rosserv.gsfc.nasa.gov (David Palmer)

1. TGRS (Transient Gamma Ray Spectrometer) support, launch, and data analysis. This instrument was launched November 1, 1994. I was involved in launch preparation, post-launch checkout, software development, and using that software to analyze the data.
2. Preliminary development and proposal writing for BASIS (Burst Arc-Second Imaging and Spectroscopy). This is a new instrument currently in the proposal stage for a MIDEX mission. I am responsible for the coded aperture mask.
3. Analysis of BATSE SD (Gamma-Ray Burst spectrometer on GRO) data. I examine the spectra of each bright gamma-ray burst (GRB) detected by the BATSE instrument on GRO. This is primarily to search for spectral features (e.g., absorption lines) which could indicate the origins of GRBs.
4. Search for radio counterparts of GRBs. I am observing the locations of GRBs long after (years), shortly after (~1 day to ~1 week) and during the burst, using the Very Large Array (VLA) and the Cambridge Low Frequency Synthesis Telescope (CLFST).

Evaluation Factors: (Describe the criteria you feel should be used to judge the relative level of achievement for each of the position requirements listed above).

1. a. Post-launch instrument operations.
   b. Software developed.
   c. Publications of results.

2. a. Capabilities of the proposed spacecraft.
   b. Quality of the proposal.
   c. My contribution to the spacecraft and proposal.

3. a. Extent of the search.
   b. Analysis of search results.
   c. Publication of results.

4. a. Extent of the search.
   b. Success of the search or, alternately, the upper limits on GRB radio emission.
   c. Publication of results.

Primary Accomplishments: (Briefly describe your output and/or the outcome of your work, relative to the position requirements and evaluation factors listed above. How well do you think you did?).

1. The TGRS instrument was launched on the WIND spacecraft on November 1, 1994. It is working almost flawlessly. There was a problem with spurious triggers (non-physical increases in the detector count rate, leading the instrument to falsely believe that a gamma-ray burst had occurred). We believe that this is due to a malfunction in a counter circuit. Tom Nolan, Helmut Seifert, and I developed and implemented a software patch which fixed the problem.

I specified and tested ground-based analysis software which was coded by our programmers. Most of this software is now in useful form, and we have been analyzing both gamma-ray burst and persistent source data. At the recent ESLAB conference on GRBs, we presented TGRS data in several papers, which will be in the (refereed) proceedings.

2. The BASIS spacecraft is a large area (~4000 cm2) high energy resolution (~6% at 60 keV) high spatial resolution (~3 arcsecond localization) gamma-ray burst detector. It will return GRB locations within seconds to allow follow-up ground-based observations. It will also provide a continuous all-sky survey which will locate transients such as X-ray novae and outbursts, and provide continuous light-curves of large numbers of Galactic and extragalactic sources.

These capabilities are provided by its innovative detector design (developed at GSFC) and its coded aperture optics. I am in charge of mask design and development (although the actual production is being done at the University of Wisconsin Center for X-ray Lithography). I developed a mask configuration that makes the goals of BASIS feasible using computing power that may reasonably be flown in space. This configuration has been simulated (by team members at Los Alamos) and found to provide high sensitivity.

I helped write proposals at two levels on this instrument this year. The first proposal, for NASA's 'New Mission Concepts In Astrophysics,' was the most highly-rated gamma-ray astronomy proposal in a crowded field. The second proposal, the Phase-A proposal for MIDEX missions, is currently in the review process. I estimate my contribution to these proposals at about the 10-15% level.

3. I am continuing my ongoing search of the BATSE SD data for all bright GRBs, and have found no significant spectral features. My previous simulations of the BATSE detectors' response to absorption line spectra measured by other instruments had verified that the BATSE SDs were sensitive to lines. Therefore, none of the bright GRBs seen by BATSE have had strong absorption lines. Papers updating the results of this search have been published.

4. I am continuing my collaboration with Cambridge University's radio astronomy department on a search for radio emission from GRBs. We have

placed the radiotelescope in a new mode which continuously observes seven times its nominal field of view, and automatically slews to GRB locations received from Scott Barthelmy's BACODINE system with a time-to-target of order 1 minute. This system has produced the best available limits on radio emission over time periods comparable to the burst duration (31 Jy over 10 seconds) and longer (1.5 Jy over 3 hours).

Although there have been no suitable GRBs within the last year, I have maintained my target-of-opportunity proposal at the VLA. At the ESLAB conference and in its proceedings, I presented results from some of my observations, including the current best limit on GRB radio emission within 24 hours (5 mJy).

David Palmer

USRA Technical Report (Apr. 1–Sep. 30, 1995)

Helmut Seifert (Task #: 93-10-00; Activity #: 5030-10A-39)

Summary:

Since 1990, I have been leading the data analysis software development for the TGRS and Konus experiments on the GGS/WIND spacecraft. After the launch on 1 November 1994, I have have also been responsible for instrument operations. I have been responsible for generating the detector response matrices for the TGRS instrument, and have started working on data analysis.

Activities:

Since launch of the WIND spacecraft on 1 November 1994, I have been responsible for the instrument operations which involves developing the appropriate instrument command loads for the Flight Operations Team (FOT), and making instrument decisions in emergency situations. The TGRS instrument to date has been performing exceedingly well.

Work on the development of the TGRS data analysis software has continued. This involves regular meetings and discussions with the instrument team and the programmers. Much progress has been made in the last half year and we have now working versions of essentially all our data analysis programs.

Monte-Carlo simulation code based on the GEANT software from CERN has been developed by me for the TGRS instrument, and has been used to generate the detector responses for our instrument. This work is crucial for calibration and the interpretation of our flight data.

I have developed the software algorithms which generate the actual instrument response matrices, and perform the deconvolution of the photon spectra from the measured count spectra.

I have begun working on the analysis of the TGRS flight data and have presented various papers about TGRS and my work: 1) an invited Paper, 1995 Spring Meeting of the American Geophysical Union (AGU), Baltimore Convention Center, Baltimore, MD, 30 May 1995 ("First Results from the Gamma-Ray Spectrometers on the WIND Spacecraft"); 2) two Contributed Papers, 29th ESLAB Symposium "Towards the Source of Gamma-Ray Bursts", ESTEC, Nordwijk, The Netherlands, 25–27 April 1995 ("Status of the Transient Gamma-Ray Spectrometer", and "First Results from the TGRS High-Resolution GRB Spectrometer"); 3) two Contributed Papers, 3rd Compton Symposium on Gamma-Ray Astronomy and Astrophysics, 12–14 June 1995 ("The Transient Gamma-Ray Spectrometer (TGRS)—An Overview and First Results", and "TGRS Occultation Analysis of the Galactic Center Region"); 4) Seminar, Laboratory of High-Energy Astrophysics, NASA/GSFC, 25 July 1995 ("First Results from the Transient Gamma-Ray Spectrometer (TGRS)").

20-Oct-1995

HALF-YEARLY REPORT: APR 95 TO SEP 95

Summary of Accomplishments

Reshmi Mukherjee (USRA)
Code 661, NASA/GSFC

1. Analysis of data from the EGRET instrument on the CGRO

My work on the analysis of the two EGRET sources, GRO 0744+54 and GRO 0957+65, is now complete. A paper entitled "EGRET gamma-ray sources: GRO J0744+54 and GRO J0957+65 (=BL Lac Object 0954+658)" by R. Mukherjee, *et al.* appeared in *The Astrophysical Journal* (1995, Vol. 445, pg. 189). The paper describes the spectrum and the time variability of the two sources.

I have completed the work on the distribution of the unidentified EGRET sources. A paper entitled "On the nature of the unidentified EGRET sources: Are they Geminga-like pulsars?" appeared in *The Astrophysical Journal, Letters* (1995, Vol. 441, pg. 61).

I was a co-author of the paper entitled "EGRET observations of gamma-ray emission from the interstellar gas in Orion," by Digel, Hunter & Mukherjee. This paper studies the high energy, diffuse emission from the interstellar gas in Orion, using observations from EGRET and the radio surveys of the HI and CO emission, and appeared in *The Astrophysical Journal* (1995, Vol. 441, pg. 270).

My proposal for the Cycle 5 CGRO (Compton Gamma Ray Observatory) observations, entitled "Data rights for quasars not seen in high energy gamma-rays by EGRET" was accepted. In the proposal we requested for data rights for the superluminal blazars, and strong, flat-spectrum radio quasars not seen in high energy gamma-rays in the earlier EGRET observations.

I have submitted a paper entitled "EGRET observations of the March 1993 gamma-ray flare from PKS 0528+134" to *The Astrophysical Journal*. This paper is currently undergoing the review process.

Work in progress:

I am currently working on a paper that will report on the EGRET observations of blazars seen in Phase 3 and Cycle 4 of CGRO.

2. Laboratory work

We have made considerable progress on the 1994 DDF (Director's Discretionary Fund) project "Development of a Time Projection Chamber (TPC) for Gamma-Ray Astronomy." During this year I spent a significant amount of time assembling the TPC and testing it using argon/methane and argon/isobutane gas mixtures. The TPC was tested using atmospheric muons traversing the active volume of the chamber. The ionization tracks of the muons were imaged using a multi-wire readout structure and the spatial resolution was measured.

TECHNICAL REPORT
March 1995 - October 1995
Kai-Wing Chan

Summary: I joined USRA in March 1995, to participate in the development of the XRT and XIS telescope of the ASTRO-E project. The principal scientific and technological goal of the present project (lead by P.J.Serlemitsos at NASA/GSFC) is to design and engineer an X-ray imaging telescope with foil-mirror approach. This provides a broad-band, light weight, less expensive telescope with large collective area. The critical issue in producing such telescope is to fabricate thin, x-ray reflective foil with highly precise figure. Many of such processes were developed or proposed by Yang Soong (also of USRA) before I joined the group. My main task since then is, together with Yang Soong, to oversee the whole process of production, such that we can start producing such foils (there are over 5 thousands of them, of various specifications, which may take about two years to produce) by fall this year. My task is basically divided into the following lines: (1) Search for the proper parameters for foil forming, sputtering, foil replication, and other processes. Extend these parameters to cover foils of every different sizes and with positions in the telescope (2) Together with Yang Soong, finalize and formalize the procedures. Plan the schedule for mass production. (3) Optical testing of foils and telescopes, analysis of optical image. (4) X-ray testing of the telescope and analysis. Items (2)-(3) are basically done together with Yang Soong. The status of the project now is encouraging. At the time of this writing, we have finalized and formalized all the major procedures (except for the 'cleaning procedure for glass mandrels— long term effect', which is expected to be studied in parallel with the production of foils.) The production of flight foils is now scheduled to start on 1 November 1995. We have acquired a new laboratory with clean room quality since this April—a factory in fact—to manufacture these foils, in addition to the clean room we already have. We now have 5 full time technicians (3 were hired since this February) assisting us in the research in foil making and will also involve directly in the production of foils. As of now, preliminary tests show that we shall be able to produce telescopes with approximately 1 arc minute (half power diameter) angular resolution in X-ray imaging capability—three times better than that of ASCA, whose foils are also made in this laboratory. In other areas, we have aquired a new CCD system, replacing the older photon detector, to study the optical image. We also acquired a highly precise scanning stage for lasar scanning of foils. This, so far, have given us much better (and digitized) data for the optical analysis. Yang Soong is the main person responsible for this progress. We have also installed, with the help of K.Gendreau from M.I.T., an X-ray CCD in the X-ray facility.

Besides the work related to the ASTRO-E project (which is now occupying over 90% of my time), I am still continuing the theoretical study of cosmic ray propagation. Some results are already published (see the Publication list below). Another paper coming out of this colaboration is "Cosmic Ray-Modified Shocks with Injection in Hydrodynamic Approach. I. Injection Linear in Thermal Pressure." by C.M.Ko, K.W.Chan and G.M.Webb. This is now in preprint form.

Publications (March 1995 - October 1995)

Ing-Guey Jiang, Kai-Wing Chan and Chung-Ming Ko. 1995. "Hydrodynamic Approach to Cosmic Ray Propagation. I. Nonlinear Test Particle Picture." Accepted for publication in Astronomy and Astrophysics.

Kai-Wing Chan and Chung-Ming Ko. 1995. "Cosmic-Ray-Modified Shocks with Injection." Int. Cos. Ray Conf. Papers, XXIV, Roma (3), 160.

Chung-Ming Ko, Kai-Wing Chan and Ing-Guey Jiang. 1995. "Hydrodynamic Approach to Cosmic Ray Propagation." Int. Cos. Ray Conf. Papers, XXIV, Roma (3), 116.

To: USRA
From: Yang Soong, LHEA Code 666, Bldg. 2, Rm 271, X66318
Date: Oct. 23, 1995
Subject: Technical Report for 4/1-9/30, 1995

In this reporting period, we have finalized the Astro-E fabrication procedures to be used in the next three years. Dr. Kai-Wing Chan joined the mirror group in March '95, and he is currently working as a lab organizer as well as a scientist to solve presently and to plan for the future the X-ray mirror related issues. In an effort to improve the X-ray mirror and/or to expand its utility, we have started programs, e.g. a multi-layer coating of the reflecting surface, and a more precise mirror geometry, in this period to aim at applications beyond Astro-E in the 21st century.

A trip to Japan was made to attend the Astro-E SWG meeting in April, '95. The new mirror fabrication technique, an epoxy replication process, was presented in the SPIE conference in July, '95 at San Diego.

These activities have been supported by the task # 5030-14A-39.

November 5, 1995

Technical report for Grzegorz (Greg) Madejski, working under USRA contract no. NAS5-30442 to NASA/Goddard Covers period 3/1/95 - 10/31/95

• Within the last 6 months, my activities continued to include programmatic work (the X-ray Spectrometer) as well as independent research (X-ray emission from AGN and BL Lacs).

1. The X-ray Spectrometer

• I have been extensively involved in the on-going work on environmental testing of the XRS blocking filters. This included substantial amount of lab work; I refurbished a vibratable helium dewar (cryogenic vessel) that will be used in testing of the flight filters. Working with the Optics branch, I also tested this dewar for resonance frequencies (at the Code 750 facilities), and, with the Mechanical Engineering branch, determined the proper "notching" of the input frequency spectrum to obtain the desired loads inside the dewar.

• In September 95 I attended the Astro-E Science Working Group. I prepared the summary of that meeting.

• PLANS FOR THE NEAR FUTURE:

• Revise the UV blocking requirements for the blocking filters

• Prepare the photon noise calculations for "single-filter failure" Astro-E scenarios

• Working with the Code 717, assess the usefulness of Polymide as an alternative candidate material for the blocking filters

2. Astrophysical Research

- In September 1995, I attended a meeting "Roentgenstrahlung from the Universe" in Wurzburg, Germany.

• PROJECTS/PAPERS COMPLETED:

• A retrospective invited paper about the research on periodicity in NGC 6814 for Swedish popular science magazine *Forskning och Framsteg* (Marek Abramowicz and Greg Madejski) appeared in press (issue No. 4/95).

• An analysis of ROSAT and Asca data for a blazar NRAO 140 (Turner, George, Madejski, Kitamoto, and Suzuki) appeared in the *Ap.J.* (June 1, 1995 issue).

• Ground-based data for multi-wavelength campaign to observe OVV blazar 3C279 (Grandi *et al.*) is in press in the *Ap.J.*

• A paper on extinction by circumnuclear dust in the Seyfert galaxy NGC 6814 (Czerny, Loska, Szczerba, Cukierska, Madejski) appeared in the *Acta Astronomica*

(Vol. 45, p. 623).

- Joint ROSAT - Asca - CGRO Egret observations of BL Lac 0235+164 (Madejski, Takahashi, Tashiro, Kubo, Hartman, Kallman, Sikora) is in press in the *Ap.J.*
- Radiation drag in AGN relativistic jets (Sikora, Sol, Begelman, Madejski) was accepted by the *Monthly Notices of R.A.S.*
- PROJECTS IN PROGRESS :
- Analysis of the Asca spectrum of Seyfert galaxy ESO-141-G55 (Zycki, Madejski, Czerny) is in progress.
- A paper on Mkn 478 (w/Andy Fabian, Neil Brandt, Jane Turner, Herman Marshall, and Otani-san) is being written.
- Hybrid thermal-nonthermal Comptonization models for X-ray emission in AGN (Zdziarski, Lightman, Coppi, Madejski) is nearing completion.
- Spectral constraints on models of BL Lac objects and OVV quasars (Sikora, Begelman, Madejski) is in preparation.
- First draft of a paper on OSSE observations of Seyfert 2 galaxy NGC 4945 has been written (w/ Chris Done).
- Data reduction of X-ray spectra of radio-loud Seyfert galaxies (w/Andrzej Zdziarski) is completed, awaiting further analysis.
- **Recently accepted proposals (as a PI):**
- XTE : X-ray spectrum of Seyfert galaxy IC4329A; Observations of selected blazars
- GRO : Observations of steep-spectrum Egret blazars
- ROSAT monitoring of blazars

Technical Report, Michael Loewenstein, 4/1/95-9/30/95

Much of my time over the past six monthes has been taken up with the completion of a major project on observations and implications of ASCA measurements of abundances in the intracluster medium, culminating in the production of two papers to be published early next year in the Astrophysical Journal.

The first paper, "Measurement of the Elemental Abundances in Four Clusters of Galaxies I. Observations," by R. F. Mushotzky, M. Loewenstein, K.A. Arnaud, T. Tamura, Y. Fukazawa, K. Matsushita, and I. Hatsukade presents the observational data and analysis. The second, "Measurement of the Elemental Abundances in Four Rich Clusters of Galaxies II. The Initial Mass Function and Mass Loss in Elliptical Galaxies, Enrichment and Energetics in the ICM," by M. Loewenstein and R. F. Mushotzky, presents the theoretical interpretation and demonstrates the importance of feedback in the formation of galaxies and clusters of galaxies. These results have been presented by me at the Astronomical Society of the Pacific (ASP) conference on "Clusters, Lensing, and the Future of the Universe" in College Park, Maryland in June, and will be again by Dr. Arnaud at the University of Maryland October conference on "Cosmic Abundances." At the ASP conference I was interviewed by Ron Cowen of *Science News* – his article appeared in the July 22nd issue.

Keith Arnaud and I have developed a suite of programs for deriving the dark matter distribution in clusters of galaxies from ASCA observations, and we (Drs. Arnaud and Mushotzky, and myself) are utilizing these methods in two ongoing projects. The first derives the dark matter distribution in ordinary nearby clusters, the second investigates more distant clusters and compares the mass distribution derived from X-rays with that derived from gravitational lensing. A third project, in collaboration with Dr. Mushotzky and Dr. Eric Gotthelf, that examines the variation with energy of the X-ray light profile in clusters is nearing completion. Preliminary results were presented by Dr. Mushotzky at the ASP meeting in June.

I am also analyzing ASCA observations of low-luminosity elliptical galaxies, based on data obtained as a result of my successful AO-3 proposals. Dr. Mushotzky, Dr. R.E. White III of the University of Alabama, and Ms. K. Matsushita of the University of Tokyo are also involved in this project. Preliminary results will comprise part of my talk at the October "Cosmic Abundances" meeting.

UNIVERSITIES SPACE RESEARCH ASSOCIATION
HIGH ENERGY ASTROPHYSICS PROGRAM

EMPLOYEE SUMMARY OF ACCOMPLISHMENTS
(for the 6-month period ending 10/31/95)

Employee Name: William Thomas Bridgman

Primary Accomplishments: Program Support

1. I have implemented procedures for regular notification of guest investigators both before and after OSSE observations. Response has been positive so far. Standard spectral observation processing is available and several GIs who do not have collaborators on the OSSE team have made use of this service.

2. I have written documentation with exercises on the use of High-Level OSSE products is available to guest investigators. It is an evolving document, where suggestions and problems posed by GIs are being incorporated into the next revision. The current release of this documentation is available on the WWW.

3. I am establishing regular procedures for keeping OSSE support software (IGORE, VSTAT, etc.) up-to-date and available through the SSC. Also exploring incorporating other software tools developed in OSSE program (such as IFOLD, a graphical-interface, model-fitting program) into the SSC archive.

4. The High-Level OSSE data products are now being regularly delivered to COSSC. Just coming on-line through OSSE High Level Product WWW pages. Accessable via:
   http://heasarc.gsfc.nasa.gov/cossc/OSSE.html

5. Performed support duties at the GRO Peer Review, the Timeline meeting, and the Users Committee meeting.

6. Participated in May OSSE Team meeting.

7. Completing tests on IGORE Response Matrix (IRM) installation kit to install this capability at remote sites currently running the limited version of IGORE.

8. Adapting NRL's High-Level OSSE Database summary generator for use at the SSC. Provides an observational summary of each OSSE pointing including source flux levels. Incorporating it into the High Level Database pipeline.

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