2005–2006 FINAL REPORT

NSF OFFICE OF INTERNATIONAL
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AWARD NO. 0418366

PAN-AMERICAN ADVANCED STUDIES INSTITUTE (PASI)

GRID COMPUTING AND ADVANCED NETWORKING TECHNOLOGIES FOR E-SCIENCE

The Institute allows scientists from the Americas to establish collaboration and new research initiatives for the 21st century. Participation is supported by a grant from the National Science Foundation and the Department of Energy.

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MENDOZA, ARGENTINA
MAY 15–21, 2005

Hotel Park Hyatt Mendoza

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PAN AMERICAN ADVANCED STUDIES INSTITUTE

GRID COMPUTING AND ADVANCED NETWORKING TECHNOLOGIES FOR E-SCIENCE

Final Report

Mendoza, Argentina

NSF Award # 0418366

Center for Internet Augmented Research and Assessment
Florida International University

May 2005

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Executive Summary

The National Science Foundation (NSF) and the Department of Energy (DOE) sponsored the Pan-American Advanced Studies Institute for Grid Computing and Advanced Networking Technologies for e-Science, in Mendoza, Argentina from May 13th-21st, 2005. This 9-day workshop for scientists from the United States and Latin America was organized in order to disseminate new theory and computer modeling ideas on the impact of cyberinfrastructure, such as grid computing and advanced networks, and its affect on the practice of science - both topics of great interest for Physics, Astronomy, and Information Technology studies around the world. In addition, the workshop provided close interactions between underrepresented minority graduate students from U.S. institutions at the graduate, doctoral, and postdoctoral level, as well as faculty from various U.S. and Latin American institutions. Such interactions help balance the sociological factors that may hinder some of these students in pursuing life-long careers in science and computing fields.

The workshop brought together scientists from institutions of higher education in the United States and Latin America, including Brazil, Argentina, Chile, Uruguay and Venezuela, to discuss emerging ideas and developments in advanced networking technologies. The goals of the PASI were (1) to bring together research faculty, students and practitioners that are actively involved in the practice of e-Science in the fields of astronomy and high-energy physics; (2) to have experienced university-level researchers and subject matter experts from North and South America lecture on recent topics of e-Science in High-Energy Physics, Astronomy, Computer Science and cyberinfrastructure technology; (3) to bring together advanced graduate-level students from the Americas to discuss issues and challenges facing High-Energy Physics and Astronomy domains in an e-Science context; (4) to encourage and enable future collaborations between students and faculty from different countries in the region.

The PASI examined the role technology played, particularly that of Grids and high-performance networks for the areas of high-energy physics and astronomy research. This PASI was organized with the purpose of increasing our collective understanding of how the technology of Grids and high-performance networks are fueling the phenomenon our community is calling e-Science. The curriculum was structured with lectures combined with focus groups, labs and informal discussions. Questionnaires about the Information Communications Technology (ICT) being applied to e-Science, and about e-Science itself, were developed for the focus groups and labs. The goal was to establish common ground among all the communities participating, then to share real world experiences from using the network- and Grid-based tools to better understand the issues and challenges that are being faced. Appendices D and E contain the questionnaires and the results from the focus groups, labs and informal discussions. This PASI will not only establish collaborative relationships, but will spawn new research initiatives for the 21st century.

1. Introduction

Grids, advanced networks for research, technology innovations, the coordinated efforts among domain researchers, students, and technology professionals, along with significant national and international investments from governments and the private sector – Cyberinfrastucture[1] - are fueling the phenomenon of e-Science. Currently, these cyberinfrastructure innovations are not yet being fully leveraged by astronomers and high-energy physicists in the Americas.

Astronomers and physicists have established a modus operandi tailored to foster domain excellence. Networking professionals are actively engaged in advancing network applications. Because they lack the rich understanding of astronomy and physics research, however, these applications are not effectively expanding the horizons for some astronomers and physicists. Faculty members are thus unable to see the full scope of opportunities enabled by Grid computing and advanced networking.

The Pan American Advanced Studies Institute (PASI), hosted in Mendoza, Argentina in May 2005, united U.S. and Latin American scientists and graduate students, participating to learn and exchange ideas about e-Science communities of practice that develop and employ advanced networking and grid computing technologies leveraged for physics and astronomy. The web site for the PASI is at http://ciara.fiu.edu/pasi/. The web site contains the curriculum

The intellectual merit is that a new bridge between astronomy, physics and the cyberinfrastructure community will be created, fostering new discoveries. The PASI will not be a locus for fundamental research; rather it will incubate a new generation of scientists and engineers who are capable of fully integrating cyberinfrastructure into astronomy and physics research and education.

The broader impacts will be to increase the rate of discovery for faculty by augmenting their research with cyberinfrastructure, to foster inter-disciplinary research, to improve the effectiveness of minority graduate education, and to propagate this change widely.

The hypothesis is that evolving graduate student education, post-graduate training, and early professional experiences to include a foundation of understanding in research and education networking will bridge the divide between the cyberinfrastructure community and astronomy and physics.

Preliminary results indicate that the hypothesis has great potential for broad impact. The

[1] "*Cyberinfrastructure* is the coordinated aggregate of software, hardware and other technologies, as well as human expertise, required to support current and future discoveries in science and engineering. The challenge of Cyberinfrastructure is to integrate relevant and often disparate resources to provide a useful, usable, and enabling framework for research and discovery characterized by broad access and "end-to-end" coordination.", SBE/CISE Workshop on Cyberinfrastructure for the Social Sciences, Fran Berman, San Diego Supercomputer Center and UC San Diego., http://www.calit2.net/newsroom/release.php?id=607

AMPATH project has hosted working groups in Astronomy and Physics that have been actively exploring these issues in the Americas for two years. We believe that if graduate fellows collaboratively create understanding of cyberinfrastructure and its benefits to astronomy and physics, the greater the opportunities will be for cross discipline communication. The institute will act as both an educational tool, and an incubator of ideas.

The remainder of the report is described in the following sections. Section 2 describes the Goals and Objectives of the PASI and what we did to accomplish them. Section 3 describes the organization of the PASI, starting with the Organizing Committee, the participating lecturers and the students. Section 4 describes the structure of the Curriculum, with lectures, focus groups and labs. Section 5 describes the outcomes of the PASI in the context of e-Science, from the perspective of the structure of collaborations, the role of cyberinfrastructure, and communities of practice. Section 6 provides conclusions and recommendations. Supplementary information is provided in the appendix sections, including photos. Appendices D contains the questionnaire and the responses regarding ICT, its application and lessons learned. Appendix E contains the questionnaire and the responses regarding e-Science issues and challenges, and the lessons learned. Appendix F contains the evaluation form and an analysis of the responses.

1.1 PASI Sponsors

The PASI was co-sponsored by the National Science Foundation (NSF) and the U.S. Department of Energy (DOE). Thanks to their generous support, students and lecturers from throughout the Americas received full travel and lodging support during the entire event.

2. Goals and Objectives of the PASI

This PASI was designed to serve the following goals: (1) to bring together research faculty, students and practitioners that are actively involved in the practice of e-Science in the fields of astronomy and high-energy physics; (2) to have experienced university-level researchers and subject matter experts from North and South America lecture on recent topics of e-Science in High-Energy Physics, Astronomy, Computer Science and cyberinfrastructure technology; (3) to bring together advanced graduate-level students from the Americas to discuss issues and challenges facing High-Energy Physics and Astronomy domains in an e-Science context; (4) to encourage and enable future collaborations between students and faculty from different countries in the region.

Throughout the course of the PASI, we examined the role technology played, particularly that of Grids and high-performance networks for the areas of high-energy physics and astronomy research. This PASI was organized with the purpose of increasing our collective understanding of how the technology of Grids and high-performance networks are fueling the phenomenon our community is calling e-Science. **From a science perspective**, we set out to discover how e-Science is practiced in high-energy physics and astronomy, and to better understand how the practice of science is being changed by technology. **From a technology perspective**, we set out to understand current issues and challenges involving e-Science and how technology innovations, from Grid computing and high-performance networks are addressing these issues and challenges. **From a community perspective**, we set out to understand the relationships that exist between the groups that are involved with e-Science – where there are divides and where there intersections connecting researchers, students and practitioners in the practice of e-Science.

3. Organization of the PASI

Lectures and informal discussions were tailored to introduce students to the frontiers of the phenomenon of e-Science and cyberinfrastructure technologies that are under development. Lab activities were designed to set the groundwork for future collaborations that would transcend national boundaries, in these disciplines.

The organizing committee was composed of 5 people, each who chaired components of the workshop. Paul Avery was in charge of student selection, overseeing student recruitment, and evaluating student proposals. Kuldeep Kumar was in charge of communications activity and provided oversight of the pre- and post-conference websites and reports. Teresa Carvalho was in charge of pedagogy and the methodology used for teaching. Julio Ibarra was in charge of instructor and student needs and resources. Anibal Gattone was the local organizer in Argentina, responsible for coordinating local logistics in Mendoza. We had 19 instructors for the PASI. Five individuals mentioned in the proposal did not attend; however, we had more than the ten originally proposed. Appendix A lists the PASI participants.

Actual Course Descriptions are hyperlinked on the website at the following URL: http://www.ciara.fiu.edu/pasi/PASI_program.htm. The PASI website also serves to disseminate information (in English) and contains links to the presentations, presentation abstracts, and well as to other valuable information discussed in the lectures. A mailing list has also been in place since the beginning and continues to be supported, as proposed.

Participating students consisted of graduate, post doctoral students, or new faculty members from lecturers' home institutions that have exhibited consistent dedication and achieved academic excellence in the areas of Physics and Astronomy. We also accepted individuals in the field of Computer Science in the realm of networking or grid computing who met the criteria. In accordance to the NSF guidelines, an equal number of students from Latin America and the United States were selected. Invited lecturers and members of the organizing committee made selections based on student evaluations. Selection criteria included research experience, supporting letters, and the ability to comprehend advanced lectures. Students were asked to describe the scope of impact the course will have on them if they were to participate. Their purpose for attending the PASI and personal biographical sketches were included in the website at the following URL: http://www.ciara.fiu.edu/pasi/registered_students.php.

4. Curriculum

The curriculum consisted of 5 days of lectures plus an excursion to Gemini South Observatory. All courses adhered to the criteria stated in the original proposal. These criteria indicated that the courses would (1) bring together experienced researchers from North and Latin America to discuss recent trends in their discipline, (2) bring together advanced graduate students from the area to discuss research and solutions to common problems, (3) introduce graduate students to new subjects and technologies under development, and (4) encourage and enable future interactions between the students and faculty from the various participating countries.

4.1 Lectures

Lectures from various speakers from North America and Latin America took place from Monday through Friday in the mornings and after lunch. Monday's lectures were meant to be an introduction to HEP, Astronomy, and Grid applications. Tuesday focused on Advanced Networks and Grids for e-Science. Wednesday's lectures addressed HEP applications; the Scholar-Practitioner Model and Communities of Practice concepts were introduced. Thursday focused on Networks and Network Monitoring and Security. Friday's Lectures tied the week's topics together and gave some students the opportunity to present their research findings to the group. All presentations are available on the website at the following URL: http://ciara.fiu.edu/pasi/PASI_program.htm

4.2 Focus Groups and Labs

The labs were structured as focus groups with the objective of identifying and addressing current obstacles in e-Science common to physics, astronomy, and computer science. Participants discussed ways to overcome these obstacles and how to form collaborations and combine their research efforts. Lab activities were also used to identify case studies, as discussions involved real life obstacles faced by the participants in their disciplines and institutions.

Lab 1 placed participants into one of three rooms according to their corresponding discipline: Astronomy, Computer Science, and High Energy Physics. The purpose of each focus group was to spark discussion among the participants that would serve as a springboard for ideas by which to complete the first questionnaires on *e-Science and Information Communications and Technology (ICT)*. This was designed to be an initial assessment of their situations and establish a baseline by which to compare further inquiry.

Lab 2 consisted of an informal lunchtime discussion in which participants were assigned to tables according to their involvement in Computer Science, Astronomy, High Energy Physics or cyberinfrastructure domains. Each table synthesized the formation of a Community of Practice, and ideas were exchanged regarding the nature of specific obstacles being faced in current research and how participants involved could share resources and ideas for further collaboration and start working together in their present disciplines to overcome these obstacles.

Please refer to Appendices C and E for the questionnaires to Labs 1 and 2, respectively. The labs and the questionnaires provided an excellent instrument to capture responses that contained rich experiences and lessons learned from many of the domain researchers and the students. A summary of the transcriptions is included in Appendices D and E.

4.3 Informal Discussions

Informal discussions took place throughout the course of the PASI. Participants "clicked" from the first day, and ideas for collaboration were tossed around before the first presentation even started. Many discussions throughout the week provided a "forum for a higher-level dialog" on the issues and challenges facing the participants from the different countries. During the second lab, mock Community-of-Practice teams were established and current obstacles currently facing e-Science were discussed. The Program Committee also held a round table panel discussion during Saturday's breakfast in order to assure that all items mentioned in the proposal had been addressed and that the corresponding goals had been met.

5. PASI Outcomes

This section describes the findings from the lectures, focus group and labs, and the informal discussions. Information compiled from lecture presentations, discussion notes and questionnaires improved understanding of the impact technology is having on the practice of science. The experiences participants shared with each other clearly conveyed the impact that technology is having in High-Energy Physics (HEP), Astronomy and Computer Science and Engineering disciplines. Lectures can be found at the PASI web site at http://www.ciara.fiu.edu/pasi/PASI_program.htm. Responses from the focus group discussions and labs can be found in Appendices D and E.

The labs and focus group were structured to stimulate discussion on e-Science from three different dimensions. The first was from the perspective of collaboration, seeking to understand how the HEP and astronomy domains collaborate in an e-Science context. These discussions are described below in section *Structure of Collaborations*. The second dimension was from the application of technology, seeking to understand the role of technology to enable global collaborations in an e-Science context. These discussions are described below in section *Role of Cyberinfrastructure*. The aim was to establish common ground on the structure of collaborations and the role of technology in e-Science. The third dimension was from the perspective of *Communities of Practice*. This dimension provided a different lens by which to look at the human – technology interactions.

An evaluation of the PASI was conducted from the responses in the evaluation form. The evaluation form and the results are available in Appendix F.

5.1 Structure of Collaborations

Lectures, labs, informal discussions and group activities were structured with the following goals in mind: (1) to understand current issues and challenges in e-Science collaborations that span beyond national boundaries; (2) to increase understanding of the role of cyberinfrastructure in e-Science; (3) to learn about the application of cyberinfrastructure in astronomy and high-energy physics. The following summarizes the outcomes from the lectures, labs and group activities.

5.1.1 High-Energy Physics

In High-Energy Physics (HEP), collaborations are normally structured around large experiments, such as the Large Hadron Collider[2] (LHC), located at CERN. The LHC consists of several collaborations in search of new particles. Two of these collaborations that were discussed are the Compact Muon Solenoid[3] (CMS) and the A Toroidal LHC ApparatuS[4] (ATLAS). Collaborations provide opportunities for division of labor among participating institutions. The ATLAS collaboration involves 150 institutions and 1,850 physicists. Modern HEP forms collaborations with globally distributed groups and institutions to organize work, ideas, and responsibilities, and eventually validate (and agree) on the scientific results. Collaborations allow significant progress to occur in methodology, understanding and discovery.

Given the size and distributedness of the HEP community, collaborating is a challenge having to work across many time zones. Tools are needed that allow everyone to communicate across all time zones effectively. Face-to-face meetings take a lot of effort, occur to infrequently, and require too much time and money for travel. As a result, it is essential to continue improving the tools for effective collaborations.

Collaboration is also about sharing resources. Members of the collaboration are able to share resources that far exceed their individual capacity. Experiments can execute with a higher degree of success when there is greater access and availability to resources. There is a greater need for interoperability, in particular for dealing with the heterogeneity of resources. Collaborations also raise complex issues, such as intellectual property and non-equitable usage or sharing of the resources.

5.1.2 Astronomy

Having radio and optical telescopes located around the world, Astronomy is a very distributed community. Much like HEP in that its communities are organized around particle accelerators, the astronomy community is organized around the effective use of its telescopes. Telescopes are located in harsh and remote environments. Multinational coordination and effective communications with geographically diverse communities are critical success factors for the astronomy community. As a result, connecting these telescopes to research networks is a requirement for effective coordination and collaboration.

For the astronomy community, collaborative relationships come with challenges: some of them are social, some political, and there are always funding challenges. Other challenges include property rights, training limitations, competition, and security issues.

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[2] http://public.web.cern.ch/Public/Content/Chapters/AboutCERN/CERNFuture/WhatLHC/WhatLHC-en.html

[3] http://cmsinfo.cern.ch/Welcome.html

[4] http://atlas.web.cern.ch/Atlas/index.html

An important practice in the development of multinational collaborations for astronomy is, prior to the use of ICT-based tools, to establish personal relationships up front, as the team is being developed. This approach helps raise issues of different cultures in a global world where project stakeholders can learn from one another. It is not uncommon to find different business cultures that must be accommodated when working with different multinational groups. Once the business relationship has been established, ICT-mediated tools for collaboration are more effective.

5.1.3 Computer Science

The Computer Science discussion mainly focused on how cyberinfrastructure can be used to further research, how the various research communities can be helped to get acquainted, and enabled with the latest cyberinfrastructure technologies. Some of the obstacles mentioned included the need to teach students at an early stage in their careers to work in collaborative ways, the lack of standardized research practices posing a problem for some collaborative activities, duplication of work as a result of grid computing technologies being so new, and different philosophies behind different implementations posing a conflict for certain activities.

Another issue that was raised was the question of leadership. Most countries of South America have lost leadership to Brazil, Chile and Mexico. An obstacle for Argentina in particular was that during the last few years, money has been a problem, making it harder to train and recruit students. Funds are needed to set up and implement faster networks and to link with the various institutions. Argentina has very few graduate students in computer science, but a strong background in math, physics, and health. Some students in the group also stressed the importance of how people-to-people meetings helped boost the relationships they were trying to build: “I don’t think videoconferencing can replace that personal touch.”

5.2 Role of Cyberinfrastructure

The lectures contained excellent explanations of the role of cyberinfrastructure in e-Science and its application to high-energy physics and astronomy. Examples were provided that showed the application of cyberinfrastructure towards making improvements to the discovery of knowledge, giving students real world case studies. From the opposite point of view, students were informed of the impact to discovery from the absence of technology.

The levels of cyberinfrastructure were explained to show the interdependencies between the hardware (network, computational and storage elements), middleware services, and collaboration services. Layers were also explained in the context of the Grid. All participants had familiarity with clusters and the Grid. Most students were involved in projects using clusters.

Participants from Argentina expressed that forming collaborations provide them with opportunities to have access to resources that are not available locally, such as clusters.

One student in theoretical physics is using a cluster in the U.S. to execute large simulations, providing results quicker than local clusters. A few universities in Argentina, such as the University of Mendoza, have clusters that are being used for local projects; however, the universities have not yet interconnected their clusters to form a Grid. Students expressed a strong interest for more international collaborations to provide them with opportunities for more access to Grid technologies and to achieve common objectives in learning and research. Participants from the U.S. and Brazil described how they are collaborating on experiments through Virtual Organizations.

Tools for collaboration are telephones, Video Conferencing, web pages (static and dynamic), Instant Messaging, Wiki, email, mailing lists. Collaborations are challenging, because of their size. There are cultural and language differences, people whom you don't know, and large time zone separations. A significant part of the experiment is building trust relationships, which can take a lot of time; however, the effective use of technology is helping reduce how long it takes.

5.3 Communities of Practice

The general goals of a Community of Practice (CoP) are for all members to work collaboratively; to consciously integrate Research, Practice and Education; and to continually learn, reflecting on the Research, Practice and Education (Wenger, 2002)[5]. Lectures on Communities of Practice and Structure of Collaborations gave students a new perspective to help them identify different roles among participants, as well as, how roles can change with context of the situation.

From the Lab exercises, the conceptual differences between "collaboration" and "community" were examined, and the ideas exchanged suggested that there is a difference between the two. Building a "Community" is setting up a shared set of goals to collaborate with each other. In astronomy, for example, telescopes are resources shared by communities of stakeholders. Telescopes are limited resources, which the community competes for time to use them; however, the community has to work together to establish rules that control how the telescopes will be shared. Collaborations can be one to one, but communities have a way of evolving on their own based on shared goals and interests. There are several discreet collaborations in a community. In the HEP community, for example, there are two large collaborations (CMS & ATLAS) making up this community. There may also be several entities collaborating within the larger collaboration.

From the lecture given by Dr. Dan Sewell and lab exercises, a framework was used to recognize varying characteristics and roles of each participant, at different times, in the context of communities. The following table defines the range of characteristics and the roles associated with the respective characteristics. Arrows represent a continuum.

Characteristics (each characteristic on a continuum)	**Roles**

[5] Wenger, E. (2002). Communities of Practice, Cambridge University Press.

Independent ← → Dependent	Coach
Interested ← → Uninterested	Guide
Involved ← → Uninvolved	Facilitator
Self-directed ← → Other directed	Mentor

Table 1 Characteristics and Roles in Communities

Activities for collaborative work in communities or practice should aim to have participants:

- Define and pose problems that are relevant to the domain space;
- Engage participants in active dialogue that address the problems presented;
- Take collective action based on problem and dialogue;
- Critically reflect on outcome through discourse and dialogue.

The goal is to produce increases in knowledge in the domain space.

5.4 e-Science

The following definitions of e-Science were provided early in the PASI to establish a basis for discussion.

> *"e-Science is about global collaboration in key areas of science and the next generation of infrastructure that will enable it."*[6]

> *"e-Science refers to large-scale science carried out through distributed global collaborations enabled by networks, requiring access to very large data collections, very-large-scale computing resources and high-performance visualization"*[7]

We asked participants to share their understanding of e-Science as a concept and as a practice, to provide characteristics of e-Science, and to share experiences within their discipline. Questions from the lab exercises on e-Science are included in Appendix D.

There was a shared understanding that e-Science has not changed the scientific method; however, it was agreed that the practice of science has been impacted dramatically by advancements in technology. The May 6, 2005 issue of Science, featuring Distributed Computing[8], was in circulation prior to the PASI. It was referenced multiple times in discussion, and was used to cite examples of e-Science, describing HEP and astronomy community-oriented activities that enable not only the scientific community, but also the public to participate in these communities.

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[6] Dr John Taylor, Director General of Research Councils, United Kingdom, http://www.e-science.clrc.ac.uk/

[7] NSF CISE Grand Challenges in e-Science Workshop Report, http://www.evl.uic.edu/core.php?mod=4&type=4&indi=142

[8] Distributed Computing. Science. Volume 308

e-Science was described as a set of tools for the practice of science; for example, tools for the practice of e-Science can take the form of a virtual lab. Before e-Science, scientists had to go to the science instruments. Now, the instruments have sensors and e-Science brings the environment to the scientists. e-Science could be viewed as the application and use of collaboration tools that are network based, such as through the Internet or Internet2. Another point of view that was given is that e-Science is about analyzing data with computers.

From a conceptual level, it might be best to accept e-Science as an open term with multiple definitions that could be applied depending on the context and desired goals. It's important to understand the aspects of e-Science from the perspective of the experiment, the environment, the technology, etc. The complete transcription from the labs is included in Appendix D.

6. Conclusions and Recommendations

The excursion of the Gemini-South and NOAO observatories was an enriching experience for both students and faculty to witness close up an example of a large-scale e-Science facility. It provided an excellent example of how cyberinfrastructure plays a critical role in the operation of these telescopes from multiple locations; it also served as an excellent prelude to the start of the PASI. The PASI organizers greatly appreciate the generosity of Jim Kennedy, Chris Smith, and the Gemini-South and NOAO staff who organized the excursion to the observatories. It was beneficial to include this excursion in the PASI program as a way to augment the learning experience for the students and faculty.

The PASI provided an excellent setting to disseminate information on the availability of high-performance research and education networks in the Americas. Advanced networks for research and education have become more available throughout Latin America, as a result of the AMPATH project, then the European Commission's ALICE initiative that launched the CLARA network. The ALICE initiative provided funds to connect 18 countries in Latin America to a regional backbone, which then connects to Europe to promote science collaborations between the nations of Latin America and Europe. Through funds from the NSF International Research Network Connections (IRNC) program, high-performance network connections have been established to Latin America. On behalf of the NSF, this effort is led by Florida International University, through the Western-Hemisphere Research and Education – Links Interconnecting Latin America (WHREN-LILA) project, to enable the U.S. science and engineering research and education community to collaborate with their counterparts.

Efforts should continue to increase awareness of the Cyberinfrastructure resources in the Americas that are available to the science and engineering research and education community. PASIs are excellent instruments to bring together domain researchers, graduate students and practitioners to share and create knowledge, and to raise awareness of the technology resources that can be used towards network-dependent science. Technology resources should be leveraged at PASIs in the form of hands-on laboratory experiences or demonstrations that will demonstrate real-world e-Science in action.

Hands-on labs and/or demonstrations that utilize these high-performance network and Grid resources should be included in PASI curriculums to enrich the students' learning experience. For students from Latin America, with limited access to technology resources, this exposure to the technology in the context of their discipline would be highly effective. A goal of this PASI was to stimulate interest among the Latin American students to further their learning and collaborations with students from the U.S. As a result of the PASI in Mendoza, several students from Argentina and Brazil traveled to the U.S. to attend hands-on Grid workshops. Several of them continue to correspond with the faculty of the PASI through the mailing lists.

Appendix A: PASI Participants

Mendoza, Argentina
May 15-21, 2005

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Speakers

We had 19 instructors for the PASI:

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Five individuals originally mentioned in the proposal did not attend; however, we had far more than the ten we originally proposed. Below are the biographical sketches of the speakers.

Julio Ibarra, Florida International University, U.S.
Julio E. Ibarra is the Executive Director of the Center for Internet Augmented Research and Assessment (CIARA) at Florida International University. He is responsible for the strategic planning and development of advanced research networking services for the University. He oversees the University's Internet and Internet2 services as the administrative and senior technical lead of Internet and Internet2 services for the University. He is the Principal Investigator of the Western Hemisphere Research and Education Network (WHREN) – Links Interconnecting Latin America (LILA) NSF-SCI International Research Networks Connection Program and the AmericasPATH (AMPATH) project and is responsible for the strategic planning and development of the regional GigaPOP and the AMPATH International Exchange Point for Research and Education networks to enable US e-Science initiatives in South and Central America, Mexico and the Caribbean. Ibarra has been active in initiatives to advance networking and Internet technologies for the State of Florida. He served on the Governor's IT Florida Task Force subcommittee on Infrastructure and Technology Development, as a subject matter expert. He is co-author of the policy recommendation for the development of a Network Access Point (NAP) in South Florida to enhance the State's e-Commerce opportunities with Latin America.

Anibal Gattone, RETINA, Argentina

Guillermo Cruz, Instituto Tecnologico Universitario, Universidad de Cuyo

Carlos Garcia Garino, Instituto Tecnologico Universitario, Universidad de Cuyo
Carlos García Garino is a Civil Engineer at the University of Buenos Aires. He has a Ph.D. in Computational Mechanics from the Technical University of Catalonia, Barcelona, Spain. He is a Professor and Head of Department at Telecommunicaitons & Network Department, ITU, Universidad Nacional de Cuyo, Mendoza, Argentina, a member of Scientifical and Technical Staff of Argentinian Council for R+D activities, a referee and member of Evaluation Committee for Information Technologies of Argentinian R+D Agency (ANPCyT). He has more than 50 papers published in proceedings of and scientific journals and international conferences carried out at Argentine, Brazil, Chile, Canada, Spain, France, Portugal, Belgium and Japan. Along his career has visited different european universities, among them University of Liege (Belgium) and Technical Universities of Catalonia and Madrid in Spain. He is presently interested in High Perfomance Computing as well as Grid Computing. Two R&D projects are being carried out and presently granted by ANPCyT.

Sergio Novaes, FNAL, Brasil

Jim Kennedy, AURA, United States

Chris Smith, NOAO, United States
Dr. R. Chris Smith is an Astronomer at the Cerro Tololo Inter-American Observatory (CTIO), the southern hemisphere branch of the U.S. National Optical Astronomy

Observatory (NOAO). His research involves studies of supernovae and the use of these explosive events to understand the evolution and fate of the universe. He is part of the team that first published the evidence for the acceleration of the expansion of the universe and the "dark energy" which may cause this acceleration. He is also involved in investigations of the remnants supernovae leave behind, trying to better understand not only the stars which exploded but also the interstellar gas in the surrounding regions.
Dr. Smith is also IT Coordinator for NOAO's southern facilities, and is the manager of NOAO's Data Products Program group in Chile. The Data Products Program is responsible for data management systems at NOAO, including high-throughput grid-capable data reduction pipelines and advanced Petabyte-scale archives supporting advanced data mining techniques. The aim of the Data Products Program is to develop end-to-end systems which take the raw data from the telescopes and generate data products of scientific interest, implementing tools and Web services for discovering, mining, and analyzing those data products, and serving the data and associated data products to the world-wide community through participation in the International Virtual Observatory. www.ctio.noao.edu/~chris

Gabrielle Allen, Louisiana State University, US

Paul Avery, University of Florida, US
Paul Avery received his Ph.D in High Energy Physics from the University of Illinois in 1980 and is Professor of Physics at the University of Florida. His research is in experimental High Energy Physics and he participates in the CLEO experiment at Cornell University and the CMS experiment at CERN, Geneva. Dr. Avery is the Director of two national NSF-funded Grid projects, GriPhyN and the International Virtual Data Grid Laboratory (iVDGL). Both projects are collaborations of computer scientists, physicists and astronomers conducting Grid research applied to several frontier experiments in physics and astronomy with massive computational and data needs. He is Co-Pi of the NSF funded projects CHEPREO and UltraLight and is one of the principals seeking to establish the Open Science Grid.

Gil C. Marques, USP, Brasil

Shawn McKee, University of Michigan, US
Shawn McKee (Ph.D., UM 1991) is a high-energy astrophysicist at the University of Michigan. During the early 1990's he lead the central tracker simulation group as an SSC Fellow on the GEM experiment. Since the demise of the SSC, he has been active in a wide range of physics collaborations: particle astrophysics (HEAT, ACCESS), neutrino physics (COSMOS), high-energy physics (ATLAS) and observational cosmology (SNAP). On two of these collaborations, ACCESS and COSMOS, he led the simulation groups. Common to all these experiments, he has been central to advancing computing technology to address the simulation and data analysis requirements of each experiment. ATLAS, with its multi-Petabyte per year data flow, represents a significant challenge for even the assumed computing infrastructure of 2007. In 2001, he was appointed Network Project Manager for US ATLAS to plan for and develop the necessary network environment to support the US ATLAS computing model. He is co-chair of the High-

Energy and Nuclear Physics (HENP) Internet2 Working Group, which is addressing similar problems in the context of all of high-energy and nuclear physics experiments. From 2002 thru 2005 he was the Technical Leader of the Michigan NMI Testbed. He is Co-PI on three network and grid related projects: UltraLight (NSF/ITR), Terapaths (DoE/MICS) and GridNFS (NFS/NMI Development) and has served as the Chair of the E2E TAG group from 2003-2004."

Marko Petek, Brasil

Sanjay Ranka, University of Florida, US

Laukik Vilas Chitnis, University of Florida, US

Daniel R. Sewell, Fielding Graduate Institute, US
Dan joined the Fielding community in January 2000. As Associate Provost, he is responsible for Research Development throughout the institution, Sponsored Program development and administration, coordination with Advancement & Development and Institutional Partnerships, Institutional Review Board (research ethics) administration, and Institutional Research development and coordination across the institution, as well as providing teaching across the university in several areas related to research. Dan created the Office of Research to facilitate further development of the research culture at Fielding by supporting faculty or groups including faculty to develop external funding for research projects. He also works to develop further the infrastructure for conducting research at Fielding. Dan works with Fielding faculty, students and alumni to nurture the development of their research and to help them obtain research funding under the auspices of Fielding Graduate University. Toward this end, the Office of Research has developed in internal grant program that provides seed funding for researchers to advance their research and eventually obtain external funding. In the area of externally funded projects, between January 2000 and July 2004, Fielding has seen sponsored projects funding grow from $0 to over $1,000,000. He has conducted, published, or presented research in cognitive psychology, clinical psychology, rehabilitation psychology, neuropsychology, systems analysis, artificial intelligence, organizational development, behavioral medicine, and public health. Dan comes to Fielding from Louisiana State University Health Sciences Center. For the LSU Medical School he was Research Coordinator for their University Medical Center campus in Lafayette, LA. He worked there for 4.5 years to develop a research culture; and, to develop sponsored research that grew from $0 to over $400,000 during his tenure. In addition, Dan worked with faculty on design, implementation, completion, and publication/presentation of their own research projects. Prior to that Dan worked as a senior scientist at a R&D company for 5 years; he trained and worked, for 12 years as a psychotherapist; and, as an independent consultant conducting research and performing systems analysis & design. Dan received a Ph.D. in Cognitive Psychology from Emory University in 1985. He received his undergraduate and masters degrees from the University of Louisiana at Lafayette. He is also a graduate of Copiah-Lincoln Community College in Wesson, MS.

Tereza Cristina Carvalho, University of Sao Paulo, Brasil

Tereza Cristina M. B. Carvalho received her Master of Science in Electronic Engineering (1988) and her Ph.D. in Electronic Engineering (1996) from Escola Politécnica, University of São Paulo, Brazil . She concluded the Sloan Fellows Program (2002) as post-doctoral work at MIT - Massachusetts Institute of Technology, USA . Currently she is an Assistant Professor at the Department of Computer and Digital System Engineering at Escola Politecnica, University of Sao Paulo, Brazil . She is also the technical director of LARC (Laboratory of Computer Architecture and Networks) being responsible for management of research and development projects in the area of on-line business, information systems, network communication, multimedia and wireless networks, management and security. In 2003 she was nominated as the International Relations of ANSP (Academic Network of the State of São Paulo, Brazil) to the International Forum of Internet 2. She was also elected as Vice-President of Technology of the MIT Sloan Alumni Club of Brazil. Awards conferred: (2001) Décio Leal de Zagottis Award from Escola Politécnica - University of São Paulo ; (2000) First Cisco Academy in Brazil - Cisco Networks, Brazil ; (1991) Siemens Award for Achievement in Computer Networks Projects, Nürnberg , Germany . She has more than 70 scientific and technology papers in peer reviewed journals and international conference. Her main current research interests include: IT and business, system management, quality of service and advanced applications for broadband networks, and security for ad hoc networks.
Guillermo Cicileo, RETINA, Argentina

John Jamison, Juniper Networks, US
John Jamison has more than 15 years experience in the design, implementation, and application of Research & Education (R&E) Networks. Before joining Juniper he was an Academic Staff Member at the University of Illinois where he worked as the Lead Engineer on the STAR TAP International R&E Peering Point project. He has also worked at MCI as a Senior Manager on the National Science Foundation's vBNS project. Mr. Jamison has a BA in Mathematics from the University of California, San Diego and an MS in Computer Science from the George Washington University. He has published several articles on R&E Networking and is a regular speaker and advisor to academic institutions around the world.

Kuldeep Kumar, Florida International University, US

Alan Tackett, Vanderbilt University, US
Alan Tackett received his M. S. in Computer Science and Ph.D. in Physics from Wake Forest University in 1998. He then went to Vanderbilt University as a post-doc in the department of Physics and Astronomy. In 2000 he transitioned to being the project leader for VAMPIRE at Vanderbilt, a 55 node Beowulf compute cluster dedicated for campus research. Following from the success of VAMPIRE and with the support of a large group of VU researchers, a proposal for the entity now know as ACCRE (Advanced Computing Center for Research and Education) was submitted to the Academic Venture Capital Fund of Vanderbilt University. An $8.3 million grant was received to transform the cluster into a University-wide resource capable of meeting the needs of any researcher on campus. The scope of the operation was expanded from a compute cluster to include data storage and data visualization capabilities. Currently ACCRE has over

1500 processors and over 200TB of storage. Dr. Tackett is now the ACCRE Technical Director and Research Assistant Professor in the department of Physics and Astronomy.

Student Bios

Thomas Davis Backes is currently pursuing the Ph.D. degree in Electrical and Computer Engineering at the Georgia Institute of Technology. His research is in the study of nanostructures, such as quantum dots and crystal superlattices. He has worked and studied abroad several times, including most recently a summer research internship in Taiwan. Thomas's future goals are to continue to work internationally and to become involved in science policy making.

Allwyn Baskin is currently a Ph.D. student at the Fielding Graduate University, which is based in Santa Barbara, California. Mr. Baskin holds an MBA in Marketing and an MA in Organizational Development and has extensive professional experience with private firms, government agencies and community-based organizations. His research interests include

intraorganizational diffusion of innovations and knowledge transfer, particularly among organizations involved in large scale social changes. Mario Leandro Bertogna worked several years in development for a private company as an analyst and project leader and now he is an assistant professor at the Universidad Nacional del Comahue. He teaches distributed systems and is in charge of the distributed systems and security lab. Since last year he has been working on several grid projects, most of them in inter-cluster computing. He is now applying for his PhD in this subject too. He is also working with a research group on remote labs.

Tiffany Driscoll earned her dual bs in physics and math from the University of Houston May 2004. During undergrad, I played both varsity water polo and for an all-star league and tried to run 2-3 triathlons a year. I'm now doing my graduate work in numerical relativity at Louisiana State University, though I don't get out much I do enjoy spoiling my doggy rotten, pool, and darts...and of course swim like a fiend every chance I get. In the future, I hope to either work for NASA or DOD doing research on black holes and gravitational waves.

Leonardo Daniel Euillades has worked in an engineering institute at the Engineering Department at the National University in Cuyo. He is a Computer Science engineer working with radar imagery, making topographic models, and is very interesting in algorithms development with parallel computing using cluster computing. His main research interest is develop algorithms for radar imagery and processing to calculate surface earth deformation in Mendoza, Argentina.

Richard T. French is studying for a Masters in Space Systems Engineering at the University of Michigan and currently work on grid computing for the UM-ATLAS project. He has worked on the NMI Grid Computing Software Suite as well as building cluster machines for scientific computing at the University.

Carlos García Garino is a Civil Engineer at the University of Buenos Aires. He has a Ph.D. in Computational Mechanics from the Technical University of Catalonia, Barcelona, Spain. He is a Professor and Head of Department at Telecommunications & Network Department, ITU, Universidad Nacional de Cuyo, Mendoza, Argentina, a member of Scientific and Technical Staff of Argentinean Council for R+D activities, a referee and member of Evaluation Committee for Information Technologies of Argentinean R+D Agency (ANPCyT). He has more than 50 papers published in proceedings of and scientific journals and international conferences carried out at Argentine, Brazil, Chile, Canada, Spain, France, Portugal, Belgium and Japan. Along his career has visited different European universities, among them University of Liege (Belgium) and Technical Universities of Catalonia and Madrid in Spain. He is presently interested in High Performance Computing as well as Grid Computing. Two R&D projects are being carried out and presently granted by ANPCyT.

Amado Gonzalez founded the FIU Graphic Simulation Laboratory in 2000. This lab serves the purpose of conducting research in the diverse aspects of Scientific Visualization and Virtual Reality for the Engineering Center at FIU and for external sponsoring agencies, and provides advanced undergraduate and graduate students with an environment in which they can gain exposure and practice in the areas of Scientific Visualization, Virtual Reality, and Computational Science research. Through collaboration with the FIU Engineering Information Center, GSL members have access to an array of specialized equipment and support. He was also instrumental in obtaining 96 AMD Opteron processor Alienware machines for 48 node Computational Cluster located in the Department of Mechanical and Materials Engineering at the MAIDROC (Multidisciplinary Analysis, Inverse Design, Robust Optimization and Control Laboratory) at Florida International University. Amado Gonzalez was also a Tutorial Presenter for the Education Program at the SuperComputing Conference 2003, National Computational Science Institute. Amado Gonzalez, through hard work and determination was also able to aquire Access Grid Capabilities for the College of Engineering at Florida International University. This Access grid award was made possible by the Advanced Networking with Minority Serving Institutions (AN MSI) program. Funded by the National Science Foundation (NSF), AN MSI is program of the National Center for Supercomputing Applications (NCSA) and the Education, Outreach, and Training Partnership for Advanced Computational Infrastructure (EOT-PACI). EOT-PACI is the outreach effort of the two NSF PACI partnerships: the National Computational Science Alliance (Alliance) and the National Partnership for Advanced Computational Infrastructure (NPACI). Amado Gonzalez is a founding member of the Minority Serving Institution Consortium, lead by University of Illinois, Urbana-Champaign, National Center for Supercomputing Application, under the leadership and direction of Stephenie Mclean. Under the Mentorship of Dr. Armando Barreto, FIU Electrical and Computer Engineering, he introduced the new course "Introduction to Web Design and Development."

Eduardo de M. Gregores: His research activities started during his PhD on Elementary Particle Physics Phenomenology, at São Paulo State University. Dutring this time, he spend one year at University of Wiconsin, working with Prof. Francis Halzen. After concluding his PhD, he returned to the University of Wisconsin for a two year post-doctoral research on Particle Physics. By this time he started his participation on the DZero experiment at the Fermilab. He presently holds a scholar fellowship at São Paulo State University where he performs research activities on Grid Computing applications for Experimental High Energy Physics as a member of Fermilab DZero, and CERN CMS experiments.

Sergio Morais Lietti did his PhD at Instituto de Física Teorica da UNESP, Brazil, in 1998. He was a post-doc at Lawrence Berkeley Laboratory, U.S.A., at Instituto de Física Teorica da UNESP and at Departamento de Física Matemática do Instituto de Física da USP, Brazil. He has published eighteen papers in the area of Phenomenology of Particle Physics. Since 2004 he is a member of the Fermilab D0 Collaboration and of the CERN CMS Collaboration.

Pedro G. Mercadante: Researcher Fellow at Instituto de Física Teórica, UNESP. He obtained his PhD in Physics in 1997 at University of São Paulo. Was a pos doc Fellow at University of Hawaii, Florida State University and University of São Paulo. During this period he worked as a phenomenologist in high energy physics, publishig 20 refereed papers. He is a member of D0 collaboration since July 2004 and is beeing involved in the CMS collaboration at CERN. He currently has a Jovem Pesquisador fellowship from FAPESP.

Surya Dev Pathak is a post doctoral research fellow at Vanderbilt's Physics and Astronomy department and is working on grid and storage related projects at the Advanced Computing Center for Research and Education (ACCRE) at Vanderbilt and is currently working on next generation storage elements for large scale grid computing clusters.

Santiago Perez is an electronic engineer and a teacher at the National Technological University in Mendoza. He teaches Computer Architecture in the Information Systems Department. He also conducts research in the LIREDAT (Laboratorio de Investigacion y Desarrollo de Nuevas Tecnologias en Redes y Comunicaciones de Datos), and is a project member and director.

Marcelo Ponce C. is part of the Field Theory workgroup at the Physics Institute in the Faculty of Sciences (Universidad de la Republica). My present activities are mainly focus on my thesis research duties which mostly includes works with numerical recipes, but I'm also very interested in the theoretical issues involved, specially phenomenological and fundamental principles. I'm currently working with Rodolfo Gambini (who is my advisor) and Jorge Pullin (from LSU), looking for an implementation of numerical applications of his own formalism developed together J. Pullin et al. for a consistent discrete quantization method.

Pablo Turjanski: M.S. in Computer Science and Lecturer in the CS. Department. Currently teaching Algorithms and Data Structures I. My research fields are Grid computing, Parallel and Distributed Systems, High Perfomance Computing and

Simulation of Physico-Chemical Processes. I'm a member of "Asociación Argentina Amigos de la Astronomía" (Friends of Astronomy Argentine Asociation).

Appendix B: Program Activities

Dates: May 15-22, 2005
Location: Hotel Park Hyatt Mendoza
Mendoza, Argentina

Sunday, May 15, 2005: Day-1

20:30 Registration and Social Reception

Monday, May 16, 2005: Day-2 "Introductions"

9:00	Welcome Address: Julio Ibarra, PASI Principal Investigator, FIU/CIARA USA
9:30	Welcome Address: Anibal Gatonne, RETINA, AR
10:00	*HEP Grid Initiatives in Brazil* Speaker: Sergio Novaes
10:30	Coffee Break
11:00	*Advanced Networking in the Americas Introduction* Speaker: Julio Ibarra, FIU
12:00	*Optical Astronomy Applications* Speaker: Jim Kennedy, AURA, USA
13:00	Lunch
15:00	*From Photons to Petabytes: Astronomy in the Era of Large Surveys and the International Virtual Observatory* Speaker: Chris Smith, NOAO
16:00	Lab Hands-on time / Free Time
18:00	Social Hour
20:30	Dinner

Tuesday, May 17, 2005: Day-3 "Advanced Networks & Grids for e-Science"

09:00	Keynote Speaker: John McGowan, FIU
09:30	*Grid Intro and Fundamentals Review* Speaker: Gabrielle Allen, LSU
10:30	*Grid Security and Basic Access* Speaker: Gabrielle Allen, LSU
11:00	Coffee Break
11:30	*HEP and Astronomy Grids in the U.S.* Speaker: Paul Avery, UF
12:30	*The e-Fisica Project* Speaker: Gil C. Marques, USP Brazil
13:30	Lunch
15:30	Mendoza Winery Tour Excursion
20:30	Dinner

Wednesday, May 18, 2005: Day-4 "Applications"

9:00	*CMS Grids* Speaker: Shawn McKee, U of Michigan, USA
10:00	*ISAM / EXEHDA Middleware to Support Mobile Applications* Speaker: Marko Petek
10:30	Coffee Break
11:00	TBA
12:00	*The Scholar-Practitioner Model as a Basis for Promoting Researcher, Practitioner, and Educator Collaboration in Physical Science and Information Technology Graduate Education* Speaker: Daniel Sewell, Ph.D.,Fielding Graduate University, Santa Barbara, CA
13:00	Lunch
15:00	Lab: Student Presentations
18:00	Social Hour
20:30	Dinner

Thursday, May 19, 2005: Day-5 "Networks"

9:00	*Overview of High Speed Network Technologies* Speaker: Tereza Cristina Carvalho
10:00	*Network Monitoring with Monalisa and Netflow* Speaker: Ernesto Rubi, FIU CIARA
10:30	Coffee Break
11:00	*Advanced Networking in Latin America and Argentina as an Infrastructure for GRIDS* Speaker: Guillermo Cicileo, RETINA
12:00	*Introduction to IPv6* Speaker: Tereza Cristina Carvalho
13:00	Lunch
15:00	Lab Hands-on time / Free Time
18:00	Social Hour
20:30	Dinner

Friday, May 20, 2005: Day-6 "Pulling it all together"

9:00	*International Collaboration at the Speed of Light: An overview of the network infrastructure that enables global academic collaboration* Speaker: John Jamison, Juniper Networks, USA
10:00	*Collaborative Research and Learning* Speaker: Kuldeep Kumar, FIU
10:30	Coffee Break
11:00	*Cluster Computing and Tuning Monte Carlo Simulations* Alan Tackett, PhD, Vanderbilt
12:00	*Grid Resource Management and Its Relationship to Monitoring* Speakers: Sanjay Ranka/ Laukik Vilas Chitnis, UF, USA
13:00	Lunch

15:00	Free Time
20:30	Tango Show and Dinner

May 21, 2005: Day-7 "Close Out and Next Steps"

9:00	All Day Group Excursion to Pierre Auger Observatory
	Breakfast Roundtable for Committee Members
10:00	Report Outline/ Assessment Survey
12:00	Check-out

Appendix C: Lab Activities- Building a Community of Practice

Lab 1: e-Science and ICT

PASI Questionnaire: e-Science and ICT

A. About You

Your Name: ______________________________ Institution: ___________________

Contact Information: e-mail _____________________ Telephone ________________

How would you describe your principle role? Please check only one:

Undergraduate student in e-Science	[ ]	
Graduate Student in e-Science	[ ]	Masters or PhD? Please indicate _________
Faculty Researcher in e-Science	[ ]	(includes faculty who research and teach)
Teacher in e-Science	[ ]	(primarily teaching responsibility)
IT (Computer science)Technologist	[ ]	(develops or provides computing support)
IT (Comp.Sc.)Faculty/Researcher	[ ]	(faculty member who research and teach in IS)
MIS/Management Faculty/Resrchr	[ ]	
IT/MIS/Management Student	[ ]	
Other	[ ]	Please describe: _______________________

Please briefly describe your research area and/or learning interests:

B. About your e-Science Collaborations (or intended collaboration)

If you already collaborate with other researchers, students, or faculty members please answer the following questions in the context of these collaborations; otherwise answer them from the perspective that you would like to like to collaborate with other researchers, students, and faculty members.

Currently Collaborate with others [ ]   Would like to collaborate [ ]

Why do you need to collaborate with others? Describe the purpose and nature of actual (or intended) collaboration:

How do you collaborate?

Who are your collaborators/ (or people you would like to collaborate with)?

Where are these people located (indicate if they are within your institution, at another institution within your country, at institutions beyond your national boundary);

Explain as to why do you think that this/these collaborations are/can be useful

Describe any issues that you either have or see as possibly happening that might cause problems with these e-Science collaborations:

C. Role of Information and Communication Technologies (ICT) in e-Science

If you already collaborate with other researchers, students, or faculty members please answer the following questions in the context of these collaborations; otherwise answer them from the perspective that you would like to like to collaborate with other researchers, students, and faculty members.

Describe the ICT that you use in your e-Science collaborations

Describe the function and uses of ICT in your e-Science collaborations. How and why do you use ICT?

What shortcomings of ICT and its functionality that you would like to have improved? __

Any other comments? ____

Appendix D: Responses to PASI Questionnaire: e-Science and ICT

The following is a distribution by discipline and ranking of the participants responding to the questionnaire:

4	Undergraduate students in Computer Science
19	Graduate Students in e-Science: (3 Masters, 13 PhD, 3 did not specify)
8	Faculty Researchers in e-Science who research and teach
1	IT/ Computer Science Technologist that provides computing support
3	IT/ Computer Science Faculty/Researchers who research and teach in IS
3	MIS/Management Faculty/Researcher
1	IT/MIS/Management Student
1	Director of Education Learning Communities
1	MEMS researcher

The following represents some of the participants' responses:

B1-WHY DO YOU NEED TO COLLABORATE WITH OTHERS?

- To gain from the shared knowledge and expertise of the various professors.

- Nowadays no project alone will have success. This kind of projects (grid) needs all kinds of people to participate: computer science to make the infrastructure, and physics, astronomers, etc, who have the application skills. Problems are too complex to be solved by one person. Large-scale projects like these benefit from collaboration of scientists, practitioners and subject matter experts.

- There is a growing need for computer power in my research area. It will be useful to obtain tools and computation time in some place that provides these services.

- A HEP laboratory is nowadays formed by hundreds of physicists that have to collaborate in order to achieve their goals. It's impossible too run a HEP experiment alone due to the complexity of the field.

- To actually "do" modern HEP requires collaboration with widely distributed groups and institutions. The intent is to organize our tasks, ideas and responsibilities and eventually validate (and agree) on our scientific results.

- To coordinate research efforts to maximize productivity. To receive feedback on research to enhance quality before publication for example. To discuss priorities on the experiment and in the field.

- Division of labor as well as teaching each other new techniques.

B2-HOW DO YOU COLLABORATE?

- Person-to-person (CISE-PHYS) collaboration at UF, UltraLight workshops UF-Caltech), VRVS/Polycom (OSG, UltraLight).
- Help on the design and implementation of high performance network assembly and work on issues related to system administration of computing resources.
- Attend meetings and working groups in person or via ICT; phone, email, video-conferencing, Wiki pages.
- Mostly through research group meetings, either at the local university (weekly) or at a central location with the entire experiment (monthly).
- Sharing information, discussing options, exploring solutions: all via email, telecom, videoconferencing, and occasional face-to-face meetings.
- Developing curriculum, searching for funding, writing grants, providing services.
- We are working to interconnect two small clusters, one in Buenos Aires and the other in Mendoza. In the biological side, we are starting to work and simulate biological processes based on experimental data.

B3-WHO ARE YOUR COLLABORATORS?

- High Energy Physicists, astronomers, gravitational wave physicists, computer scientists, and networking technologists.
- Now I collaborate with CRIBBAB, U. NAC de Cuyo and U. Nac de La Plata, we have SOND and ALFA project with other Latin countries and Spain, Italy.
- I would like to collaborate with faculty/students doing research in cosmology or extragalactic astronomy other than the areas I've already worked in.
- HBCUs, HSIs,, TCUs, and Hawaii Islanders, also with educational community centers like the Joint Education Facility in Washington DC, also DoD.
- HEP physicists, astrophysicists, cosmologists, network engineers, grid scientists, computer scientists, those studying collaborative tools.

B4-WHERE ARE THEY LOCATED?

- In Sao Paulo - Brazil, in south region of USA, India and Mexico.
- Many US Universities, National labs, two universities in Brazil, in Korea. We also collaborate with people in Europe (CERN). Game department (CISE UF); different department (PHYS @ UF); different institute (Caltech, OSG).
- In Sao Paulo - Brazil, in south region of USA, India and Mexico.
- LSU, USA and Uruguay Institute of Physics, Universidad de la Republica.
- Tyom is in England, and the rest are in the Albert Einstein Institute in Germany.

B5-WHY ARE THESE COLLABORATIONS USEFUL?

- Doing all of the required work at a single location would require a substantial investment.
- First, economically developed countries could help Latin American countries; mostly, the exchange of ideas is what helps most.
- Collaboration is necessary to bring together multiple resources, ideas, skills, and access to instruments, funding and perhaps data.
- Knowledge and responsibility is shared.
- Due to the funding restrictions, today it's impossible to build computational hardware (clusters) that is fundamental in my research topic from scratch. These collaborations will allow the experimentation and creation of new problems with possible solutions within the scope of atomic physics.
- International collaboration is growing very fast because of all the facilities available. There is no experience of grid computing in Argentina.
- I could not support the cluster w/o help and resources of technicians, scientists & even secretaries (especially for ordering parts).
- Collaboration is essential to ensure growth for all. Collaborators focus on their areas of expertise and must be interdisciplinary.
- We are working hard to improve our network infrastructure and trying to lower the digital divide that prevents us from doing more intensive collaborations.
- These collaborations are useful because the amount of data available is so big that no single person or institution would be able to analyze in any reasonable amount of time.

- Collaborations are critical to doing E-science. In many cases, they allow significant progress to occur in methodology, understanding and discovery.

- There is currently a lack of information so common interests can be explored.

- These collaborations are useful because they help the definition of standards and the coordination of effort on an international level.

- There are more hands to help and different people bring different skills and viewpoints to the group.

- They help me leverage the existing expertise available to solve/help to solve problems that I am interested in.

B6-DESCRIBE ISSUES THAT YOU HAVE OR SEE AS POSSIBLY HAPPENING THAT MAY CAUSE PROBLEMS WITH E-SCIENCE COLLABORATIONS

- Cultural differences between disciplines. Time zones. Depending on people with whom one has no or slight relationship with.

- Restricting government policies on technology and/or data export/import; lack of budget. In Argentina the bigger problem is the lack of advanced network infrastructure for research and the lack of funds. VRVS/Polycom is good but meeting in person has its own flavor and that's where PASI will score.

- My primary responsibility of being a student means my time spent is limited, but without external support ($) the collaboration couldn't happen.

- Intellectual Property protection and new discoveries. Making sure people and institutions are at the same level when it comes to network connection. People talk of sharing resources yet when it really comes down to it, they don't want to share. The lack of vision of various administration and departments when it comes to emerging technologies and e-Science.

- The digital divide is our main problem. It is not possible for us to work on multilambda connections, for example. We showed at SC2004 that we can do interesting things (2 Gbps transmission between hemispheres), but unfortunately our resources are quite limited.

- Bad network connection, difficult to get financial support for the necessary resources.

- Certain collaborations that are both on my experiment and a competing experiment may have a skewed agenda. Tasks delegated to some are often performed in a way unlike others in the collaboration would like to see- sometimes the differences are productive, sometimes they are trivial and waste lots of time. Faster feedback from collaborators would be useful. Getting comments every few months on analyses can waste lots of time. Getting comments earlier can change the entire way the analysis is done.

- If we don't have an Internet connection it's impossible for us to access to mail, IM, connection to the cluster and so on.

- We can't afford some of the latest technologies, like Infiniband. We can use Ethernet, Gigabit Ethernet.

- People not responding or responding late; computer malfunction (technical); cultural misunderstandings thru language; developing trust among colleagues often takes time.

- The lack of funding and infrastructure.

C1-DESCRIBE ICT THAT YOU USE IN E-SCIENCE COLLABORATIONS

- Networking, conference phone calls, video conferencing, email, web pages (static, dynamic), instant messaging, web software for meetings, remote data archives, remote-job submissions.

- Micro-electrons and MEMS is being inherently used for many years now. Design, fabrication and testing are usually done in different places or countries.

- I use a database often that allows me to view pre-printed, peer-reviewed articles before publication. I don't subscribe to any journals and my university only carries a few.

- I will use tools concerning to digital libraries/databases for one hand and it would be necessary for the utilization of computation time for simulations of physical processes.

- Mostly email. I am informed of most of the needs of the cluster and scientists through email. Support from companies is also through email. However websites like the clusters Monalisa site is also very important for knowing what is going on.

- AcccessGrid: over 720 times last year. 967 node AMD opteron-based linux cluster science portals with Geoftrey Fox for Grid job submission as a web service.

- We have been working on a 3-phase project aiming at assembling an 80 dual-node cluster system at Sao Paulo city and joining this system to the Rio de Janeiro HEPGrid group. These joint resources will then be connected to US sites through a high-speed network channel.

- Internet, email, the web, video conferencing via internet. Our group is going to start using grid.

- Midrange; fiber networks, workstations, Internet (1), TCP/IP, Web, video conferencing via the Internet

C2-DESCRIBE FUNCTIONS AND USES OF ICT IN YOUR E-SCIENCE COLLABORATIONS. HOW AND WHY DO YOU USE ICT?

- Dynamic web pages to display existing resources, software packages. Wiki technology to allow multiple people to edit web pages. Create agendas, upload talks, and maintain meeting archives with talks, documents.

- Mostly used to keep track of the status of the project as a whole. Some ideas that can change the project's direction are handled by email.

- For meetings, Polycom or Web pages and coordinate documentation or source code

- Getting background research on topics of interest in designing research programs; I use email to communicate with those I have collaborated with. We also use a system to get data from the telescope operations computer to the UH Network Systems where it can be stored and used.

- The function of ICT in my research topic is of fundamental importance. The majority of my work is numerical and computational in essence, so if I will be able to do some collaboration with some center of High Performance Computer, my research work will grow considerably. Also I will increase my knowledge in scientific and computational tools.

- Cactus allows us to compile and simulate large amounts of data quickly. It also has some codes - such as for waves already written in its database. It’s a good way to share data.

- In large-scale simulation (in my case Electrochemical treatment of tumors) there is much use of HPC (High performance computing). On the other hand, cooperation for e-Science education needs Grids.

- Computing resources and storage facilities at Sao Paulo Analysis center are being used to help the D0 collaboration experiment from Fermilab. We also use audiovisual resources to improve the interaction with remote partners using videoconferencing hardware and software.

- Use Wiki to communicate with other collaborations, share data, etc. also videoconference with other collaborations around the world.

- Storage, processing data; communications (email and video conferencing); and in a smaller scale education also.

C3-WHAT SHORTCOMINGS OF ICT AND ITS FUNCTIONALITY THAT YOU WOULD LIKE IMPROVED?

- High tech ICT are costly. Low tech ICT are often more efficient.

- If you are talking about the grid infrastructure itself, in my view, standardization needs to be worked on (which I know is not easy due to the research phase I think the grid is in).

- I think there is little diffusion of new tools, at least in the scope of numerical tools. On the other hand I consider the question concerning Internet speed are essential to obtain correct intercommunication between the actors in this play (computers, humans, etc.).

- There is a slight learning curve when you first start using Cactus but that occurs within anything new you are exposed to.

- Easy install, transparent access to resources. Performance measurement.

- Cluster interfaces (Web) can be complicated and not fully integrated. Monitoring health of the cluster would be made easier with an all-encompassing cluster health service.

- Need full immersive environment (RAVE, RAVE II, Flex), or augmented environment to be able to better integrate with the Lambda Inititatives, and the work being done by Defanti, EVL, NCSA, and JSU, to see visualized, steered results.

- Currently working on details related to our networking infrastructure. This will result in an improvement of the collaboration between the US and our partners abroad. I'm also trying to stay in close contact with US network engineers, trying to bring up-to-date technology to our country. I think that multi lambda technology and its use of data grids is a key area and it's worth doing research on this subject.

Appendix E: Communities of Practice Lab

CoP Lunch Discussion Questions

Instructions

Talk about these in your group but write your answers individually this afternoon and turn in the paper at dinner tonight.

Prompt: What is e-Science?

- What does it mean conceptually?
- What does it mean methodologically?
- What does it mean functionally?

Prompt: What are the characteristics of e-Science?

- What are the dimensions (units of measure) of e-Science?
- What are the observable measurable variables that define e-Science?
- What is your experience with e-Science in your own discipline?

CoP Lunch Discussion Notes

This lab activity took place during lunchtime. Groups were selected according to the discipline individuals corresponded to (Physics, Astronomy, or Computer Science), and there were 10 individuals to a group, approximately. Below are statements generated from the discussion on e-Science.

Group 4

In order for e-Science to work, institutions should encourage support for the point-to-point (P2P) ongoing collaborations. Now, P2P is becoming more common in physics- we're starting to see more social networks popping up, probably because P2P connections occur naturally because of like interests. We should also plan ahead and see how can we facilitate P2P connections down the road. There is a scientific necessity to share, but the willingness to share the data is not part of the culture until the paper is published, probably because of intellectual property rights issues. (Example: Data mining = that data is mine, that data is mine!). We're acknowledging there is a boundary, but also that there is a value in sharing data.

E-Science is a tool rather than a science to itself. More specifically, how the practice of E-Science can take the form of a virtual lab. In previous days scientists had to go to the science instruments. Now, the instrument has sensors and e-Science brings the environment to the scientist. You can look at e-Science as using collaborative tools such as the Internet and Internet2—that's one point of view. Another point of view is that e-Science is analyzing data with computers. There can be several notions available that may provide an answer to the question of "What is e-Science?" I don't know if it is possible to define the term e-Science or if it's an open term. That's what we want to explore first rather than accept that e-Science has a particular definition. We want to know all the aspects of e-Science: experiments, environments, networking aspects, etc. Maybe e-Science is the result of collaboration and "doing" science with ICTs. Maybe e-Science is using computation and communications to accelerate discovery. Maybe you are only doing e-Science if you are doing experiments in a "digital world."

With data becoming more public, there is a feeling of property one is entitled to claim on new scientific discoveries. E-Science and Ownership is an entirely new topic. Many now are worried about who owns the data. For example, there are many examples of nationality (country) based science projects: a Quantum computing program at Johns Hopkins, a NSA funded project, requires you to be American born to work on this project!

Group 6

I think e-science is necessary for collaborative research. What we see here is an attempt to bring scientists together. All the elements are here, but what we are failing to do is think outside the box, outside our areas. We know we have 10 Gig pipes and we will have more by a certain time (NLR, FLR, etc), but the concern is that the community of researches is not working with the engineers and the computer scientists to establish bridges and use each other's resources to solve problems. We aren't breaking down the barriers and the physicist is not going to the computer scientist and saying, "I need your expertise to figure out how to fix my grid problem." Disappointed, we aren't trying to look at these issues and trying to solve them together, because we are in our own areas.

We have a committee set up from scientists of different disciplines working internally with grids for the university. People from different disciplines don't necessarily have a unified theory. Look at all the papers and you see that most authors are groups of authors. That's where collaboration comes to play, eg Human Genome Project. My SETI is working on protein folding. Here is harder because we don't all think outside our theories. There is no theory of everything so we can't all talk about it on general terms. You have to look at it more holistically. I think that's the key. E-science can be used on all our desktops.

E-science is about community software for people to help global collaboration. Computational intensive science, also type of science carried out by distributed network environments (talking about the definitions of e-science she got when she Googled). E-science is vital to exploring next generation research equipment. Concerned with promoting more effective science.

It's about access to the system. If it's easier about having a joint machine that's easier to have it in the US, it should be ok. The software tools and applications should operate with that environment. And I would rather the machine be far away and get a good service than having to maintain these machines and have them here. It's expensive! I think the important thing is that you don't have to know everything, but you can share what you do know. It really is about enabling.

Appendix F: Evaluation

PASI 2005 Evaluation Form

Name (Optional)__________________________ Institution_________________________

1. Have you attended PASI in the past? Y N If so, how many times? _______

2. What other conferences do you attend on a regular basis?

Circle the response that best fits your opinion:

3. PASI was a valuable professional development experience for me.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
4. The lectures offered valuable and up-to-date information.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5. PASI facilitated knowledge sharing among the participants.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
6. Quality of the technical content:	Excellent	Good	Neutral	Fair	Very Poor
7. Quality of the afternoon labs:	Excellent	Good	Neutral	Fair	Very Poor
8. Quality of the web site:	Excellent	Good	Neutral	Fair	Very Poor
9. PASI was well-organized and a pleasure to attend.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
10. Overall quality of PASI	Excellent	Good	Neutral	Fair	Very Poor

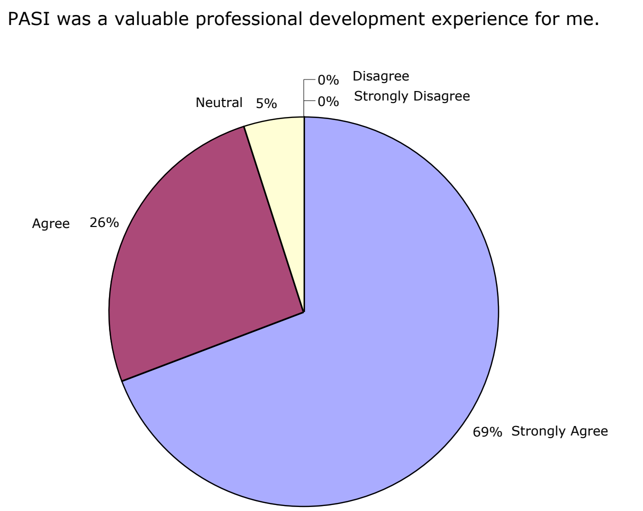
11. What did you like best about the PASI? Why?

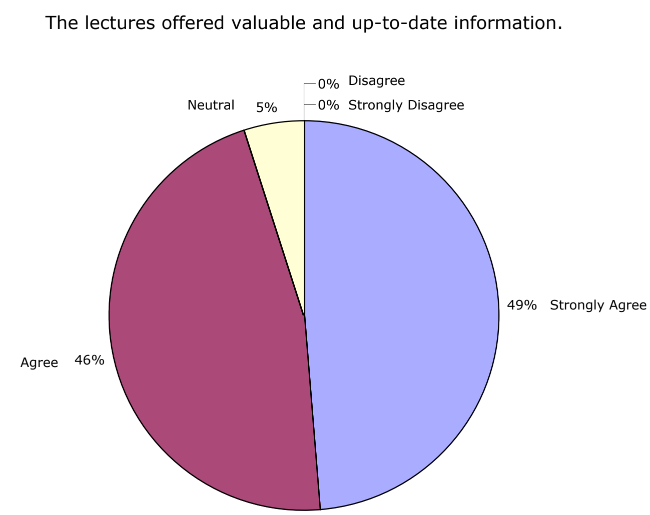
12. What did you enjoy least about the PASI? Why?

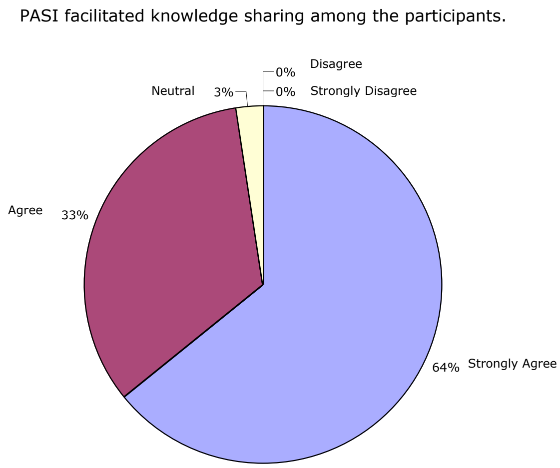
13. Additional Comments/Suggestions?

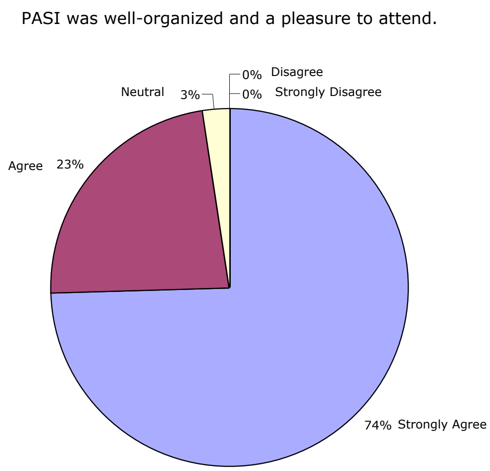
The evaluation form was provided to each of the participants. Below is a series of pie charts showing the responses for the second section of the evaluation form, 5 being the highest positive rating for each of the questions. A good or above rating (>4) was obtained for each of the questions regarding the instructors' performance.

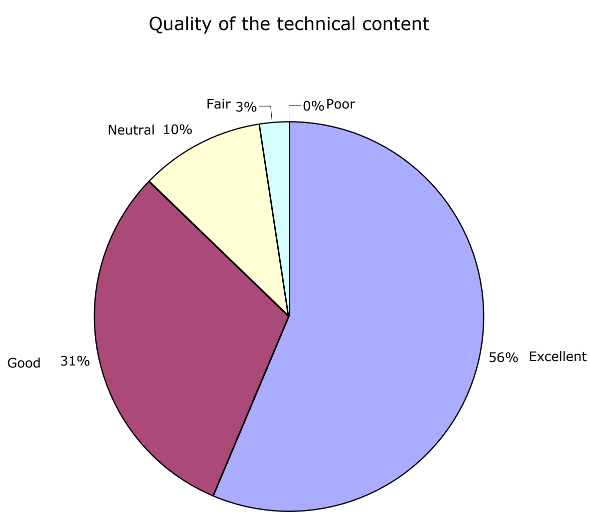
Quantitative Feedback from Evaluation Form



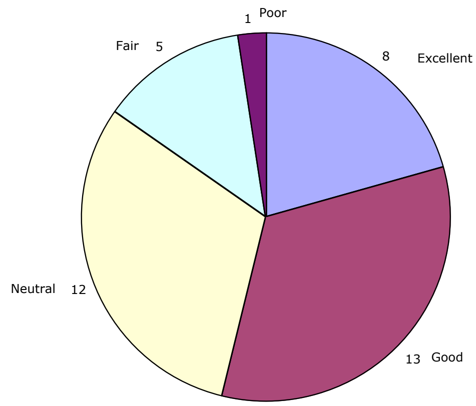



PASI facilitated knowledge sharing among the participants.
0% Disagree
Neutral 3%
0% Strongly Disagree
Agree 33%
64% Strongly Agree

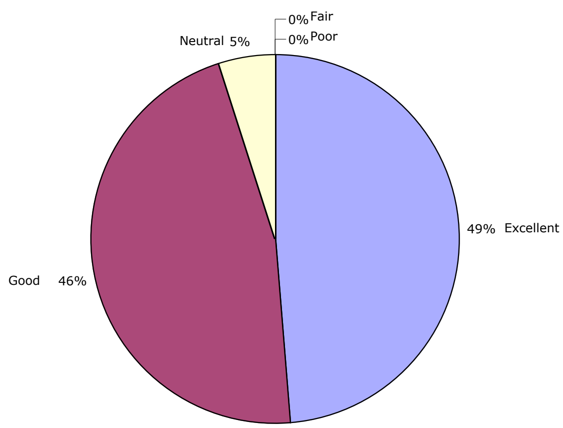

PASI was well-organized and a pleasure to attend.
0% Disagree
Neutral 3%
0% Strongly Disagree
Agree 23%
74% Strongly Agree


Quality of the technical content
Fair 3%
0% Poor
Neutral 10%
Good 31%
56% Excellent

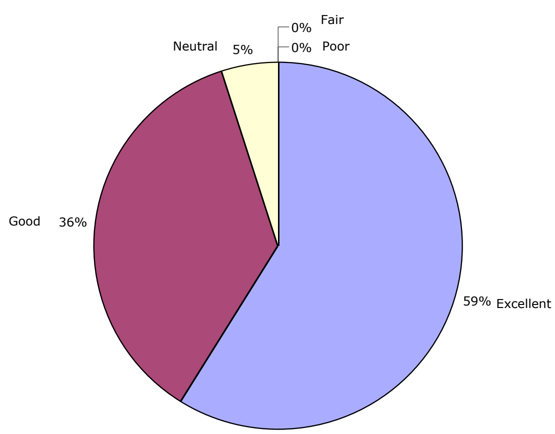
Quality of the afternoon labs



Quality of the web site



Overall quality of PASI



Testimonials and comments

US Participants

"I want to say how much I enjoyed my experience in Mendoza. Aside from the first-rate accommodations and food, the meeting presented a unique opportunity for me to make connections with astronomers and scientists outside of Brazil. I also was pleasantly surprised by the discussions I had with our social science colleagues, who bring trained insights on how collaborations are formed and sustained. It would be good to follow this up in some way (documentation would also be desirable) and make it more widely known, given the fact that there is great interest throughout the Americas in building science-related collaborations. FIU (CIARA + CHEPREO) can play a strong role here. I also hope it is possible to develop further collaboration relationships between North and South American scientists, similar to what we currently enjoy with our Brazilian colleagues in Sao Paulo and Rio. Making contact with the right people from the region is important, and again this is an area where our FIU friends can be a strong enabler."

Latin American Participants

Argentina has been the host to several PASIs. This one has been extremely beneficial for Argentina, because it brought together a diverse group of interdisciplinary researchers, students and practitioners. It exposed to us innovations in technology that are being applied in the physical sciences disciplines. The concepts of collaboration and community that were introduced in the context of e-Science, I think is very timely. It provides our students and faculty an understanding to participate in the collaborations and communities, even from a distance. We greatly appreciate our colleagues at FIU and the NSF for allowing us the opportunity to host the PASI in Mendoza.

Appendix G: Photo Album

Figure 1 Gemini Control Room

Figure 2 Top of the Gemini-South telescope

Figure 3 Exchanging Ideas

Figure 4 Focus group from Lab 2

Figure 5 Anibal Gatonne (Local Organizer) and Ibarra (PI)

Figure 6 Group in route to Gemini telescope

Figure 9 Students with faculty/lecturer

Figure 7 Walking to the next telescope

Figure 10 Together nn a group excursion

Figure 8 Lecture in progress