

Research Experiences for Undergraduates within the NMI Integration Testbed Program

As of June 2003, five student research experiences are being supported within the NMI Integration Testbed through a proposal from SURA to the NSF REU (Research Experiences for Undergraduates) program. This REU Supplement award will place students at four different NMI Integration Testbed sites, each with previous experience involving students as peers in research and education projects. Positions are grounded in the qualifications, experience, and facilities of the host institutions but will be unified through the processes of the NMI Integration Testbed Program. Students will work with middleware that is actively under development and will have opportunities to influence how that development proceeds. As a NMI Site team member, a student may interact with NMI developers, program management, and Outreach as well as the broader community interested in "lessons learned". A student's contribution will be as an individual researcher working as part of a focused project team.

The NMI is expected to "lay foundations for middleware infrastructure and spur adoption of the advanced services that will define the networks and distributed systems of tomorrow." [Alan Blatecky, NSF Middleware Program Director, as quoted on the NMI Web site at http://www.nsf-middleware.org/about_NMI, as of March 10, 2002] The NMI is already bringing about a national research middleware infrastructure that is globally significant and inter-operable. REU within NMI can provide students with an opportunity to contribute to this critical and rapidly developing information technology. Within the NMI Integration Testbed, this potential will be realized through students positioned as part of a NMI Testbed site team and contributing directly to the component integration and assessment which informs and influences NMI middleware development.

SURA as NMI Testbed REU Lead

An important component of the SURA mission is to "provide outstanding training opportunities for the next generation of scientists and engineers." SURA has successful programs in educational outreach in the nuclear physics and materials science fields. The SURA/Jefferson Lab graduate fellowship program has supported a total of ninety graduate students competitively selected to undertake research at the Jefferson Lab, a DOE-funded nuclear physics research facility managed and operated by SURA. The SURA/ORNL summer cooperative research program supports approximately eight research proposals per summer competitively selected to conduct experiments in material sciences at the Oak Ridge National Lab. SURA has managed both programs since 1989. In addition, both the SURA PI and senior staff on this award have experience mentoring graduate and undergraduate students. SURA is using this combined perspective and collective experience to manage the activity of the REU program within the NMI Integration Testbed.

SURA's role in this REU Supplement is to coordinate and assure the overall quality of the REU student selection process, REU environment and mentoring components, and reporting of results. NMI Integration Testbed sites that host REU students take responsibility for insuring these aspects of their requested position(s). In addition to annual reporting for the award, student learning and progress will be captured and disseminated through the inclusion of student input on NMI component reports and related documentation and as supporting detail for NMI Testbed project summaries and status reports published on the NMI Testbed Web site. SURA's ability to organize and manage multiple REU positions under the umbrella of the NMI Integration Testbed relieves participating universities of the administrative burden while enabling them to engage promising students in vital work for the shared benefit of all – the student, the mentor(s), the REU program, and the NMI.

Specific REU Positions within the NMI Testbed

Georgia State University

Georgia State University has been working for nearly 3 years to develop research and enterprise middleware capability and has consistently involved graduate as well as undergraduate students in this work. REU positions in middleware development and integration within the NMI Integration Testbed include:

“Muon particle detector GRID for K-12” – (1 position)

Dr. Xiaochun He is working on involving K-12 schools in the physics related to muon particle detectors. Dr. He has designed low-cost muon detector hardware to be deployed in selected K-12 schools in Georgia, creating a distributed network of detectors. The use of GRID technology to manage and access these distributed resources is a desirable outcome. The student assigned to this project will participate with Dr. He in the design and deployment of the muon-detector project in Georgia high schools and contribute to the preparation of a related report on K-12 GRID deployment issues and outcomes. The student will help deploy the Globus Toolkit and Network Weather Service sensor components to manage the distributed nodes of muon detectors. The student will get experience with collaborative research tools, hands-on experience establishing an experimental muon detector grid, and experience in how such a project fosters interest in physics research among K-12 students. The student's work will also contribute to GSU's long term goal for GRID access to the RHIC at Brookhaven and LHC at CERN.

“GRID-enabled Applications, including Graphic Rendering with the GSU Digital Aquarium” – (1 position)
GSU is supporting graphic rendering for biology and providing support for students to use visualization as a learning modality. The newly opened Digital Aquarium lab (<http://www.gsu.edu/~wwwdaq/>) provides students with high-end workstations equipped with multi-media production tools. The ability to bring these high-end resources onto a GRID would provide access of significant benefit to students and faculty. The CIO and the VP of Sponsored Research in GRID services have also agreed to support expansion of GRID technology for “intensive computation”. Dr. Harrison is engaged in building GRIDs and works with Chemistry and Biology researchers (cf. Dr. Irene Weber and others) in options for modeling of complex molecular structures. The student on this project will GRID-enable the Digital Aquarium resources and amend related applications to execute effectively over this GRID. The student will also participate in cataloging other applications to be “GRID-enhanced” and evaluate and report on the effectiveness of doing so. The student will specifically investigate GRID development for SERCAT (<http://www.ser.aps.anl.gov/new/index.html>), a distributed crystallography initiative involving several NMI Integration Testbed sites.

University of Michigan

"Exploring NMI components in ATLAS and MGRID" - (1 position)
The NMI REU student on this project will explore and learn about the various components of NMI grid middleware in the context of the gigantic ATLAS experiment, scheduled to begin taking data at CERN in several years, and the brand-new institutional MGRID (Michigan Grid Research and Infrastructure Development) Center. Given the centrality of grids in future high energy and nuclear physics experiments, this research experience is invaluable and not available through the normal academic program. The student will have an opportunity to learn about "Grids", grid toolkits, and critical middleware within the context of an active scientific program of physics at CERN. The student will have an extended pool of mentors available through the MGRID Center, providing a supportive context for the student to follow their interests. Active testing of how NMI components work in a "production" grid will be of significant benefit to the student in aiding their understanding of middleware and how grids operate. After learning this, the student will be capable of branching out to specific areas of interest in simulation and analysis software that is in use within the ATLAS experiment.

Texas Advanced Computing Center (TACC), University of Texas, Austin

“Grid Computing Portals for the NMI Integration Testbed” – (1 position at TACC and 1 at UVa)
This REU experience is part of a multi-site project involving three NMI Integration Testbed sites: TACC (lead M. Thomas), the University of Virginia (co-lead Marty Humphrey), and the University of Michigan (co-lead Charles Severance). It will be based on current work by the named investigators in the area of Grid Portals (Thomas, Severance), Open Grid Services Architectures (OGSA - Thomas, Humphrey, Severance), Grid Technologies and Security (Thomas, Humphrey). This collaborative project provides students with several unique opportunities: They will be exposed to several high-level NSF programs and will learn about high performance computing through interactions with the co-leads' research teams whose work supports the PACI, TeraGrid and NeesGrid programs as well as others (DOE, DoD, and NASA). Students located at each site will also learn to work

collaboratively with each other in order to develop the portal and infrastructure. Additionally, the REU students will have the opportunity to study state-of-the art technologies in web portals (JetSpeed/Portlet, web services) and Grid technologies (the portal system will utilize installation of NMI GRIDS Center components such as Globus, GridFTP, MDS 2.2, etc.). Thomas, Severance and Humphrey all have experience mentoring undergraduate students and have included interns on publications and presentations. Thomas has been awarded NPACI REU internships for portal investigations in 2001, 2002, and 2003.