NATIONAL SCIENCE FOUNDATION

Division of Advanced Networking Infrastructure and Research

NSF 0123388 Award

FIU AMPATH Workshop to Identify Areas of Scientific Collaboration between the US and the AMPATH Service Area

August 15 – 17, 2001

AmericasPATH (AMPATH)

Computational Science and Engineering Applications

http://www.ampath.fiu.edu/APPLICATIONS/Appendix A.htm

All applications documented herein appear on the AMPATH web site; the vast majority relate to collaborative research among US scientists and colleagues at National Research potential or connected institutions in the AMPATH services area of South and Central America, Mexico and the Caribbean.

Document preparation by Heidi Alvarez, Melyssa Fratkin, Florida International University. AMPATH web page preparation by Heidi Alvarez, Florida International University.

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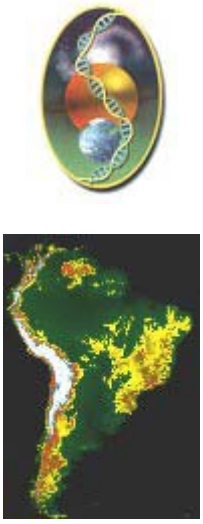
A. Biology



A Virtual Laboratory: NASA Astrobiology Institute, NASA Ames Research Center

The "Rapid Rates of Change" project has chosen South America as the analog of a cooling and drying biosphere, in order to simulate a planetary end-of-life scenario. The ecosystems that cover the continent today evolved over the last 10,000 years in response to gradients of physical factors such as radiation, temperature, precipitation, and wind. The combination of such gradients generated in turn a gradient in biodiversity. Moving from the equator to the southern end of the continent one finds ecological conditions that can be viewed as the steps in time that a complex, tropical biosphere may undergo as its planet is cooling and drying. This analog has yet another complicating factor, the "El Niño" Southern Oscillation (ENSO). This intensive, short-term global factor deeply affects ecosystems in four regions of South America and its effects alter, sometimes significantly, the long-term of life in the continent. A study of monthly data of vegetation in 30 sites (affected and non-affected by ENSO) in the 1982-1993 period revealed sharp changes in the spectral signature of vegetation from ENSO to non-ENSO years. These changes in the optical properties of vegetation may be due to differences in water content of the leaves, chlorophyll and accessory pigments concentration, photosynthesis activity, droughts, fires, floods, etc. In order to address as many problems as possible in this project, an extensive net of collaborators was established in Puerto Rico and South America. Scientists from Puerto Rico, Argentina, Brazil, and Ecuador exchange data and ideas with scientists from NASA Ames Research Center.

Data exchange would be facilitated by a faster way of communication such as Internet 2 within the service area of AMPATH. This would also facilitate the full establishment of a virtual laboratory where users can remotely control experiments with the suite of instruments available at our laboratory at NASA Ames Research Center. Reciprocally, Ames' scientists could remotely access field sites, collections and unique specimens held in South American museums and research institutes. The Virtual Laboratory would initially include: (1) a high resolution imaging micro-spectrophotometer; (2) a tri-spectroscopy interferometric micro-imaging sensor; (3) a light microscoppy imaging workstation; (4) a sensitive fluorescence genetic analysis facility; (5) a basic remote sensing analysis and GIS facility; (6) a suite of predictive tools; and (7) a high resolution spectroradiometer.

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The goals of the project are to develop theoretical models for parallel processing driven for high performance applications; propose theoretical models for distributed computing, including support for physical and logical mobilities; and develop tools for parallel and distributed computing in the areas of Visual Programming, Monitoring, Debugging, Code Static Analysis, Scheduling Support, etc.

Current Projects include:

- APSE - Superscalar Processor Architectures
- DECK - Distributed Execution and Communication Kernel
- DPC++ - Distributed Processing in C++
- EXEHDA – Execution Environment for High Distributed Applications
- HetNOS - Heterogeneous Network Operating System
- HoloParadigm – Multiparadigm Distributed Environment and Language
- ISAM – Mobile Application Support Infrastructure
- MultiCluster - Support for Parallel Programming on Multiple Clusters
- OPERA - Implicit Parallel/Distributed Programming Environments
- PADI - Parallel Debugger Interface
- SEGIME - Medical Image Segmentation
- SEMEAI - Teaching-Learning Environment using Internet

UFRGS is cooperating with the ACCESS grid, and is starting a node. They will be participating in Supercomputing 2001 in Denver, November 10-16, 2001. Other cooperative projects include the High Performance Constraint Logic Programming Systems (CNPq-NSF), High Performance Inductive Logic Programming for Biochemical applications

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New Mexico State University, United States
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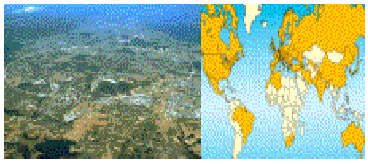
Bell Labs
Universidade Católica de Pelotas, Brazil

URL: http://www.inf.ufrgs.br/

B. Computer, Information Systems

B.1. Advanced Computational Infrastructure and Research



HEP Data Grids, the LHC and Global Networks

The Large Hadron Collider (LHC), expected to come on-line in 2006-, is a next generation particle collider representing the largest superconductor installation in the world. LHC will require real-time data filtering on a scale of petabytes per second to Gigabytes per second. Accumulated data of many Petabytes/Year (1 Exabyte by ~2012) demands a distributed compute and data-server environment. The GriPhyN project with principle investigators at University of Florida, Argonne National Laboratories, and California Institute of Technology / CERN, is addressing these computing challenges. The strategy includes setting up various tiers of data centers connected by advanced networking infrastructures throughout the world.

Currently 1800 physicists in 144 institutions in 31 countries are part of this process. The challenge involves the geographical disperson of people and resources, coupled with the complexity of the detector and the LHC environment and the scale of data, tens of Petabytes per year. These major challenges are associated with communication and collaboration at a distance,; Network-distributed computing and data resources; Remote software development and physics analysis; requiring research and development into new forms of Distributed Systems known as Data Grids

Networking requirements go beyond the simple requirement of adequate bandwidth. Physicists in DoE/DHEP's (and NSF/EPP's) major programs require an integrated set of local, regional, national and international networks able to interoperate seamlessly, without bottlenecks. Network and user software that will work together to provide high throughput and manage bandwidth effectively and A suite of videoconference and high-level tools for remote collaboration that will make data analysis from the US and from other remote sites effective.

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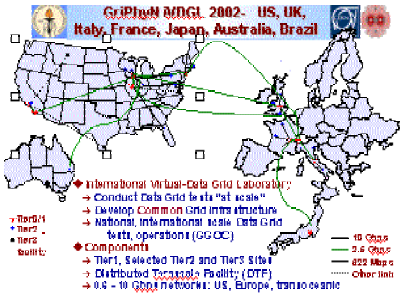
Collaborators:

WORLDWIDE COLLABORATIONS BASED AT CERN
URL: HTTP://L3WWW.CERN.CH/~NEWMAN/AMPATH82001.PPT



GriPhyN iVDGL 2002- US, UK, Italy, France, Japan, Australia, Brazil

The GriPhyN project is an International Virtual-Data Grid Laboratory being assembled to conduct Data Grid tests "at scale"; Develop Common Grid infrastructure; National, international scale Data Grid tests, operations (GGOC). Components include: Tier1, Selected Tier2 and Tier3 Sites ; Distributed Terascale Facility (DTF); and 0.6 - 10 Gbps networks: US, Europe, transoceanic network links.

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Collaborators:

http://www.griphyn.org/people.html

URL: http://www.griphyn.org/

Use Of Metadata In Cross Language Information Retrieval For Multinational Counterdrug Agencies

This is a multinational forum to enhance policy development and operational coordination in the counter-narcotics domain. The program is hosted by the United States Southern Command and the Organization of American States' InterAmerican Drug Abuse Control Commission (OAS/CICAD). Multinational agencies participate in operations such as air and maritime interdiction. Policy formation is carried out by national anti-drug councils and foreign ministries. US agencies involved in the project include JIATF-E, Coast Guard, Customs, DEA, and the Department of State. Participating nations are: Argentina, Bolivia, Brazil, Colombia, Ecuador, Guatemala, Mexico, Panama, Paraguay, Peru, Trinidad & Tobago, United States, Venezuela. Observer countries are: Belize, Chile, Dominican Republic and Uruguay.

The purpose of the UCD is to allow multinational agencies, regardless of their language, to exchange information by searching multilingual databases. A major challenge is the slow Internet access in most Latin American countries. Access to large databases using a phone is slow, making a system ineffective. The research goal is to develop methods for multinational agencies in a domain specific area to effectively exchange information in a timely manner regardless of language.

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Participating Nations:

Argentina
Bolivia
Brazil
Colombia
Ecuador
Guatemala
Mexico
Panama
Paraguay
Peru
Trinidad & Tobago
United States
Venezuela
Belize (observer)
Chile (observer)
Dominican Republic (observer)
Uruguay (observer)

TerraFly: NASA Regional Applications Center

The NASA Regional Applications Center (RAC) at FIU was designed to facilitate the distribution of remote sensed data to public/private organizations; provide & develop algorithms for image analysis; develop software to assist in large imagery handling; and match the public's needs for remote sensed data and applications.

The flagship application of the RAC is Terrafly. This program coordinates maps and navigational data inputs with laser altimetry data, GNIS data and vector data to produce up-to-the-minute mapping of user-directed "flights" over the Earth.

HPDRC and FIU NASA RAC have entered into a Cooperative Research and Development Agreement (CRADA) with the United States Geological Survey, to provide users with on-line access to USGS data. The CRADA project will use new technologies and standards to make both archived and newly acquired data far more accessible to the public. Under CRADA, FIU will add aerial photography, Landsat 7 images, and other types of USGS data to the TerraFly Web site. These additions could make TerraFly one of the largest collections of publicly available data on the Web.

Terrafly will provide users with multiple options while viewing aerial maps of US Cities:

- Smooth Flight Over Spatial Data – the data is mosaicked during pre-processing, to provide an even image,
- Multiple Data Type Support – including IKONOS, Landsat, US Census, aerial photography, etc.
- Multiple Windows – the user will be able to view the image in a variety of formats.
- Geolocation ID – Updates the geographical coordinates of the image as you "fly" over; provides a "Go-To Coordinate" feature, as well as the ability to choose among 5 "point-of-interest" locations for the displayed coordinates.
- Compass Control Tool – allows the user to control flight speed, direction and refresh rate with the click of the mouse.
- Spectral Band Control – Provides the user with the capability to create false-color images on-the-fly by combining spectral bands, either in commonly used or custom combinations.
- Go-To Place – allows the user to go to a specific place of interest by name.
- Place Identifier – Finds the closest place of interest and populated place; Finds the exact coordinates of any point in the image, even during flight.
- Street Address Lookup – finds the coordinates and goes to a specific street address.
- Zoom In/Zoom Out
- Data Delivery Capabilities – allows the user to receive data in their choice of format on any area they select using the GUI.
- Information Overlay – features can be highlighted, with data or icons overlaid from different sources, such as airports and hotels.

Image Processing Filters – can be used to enhance any image.

A new GUI has been developed for Terrafly, making the user experience as simple and manageable as possible. Complete US coverage will be available within a year, with global landmass to follow.

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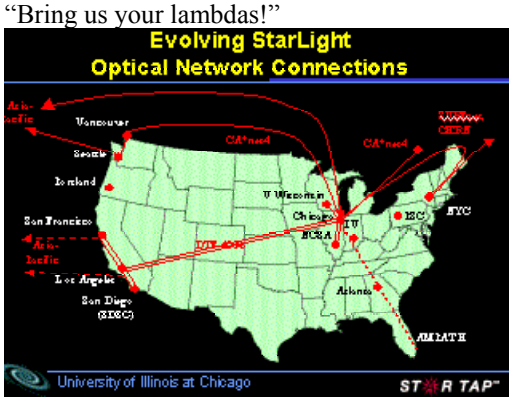
Collaborators:

US Geological Survey
NASA
National Science Foundation
IBM

URL: http://TerraFly.fiu.edu

B.2. Advanced Networking Infrastructure and Research

"Bring us your lambdas!"



STARLIGHT, the Optical STAR TAP; The Future of STAR TAP: Enabling e-Science Research

StarLight is an advanced optical infrastructure and proving ground for network services optimized for high-performance applications.
StarLight is *a large research-friendly co-location facility* with space, power and fiber that is being made available to university and national/international network collaborators as a point of presence in Chicago. StarLight is *a 1GigE and 10GigE switch/router facility* for high-performance access to participating networks Fiber/Equipment at StarLight (2001

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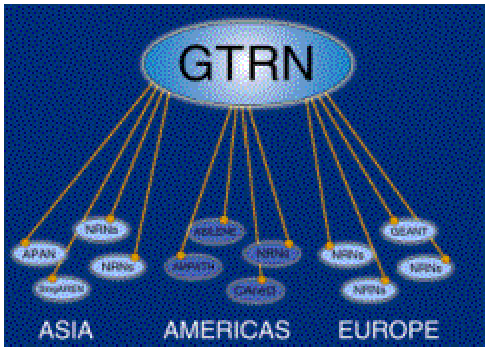
StarLight is being developed by the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago (UIC), the International Center for Advanced Internet Research (iCAIR) at Northwestern University, and the Mathematics and Computer Science Division at Argonne National Laboratory, in partnership with CANARIE and SURFnet.

URL:
http://www.startap.net/starlight/
http://www.startap.net
http://www.evl.uic.edu/movie.html
http://www.icair.org/
http://www-fp.mcs.anl.gov/division/welcome/default.asp
http://www.canarie.ca/
http://www.surfnet.nl/



Global Terabit Research Network; A Vision for 21st Century Network-Enabled Science and Research

The vision is for this global infrastructure and data to be integrated into "Grids" – seamless global collaborative environments tailored to the specific needs of individual scientific communities

High performance networks are fundamental to integrating Global Grids together. There are, very broadly speaking, three components to Global Grids: Campus Networks (the last kilometer), National and Regional Research and Education Networks (NRRENs), and Global connections between NRRENs.

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Internet2: Accelerating the Growth of Tomorrow's Internet – An International View

Internet2 enables new applications development and use by providing an advanced networking environment and technology transfer. University-led with 0180+ university members and partnership with industry, government and other countries.

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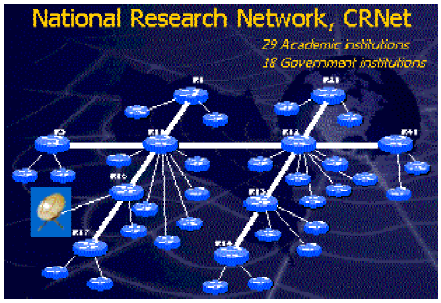
AMPATH provides an important contribution to the rest of Internet2 membership. The AMPATH project joins STAR TAP, TransPAC, EuroLink, MIRnet, CALREN2, PNWGP in facilitating international connectivity for the Internet2 community; Internet2 partners in South/Central America and the Caribbean such as Argentina, Brazil, Chile, Mexico, Panama, (Colombia, Costa Rica) and to other advanced research and education networks in other countries

URL: http://www.internet2.edu



Large Scale Implementation Of An Advanced Network Infrastructure In Costa Rica

The Costa Rican National Research Network, CRNet, interconnects major academic and research institutions, allowing ample access to global information and computer resources This project gives access to all Costa Ricans and provides long-range availability of content, information and services from government sites as well as other institutions. The backbone and architecture of CRNet make it one of the best networks in Latin America.

The Advanced Internet Initiative was structured to provide all Costa Ricans, even those in rural areas, access to an IP-based high bandwidth telecommunications infrastructure.

CRNet provides high capacity bandwidth with dedicated connectivity to the end user at low cost. The network is secure and reliable, while maintaining its scalability and flexibility. The new Internet initiative is also compatible with existing platforms. In addition, the network architecture is designed to migrate towards future technologies.

CRNet has received important contributions from the OAS and the National Science Foundation of the United States (NSF) to cover the high costs of communication. CRNet forms part of the National System of Science and Technology. The Advanced Internet Initiative is expected to vault Costa Rica to third place among nations worldwide in terms of broadband connections per hundred residents.

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C. Engineering

Acquisition and Analysis of Signals – PAAS-UN

This project of the Universidad Nacional de Colombia measures lightning parameters in Tropical Zone by means of a Lightning Location System with eleven sensors and a research station. The main goal of the project is to design and build a station for the measurement of direct lightning strikes in Colombia in order to obtain information about lightning parameters in tropical zone. This data can be used to define new criteria of systems and electrical equipment design. Additionally, the project results can provide information to design adequate protection for buildings and structures against lightning strikes.

The direct lightning characterization in Colombia will allows, in a short term, design and construct an adequate and optimum transformer for tropical zone that will be standardized and installed in every zone of the country with a high electrical atmospheric activity.

The information will be used as a well to enhance the knowledge of electrical utilities, in order to improve the Power Quality of the Colombian system and revolutionize the competition and increase productivity in the industry.

Results from the eleven sensors, located across Chile, are plotted on a graph resembling a topographical map, which indicates the highest electrical charge point of the lightning strike.

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Prof. Dr. Silverio Visacro. Federal University of Minas Gerais, Brazil.
Dr. Carlos Romualdo Torres, Institute of Electrical Research (IIE), Cuernavaca, Mexico.
Dr. Miguel Castro, Center of Research and Electrical Test (CIPEL), Cuba
Prof. Dra. Maria Teresa Correia – University of Lisbon, Portugal
Prof. Dr. Carlo Alberto Nucci – University of Bologna, Italy
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URL: http://www.paas.unal.edu.co

D. Environmental Research and Education

The Andean Amazon Rivers Analysis and Management (AARAM) Project

The objectives of the AARAM project are to develop a quantitative understanding of the dynamics of Andean Amazon river systems as a function of land-use and climate variability; educate researchers and the public in the connections between human actions and water quality and abundance; and collaborate with local communities in the formulation of water management programs.

Scientific activities include: determine the current spatial distribution of land use and land cover (vegetation, soils, geomorphology, etc.) in the region; quantify the temporal fluxes of water, sediments, and solutes at points representative of the spatial variability of land use and land cover; determine the processes (natural and anthropogenic) which control the spatio-temporal variation in these fluxes; and translate project findings into quantitative models which can be used for the effective management of land, water, and human resources of the region (considering changes in climate and land use).

The Modeling Application uses the Soil-Water Integrated Model (SWIM) – PIK. imulates the hydrological cycle, erosion, vegetation growth and nutrient transport. Input data include elevation (DEM), land use, soil parameters, and climate parametersThe educational application involves distance learning of Biogeochemistry / Remote Sensing. Nine local high schools in Peru participate in the project via the GLOBE program.

Networking requirements for AARAM involve Florida International University's connectivity to both the Internet2 Abilene network and the AMPATH network. Other institutions in South America connect as follows:

- Escuela Politecnica Nacional (2.5Mbps)ISP Cyberweb - TeliaUniversidad de los Andes (2.5Mbps)Teleglobe
- Universidad Nacional Agraria La Molina (no connection information available)
- Universidad Mayor de San Andres (no connection information available)

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Jose Efrain Ruíz – Universidad de los Andes, Bogota

Collaborators:

Additional Participating InstitutionsUniversity of Washington, Seattle
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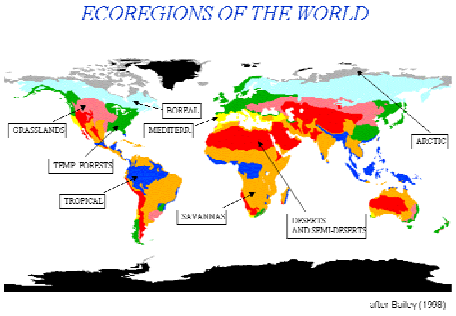
Potsdam Institute for Climate Impact Research, Germany
Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM), Bogotá
Instituto Nacional de Meteorología y Hidrología (INAMHI), Quito
Servicio Nacional de Meteorología y Hidrología (SENAMHI), Lima

Servicio Nacional de Meteorología y Hidrología (SENAMHI), La Paz
Centro de Agua del Trópico Humido para América Latina y el Caribe
Consorcio para el Desarrollo Sostenible de Ucayali (CODESU), Lima
Instituto del Bien Comun, Lima
Pro Naturaleza, Lima
Proterra, Lima

URL: http://www.amazonrivers.org/aaram/



Collaborative Research Network (CRN) Inter-American Institute for Global Change Research

The Role of Biodiversity and Climate in the Functioning of Ecosystems

Participants from six countries – Argentina, Chile, Mexico, United States, Uruguay, Venezuela

The impact of global change on the relationship between biodiversity and ecosystem functioning is at the heart of many of the most pressing environmental problems that are currently facing the globe. The Americas, with its broad variance in climate, natural biodiversity, and land use, and the striking climatic similarities between the North and the South, offer an extraordinary opportunity to address the relationships between climate, biodiversity, ecosystem functioning and global change. It is a unique setting with similar gradients of precipitation and temperature in the North and the South but contrasting biotic conditions determined by the different evolutionary history and the current pattern of human utilization.

The scientific objectives are to understand the individual and interacting effects of biodiversity and climate on the functioning of ecosystems and their response to disturbances. Our analysis will consist of two simultaneous approaches. One will be an analysis of existing data sets on biodiversity, climate and ecosystem processes in the Americas. Through this effort, we will identify and establish biodiversity gradients on both continents. A subset of these sites in South America will be used for a manipulative experiment on biodiversity and nitrogen cycling, while greenhouse manipulation will be conducted to explore these effects in a controlled environment. Finally, simulation modeling will complement experiments and add in the interpretation of results. Moreover, we intend to develop a research network involving six countries and a number of scientists encompassing a wide variety of research interests and expertise. Finally, we will generate information and train young scientists to contribute to the development of policy in issues such as biological conservation, land management, and sustainability.

Networking goals include: Latin American consortia of libraries, Access to large databases and synthesis information; Interchange of students from various institutions; Closure of the digital divide.

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Amy Austin, Universidad de Buenos Aires, Argentina
Zdravko Baruch, Universidad Simón Bolívar
Rodolfo Dirzo, Universidad Nacional Autónoma de México
Douglas Frank, Syracuse University, USA
Robert Jackson, Duke University, USA
Martín Oesterheld, Universidad de Buenos Aires, Argentina
José Paruelo, Universidad de Buenos Aires, Argentina

URL: http://www.ifeva.edu.ar/crn/ http://www.iai.int

Inter-American Institute for Global Change Research Data and Information Service

The IAI-DIS is a collaborative database system through which scientific organizations in the Americas can contribute and share information about their Global Change data holdings. It was designed as a network of national nodes, interconnected by the Internet, offiering anyone with a Web browser, free distributed search capability at both directory and inventory levels. Participating organizations in each country can remotely submit and update metadata about their assets, also at no charge.

The DIS is coordinated by the IAI as a tool to foster and support international scientific cooperation and joint research efforts in the area of Global Change. The IAI-DIS was installed at the IAI Directorate in Brazil and began providing service in November, 1999. The objective is to create a distributed system composed of one Coordinator Node, 18 National Nodes, and Participating Organizations associated with each National Node.

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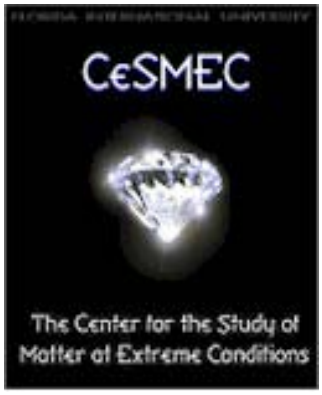
Collaborators:

18 Counties in the western hemisphere participate in the IAI.

URL:
http://disbr1.dir.iai.int
http://www.oas.org/juridico/english/Treaties/c-19.html

E. Geosciences



FIU CeSMEC: High-Pressure Physics For The Study Of Matter Under Extreme Conditions

The Center for the Study of Matter At Extreme Conditions, led by Dr. Surendra Saxena**,** hopes AMPATH will let scientific researchers work on the same research problem by operating instruments remotely. It will also allow these scientists to train students in techniques, data process and analysis of experimental results from any where in the world.

The Virtual International Laboratory involves distributed sites in Montreal, Canada, Argonne National Laboratories in Illinois, Brookhaven, New York, Cornell University, Washington D.C., Arizona and Bariloche, Argentina. Virtual instrument sharing using a high performance network, such as Internet2 and AMPATH enable this vision. The future goal is to build a Spallation Neutron Source to advance the frontiers of science and technology with backing from the US Department of Energy and other sources. The advantage of this development are highly sophisticated and unique facilities available to researchers and students world-wide.

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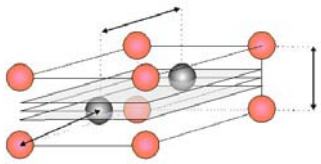
URL: http://cesmec.fiu.edu/



Thermodynamics, Phase Stability and Transformations in Complex Material Systems: A Long-Term Project Involving Research and Education

The general problem is to establish the effects of changing the main thermodynamic variables Temperature (T), Pressure (P) and Composition (X) upon the Structure, properties and the Transformations taking place in Material Systems. Characteristics and scope of the studies are derived from elements to multi-component systems. The main research subjects are thermodynamics of equilibrium and transformations. Representative systems are high-melting elements of the transition series, multi-component alloys with magnetic effects, alloys, high-melting carbides and other inorganic systems.

Contacts:

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Physics Department, University of La Plata.
Faculty of Engineering, University of Comahue, Neuquen.
Solid State Physics Group, INTEC, Santa Fe.

Collaborators in the US and Europe:
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Materials Science Department, The Royal Institute of Technology, Stockholm, Sweden.
Materials Theory group, Department of Theoretical Physics, The Royal Institute of Technology, Stockholm, Sweden.
Institute Laue-Langevin, Grenoble, France.

Activities Stimulating International Collaboration:
The annual CALPHAD meeting on Phase Diaram Calculations.
The Ringberg Workshops on various aspects of thermodynamics of alloys organized by the Max Planck Institut fur Matallforschung, Schloss Rinberg, Germany (1995, 1996, 1997, 1999)

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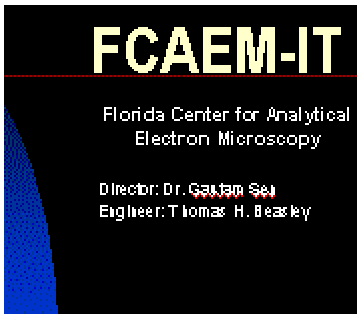

Florida Center for Analytical Electron Microscopy

The Florida Center for Analytical Electron Microscopy, FCAEM, is an I2 center located at Florida International University. The primary purpose of the center is to provide instrumentation capable of performing structural and chemical analysis of samples that are either organic or inorganic. Of primary importance is the capability of the center to provide this service to remote locations via the internet.
FCAEM has two brand new instruments produced be JEOL, a JSM 5900 SEM and a JXA 8900R EPMA and both configured for internet remote control using an X-server software. The Center is currently operating one instrument on the internet using reflection-X, produced by WRQ.
The 8900R will be operated from University of South Florida to perform high accuracy quantitative analysis by sending their samples to us and schedule probe time. This process could be accomplished from anywhere in the world and where I2 connections are established, high speed connections will provide high speed data streaming in real time application. For locations that are not able to provide large ticket instrumentation such as EPMA, the Center will provide an invaluable service to the scientist, making it possible to utilize analytical instrumentation without ever leaving the office. It will be up to the scientist, however to acquire the computer software necessary to operate the system remotely.

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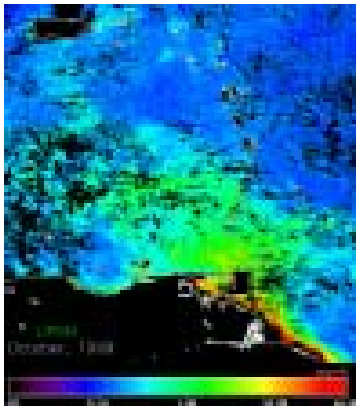

Remote Sensing Research and Digital Archives at the University of Puerto Rico

NASA's Tropical Center for Earth and Space Studies (TCESS) is located at the University of Puerto Rico. The Space Information Laboratory (SIL) component TCESS is an effort to provide images as well as raw data from several orbiting satellites to the scientific community.

UPRM operates a Synthetic Aperture Radar (SAR) and HRPT tracking stations. These are national facilities, open by invitation to other NASA and US universities' researchers. SIL is a training center for scientists and engineers in a bilingual environment. This Laboratory has great prospects for research into the problems of the tropical circum-Caribbean.

The Center collects data from oceanographic research, such as ocean fertilization studies. In addition, data has been collected from the study of coastal upwelling in Venezuelan Waters, South American river intrusions in the Eastern Caribbean, and the effects of Sahara dust aerosols in the tropical Western Atlantic. The data and images collected require intensive processing and massive storage space, as well as high bandwidth for data transfers.

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F. Math, Physical Sciences

F1. Astronomy

Gemini Observatory Connectivity to Facilities and Partners in South America

The Gemini Observatory has two 8m Optical/IR telescopes, one in Cerro Pachón, in Chile (at 9,000 ft), and another at Mauna Kea, Hawai'i (at 13,700 ft). The two centers are approximately seven thousand miles apart. Each center also has a control room at sea level. The Observatories are connected to a data center in Victoria, British Columbia, Canada.

Gemini partners with seven nations, to maintain the cost-effectiveness of their research activities. (The major expense of the observatories is the equipment: each telescope costs $92million, while the mirrors cost $15million each). The United States is the major funding source, providing over fifty percent of the grant for the observatories through the National Science Foundation. The other member nations are the United Kingdom, Canada, Australia, Chile, Argentina and Brazil.

The observatories are tasked with tracking scientific activity in deep space, including black holes in galactic cores, stellar nurseries, the evolution of planetary systems, visualizing planets around other stars, and the formation and evolution of galaxies and elements.

The Hawaii observatory is already connected to Abilene. The Chilean observatory connects via microwaves to its base station, but the base facility is not yet connected to Abilene – they hope to do so through the international POP in Santiago, which will connect them to AMPATH.

Internet Applications used in managing the Gemini observatories:

- Videoconferencing (H.323), Tele-collaboration, etc.
- Remote Execution of Observing, from Sea Level or Partner Site
- Remote Specification of Observing Sequences
- Data Delivery to Scientists and Archives
- Remote Analysis of Data, Grid Processing
- Network-based Education and Outreach

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Collaborators:

UK Gemini Support Group
Canada Gemini Office
CONICYT - Oficina Chilena del Proyecto Gemini
Australian Gemini Office
Comité Gemini Argentino
Laboratório Nacional de Astrofísica, Brazil
URL: http://www.gemini.edu/

Arecibo Observatory & Internet Connectivity

The Arecibo Observatory is a 300meter (diameter) fixed spherical reflecting dish pointing straight up. The dish is located close to Arecibo, Puerto Rico. Movable receivers suspended above the dish can track celestial objects within 20 degrees of zenith. Unfortunately, this means that any celestial object can be observed for no more than 2.8 hours per day.

The Observatory operates in both "passive" mode (reception only) and "active" mode (transmission & reception, i.e. radar). In passive mode, the dish allows researchers to study radio emission from the solar system, the Milky Way galaxy, and external galaxies. In active mode, the dish allows for the study of Earth's ionosphere, planets, their satellites, and nearby asteroids.

Current projects at the observatory include passive reception of radio-frequency radiation from interstellar clouds in our galaxy, and estimation of magnetic field strengths in these clouds via Zeeman effect. Magnetic fields may influence star formation if they are strong enough. This project requires very high sensitivity, i.e., hundreds of hours of telescope time spread over many months for observation. Currently, the project has used about 700 hours of observatory time, with several hundred hours still to be allocated. The data analysis is only partially complete.

An advanced network provides researchers with the ability to complete real-time observing from a remote location, especially when the project requires weeks or months of data collection. Observers also benefit from the use of the Virtual Control Room, which exports displays of telescope parameters to the remote user and allows remote pointing of telescope. For the successful administration of these remote activities, the network connection must be very reliable

In addition, data from the Arecibo observatory is often exported to a remote computer for off-line data analysis, or data sets on Arecibo computers are analyzed from a remote location. The network must function at high capacity in order to export large data sets efficiently and/or export graphics displays from Arecibo computers

Arecibo will connect to the Puerto Rican Internet2 Services Association (PRISAnet) for Internet2 and AMPATH access, as well as to the University of Puerto Rico campuses. Physical Internet2 connectivity could be established at Arecibo as early as October, 2001.

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Atacama Large Millimeter Array (ALMA) Computing & Network Requirements

ALMA is a $700 million international collaboration to build and operate a millimeter wavelength telescope comprised of sixty-four antennas located in the Chajnantor region of the Chilean Andes. The telescope will be operated cooperatively by the United States, Europe, Japan and Chile. The antennas will be built at an altitude of 16,400 feet above sea level.

The Array is an imaging instrument in all atmospheric windows between 0.35 mm and 10 mm in wavelength. ALMA's spatial resolution is ten times better than the Very Large Array in New Mexico and the Hubble Space Telescope. ALMA is the largest and most sensitive instrument in the world at millimeter and sub-millimeter wavelengths.

With the AMPATH connection, researchers will not have to travel to Chile to collect and analyze the data from ALMA. The array will run observing scripts issued by electronic proposals, with near real-time data transfer, real-time data access and remote data processing. Internet telescope access will provide visualization, imaging and analysis tools, as well as collaboration tools for researchers and distributed data archives. The National Virtual Observatory (NVO) will maintain a final image library.

When completed, ALMA will be world's leading radio telescope system. Network operations for observing and data transfer will be essential for its success.

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Collaborators:

Caltech Submillimeter Observatory
Center for Astrophysics Research in Antarctica
Cerro Tololo Interamerican Observatory, Chile
Cornell Atacama Observatory
Harvard-Smithsonian Center for Astrophysics
Herzberg Institute for Astrophysics, Canada
James Clerk Maxwell Telescope, Hawaii
Royal Observatory Edinburgh, Scotland

URL: http://www.alma.nrao.edu/

F2. Chemistry

Modeling 13C and 15N Chemical Shifts in Crystalline Systems

The University of Utah performs research projects in the area of Quantum Chemistry, using NMR Spectrometers. Among these projects is the chemical shift modeling project, partially funded by the National Science Foundation. The Center for High Performance Computing at the University of Utah is collaborating on this project with the Physics department at the Department of Natural and Exact Sciences (FCEyN), University of Buenos Aires, Argentina.

Chemical shifts are the "shift" of the NMR signal due to the molecular and crystalline environment. These shifts have a tensorial quantity, i.e. the shift depends on the orientation of the molecule in the magnetic field. Chemical shift calculations are important because they are highly dependent of molecular and crystalline structure. Chemical shifts calculations provide the link between "structure" and "measurements."

The collaboration between Utah and Buenos Aires is intended to leverage expertise and resources available in both locations; develop robust techniques to include intermolecular effects in the calculations; and apply these techniques to solving structural problems in biologically active compounds from marine invertebrates from the South Atlantic.

The collaboration and sharing of data requires connectivity from FCEyN to CHPC, remote access to systems (using Windows), file transfers and distributed processing.

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F3. Physics

HEP Data Grids, the LHC and Global Networks

A next-generation particle collider the largest superconductor installation in the world. A bunch-bunch collision every 25 nanoseconds: each generating ~20 interactions. Only one in a trillion may lead to a major physics discovery.

Real-time data filtering:

Petabytes per second to Gigabytes per second
Accumulated data of many Petabytes/Year (1 Exabyte by ~2012)
Large data samples explored and analyzed by thousands of geographically dispersed scientists, in hundreds of teams

Geographical dispersion: of people and resources
Complexity: the detector and the LHC environment
Scale: Tens of Petabytes per year of data
Major challenges associated with:
Communication and collaboration at a distance
Network-distributed computing and data resources
Remote software development and physics analysisR&D: New Forms of Distributed Systems: Data Grids

1800 Physicists
144 Institutes
31 Countries

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G. Other

Infrastructure Enabling Potential Areas of Collaboration Between the International Space Station and the Americas

In order to conduct space-based payload operations, a research institution must be able to receive and process telemetry; talk with the ground cadre and ISS on-board crew; receive video of on board activities and science projects; command the payload/experiment activities; and conduct payload planning and training activities with cadre and crew.

In prior years, any payload operations being carried out on the Space Station could only be monitored from Marshall Space Flight Center (MSFC) in Huntsville, Alabama. Now, data can be transmitted over STAR TAP, Abilene*, AMPATH, and other research and education networks, which allows the researcher to remain at home. The MSFC/Payload Operations Integration Center (POIC) provides the capabilities needed to conduct payload operations at the researcher's home facilities, including processing telemetry, voice and video link to the Space Station, commanding activities and operations planning.

NASA has developed a system called TreK, the Telescience Resource Kit, which enables telemetry and payload commanding activities. They have also developed the Internet Voice Distribution System (IVoDS), which transmits mission voice activity to the ground-based researcher. Using these tools, as well as Abilene, AMPATH and STAR TAP, scientists can collaborate (using existing connectivity) in development, operation and/or the science of experiments flying on the International Space Station from virtually anywhere in the world.

*Abilene cannot be used to access a NASA network from another network

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and http://spaceflight.nasa.gov/station/index.html