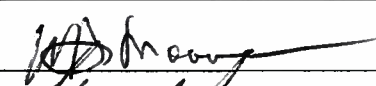
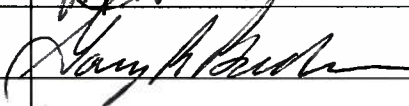

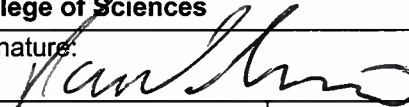
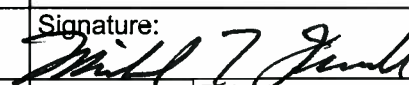


**COVER PAGE FOR TRADITIONAL AND UNDERGRADUATE ENHANCEMENT PROPOSALS
BOARD OF REGENTS SUPPORT FUND, FY 2007 - 08**

1. This Proposal involves: <u>XX</u> One Institution _____ More Than One Institution		2. Enhancement Subprogram: (check one) _____ Traditional Enhancement Program <u>XX</u> Undergraduate Enhancement Program	
3. This Proposal is: (check one) <u>X</u> Primarily an Equipment Request _____ Not Primarily an Equipment Request			
4. Name(s) of Submitting Institution(s) of Higher Education (Include Branch/Campus/other Components)		Louisiana State University in Shreveport	
5. Address of Institution of Higher Education (Include Dept/Unit, Street Address/P.O. Box Number, City, State, Zip Code)		Physics & Astronomy Program One University Place Shreveport, LA 71115	
6. Title of Proposed Project: <u>UNDERGRADUATE PHYSICS & ASTRONOMY LAB ENHANCEMENT</u>			
7. First-Year Support Fund Money Requested: <u>\$63,600</u>	8. Second-Year Support Fund Money Requested (if applicable) \$	9. Proposed Duration (Circle # of Years)	<u>①</u> 2
10. Category in Which Proposal is Being Submitted (check one only)		11. Using the Taxonomy in Appendix a of the RFP, Identify All Specific Subcategories of the General Category That Apply to this Proposal and Provide Taxonomy Numbers:	
<input type="checkbox"/> Business	<input type="checkbox"/> Special Multi-disciplinary (see section III.B.2.c of the RFP.)	Subcategory(ies):	Taxonomy Number(s)
<input type="checkbox"/> Chemistry			
<input type="checkbox"/> Education		Astronomy	0801
<input type="checkbox"/> Mathematics		Physics	0899
<input checked="" type="checkbox"/> Physics/Astronomy		Optics	0806
12. This Proposal is a <u>XX</u> New Request _____ Request for Continuation of a Previously-funded support fund project (Check one) (Provide previous contract number: _____)			
By signing and submitting this proposal, the signators are certifying that: (1) the proposed project has not already been funded/is not currently being funded/has not been promised funding; (2) this proposal has been reviewed and approved by an Institutional Screening Committee; and (3) the institution and the proposed project are in compliance with all applicable Federal and State laws and regulations, including, but not limited to, the required certifications set forth in: (a) Grants for Research and Education in Science and Engineering, NSF 83-57 (rev. 11/87); and (b) Appendix C, 45CFR 620, Subpart F (Requirements for a Drug-Free Workplace).			
Name/Title (type or print Institution if different from Item #5 above)	Dept./Telephone No.	Degree/Year	Signature
PI/PD W. Decker Moore Assistant Professor	Physics & Astronomy/ (318) 797-5284	M.S. 1968	
Co-PI/PD Gary R. Boucher, Associate Professor	Physics & Astronomy/ (318) 797-5192	D.Eng. 1999	
Co-PI/PD			
Campus Head or Authorized Institutional Representative	Dean		Authorized Fiscal Agent
Name/Title: (type or Print) Stuart E. Mills Provost & VCAA	Name/Title: (type or print) Paul Sisson, Dean College of Sciences		Name/Title: (type or print) Michael Ferrell VC Business Affairs
Signature: 	Signature: 		Signature: 
Date: <u>10-18-07</u>	Telephone Number: 318.797.5374	Date: <u>10/18/07</u>	Telephone Number: 318.797.5231
		Date: <u>10/18/07</u>	Telephone Number: 318.797.5200

PROJECT SUMMARY

Name of Institution

LOUISIANA STATE UNIVERSITY IN SHREVEPORT

Address

**Physics & Astronomy Program
One University Place
Shreveport, LA 71115**

Principal Investigator(s) **W. Decker Moore; Gary R. Boucher**

Title of Project: ***UNDERGRADUATE PHYSICS & ASTRONOMY LAB ENHANCEMENT***

Abstract (DO NOT EXCEED 250 WORDS)*

This BORSF project is designed to enhance equipment resources for undergraduate education in the physics and astronomy laboratories at Louisiana State University in Shreveport (LSUS). In The overall project goal is to expand and improve opportunities for student learning in physics and astronomy. The project is designed to complement ongoing physics and astronomy curriculum upgrades by expanding emphasis on the laboratory as a place for conceptual understanding and by including more technology in the laboratory experience. Specific project objectives include the following:

- ✦ Enhancing physics and astronomy lab equipment resources in order to expand capacity to serve more students per lab session and to enrich the educational experience of undergraduate students in those labs,
- ✦ Training students on up-to-date equipment so they may bring appropriate knowledge and skills to their future employment careers or advanced academic endeavors and/or promoting students' development of further interest in and appreciation for science and technology,
- ✦ Increasing the effectiveness of teaching and career development for physics and astronomy faculty who will utilize the new equipment, and
- ✦ Promoting interest in physics, astronomy, and science in general through outreach activities for K-12 students, including science education events held in conjunction with area partner organizations.

This equipment request of \$63,600 for additional lab equipment will significantly enhance undergraduate physics and astronomy education at LSUS. For this project, we will provide an institutional match of over \$30,000.

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UNDERGRADUATE PHYSICS & ASTRONOMY LAB ENHANCEMENT

NARRATIVE AND BIBLIOGRAPHY

A. THE CURRENT SITUATION

1. Institutional Description

Louisiana State University in Shreveport (LSUS) is the only public 4 year college in Shreveport, Louisiana's third largest metro area, (population 350,000). Shreveport is the business and industrial center of the Ark-La-Tex region (north Louisiana, south Arkansas, and east Texas). The University currently serves 4,000 regular students and 11,000 non-credit students per year. Since 1989, minority enrollment has grown rapidly, with minority students now comprising over 36% of the student population. Students at LSUS are drawn from an urban population, most of whom are the first in their families to attend college; 37% are "low income" according to federal guidelines. LSUS is the only public 4-year university offering physics and astronomy within 75 miles of Shreveport. The university is fully accredited by the Southern Association of Colleges and Schools (SACS). LSUS also works with Barksdale Air Force Base to offer credit and noncredit programs for Air Force personnel.

The Physics program is guided by five physicists, offering areas of specialization in general physics and optics, astronomy, particle physics, condensed matter and quantum physics, mathematical and theoretical physics, and electronics and robotics. All of the curricula in the College of Sciences require course work in physics, with the exception of computer science and a few allied health programs. This means that approximately 1,100 students take 2 to 4 courses in the physics curriculum. Additionally, the physics program offers general education courses in Astronomy to non-science majors, as well as courses in electronics and robotics in collaboration with the Computer Science Department, and additional courses in support of the Secondary Education Science-Physics degree program in the College of Education.

2. Rationale for Project

This BORSF project is designed to upgrade equipment resources needed to train students in undergraduate physics and astronomy lab courses. Physics and astronomy laboratory equipment shortages can be traced to the university's founding as a two-year institution and rapid transition to four-year status. LSUS was founded in 1967 and became a four-year institution in 1973. In those intervening years, the physics department was formed and the laboratories were stocked. In the ensuing years, however, there have been only minimal budgets for renewing these labs. What supply money was available was used to keep existing equipment running and, when possible, to replace equipment that was beyond repair. An additional impediment to progress was the wiring in the laboratories, which was insufficient. The wiring problem was corrected during the renovation of the Science Building, funded with the support of a \$1.47 million National Science Foundation grant and matched with institutional and state funds to upgrade our facilities. Both the upgraded teaching and research facilities and the turn of the 21st century prompted us to rethink our laboratory offerings. We are making major revisions to our laboratory curriculum, including previously missing concepts, expanding emphasis on the laboratory as a place for

conceptual understanding of topics, and including more technology in the laboratory experience.

Physics Lab Equipment Needs: At LSUS, two advanced laboratory courses, Physics 462 and Physics 463, are required of all physics majors. Because the courses are required of physics majors, the demand is constant and several key items of equipment are outdated and in need of replacement. Some of the existing lab equipment is obsolete, and several major items are worn out through heavy undergraduate usage. This shortage of adequate equipment currently limits enrollment in Physics 462 and Physics 463. Key specific items of new equipment are requested, with the most important being the following: Coulomb's Law Apparatus, Planck's Constant Apparatus, Cavendish Apparatus, Photoelectric Effect Experiment, Millikan Oil Drop Apparatus, Diffusion Cloud Chamber System.

Astronomy Lab Equipment Needs: In the LSUS astronomy laboratories the lack of usable equipment prompted the physics program to cancel offering Astronomy labs in 1991 until 1999 when we acquired enough student telescopes to hold labs. LSUS has a science core requirement for all students. Even non-science students are required to complete a two-semester sequence of science course with an accompanying lab. Many of those students have chosen Astronomy. With the recent discontinuation of the Integrated Science 101, 102, and 103 courses, enrollment demand for the astronomy sequence has doubled. The laboratory courses, Astronomy 105L and Astronomy 106L are both outside observing courses. Enrollment in each section is limited by the number of telescopes available to the students. The proposed equipment enhancement will enable us to serve 28 students per lab session in Astronomy 105L and 28 students per lab session in Astronomy 106L, instead of the current limit of 20 students per session in each course. Retrofitting/upgrading of the existing 10 usable student telescopes will much improve field deployment capability of those older scopes to match with that of the new telescopes.

The requested physics and astronomy lab equipment will enable us to better reinforce conceptual learning in the lab increasing the effectiveness of the Physics 462/463 and Astronomy 105L/106L lab courses in terms of student learning and student hands-on experience with modern equipment. An enhanced laboratory experience, combining conceptual understanding with of technological experience, will produce better educated graduates needed for state and national competitiveness in the global economy.

3. Impact on Existing Resources

This project will produce a significant impact on our resources available for physics and astronomy education. Some of our existing physics laboratory equipment items, especially items dating from the mid 1970's, are outdated and/or worn out from constant undergraduate usage and are in need of upgrading or replacement. When LSUS was established as a 2-year institution in 1967, the state did not plan for LSUS to attain 4-year status until the turn of the century. However, given our location as the first public university in the state's third largest metro area, the need was such that 4-year status was granted in 1973. Several of our key items date from around that time. For example, in the physics labs, the existing Millikan oil drop apparatus is 27 years old and the scalar counter is almost

30 years old.) Some of these existing resources need to be replaced with more modern versions. In astronomy, enrollment in the lab sessions has been limited by an inadequate number of student telescopes.

Equipment requested in this project will help bring our physics and astronomy laboratories up to adequate equipment levels and support our revitalized laboratory curricula, including design of additional exercises for students that will reinforce conceptual understanding of topics covered in class. With the new equipment, we will be better able to prepare students as they move into industrial, scientific, and academic careers. Some of the new physics items will replace obsolete and/or worn out equipment with modern versions of key lab items. In addition to enhancing LSUS student learning, the new astronomy equipment will also serve as a resource for young people in our outreach activities, which include star parties for area K-12 students. Retrofit of usable student telescopes will make those existing instruments more functional for field use. The proposed new resources will complement existing resources, enable us to serve more students in lab sessions, and support improved physics and astronomy lab instruction and student learning.

B. THE ENHANCEMENT PLAN

1. Goals and Objectives

The overall project goal is to expand and improve opportunities for student learning in physics and astronomy. The project is designed to complement ongoing upgrades to our curriculum by expanding emphasis on the laboratory as a place for conceptual understanding, and by including more technology in the laboratory experience. Project objectives include the following:

- ✦ Enhancing physics and astronomy lab equipment resources in order to expand capacity to serve more students per lab session and to enrich the educational experience of undergraduate students in those labs. The labs targeted for enhancement are advanced physics (primarily used for Physics 462/463) and astronomy (105L/106L).
- ✦ Training students on up-to-date equipment so they may bring appropriate knowledge and skills to their future employment careers or advanced academic endeavors and/or promoting students' development of further interest in and appreciation for science and technology.
- ✦ Increasing the effectiveness of teaching and career development for physics and astronomy faculty who will utilize the new equipment.
- ✦ Promoting interest in physics, astronomy, and science in general through outreach activities for K-12 students, including science education events held in conjunction with area partner organizations.

2. Workplan of Proposed Project

This BORSF project is designed to enhance undergraduate physics and astronomy instruction and learning via the acquisition and utilization of specific new equipment items

for student instruction in the Physics 462/463 and Astronomy 105L/106L laboratory courses.

a. Project Management:

W. Decker Moore, the project director and principal investigator (PI) will be responsible for supervision of grant project activities, including purchasing the new equipment, coordinating acquisition, installation and utilization of the new resources in the laboratories, and reporting to BORSF. Co PI Gary Boucher will assist with supervision of equipment installation and with utilizing the new items in the labs. He will also supervise student researchers using the Physics labs for upper-level projects. The Dr. Cynthia Sisson, Department Chair, other department faculty and the Dean of Sciences will assist as needed with institutional resource allocation, course scheduling, etc. Cassandra Johnson, LSUS Assistant Director of Accounting Services, handles external grants accounting and will assist the PI with grant budget matters and project financial reports.

b. Physics Laboratory Enhancement Activities:

Several key items of equipment are need of replacement due to being outdated and/or worn out through heavy, constant undergraduate usage. Key specific items of new equipment are requested, with the most important being the following: Coulomb's Law Apparatus, Planck's Constant Apparatus, Cavendish Apparatus, Photoelectric Effect Experiment, Millikan Oil Drop Apparatus, Diffusion Cloud Chamber System. We plan to offer the enhanced Physics 462 lab course utilizing the additional and upgraded equipment in the Fall semester and the enhanced Physics 463 lab course in the Spring semester with the new equipment proposed here. The new physics equipment will increase the effectiveness of the Physics 462 and 463 courses and increase LSUS capacity for graduating well-prepared physics majors.

c. Astronomy Laboratory Enhancement Activities:

By upgrading telescope resources, instruction and learning in Astronomy 105L and 106L will be enhanced, encouraging more students to enroll. We plan to offer an enhanced Astronomy 105 Lab with the additional and upgraded Questar student telescopes in the Fall semester and an enhanced Astronomy 106 Lab in the Spring semester with full (enlarged) student sections made possible via the new equipment proposed here. Adding new telescopes will enable the lab sessions to serve more students per session and retrofitting existing student telescopes will make those existing instruments more functional for field use. The new and retrofitted telescopes will directly improve support the effectiveness of the introductory astronomy courses in terms of student learning and interest in astronomy.

d. Anticipated Outcomes:

With an overall project goal of expanding and improving opportunities for student learning in physics and astronomy, the project will complement ongoing upgrades to the curriculum by expanding emphasis on the laboratory as a place for conceptual understanding and by including more modern technology in the laboratory experience. By upgrading essential lab resources, instruction and student learning in Physics 462/463 and Astronomy 105L/106L will be directly enhanced. The P and CoPI, with assistance of faculty colleagues and LSUS staff, will oversee acquisition and installment of the new resources in the labs. All appropriate state and institutional policies and procedures will be followed regarding

equipment acquisition and set-up. This process will begin as soon as the grant contract is finalized, which would likely occur in summer 2008. Adding the requested new equipment will enable the lab sessions to better serve undergraduate physics majors at LSUS.

e. Project Evaluation, Dissemination, Reporting:

Project evaluation will include qualitative procedures to measure whether the project has made substantial changes in students' understanding of topics covered in the Physics 462/463 or the Astronomy 105L/106L courses as well as a number of quantitative measures, such as tracking of credit hours supported and numbers and types of students served. **(See Performance Measures in Section B. 7.)** Dissemination of project information will occur via the LSUS website, news articles, partnership activities, etc. Reporting to BORSF: The PI will submit the following reports, in accordance with the required BORSF time table and format: June 30, 2009– Final Project Report; September 30, 2009– Final Expenditures Report. All publications, presentations, etc. that emanate from the work supported by the project will cite the support of the BORSF program and the appropriate BORSF contract number.

d. Timeline:

Implementation of the project will begin July 1, 2008. The following table outlines the schedule of the various phases of the project, ending with June 2009.

ACTIVITY	J	A	S	O	N	D	J	F	M	A	M	J
Grant start up; Purchase and set up new equipment for physics & astronomy labs	X	X	X									
Conduct enhanced Physics 462 & Astronomy 105 laboratories		X	X	X	X	X						
Conduct enhanced Physics 463 & Astronomy 106 laboratories							X	X	X	X	X	
Analyze effects of the new lab elements on student learning											X	X
Prepare/submit project reports to BORSF											X	X

3. Evidence of Potential to Achieve Recognized Eminence

The LSUS physics program is designed to provide high quality instruction to meet the needs of all academic programs at the University, with a special emphasis on science and engineering students. The program includes courses for curricula in physics, biochemistry, chemistry, mathematics, and pre-engineering. Service and general education courses for other curricula include astronomy, physical science, and non-calculus physics courses, with the later designed primarily for students in biochemical science, biological science, and related health sciences fields. One of Louisiana's two public medical schools, LSU Health Sciences Center-Shreveport (LSUHSCS) is located in Shreveport, which results in a large number of future health professionals taking undergraduate courses through the physics program at LSUS. The *Gourman Report*, a nationally respected ranking of colleges worldwide, ranks LSUS as #3 among Louisiana universities in quality of academic

programs, behind only Tulane (private, Research I-level) and LSU A&M (public, Research I-level).

a. Student Success:

The excellent success rate of students graduating from the program is the primary indicator of an excellent undergraduate physics program. Overall 25% of our physics graduates have received Ph.D. degrees and are employed at various universities, national laboratories, and industries. Presently 20% are engaged in Ph.D. graduate programs in physics. Employers of our graduates include Texas Instruments, AT&T, Hughes Aircraft Corporation Radar Systems, and several government agencies.

The quality of our physics program is also reflected in the success rate of non-majors. Over the last six years, more than 100 of the 600 entering first-year medical students have arrived with undergraduate degrees from LSUS. Many additional students take their science prerequisites at LSUS, after having earned an unrelated degree at another university. On average, almost 25% of the entering class at LSUHSCS have taken some or all of their course work at LSUS. This is far out of proportion to the size of our student population in comparison to other universities in the state, and a strong indicator of the quality of LSUS science education.

Most LSUS students have considerable outside demands from jobs and family responsibilities, yet they show a strong determination to succeed. According to the Southern Association of Colleges and Schools (SACS): *"LSUS has test scores on the General Education Proficiency Examination (taken by graduating students) that are in the upper one-third of the mean scores of 23 peer institutions, yet LSUS freshmen students have beginning ACT scores that fall in the bottom one-third when compared to students at these same institutions. This suggests the general education requirements at LSUS are, in reality, 'adding value' to its students. The students' scores are well above the mean scores for these other 23 comparable institutions."*

b. Faculty Success:

LSUS has been singled out by the Louisiana Board of Regents for its excellence in teaching and involvement in undergraduate research. Undergraduate students at our institution have opportunities for involvement in hands-on research projects with the faculty, in contrast to some Universities where research is strictly a graduate-level experience. New faculty at LSUS are recruited both for their abilities as a classroom instructor and for their ability to provide research opportunities for students.

In the wake of several years of inadequate state budget funding for higher education, faculty at LSUS have increased efforts to obtain external funding. Our NSF Academic Research Infrastructure (ARI) Facilities Renovation grant for \$1.47 million was the single largest NSF-ARI grant ever awarded in Louisiana.

Faculty in the physics program provide active involvement to students in research, such as recent efforts involving both condensed matter computer simulations and biophysics computer simulations of photons in tissue. These research efforts are a collaborative effort

with faculty from Centenary College, the Louisiana State University Health Sciences Center, and LSUS, and are funded by the Biomedical Research Foundation of Shreveport, Louisiana.

Undergraduate education reform and related curriculum development activities are also of importance at LSUS. In a project that spans both the College of Sciences and the College of Education, lower-level science courses (for elementary education majors, among others) have been developed/revised to increase focus on hands-on, inquiry-based methods. Some of these curriculum development efforts were funded by the Louisiana Collaborative for Excellence in Teaching (LaCEPT), with LSUS faculty developing course textbooks and lab handbooks to accompany such courses. In 2006, LSUS faculty developed a new upper-level radio astronomy course which includes collaboration with MIT Haystack Observatory and is intended to further strengthen the science interests of LSUS students.

c. Community Service/Outreach:

LSUS faculty members are also in outreach programs to encourage K-12 students to consider science careers. The PI and several other LSUS faculty members are very active in the Shreveport-Bossier Astronomical Society, which holds Star Parties at the Worley Observatory (owned by the Caddo Parish School System and operated by LSUS) for K-12 students to experience specific sky events. The PI and other faculty are also active in SciPort, a hands-on science museum. SciPort now contains a Mars Rover exhibit (built by LSUS faculty and students) in the SciPort Space Center and LSUS faculty advise on programs in SciPort's new Space Dome Planetarium. LSUS's Public Radio Station KDAQ, which airs programs such as "Star Date", often features LSUS faculty commentary on astronomical events and forthcoming public "star parties". We also host forums featuring nationally recognized scientists, such as Dr. Neil deGrasse Tyson, noted astrophysicist, author and director of the Hayden Planetarium in New York. The LSUS LaPrep summer math/science enrichment program for minority and women middle school students was established to encourage more minority and women students to consider careers in science. LaPrep has won national recognition from the U.S. Depts. of Energy and Education, and one of our faculty members has received an NSF Presidential Award for Excellence for work in mentoring minority students interested in science careers.

4. Impact on Curriculum and Instruction

With the new equipment proposed here, instruction in the Physics 462/463 laboratory courses and the Astronomy 105L/106L laboratory courses will be directly and significantly enhanced. The Physics 462 and 463 courses are required for all physics majors, so enhancement of key equipment items will eventually benefit all LSUS physics graduates. The majority of students enrolling in the Astronomy 105L and 106L courses are non-science majors, many of whom are education majors. Enrollment in each astronomy lab section is limited by the number of telescopes available to the students, so the new telescopes and other resources requested will improve student learning opportunities as well as allow more students to be served in each lab session. The courses that will directly benefit from this proposed equipment enhancement project are described below.

PHYS 462: Advanced Laboratory - Prerequisite: PHYS 220. An advanced laboratory course for upper-level Physics majors. Selected experiments in several branches of physics. Three hours of laboratory.

PHYS 463: Advanced Laboratory - Prerequisite: PHYS 462. An advanced laboratory course for upper-level Physics majors. Selected experiments in several branches of physics. Three hours of laboratory.

ASTR 105L: Laboratory - Prerequisite: ASTR 105, MATH 007 or sufficient score on math diagnostic test. A laboratory course to accompany ASTR 105: The Solar System (survey course). Visual and photographic observations of the planets and moon are made with an 8-inch reflecting telescope; practical problems in solar system astronomy are studied. Two hours of laboratory.

ASTR 106L: Laboratory - Prerequisite: ASTR 105, 106. A laboratory course to accompany ASTR 106: Stellar Astronomy (survey course). Visual observations of stars and nebulae are made with a reflecting telescope; practical problems in stellar astronomy are studied. Two hours laboratory.

5. Impact on Quality of Students

The physics and astronomy laboratory enhancements resulting from this project will significantly affect physics majors, many other students in the College of Sciences, several dozen science education majors in the College of Education, and another 75-80 students taking departmental offerings as general education requirements. This project will improve their laboratory experiences, and produce better educated and better trained students as a result. The presence of additional modern physics and astronomy equipment will serve as an asset to attract more quality students to undergraduate science programs at LSUS. Use of the new resources, combined with existing resources, for K-12 outreach events and summer teacher institutes will also help more young people to develop a strong interest in science, perhaps leading to the pursuit of science/technology degrees in college and eventual science and technology-oriented careers. The success rate our graduating physics students is a primary indicator of an excellent undergraduate program and the quality of our students. Many of our baccalaureate physics graduates have gone on to receive Ph.D. degrees and are employed at various universities, national laboratories, and in industry. Among them are graduates of doctoral programs at Yale, Texas A&M, Iowa, North Carolina State, University of Arizona, LSU, and Tulane. The presence of additional physics and astronomy equipment will serve as an asset to attract more quality students to undergraduate physics and other degree programs at LSUS.

6. Impact on Faculty Development

Project impact on improving pedagogical effectiveness of faculty teaching physics and astronomy laboratory courses and corresponding lecture courses will be significant. The proposed project will give faculty additional tools to better train students, allow faculty to develop new laboratory and field activities, and enable faculty to better experiment with new pedagogical techniques in the lab courses impacted by the project. Both faculty members

and students will benefit from the improvement of teaching and learning opportunities in the lab courses afforded by the presence of adequate levels of modern equipment in quantities sufficient to serve current student demand.

Enhancement of physics and astronomy laboratory resources will also increase the attractiveness of LSUS for new faculty recruitment as well as improve the University's ability to attract and retain promising students who may advance to scientific-related jobs or academic careers, increasing the reputation of LSUS's physics program for instruction and hands-on training. Enhanced program image will help attract future students and potential funding support from external sources, both important factors in future opportunities for faculty development. The project will expand student discovery-based learning to more effectively integrate research and education, as recommended in national undergraduate science education reform efforts (NRC, 1999, 2001, 2003; NSF, 1995; 2003, etc.). Adequate levels of modern equipment for training students is a key component of undergraduate science education reform in both Louisiana and the United States.

7. Performance Measures

Evaluation of this physics and astronomy enhancement project will involve utilizing both quantitative and qualitative measures, including measures such as number of student credit hours, student research/outside class time, and student academic/career success supported by the project, development of additional projects, additional grants, etc. For example, in quantitative evaluation, we will track the number and type of students and their credit hours supported by this project and instructors in the courses will also use such measures as comparing class averages after the enhancement project to the same averages from prior years. For qualitative evaluation, students will be surveyed on the impact of the new equipment to their understanding of concepts emphasized in the particular lab courses targeted for enhancement by this project, and, over the longer term, we will collect observation reports from faculty, graduates, and cooperating institutions and organizations. Evaluation/assessment assistance will be provided by the LSUS Office of Institutional Effectiveness, which regularly tracks statistical and financial measures for all LSUS programs. The BORSF final project report will include a summary of project evaluation and student impact assessment.

C. EQUIPMENT

This project requests equipment to enhance and upgrade undergraduate physics (462 & 463) and astronomy (105L & 106L) laboratory courses at LSUS. Need for Physics equipment: The Physics 462/463 laboratory courses are required of all physics majors and because of this, the demand is constant. Some of the existing lab equipment is obsolete and several major items are worn out through heavy undergraduate usage. This shortage and/or inadequacy of equipment currently limits enrollment in the 462/463 lab courses. Need for Astronomy equipment: The Astronomy 105L/106L lab courses are both outside observing courses. Enrollment in each astronomy lab section is limited by the number of telescopes available to the students. The proposed equipment will directly enhance service to students in these physics and astronomy lab courses.

1. Equipment Request: (SEE DETAILS IN BUDGET SECTION)

Major Items Requested:	Amount
<u>For Physics 462/463 Labs:</u>	
Cavendish Apparatus (Pasco)	\$2,000
Coulomb's Law Apparatus (Pasco)	\$2,500
Millikan Oil Drop Apparatus (Cenco)	\$1,500
Planck's Constant Apparatus (Cenco)	\$2,500
Photoelectric Effect Experiment (Pasco)	\$2,000
Diffusion Cloud Chamber (TelAtomic)	\$1,000
Teslameter (TelAtomic)	\$1,000
Additional Items: Ionizing air blower @ \$500; Digital Strobe @ \$500; Photoelectric Scanner @ \$300; Security/Storage Cabinet @ \$1,800;	<u>\$3,100</u>
Subtotal Physics Equipment:	\$15,600
<u>For Astronomy 105L:</u>	
4 additional student telescopes: Questar 3 ½ in. telescope: full aperture solar filter, 12 mm eyepiece, Powerguide II system. 4 @ \$6,000 each	\$24,000
4 tripods for above student telescopes: Gitzo telestudex tripod, low head profile. 4 @ \$750 each	\$3,000
Upgrade of 10 existing Questar 3 ½ in. student telescopes: Powerguide system retrofits. 10 @ \$500 each	\$5,000
<u>For Astronomy 106L:</u>	
4 new 10 inch telescopes: Meade 10 in. Ritchey-Chretien telescopes with Meade equatorial wedge. 4 @ \$4,000 each	<u>\$16,000</u>
Subtotal Astronomy Equipment:	\$48,000
TOTAL REQUEST:	\$63,600

Physics 462 consists of a series of experiments illustrating the history of physics. The include: the Cavendish experiment, the Balmer lines of hydrogen equipment, the e/m experiment, the use of the Michelson interferometer, the Millikan oil drop experiment, the Young's double slit experiment, and the Photoelectric Effect, and the Coulomb's Law experiment. The equipment for many of these experiments is obsolete or worn out through constant undergraduate usage. The torsion band of the Cavendish apparatus is broken, the objective of the Millikan telescope is missing, the laser used to illuminate the double slits is 27 years old, the Photoelectric Effect tubes no longer respond, the air cell of the Michelson interferometer leaks, and the Coulomb apparatus needs to be replaced completely.

Physics 463 students select from a variety of experiments, ranging from the Faraday Effect to scanning diffraction patterns to radioactive counting. We have no portable Teslameter to measure the magnetic field strength of our magnet, our scalar counter is almost 30 years old, and the photoelectric scanner is outdated. There is a need to expand the offerings of this course to include a polarization experiment (verifying Fresnel's equations), and a quantitative cloud chamber experiment. This BORSF project also requests a storage cabinet to hold key new physics equipment items for safety and security purposes.

Astronomy 105L: The lab currently has 10 usable 3 ½ inch Questar telescopes available for student use. These small scopes are ideal for our use because they are portable.

Approximately seven of the 14 lab activities are done at the Worley Observatory located 15 miles south of the LSUS campus. All equipment for each activity must be transported to the observatory. Usually two students are assigned to each telescope. This limits the enrollment to 20 students. The purchase of four additional Questar student telescopes (with tripods) will allow eight more students into each Astronomy 105L section. The proposed new telescopes are chosen to match the existing telescopes. Providing power to the older scopes is a major problem. Long extension cords in the grass at night are dangerous. Questar now offers a self-contained Powerguide system for its telescopes. A retrofit service for Questar's older scopes is available (three of our scopes are over 30 years old) to upgrade our existing 10 Questar students telescopes.

Astronomy 106L: The Astronomy 106 lab presently has two Questar seven inch telescopes and a Meade 14 inch Cassegrain available for student use. Because of their size and weight they are difficult to transport to the observatory and difficult for the students to assemble. The Meade 10 inch Ritchy-Chretien is lighter and easier to assemble. The purchase of four Meade 10 inch scopes will allow additional students into each lab section as well as provide better field equipment for students in the 106L course.

2. Equipment on Hand for Project

Through a combination of LSUS resources and external funding there are adequate student computers in our labs. However, many existing equipment items are over 30 years old, having been purchased between the time that LSUS opened in 1967 and when it became a four year institution in 1973. This project focuses on adding new items needed to expand student enrollment in lab sessions as well as replacing several key items which are obsolete or worn out through heavy undergraduate usage over the years. A general list of available existing lab equipment related to the project includes:

Physics Labs:

In addition to key items needing replacement (Coulomb's Law Apparatus, Planck's Constant Apparatus, Cavendish Apparatus, Photoelectric Effect Experiment, Millikan Oil Drop Apparatus, Diffusion Cloud Chamber), the physics labs have the following:

- ✦ Standard physics items (12): 12 set-ups of many of the standard experiments; including, as a partial list, force tables, projectile motion spring guns, rotational motion apparatus, optics set-ups, and circuit set-ups.
- ✦ Collision Tracks (12) and friction cart accessory (12): These tracks are nearly frictionless, allowing a much larger range of angles of inclination during use, and because they don't require air blowers, are quieter than air tracks.
- ✦ e/m apparatus (1) and power supply: This apparatus measures the ratio of the electron's charge to its mass and is used for demonstration experiments.
- ✦ KaleidaGraph (14): used for graphing and data analysis (linear regression, smoothing fits, non-linear fits).
- ✦ Computer (1) and KaleidaGraph software: one student computer and graphing package in the Advanced Lab.
- ✦ Multichannel Analyzer: A multichannel analyzer.
- ✦ Picoammeter: provides precise current measurements.
- ✦ Maltese Cross Tube, stand, and power supply:

- ✦ Hall Effect Gaussmeter: measures the magnetic field strength.

Astronomy Labs:

- ✦ Student telescopes and tripods (10): 10 usable Questar 3½" student telescopes.
- ✦ Larger telescopes (3): Questar Classic 7" LW Titanium, Meade 14" Cassegrain, older Questar 7" (used as a back-up instrument).
- ✦ Small Radio Telescope (1): 7-foot diameter, for use in a new upper-level radio astronomy course (Physics 487) introduced in 2006.

Available astronomy resources also include facilities/equipment at the Ralph A. Worley Observatory which is operated by LSUS and located 8 miles south of our campus. The observatory dome contains a 16-inch Newtonian reflector and another observatory building contains a 6-inch refractor. We also have a separate fabrication lab for faculty and student projects (machining, milling, welding, etc.). Such equipment includes a modern lathe/milling machine package, small lathe/mill, drill press, bench grinder, TIG welding system, Lathe DRO (Digital Read-Out System), etc.

3. Equipment Housing and Maintenance

The new equipment will be housed, along with existing equipment, in our undergraduate physics and astronomy labs in the main LSUS Science Building. The lab facilities are locked when labs are not in session, thus providing a secure location for the new apparatus. (We recently completed a major renovation of LSUS science/engineering facilities with support from a \$1.5 million NSF award and \$4 million from state capital outlay funds. This enabled us to modernize basic infrastructure, including HVAC, wiring, shelving, fixed equipment, safety and ADA improvements.) Maintenance of the new equipment will be the responsibility of LSUS and will be funded out of the annual departmental budget. The physics faculty has considerable experience maintaining departmental equipment. Departmental and institutional safety and security procedures are already in place. All bids solicitation and purchasing of the new equipment items will be handled in accordance with appropriate LSUS institutional policies and procedures (with final oversight by the State Legislative Auditor) and installed with assistance from LSUS's staff of qualified equipment technicians. For astronomy education, in addition to classes and exercises held on the LSUS campus, we manage and utilize the Ralph A. Worley Observatory which is located 8 miles south of our campus on LA Hwy. 175. This observatory was originally built by the Shreveport-Bossier Astronomical Society in 1964, later donated to the Caddo Parish School System, and is now operated by LSUS. This facility is used for LSUS astronomy classes as well as for public programs such as free public star parties. LSUS equipment utilized at the observatory is transported (with faculty supervision) to and from the observatory according to appropriate institutional procedures.

D. FACULTY AND STAFF EXPERTISE

Project Director/PI: W. Decker Moore, Assistant Professor of Physics at LSUS, holds the M.S. from Northeast Louisiana University and will serve as Project Director. He is the primary instructor of the introductory Astronomy lecture and laboratory courses, as well as having had responsibility for teaching the Advanced Physics lab courses to physics majors at LSUS for the last 20 years. He is the author of the laboratory manuals used in all of the

introductory laboratories, as well as all of the Advanced Lab materials. He will coordinate the purchasing of equipment for this grant, management, budgeting, and other grant matters. He will also coordinate usage of the new astronomy instrumentation for K-12 outreach, including star parties at the Worley Observatory, and other activities sponsored by the Shreveport-Bossier Astronomical Society.

CoPI: Gary R. Boucher, Assoc. Professor of Physics, holds a doctoral degree and an M.S. from Louisiana Tech as well as an M.S. from Northwestern State and will serve as CoPI. He is active in industrial outreach to assist entrepreneurs to develop new products, including a recent U.S. Dept. of Defense SBIR project to develop devices for extreme environments. He served as CoPI on a \$400,000 NSF grant to attract more disadvantaged and minority students to science careers. He teaches the General Physics 251 and 252 lab courses, the Physics 320 electronics lab, and other physics courses, is experienced in using the requested physics equipment, and will assist the PI in supervising installation of the new resources and in utilizing them in the labs. He will also supervise student researchers using the Physics labs for upper-level projects.

Other Key Personnel:

Department Chair: Dr. Cynthia J. Sisson, Ph.D., University of South Carolina, Associate Professor and Chair at LSUS. Dr. Sisson has been involved in curriculum development at LSUS supported by grants from the Louisiana Collaborative for Excellence in the Preparation of Teachers (LaCEPT) totaling \$187,000 for development of integrated science courses for elementary education majors. As a member of the science writing team, Dr. Sisson has developed inquiry-based labs for such courses and is in the process of writing a text "Integrating Science, Explorations in Biology, Chemistry, and Physics" for publication. Dr. Sisson also served as co-PI on our \$1.47 million NSF grant that made possible the renovation of facilities in the Science building at LSUS. This grant provided funds for reconfiguring the rooms in which the physics/astronomy labs are taught, including rewiring.

Other Faculty/Staff: Dr. Laura Whitlock, Assistant Professor of Physics, and Dr. Cran Lucas, Professor and head of the Shreveport-Bossier Astronomical Society, will assist as needed. Cassandra Johnson, LSUS Assistant Director of Accounting Services, handles external grants accounting and will assist with grant budget matters and project financial reports. Melissa Mainiero, Director of the LSUS Office of Institutional Effectiveness, will assist with statistical data for project evaluation. LSUS's qualified equipment technicians will help, as required, with installation and maintenance of the new equipment.

E. ECONOMIC AND/OR CULTURAL DEVELOPMENT AND IMPACT

1. Relationships with Industrial/Institutional Sponsors

Many LSUS physics and other science graduates are employed at various industrial facilities, analytical laboratories, universities, and government agencies. We have established an internship program for mutual benefit of students and sponsors which includes several area firms: General Motors, BASF, Schumpert Hospital, ARKLA (natural gas utility), and SWEPCO (electric utility company). This project will strengthen our ties to local industries employing scientific personnel.

In community outreach efforts to attract public school students to the sciences, LSUS has partnered with the SciPort Discovery Museum, Barksdale AFB, area public school systems, and nonprofit educational and youth organizations. Outreach events include hosting annual K-12 science fairs, summer science programs for area youth, and special programs related to particular science topics. LSUS also partners with the Caddo and Bossier Parish School Systems on in-service science teacher training institutes that may utilize the new resources. For astronomy outreach to K-12 students, LSUS regularly partners with the Shreveport Astronomical Society, STAR Planetarium, SciPort Planetarium, BAFB STARBASE Louisiana program, etc. to host "Star Parties" and special programs related to asteroid events. This project will directly enhance such cooperative relationships and will also enhance ongoing cooperative transfer partnerships with area community colleges, by making the LSUS 4-year physics program more attractive to students transferring from 2-year community college science programs.

2. Promotion of Economic Development and/or Cultural Resources

According to the State Vision 2020 economic development plan, *"Technology innovation and education must become the driving factors behind Louisiana's diversification..."* The State Department of Economic Development is actively seeking to attract technology-oriented industries to our state. Students who are trained in the enhanced physics and astronomy laboratories will have better technical and knowledge discovery skills and will be better prepared to contribute to the local economy. Shreveport is a rapidly growing center of high tech industry and biomedical research, and the skills our students learn in the upgraded labs will be valued by future employers. Enhancement of our laboratories will allow us to retain more students and attract new students into the physics program and other science disciplines.

The project will have a positive impact on the state workforce. In the short term Louisiana will benefit when a greater number of LSUS students successfully pursue science-oriented careers and enter the market place with increased technology, laboratory, and research skills. Those students who pursue careers in secondary and higher education will further multiply the benefits of their knowledge by instructing their own students, who may in turn pursue science careers. The *"Micro Occupational Supply-Demand Report"* prepared by the Louisiana Department of Labor projects a 14.3% growth science-oriented job categories over a 5-year period. This equipment enhancement project will help strengthen our program and provide better science/technology education opportunities for students. Over the longer term, this project will benefit future economic development-related efforts. A pool of personnel trained in science and technology skills will directly enhance Louisiana's attraction for industry. This project will help expand workforce capacity required for specific future projects related to key economic growth sectors, such as the following:

USAF Cyber Command: LSUS is working with the Air Force and with State and local government agencies to support creation of the new USAF Cyber Command, designed to combat electronic and network threats, especially "organized cyber attacks capable of causing debilitating disruption of America's critical infrastructures, economy or national security." In 2006, the Air Force announced it would create the Cyber Command, to be headquartered at 8th Air Force HQ at Barksdale Air Force Base (BAFB), located less than

10 miles from the LSUS campus. The Cyber Command is being designed to integrate AF cyber capabilities, including command and control, electronic warfare, network warfare, and intelligence, surveillance and reconnaissance. With the command expected to be fully operational by late 2009, the Air Force is now working on professional cyber education/training plans and cyber career paths. LSUS has an excellent track record of working with BAFB via on-base educational programs. In anticipation of Cyber Command growth at BAFB, the State of Louisiana and local governments have committed over \$100 million to a Cyber Innovation Center (CIC) and the Caddo Parish Commission is creating a new endowed chair in cyber communications at LSUS. The CIC is expected to broaden the impact of Cyber Command at BAFB to civilian business/industry, furthering the area demand for science/technology graduates. Over the next 5 years, 10,000 to 20,000 Cyber Command-related jobs are projected for the Shreveport area.

Area Industrial Expansion: Major expansions of area industries will require more technologically literate personnel. Some companies with recent plans for expansion include several area hospitals (including Willis-Knighton, which has built a new medical center adjacent to LSUS), International Paper, SWEPCO (regional electrical utility), BASF, Olin, and Boeing. General Motors, the area's largest private employer, is developing a \$1 billion+ truck (and Hummer) plant expansion and suppliers park in Shreveport. A scientific research park in Shreveport is in the development stages adjacent to LSUHSCS, with several state-financed facilities recently completed or under construction. The \$50+ million Biomedical Research Institute, nearby Institute for Micromanufacturing, and growing regional technology-oriented companies will result in increased demand for personnel with science/technology training. The opening of the Caddo-Bossier Port facility on the Red River has increased interstate and international trade, as well as increasing the demand by north Louisiana companies for employees with technological knowledge and skills.

Investment in undergraduate physics and astronomy laboratory education and training will contribute to the advancement of both economic development and academic resources in Louisiana. The direct benefits of this project to students, faculty, and future employers of our students are multiplied by the long-term indirect benefits to the community. By meeting the needs of our students, this project will meet national goals of greater technological competence and global competitiveness. In the long run, the State of Louisiana will benefit by having more technologically educated citizens who are better prepared to compete in the global economy of the 21st century.

F. ADDITIONAL FUNDING SOURCES:

LSUS will provide over \$30,000 in institutional match. Opportunities exist with the NSF, Dreyfus Foundation, V.M. Slipper Committee (for astronomy), and other sources supporting undergraduate scientific education and research. Pending the outcome of this proposal, we will direct our proposals to those supporting laboratory equipment enhancement. With the addition of adequate equipment to train our students, we will become more competitive for future external funding from Federal and foundation sources.

PREVIOUS BORSF AWARDS:

PI Decker Moore received a \$7,250 BORSF grant in 2001 and a \$26,000 grant in 2004 to add equipment for instruction. CoPI Gary Boucher was PI on previous awards including: \$23,000 for EMI monitoring equipment and \$16,800 for a lathe and accessories; \$37,000 for measurement/testing equipment, \$14,000 for CNC equipment, \$46,406 for robotics training enhancement, \$30,300 for new computers for student instruction, \$5,500 and \$20,000 grants for lab fabricating equipment. All these projects were successfully completed and reported to BORSF. This new project will, if funded, build upon those previous projects and two previous NSF grant projects to further improve our capacity for undergraduate student education. The CoPI was CoPI on a recent \$400,000 NSF grant to attract more minority and women students to undergraduate science and technology degree programs. The PI and CoPI were also involved in implementing a \$1.5 million NSF grant which has provided laboratory facility renovation, including rewiring our physics and astronomy laboratories, to accommodate this project.

BOARD OF REGENTS SUPPORT FUND
 ENHANCEMENT PROGRAM, FISCAL YEAR 2007-08
 BUDGET
 PROJECT YEAR (CIRCLE ONE)
1 2 COMPOSITE

Title of Proposal :	UNDERGRADUATE PHYSICS & ASTRONOMY LAB ENHANCEMENT
Principal Investigator(s):	W. Decker Moore; Gary R. Boucher
Institution of Higher Education:	LOUISIANA STATE UNIVERSITY IN SHREVEPORT

I. PROPOSED BUDGET:	Support Fund Money Requested	Institutional Match*	Private Sector/Other Match**
A. Equipment	\$63,600	\$4,000 cash	\$0
B. Software	\$0	\$0	\$0
C. Supplies	\$0	\$600 cash	\$0
D. Shipping/Handling	\$0	\$0	\$0
E. Installation	\$0	\$2,000 in-kind	\$0
F. Personnel Training (including fringe benefits)	\$0	\$3,200 in-kind	\$0
G. Other Expenses (Identify)	\$0		
1. Student Workers	\$0	\$800 cash	\$0
2. Faculty time	\$0	\$12,000 in-kind	\$0
3.	\$0	\$0	\$0
4.	\$0	\$0	\$0
5. (etc.)	\$0	\$0	\$0
H. Indirect Costs	NOT ALLOWED	\$8,077 in-kind	\$0
I. Maintenance	STRONGLY DISCOURAGED	\$2,500 in-kind	\$0
J. Total Costs (A through I)	\$63,600	\$33,177	\$0

*Stipulate whether in-cash or in-kind. The Board strongly encourages the sharing of costs for proposed projects. Applicants and university officials should note, however, that the employing university will be required to honor the commitments made in the original proposal before Support Fund money will be awarded. Discounts received for equipment purchases are not allowable as institutional match.

**The budget page(s) must reflect and the budget justification page(s) must explain any external funds that are claimed in the proposal. These funds must be itemized and their expenditure accounted for in the same manner as Support Fund money and institutional match.

A. BUDGET NARRATIVE:

This project requests equipment to enhance and upgrade undergraduate physics (462 & 463) and astronomy (105L & 106L) laboratory courses at LSUS. Need for Physics equipment: The Physics 462/463 laboratory courses are required of all physics majors and because of this, the demand is constant. Some of the existing lab equipment is obsolete and several major items are worn out through heavy undergraduate usage. This shortage and/or inadequacy of equipment currently limits enrollment in the 462/463 lab courses. Need for astronomy equipment: The Astronomy 105L/106L lab courses are both outside observing courses. Enrollment in each astronomy lab section is limited by the number of telescopes available to the students. The proposed equipment will directly enhance service to students in these physics and astronomy lab courses.

Major Equipment Item:	Amount
For Physics 462 & 463: (Potential supply source)	
<u>Cavendish Apparatus:</u> Gravitational torsion balance: (Pasco) Features: measures the universal gravitational constant in a single lab period; adjustment & locking mechanisms decrease lab setup time; torsion band easily replaced.	\$2,000
<u>Coulomb's Law Apparatus:</u> (Pasco) Features: Measures charge, force, distance; symmetric design minimizes stray & mirror charges; magnetic damping for accurate measurements.	\$2,500
<u>Millikan Oil Drop Apparatus:</u> (Cenco) Features: Complete unit provides clear visibility of spheres; compact tabletop unit with all accessories needed to perform Millikan experiments	\$1,500
<u>Planck's Constant Apparatus:</u> (Cenco) Features: Complete apparatus achieves highly accurate results under normal lab conditions.	\$2,500
<u>Photoelectric Effect Experiment:</u> (Pasco) Features: photoelectric head designed to minimize secondary emissions from the anode. Key concepts: Wave model of light versus the quantum model of light; relationship between energy, wavelength and frequency.	\$2,000
<u>Diffusion Cloud Chamber System:</u> (TelAtomic) Tel 400-DC-SYS, Features: includes DCC, port for inserting radioactive sources, 3 exempt quantity radioactive sources, anti-fog compound.	\$1,000
<u>Teslameter:</u> (TelAtomic) Features: Smart magnetic sensor; probes for axial or transverse magnetic fields; ranges: 2000, 200, 20mT & auto; analog & digital output; 3½ digit LCD readout; auto shut-off; temperature compensated sensor; software included; with tri-axial probe option.	\$1,000
<u>Additional Needed Items:</u> Also needed are: <u>Ionizing air blower:</u> (Simco or comp.) To provide high volumes of ionized air to eliminate static charge from materials or surfaces where high voltages are created @\$500; <u>Digital Strobe:</u> (Cenco) High precision digital strobe @ \$500; <u>Photoelectric Scanner:</u> (Daedalon) @ \$300; <u>Large Security Storage Cabinet:</u> (Cenco or comp.) For equipment storage, safety, security.	\$3,100
Subtotal Physics:	\$15,600
For Astronomy 105L:	
<u>4 additional student telescopes:</u> Questar 3 ½ in. telescope: full aperture solar filter, 12 mm eyepiece, Powerguide II system. 4 @ \$6,000 each	\$24,000
<u>4 tripods for above student telescopes:</u> Gitzo telescudex tripod, low head profile. 4 @ \$750 each	\$3,000
<u>Upgrade of 10 existing Questar 3 ½ in. student telescopes:</u> Powerguide system retrofits. 10 @ \$500 each	\$5,000
For Astronomy 106L:	
<u>4 new 10 inch telescopes:</u> Meade 10 in. Ritchey-Chretien telescopes with Meade equatorial wedge. 4 @ \$4,000 each	\$16,000
Subtotal Astronomy Equipment:	\$48,000
TOTAL REQUEST:	\$63,600

JUSTIFICATION:

Physics 462 consists of a series of experiments illustrating the history of physics. The include: the Cavendish experiment, the Balmer lines of hydrogen equipment, the e/m experiment, the use of the Michelson interferometer, the Millikan oil drop experiment, the Young's double slit experiment, and the Photoelectric Effect, and the Coulomb's Law experiment. The equipment for many of these experiments is obsolete or worn out through constant undergraduate usage. The torsion band of the Cavendish apparatus is broken, the objective of the Millikan telescope is missing, the laser used to illuminate the double slits is 27 years old, the Photoelectric Effect tubes no longer respond, the air cell of the Michelson interferometer leaks, and the Coulomb apparatus needs to be replaced completely.

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B. INSTITUTIONAL MATCH:

LSUS will provide an institutional match for this project as detailed below:

\$4,000 (cash)	Related equipment for labs
\$600 (cash)	Supplies for labs
\$2,000 (in-kind)	Installation, @ \$25/hr X 80 hrs. by LSUS technical staff
\$3,200 (in-kind)	Personnel training, @ \$40/hr X 80 hrs. by faculty/professional staff
\$800 (in-kind)	Student lab assistance
\$12,000 (in-kind)	Faculty time to work on project @ \$40/hr X 300 hrs.
\$2,500 (in-kind)	Maintenance, @ \$25/hr X 100 hrs. by LSUS technical staff
\$8,077 (in-kind)	Indirect costs, @ 41% (Federal negotiated rate) of Installation, Personnel training, Faculty time and Maintenance
\$33,177	Total Institutional Match

Note: All faculty/staff salaries, purchasing, and other budget items will be handled in accordance with LSUS and State policies/procedures.

BIOGRAPHICAL SKETCH			
<u>NAME/ADDRESS</u> W. Decker Moore LSUS One University Place Shreveport, LA 71115		<u>POSITION TITLE</u> Assistant Professor, Physics & Astronomy	
<u>EDUCATION</u>			
INSTITUTION	DEGREE	YEAR CONFERRED	FIELD OF STUDY
Northeast LA State University	MS	1968	Physics/Astronomy
Northeast LA State University	BS	1966	Mathematics

ASSISTANT PROFESSOR,

Louisiana State University In Shreveport 1968 – Present.

W. Decker Moore is in charge of developing and maintaining the introductory (first Year) physics and astronomy laboratories. At present, he is also a primary instructor for two advanced physics laboratories. This includes maintenance and repair of the advanced lab equipment. He is the developer and instructor of the two introductory astronomy laboratories and was, for approximately four years, the instructor of astronomy classes for gifted high school students at the Worley Observatory. He is also a consultant to SciPort, the Shreveport hands-on science museum, and their exhibit committee.

Publications:

Physics 251 Lab Manual, LSUS College of Sciences.

Physics 261 Lab Manual, LSUS College of Sciences.

Physics 252/262 Lab Manual, LSUS College of Sciences

Professional Memberships:

Shreveport-Bossier Astronomical Society

SciPort Exhibit Museum, Exhibit Committee Member

Collaborators:

Boucher, Gary; Sisson, Cynthia; Lucas, Cran

Graduate Students/Post-Doctoral Scholars Supervised:

All students taught are undergraduate students.

BIOGRAPHICAL SKETCH

NAME/ADDRESS			POSITION TITLE
Gary R. Boucher Physics Program, College of Sciences LSUS, One University Place, Shreveport, LA 71115			Associate Professor of Physics
EDUCATION			
INSTITUTION	DEGREE	YEAR	FIELD OF STUDY
Northwestern State University	B.S.	1972	Electronic Engineering Technology
Northwestern State University	M.S.	1976	Electronic Engineering Technology
Louisiana Tech University	M.S.	1995	Electrical Engineering
Louisiana Tech University	D. Eng.	1999	Engineering

EXPERIENCE:

2000- Present: Louisiana State University in Shreveport (LSUS), Associate Professor of Physics
 1998-2000: LSUS, Assistant Professor of Physics
 1987-1997: LSUS, Instructor, Engineering, Electronics, Physics
 1984-1986: Northwestern State University, Assistant Prof., Engineering Technology
 1982-Present: Data Tech, Inc., President of Data Tech, Inc., software development firm.
 1976-1980 Microtex, Inc., (microcomputer sales/service company, Houston, TX)

Publications/Professional Presentations:

Boucher, G. R., "Strategic Considerations for Launch and Recovery of a Personal Submersible", 2004 PSUBS Conference, Portland, OR, August 21, 2004. (invited paper; proceedings)
 Boucher, G. R., "User Constructed Sonar Equipment", 2004 PSUBS Conference, Portland, OR, August 21, 2004. (invited paper; proceedings forthcoming)
 Boucher, G. R., "Rovar: Mobile Interactive Robot" presented to Biomedical Research Foundation, Oct. 2002.
 Sanati, Reza, Krishna Agarwal, Gary Boucher, and Alfred McKinney, "A Robotics Lab for Undergraduate Majors", Journal of Computing in Small Colleges, vol. 14, no. 3, March 1999.
 Boucher, G. R., "Sonar 3-D Image Formation for Underwater Vehicular Collision Avoidance", presented to the College of Sciences Faculty Research Seminar, March 1999.
 Boucher, G. R., "Development of Water Encapsulation Devices for Explosion Suppression", presented to Shreveport Ordinance Facility staff, April 1998.
 Matlock, Rex, Frank Collins, and Gary Boucher, "Separation Factors for Hydrogen Isotopes on Nickel and Platinum During Electrolysis", Fusion Technology, March 1997. .
 Agarwal, Krishna, Alfred McKinney, Reza Sanati, and Gary Boucher, "A Computer Engineering Hardware Course", Journal of Computing in Small Colleges, May 1995.
 Collins, Frank, Rex Matlock, and Gary Boucher, "Separation Factors for Hydrogen Isotopes on Palladium," Fusion Technology, 24:200, 1995.

Inventions/Awards:

WHEELMA: Wheeled Hybrid Electrically Engineered Linear Motion Device, an all-terrain mobile observation platform capable of deployment to remote locations; this robot is designed for performing a number of functions which carry high human risk.
Rovar: mobile robot, demonstrated at Biomedical Research Foundation, LSUS, etc.

Vindicator: Submarine, one-man submersible, demonstrated at LSUS, Caddo Lake, Florida, etc.

Several new innovations were demonstrated on this submarine, which was featured in Forbes magazine [Armstrong, D., "*Run Silent, Run Cheap*", *Forbes*, April, 2003].

Heated Glove System: Developed for U.S. Dept. of Defense SBIR project and demonstrated at U.S. Army Soldier Systems Center in Natick, MA. Contract # USZA22-00-P-0039, 2000.

Campus Research Committee Award for Hydrogen Isotope Research, 1993.

LSUS R&D award for Sonar 3-D Image Formation for Underwater Vehicular Collision Avoidance, 1999.

RECENT OUTREACH/CONSULTING:

Science Education/Outreach:

In 2005, Dr. Boucher negotiated a contract between LSUS and SciPort Discovery Center to design and construct robotic devices to comprise a new Mars Rover exhibit. This effort spanned nine months of work to construct two Mars rover robots, three mechanical robotic arms, and an overhead robotic device to simulate a satellite's view of the Martian terrain. These robots are controlled remotely by visitors to the science museum. Machining for the robots was done at LSUS with in-house equipment. Remote wireless control and video links were employed for the rovers and the overhead rail-bound robotic systems. A border sensing system was designed and implemented by Dr. Boucher to notify the control system when a rover crosses a perimeter wire located in the terrain. This prevents operations outside the normal terrain limits. The robots are deployed in the ongoing SciPort Mars Rover exhibit. Dr. Boucher also has been a technological contributor to aid in the design and development of other SciPort exhibits.

Economic Development/Oil Producer Assistance:

In 2006 Dr. Boucher joined a technology transfer group at LSUS developing electronic systems for smaller scale oil producers in the Northwest Louisiana area. These producers of small shallow oil wells do not have the technology afforded by the major producers due to cost and availability and, subsequently, have been required to do many well operations manually. Lower cost automation could greatly benefit this group of Louisiana businesses and make their operations more competitive. With innovations such as automatic well shutdown and monitoring/control systems, such producers should have enhanced safety and increased production in their wells. Along with the aforementioned system development, Dr. Boucher has also filed a patent disclosure on a new method of horizontal drilling to enhance oil recovery from existing wells. This approach is not seen in the patent literature and should prove to be a viable method for enhancing existing production as well as having potential in combination with EOR (Enhanced Oil Recovery) systems currently being researched at LSUS by other professors.

Community Assistance – Adaptive Technologies Communications Devices for the Disabled:

In late 2006, at the request of the Northwest Louisiana Developmental Center (NLDC), Dr. Boucher designed and constructed a microprocessor-based electronic communications voice box for an NLDC patient with a form of palsy that had prevented her from speaking. The adaptive technologies "speech box" was developed by Dr. Boucher utilizing LSUS resources and with LSUS students assisting him. The device has enabled the 50 year old patient to communicate verbally for the first time.

Current and Pending Support

Investigator: W. Decker Moore		
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project Title: Undergraduate Physics & Astronomy Lab Enhancement (PI) Source of Support: BORSF Total Award Amount: \$63,600 Total Award Period Covered: 06/01/08 – 06/30/09 Location of Project: Louisiana State University in Shreveport Person-Months Per Year Committed to Project: Cal: _____ Acad: <u>10%</u> Sumr: _____		
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input checked="" type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project Title: Space, Still the Final Frontier, Exploring our Universe Source of Support: V.M. Slipher Committee Total Award Amount: \$15,000 Total Award Period Covered: 2008 – 2009 Location of Project: Louisiana State University in Shreveport Person-Months Per Year Committed to Project. Cal: <u>5%</u> Acad: _____ Sumr: _____		
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project Title: Source of Support: Total Award Amount: Total Award Period Covered: Location of Project: Person-Months Per Year Committed to Project. Cal: _____ Acad: _____ Sumr: _____		
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project Title: Source of Support: Total Award Amount: Total Award Period Covered: Location of Project: Person-Months Per Year Committed to Project. Cal: _____ Acad: _____ Sumr: _____		

CURRENT AND PENDING SUPPORT

Investigator: Gary R. Boucher
Status of Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future Proposal Title: Undergraduate Physics & Astronomy Lab Enhancement (CoPI) Source of Support: Board of Regents Support Fund Award Amount (or Annual Rate): \$63,600 Period Covered: 2008-2009 Location of Activity: Louisiana State University, Shreveport, LA 71115 Person-Months or % of Effort Committed to the Project: 5% Cal Yr Acad 10% Summ
Status of Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future Proposal Title: EMI Monitoring System for Electronics Lab (PI) Source of Support: Board of Regents Support Fund Award Amount (or Annual Rate): \$23,380 Period Covered: 2007-2008 Location of Activity: Louisiana State University, Shreveport, LA 71115 Person-Months or % of Effort Committed to the Project: 15% Cal Yr Acad Summ
Status of Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future Proposal Title: Technology Upgrade to Enhance Undergraduate Courses (PI) Source of Support: Board of Regents Support Fund Award Amount (or Annual Rate): \$16,868 Period Covered: 2007-2008 Location of Activity: Louisiana State University, Shreveport, LA 71115 Person-Months or % of Effort Committed to the Project: 10% Cal Yr Acad Summ
Status of Support: <input checked="" type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future Proposal Title: Hybrid Instruction in Multidisciplinary Settings to Advance Student Learning (CoPI) Source of Support: Board of Regents Support Fund Award Amount (or Annual Rate): \$52,015 Period Covered: 2007-2008 Location of Activity: Louisiana State University, Shreveport, LA 71115 Person-Months or % of Effort Committed to the Project: 5% Cal Yr Acad Summ



Shreveport-Bossier Astronomical Society, Inc.
353 Ockley Drive
Shreveport, LA 71105
318-797-1524

October 15, 2007

Mr. W. Decker Moore
Department of Chemistry and Physics
LSU in Shreveport
One University Place
Shreveport, LA 71115

Dear Mr. Moore:

The Shreveport-Bossier Astronomical Society, Inc. wholeheartedly supports your effort to obtain additional Questar telescopes to aid enrollment in the astronomy classes at LSUS. This is an outstanding optical instrument and will contribute greatly to the observational aspects of your astronomy laboratories. In addition to enhancing the educational experience for LSUS students this will also contribute to the free public star parties jointly sponsored at the Ralph A. Worley Observatory by LSUS and the Shreveport-Bossier Astronomical Society. Currently the Astronomical Society has about 45 members who are dedicated to bringing the joy and fun of astronomical education to the public as well as the students of Northwest Louisiana.

We look forward to a continued close and beneficial relationship with LSUS and wish that you success in your endeavors to enhance the astronomical experience for LSUS students and the public in Northwest Louisiana.

Sincerely yours,

Cran Lucas, Ph.D.
President