



Physics without Boundaries

Chris Quigg

Physics for Everyone

April 22, 2003

CQ Lectures & Seminars Abroad

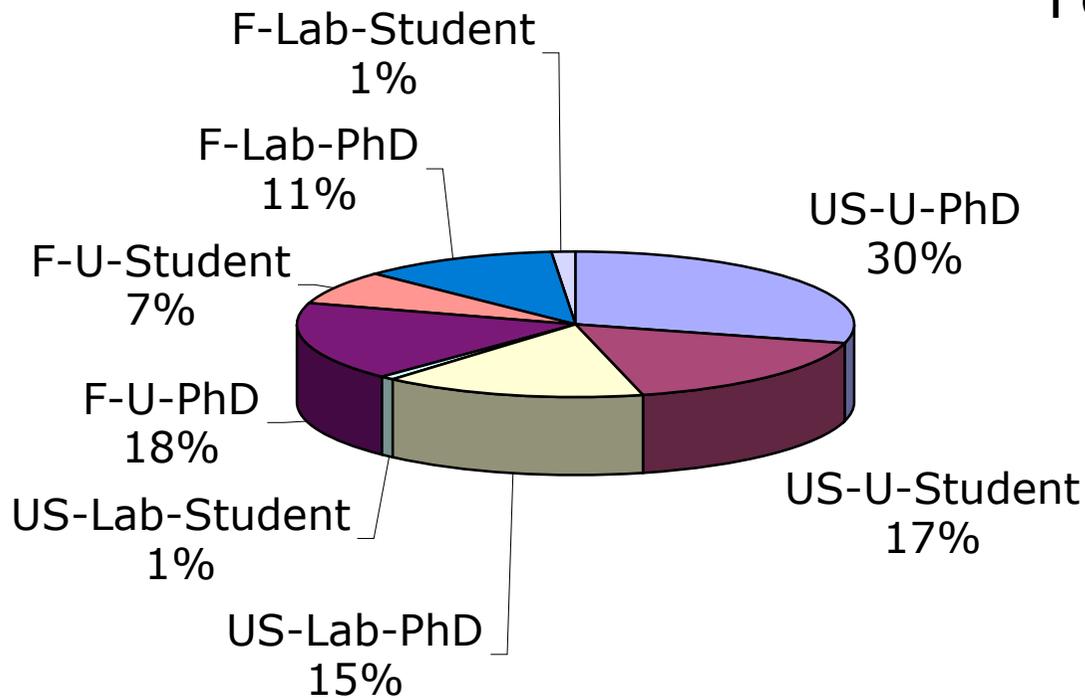
Russia		China		Yugoslavia	
France		Virgin Islands		Israel	
United Kingdom		Italy		Brazil	
Switzerland		Netherlands		Viet Nam	
Canada		Germany		Norway	
Poland		South Africa		Spain	
Belarus		Croatia		Ireland	
Singapore		India		Turkey	
Japan		Austria		Greece	
Korea		Australia		Mexico	



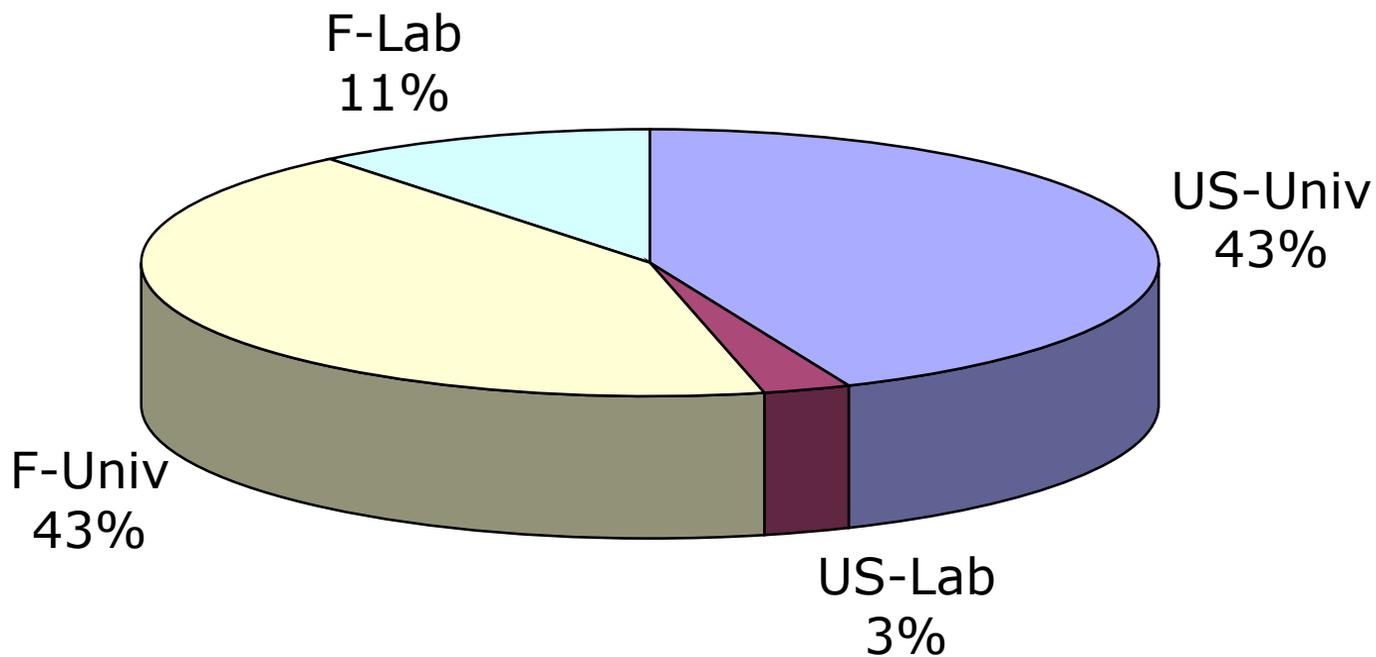
From a “Truly National Laboratory” ...

... to an international center

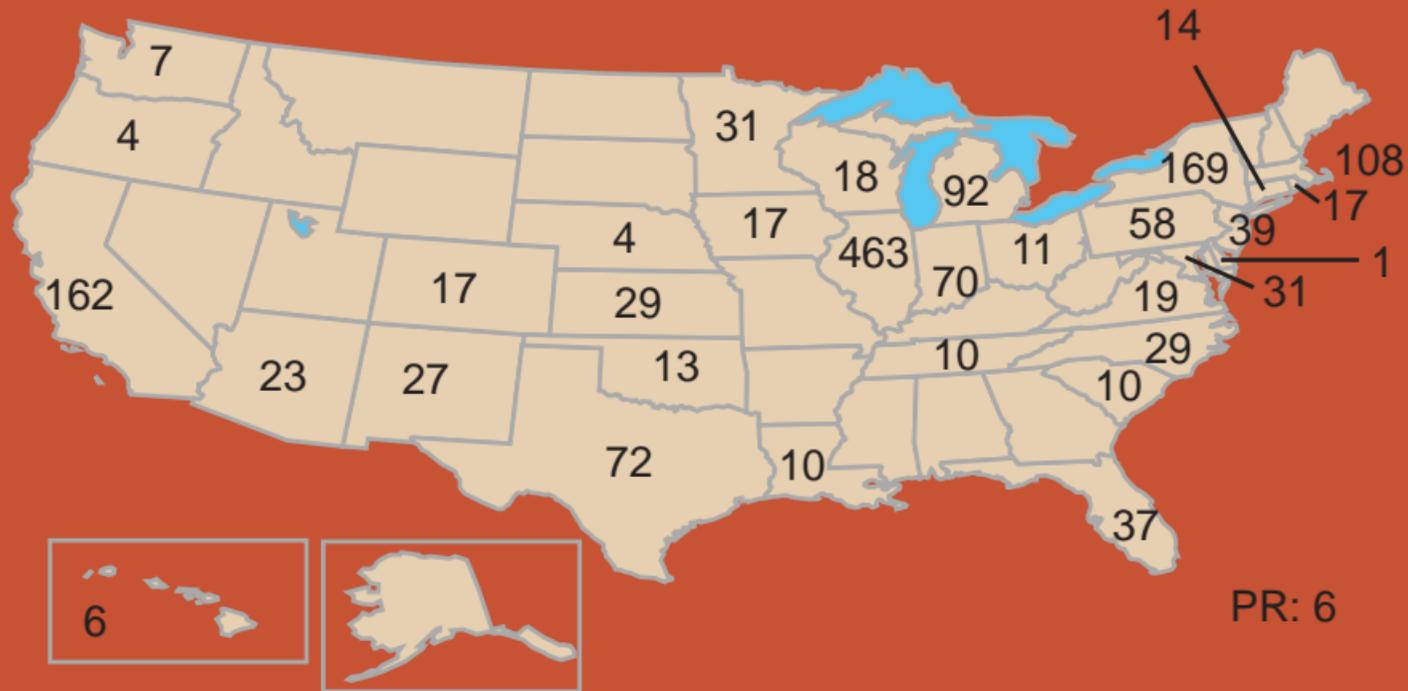
Fermilab's 2615 Users



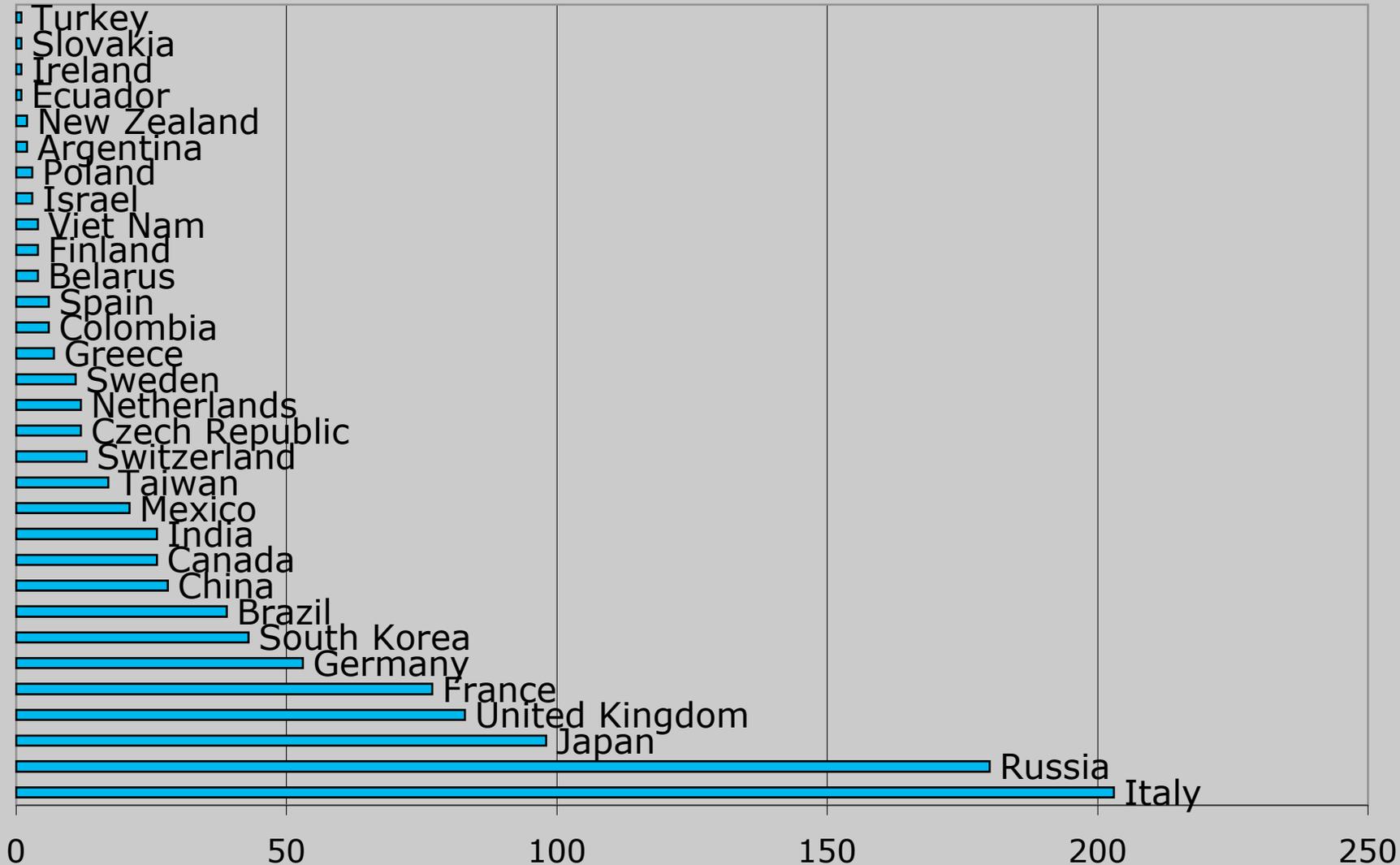
Fermilab's 213 Collaborating Institutes



Fermilab's US Users (2003)



Fermilab's Foreign Users



Particle Physics as Constructive Engagement

From the Nixon–Brezhnev accords ...

... to Ping-Pong Diplomacy



The Languages of Fermilab

To get a better sense of the nationalities represented in modern physics experiments, FermiNews recently conducted a thoroughly unscientific and completely unofficial survey of the laboratory's two largest collaborations, CDF and DZero. We asked the collaborators to tell us by email what languages they speak. We figured that the languages that turned up would give us a pretty good idea of the diversity of the experimenters' nationalities. So far, we have compiled a list of 63 different languages.



If you are a Fermilab experimenter and you speak a language that isn't listed, we would very much like to hear from you. Send us an email at ferminews@fnal.gov with your name, your experiment, and the languages you speak. We'll keep an updated tally on this webpage.

CDF

Assyrian Italian
Belorussian Japanese
Bengali Korean
Cantonese Leccese
Catalan Luxembourgish
Croatian Mandarin
Czech Marathi
Danish Persian
Dutch Polish
English Portuguese
Finnish Romanian
Flemish Russian
French Serbian
Gaelic Slovak
German Spanish
Georgian Swedish
Greek Tagalog
Hebrew Taiwanese
Hindi Turkish
Hungarian Urdu

DZero

Afrikaans Hungarian Tamil
Arabic Indonesian The Queen's English
Armenian Italian Tulugu
Assyrian Japanese Turkish
Bangla Kannada Ukrainian
Bengali Korean Urdu
Cantonese Latvian Vietnamese
Croatian Limburgs Welsh
Chinese Malayalam Wolof
Czech Mandarin
Danish Marathi
Dutch Megrelian
English Polish
French Portuguese
Georgian Punjabi
German Russian
Greek Romanian
Gujarati Serbian
Hebrew Spanish
Hindi Swedish

Theoretical Astrophysics Group

American Sign Language

 Fermilab Theoretical Physics Staff & Postdocs

Bill Bardeen 

Andreas Kronfeld 

Ayres Freitas 

Marcela Carena 

Joseph Lykken 

Andre de Goûvea 

Bogdan Dobrescu 

Ulrich Nierste 

Ulrich Haisch 

Estia Eichten 

Yasunori Nomura 

Adam Leibovich 

Keith Ellis 

Paul Mackenzie 

Eduardo Pontón 

Walter Giele 

Stephen Parke 

Masataka Okamoto 

Christopher Hill 

Chris Quigg 

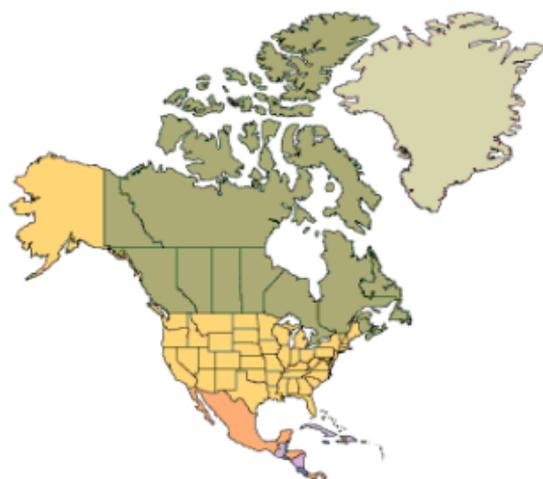
Zack Sullivan 

Boris Kayser 

Gabriela Barenboim 

Tim Tait 

CDF Institutions Map



Canada

[McGill Univ.](#)
[Univ. of Toronto](#)

USA

[Argonne National Laboratory, IL](#)
[Brandeis Univ., MS](#)
[Univ. of Chicago, IL](#)
[Davis UC, CA](#)
[Duke Univ., NC](#)
[FNAL, IL](#)
[Univ. of Florida, FL](#)
[Harvard Univ., MA](#)
[Univ. of Illinois, IL](#)
[The Johns Hopkins Univ., MD](#)
[LBNL, CA](#)
[MIT, MA](#)
[Michigan State Univ., MI](#)
[Univ. of Michigan, MI](#)
[Univ. of New Mexico, NM](#)
[The Ohio State Univ., OH](#)
[Univ. of Pennsylvania, PA](#)
[Univ. of Pittsburgh, PA](#)
[Purdue Univ., IN](#)
[Univ. of Rochester, NY](#)
[Rockefeller Univ., NY](#)
[Rutgers Univ., NJ](#)
[Texas A&M Univ., TX](#)
[Texas Tech Univ., TX](#)
[Tufts Univ., MA](#)
[UCLA, CA](#)
[Univ. of Wisconsin, WI](#)
[Yale Univ., CT](#)

Russia

[JINR, Dubna](#)
[ITEP, Moscow](#)

Germany

[Univ. Karlsruhe](#)

Switzerland

[Univ. of Geneva](#)

UK

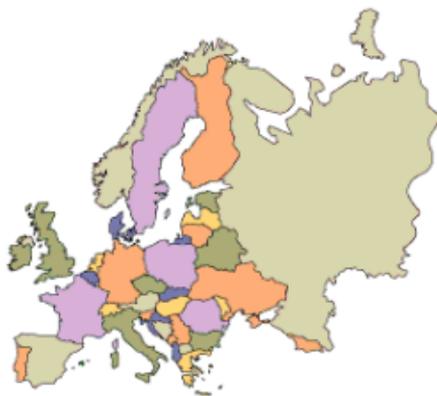
[Glasgow Univ.](#)
[Univ. of Liverpool](#)
[Univ. of Oxford](#)
[Univ. College London](#)

Italy

[Univ. of Bologna, INFN](#)
[Frascati, INFN](#)
[Univ. di Padova, INFN](#)
[Pisa, INFN](#)
[Univ. di Roma I, INFN](#)
[INFN-Trieste](#)
[Univ. di Udine](#)

Spain

[Univ. of Cantabria](#)



Korea

[KHCL](#)

Japan

[Hiroshima Univ.](#)
[KEK](#)
[Osaka City Univ.](#)
[Univ. of Tsukuba](#)
[Waseda Univ., Tokyo](#)

Taiwan

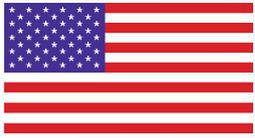
[Academia Sinica,](#)
Taipei



Don't they ever work?

The role of conferences ...

Lepton/Photon '79 and the origins of CDF



AZ U. of Arizona
 CA U. of California, Berkeley
 U. of California, Riverside
 Cal. State U., Fresno
 Lawrence Berkeley Nat. Lab.
 FL Florida State U.
 IL Fermilab
 U. of Illinois, Chicago
 Northern Illinois U.
 Northwestern U.
 IN Indiana U.
 U. of Notre Dame
 IA Iowa State U.
 KS U. of Kansas
 Kansas State U.
 LA Louisiana Tech U.
 MD U. of Maryland
 MA Boston U.
 Northeastern U.
 MI U. of Michigan
 Michigan State U.
 NE U. of Nebraska
 NJ Princeton U.
 NY Columbia U.
 U. of Rochester
 SUNY, Stony Brook
 Brookhaven Nat. Lab.
 OK Langston U.
 U. of Oklahoma
 RI Brown U.
 TX U. of Texas at Arlington
 Texas A&M U.
 Rice U.
 VA U. of Virginia
 WA U. of Washington



U. de Buenos Aires



LAFEX, CBPF, Rio de Janeiro
 State U. do Rio de Janeiro
 State U. Paulista, São Paulo



IHEP, Beijing



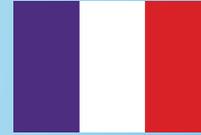
U. de los Andes, Bogotá



Charles U., Prague
 Czech Tech. U., Prague
 Academy of Sciences, Prague



U. San Francisco de Quito



ISN, IN2P3, Grenoble
 CPPM, IN2P3, Marseille
 LAL, IN2P3, Orsay
 LPNHE, IN2P3, Paris
 DAPNIA/SPP, CEA, Saclay
 IReS, Strasbourg
 IPN, IN2P3, Villeurbanne



U. of Aachen
 Bonn U.
 U. of Freiburg
 IOP, U. Mainz
 Ludwig-Maximilians U., Munich
 U. of Wuppertal

The DØ Collaboration



Panjab U. Chandigarh
 Delhi U., Delhi
 Tata Institute, Mumbai



University College, Dublin



KDL, Korea U., Seoul



CINVESTAV, Mexico City



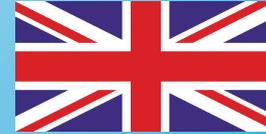
FOM-NIKHEF, Amsterdam
 U. of Amsterdam / NIKHEF
 U. of Nijmegen / NIKHEF



JINR, Dubna
 ITEP, Moscow
 Moscow State U.
 IHEP, Protvino
 PNPI, St. Petersburg



Lund U.
 RIT, Stockholm
 Stockholm U.
 Uppsala U.



Lancaster U.
 Imperial College, London
 U. of Manchester



HCIP, Hochiminh City

DZero Goes Global

New monitoring system allows serving control room shifts as far away as India

by Mike Perricone

On Friday, January 3 at about 5 a.m. Central Standard Time, Onne Peters was on a control room shift for Fermilab's DZero detector when he saw something that wasn't right: hot cells, or excess jets, appearing in the detector's calorimeter. He immediately notified the shift captain, who alerted the calorimeter expert on shift, and the problem was solved.

It might sound like particle physics business as usual in the predawn of a winter morning, but there was a big difference: Peters was serving his DZero control room shift from a computer at NIKHEF, the National Institute for Nuclear Physics and High Energy Physics in Amsterdam, Holland. Some 4,000 miles and an ocean away from the chilly predawn in Batavia, Illinois, Peters was hooked into DZero's new Global Monitoring System.



DZero has seen the future, and it works.

It works as far away as NIKHEF in Holland; the Saclay laboratory of CEA, the French Atomic Energy Commission; and the Tata Institute of Fundamental Research in Mumbai, India, where experimenters have taken "virtual" shifts in the DZero control room through the Global Monitoring System.

"This is absolutely the wave of the future," said Peters. "With increasingly international collaborations, it is just not feasible to expect people to be available on-site for a large amount of time. This is a trend we see with remote computing, the remote analysis stations, as well, and I certainly foresee that these projects will benefit high-energy physics greatly."

DZero spokesperson John Womersley also sees future applications when the Large Hadron Collider begins operations at CERN, the European Particle Physics Laboratory.

"Five to ten years from now, many U.S. institutions, Fermilab among them, will themselves become remote collaborators working on LHC experiments," Womersley said. "We need to learn how to contribute effectively to all aspects of LHC physics, and remote participation in data taking operations will be an important piece of the puzzle."

The global monitoring hookup was "godmothered" from concept to operation by DZero physicist Pushpalatha Bhat, with yeoman work on the user interface and the communication system—a global message board—by her undergraduate student, Jason Webb, who works part-time at DZero while studying electronic engineering at DeVry University in Addison, Illinois.



"It's a joy to work with bright and motivated students," Bhat said. "I love to encourage them to pursue studies in physics and perhaps a career in physics."

The project has had exactly that effect on Webb.

"After working here at Fermilab," he said, "I have been seriously considering going for a Master's degree in Physics."

Bhat explained that the message board is used for chatting between people in the control room at the detector and remote shifters. Anyone else who wants to join and share information online can also communicate through the messenger system. A problem can be sent to this chat box, and it also appears on a web search board, where messages can be seen between the control room and the remote shifters. The messenger system also provides for archiving.

"Sometimes, if I'm up late at night, I can go to the message board," Bhat said. "Even if I do not log on to the detector's online system, I can see what is being said back and forth, if there are

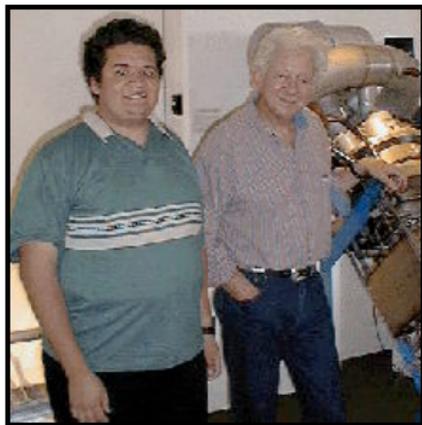
Global Accelerator Network: *How to plan, build and operate the next large accelerator in collaboration*

- **Global accelerator Network**
- **Icfa Study Groups**
- **Report from 1st Workshop at Cornell**



QuarkNet Centers





Latin American Partnerships

Alfredo Raya, Escuela de Físico-Matemáticas UMSNH, Morelia, Mich., Mexico, 1997 Leon M. Lederman Award Winner

In 1986, at the invitation of Leon M. Lederman, then Fermilab Director, ten Latin American educators attended the Conference on the Teaching of Modern Physics at Fermilab. The expectations were that these educators will disseminate the information gained to other colleagues in their respective countries. They did and continue to do so. Fermilab and Friends of Fermilab continue to be directly involved in several of these activities.

Activities have been conducted in the following countries

- [Argentina](#)
- [Colombia](#)
- [Mexico](#)
- [Venezuela](#)

V InterAmerican Conference on Physics Education, July 16–22, 1994 at Texas A & M, College Station, TX. A pre-conference Minicourse: Introduction to Particle Physics, and a Panel Discussion: Teaching Particle Physics in the Classroom, were conducted by Fermilab teachers and scientists and colleagues from Argentina and Mexico.

Science Education Materials available in Spanish

The education materials developed at Fermilab have been translated into Spanish for use with the mini-courses and other programs offered in Latin America. These include:

- El Concepto de Simetría en la Física. Dr. Christopher T. Hill. Fermilab-PUB-86/140-T.
- Física de las Partículas Elementales: Descubrimientos, Ideas y Herramientas. Dr. Chris Quigg, Fermilab. Fermilab-CONF-86/139-T.
- Introducción a la Astrofísica, Dr. Armando Pérez C., Fermilab y Universidad de Valencia, España, no publicado.
- Notas del Taller de Partículas Elementales y Notas del Taller de Cosmología, J. Ruebush, J. Johnson y W. Schearer, no publicado.
- El Modelo Estandar, Drasko Jovanovic, Fermilab, no publicado.
- Belleza y Encanto en el Fermilab, Una Guía para Maestros, Fermilab, no publicado.
- Several physics posters developed at Fermilab are also available in Spanish.

!Hecho en Mexico!

Kaon experiment commissions detector components from Mexican university

by Gary Ruderman

In his 28 years at Fermilab, physicist Herman White has both witnessed and helped encourage the globalization of science.

“The focus today is on international cooperation,” White said, “especially in high-energy physics. We are a world society.”

With this extended focus, every part of the world takes on increasing importance—and offers increasing opportunities.

White recently worked as both kaon researcher and diplomat in helping complete an agreement with Universidad Autonoma de San Luis Potosi (UASLP), in Central Mexico north of Mexico City, to build part of the detector for Fermilab's Charged Kaons at the Main Injector (CKM) experiment. While Mexican researchers have a longstanding presence at Fermilab, the agreement marks the first time that a Mexican institution has been responsible for building part of a new experiment.

“This is an embryonic collaboration between the U.S., Mexico and Russia,” White explained. “It’s an opportunity to bring people together from all around the world.”



Announcement:

2nd Latin American School of High Energy Physics

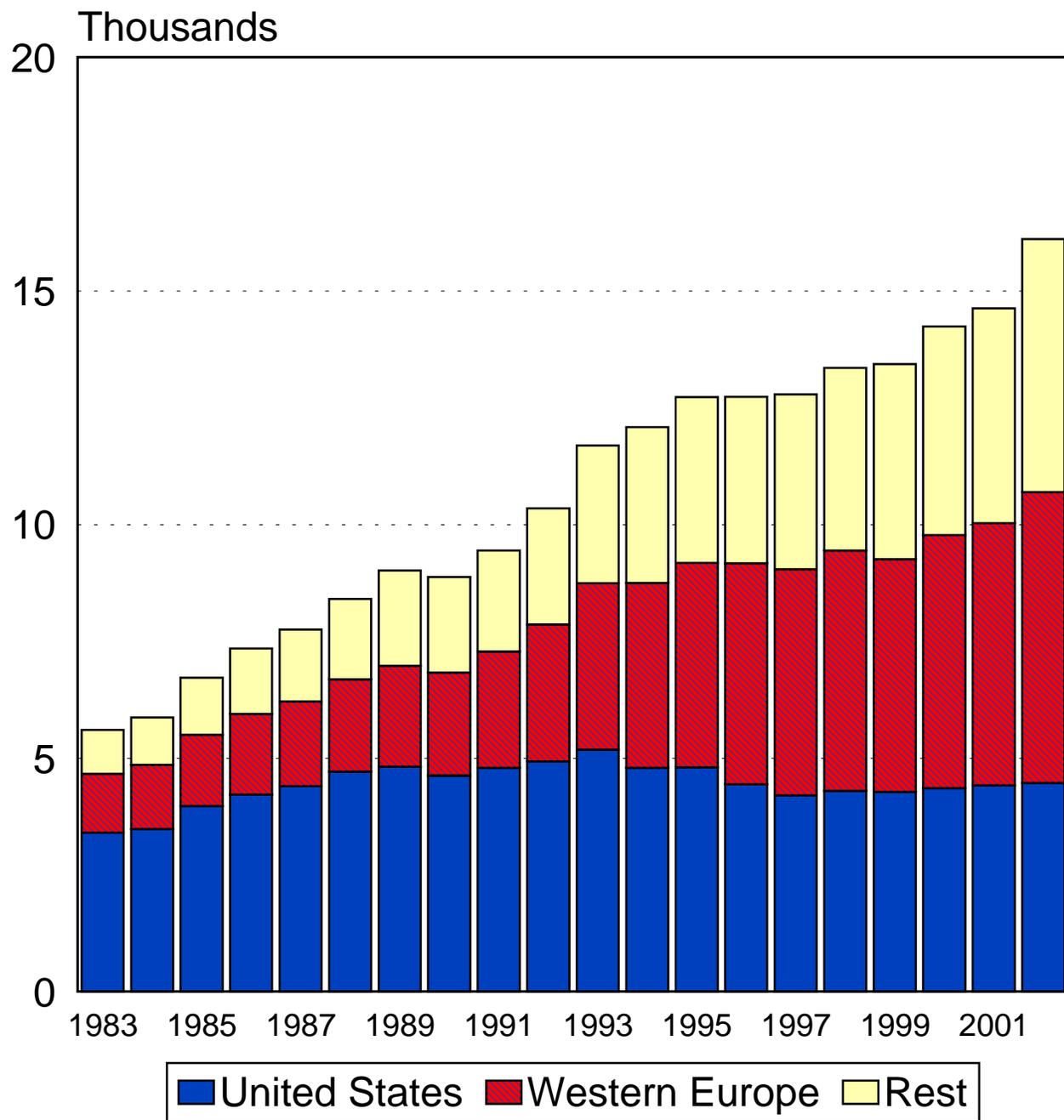
San Miguel Regla, Mexico 1 – 14 June, 2003 Organized jointly by CERN,
CLAF, CONACyT and DPF MPs

Other sponsors: EU, Brazil, Spain, Portugal, Italy and France



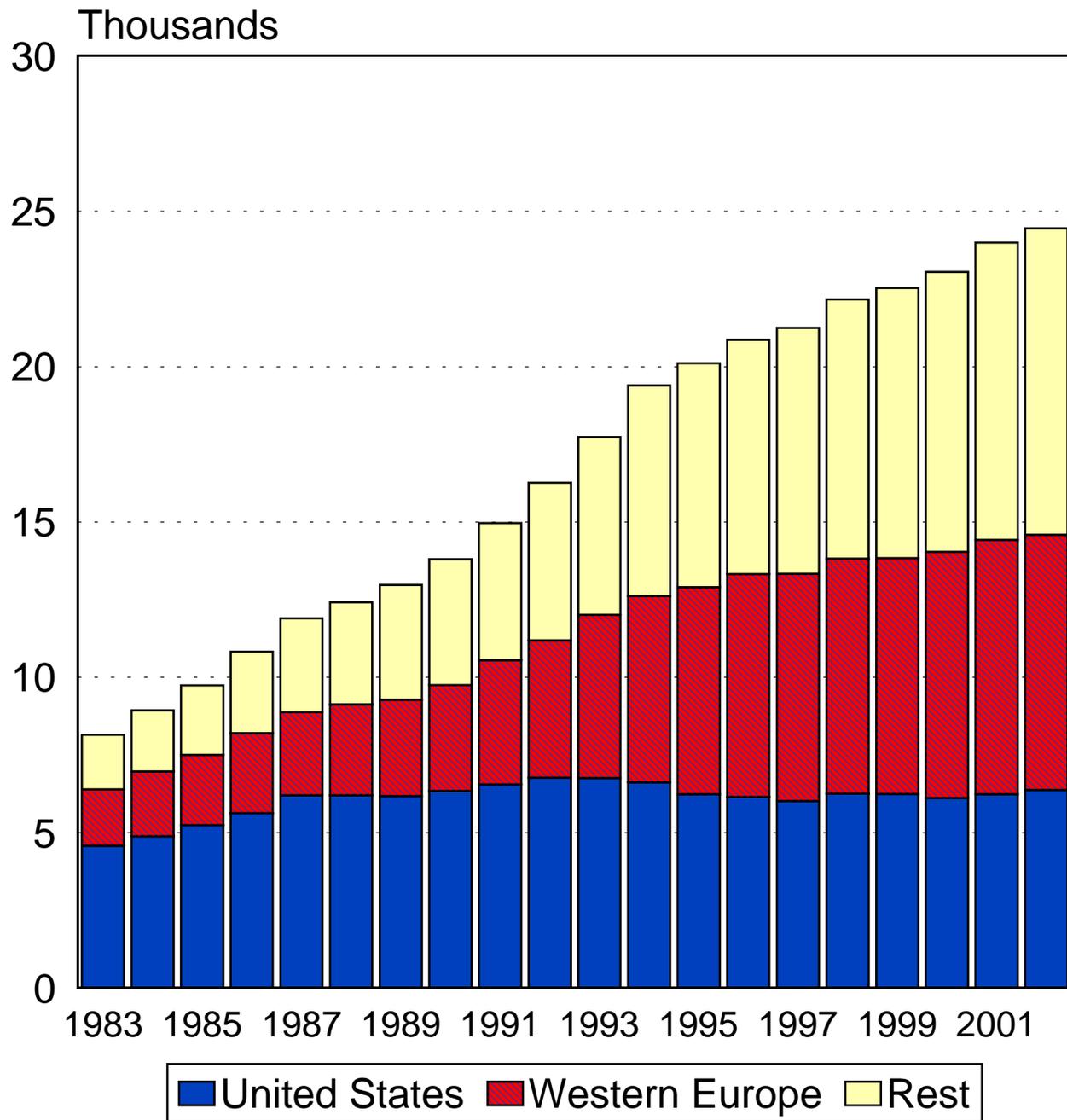
The 2003 Latin-American School of High-Energy Physics will be organized jointly by the European Organization for Nuclear Research (CERN), Geneva, Switzerland and the Centro Latino Americano de Fisica (CLAF), together with Division of Particles and Fields of the Mexican Physical Society. The basic aim of the School is to teach various aspects of high-energy physics, and especially theoretical physics, primarily to Post-Graduates in experimental particle physics, typically aged under thirty years and about one year from submitting their Ph.D. theses. However, a few Latin American Post-Doctoral students in experimental high-energy physics and Master's Degree students in theoretical physics may be accepted, assuming their background knowledge in theoretical physics is of approximately the same level as the experimental Ph.D. students.

Physical Review and Physical Review Letters Published 1983 - 2002



Physical Review and Physical Review Letters Submissions

1983 - 2002



Cooperation, Collaboration, Competition

Increasingly, the standards of world-class science are defined outside the United States. Brilliant experimental work by international teams in Europe and Japan has driven the research agenda for my field of particle physics over the past decade.

Governments abroad are investing strongly in basic and applied research, enhancing their capabilities, while we in the United States are missing opportunities and doing too little to encourage our own best students. Our national policy amounts to a retreat from excellence.





CMS collaboration

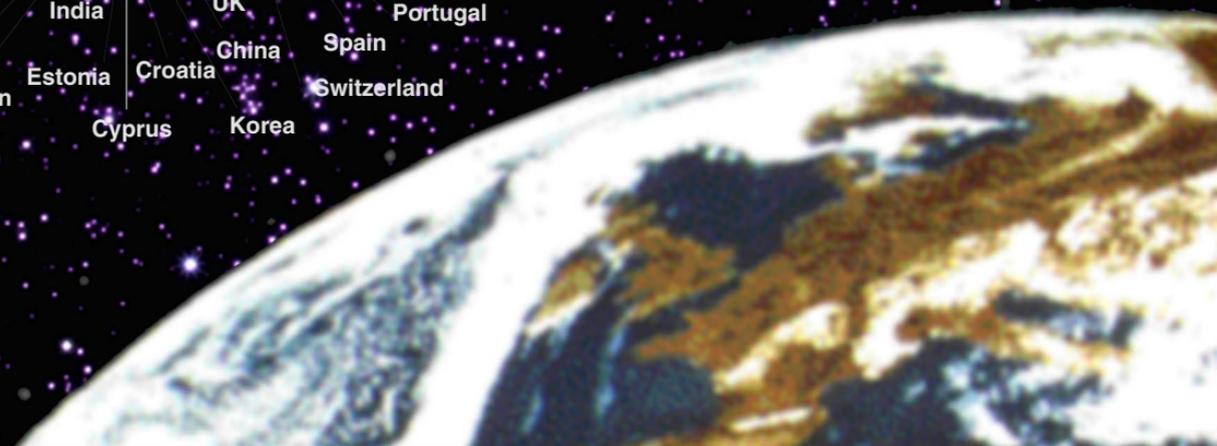
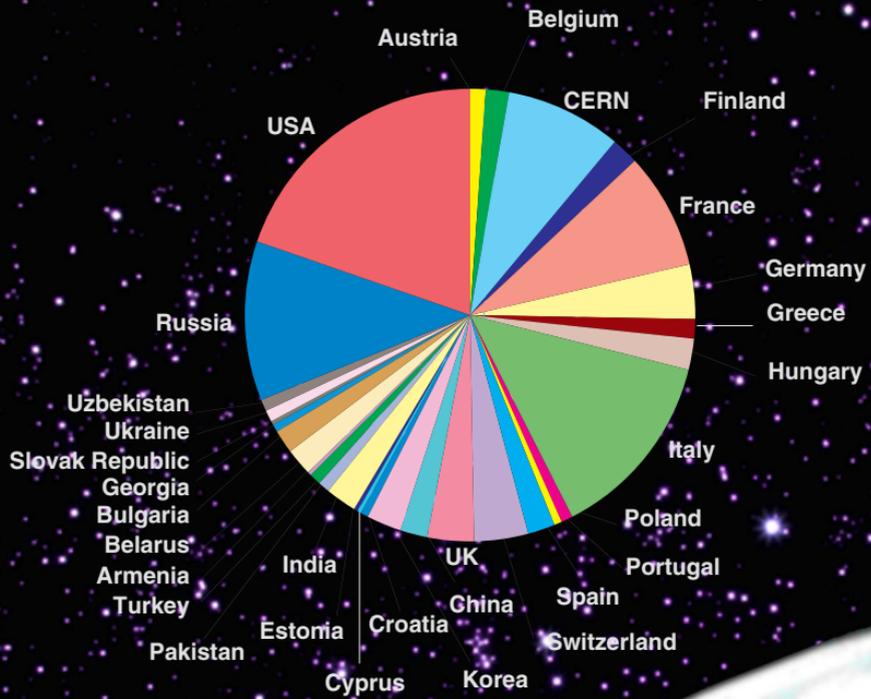
(144 Institutions with about 1700 scientists)

- ARMENIA**
 - Yerevan Physics Inst., Yerevan
- AUSTRIA**
 - HEPHY, Wien
- BELARUS**
 - Institute of Nuclear Problems, Minsk
 - National Centre of Part. and HEP, Minsk
 - Res. Inst. of Applied Physical Probl., Minsk
 - Byelorussian State Univ., Minsk
- BELGIUM**
 - Univ. Instelling Antwerpen, Wilrijk
 - Univ. Libre de Bruxelles, Brussels
 - Vrije Universiteit Brussel, Brussels
 - Univ. Catholique de Louvain, Louvain-la-Neuve
 - Univ. de Mons-Hainaut, Mons
- BULGARIA**
 - Inst. for Nucl. Res. and Nucl. Energy, Sofia
 - Univ. of Sofia, Sofia
- CHINA, PR**
 - Inst. of High Energy Physics, Beijing
 - Peking Univ., Beijing
 - Univ. for Science & Tech. of China, Hefei, Anhui
- CROATIA**
 - Tech. Univ. of Split, Split
 - Univ. of Split, Split
- CYPRUS**
 - Univ. of Cyprus, Nicosia
- ESTONIA**
 - Inst. of Chemical Phys. and Biophys., Tallinn
- FINLAND**
 - Helsinki Institute of Physics, Helsinki
 - Dept of Phys., Univ. of Helsinki, Helsinki
 - Univ. of Jyväskylä, Jyväskylä
 - Helsinki University of Technology, Helsinki
 - Univ. of Oulu, Oulu
 - Tampere Univ. of Tech., Tampere
- FRANCE**
 - LAPP, IN2P3-CNRS, Annecy-le-Vieux
 - IPN, IN2P3-CNRS, Univ. Lyon I, Villeurbanne
 - LPNHE, Ecole Polytech., IN2P3-CNRS, Palaiseau
 - DSM/DAPNIA, CEA/Saclay, Gif-sur-Yvette
 - IRES, IN2P3-CNRS - ULP, UHA, LEPSI, Strasbourg
- GEORGIA**
 - High Energy Phys. Inst., Tbilisi State Univ., Tbilisi
 - Inst. of Physics Academy of Science, Tbilisi

- GERMANY**
 - RWTH, I. Physik. Inst., Aachen
 - RWTH, III. Physik. Inst. A, Aachen
 - RWTH, III. Physik. Inst. B, Aachen
 - Humboldt-Univ. zu Berlin, Berlin
 - Inst. für Exp. Kernphysik, Karlsruhe
- GREECE**
 - Univ. of Athens, Athens
 - Inst. of Nucl. Phys. "Demokritos", Attiki
 - Univ. of Ioannina, Ioannina
- HUNGARY**
 - KFKI Res. Inst. for Part. & Nucl. Phys., Budapest
 - Kossuth Lajos Univ., Debrecen
 - Institute of Nuclear Research ATOMKI, Debrecen
- INDIA**
 - Punjab Univ., Chandigarh
 - Bhabha Atomic Res. Centre, Mumbai
 - Univ. of Delhi South Campus, New Delhi
 - TIFR - EHEP, Mumbai
 - TIFR - HECR, Mumbai
- ITALY**
 - Univ. di Bari e Sez. dell'INFN, Bari
 - Univ. di Bologna e Sez. dell'INFN, Bologna
 - Univ. di Catania e Sez. dell'INFN, Catania
 - Univ. di Firenze e Sez. dell'INFN, Firenze
 - Univ. di Genova e Sez. dell'INFN, Genova
 - Univ. di Padova e Sez. dell'INFN, Padova
 - Univ. di Pavia e Sez. dell'INFN, Pavia
 - Univ. di Perugia e Sez. dell'INFN, Perugia
 - Univ. di Pisa e Sez. dell'INFN, Pisa
 - Univ. di Roma I e Sez. dell'INFN, Roma
 - Univ. di Torino e Sez. dell'INFN, Torino
- KOREA**
 - Chonju National University, Chonju
 - Chonnam National University, Kwangju
 - Chongbuk National University, Chongju
 - Dongshin University, Naju
 - Kangnung National University, Kangnung
 - Kangwon National University, Chuncheon
 - Kon-Kuk University, Seoul
 - Korea University, Seoul
 - Kyungpook National University, Taegu
 - Pohang University of Science and Technology, Pohang
 - Gyeongsang National University, Jinju
 - Seonam University, Namwon
 - Seoul National Univ. of Education, Seoul
 - Wonkwang University, Iri

- PAKISTAN**
 - Quaid-I-Azam Univ., Islamabad
 - Ghulam Ishaq Khan Institute, Swabi
- POLAND**
 - Inst. of Exp. Phys., Warsaw
 - Soltan Inst. for Nucl. Studies, Warsaw
- PORTUGAL**
 - ULP, Lisboa
- RUSSIA**
 - JINR, Dubna
 - Inst. for Nucl. Res., Moscow
 - Inst. for Theoretical and Exp. Phys., Moscow
 - P.N. Lebedev Phys. Inst., Moscow
 - Moscow State Univ., Moscow
 - Budker Inst. for Nucl. Phys., Novosibirsk
 - Inst. for High Energy Phys., Protvino
 - Petersburg Nucl. Phys. Inst., Gatchina (St Petersburg)
- SLOVAK REPUBLIC**
 - Slovak University of Technology, Bratislava
- SPAIN**
 - CIEMAT, Madrid
 - Univ. Autónoma de Madrid, Madrid
 - Univ. de Oviedo, Oviedo
 - IFCA, CSIC-Univ. de Cantabria, Santander
- SWITZERLAND**
 - Univ. Basel, Basel
 - CERN, Geneva
 - Paul Scherrer Inst., Villigen
 - Inst. für Teilchenphysik, ETH, Zurich
 - Univ. Zürich, Zurich
- TURKEY**
 - Cukurova Univ., Adana
 - Middle East Technical Univ., Ankara
- UKRAINE**
 - Inst. of Single Crystals of Nat. Acad. of Science, Kharkov
 - Kharkov Inst. of Phys. and Tech., Kharkov
 - Kharkov State Univ., Kharkov
- UNITED KINGDOM**
 - Univ. of Bristol, Bristol
 - Brunel Univ., Uxbridge
 - Imperial College, Univ. of London, London
 - RAL, Didcot

- USA**
 - Univ. of Alabama, Tuscaloosa
 - Iowa State Univ., Ames
 - Boston Univ., Boston
 - California Inst. of Tech., Pasadena
 - Carnegie Mellon Univ., Pittsburgh
 - Univ. of Illinois at Chicago, Chicago
 - Fairfield Univ., Fairfield
 - Fermi National Accelerator Lab., Batavia
 - Florida State Univ. - HEPG, Tallahassee
 - Florida State Univ. - SCRI, Tallahassee
 - Univ. of Florida, Gainesville
 - The Univ. of Iowa, Iowa City
 - Johns Hopkins Univ., Baltimore
 - LLNL, Livermore
 - Los Alamos Nat. Lab., Los Alamos
 - Univ. of Maryland, College Park
 - Univ. of Minnesota, Minneapolis
 - Univ. of Mississippi, Oxford
 - Massachusetts Inst. of Tech., Cambridge
 - Univ. of Nebraska-Lincoln, Lincoln
 - Northeastern Univ., Boston
 - Northwestern Univ., Evanston
 - Univ. of Notre Dame, Notre Dame
 - The Ohio State Univ., Columbus
 - Princeton Univ., Princeton
 - Purdue Univ., West Lafayette
 - Rice Univ., Houston
 - Univ. of California, Riverside
 - Univ. of Rochester, Rochester
 - Rutgers, the State Univ. of New Jersey, Piscataway
 - Texas Tech Univ., Lubbock
 - Univ. of Texas at Dallas, Richardson
 - Univ. of California at Davis, Davis
 - UCLA, Los Angeles
 - Univ. of California San Diego, La Jolla
 - Virginia Polytech. Inst. and State Univ., Blacksburg
 - Univ. of Wisconsin, Madison
- UZBEKISTAN**
 - Inst. of Nucl. Phys. of the Uzbekistan Acad. of Sciences, Tashkent

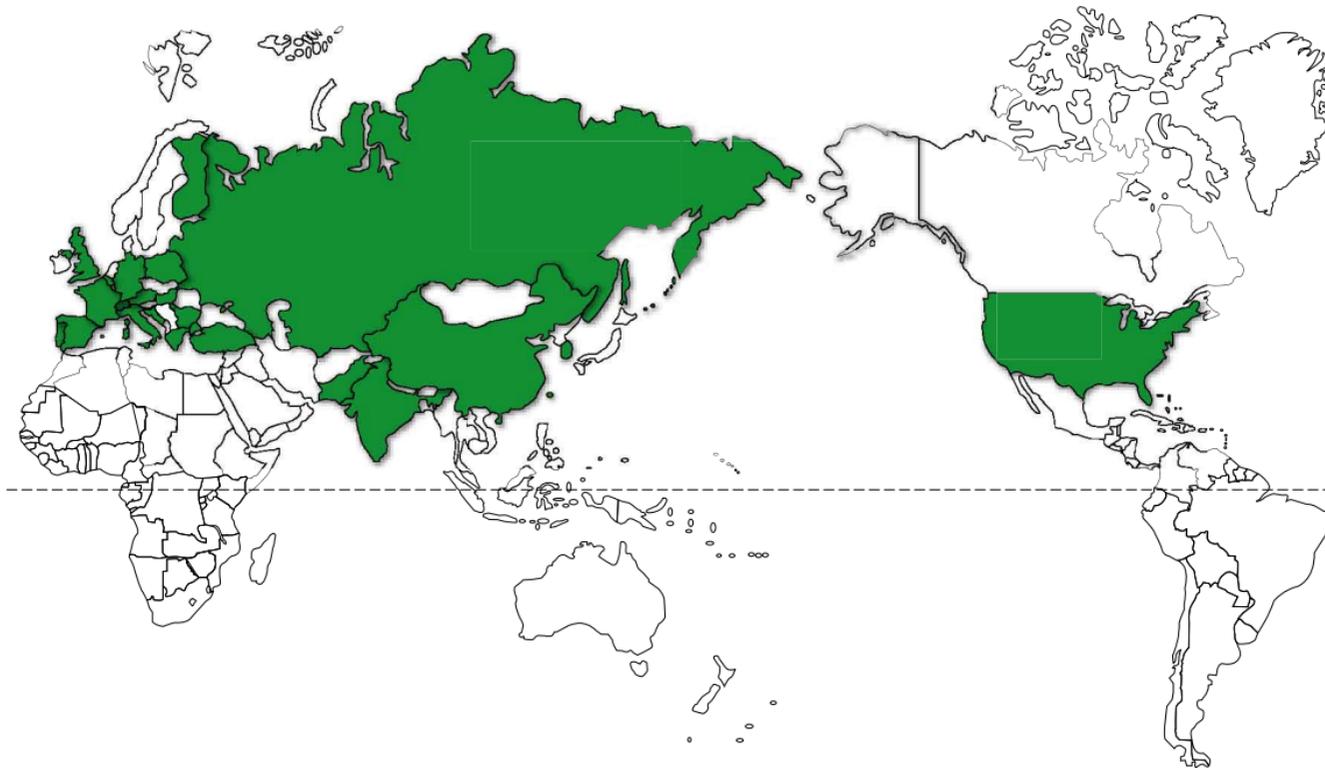




CMS Collaboration



31 Nations, 150 Institutions, 1870 Scientists and Engineers



- Armenia
- Australia
- Austria
- Azerbaijan
- Belarus
- Brazil
- Canada
- China
- Germany
- Danmark
- Spain
- Finland
- France
- Georgia
- Greece
- Italy
- Israel
- Japan
- Kazakhstan
- Morocco
- Norway
- Netherlands
- Portugal
- Poland
- Romania
- Russia
- Sweden
- Switzerland
- Slovenia
- Slovakia
- Taiwan
- Turkey
- UK
- USA



ATLAS Collaboration



Physics
without
Boundaries?



Nevis Labs Team Tours South Africa Teaching Schoolchildren Principles of Physics

By Joseph Kennedy

In a chilly classroom near Johannesburg, four nervous high school students linked hands as Columbia physicist Jeremy Dodd operated a Van de Graaff generator nearby. Then, Will Serber, CC'03, touched one hand to the generator and the other to the last student in the row, sending an electric shock through the group and an intellectual shock through the entire class.



Ian Tolfree, left, and physicist Jeremy Dodd, right, demonstrate static electricity for a South African student.

Welcome to Physics Emasondosondo, or "Physics Moving on Many Wheels," a mobile physics lab and science outreach program that an international group of scientists, educators and university students brought to underprivileged schools in two South African provinces last summer.

COUNTRY	RESEARCH SCIENTISTS	ARTICLES WITH 40 OR MORE CITATIONS	NUMBER OF FREQUENTLY CITED PAPERS PER MILLION PEOPLE
United States	466,211	10,481	42.99
India	29,509	31	0.04
Australia	24,963	280	17.23
Switzerland	17,028	523	79.90
China	15,558	31	0.03
Israel	11,617	169	36.63
Egypt	3,782	1	0.02
Republic of Korea	2,255	5	0.12
Saudi Arabia	1,915	1	0.07
Kuwait	884	1	0.53
Algeria	362	1	0.01



ICFA

INSTRUMENTATION SCHOOL

Istanbul, Turkey

28 June - 10 July 1999

School on

INSTRUMENTATION IN ELEMENTARY PARTICLE PHYSICS

University of Istanbul, Faculty Sciences, Department of Physics and Meteorological Model



First ICFA Instrumentation School / Workshop at the ICFA Instrumentation Center in Morelia

November 18-29, 2002
University of Michoacan
Morelia, Michoacan, Mexico

The school/workshop will focus on the teaching of experimental techniques for particle, nuclear, cosmic-ray, and medical physics by means of laboratory sessions, lecture courses, and review talks. It is aimed primarily at graduate students with some participation of young Post Docs and promising undergraduate students. Applications are invited from all parts of the world, especially from institutions in Mexico and from other countries in Latin America.

Laboratory Sessions

Interfaces and Data Acquisition (LabView)

Simon Kwan (FNAL), Marleigh Sheaff (Madison, USA),
Aurora Vargas (BUAP, MEXICO), Sergio Vergara (BUAP, MEXICO),
Marvin Johnson (FNAL, USA)

Moon and Plan Lifetime Measurements

L. Villaseñor (UMSNH, MEXICO)

Drift Chambers

A. Walenta (Siegen, Germany)

Silicon Detectors

Paolo Giubellino (CERN, Torino), Sharon Roe (CERN),
Alick Macpherson (CERN), Alan Rudge (CERN)

PMT Arrays for Fluorescence Detector Cameras and PMT Characterization

Humberto Salazar (BUAP, MEXICO)

Multire Proportional Chambers

Arturo Menchaca (UNAM, MEXICO)

Data Analysis (Root)

Umberto Cotti (UMSNH, MEXICO)

Radiation Detectors of PIN Type for X Rays

Francisco Javier Ramirez (ININ, MEXICO)

Applications of Sensitive Films to Medical Imaging

Maria Ester Brandan (UNAM, MEXICO)

Mathematical Analysis of Bio-electrical Signals

Guadalupe Ruiz (UMSNH, MEXICO)

Silicon Detectors Applied to Medical Imaging

Luis Manuel Montaña (CINVESTAV, MEXICO)

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John Ellis, CERN

Arnulfo Zepeda, CINVESTAV, Mexico

Arturo Menchaca, UNAM, Mexico

Jurgen Engelfried, UASLP, Mexico

Humberto Salazar, BUAP, Mexico

Luis Maspieri, CLAF, Brasil

Lecture Courses and Review Talks

Jurgen Engelfried (SLP, Mexico), Particle Identification I

Eugenio Nappi (CERN), Particle Identification II

Arnulfo Zepeda (CINVESTAV, Mexico), Ultra High Energy Cosmic Rays

Gerardo Herrera Corral (CINVESTAV, Mexico), Physics with ALICE at the Large Hadron Collider

A. Wplenta (Siegen, Germany), New Ideas in Radiation Detectors

Marleigh Sheaff (Madison, USA), Heavy Quark Physics, potential of BTeV

Paolo Giubellino (Torino, CERN), Silicon Detectors

Car Haber (Berkeley Lab), Tracking Detectors

Helmuth Spieler (Berkeley Lab), Signal processing, front-end electronics

Joel N. Butler (FNAL), Triggering and Data Acquisition

Hans-H. Prosser (Florida State University), Confidence Levels and Upper Limits

Richard Wigmans (Texas Tech), Calorimetry

Juan José Gómez Cadenas (CERN), Neutrino Detectors

John Ellis (CERN) to be confirmed

Ariella Cattal (CERN) to be confirmed

Modesto Sosa (IFUG, Mexico), Application of Detectors of Magnetic Fields in Medical Physics

Aurora Aldana (Hospital Angeles del Pedregal, Mexico), Radiotherapy

Brenda Dingus (Madison, USA), Gamma-Ray Astronomy: Probing Nature's

Particle Accelerators

Round Tables

There will be one or more Round Tables on "Instrumentation in Mexico,
Central America and the Caribbean" with the following participants:

Jurgen Engelfried (Mexico)

Antonio Morelos (Mexico)

Arturo Menchaca (Mexico)

Gerardo Herrera Corral (Mexico)

Marleigh Sheaff (USA)

Paolo Giubellino (Italy)

Luis Villaseñor (Mexico)

Humberto Salazar (Mexico)

Arnulfo Zepeda (Mexico)

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**The School/Workshop is organized
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• BUAP

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• ICFA

• IFUG

• ININ

• NSF

• SMF

• UASLP

• UMSNH

• UNAM

Deadline for Applications: October 1, 2002.



Further Information

Mary Cervantes: mary@ifm.umich.mx

www.ifm.umich.mx/school/

SESAME

Synchrotron Light for Experimental Science and Applications in the Middle East

**an International Center for Advanced Science and Technology
under the Auspices of UNESCO**



The SESAME project, installed on a site in the Middle East, would become the core of a world-class research centre attracting scientists from the Middle East, the Mediterranean as well as other parts of the world. As a scientist myself, I have always envisaged a central role for science in the process of transition from a culture of war and violence to a culture of peace and dialogue. This project is a model of its kind because it meets a very real need and it shows that the concept of science for peace is not just a matter of words or good intentions but of concrete action. UNESCO could provide the international framework for the organisation and the development of this project and it is assisting already in its preparatory efforts. I hope that SESAME will become a full success.

Federico Mayor, Director General of UNESCO

The creation of an international centre for synchrotron light in the Middle East presents a great challenge and to make it a success requires the co-operation of all parties involved. The great interest in the region is demonstrated by the active participation of scientists in the Scientific and Technical Committees. The positive attitude of government representatives assembled at the invitation of the Director-General of UNESCO provides a good basis for success. Thanks to the generous gift of BESSY I by the German government, this project will be extremely cost effective. It will not only contribute to the development of scientific research and practical applications in the region, but, perhaps even more important, by bringing frontier research opportunities to scientists, engineers, and technicians in the region, it will be a major factor in the development of these human resources so vital for regional growth in the next century.



Very positive steps towards the realisation of the project have already been passed, but a site has to be selected in a fair procedure, the organisation of the laboratory must be established and the financing of the investments and operation of this international centre has to be found. In view of the extraordinary merits of this project one can hope that also these essential issue will find a solution.

Herwig Schopper, President, Interim International Council for SESAME

September 29, 1954: CERN, the European Particle Physics Laboratory is created in Geneva under the auspices of UNESCO. Shortly after a devastating war, scientists from different European countries work together again. The results are extremely positive: CERN has become a leading international center for science and technology, with huge benefits for human knowledge and technology transfer.

**A renewal
of the
successful
dream of
CERN: an
international
science and
technology
center in the
Middle East**

The dream is now being renewed, again within the UNESCO framework. SESAME, an international science and technology center is proposed for the Middle East as a propeller of the regional science and economy and as a promoter of peaceful cooperation. The center will be jointly operated and supported by all member countries, with additional support from other countries interested in promoting the peaceful development of science and technology in the Middle East.

Its key component is the synchrotron light source Bessy IA: a forefront instrument for industrial fabrication and for applied and fundamental research in biology, medicine, environmental science, archaeology, materials science, physics and chemistry. The core mission of SESAME includes applications of direct and immediate relevance to society -- notably, in human health and the environment, and in the development of new materials and industrial processes.

SESAME will host and support a large number of users from Middle Eastern countries, the Mediterranean basin and the entire world. They will perform research close to their home countries, at an international excellence level. The benefits for the entire region will be enormous: SESAME will be the breeding ground of new industrial technologies and contribute to the preservation of natural and cultural resources. It will create a market for technologies and services, stimulating the regional economy in many different ways.



**Synchrotron light: what is it? Why is it so useful?
How does it promote economic development?**

A resource for all technologists and scientists in the region.

A center like SESAME is not reserved for use by a few privileged scientists: it will serve a thousand or more users from the region and the rest of the world. Well-tested review procedures will enable potential users to gain access to the center, based on the quality of their proposal and also taking into account regional needs and priorities. Special funding will support the travel and living expenses of users. Visiting positions will enable scientists to work at the center for long periods of time.

SESAME users will be assisted by a highly-trained technical and scientific staff to assure that even new users, inexperienced with the use of synchrotron light, are successful. To assist in the buildup of this user-support staff, funds have already been secured to enable scientists and engineers from the Middle East to work for one year-periods at synchrotron laboratories in several other countries and gain experience with all aspects of a synchrotron source and user facility. SESAME users will have access not only to the source and the user-support staff, but also to an advanced infrastructure of instruments and facilities -- often not available at their home institution. Above all they will find a stimulating environment of international cooperation.

The benefits will be particularly important for young users. The center will host many students and postdoctoral fellows at different levels, and support the training of hundreds of PhD's, with immense benefit to their education. Operating the facility and the experiments will also provide an excellent opportunity to train in various kinds of modern technologies engineers and technicians who later might move to industry.

In short, by offering excellent source performance and outstanding user support, SESAME will enable its users to transform their ideas and talent to top-level scientific and technological research.

A CERN-inspired international laboratory - in particular a synchrotron center - is much more than a scientific facility. Past experience from different geographic areas shows the substantial and practical benefits to the hosting region:

- Its best scientists and technologists are **motivated not to leave the region**, and often to return if they already emigrated.
- The construction and operation of the center **benefit many regional enterprises**. Quite often, such enterprises acquire additional know-how, thus enhancing their competitiveness and scope.
- Activity at the center **creates business** for local and regional operators, for travel, lodging, restaurants, logistics and technical support needs.
- By stimulating the regional economy, the center **creates jobs** well beyond those in its own staff.
- New synchrotron-based technologies like microfabrication and microanalysis can lead to **spin-off enterprises**.



A propeller for regional economic development



SESAME, an international enterprise linking the Middle East to the entire world

The idea of an international synchrotron source in the Middle East was first proposed in 1997 by H. Winick (SLAC) and G.-A. Voss (DESY) and elaborated with E. Wehreter (Bessy). The project was developed with the support and participation of the CERN-based MESC (Middle East Scientific Cooperation) group -- headed by S. Fubini and H. Schopper and including scientists from the interested region and other countries. The plan was brought to the attention of Federico Mayor, Director General of UNESCO, who expressed his enthusiastic support; in June 1999, he called a meeting of delegates from the Middle East and other areas at the UNESCO headquarters in Paris. The delegations unanimously adopted a resolution launching the project. An interim Council was created (all interested countries are cordially invited to join it), assisted by four committees: the Technical Committee for the source, the Scientific Committee for its utilization, the Training Committee for the preparation of personnel and users, and the Financial Committee to identify funding sources. The composition of the Council and of its committees is the best evidence of the international character and level of the project -- and a guarantee for its success.

The SESAME INTERNATIONAL (INTERIM) COUNCIL:

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The Goal of Science . . .

. . . gradually reduce prejudice

—Niels Bohr



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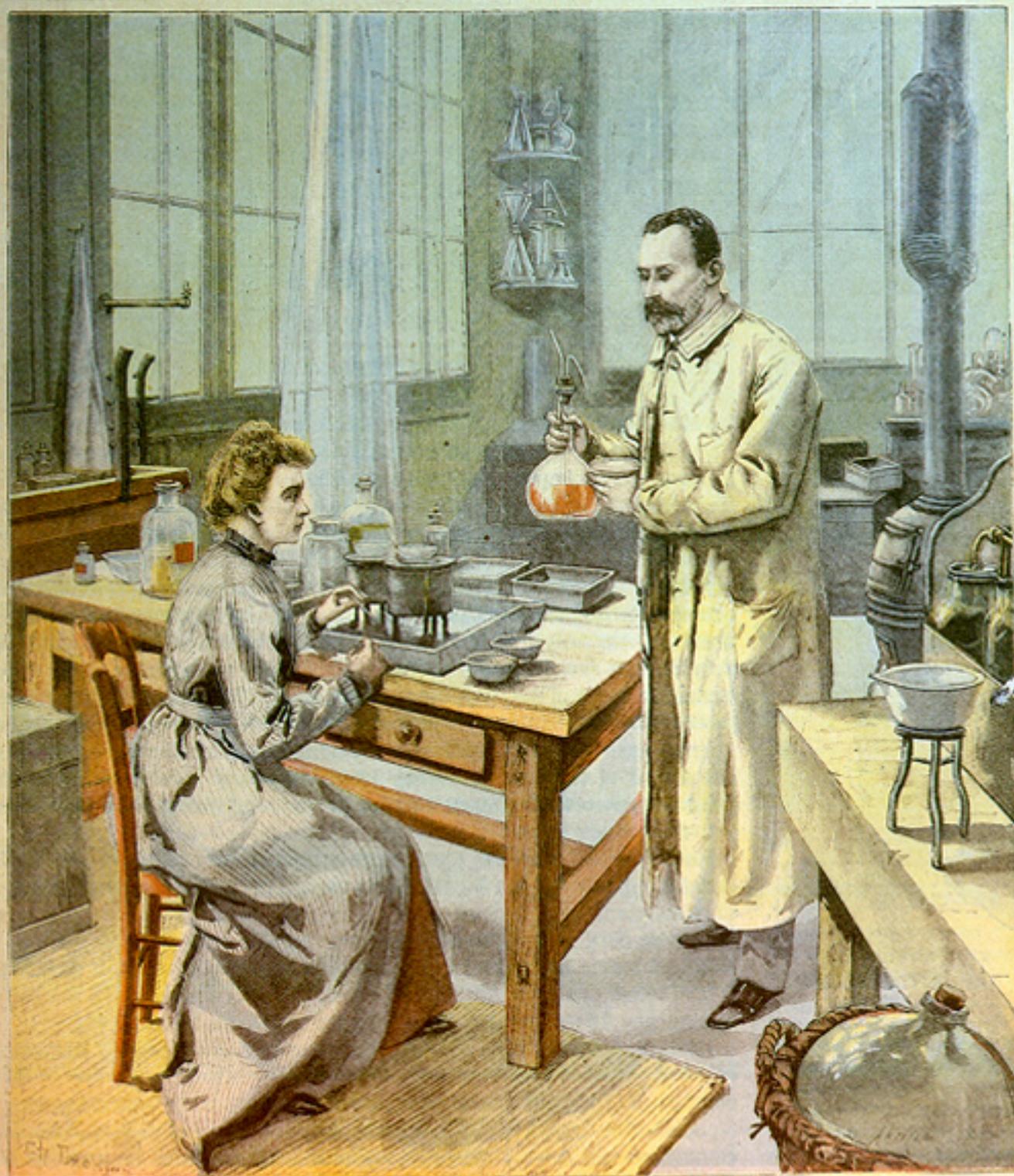
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M. ET M^{ME} CURIE DANS LEUR LABORATOIRE



Girls Scientific Salon Expanded!

Audience: Students , Grades 6 – 8 (In or Entering)

Description: Come experiment with some really hip women scientists. See the science in things that are important to you. Learn how science is important in your daily life. Experiments will let you learn, explore and question. Activities or projects to take home will let you share with all you know. Develop new relationships with women of science. Tour of Fermilab research area included.

Fee: \$60/person

Session: July 18 & July 19, 2003, 9:30 AM–1:00 PM

Instructor: Gail Green, Keller Junior High School, Schaumburg
School District 54

Bonnie Fleming, Fermilab Scientist

Natalia Kuznetsova, Fermilab Scientist

Women in High Places



Sally Dawson, Head of Theoretical Physics at Brookhaven National Lab and Chair-Elect of the APS Division of Particles & Fields.

Presidents Three



Photo Credit: Lalena Lancaster

Three of the four women to serve in the APS Presidential line got together at the American Center for Physics in College Park, MD, in March to attend the meeting of the governing board of the American Institute of Physics. Myriam Sarchik (left) is the current APS President, Mildred Dresselhaus (center) was President in 1984, and Helen Quinn (right), as the current President-elect, will become president in 2004. The fourth woman APS President was the late Chien-Shiung Wu, who served in 1975.

American Physical Society Presidents



Shirley Ann Jackson, President of Rensselaer Polytechnic Institute, former Head of Nuclear Regulatory Commission

Fermilab Statement on Human Rights

Prejudice has no place in the pursuit of knowledge. ...

... In any conflict between technical expediency and human rights, we shall stand firmly on the side of human rights. Our support of the rights of the members of minority groups in our Laboratory and its environs is inextricably intertwined with our goal of creating a new center of technical and scientific excellence.



The Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois, 60510-0500

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What's New

[Fermilab's policy on Nondiscrimination](#)

Last modified: Tue Dec 24
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For Interns

Accepted to the program? Congratulations!! [Find out here](#) what you need to know about the Program as well as what to expect and what we expect from you. ([Login required](#))

For Staff

FNAL Staff members looking for interns from the SIST program should [visit these pages](#). From here, you can post jobs and learn more about hiring from our talented pool of recruits. ([Access restricted to fnal.gov domain](#))

This Fermilab summer program focuses on giving opportunities in science and technology to the minorities that historically have been underrepresented in science in the United States of America. This program is for undergraduate college students currently enrolled in four-year colleges in the US.



Internships are offered in physics, electrical engineering, computer programming and mechanical engineering. These internships offer a chance for approximately twenty college students to work with Fermilab scientists or engineers on a project within the context of laboratory research. We have been in operation since 1971, 2003 is our 32nd year!

SIST is not right for you?
See the [Fermilab Internships Summary page, here](#).

Looking for a scholarship?
Try the program at the [American Physical Society Committee on Minorities](#)

THE BACK PAGE

The Status of the African-American Physicist in the Department of Energy National Laboratories

By Keith H. Jackson

The National Society of Black Physicists (NSBP) has been concerned about the small number of African-Americans with career scientific staff appointments at Department of Energy funded national laboratories. NSBP has also been frustrated with the overall lack of participation of Historically Black Colleges and Universities (HBCU's) in DOE-funded scientific user facilities such as high energy physics and nuclear facilities, Synchrotron Light Sources, and the Spallation Neutron Source. As a result of these concerns, the Technical Executive Officer of NSBP began to collect data, which were placed before the American Physical Society Committee on Minorities (COM). The American Physical Society Committee on Minorities formally took up the issue but first wanted to verify the data provided by NSBP, and to expand the study to include Hispanic physicists. COM enlisted and received the full support of both the National Society of Black Physicists and the National Society of Hispanic Physicists (NSHP).



Our data show that in general African American Ph.D. physicists are less than 0.5% of the Ph.D. physicists employed at the DOE labs. African Americans make up nearly 2% of the physics faculties across the United States, including the faculties of HBCU's. Looking at data compiled by Professor Donna Nelson at University of Oklahoma, we find that the percentage of African-Americans on the faculties of the top 50 physics departments in the U.S. is much smaller (N=60 or 0.6% of total).

SNOWMASS 2001

A Summer Study on the Future of Particle Physics

Nobel Prize-winner Leon Lederman highlights La Noche de la Ciencia at Carbondale Community School, Monday, July 9, from 6 p.m. to 10 p.m.

SNOWMASS VILLAGE—Leon Lederman, winner of the Nobel Prize for Physics in 1988, leads a group of distinguished physicists in a Spanish-language presentation at Carbondale Community School on Monday, July 9 from 6 p.m. to 10 p.m.

“La Noche de la Ciencia,” which is free and open to the public, begins at 6 p.m. with lively science demonstrations by the traveling Physics Van of the University of Illinois at Urbana-Champaign. Spanish-speaking physicists will be on hand to offer translations.

During a refreshment break at 7 p.m., Dr. Lederman and many other physicists—including those speaking Spanish—will be available for informal conversations. At 7:30 p.m., Prof. Arnulfo Zepeda of CINVESTAV in Mexico, a member of the Pierre Auger Cosmic Ray Observatory, will speak on “Ultra-Energetic Cosmic Rays: A New Window to Our Universe. At 8 p.m., a panel will discuss “What Does Basic Science Have to Offer Us: Questions and Responses.”

Among the panelists who have confirmed their participation:

- Gabriela Barenboim (Argentina), of Fermi National Accelerator Laboratory in Batavia, Illinois near Chicago;
- Gustavo Burdman (Argentina), of Boston University and California’s Lawrence Berkeley National Laboratory;
- John Ellis (Colombia), of CERN, the European Particle Physics Laboratory in Geneva, Switzerland;
- Belen Gavela (Spain), of the University of Madrid;
- Ramon Miguel (Spain), of the University of Barcelona;
- Mayda Velasco (Puerto Rico), of Northwestern University in Evanston, Illinois;
- Luis Manuel Villasenor (Mexico), of the University of Michoacan;
- Arnulfo Zepeda (Mexico), of CINVESTAV;

...and many more.

To reach Carbondale Community School, take route 82 to 133 and turn left; go to Doloras Way and turn right; after passing the rental equipment store, turn right and look for the school sign.

La Noche de la Ciencia is a community outreach effort of the Science Outreach Center in Carbondale, and of “Snowmass2001: A Summer Study on the Future of Particle Physics.” The three-week conference is being held at the Snowmass Conference Center. For more information, see the website: <http://www.snowmass2001.org>.



Physics
without
Boundaries?

New DOE Security Guidelines Impose Restrictions on National Labs

By Pamela Zerbinos

New interim security guidelines outlined by the US Department of Energy (DOE) are causing upheavals in the way some national laboratories handle their identification and access procedures. The guidelines went into effect on April 4. The restrictive measures taken include tying laboratory identification and access cards to visa status, as well as rescinding the exemptions granted to seven national labs due to the unclassified nature of their work. Final regulations are expected to be approved later this year.

The seven labs directly affected by the new guidelines are Ames Laboratory, Fermi National Accelerator

Laboratory, Lawrence Berkeley National Laboratory, the National Renewable Energy Laboratory, Princeton Plasma Physics Laboratory, Stanford Linear Accelerator Center, and the Thomas Jefferson National Accelerator Laboratory. These were exempt from much of the previous DOE directives concerning foreign visitors and assignments, because the work they perform is not classified. "Everyone expects a higher security standard when you're designing nuclear weapons," said John Womersley, co-spokesperson for Fermilab's DZero experiment. "What we were unprepared for is that this standard

would be applied to us."

The prior exemption meant that the labs did not have to collect and report certain information on foreigners, including biographical and personal data; passport and visa information; the purpose of the visit; the actual areas and subjects to be visited, and the host and sponsoring organization of the visit. Under the new policy, this information is now to be collected and entered into DOE's Foreign Access Central Tracking System (FACTS). This translates into interviewing every foreign visitor to the seven labs to ensure that the DOE has their information on file. It also necessitates issuing new ID badges tied to their visas; when the visa expires, so does the ID badge. Scientists must go through the interviewing pro-

See **GUIDELINES** on page 2

Dear Congressman...



Harvey Gould of Clark University (standing) offers some advice to William Jensen of UMass-Boston, who is preparing to write to his representatives in Congress using special software provided by the APS Office of Public Affairs. More than 2000 letters to Congress were written by attendees at the March meeting.

March Meeting Prize and Award Recipients

THE CHRONICLE

of Higher Education®

April 11, 2004
Volume XLII

INSIDE



ng Their Case Supreme Court

ers and protesters
o sway the justices
ormative action: **A31**

ngs Attached

re companies replace
ions with deals that
many conditions: **A41**

ting Missions

gest community college
our-year degrees, will
s rethink how they
higher education? **A34**



Learning om Pericles

I. Lang's new campaign
s colleges to promote
gement by students: **A47**

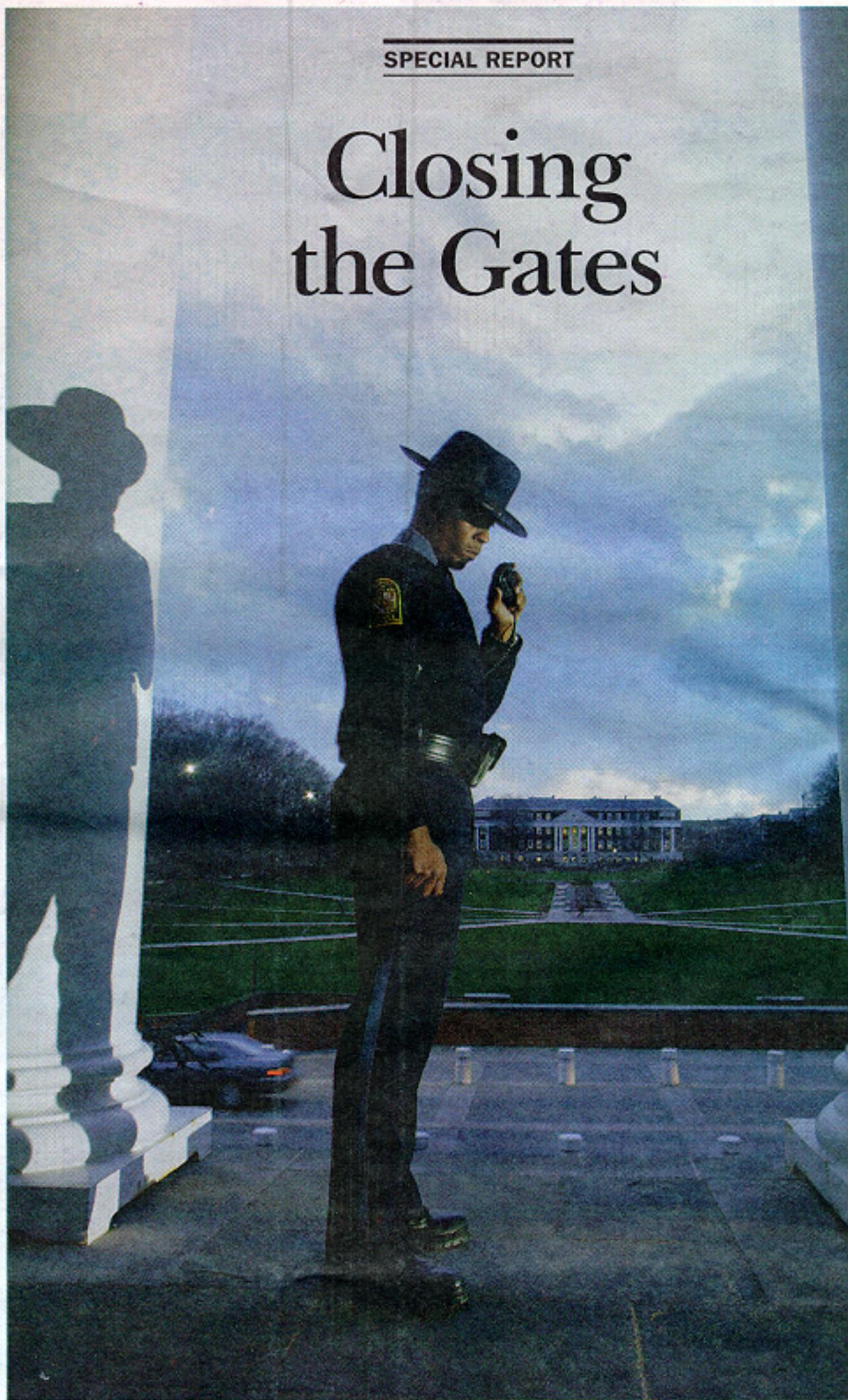
Million Richer, nd Still Poor

e of the largest gifts
e education fails to turn
nd a university: **A36**

ie guide to this issue: **A5**
nicle Review: **Section 2**
pportunities: **Section 3**

SPECIAL REPORT

Closing the Gates



For American colleges, homeland security
comes at a high price: **A12**

CLOSING THE GATES

Stalled at the Border

Many research projects have been delayed or disabled by strict U.S. visa policies

By LILA GUTERMAN

The homeland-security measures adopted since September 11 have derailed an untold number of scientific research projects. In particular, stricter reviews of visa applications have delayed many scientists seeking to enter, or re-enter, the United States. As a result, cells have languished, lasers have gone unused, and even pencil-and-paper theoretical projects have stalled.

The magnitude of the problem is unknown. Rep. Sherwood L. Boehlert, the New York Republican who leads the U.S. House of Representatives Science Committee, said last month that he would ask the General Accounting Office to collect data. Stuart Patt, a State Department spokesman, estimates the average wait for a visa to be one month. "We are working to improve the security-review process," he says. "The reviews are more timely than they were six months ago."

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* Twenty-three scientists planning to use the particle accelerator at Fermi National Accelerator Laboratory, in Batavia, Ill., have experienced delays or are still waiting for visas. The scientists are from countries including China, India, Poland, Russia, and Vietnam. Two scientists from India were denied visas. Many of the foreign scientists are graduate students or postdoctoral researchers at American universities.

"It has had a negative effect on the overall project," to study the fundamental constituents of matter, says John Womersley, a physicist there. Only eight of the scientists have received visas to date.

Section: Special Report · Volume 49, Issue 31, Page A20

Researchers rage at tightened restrictions on US immigration

Geoff Brumfiel, Washington

Scientific leaders are increasingly fearful that tighter immigration procedures, introduced in the wake of the terrorist attacks on 11 September 2001, are threatening the United States' position as a magnet for the world's scientific talent.

Researchers from countries as diverse as Indonesia and Germany are now subject to detailed security checks and rigorous interviews. The clampdown covers first-time visitors to the United States and those returning to lab positions there — delaying trips by weeks or months, and deterring some from coming at all.

The consequences of the change, which intensified with the introduction last August of new visa guidelines for consular officials, could be far-reaching. "We are in a rapid transition, whereby the United States will cease to be the destination of choice for researchers," predicts Irving Lerch, director of international affairs at the American Physical Society.

Some researchers and officials outside the United States — such as those at top European universities — acknowledge that they could benefit from a protracted reduction in the flow of scientists into US institutions. But publicly, at least, they draw little comfort from the situation.

"I'd prefer a world in which individuals make free decisions about where to go and



Locked out: Chinese students protest over the US embassy's refusal to grant them a study visa.

work," says Robert May, president of Britain's Royal Society. "We need to keep Britain and other European destinations attractive for scientists — but not as second-choice countries."

Last week in Congress, the House Science Committee held hearings to address scientists' concerns. "The current situation is untenable," argued the committee's chairman, Sherwood Boehlert (Republican, New York). "Foreign students fill our graduate

programmes; foreign scholars fill our faculty and laboratory positions. These people are a vital source of new ideas and perspectives." But not all committee members agreed, with some voicing satisfaction at the exclusion of foreign scientists (see below).

The overall scale of the shift is difficult to quantify, but some indicators suggest that it is significant. At the Human Frontier Science Program, which funds international collaborations between biologists, for example, the

Congressmen unmoved by foreigners' plight

Worries about the entry delays being experienced by foreign researchers coming to the United States were the avowed topic of a hearing of the House Science Committee on 26 March. But most of the members who turned up had different concerns on their minds. They wanted to know what is being done to make the United States more secure — and to lessen its dependency on foreign scientific talent.

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Ralph Hall (Democrat, Texas), the senior

minority member on the committee, said that America's dependence on foreign students bothered him almost as much as the country's dependence on foreign oil.

And Dana Rohrabacher (Republican, California) suggested that the domestic shortage could be remedied if US students were given preference over foreigners for places in US graduate education programmes. "There are scientists from communist China swarming all over Los Alamos lab," he said, "and when the Chinese start building rockets efficiently enough to hit any American city, we can start blaming this open exchange that we've had between scientists and our universities."

Some research leaders at the hearing were discouraged by the lack of sympathy expressed by committee members towards the plight of foreign scientists. But Wendy White, who directs the National Academies' Board on International Scientific Organizations, was pleased just to see the issue raised. "I was heartened by the fact that there were hearings at all," she says.

Hall and Sherwood Boehlert (Republican, New York), the chairman of the committee, said at the hearing that they have written to the General Accounting Office requesting a study to assess the backlog and to review visa security-check procedures.

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ILLUSTRATION BY JESSE MALDONADO FOR THE CHRONICLE

*When We Hinder Foreign Students
and Scholars, We Endanger
Our National Security*



Science's latest discovery: how much we don't know

Flora Lewis

Wednesday, April 3, 2002

The edge of knowledge

DIVONNE, France A seminar from the frontiers of research in various fields, such as one presented here during the Forum 21 conference recently, is breathtaking. While we've been busily reading about war in Afghanistan, violence in the Middle East and fallout from the Enron scandal, the scientists have been quietly but steadily pressing on with revelation of nature's secrets.

Reporting to about a hundred laymen on the latest word from their specialties, a cosmologist, a particle physicist, a molecular biologist, a nanoelectronics physicist and an astronaut showed that the understanding of the physical world has changed profoundly in recent years.

Passports, religion and cultural tradition are irrelevant. It takes knowledge to grasp the voice of science, but it is a single voice, open to all. That is particularly evident nearby at CERN, the European atom-smashing laboratory that is now building a 27-kilometer supercollider to find the particle that is believed to be responsible for the existence of mass. People from all kinds of countries work easily together, even if their countries don't recognize each other or are at war.

But as each expert explains the latest developments in his field, what is most impressive is no longer the tremendous progress made in the last century or so but the increasing awareness of how much is unknown. Not so long ago, we had the impression we were near to discovering the ultimate facts of existence - just a few more basic questions, scientists thought, and the essentials would be clear.

On the contrary, new research is finding more and more to study, critical things we didn't even know we needed to know.

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The greatest lesson of science these days, as it floods us with amazing possibilities, is the excitement of learning why we need humility.



Physics
without
Boundaries!