REQUIRED COVER PAGE

APPLICATION FOR FACULTY RESEARCH GRANT

**All questions must be completed to be considered for grant award.**

Choose one: [ ] Creative [ ] Research

Date of Last FRG Award (Semester and Year awarded): N/A
Date of ATU Faculty Appointment (Semester and Year): Fall 1997

1. Project Title: NEO-PHA Observations

2. Name of Principal Investigator/Project Director: Dr. Jeff Robertson


5. Campus Mail Address: Jeff Robertson, MclEver 38-1 6. PI/PID Campus Phone: 964 0548

8. Total Cost of Project: $ 2,095.00

9. Does this project involve:
   [ ] human subjects?
   [ ] animals/animal care facility?
   [ ] radioactive materials?
   [ ] hazardous materials? We are observing potentially hazardous materials.
   [ ] biological agents or toxins restricted by the USA Patriot Act?
   [ ] copyright or patent potential?
   [ ] utilization of space not currently available to the PI/PID?
   [ ] the purchase of equipment/instrumentation/software currently available to the PI/PID?

NOTE: If the answer is "yes" to any of the above questions, the investigator must attach appropriate documentation of approval or justification for use/purchase.

SIGNATURES

Department Contribution (if applicable): $ 95
Account Number: __________________________
Sign: __________________________
Chairperson: Jeff Robertson 2006 Sept 12
Date: __________________________

School Contribution (if applicable): $ 0
Account Number: __________________________
Sign: __________________________
Dean: __________________________
Date: 9-12-06

This Section to be completed by the Office of Academic Affairs

FSBA Committee Award Recommendation: Yes____ No____
FSBA Committee Proposal Rank: ______ of ______ Total Proposals.
Recommendation of VPAA: Yes____ No____
Recommendation of President: Yes____ No____
Award Date: __________________________
Near Earth Object, Potentially Hazardous Asteroid Observations

Dr. Jeff Robertson

ABSTRACT

Near-Earth Objects (NEO) are asteroids or comets that have been nudged by the gravitational attraction of nearby planets into orbits that allow them to enter the Earth's local neighborhood, sometimes having Earth-Orbit crossing trajectories that cause them to be labeled Potentially Hazardous Asteroids (PHA). The purpose of the proposed research will be to involve undergraduates in a campaign to gather observations of minor planets. Follow up observations of NEO-PHAs both newly discovered and those with poor orbital elements will be obtained, analyzed and processed to yield celestial coordinates that are then submitted to the Minor Planet Center database at the Harvard-Smithsonian Center for Astrophysics. These coordinates are used to accurately calculate and refine the orbits of these objects and determine their trajectories and earth impact hazard probabilities.

PURPOSE / OBJECTIVES

The primary objective of this research is to provide follow-up observations of minor planets designated NEO-PHA. In short, we'd like to help find the next "dinosaur killer" before it smacks us unawares and ends our time here on earth.

SIGNIFICANCE / NEED

Large collaborative research surveys are finding thousands of targets demanding an increased capability to perform follow-up astrometry. Figure 1 shows the number of known minor planets over the past 10 years. New discoveries are accelerating by the increased size and use of survey telescopes and the increase in technology available to
astronomers during this time as Department of Defense technology used by the navy and air force for identifying and tracking high speed ballistic targets in low earth orbit and/or at high altitudes became declassified and put to work in the astronomical community. The trend in figure 1 leads many astronomers to estimate that fully ~75% of these objects are YET TO BE DISCOVERED! Many of the current new discoveries of minor planets are lost within a few days due to the lack of follow-up activity and long-term positional astrometry needed to lengthen the known trajectory paths and to refine the orbits of these objects, some of which may be potentially hazardous asteroids. With enhanced capabilities to recover fainter objects, we will be able to increase the quantity and quality of follow-up observations used to upgrade poorly known orbits of NEO-PHAs that are currently being discovered by these large scale surveys.

![Minor Planet Center Database](image)

**Figure 1**

Observations submitted by the ATU astronomical observatory will contribute to the development of accurate orbital parameters and trajectory predictions of NEO-PHAs, and reduce the loss of these objects resulting from lack of timely follow-up observations and positional astrometry. Improved accuracy in their predicated orbits will aid NASA in solar system missions and in fulfilling its congressional mandate to
identify potentially hazardous space objects. The probability of a major impact on the Earth is remote, on the order of the likelihood for the typical American to die in a plane crash. However, impacts with the Earth occur daily for particles the size of dust grains to the size of your fist. The history of the Earth shows that the potential hazard from very large bodies has happened in the past and will happen again. Figure 2 illustrates this, showing the occurrence of impacts by asteroids and comets as a function of their size. The potential harm to our environment is catastrophic for large impacts. Over 65 million years ago the dinosaurs probably did not consider large impacts to be any big deal. The isolation and remoteness of Siberia probably kept the last modestly large impact on the Earth at Tunguska (1909) from being very significant, however, no one can deny that if any single fragment of comet Shoemaker/Levy-9 had hit the Earth rather than Jupiter in 1994, the Earth itself would certainly not be here at all. This research is directing energy at helping to discover and map potentially hazardous asteroids that could harm the Earth’s environment in a cataclysmic way. By discovery, classification and predicting their orbits we hope to reduce their potential “impact.”

Figure 2
PROCESS FOR ATTAINMENT OF OBJECTIVES / GOALS

The students and I will perform these tasks together in a mentorship fashion. As students learn to utilize the equipment and perform the analysis more and more autonomy will be afforded. Specific skills they will learn and perform are as follows: 1) operation of the telescope instrumentation and observatory dome, 2) use of CCD imaging equipment for collecting images of minor planets, 3) use of software to manipulate astronomical images and extract photometry (brightness) information and astrometry (coordinates), 4) processing and formatting of data for scientific reporting to the Minor Planet Center, 5) production and dissemination of scientific research through presentation and publication.

Gantt Chart: Months after anticipated starting date: November 1 2006

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DISSEMINATION OF RESULTS

We plan to disseminate results in presentations at scientific conferences such as the ATU undergraduate research and honors symposium, the Arkansas Academy of Science annual meeting and perhaps the annual meeting of the American Astronomical Society. Publication of astrometry results and discoveries is actually automatic for
minor planet observations submitted to the Minor Planet Center (MPC) by an accepted observatory with an observing code through the International Astronomical Union Bulletins. Our initial astrometry of well known asteroids were within the error tolerances of the MPC and we obtained an observatory code (H49) for ATU during the past year as confirmation of our ability to observe NEO-PHAs and obtain coordinates with suitable accuracy. Figure 3 shows a set of images taken on campus by ATU students, capturing the motion of an asteroid over the course of an hour or so. We intend to publish results for any new discoveries or reports on rotational light curves for individual asteroids in the Journal of the Arkansas Academy of Science and/or the conference publication from the annual meeting of the American Astronomical Society.

Figure 3

REPEATED REQUESTS

This is the first request of this kind for a Faculty Research Fund Grant to the ATU Faculty Salary, Benefits and Awards Committee.
Budget

Student labor support is requested in the amount of $375 for the student who will be working on this project. This amount will be assigned as non-work study funds and is based on the assumption that 1) the student will work on average approximately 2 hours/week at $6.25/hour for the project duration of ~30 weeks and 2) the student will turn in time sheets to the supervisor each month for time spent while working on the project. This research will take place during part of the fall 2006 and the spring semester of 2007. Travel funds of $250 are requested in order to provide for hotel, registration, mileage, and food of the student and faculty to a scientific conference. This travel is anticipated to be in-state to a symposium such as the Arkansas Academy of Science or the Arkansas Space Grant Symposium to make a presentation of their results and publish them in the meeting proceedings. Standard astronomical imaging filters and a filter wheel ($1470) necessary for multicolor photometry with the CCD imaging camera and software for processing CCD images for astrometry is requested.

Budget Details

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<td>supplies</td>
<td>CFW9 filter wheel w/UBVRI standard filters</td>
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<td>travel</td>
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<td>student labor</td>
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<td>$375 + 100 = 375</td>
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<td><strong>TOTAL</strong></td>
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Faculty Vita

Jeff Robertson, Ph.D.
Arkansas Tech University
Associate Professor of Physical Sciences
Director of the Astronomical Observatory
http://cosmas.atu.edu/

EDUCATION

1995 Ph.D. Astrophysics Indiana University
1991 M.S. Astronomy San Diego State University
1989 B.S. Physics, B.S. Astronomy University of Kansas

APPOINTMENTS

1997 - Present Arkansas Tech University Russellville, Arkansas
Courses Taught, Arkansas Tech University
Introductory Physics & Physics Laboratories (Serway & Faughn; Halliday & Resnick)
Physical Science (physics, chemistry, astronomy, geology) & Laboratories (Shipman 11e)
Introductory Astronomy & Observational Astronomy Laboratory (Seeds 7e)
Meteorology (Ahrens 4e)
Advanced Topics in Physics and Astronomy: Cosmology
Optics (Hecht 4e)
Remote Sensing and the Environment
Distance Learning Courses (Web based): Astronomy, Physical Science, Physical Science Laboratory

1995 - 1997 Postdoctoral Fellow Indiana University Bloomington, Indiana
Software development for unattended data acquisition, reduction and analysis of automated photometry and spectroscopy observations. Assisted in the design and commissioning of instrumentation for a 1.25-m telescope automated for unattended photometry and spectroscopy observations.

1992 - 1995 Research Assistant; RoboScope Project Indiana University Bloomington, Indiana
Observe with and monitor 0.41-m Robotic Telescope CCD detector system. Software development for unattended, automated data acquisition, reduction and analysis of photometry and spectroscopy.

1991 Research Assistant San Diego State University San Diego, California
CCD spectroscopy and analysis of Algol-type and RS CVn-type binaries.

STUDENT MENTORING

2005 Anthony Tusing: Research Project; Portable Spectrograph for Astronomical Observations
2004 Chris Justice: Research Project; Light Curve Modeling of HH97-79
2003 Scott Ryan: Honors Research Project, Photometric Analysis of the Cataclysmic Variable V1159 Orionis
2003 Daniel and Timothy Ibarra: Research Grant, ATU RoboDome
2001 Bret Taylor: Project, Photometry of the variable star RZ LMi Orionis
2001 Tut Campbell: Project, Photometric Analysis of the Cataclysmic Variable ER UMa
2000 Ed Roberts: Teacher, Pottsville Jr. High, Project ASTRO (Science Ed Workshop Advisor)
2000 Mylinda Thomas: Teacher, Morrilton Jr. High, Research Based Science Education Mentor
2000 Ed Roberts: Teacher, Pottsville Jr. High, Research Based Science Education Mentor
2000 Benji Myers: Project, Astronomical All-sky Cloud Monitor
1999 Brian Beach: Project, Astrophotography of the Solar Sunspot Cycle
1999 Benji Myers: Research Grant, NASA-ASGC Kepler Variable Stars
1999 Tut Campbell: Project, Supernovae Patrol Program
1998 Benji Myers: Project, Photometry of the Eclipsing Variable Star RW Tri
1998 Albert Martin: Research Grant; NASA-ASGC Satellite Support Observations
1998 Tut Campbell: Project, Large telescope mirror fabrication
1998 Anura Abeywickrama: Project, Light curve analysis of variable star TT Ari

PUBLICATIONS
(http://cosmos.atu.edu/bigjay/abstracts.html)


Systematics of Superhumps in the Short Superhump Cycle SU UMa Dwarf Nova V1159 Ori," Pitts, M.A., Robertson, J. W. and Honeycutt, R. K., 2002 BAAS, 201, 40.11


