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PI/PD Name: Roscoe C Giles

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☐ Not Hispanic or Latino

Race: (Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☒ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status: (Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other _____
- ☒ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☒

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White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

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PI/PD Name: Geoffrey C Fox

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race: (Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☒ White

Disability Status: (Select one or more)
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- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
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- ☐ None

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PI/PD Name: Louis M Gomez

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☒ Hispanic or Latino ☐ Not Hispanic or Latino

Race: (Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status: (Select one or more)
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- ☐ Visual Impairment
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- ☒ None

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PI/PD Name: Reagan W Moore

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☐ Not Hispanic or Latino

Race: (Select one or more)
☐ American Indian or Alaska Native
☐ Asian
☐ Black or African American
☐ Native Hawaiian or Other Pacific Islander
☒ White

Disability Status: (Select one or more)
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☐ Visual Impairment
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COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 00-2

NSF 99-167 **01/05/00**

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

INFORMATION TECHNOLOGY RESEARC

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

0076912

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
				049435266	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

042103547

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYMS(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Boston University

AWARDEE ORGANIZATION CODE (IF KNOWN)

0021303000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

Boston University
881 Commonwealth Avenue
Boston, MA. 022151303

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply)
(See GPG II.D.1 For Definitions) ☐ FOR-PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT **ITR/EWF+HCI: Scalable Computational Science Education Portals**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PREPROPOSAL NO., IF APPLICABLE
$ **4,985,715**	**60** months	**09/01/00**	

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG 1.A.3)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.D.1)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG II.D.10)
☐ NATIONAL ENVIRONMENTAL POLICY ACT (GPG II.D.10)
☐ HISTORIC PLACES (GPG II.D.10)
☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.D.12)
☐ GROUP PROPOSAL (GPG II.D.12)
☐ VERTEBRATE ANIMALS (GPG II.D.12) IACUC App. Date _____
☐ HUMAN SUBJECTS (GPG II.D.12)
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES _____
☐ FACILITATION FOR SCIENTISTS/ENGINEERS WITH DISABILITIES (GPG V.G.)
☐ RESEARCH OPPORTUNITY AWARD (GPG V.H)

PI/PD DEPARTMENT
Center for Computational Science

PI/PD FAX NUMBER
617-353-6062

PI/PD POSTAL ADDRESS
3 Cummington Street

Boston, MA 02215
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME **Roscoe C Giles**	**Ph.D.**	**1975**	**617-353-6082**	**roscoe@bu.edu**
CO-PI/PD **Geoffrey C Fox**	**Ph.D.**	**1967**	**315-443-2163**	**gcf@cs.fsu.edu**
CO-PI/PD **Louis M Gomez**	**Ph.D.**	**1979**	**847-467-2821**	**l-gomez@nwu.edu**
CO-PI/PD **Reagan W Moore**	**PHD**	**1978**	**619-534-5073**	**moore@sdsc.edu**
CO-PI/PD				

CERTIFICATION PAGE

Certification for Principal Investigators and Co-Principal Investigators:

I certify to the best of my knowledge that:

(1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
(2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this application.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S.Code, Title 18, Section 1001).

Name (Typed)	Signature	Social Security No.*	Date
PI/PD **Roscoe C Giles**		**SSN's are confidential and are not displayed *ON FASTLANE SUBMISSIONS***	
Co-PI/PD **Geoffrey C Fox**			
Co-PI/PD **Louis M Gomez**			
Co-PI/PD **Reagan W Moore**			
Co-PI/PD			

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding Federal debt status, debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in Grant Proposal Guide (GPG), NSF 00-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuring award is a criminal offense (U. S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of Grant Policy Manual Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflict which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Debt and Debarment Certifications

(If answer "yes" to either, please provide explanation.)

Is the organization delinquent on any Federal debt? Yes ☐ No ☒

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure Form to Report Lobbying,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME/TITLE (TYPED) **John F. Imbergamo**		**01/05/00**

TELEPHONE NUMBER	ELECTRONIC MAIL ADDRESS	FAX NUMBER
617-353-4365	**ckowal@bu.edu**	**617-353-6660**

*SUBMISSION OF SOCIAL SECURITY NUMBERS IS VOLUNTARY AND WILL NOT AFFECT THE ORGANIZATION'S ELIGIBILITY FOR AN AWARD. HOWEVER, THEY ARE AN INTEGRAL PART OF THE INFORMATION SYSTEM AND ASSIST IN PROCESSING THE PROPOSAL. SSN SOLICITED UNDER NSF ACT OF 1950, AS AMENDED.

Project Summary

This project brings together a uniquely situated and highly qualified team of computer scientists, educational researchers, educators and computational scientists to address the problem of designing, implementing, and testing architectures that link education to the national high performance information infrastructure. The goal of this project is to investigate, design, implement, and test architectures for scalable 'education portals' which support effective educational use of grid resources.

The objectives of this project are:

Conduct research on learning and collaborative portal environments needed to support computational science education.

Conduct research on the web system architecture and human computer interfaces for educational portals taking into account current research and existing and planned commercial, academic, and especially scientific computing portals.

Define the mapping between the information models used to support computational research and the information model to be used to support education and learning. Realize this mapping as a set of fundamental research tools for domain expert developers of educational portal systems.

Produce a sequence of testbed educational portal implementations that leverage the rich research and educational resources of PACI and EOT-PACI, addressing various populations of teachers and students with a focus on the IT workforce by virtue of content in the areas of computer science, computational science and information sciences.

The project has four thrust areas. Learning Environment Design will identify human-computer interface elements needed to support learning in the context of the scalable education portal; Portal Architecture will focus on underlying web technologies, particularly within the broad framework of event based models; Information Systems will focus on the relation of the information models underlying the learning goals, knowledge areas, and portal events; Testbeds will develop application testbeds with teachers, scientists, and students.

The project will last 5 years.

TABLE OF CONTENTS

For font size and page formatting specifications, see GPG section II.C.

Section		Total No. of Pages in Section	Page No.* (Optional)*
Cover Sheet (NSF Form 1207 - Submit Page 2 with original proposal only)			
A	Project Summary (not to exceed 1 page)	1	
B	Table of Contents (NSF Form 1359)	1	
C	Project Description (including Results from Prior NSF Support) (not to exceed 15 pages) **(Exceed only if allowed by a specific program announcement/solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)**	5	
D	References Cited	1	
E	Biographical Sketches (Not to exceed 2 pages each)	19	
F	Budget (NSF Form 1030, including up to 3 pages of budget justification)	3	
G	Current and Pending Support (NSF Form 1239)	0	
H	Facilities, Equipment and Other Resources (NSF Form 1363)	0	
I	Special Information/Supplementary Documentation	0	
J	Appendix (List below.) **(Include only if allowed by a specific program announcement/ solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)**		
	Appendix Items:		

*Proposers may select any numbering mechanism for the proposal, however, the entire proposal must be paginated. Complete both columns only if the proposal is numbered consecutively.

Overview

Information technology is now fundamental to the practice of all science, mathematics, and engineering. Building on pioneering computer science work of the past fifty years, programs like NSF's Partnerships for Advanced Computational Infrastructure (PACI) are prototyping tools that enable scientists and the scientific community as a whole to incorporate advanced computation and networking into all aspects of their work. This emergent computational environment has come to be called by some the 'grid' [1].

To sustain this transformation, the information resources of the grid must be incorporated in a fundamental way in education. This can only be achieved at a national scale by empowering teachers, students, and scientists themselves to develop educational applications and environments based on the computational and information resources of the grid. Teachers must be able to structure learning environments from grid resources; learners at all levels must have a rich, adaptable environment for working on the grid; teachers and learners must be able to work collaboratively and assess progress in learning; grid knowledge workers must have means to readily transfer results and tools to education; and students must be empowered to do real science and computation on the grid.

These results cannot be achieved using existing technologies and tools. Fundamental computer science research must be combined with research in computer supported learning environments in order to create the basis for scalable systems supporting science education.

Goal

The goal of this project is to investigate, design, implement, and test architectures for scalable 'education portals' which support effective educational use of grid resources.

Objectives

This project brings together computer science and learning researchers and scientific/educational communities of practice needed to achieve this goal. There are four interdependent objectives:

1. Conduct research on learning and collaborative portal environments needed to support computational science education.
2. Conduct research on the web system architecture and human computer interfaces for educational portals taking into account current research and existing and planned commercial, academic, and especially scientific computing portals.
3. Define the mapping between the information models used to support computational research and the information model to be used to support education and learning. Realize this mapping as a set of fundamental research tools for domain expert developers of educational portal systems.
4. Produce a sequence of testbed educational portal implementations that leverage the rich research and educational resources of PACI and EOT-PACI, addressing various populations of teachers and students with a focus on the IT workforce by virtue of content in the areas of computer science, computational science and information sciences.

Team

The team consists of PI Giles and co-PI's Gomez, Fox, and Moore, each of whom will lead a major thrust area related to one of the four objectives. Senior personnel include a number of EOT-PACI and PACI partners who will participate in the various objectives, including the support of high impact testbeds for evaluation of the effectiveness of the research through educational portal prototypes and classroom instruction.

Senior Personnel: Dennis Gannon, Steve Stevenson, Robert Panoff, Gregg Vanderheiden, Al Gilman, Scott Lathrop, Lisa Bievenue, and Raquell Holmes.

Activities

Learning Environment Design

Learning Environment Design focuses on 1) learning and cognitive elements that drive the design of portals and information systems, and 2) on the analysis of testbed results.

The computational science education portal architecture must be able to support a variety of teaching and learning models. Our intent is not to commit to a single educational approach but to identify elements of broad applicability

that will support the scaling of many learning models to the grid [1]. In the early phases of the project, we focus on basic issues that will enable useable portals for experimentation and testing. As the project progresses, we will be able to design support for more sophisticated agents and adaptive interfaces.

We will create education portals that empower learners to do real science, computation and discovery using the most powerful tools that the nation has to offer. Students can pursue authentic inquiry as scientists themselves and move beyond artificially constrained 'sandboxes'. Our educational portals must support teaching and learning in both 'individual' and collaborative modes. A key task is to characterize the supportable learning environments in terms of the event based model of the underlying web portal architecture described in the next sections. A science education portal is also a realization of a mapping between an information model of the science domain and an information model of learners.

Education Models of Learners & Information Systems

One recognized aid to learning is enhancing the ability of students to interact with their peers as they gain understanding. Collaboration environments have focused on delivering the same information to each person. An extension of the environment's capability is to promote interchange of information between students while also interacting with the instructor/teacher. An example would be the validation by a peer rather than by the teacher that a student has understood a concept. Another example is in problem based learning in which students are posed with a problem, develop hypotheses, collect information, and identify learning objectives. This implies the collaboration environment supports multiple distributed simultaneous sessions, between teacher & students, between peers within the class, and with people outside the class such as mentors, domain experts, and community members. In an educational setting, the collaboration between the peers can be structured to focus on the information that is being learned. In the computer science context, instead of the acknowledgment going from the original receiver of information back to the source, the acknowledgment now is validated by a distributed third party.

Users and Agents

User customization is a service of value in all portals and we will exploit such general capabilities and research the education specific features.

A longer term goal is to create portals that adjust to the abilities of learners, including their level of knowledge or expertise in the field. A system that "knows" its learners can better assist them in understanding new concepts. For example, the level or amount of tutorial versus reference information provided might be customized to the learner.

"Knowing a user" also means having a long-term history of the individual. This may mean recording and tracking interactions and discussions for later recall. A system that knows the user can remind the individual of what they had forgotten, or review the materials they had been through (whether it was a week ago or 10 years ago). On the other hand, the individual should be able to alter the knowledge base to reflect changes and indicate that past information is no longer be valid. The system can then adapt appropriately.

Finally, in any modern interface system, the 'user' will likely be accompanied by agents that will interact with the portal information resources electronically. For example, students must be able to integrate portal information resources into their own portfolios, notebooks, etc. The interface must support access by multiple entities.

Instrumentation of Portals

It is very important to design the 'instrumentation' necessary to turn streams of low-level portal events into meaningful higher-level indicators that can be incorporated into assessments of. For example, instrumentation will be designed to address the length of time and depth of discovery within on-line sources (web pages, databases, simulation and visualization models, etc). It will help to assess whether someone is really engaging with the electronic source, and help to determine whether the source is useful or of interest to the learner. This will help assess how members of a team engage one another and build off the experience of working on a team.

Portal Architecture

The portal architecture effort will provide a framework for realization of learning environments using web event and distributed object technologies. Portal event data will be a fundamental input to the information model characterizing learners' interactions with the portal. Testbeds will implement and evaluate the evolving portal architecture and provide guidance for its design.

The architecture of scalable computational science education portals builds on and extends the efforts within PACI to create science portals.

Science Portals

PACI is developing and prototyping portals that support advanced research applications on the national computational grid. These portals will give web based, desktop access and support to researchers across the nation and around the world. This effort has been abstracted from the specific PACI context to a general Computing Portals effort (see http://www.computingportals.org). Co-PI Fox, who will lead the portal architecture effort is a leader of the computing portals group.

The portal architecture will need to support seamless access to distributed national resources. These resources include distributed databases, prototypical and large-scale scientific simulations, immersive visualization environments, as well as colleagues, mentors, and experts in the field. The resources will be accessed in asynchronous and synchronous modes including real-time interactive capabilities. A base architecture for such portals is defined by emerging web-based, distributed object, component technologies and information repositories standards.

The proposed educational portal effort will build on this computing portals work and will emphasize co-development of middleware with the Alliance portal effort, which is coordinated by senior participant Dennis Gannon.

Event Based Systems

A unifying framework for the planned portal architecture and its linkage to information models representing grid resources and learning models is its characterization in terms of 'events'.

In this context, events are units of information (essentially messages) with tags which include time-stamp," sender" "subject" (as in email events), and some indicator of domain (to distinguish, for example, mouse, email, voice, user customization events). In email or MPI messages, events are sometimes sent out and stored in distributed queues associated with particular recipients. Other times they are "all" stored in a source dependent queue and then "listened to" by recipients who register interest. Given the large number of events implied by integration of all communication into queued rather than synchronous delivery, the "architecture of an event system" is a major issue. Note that "collaborative systems" essentially federate otherwise disjoint event services. (e.g. they transfer mouse events from one machine to another).

Event Integration

An event based approach provides a framework for integrating synchronous and asynchronous activities and for looking at the performance of adaptable systems. For example, audio video conferencing is one of the tools utilized for scientific and educational collaboration and instruction. Current approaches involve 3 distinct buffer (aka event) sizes:

(1) Real-time audio/video conferencing (CUseeMe, Tango, Access Grid) fraction of a second; (2) Real Audio (several seconds); (3) Download file locally and play (indefinitely large)

Thinking of AV as events (with very fast real time processing if necessary) of a small size which can be transmitted redundantly for mode 1) and concatenated for modes 2) and 3) appears to allow more flexible robust A/V conferencing where you can dynamically move between 1) 2) or 3) dependent on line-quality and lateness of arrival of listener to a session. Note that a difficult issue is retaining real-time (high) performance for synchronous modes even with intermediate buffers and filters (for user customization such as that needed for universal access). A simple but important issue is "event format" (e.g. XML DTD for events) which allows very fast retrieval of critical tags and allows a more relaxed analysis to fully process others.

Strategies

It is important that we develop research prototype portals to enable testbeds and to enable interface and learning technology research as we investigate portal issues. We will proceed along several parallel tracks: (1) develop a initial prototype portal architecture based on XML to define objects/portals and the existing TangoInteractive collaboration framework[11]. This will interact with other thrusts in terms of basic object (XML) structure. (2) Build a prototype problem based learning framework with a well-defined collaborative interface that can port to future infrastructure. This thrust will interact with Learning Environment Design group to evolve design. (3) Develop a

more robust collaborative infrastructure around an event service system such as Ninja from UCB [5], and research event architecture and services that support learning (assessment) and collaboration. (4) Work with Alliance Access Grid and commercial vendors on the A/V issues; and interact with testbeds on the types of A/V that are needed. (5) Investigate issues of adaptable, accessible interfaces built on top of event services and supporting a universally accessible mapping tool (with collaboration of the Trace Center, participants Gilman and Vanderheiden).

Information Systems

The universe of resources to which computing portals offer access include computer systems, instruments, and data collections. The Information Systems effort will integrate information models describing learning, the user's interaction with the education portal architecture, and the information resources of the grid. Testbeds will prototype the information models and tools.

Information Modeling

By applying a consistent model for information across existing information collections, the learning model that will be used to transfer the information, and the collaboration model for delivery of the information, it will be possible to dramatically improve the ability of the system to support education. Results will include the ability to use current scientific data collections in educational settings, the ability to map between the information organization provided within a collection and the information organization required by the learning model, and the ability to support the learning model within a collaborative distributed environment.

Critical issues include developing an event based information model for events important in analyzing learning. For example, the 'path' a learner or group of learners takes through the information of a collection is of significance in learning. How are such paths represented, compared, stored, and mapped onto other representations of the collections content? Of critical importance is the characterization of learning events. The delivery of information must be augmented with events that validate the understanding of the information. This implies a causal relationship between events in learning. A similar causal relationship is present in event-based collaboration. The information model needs to integrate both sets of causal events to describe the learning process.

Mapping Tools

We will develop methodology for mapping between these information models based on our learning design and on our series of testbed results. We will create tools that will assist applications designers – teachers and scientists – in creating science education portals.

Strategies

The information systems effort will link the learning design and portal efforts. In the early phases, we will insure that the XML object/portal representation can access collections as well as other grid resources. In parallel, we will work with the learning environments team to develop explicit information models based on example learning models. These examples will serve as a basis for studies of the mapping problem.

Testbeds and Workforce Development

We will put the research ideas about learning, architecture, and information systems to the test with real teachers, learners, and scientists. The testbed effort will move in parallel with the other technical components so that evaluation of effectiveness informs the designs continuously. The results from such tests will be evaluated by all teams and will define the direction of our efforts.

We will leverage our team members' collaborations in EOT-PACI (http://www.eot.org) in order to develop content and exploit additional technology for the testbeds.

The mission of EOT-PACI is to develop human resources through the innovative use of emerging information technologies to understand and solve problems. This includes developing a national framework for dissemination of PACI science, computational science, and computing knowledge and resources in support of education. We have already observed the need for scalable computational science education portals in pursuing these goals and team members have begun to work on elements of them. For example, Steve Stevenson of Clemson/Shodor Foundation has been working closely with Geoffrey Fox and Dennis Gannon in the computing portal effort so as to create portals that can enhance teacher education in Shodor's SCSI program.

We will readily engage a number of EOT-PACI partners to create effective testbeds for evaluation of prototypes of the portal and information architecture developed in this project, as well as to introduce the emerging IT methodologies into curriculum at the K-12 and undergraduate levels with a focus on computer science,

computational science and information sciences. The inclusion of the latest research on information technologies within science and IT curricula is critical for creating an information technology savvy workforce. This also provides additional opportunities for students to become engaged in information technology research, development, and application. Existing EOT-PACI efforts are focused on communities receptive to development and incorporation of new technologies for education. Examples of current testbeds include:

- A K-12 team that is addressing incorporation of computational science, visualization and modeling in pre-service teacher education in collaboration with K-12 communities. This effort is also independently supported by NSF and the Department of Education.
- An undergraduate team that is working with computational scientists to adapt portal environments such as those developed in chemistry and biology (http://glycine.ncsa.uiuc.edu/educwb/) for educational communities. The team is also working with faculty through various workshops and institutes to introduce new methods and techniques into the undergraduate curriculum, such as through the SCSI workshops of the Shodor Education Foundation.
- We are participating with EDUCAUSE in a project focused on Advanced Networking for Minority Institutions. Our part in this effort relies heavily on grid and web based systems developed by PACI. We will incorporate prototype portals and new curriculum modules within these communities.

All project areas will involve postdocs, graduate students, and undergraduate students as another step in the efforts of the PIs to impact the IT workforce and to encourage the students to pursue advanced studies in math, science, and information technology fields. The EOT-PACI Women and Minorities Team will help to ensure that under-represented students are part of the team.

Evaluation

The project will involve an external evaluator to assess the effectiveness of the prototype portal architectures in the various testbeds, and to evaluate the effectiveness of immersing new research methodologies into the curriculum. The evaluation will seek to address the following questions:

(1) Does the portal support learning more effectively than other collaboration environments, for individuals and for groups? (2) How well and in what ways does the portal adapt to the individual and to groups? (3) Is the portal as effective at all learning levels? (4) How does it need to differ for various learning levels? (5) How do scientific portals differ from educational portals? (6) What design characteristics are necessary to support both environments? (7) Are portals scalable and sustainable in the education community? (8) What would be the most effective next steps to improve portals for education? (9) To what extent are new research methodologies incorporated into the curriculum? (10) What instrumentation is useful and appropriate for assessing learning in the IT domain through the use of portals?

Management & Budget

This project will be coordinated by the PI (Giles). Many of the team members have a history of collaboration and joint work, especially in the context of the PACI program. The PI and co-PI's are responsible for the four areas of the effort and for ensuring that the four teams work effectively together. There will be an iterated series of design/implement./test cycles for all the system components.

The budget for this project is anticipated to be $1M per year balanced over the four thrust areas. Boston University is the lead institution with subawards to Northwestern University, Florida State University, and University of California San Diego. We plan to support on the order of 16 graduate students, 20 undergraduate research students, and 3 postdocs among the 4 teams.

The duration of the project is 5 years. The initial phase of the project will be focused on developing prototype portals and components to enable the learning and systems research. The mid-phase will emphasize research into robust systems and broader support of learning models. The end phase will emphasize mature testbeds and the dissemination of components of the architectures, API's, etc.

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7. Tango Interactive Collaboration System home page http://www.npac.syr.edu/tango
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Professional Employment

1985-Present	Professor, Department of Electrical, Computer and Systems Engineering, College of Engineering, Boston University.
1979-1985	Assistant Professor, Department of Physics and Center for Theoretical Physics, Massachusetts Institute of Technology
1976-1978	Post-Doctoral Fellow, Center for Theoretical Physics, Massachusetts Institute of Technology.
1975-1976	Post-Doctoral Fellow, Theoretical Physics Group, Stanford Linear Accelerator Center (SLAC)

Education

Ph.D.,	Physics	Stanford University, 1975
M.S.,	Physics	Stanford University, 1973
B.A. Honors,	Physics	University of Chicago, 1970

Honors and Fellowships

DOE Undergraduate Computational Science Award, DOE, 1995
DOE Undergraduate Computational Science Award for "Introduction to Parallel Computing Course," 1994
Boston University Scholar–Teacher of the Year 1992-93.
Elected to Sigma Xi Society, Stanford University, 1975
Fannie and John Hertz Foundation Fellow, 1970-1974
Elected to Phi Beta Kappa, 1969

Professional and Research Interests

My research focuses on the application of high performance and parallel computing to physics and materials problems. I have developed, implemented, and used parallel algorithms for large scale micromagnetic modeling and for molecular dynamics simulations.

As an outgrowth of these computational science research efforts, I have become committed to prototyping and building computational and educational infrastructure that will enable broad participation of scholars and students in advanced computing and networking. I have participated in the NSF Cooperative Research in Learning Technologies program with a project entitled "Teacher-Researcher Collaboration in Scientific Modeling…".that uses distributed computing to support realistic scale scientific modeling at secondary school level. At Boston University, I helped pioneer award-winnint courses in parallel computing addressed to undergraduate students.

As a co-PI on the NCSA Alliance (an NSF Partnership for Advanced Computational Infrastructure), I head the Education, Outreach, and Training teams of the Alliance and am part of the Leadership Team for the National EOT-PACI effort. I also direct the EOT-PACI component of the NSF supported project “Advanced Networking with Minority Serving Institutions”, led by EDUCAUSE. This project works to establish effective use of the high performance computational ‘grid’ by minority serving institutions.

5 Selected Publications

Daniel Reed, Roscoe Giles, Charles Catlett. "Distributed Data and Immersive Collaboration", Comm. ACM. **40**, p 39, 1997.

Elizabeth R. Jessup, Roscoe C. Giles, "Teach Computing in Context," Computational Science & Engineering, **3**, Fall 1996, p54.

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Education:

B.A. in Mathematics from Cambridge Univ., Cambridge, England (1961-1964)
Ph.D. in Theoretical Physics from Cambridge University (1964-1967)
M.A. from Cambridge University (1968)

Professional Experience:

2000-	Professor of Computer Science, Florida State University
1990-	Professor of Computer Science, Syracuse University
1990-	Professor of Physics, Syracuse University
1990-2000	Director of Northeast Parallel Architectures Center
1979-1990	Professor of Physics, California Inst. of Tech.
1986-1988	Associate Provost for Computing, California Inst. of Tech.
1983-1985	Dean for Educational Computing, California Inst. of Tech.
1981-1983	Executive Officer of Physics, California Inst. of Tech.
1974-1979	Associate Professor of Physics, California Inst. of Tech.
1971-1974	Assistant Professor of Physics, California Inst. of Tech.
1970-1971	Millikan Research Fellow in Theoretical Physics, Caltech
1970	Visiting Scientist (April-May), Brookhaven National Laboratory
1969-1970	Research Fellow at Peterhouse College, Cavendish Lab.,Cambridge
1968-1969	Research Scientist, Lawrence Berkeley Lab., Berkeley, Calif.
1967-1968	Member of School of Natural Science, Inst. for Advanced Study, Princeton, New Jersey

Five Selected Publications

1) Erol Akarsu, Geoffrey Fox, Tomasz Haupt, Alexey Kalinichenko, Kang-Seok Kim, Praveen Sheethaalnath, and Choon-Han Youn , *Using Gateway System to Provide a Desktop Access to High Performance Computational Resources*, Proceedings of HPDC-8 Conference, Redondo Beach Ca., Aug 3-6, 1999, IEEE Press.
2) Fox G.C., *From Computational Science to Internetics: Integration of Science with Computer Science*, Chapter in a book dedicated to John Rice of Purdue (to be published). http://www.npac.syr.edu/users/gcf/internetics2/
3) Bernholdt D.E., Fox G.C., Malluhi Q., Markowski R., McCracken N., Mitra D., Podgorny M., Scavo T., *Synchronous Learning at a Distance: Experiences with Tango*, Proceeedings of SC98 Orlando, IEEE. http://www.npac.syr.edu/projects/training/Papers/sc98/
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Education:
- State University of New York at Stony Brook, 1974, B.A., Psychology
- University of California, 1979, Ph.D., Psychology

Work Experience
- Northwestern University, Since 1993, Associate Professor of the Learning Sciences, Joint appointment in Electrical Engineering and Computer Science.
- Bellcore, 1989-1993, Director, Human-Computer Systems Research.
- Bell Communications Research, 1987-1989, District Research Manager, Information Technology.
- Bell Communications Research, 1984-1987, Member of technical staff in the Cognitive Science Research Group.
- Bell Laboratories, 1980-1983, Member of the technical staff in the Person-Computer Interaction Research Group.
- Bell Laboratories, 1979-80, Post doctoral member of technical staff, Person-Computer Interaction Research Group.

Selected Professional and Consulting Experience
- 1993, Member of Organization for Economic Cooperation and Development, working group on the future of technology in post-secondary education.
- 1992-present, Research advisor to Morris County Automation and Information Network (Morris County Libraries) community networking project.
- 1992-present, Member of Visiting Panel of Research, Educational Testing Service, Princeton, NJ.
- 1991-1992, Member of New Jersey Statewide Technology Plan Task Force.

Research Grants
- 1998 - 2001 *The WorldWatcher Curriculum: Integrating Visualization in Inquiry-Based Science Learning*, NSF (Co-PI)
- 1997-1999, *Spencer Mentoring Award*, The Spencer Foundation, (Co-PI)
- 1996 -2001, *Reality-Based Learning*, Department of Education ,(LEAKirby School District) (Co-PI)
- 1997-2000, *The Living Curriculum Project*, NSF
- 1997 - 2001, Center for Learning Technologies in Urban Schools, NSF, (Co-PI).
- 1998, Enacting Standards-Based Science Curriculum: Building Capacity for Change, State of Illinois Board of Higher Education, (Co-PI).

Selected Publications

Fishman, B., Gomez, L., Pea, R., & Gordin, D. (1995). Using the WWW to Build Learning Communities in K-12 Settings, Part II: The Next Generation of Web Servers to Support Learning Communities. The Global Network Navigator [Electronic Document]. Available: http://gnn.com/gnn/meta/edu/features/covis.html.

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Pea, R & Gomez, L. (1992). Distributed multimedia learning environments: Why and how? *Interactive Learning Environments, 2*(2), 73-109.

<u>Recent Collaborators</u>

Roy Pea, SRI
Elliott Soloway, University of Michigan
James Hollan, UCSD
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Philip Bowman, Northwestern University
Brian Reiser, Northwestern University
Daniel Edelson, Northwestern University
Joe Polman, Washington University
Douglas Gordin, SRI
Laura D'Amico, LRDC
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Education:

B.S. Physics	Caltech	1967
M.S. Plasma Physics	University of California, San Diego	1970
Ph.D. Plasma Physics	University of California, San Diego	1978

Positions:

Fusion Research Staff	General Atomics, Inc.	1977-1985
Manager of supercomputer systems	San Diego Supercomputer Center	1986-1988
Manager of systems group	San Diego Supercomputer Center	1988-1994
Associate Director	San Diego Supercomputer Center	1994-present
Adjunct Professor	University of California, San Diego	1997-present

Awards:

Tau Beta Pi	Caltech	1967
Regents Fellow	University of California, San Diego	1967-1968
Patent co-holder	Elongated Toroid Fusion Device	1988

Funding:

Since 1987: ten NSF grants, 1 DARPA grants, 1 DARPA/USPTO grant, 2 NARA grants, 2 DOE grants, 1 NLM grant, 1 NASA grant. Ten grants are currently active.

Professional Service:

Chair – Program Committee IEEE Symposium on Mass Storage Systems	1999, 2001
Chair - NSF Workshop on Knowledge Networking	1997
Chair – SDSC/NSF workshop on Managing and Mining Massive Data	1995, 1998
Chair - SC'95 BOF on Characteristics of Workloads on Large Parallel Machines	1995
Chair - Cray User Group Software Tools Special Interest Committee	1988 – 1992
Chair - CTSS Baseline Utility Group	1986 - 1988
Member - IEEE Mass Storage System Technical Committee	1997 - present
Member - NSF LIGO Project Advisory Committee	1997 - 1998
Member - NASA Data Assimilation Office Advisory Committee	1996 – 1998
Member - Alexandria Digital Library Advisory Board	1996 - 1998
Member - Parallel Tools Consortium Steering Committee	1994 - 1995
Program Committee - 12th Int. Conf. on Scientific and Statistical DBM	2000
Program Committee - IEEE Symposium on High Perf. Distributed Computing	1998
Program Committee - IPPS	1998
Program Committee - IPPS Workshops, Job Sched. Strategies for Parallel Proc.	1995, 1997
Program Committee - Heterogeneous Computing Workshop	1996
Program Committee - SC Paper Selection	1996, 1998
Program Committee - HPCC Second Pasadena Workshop on System Software	1995
Program Committee - HPCC Workshop and Conf. on Grand Challenges Apps.	1993
Program Committee - HPCC Workshop on System Software and Tools	1992

Teaching Experience:

Graduate level course on Information Based Computing. Undergraduate course on advanced computer architecture. Serving on Ph.D committees for 3 students, and supervising a group of 10 staff members.

Publications:
Over 48 publications including refereed journals, workshop findings, and conference proceedings

Five most closely related publications:
Rajasekar, A., R. Marciano, R. Moore, "Collection Based Persistent Archives," Proceedings of the 16th IEEE Symposium on Mass Storage Systems, March 1999.

Foster, I., Kesselman, C., "The Grid: Blueprint for a New Computing Infrastructure," Chapter 5, "Data Intensive Computing," Morgan Kaufmann, San Francisco, 1999.

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Education

B.S. in Computer Science, University of Illinois at Urbana-Champaign; May, 1986.
M.A. in Speech Communication, University of Illinois at Urbana-Champaign; May, 1989.
Teacher certification in Secondary Teaching of Computer Science, Mathematics, Physics, Language Arts and Speech; May, 1989.

Professional Experience

Specialist in Education

National Center for Supercomputing Applications, 605 E. Springfield Ave., Champaign, IL 61820. Supervisor - Scott Lathrop. August, 1991 – present. Administration and development of K-12 educational experiences at NCSA, education program development and proposals.

Teacher

Centennial High School, 913 S. Crescent Drive, Champaign, IL 61821. Principal - Dr. Lila Sullivan. August, 1994 - June, 1995. Hypermedia, Multimedia, Algebra, AP Pascal.

Research Assistant

Department of Speech and Hearing Science, 901 S. Sixth St., Champaign, IL 61820. Supervisor - Charissa Lansing. January, 1991 – August, 1991. Designed and programmed an experimental lesson in the TenCore authoring language to test hearing impaired people.

Instructor

Extramural Courses, University of Illinois, 302 E. John, Suite 1406, Champaign, IL 61820. August, 1990 – present. Independently prepared and taught computer courses on WordPerfect, Telecommunications, Introduction to Microcomputers, Internet, and Simulation and Modeling.

Grant Activity

Workshop to Integrate Computer-based Modeling and Scientific Visualization into K-12 Teacher Education Programs; National Science Foundation, EHR/REC/Research in Education Policy and Practice; 2000.

Moving K-12 Teachers into 21st Century Science with 21st Century Technology, Building the Educational Grid for Pre-Service Training, a Catalyst Program; U.S. Department of Education, Preparing Tomorrow's Teachers to Use Technology; 1999-2001.

ChemViz II: A Visual High School Chemistry Curriculum; National Science Foundation, EHR/ESIE/Instructional Materials Development; 1999 – 2001.

Resource for Science Education; National Science Foundation, EHR/ESIE/Teacher Enhancement; 1993-1996.

Education Affiliates in High Performance Computing and Communications; National Science Foundation, EHR/ESIE/Teacher Enhancement; 1993-1996.

Selected Publications

Brehm, Barbara, Juan Moran, Lisa Bievenue, James Andris, Marianne Handler, Jim Levin, and Anneliese Payne. "Integrating Technology into Teacher and Administrator Preparation Programs: Five Models in Illinois," *Illinois School Research and Development Journal*. (Fall, 1997).

Bievenue, Lisa and Edna Gentry. "Transforming Teaching for the 21st Century," *Proceedings of Supercomputing 97*. (ACM, 1997).

Lansing, Charissa and Lisa Bievenue. "Intelligent Computer-Based Systems to Document the Effectiveness of Consonant Recognition Training," 96:1 *The Volta Review* 41-49 (1994).

Bievenue, Lisa and Eva Erdosne Toth. "The NCSA Living Laboratory: Preparing Students for a High Tech World," *Technology and Teacher Education Annual* (Association for the Advancement of Computing in Education, 1992).

Nagel, Stuart and Lisa Bievenue. "Education Policy and Multi-Criteria Decision-Making" Chapter in *Analytic Methods for Educational Productivity* (1990).

_____. "Using Decision-Aiding Software for Teaching in All Fields of Knowledge" *Collegiate Microcomputer* (1990).

Collaborators

University of Illinois	M. Pauline Baker, Richard Braatz, Bertram (Chip) Bruce, Mike Folk, James Levin, Terry McClaren, Stuart Nagel, Steve Petrowicz, Rene Stofflett, Michael Waugh
Illinois State University	Barbara Brehm
Southern Illinois University, Edwardsville	James Andris
National Louis University	Marianne Handler
Eastern Illinois University	Judith Ivarie, Henry Taitt
ASPIRE, University of Alabama, Hunstville	Edna Gentry, Carl Davis
BioQUEST	Ethel Stanley
Maryland Virtual High School	Mary Ellen Verona, Susan Ragan
Ohio Supercomputing Center	Steve Gordon, Tom Stone
Shodor Education Foundation	Robert Panoff, Robert Gotwals
SRI International	Robert Kozma

Graduate Advisors

Richard Dennis
Michael Waugh

Dennis Gannon

Professional Preparation:

B.S., University of California, Davis, 1969 (Mathematics)
M.S., University of California, Davis, 1971 (Mathematics)
Ph.D., University of California, Davis, 1974 (Mathematics)
Ph.D., University of Illinois, 1980 (Computer Science)

Appointments:

Professor and Department Chair, Computer Science, Indiana University (1997-present).
Visiting Scientist, NASA Ames Research Center, 1999-present (on leave from IU)
Associate Professor, Computer Science, Purdue University, 1985.
Assistant Professor, Computer Science, Purdue University, 1980-1985.
Senior Visiting Research Scientist, Center for Supercomputer Research and Development, UIUC, 1985-90.

Synergistic Activities:

Dr. Gannon's research interests include programming systems and tools, distributed computing, computer networks, parallel programming, computational science, problem solving environments and performance analysis of MPP systems. Much of his work involves the application of object oriented software technology to the design of tools and application for scientific computation. He led the DARPA HPC++ initiative, which has led to a set of standard interfaces to object-oriented runtime systems for large-scale parallel and distributed computing. The core of this work, HPC++Lib, is used in a variety of applications. Most recently he has been involved with the Department of Energy DOE2000 Common Component Architecture (CCA) project. This work has led to a framework for building component-based scientific applications called the Common Component Architecture Toolkit which uses HPC++ and Java to encapsulate and reuse Fortran-based scientific code in distributed applications. He is also the author of the Sage++ compiler toolkit, which has been used in dozens of research compiler projects at universities and government labs. Professor Gannon also worked with associates at Indiana University, Caltech, Los Alamos, Drexel, and the University of California at Irvine on the design of a software infrastructure for Problem Solving Environments as part of their NSF PSE Challenge project. In addition, he was a partner in the NSF Computational Cosmology Grand Challenge project and the NCSA Alliance where he is helping to lead an effort to design distributed scientific portals. He also chairs the "Concurrency and Parallelism" subgroup of the Java Grande Forum. In 1998, he took two years off from Indiana University to devote to the NASA IPG project. Dr. Gannon has served as General Chair of the 1998 International Symposium on Scientific Object Oriented Programming Environments (ISCOPE) and the 2000 ACM Java Grande Conference, and Program Chair for the 1997 ACM International Conference on Supercomputing as well as the 1995 IEEE Frontiers of Massively Parallel Processing. He has served on steering committees and program committees on numerous additional major conferences.

In the area of education, he chaired the committee that made the initial design for Indiana University's new School of Informatics. This school extends education in information technology to areas that are well beyond the traditional computer science/engineering curriculum. At Indiana, Informatics refers to the study of the application of IT in areas such as Economics, Business, the Social and Physical Sciences and the Arts. Students from this school will be the builders of the information economy of the 21st century. While at Purdue University, Dr. Gannon was awarded the Outstanding Teacher in the School of Science from 1981-1984.

Publications:

1. "Component architectures for distributed scientific problem solving", D. Gannon, R. Bramley, T. Stuckey, J. Villacis, J. Balasubramanian, E. Akman, F. Breg, S. Diwan and M. Govindaraju, *IEEE Computational Science and Engineering*, vol 5, no. 2, 1998, pp. 50--63.
2. K. Keahey and D. Gannon, "PARDIS: CORBA-based Architecture for Application-Level Parallel Distributed Computation", Kate Keahey and D. Gannon, Proceedings Supercomputing `97, November 1997, San Jose.
3. Fabian Breg, Shridhar Diwan, Juan Villacis, Jayashree Balasubramanian, Esra Akman, Dennis Gannon, "Java RMI Performance and Object Model Interoperability: Experiments with Java/HPC++ Distributed Components", to appear in the Proceedings of the 3rd High Performance Java Workshop (*Journal of Concurrency: Practice and Experience*), 1998.
4. M. Norman, P. Beckman, G. Bryan, J Dubinski, D. Gannon, L. Hernquist, K. Keahey, J.P. Ostriker, J. Shalf, J. Welling, S. Yang, "Galaxies Collide on the I-WAY: An Example of Heterogeneous Wide-Area Collaborative Supercomputing", *Journal of Supercomputing Applications*, MIT Press, 1996.
5. D. Gannon, and A. Grimshaw, "Object-Based Approaches", (*The Grid: Blueprint for a New Computing Infrastructure*}, Ian Foster and Carl Kesselman (Eds.), pp. 205--236, Morgan-Kaufman, 1998.

Other Relevant Publications:

1. W. Johnston, D. Gannon, B. Nitzberg, "Grids as Production Computing Environments: The Engineering Aspects of NASAs Information Power Grid," Proceedings, High Performance Distributed Computing Conference 1999.
2. R. Armstrong, D. Gannon, A. Geist, K. Keahey, S. Kohn, L. McInnes, S. Parker, B. Smolinski, "Toward a Common Component Architecture for High-Performance Scientific Computing," Proceedings, High Performance Distributed Computing Conference 1999.
3. J. Villacis, M.Govindaraju, D. Stern, A. Whitaker, F. Breg, P. Deuskar, B. Temko, D. Gannon, R. Bramley, "CAT: A High Performance, Distributed Component Architecture Toolkit for the Grid," Proceedings High Performance Distributed Computing Conference 1999.
4. "Capabilities Based Communication Model for High-Performance Distributed Applications: The Open HPC++ Approach", S. Diwan and D. Gannon. Proceedings of the Second Merged Symposium IPPS/SPDP, April, 1999.
5. "PARDIS: A Parallel Approach to CORBA", Kate Keahey and D. Gannon Proceedings 6th IEEE International Symposium on High Performance Distributed Computation, August 1997, Portland.

Collaborators:

Randall Bramley (Indiana), K. Mani Chandy (Caltech), Bruce Char (Drexel), John Reinders (Los Alamos), Andrew Grimshaw (Virginia), David Padua (Illinois), Allen Malony (Oregon), Geoffrey Fox (Syracuse), Joel Saltz (Maryland), J.P. Ostriker (Princeton), Mike Norman (NCSA), Dirk Grunwald (Colorado), Bart Miller (Wisconsin), C. Johnson (Utah), S. Parker (Utah) Geoffrey Fox (Florida), Bill Johnston (LBL/NASA), Bill Nitzberg (NASA), R. Armstrong (Sandia), Scott Kohn (LLNL), Fran Berman (UCSD), Andrew Chien (UCSD) and the other PIs on this proposal.

Graduate Students and Postdocs:
Peter Beckman (Post Doc), Shelby Yang (Post Doc), Francois Bodin (Post Doc), Aart Bik (Post Doc). Students: S. Diwan (HP), J. Villacis, Kate Keahey (LANL), Suresh Srinivas (SGI), Neel Sundaresan (IBM), S. R. Sarukkai (HP), J. K. Lee (NTHU), Jacob Gotwals (Intel), Larry Tenny (IU-UCS), Daya Atapattu, A. Kapauan, Ko-Yang Wang (IBM), Elizabeth Johnson (Xavier U), Mann-Ho Lee, Jairo Panneta, S. Bechtolsheim, and three current Ph.D. students.

Thesis Advisor: Bill Gear

Raquell M. Holmes, Ph.D.

Boston University
3 Cummington St.
Boston, MA 02215
(617) 353-6266 (office) /// (617) 353-6062 *(FAX)*
rmholmes@bu.edu *(e-mail)*

Education

1997	Ph.D., Cell and Developmental Biology, Sackler School of Graduate Biomedical Sciences, Tufts University, Boston MA.
1993	Physiology Course, Marine Biological Laboratory, Woods Hole, MA.
1991	BA, Biology, University of California at Santa Cruz, CA.

Positions:

1998-	Program Manager, Center for Computational Science, Boston University, Boston, MA
1998-	Coordinator of Recruitment and Retention, Bioinformatics Graduate Program, Boston University, Boston, MA
1997-1998	Research Fellow, Department of Pathology, Harvard University, Boston, MA.
1997-1998	Research Fellow, Dana Farber Cancer Institute, Boston, MA

Awards and Honors

1997-1998	National Research Service Award (NRSA), NIH.
1991-1996	Minority Access to Research Careers (MARC), Predoctoral Fellow, NIH
1993	Marine Biological Laboratories (MBL) Porter Foundation Scholarship
1993	MBL American Society for Cell Biology
1989-1991	MARC- NRSA, NIH

Professional Affiliations/Service

1992-	Member, American Society for Cell Biology **(Update membership)**
1998-	Member, American Association for the Advancement of Science
1999-	Member, Institute of Electrical and Electronic Engineers (IEEE)
1999-	Member, Admissions Committee, Bioinformatics Graduate Program, Boston, University
1999-	Member, Committee of the Northeast Alliance for Minority Graduate Education, Boston University, Boston, MA.
1999-	Editor, BioQUEST Library, BioQUEST Curriculum Consortium

Publications

Holmes, RM, Cuhna MJ and Albertini DF. Cytoskeleton-mediated aspects of signal transduction. In: Getzenberg RH, ed. Cell Structure and Signaling. JAI Press Inc., 1997:95-123 (Bittar EE, ed. Advances in Molecular and Cell Biology; vol 24)

Can A, Holmes RM and Albertini DF. Analysis of the mammalian ovary by confocal microscoy. In Motta PM ed. Microscopy of Reproduction and Development.

Messinger SM, Can A, Holmes RM, Mak E and Albertini DF (submitted). Pesticide-induced disruption of cell cycle progression in primate ovarian cells. Environ and Molec Mutagen.

Holmes RM and Albertini DF (in preparation). Development of mouse ovarian follicles involves coordinated expression of cadherins and phosphotyrosine.

Giles, RC and Holmes, RM. (submitted). Minority Participation in Computational Science. Computers in Science and Engineering

Vita for Scott Lathrop
July, 1999

Education: B.A. in Mathematics - University of Rochester, Rochester, New York

Employment: Employed by the University of Illinois since 1973.
1973 to Feb. 1986 - Computing Services Office
Feb. 1986 to present - National Center for Supercomputing Applications

Experience: Experience on mainframes including IBM OS/MVT, IBM VM/CMS, DEC-10 TOPS, CDC Cyber NOS, and VAX 11/780 UNIX systems. Experience on supercomputers including CRAY X-MP/48 with CTSS and UNICOS and CRAY-2 with UNICOS. Experience with various workstations including IBM PCs, Apple Macintosh and SUN.

Three years experience with data communications and networking including modems, multiplexors, and local area networks using baseband, broadband and fiber-optic media. Direct experience has been with Sytek, HYPERchannel, Ethernet, ProNET and IBM PC Networks and helping define the specifications for the campus backbone data network, and helped select and test the equipment.

In my years with NCSA, I enjoyed a challenging professional growth path. This has included supervising activities in documentation, visualization, applications software, consulting, training, and education.

As the Program Manager for Education, Outreach and Training (EOT), I assist the Senior Associate Director in the activities related to External Programs. External Programs works with Industry, Government and Education to identify and support collaborations with the National Computational Science Alliance (the Alliance). The Alliance is a ten year NSF funded program to create an advanced computational infrastructure for the 21st Century. Through these activities, I am involved in working with the national Education, Outreach and Training partners of the National Computational Science Alliance.

Associations: Member of ACM, IEEE

Grants: $75,000 - NSF grant for 1987 Summer Institute
$42,062 - NSF grant for 1988 Summer Institute
$26,752 - NSF grant for Research Experiences for Undergraduates, 1990
$20,000 - NSF grant for Research Experiences for Undergraduates, 1991
$20,000 - NSF grant for Research Experiences for Undergraduates, 1992
$538,135 - NSF 3 year sub-contract for SuperQuest, 1991-1994
$155,690 NSF grant for HPCC Education Affiliations
$256,588 - NSF grant for Resource for Science Education
$553,000 - NSF grant for Networking Infrastructure for Education

$21,980 - NSF grant for EUFOTTET Project
$319,710 - NSF grant for Biology Student Workbench

Dr. Robert M. Panoff

Dr. Robert M. Panoff is founder and Executive Director of The Shodor Education Foundation, Inc., a non-profit education and research corporation dedicated to reform and improvement of mathematics and science education by appropriate incorporation of computational and communication technologies. Under his leadership, the Shodor Foundation has established itself as a national leader developing innovative approaches to the revitalization of undergraduate education. In 1996, the National Science Foundation named Shodor as a Foundation Partner in this effort. Shodor is also a research partner of the National Computational Science Alliance, an NSF-funded effort under the Partnerships for Advanced Computational Infrastructure program.

As principal investigator on several grants and contracts that seek to explore the interaction of high performance computing technologies and education, Dr. Panoff has worked to develop a series of interactive simulations which combine supercomputing resources and desktop computers. Besides developing and teaching a new course in Information Technologies, he continues an active research program in computational condensed matter physics while defining and implementing educational initiatives at the Shodor Foundation. His research specialties are stochastic optimization, quantum simulations of strongly-correlated systems, and computational science education.

At Kansas State University and Clemson University from 1986-1990, he developed a fully interdisciplinary computational science and engineering course. He served as director of the Carolinas Institute in Computational Science, an NSF-funded initiative in Undergraduate Faculty Enhancement, 1991-1993. His work has won several major science and education awards, including the 1990 Cray Gigaflop Performance Award in Supercomputing, the 1994 and 1995 Undergraduate Computational Science Education Awards from the U.S. Department of Energy, and a 1995 Achievement Award from the Chicago Chapter of the Society for Technical Communication. In 1993-1994, his interactive simulations were used as the basis of an international science collaboration demonstrating network technologies involving four of the schools from the Department of Defense Dependent Schools, for which he received a letter of commendation from the Department of Defense.

Dr. Panoff has been a consultant at several national laboratories and is a frequent presenter at NSF- sponsored workshops on visualization, supercomputing, and networking. He has served on the advisory panel for Applications of Advanced Technology program at NSF. Dr. Panoff received his B.S. in physics from the University of Notre Dame and his M.A. and Ph.D. in theoretical physics from Washington University in St. Louis, undertaking both pre- and postdoctoral work at the Courant Institute of Mathematical Sciences at New York University.

The following publications relate directly to the are of Computational Science Education:

"Visualization of the local contribution to the nodal surface of a many-fermion wave function, " A. C. Calder, M. R. Curry, R. M. Panoff, and Y. J. Wong, Phys. Rev. **E**53, 5451 (1996).

“The Four A’s of CSE Education: Application, Algorithm, Architecture, and Active Learning,” Computational Science & Engineering, Vol. 2, No. 4, 6 (1995).

"Experiences in Building the Computational Science Program at Clemson," D. E. Stevenson and R. M. Panoff, IEEE Proceedings of Supercomputing '90, 366, 1990.

"UNIX for Super Computing?" UNIX Review, Vol. 8, 54 (1990).

The following publications are representative of Dr. Panoff's research work:

"Fermion Monte Carlo Algorithms for Quantum Fluids," R. M. Panoff, in *Recent Progress in Many-Body Theories, Vol. 2*, ed. by Y. Avishai, (Plenum, New York, 1990).

"Elementary Excitations of Spin-Aligned Deuterium," R. Dave, J. W. Clark, and R. M. Panoff, Phys. Rev. **B**41, 757 (1990).

"Fermion Monte Carlo Algorithms and Liquid ^{3}He," R. M. Panoff and J. Carlson, Phys. Rev. Lett. **62** 1130 (1989).

"Momentum Distributions in Quantum Liquids from Green's Function Monte Carlo Calculations," R. M. Panoff and P. A. Whitlock, *Momentum Distributions*, ed. by R. Silver, (Plenum, New York, 1989).

"Ground-state Phases of Polarized Deuterium Species," R. M. Panoff and J. W. Clark, Phys. Rev. **B**36, 5527 (1987).

Dr. Panoff has supervised the following Master's theses during the past five years: at Clemson University: Marc R. Curry, Brent M. Han, and Alan C. Calder. He has also directed the undergraduate research of more than a dozen undergraduate students at Clemson and the University of Illinois.

Dr. Panoff received his doctorate under Prof. John W. Clark at Washington University in St. Louis. His post-doctoral work was under Dr. Malvin H. Kalos. During the last four years he has continued to work closely with Drs. Michael A. Lee, Joseph A. Carlson, Kevin E. Schmidt, and Paula A. Whitlock on problems in condensed matter physics. He works with Dr. Daniel D. Warner and Dr. D. E. Stevenson of Clemson University, and Dr. Holly P. Hirst of Appalachian State University on developing curricula and materials in computational science education.

NSF Biographical Sketch of Dennis E. Stevenson

EDUCATION

Ph.D., Clemson University, 1983, Mathematical Sciences. (Dr. D. D. Warner)
M.S., Rutgers University, 1975, Computer Science.
A. B., Eastern Michigan University, 1965.

EXPERIENCE

Academic

Department of Computer Science, Clemson University, Clemson, SC.
Associate Professor (1987-present), Assistant Professor (1983-1987), Lecturer (1980-1983).

Industrial

Bell Telephone Laboratories, Piscataway, NJ. Member of Technical Staff (1969-1980).

Military

Captain, US Army, Infantry. Service in Viet Nam, Combat Infantryman's Badge, Bronze Star. (1965-1969).

MEMBERSHIPS
Member of American Mathematical Society, Association for Computing Machinery, Association for Symbolic Logic, Society of Industrial and Applied Mathematics.

PROFESSIONAL SERVICE

Past Member of the Department of Energy's Undergraduate Computational Engineering and Science Group sponsored by Ames Labs, Iowa.

RESEARCH GRANTS

Investigator on "The Carolinas Summer Institute in Computational Science", Funded by NSF. Ongoing.

Principal Investigator, "Validation and Verification of Scientific Models", US Army, DAAE07-97-C-X130. Continuance begin negotiated.

Principal Investigator, "Development of Pre-Service Teacher Course in Science". Funded by NASA. Concluded.

Investigator on "The Component Packing Problem. A Vehicle for the Development of Multi-Disciplinary Design and Analysis Methodologies". Funded by NASA. Concluded.

Investigator on "The Carolinas Summer Institute in Computational Science", Funded by NSF. Concluded.

COLLABORATORS WITHIN PAST 48 MONTHS

D. D. Edie, Clemson University
G. Fadel, Clemson University

R. H. Nowaczyk, Clemson University
R. M. Panoff, Shodor Foundation, Inc.
D. D. Warner, Clemson University

RECENT PUBLICATIONS RELATING TO RESEARCH

D. E. Stevenson. ``A Foundation for Validation: The Michelson-Morley Experiment", Volume 1 of the *Proceedings of the 13th European Simulation Multiconference, Warsaw Poland, June 1–4, 1999*. 269–275 .

D. E. Stevenson, ``A Critical Look at the Quality of Large Scale Simulations". *Computing in Science and Engineering*, May-June, 1999, 53–63.

D. E. Stevenson. "Safer C: Can Integrity Be Brought to Scientific Simulations?" To appear *Scientific Programming*.

D. E. Stevenson, ``What Is Computational Knowledge and How Do We Acquire It?" Submitted to *Synthese*.

D. E. Stevenson, "Introducing Computational Science Methods Using Parallax", *SIAM Review*. Mar, 1998, 40(1). 81–86.

D. E. Stevenson, ``How Goes CS\&E: Thoughts on the IEEE CS Workshop at Purdue. *IEEE Computational Science and Engineering*, **4**(2), Apr-Jun, 1997. 49–54.

D. E. Stevenson, "A Constructive Theory of Euclidean Geometry: The first twenty-eight theorems plus one", contributed talk, Annual Meeting, Association for Symbolic Logic, Madison, WI, 8-11 March 1996. Abstract to appear, Bull. of ASL.

D. E. Stevenson, "Software Engineering Frontiers in Computational Science," Proc. *33d Annual Southeast Conference*, Clemson, SC, 17–18 March 1995, 120–127.

UNDERGRADUATE ADVISEES

Honors advisor.

GRADUATE ADVISEES

3 Current M.S. Students:
Recent Ph.D. Students:
[1995] William A. George, David A. Sykes.
[1988] John (Abbas) Youseffi.

CURRENT AND PENDING SUPPORT FOR D. E. STEVENSON

Current Support:

Grant DUE-9752815, $155,114

Pending Support:

Department of Energy EPSCoR, "Analysis and Testing Tools for Fortran and C++ in the ASCI Environment" Asking $200,500.

SUMMARY PROPOSAL BUDGET YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **Boston University**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Roscoe C Giles**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Roscoe C Giles - PI**	**0.00**	**0.00**	**5.00**	$ **57,607**	$
2. **Geoffrey C Fox - co-PI**	**0.00**	**0.00**	**0.00**	**0**	
3. **Louis M Gomez - co-PI**	**0.00**	**0.00**	**0.00**	**0**	
4. **Raquell Holmes**	**5.00**	**0.00**	**0.00**	**27,854**	
5. **Reagan W Moore - co-PI**	**0.00**	**0.00**	**0.00**	**0**	
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**5**) TOTAL SENIOR PERSONNEL (1 - 6)	**5.00**	**0.00**	**5.00**	**85,461**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.00**	**0.00**	**0.00**	**0**	
3. (**20**) GRADUATE STUDENTS				**380,000**	
4. (**25**) UNDERGRADUATE STUDENTS				**150,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**615,461**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**17,862**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**633,323**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**86,663**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**10,833**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**3,713,815**	
6. OTHER				**20,500**	
TOTAL OTHER DIRECT COSTS				**3,745,148**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**4,465,134**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 63.0000, Base: 826320)**					
TOTAL INDIRECT COSTS (F&A)				**520,581**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**4,985,715**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **4,985,715**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*: **Roscoe C Giles** DATE

ORG. REP. TYPED NAME & SIGNATURE* DATE

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

**** C- Fringe Benefits**
20.9%
**** E- Travel**
Collaboration will require occasional face to face meetings of PI's and senior personnel. Attendance and presetation at related conferences.
**** G-5 Subcontracts**
3 subawards
**** G-6 Other**
Communication, software, postage

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **Boston University**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Roscoe C Giles**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Roscoe C Giles - PI**	**0.00**	**0.00**	**5.00**	$ **57,607**	$
2. **Geoffrey C Fox - co-PI**	**0.00**	**0.00**	**0.00**	**0**	
3. **Louis M Gomez - co-PI**	**0.00**	**0.00**	**0.00**	**0**	
4. **Raquell Holmes**	**5.00**	**0.00**	**0.00**	**27,854**	
5. **Reagan W Moore - co-PI**	**0.00**	**0.00**	**0.00**	**0**	
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**5**) TOTAL SENIOR PERSONNEL (1 - 6)	**5.00**	**0.00**	**5.00**	**85,461**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.00**	**0.00**	**0.00**	**0**	
3. (**20**) GRADUATE STUDENTS				**380,000**	
4. (**25**) UNDERGRADUATE STUDENTS				**150,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**615,461**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**17,862**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**633,323**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**86,663**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**10,833**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**3,713,815**	
6. OTHER				**20,500**	
TOTAL OTHER DIRECT COSTS				**3,745,148**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**4,465,134**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**520,581**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**4,985,715**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **4,985,715**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*: **Roscoe C Giles** DATE

ORG. REP. TYPED NAME & SIGNATURE* DATE

FOR NSF USE ONLY

INDIRECT COST RATE VERIFICATION

Date Checked	Date Of Rate Sheet	Initials - ORG

NSF Form 1030 (10/98) Supersedes all previous editions

C***SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)**