REPORT FOR:

"Cooperative Program In Space Science"

Cooperative Agreement #NCC 5 - 637

For the base period July 1, 2003 – June 30, 2004

Submitted To:

Ms. Brenda Smith
Grants Officer, Mail Code 210.G
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

From:

Universities Space Research Association
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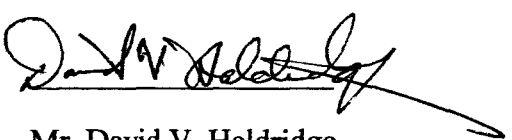
Dr. David Black, PI



Mr. David V. Holdridge
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UNIVERSITIES SPACE RESEARCH ASSOCIATION
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30 July 2004

Ms. Brenda Smith
Grants Officer
Mail Code 210.G, Bldg. 28
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

Dear Ms. Smith:

Submitted herein please find the Summary of Research and Technical Report for the base period: July 1, 2003 through June 30, 2004 for:

Cooperative Agreement #NCC 5 – 637, for research entitled:

"Cooperative Agreement in Space Science"

Submitted by:

Universities Space Research Association
10211 Wincopin Circle, Suite 500
Columbia, MD 21044

Sincerely,

Ginny Peles
Administrative Assistant III – Procurement

cc: David Black (PI)
Frank Marshall (cc/disc)
CASI (3)
Michelle Giller (2)

INTRODUCTION:

The Universities Space Research Association received a follow-on award for the Cooperative Agreement #NCC5 - 637 on April 1, 2002. The mission of this activity, know as the Cooperative Program in Space Sciences (CPSS), is to conduct space science research and leading-edge instrumentation and technology development, enable research by the space sciences communities, and to expedite the effective dissemination of space science research, technology, data, and information to the educational community and the general public.

To fulfill this mission, USRA recruits and maintains a staff of scientific researchers, operates a series of guest investigator facilities, organizes scientific meetings and workshops, and encourages various interactions with students and university faculty members.

This is the report for the period of performance July 1, 2003 – June 30, 2004.

FINANCIAL & OPERATIONS SUMMARY:

The original award amount totaled $[redacted]. This was increased by $ [redacted] as the two optional extensions were activated at the end of June 2003, thus bringing the total awarded amount to $[redacted]. The actual costs, as of June 30, 2004, were [redacted].

As of June 30, 2004, USRA had 33 Total Direct Staff Members under employment. There were 31 Active Staff Scientists (one on TDY to INTEGRAL Data Center in Geneva, Switzerland), one On-Site Administrator (CGRO/GLAST), and one Visiting Fellow. Twenty-seven of these employees work in Code 660, three in Code 690, and one in Code 680. The staff turnover has been running at a level of 20% over the last 10 years experience in the GSFC Space Sciences Directorate. Over the last year, there were four new hires (two more due to start in August and October respectively), and nine* departures (*we expect another of our scientists to be leaving in July for the SWRI). These individuals arrive from and return to a mixture of Government, university, industry, and foreign organizations. The vast majority of new hires are a result of national recruitments. In this time frame, July 2003 – June 2004, we conducted 5 different recruitment exercises, resulting in four new hires.

144 short-term visitors and 14 consultants were brought in to support the mission of the Space Sciences Directorate through USRA during the base period. USRA scientists led at least 15 teacher and student (k-12) space science education workshops nationwide. USRA scientists and administrative personnel combined to run and support at least 12 scientific meetings and/or workshops between July 2003 and June 2004. While a formal recruitment for the Summer Student Research Opportunities Program was not conducted this

year, there are six students returning this summer and two college professors taking summer sabbaticals through USRA while working in the GSFC Space Sciences Directorate.

ACCOMPLISHMENTS:

Scientific Research and Instrument Development:

As an indication of scientific research accomplishments, USRA scientists working under this Cooperative Agreement submitted 50 PI-level and 53 Co-I level research and education proposals during the year. Indicative of the high level of community action, a majority (84) of these submitted proposals were made in conjunction with a university-based collaborator. There were 16 awarded (in this time period) – totaling [redacted] ([redacted] to USRA). (Twenty proposals are currently in the Phase I selection process). Approximately 162 papers were published; 76% in refereed journals, averaging 5.1 published papers per Ph.D. staff member (papers with multiple USRA co-authors were counted as one). A publication list is attached to this report.

What follows are excerpts from individual technical accomplishment reports of the USRA scientific staff:

LABORATORY FOR HIGH ENERGY ASTROPHYSICS (660)

Detector Technology Development

DR. JOHN KRIZMANIC:

John has been involved in simulating and developing future astroparticle physics experiments, developing novel x-ray/gamma-ray optics, developing and characterizing new astroparticle detectors, and developing a x-ray polarimeter experiment as a co-investigator.
He is also a co-investigator on the accepted NASA proposal involving the development of a balloon-borne, gamma ray polarimeter experiment known as POGO. The activities related to POGO include attending collaboration meetings, an x-ray polarization workshop, and GEANT4 tutorial school. The GEANT4 simulation is becoming the standard particle detector simulation code, and POGO collaborators have performed an initial GEANT4 simulation of POGO.

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Gamma Ray Large Area Space Telescope / Anti-Coincidence Detector (GLAST/ACD)

DR. ALEXANDER MOISEEV:

Dr. Moiseev is involved in the research, development, and testing of the LAT ACD (Anti-Coincidence Detector) Instrument. He has been extensively involved in the design of the detecting elements (scintillating tiles, fiber ribbons); fabrication and tests of the prototypes, and experimental proof of their performance. He has been responsible for defining the requirements for the flight detector units, overseeing their fabrication, integration and tests in flight ACD; and the study of the backsplash effect in the high energy gamma-ray instruments used with the BESS and ACCESS missions.

Gamma Ray Large Area Space Telescope / Space Science Center (GLAST/SSC) and Astronomy Picture of the Day (APOD)

DR. JERRY BONNELL:

Dr. Bonnell has been involved in research in temporal and spectral properties of gamma-ray bursts using GLAST, including simulation of GRBs for GLAST Data Challenge I. The burst algorithm was proven and exceeded expectations in localizing and triggering on simulated GRBs. He participated in the development of software for GLAST data challenge I, and acted as liaison between LAT and SSC on reporting related issues and developments – i.e. interface control document (ICD) defining file formats and interactions between MOC, GBM, and LAT in the development phase of the GLAST Science Support Center.

He has continued to support the education and public outreach efforts for GLAST and gamma-ray astronomy by producing gamma-ray E/PO material for the APOD website and planning a Comic Book style E/PO publication for the future. He continues to develop and maintain the Astronomy Picture of the Day (APOD) website, producing 50% of the material in collaboration with R. J. Nemiroff (MTU).

DR. HANS KRIMM:

Dr. Krimm has been involved with the Swift mission, serving as a Swift Science Team member, working to organize and oversee development of the Swift Burst Alert Telescope (BAT) ground software, contributing significantly to the verification of the BAT flight software, writing analysis software and developing simulations related to the BAT hard X-ray survey.
He has also been deeply involved in the InFOC□S task as a field campaign team member, supporting the balloon campaigns and analysis of data from the flight, development of improvements to InFOC□S including preparation of the next three-year proposal and supporting upgrades and modifications to the telescope in anticipation of future flights.

Numerical Relativity (GravityWave)

Dr. Dae-Il (Dale) Choi:

Dr. Choi has been involved with theoretical, computational and experimental research in Gravitational Wave Astrophysics, helping to develop theoretical and computational tools and infrastructure necessary to understand the astrophysics of sources of gravitational waves. He researched and carried out simulations of head-on collisions of equal mass black hole binary using fixed mesh refinement and coordinate conditions that will "freeze" evolution once two black holes merge. He has provided direct inputs to the space-based gravitational wave observatory, LISA, jointly sponsored by NASA and ESA.

X-Ray Optics

DRS. KAI-WING CHAN and YANG SOONG:

Drs. Chan and Soong have been involved in the preparation, development and production of 5 x-ray thin foil X-Ray Telescopes (XRT) for the mission Astro-E2. The 5 X-Ray Telescopes were successfully completed and delivered to Japan. The XRT's were completed within budget and on time (the schedule of the last XRT delivery was revised, at the beginning of the year, from late March / beginning April to May, 2004, upon request of ISAS as more time was needed for ISAS to complete the x-ray characterization of previously delivered XRT's.) Assembly of reflectors and integration of XRT's were completed as planned. All qualification tests were completed, including: quality control of individual reflectors, optical characterization of individual XRT quadrants, x-ray tests of sections of XRT quadrants, optical tests of integrated XRT, confocality test of XRT quadrants, and vibration tests. Final x-ray characterization is going on at ISAS before integration with the spacecraft.

Their research in segmented thin foil mirrors at GSFC to support future high angular resolution high throughput missions continues, despite the heavy workload of the flight project Astro-E2. In particular, new opportunity came up as NASA/GSFC and JAXA/ISAS of Japan prepare to team up again for the next high energy x-ray imaging mission, appropriately called "NeXT" (New X-ray Telescope, which, in traditional order, is also known as Astro-G.) Peter Serlemitsos and Dr. Chan presented their team's technical concept for the hard x-ray telescopes in a preparatory Astro-G meeting in Japan last year. Japan since then has gone through major proposal hurdles and the mission is on its way to becoming a reality. Effort was made at GSFC to prepare for a complementary NASA proposal of this mission.

DR. JOHN LEHAN:

Dr. Lehan has been involved in the invention, testing, simulation, and implementation methods for characterizing Wolter I soft x-ray telescopes. He conceived of an automated Mandrel test station and with Richard Koneke, assisted in troubleshooting various issues related to present metrology. He assisted in CGH metrology procedure development. He has been working on a new approach to fabricate mirror segments and other soft x-ray telescope components, including identifying problems and solutions with telescope integration and having the improvements adopted by the program.

DR. STEPHEN HENDERSON:

1. Vacuum chambers, etc:
   - completed design for mandrel holding and mandrel transport fixtures.
   - holding fixture fabrication initially tried off-site, but contractor failed to meet specs. Second attempt for fabrication underway now in NASA shops in an effort to contain quality issues.
   - transport fixture procurement delayed by NASA procurement freeze.
   - sputter vacuum chamber and replication vacuum chamber designed and submitted to NASA procurement for bid ($0.8 million) – delivery in 2004.
2. Robotic glass cutter:
   - robot project initiated with Swales prior to my arrival in June '02.
   - semi-complete robot delivered by Swales to GSFC late 2002
   - major mechanical errors found in design – software quality also abysmal

- Swales contract terminated (Dec). Swales work judged unsalvageable
- decide to pursue commercial alternative of purchasing a computerized machining center and customizing this into a similar robot.

3. Researching new materials and processes:
   - discovered several new potential mold release materials to be used for reflector fabrication: CVD boron nitride, PVD TiAlN, and several BN composite materials. The first two of these are undergoing further development at this point in time.
   - discovered special diamond tools used in semiconductor industry to dice chips that is being studied now for application to the glass foils.
   - discovered Hysitron company that does makes ultra-precise scribing machines which are under evaluation now
   - discovered superior (wrt CTE and viscosity) glue for bonding gold to the foils, which will soon be tested. This bonding is a key element in the telescope's final performance. It can also be CTE matched to the structural elements supporting the foils.
   - discovered superior titanium alloy that is now the currently adopted support material for the foils. This titanium 21S improved the CTE match to our glass by a factor of two over the best efforts of the NASA engineers.
   - discovered an even better Be-BeO material to be used as the support material for the foils. Even though technically superior to titanium, more education of key GSFC personnel is needed before it will be adopted.

4. Glass etching R&D:
   - introduced concept of etching glass foils to impart additional strength needed to survive launch stresses.
   - designed procedure for testing this. This was re-designed twice by Code 500 and after many months of delays, the study will soon start using the procedure.
   - discussions with Will have revealed a need and possibility of developing this methodology to actually lower surface roughness.

ROSSI X-ray Timing Explorer Space Operations Center (RXTE-SOC)/GLAST/SSC

DR. ROBIN CORBET:

Dr. Corbet has been involved in the supervision of the RXTE Science Operations Facility, ensuring science return and safe operations. He has overseen the rounds of proposals, SOF proposal reviews and scheduling of observations. He has also participated in the evaluation of Target of Opportunity (ToO) proposals and

supervised SOF execution of ToO observations, ensuring that these are carried out effectively. He supervises the data production and provision to observers (rapid production), and to GOF (standard production), and investigates and solves any problems encountered. He has been active in the GSSC and GOWG (GLAST Operations Working Group), helping to create the GSSC design document, evaluate different scheduling tools, participating in and organizing meetings, and participating as a peer review panel member.
In his research he has made several discoveries during this year include determining the orbital periods of four different X-ray binaries and the discovery of four new transient X-ray pulsars.

High Energy Astrophysics Science Archive Research Center (HEASARC)

DR. MICHAEL CORCORAN:

Dr. Corcoran has been involved with scientific research involving studies of X-ray emission from massive stars, Eta Carinae, WR 140, and other stars, maintaining and organizing the XMEGA website and publishing web pages summarizing X-ray studies of Eta Car. He has also been involved in managing the ROSAT, HETE-2, and GLAST archives at HEASARC, providing archive support to the GLAST mission, consulting on data management issues, managing the HEASARC calibration database and consulting with CALDB users at other sites, and with upcoming missions like SWIFT and ASTRO-E2.

DR. STEPHEN DRAKE:

Dr. Drake has been involved with overseeing the creation and update of tables in the HEASARC Browse database systems, adding or substantially modifying 26 catalogs or database tables to the BROWSE database system. Working closely with the database technical person, he ensures that the new databases are accurate representations of the original catalogs and that the help documentation accurately describes the HEASARC's online versions of these database tables. He is the primary HEASARC scientist responsible for the RXTE, XMM-Newton and Integral archives at the HEASARC. He has been working with the XMM-Newton Project (Steve Snowden and the staff at the ESA XMM Science Archive) to get more information into the XMM Master table in the HEASARC Browse system, e.g., instrument modes and filters; and also with the Integral Project (Chris Shrader) in preparation for the official opening of the public Integral Archive at the HEASARC in July 2004) to ensure that the archive structure conforms to HEASARC standards and that the data will be able to be easily accessed via Browse. He is responsible for ensuring the integrity and structure of the 3 TB HEASARC data archive, predicting future growth rates to ensure that

storage requirements can be met, with particular responsibility for ensuring missions such as EUVE, CGRO and ASCA which have gone from their active to 'legacy' archive phases, and those such as RXTE, XMM-Newton and Integral which are still operational.

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Advanced Satellite for Astrophysics and Cosmology Guest Observer Facility (ASCA-GOF)

DR. KOJI MUKAI:

Dr. Mukai is involved in the support of the ASTRO-E2 and the ASCA Guest Observer Facilities. Pre-launch preparations of software and documentation, and development and testing of the software necessary for processing ASTRO-E2 data is in process and undergoing further testing before being released to the public. Continued archival support is continuing for the ASCA GOF in the form of final reprocessing of the ASCA archive to provide the best calibration possible to the archival data. He has continued to work on proposal support software activities (PIMMS and Viewing), successfully including the Swift responses (including UVOT) into PIMMS to support Swift proposers, and an inclusion of ASTRO-E2 capability is in progress, as instrument responses become available. The capability for moon angle constraint has been included in Viewing (important for Swift/UVOT).

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DR. STEVEN SNOWDEN:

Dr. Snowden acts as the lead scientist and manager of the NASA/GSFC XMM-Newton Guest Observer Facility (GOF). The *XMM-Newton* GOF continues to function quite well. Support activities over the last year have included the maintenance of the US data archive and distribution of GO and GT data to US PIs, updates of the "ABC Guide" for the analysis of *XMM-Newton* data (currently on-going), organization of the AO-3 GO budget process including proposal submission and the organization of the budget peer review, oversight of the distribution of GO grants for successful AO-2 and AO-3 proposals, and of course, directly aiding the US users community through helpdesk, visitor, and outreach activities.

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Education and Public Outreach

DR. JAMES LOCHNER:

Dr. Lochner's responsibility is to direct all the education and public outreach (E/PO) initiatives within the CPSS and the LHEA. The primary focus is on maximizing E/PO investments related to the NASA OSS Theme of Structure and

Evolution of the Universe (SEU). He is responsible for leading the design, implementation and execution of certain E/PO projects within LHEA, as well as coordinating activities within LHEA and LHEA/CPSS E/PO activities with other relevant outside partners. At least 15 teacher and student (k-12) space science education workshops were given nationwide, most at NSTA regional and state meetings. The "Imagine the Universe" web site has been updated with new features such as a monthly "Featured Scientist" article, a new Satellite Showcase feature, and joint Satellite Showcase and Research group articles featuring LISA and gravitational waves, and updated the Resources areas, both general and teacher resources. The 8th edition of the "Imagine the Universe" CD was produced and also externally evaluated.

The web site for the Cosmic Elements materials is now complete, including the activities that appear in the booklet, and on-line activities that are in addition to the booklet. We have begun distributing the poster via email request, teacher conferences and our own workshops. We have thus far distributed more than 6,000 copies of the poster and booklet. The "Cosmic Elements" workshop was given at the New York State Teacher conference, and at 1 NSTA regional conference and the NSTA national conference. This workshop has been given a total of 6 times, reaching 200 teachers. He also did a half-day presentation of "Cosmic Elements" content and activities for the "Exceptional Materials for Exceptional Students" workshop (a workshop for teachers of special needs students) at GSFC in July 2003.

International Gamma Ray Astrophysics Laboratory Guest Observatory Facility (INTEGRAL-GOF)

DR. KEN EBISAWA: (ON DETAIL TO INTEGRAL SCIENCE DATA CENTER, GENEVA, SWITZERLAND)

Dr. Ebisawa has been involved in research and development related to the INTEGRAL Guest Observer Facility, and has been working at the INTEGRAL Science Data Centre in Geneva, Switzerland, acting as the USRA/GSFC liaison to this ESA organization. He has been responsible for the ASCA archives and calibration database, and preparation for future ASTRO-E2 GOF activities. Although the INTEGRAL data system was started from a very unique, complicated file format and software, ISDC has decided to adopt the standard format in the data archives. Dr. Ebisawa participated in the development of an INTEGRAL science analysis system for Guest Observers to make the system comply with the standard system US Guest Observers are familiar with. By having the standard format, INTEGRAL data can be read by generic high-energy astronomical tools such as FTOOLS or ds9, as well as analyzed by INTEGRAL specific software by ISDC. One of his responsibilities was to help the Japanese

GINGA team build the final archives, bring the data to HEASARC, and maintain it.

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INTERNATIONAL GAMMA RAY ASTROPHYSICS LABORATORY GUEST OBSERVATORY FACILITY (INTEGRAL)

Advanced Composition Explorer (ACE) & TIGER GEORGIA DENOLFO: (August, 2002 – June, 2003)

Dr. DeNolfo has been involved in two major projects this past year, ACE and TIGER. She has been analyzing ACE/CRIS data for light element abundances (He, Li, Be, B, and C), using GALPROP to interpret Li, Be, and B abundances. She has worked on characterizing detector efficiencies for ACE/CRIS; providing support for ACE archiving, the monitoring of ACE housekeeping, and contributing to the ACE and TIGER E/PO initiatives.

While working on the TIGER mission, she assisted in the preparation and calibration of the Photomultiplier tubes (PMTs) for both Cherenkov Counters for the TIGER 2003 flight. She supported the TIGER campaign in Antarctica by preparing the software used to remotely view the TIGER data at GSFC and to help with remote monitoring. She also worked on re-writing the previous routines to read in the new TIGER data formats and to optimize the viewing of real-time data. She has been working on the analysis of the TIGER 2001/2003 data, maintaining the data files and analysis code at GSFC.

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DR. CHRIS SHRADER:

Dr. Shrader has been involved in providing various areas of scientific and technical support to the US INTEGRAL Guest Observer Community, including solicitation of proposals, organization of scientific peer-review, and oversight of grant administration. He is involved with NASA HQ support for matters pertaining to INTEGRAL and a member of the INTEGRAL/SPI instrument team and has been extensively involved with the development of software and calibration databases for the instrument. The mirror archive of all public domain INTEGRAL data and software at GSFC has been physically established, and improved methods for network data transfer have been set up, keeping lines of dialog with the ISDC and the HEASARC open. Development and maintenance of documentation and web-based resources for INTEGRAL guest observers have been started, and the GOF makes users aware of incremental improvements to the analysis software, also answering concerns and dealing with any problems that arise.

Dr. Shrader helps to support NASA HQ in the implementation of a US INTEGRAL research grants program. This includes preparation and maintenance of NRAs (with cognizant HQ official) and organizing and implementing

Community based peer-review of all responses to NASA INTEGRAL budget proposal solicitations. As the GSFC site manager for the INTEGRAL Data Analysis Working Group (ISDAG), Dr. Shrader has the oversight of deliverable software and calibration data products to the INTEGRAL Science Data Center. He continues to establish and maintain regular channels of information exchange regarding, instrument calibration and data analysis issues, between ISDAG, ISDC and GSFC. This has led to a successful effort to fine-tune the SPI calibration (response matrices), based on comparison between methods, and comparisons with other experiments. The outcome is now believed to be the most reliable among the INTEGRAL experiments.

DR. STEVEN STURNER:

The major objective of my position is to perform scientific services on behalf of the INTEGRAL Guest Observer Facility at NASA/GSFC. These services include helping to develop and maintain data analysis software, aid the scientific community in utilizing the INTEGRAL observatory, and producing and maintaining up-to-date INTEGRAL/SPI instrument response matrices. I also conduct independent research in astrophysics in the field x-ray and gamma ray emission from supernova remnants and pulsars.

As part of the INTEGRAL Guest Observer Facility staff I am tasked to provide aid to the scientific community in utilizing the INTEGRAL observatory. This includes direct guest observer support; preparing and maintaining online help documents and services, as well as supporting the NASA mirror to the INTEGRAL public archive.

Analysis of INTEGRAL/SPI flight calibration data and testing of analysis software. This analysis has multiple functions. My position with the INTEGRAL Guest Observer Facility lets me familiarize myself with the use of the analysis software. It was also useful in discovering bugs in the software and suggesting improvements. It is also essential for assessing the accuracy of the SPI response and implementing revised correction tables to modify the response.

Production of the INTEGRAL/SPI Imaging Response Functions or IRFs. One of the major tasks allocated to NASA/GSFC within the INTEGRAL/SPI team is the production and documentation of the instrument response using Monte Carlo simulations. Production of the base IRFs is primarily my responsibility.

Basic scientific research including analysis of x-ray and gamma-ray data from the supernova remnants (SNRs) and pulsars. I am designated by ESA as one of three INTEGRAL Responsible Scientists for the topic of SNR continuum emission. As such, it is my duty to oversee the analysis of INTEGRAL Core Program Data for the SNRs CasA, MSH 11-61A, Monoceros, W28, G312.4-0.4, CTB 80, & CTA1. I am also involved in the analysis of Core Program data for the pulsar PSR

B1509-58.

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SWIFT Science Center

DR. MARTIN STILL:

Dr. Still is involved in supporting the analysis of Swift data by the astronomy community. This includes the delivery of UVOT analysis software and calibration products to the mission, facilitating the submission of GO proposals to NASA and supplying on-line and off-line help, analysis software, documentation and data to successful GOs and the general astronomical community in the exploitation of the XMM-Newton data archive.

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Super Nova Remnant Research

DR. ZAVEN ARZOUMANIAN:

Dr. Arzoumanian is involved in research, through multiwavelength observations and modeling, on supernova remnants, neutron stars, and associated phenomena to further our understanding of the endpoints of stellar evolution: their various forms, interactions with their environments, and implications for high-energy emission mechanisms and the nature of gravity. He developed software to remove the effects of orbital motion from photon arrival time data from a binary star system given an orbital ephemeris, for use in analysis of XMM data on the relativistic binary pulsar J0737-3039. He also developed a (relatively straightforward) technique for assessing the significance of angular extent, relative to an instrument point-spread function, of a faint linear feature in archival ASCA data for the supernova remnant DA 495.

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National Virtual Observatory (NVO)

DR. JEONGIN LEE:

Dr. Lee has been involved in development of a scientific application utilizing the National Virtual Observatory (NVO) registry. Data Inventory Service (DIS) program has been developing in conjunction with the NVO project. The DIS is a web-based high level science product with the distinguished feature in terms of discovering astronomical resources, which is from the NVO registry, i.e., the DIS has a real time interface with a global database rather than a local database. The DIS is one of the showcases that the NVO project aims for regarding the NVO usability to the astronomical community.

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X-Ray Astrophysics Research

DR. JAMES REEVES:

Dr. Reeves has been involved in research in X-ray astronomy, specifically on active galactic nuclei and X-ray surveys, primarily involving the analysis of active galaxy data in the high-energy X-ray waveband through XMM-Newton and Chandra observations, using spectroscopy to study the iron line profile around black holes in active galaxies. One of the main highlights of his research in the last year, which has now been published in 3 papers, has been the discovery from XMM-Newton observations of material being expelled at relativistic velocities from the centers of several active galaxies. The major implication of this discovery was that the majority of the energy output in these active galaxies was kinetic (from a relativistic outflow) rather than emitted in the form of electromagnetic radiation.

Secondarily, he also is doing research on observations of Gamma-ray bursts and follow-up observations of burst X-ray afterglows. One major unexpected discovery presented in one of these papers was of an expanding X-ray halo centered on the afterglow emission several hours after a burst. The X-ray halo, discovered in an XMM-Newton follow-up observation of a burst detected by the Integral satellite was caused by scattering of the burst emission off dust grains in our own galaxy. The observations allowed us to infer the properties of dust in the Inter-stellar medium in our galaxy as well as the initial X-ray emission of the prompt Gamma-ray burst, through the properties of the scattered radiation.

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LABORATORY FOR ASTRONOMY AND SOLAR PHYSICS (680)

Solar and Heliospheric Observatory (SOHO)

SCOTT MCINTOSH:

Dr. McIntosh has been involved with the scientific planning of SOHO observations with the CDS and EIT instruments and providing coordination between those instrument groups, guest investigators and other observatories. To facilitate scientific observations with the CDS and EIT instruments on the Solar and Heliospheric Observatory (SOHO) by providing coordination of observations with other SOHO instrument teams, guest investigators, ground and space-based observatories based in the Laboratory for Astronomy and Solar Physics (LASP) at Goddard Space Flight Center (GSFC). His research includes the analysis of SOHO multi-instrument data and TRACE observations to better understand the solar side of Sun-Earth connectivity. He has been working on the development and implementation of a database detailing the variation of coronal features over the solar cycles as observed by SOHO EIT.

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LABORATORY FOR EXTRATERRESTRIAL PHYSICS (690)

Electrodynamics Forecast Modeling

DR. DIMITRIS VASSILIADIS:

Dr. Vassiliadis has been involved in the development of innovative modeling and analysis techniques with the aim of quantifying and understanding space plasma stability and transport. His research includes: relativistic electron flux in the inner magnetosphere and radiation belts, using modeling and analysis, and electrodynamics of the high-latitude ionosphere.

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Space Plasma Physics

DRS. PHILIP WEBB and YUSUKE EBIHARA:

Drs. Webb and Ebihara have been working with Dr. Mei-Ching Fok on modeling and data analysis of Space Plasma Physics data obtained from IMAGE missions and relevant data sets from the ISTP Solar Max database.

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Interplanetary Physics

DR. SHING-HSIEN (SEAN) CHEN:

Dr. Chen is involved in conducting research and writing proposals related to modeling and data analysis of plasma sheet, ring current, radiation belt, and global plasma circulation modeling from the IMAGE missions, the ISTP Solar Max database, and the GGS Polar missions. Using data from these missions, he conducts research on the Earth's ionosphere and magnetosphere boundary layers and global plasma circulation. The research work discovered the presence of cold ionospheric ions at the front end boundary of the Earth's magnetosphere – the magnetopause, and their critical role in global magnetospheric convection. Particularly the cold ionospheric ions play an important role in the magnetic reconnection process at the magnetopause and their spatial occurrence distribution hinted at a previously unknown dynamo process that hasn't been known before in the magnetospheric convection.

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Interplanetary Physics

BEN PILKERTON:

Summary of the Position:
Mr. Pilkerton has been involved in research and providing scientific support to projects at the Interplanetary Physics Branch of the Lab for Extraterrestrial Physics (LEP). Work includes analysis and interpretation of datasets from several

space borne missions including the Thermal Ion Dynamics Experiment (TIDE) on the Polar mission, and the Low Energy Neutral Atom (LENA) Imager on the IMAGE spacecraft. He worked to support instrument design and development under the IPB IRAD task, through simulations using various scientific software tools. He assisted in the operation of the Lab for Extraterrestrial Physics' ion beam testing and calibration facility. One such project was to develop a software package to control a data acquisition device, which takes measurements of a source and sends the data to the users computer. The software automates the process and allows for easy I/O control and visualization by a graphical user interface. The software has been successfully implemented in the lab and is currently being used in support of scientific studies.

Magnetospheric Physics

DR. NIKOLAI TSYGANENKO:

Dr. Tsyganenko has been involved in devising new mathematical methods to represent the magnetic field in the Earth's magnetosphere and creation on that basis of advanced models of the geomagnetic field. He has made a compilation of new data bases, including in-situ magnetospheric and solar wind field/plasma spacecraft observations, and ground magnetometer data. In addition, he has undertaken the development of computer codes for the data-based modeling of the geomagnetic field and plasma environment in the Earth's magnetosphere, calibration of the model parameters by fitting them to spacecraft data, and evaluation of the accuracy of the new models. A fortran code for the new storm-time magnetospheric model was written and underwent various tests, including a comparison of the model field at Earth with the observed ground Dst field. A new fully revised and modified library of Fortran subroutines for calculation and mapping of the geomagnetic field (GEOPACK) was developed, tested, and made publicly available.
A Chapman Conference on the Physics and Modeling of the Inner Magnetosphere was held in Helsinki, Finland, convened by Dr. T. I. Pulkkinen and Dr. Tsyganenko. Based on the results of the Conference, an AGU Geophysical Monograph is currently under preparation.

COOPERATIVE PROGRAM IN SPACE SCIENCE (CPSS)

(NASA COOPERATIVE AGREEMENT NCC 5 – 637)

Publications Listing

1 October 2003 through 30 September 2004

UNIVERSITIES SPACE RESEARCH ASSOCIATION

(USRA)

David V. Holdridge
Program Manager

*As gathered from 2004 Annual Performance Evaluations

USRA CPSS 2003 - 2004 Scientific Publications List

1. Abe, K.; Sanuki, T.; Anraku, K.; Asaoka, Y.; Fuke, H.; Haino, S.; Ikeda, N.; Imori, M.; Izumi, K.; Maeno, T.; Makida, Y.; Matsuda, S.; Matsui, N.; Matsukawa, T.; Matsumoto, H.; Mitchell, J. W.; **Moiseev, A. A.;** Nishimura, J.; Nozaki, M.; Orito, S.; Ormes, J. F.; Sasaki, M.; Seo, E. S.; Shikaze, Y.; Sonoda, T.; Streitmatter, R. E.; Suzuki, J.; Tanaka, K.; Tanizaki, K.; Yamagami, T.; Yamamoto, A.; Yamamoto, Y.; Yamato, K.; Yoshida, T.; and Yoshimura, K.; 2003: "Measurements Of Proton, Helium And Muon Spectra At Small Atmospheric Depths With The Bess Spectrometer"; Phys. Lett.; B564; 8-20.
2. Allen, B.; **Leonhardt, V.;** 2004: "Upper Limits On The Strength Of Periodic Gravitational Waves From PSRJ1939+2134"; Class. Quant. Grav. 21; 671-676.
3. Andersson, B.-G.; Knauth, D. C.; **Snowden, S. L.;** Shelton, R.; and Wannier, P. G.; 2004: "A Hot Envelope Around The Southern Coalsack, X-Ray And FUV Observations"; in The Astrophysical Journal; 606; 341.
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5. **Arzoumanian, Z.;** 2003: "A Stalwart Control Experiment: New Bounds On Violations Of The Strong Equivalence Principle From PSR B0655+64"; in Radio Pulsars; Bailes, et al. eds.; ASP Conference Series; 302; 69.
6. **Arzoumanian, Z.;** Gendreau, K. C.; & Queen, S. Z.; 2003: "An X-Ray Interferometer At NASA Goddard"; in Future Directions in High-Resolution Astronomy, Romney & Reid eds.; ASP Conference Series; in press.
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8. Attié, D.; Cordier, B.; Gros, M.; et al. (incl. **Shrader, C. R.; and Sturner, S. J.**); 2003: "INTEGRAL/SPI Ground Calibration"; A&A, 411, L71.
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10. Baker, J. B. H.; Greenwald, R. A.; Ruohoniemi, J. M.; Förster, M.; Paschmann, G.; Donovan, E. F.; **Tsyganenko, N. A.**; Quinn, J. M.; Balogh, A.; 2004: "Conjugate Comparison of Super Dual Auroral Radar Network and Cluster Electron Drift Instrument Measurements of E × B Plasma Drift"; J. Geophys. Res., v. 109(A1), A01209, 10.1029/2003JA009912.
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