

# HEP Impact on the Workforce and Education

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Notre Dame

# Directions of Effort

- **Workforce Development**
  - Training and education
  - Professional Development
  - Science Centers
- **Education**
  - Formal (classroom or instructional setting)
  - Informal (displays, museums)
- **Outreach**
  - Public events
  - Websites
  - Social Networking

# Methodology

## What/how

- What are the needs and/or objectives
- Target audiences
- Ideas
- Approach
  - Team
  - Proposal and resources
- Implementation
- Evaluation
- Sustainability

## Scale/scope

- Individual
- Local
- Regional
- State
- National
- International
- ...

# Workforce Development and Science Education Centers

- PIRE
- REU
- Fermilab Education Office
- LIGO Science Education Center
- DUSEL Science Education Center
- Soudan Underground Laboratory

# Partnerships in Research and Education



# US universities collaborate with institutions abroad – PSI and ETH

## What

- Scientific Research
  - Particle physics with the CMS detector
  - Silicon pixel detector technology
- Education
  - Study Abroad for science students
  - ETH – Zurich exchange program
  - Undergraduate Research

# Example of a program year

2010

Students working on PIRE projects (19):

7 Graduate 12 Undergraduate

13 Students in Switzerland

- Spring: 1 Grad, 2 UG
- Summer: 3 Grad, 10 UG
- Fall: 3 Grad, 2 UG

ETH Study Abroad:

- Spring (2):

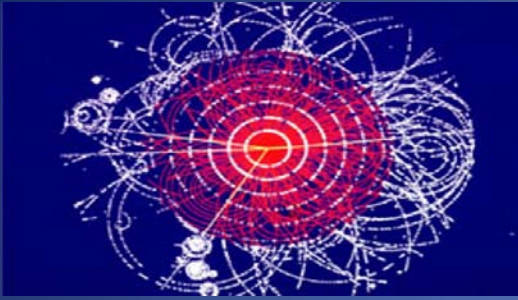
1 KSU UG through KU

1 UIC UG through UIC

- Fall(2) :

1 UNL and 1 KSU UG via KU





## University of Michigan-CERN REU Program 2001-2010

139 Students

(44 (31.6%) women, 23 (16.5%) underrepresented groups)

### Recent Participant Institutions

#### 2007

- Northwestern
- MIT
- NC
- U. Washington
- Norfolk State
- Reed
- U Missouri
- Rose-Hulman
- Michigan State
- U Colorado
- Benedict College
- U Dallas
- U Rochester
- Tulane
- UMichigan

#### 2008

- Alma
- Drake
- Hampton
- Loyola (MD)
- Norfolk State
- Notre Dame
- Otterbein
- Penn State (2)
- Purdue
- Rochester
- St. Mary's (Texas)
- U Michigan
- West Point
- Yale

#### 2009

- SUNY(Binghamton)
- Duke
- Georgia Tech
- Hampton
- Layfayette College
- Michigan State
- MIT
- Olin College of Eng.
- Purdue (2)
- Rutgers
- Univ. of Dallas
- Univ of Fla.
- Univ of Mich.
- Univ. of Texas

#### 2010

- CalTech
- Florida Inst. Tech.
- Ill. Inst. Tech.
- Johns' Hopkins
- Lincoln University
- Oregon State
- Purdue
- Stanford
- Univ. of Michigan
- Univ. of North. Arizona
- Univ. of North Carolina
- Univ. of South. Cal.
- Univ. of South Fla.
- Univ. of Texas
- Valparaiso University



# Program Structure-Research

- CERN runs a summer program for European physics students from Member State Countries ( ~150 students).
- With special permission (though the U.S. is not a Member State), 10 of our 15 students are in this program with their research assigned by CERN. 5 of our students have their research arranged by the Michigan program organizers.
- There are several student presentation sessions during the program. The final presentation is recorded and posted on our website.



# Typical Day in July

- 9-12 am: Summer Student lecture series, discussion sections
- 1-5 pm ++: Research group work
- Evenings, weekends often free for travel



2007 and 2009 student s



# Teacher Component

- CERN runs a 3-week summer program for High School Physics Teachers.
- In partnership with QuarkNet, 5 US physics teachers participate in the program.
- The support structure for the US REU students is available to help the teachers also.

*Waxahachie*  
**Daily Light**

**News**

**Global High teacher spends summer with CERN collider program in Switzerland** Print Page

**From STAFF REPORTS**  
Published: Wednesday, September 10, 2008 9:50 PM CDT

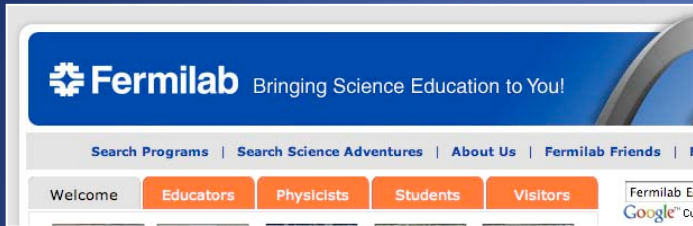
Evelyn Restivo of Maypearl, a chemistry and physics teacher at Global High School in Waxahachie, was selected to participate this summer in the High School Teacher Program at the European Organization for Nuclear Research, CERN, in Geneva, Switzerland.

"This was an absolutely incredible experience that I will be using in my classroom for years to come," Restivo said. "It was 3 1/2 weeks where I learned more than I've ever learned before. It's incredible to be selected to be involved in the study."





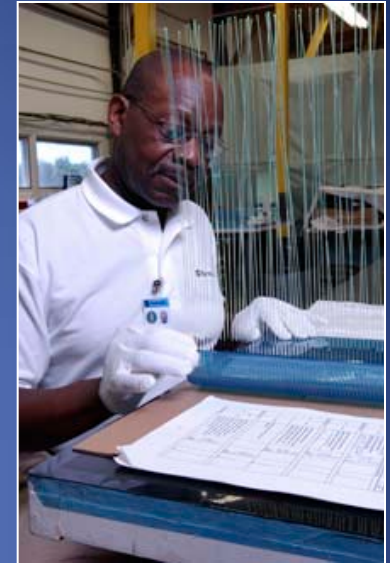
# Fermilab Education Office – for Teachers...



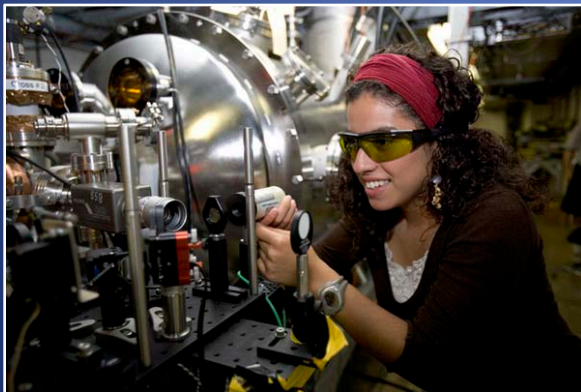
Website



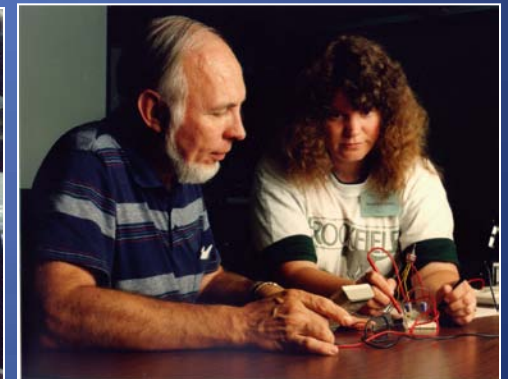
Teacher Resource Center



Research Appointments



Workshops



Lederman Science Center....



# Fermilab Education Office - for Students...

## Field Trips & Open Houses

### Physics Exhibits



Symposium on Nature of Science



Classroom Presentations

Lederman Science Center...

# Participants in FY10 Fermilab Programs

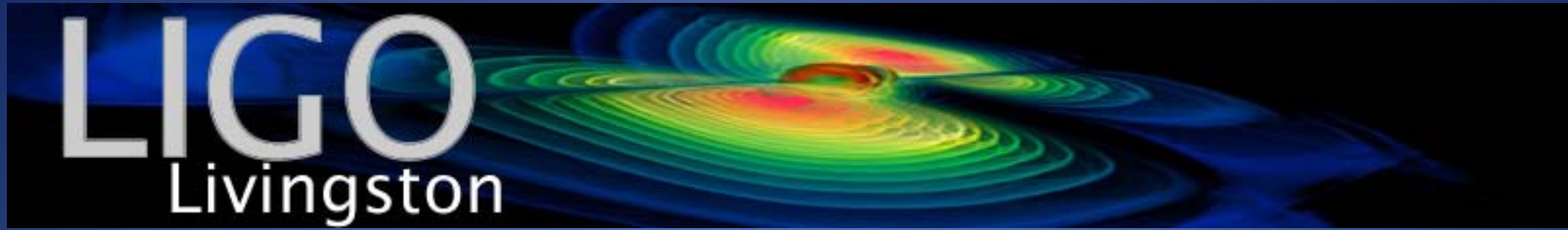
65 Post Docs

551 Graduate **Students**

78 **Undergraduate** Interns

2,499 K-12 Teachers

37,629 K-12 Students



## A collaborative

- Scientists
- Universities
  - Southern University Baton Rouge
  - LSU...
  - The experiment
- State of Louisiana
  - LA GEAR UP, LASIP
- Exploratorium

## Pre-high school grades

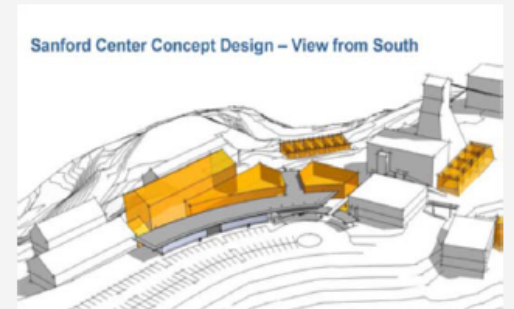
- Education program built around informal education exhibits
- Additional exhibits at SUBR
- Docents from SUBR





## Education and Outreach

The Sanford Center for Science Education (SCSE) will be the education and outreach arm of DUSEL. Philanthropist T. Denny Sanford donated \$70 million to help convert Homestake into an underground laboratory, of which \$20 million will be used to help establish a state-of-the-art science education facility.



- **Physical facility**
- **27,000 ft<sup>2</sup> facility (not yet constructed)**
- **- majority of the funding from in-hand, private donations**
  
- **Location/Audience**
- Geographic location close to high-volume tourism areas (3 million/year)
- Market analysis shows likely visitors to be family-oriented and receptive to science topics
  
- **Programs**
- Will concentrate on ongoing experiments in the underground environment as well as surface environmental studies
  
- **Digital presence**
- vDUSEL – acts as a virtual science center to connect online visitors to the physical SCSC
  
- **Cultural outreach**
- - the local region is home to many American Indian communities



# Building partnerships: South Dakota Science Scholars

Two programs give top-achieving science students from across the state a chance to participate in programs at Sanford Lab and its partners.



The 2010 Davis-Bahcall Scholars finish a five week program at Sanford Lab, CERN, Gran Sasso and Princeton by posing with Governor Mike Rounds and Prof. Netta Bahcall.



The 2010 Homestake-Fermilab Scholars pose in the atrium at Fermilab.

# Partnering with American Indian education: GEAR-UP workshops and tours

In 2010, we worked with American Indian high school freshmen (water treatment), juniors (chemistry) and seniors (nuclear forensics) in the summer GEAR-UP program – a residential program at SDSMT preparing students to succeed STEM disciplines in college – reaching 230 students.



*Juniors mix polymer*



*Freshmen pose at the Open Cut*

# DUSEL Workforce Development

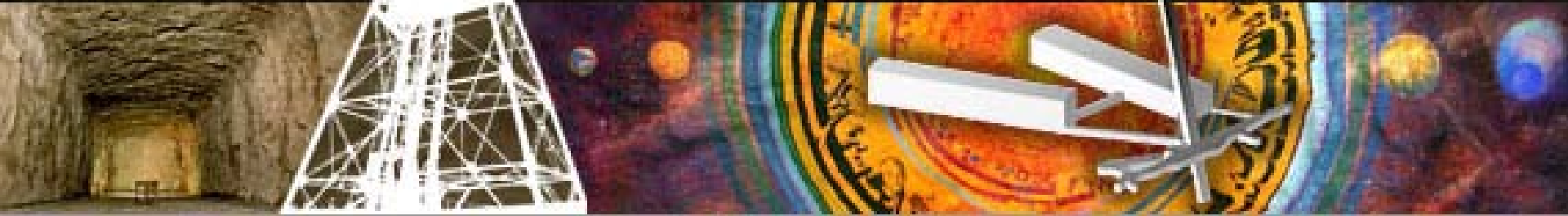
Type	Early Science (currently operating)*	Project Construction and Operation (anticipated)
Graduate students	~70	~600
Post-Doctoral	2	~85**
Staff Scientists	2	20
Engineers and Technicians	5	12
Trained underground workforce	~90	~105

\* The Early Science Program at the laboratory currently is operating in support of dark matter experiments, neutrino experiment, and other non-physics science. Numbers include all disciplines

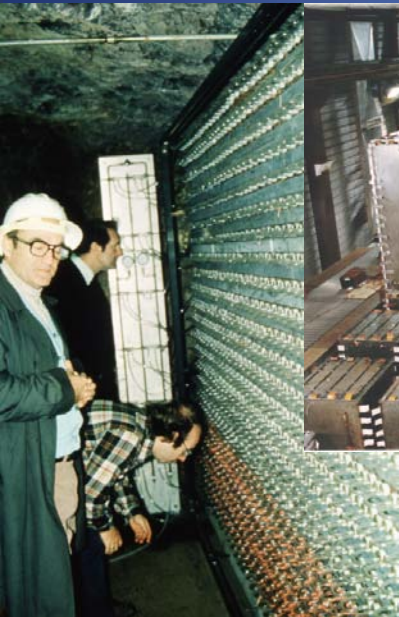
\*\* It is anticipated that the Facility will have post-doctoral positions as well as post-doctoral positions associated with the experimental collaboration programs

# SOUDAN

# UNDERGROUND LABORATORY



## 30 Years of Education and Outreach



MINOS-5.6Kt  
1999-2011...



Soudan 2-1Kt  
1985-2001

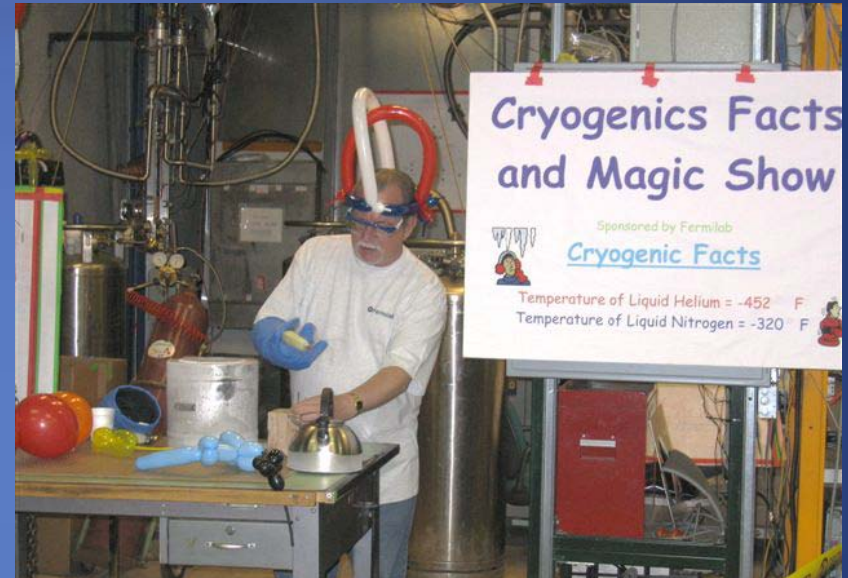


Soudan 1-35t  
1981-1989

CDMS  
2000-2013...

# Public Tours at the Lab

- Annual Free Open House is a VERY important part of making sure the local community supports the work we are doing
- State Park provides historic tours to 40,000 people per year
- 4,000 people tour the Soudan Underground Lab lead by HS Teachers and undergraduate students hired under our outreach program.



# Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE)



**Wilson Synchrotron Laboratory**

**ACCELERATING TOWARD A BRIGHTER FUTURE!**

**Saturday June 27**

**Wilson Synchrotron Laboratory  
Cornell University**

(visit our web and important information)

- Hands-on activities for the whole family!
- Door prizes!
- Demonstrations!
- Free refreshments!
- Tours of the particle accelerator and x-ray facilities!
- Free helium balloons!
- Give-a-ways!

visit [www.lepp.cornell.edu/education/](http://www.lepp.cornell.edu/education/) for additional information, directions and other important information



## Rural Schools, Local Knowledge and Classroom Science

In this forum, we will learn hands-on activities that focus on science and engineering in the context of rural life. We will explore how to validate and capitalize students' local rural knowledge and use these activities as a 'hook' to engage students in science.

We will be utilizing innovative science engineering curricula – Engineering is Elementary (EiE), Engineering the Future, and Cornell Environmental Inquiry (EI) – as models for implementing inquiry-based science and engineering activities in grade 3-10 classrooms.

Attendance includes a \$300 stipend, curricular materials, kits, lodging, meals and travel reimbursement.

Registration deadline: May 29, 2009. Limited space – register soon!

A \$40 refundable deposit is required w/application.



An Educational Field Experience for High-Needs

Hosted by the Cornell University Center for Rural Science, Knowledge and Engineering Technology, and Engineering Education

July 2009  
Cornell University  
Ithaca, NY

Visit [www.lepp.cornell.edu/Education/RuralScience/](http://www.lepp.cornell.edu/Education/RuralScience/) for additional information and to register.

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EDUCATION UPDATE \* OUTREACH

June 2009

**Angels & Demons Public Forum (Yuval Grossman & Peter Wittich)**  
At the public library, Peter and Yuval discussed some of the science facts and fiction revealed in the book and movie, Angels & Demons.

**Atoms for Kids After School Program Candor Elementary School**  
Students used microscopes to view coffee grinds, fibers, salt and skin cells. They recorded what they saw and noted details they could not see with their naked eye...  
They discussed phases of matter and then made Oobleck. They debated whether it was a solid or a liquid and discussed experiments they could perform to support their hypothesis...  
Students did an activity to help explain how Atomic Force Microscopes work...  
Each had to try to determine what object was in their "Mystery bag" without opening up their bag and looking at the object.

**Expanding Your Horizons at Lansing Residential Center (Tracy Davenport)**  
The residents learned about energy conversion by participating in activities involving two-potato clocks, steam put-put boats, poppers and solar powered cars.

**Visit by Cayuga Heights 2nd Graders**  
Students about to see the ERL injector.

**Math Day at Boynton Middle School (Yuval Grossman)**  
Students spent their math period involved in math-related workshops. Our workshop focused on Statistics using M&M's. Yuval focused on Game Theory and how to increase your chances of winning various games.

For information or to volunteer, visit: [www.lepp.cornell.edu/Education](http://www.lepp.cornell.edu/Education)

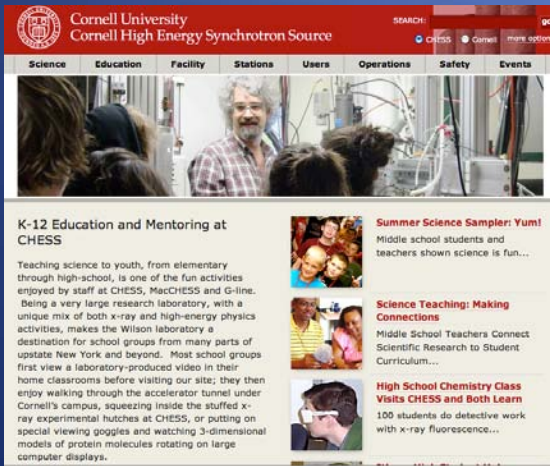
# Recent Accomplishments

## *Highlight four successful efforts:*

1. Meaningful undergraduate research experiences
2. Development of a portable XRF device for E&O
3. Delivering programs to diverse populations
4. Connections with rural school populations



*A fourth grade student from Waverly Central School District (36% FRPL) observes crystals growing in his jar as part of the after-school program.*



**Cornell University**  
Cornell High Energy Synchrotron Source

SEARCH:

Science Education Facility Stations Users Operations Safety Events

**K-12 Education and Mentoring at CHESS**  
Teaching science to youth, from elementary through high-school, is one of the fun activities enjoyed by staff at CHESS, MacCHESS and G-line. Being a very large research laboratory, with a unique mix of both x-ray and high-energy physics activities, makes the Wilson laboratory a destination for school groups from many parts of upstate New York and beyond. Most school groups first view a laboratory-produced video in their home classrooms before visiting our site; they then enjoy walking through the accelerator tunnel under Cornell's campus, squeezing inside the stuffed x-ray experimental hutches at CHESS, or putting on special viewing goggles and watching 3-dimensional models of protein molecules rotating on large computer displays.

**Summer Science Sampler: Yum!**  
Middle school students and teachers shown science is fun...

**Science Teaching: Making Connections**  
Middle School Teachers Connect Scientific Research to Student Curriculum...

**High School Chemistry Class Visits CHESS and Both Learn**  
100 students do detective work with x-ray fluorescence...



*David Aguman-Budu demonstrates how a vacuum chamber works at the October '10 Science & Engineering EXPO in Washington DC*

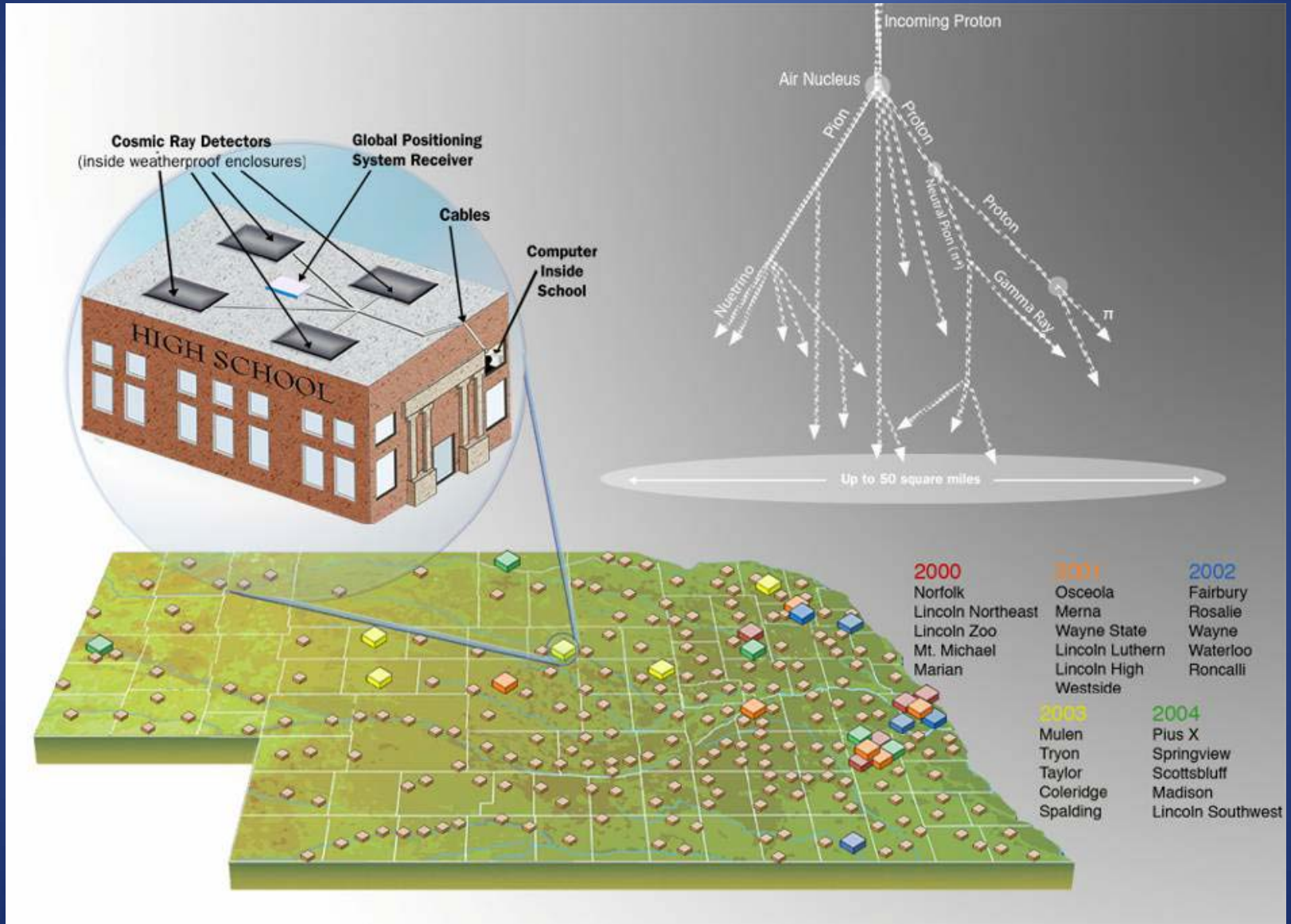
Learn more about Education and Outreach at <http://www.chess.cornell.edu>

# Education Projects

- CROP
- Mariachi
- CHEPREO
- QuarkNet
- I2U2



# State – Cosmic Ray Observatory Project



# Summer 2004 Workshop Activities

## Detector assembly and testing

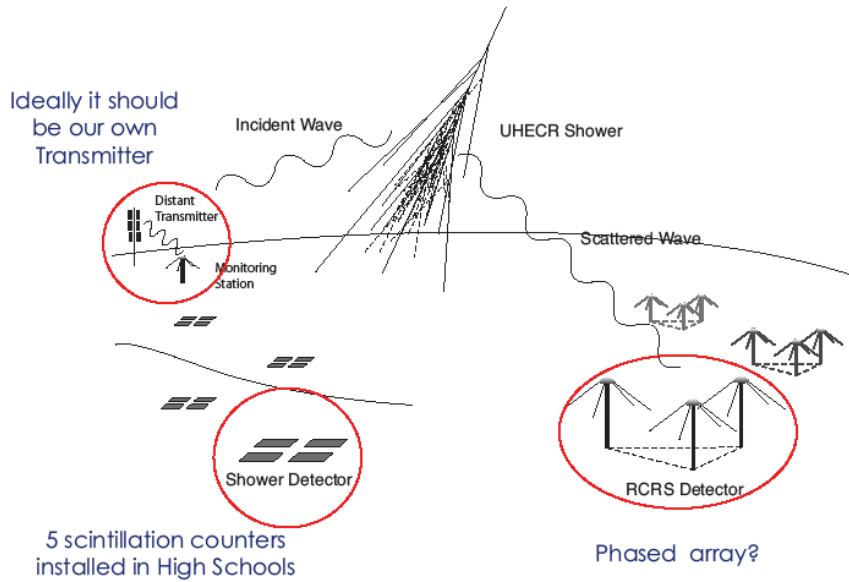


# Excellent extensive air shower data taking run overnight



# MARIACHI

## Experimental Setup

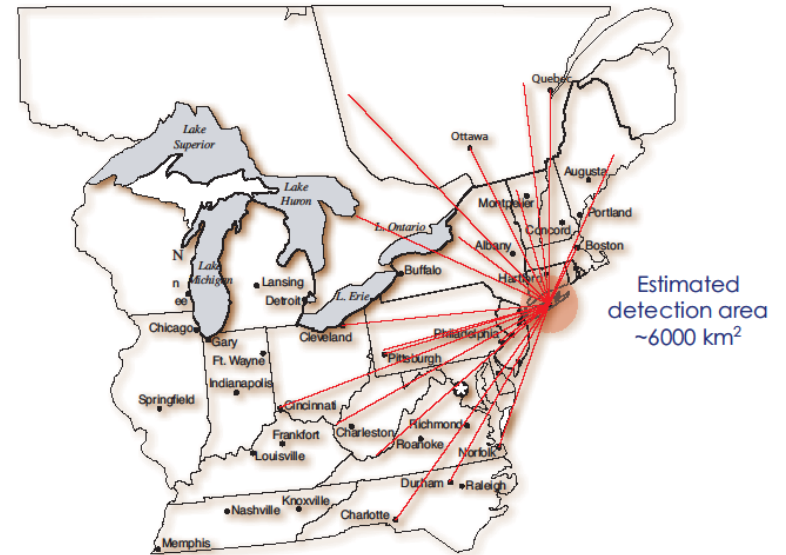


## Mixed Apparatus for Radar Investigation of Atmospheric Cosmic-rays of High Ionization



planned offline low rate active

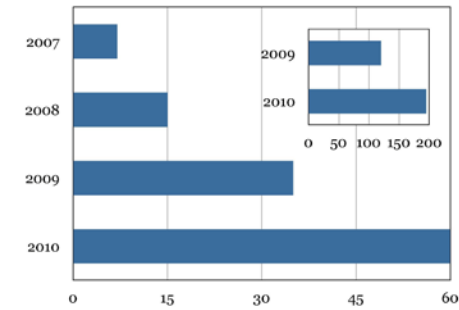
## TV Broadcast Stations



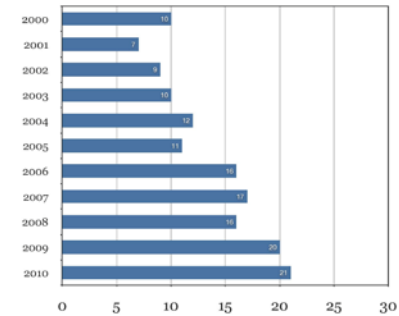
# Mariachi in action



# MARIACHI Impact



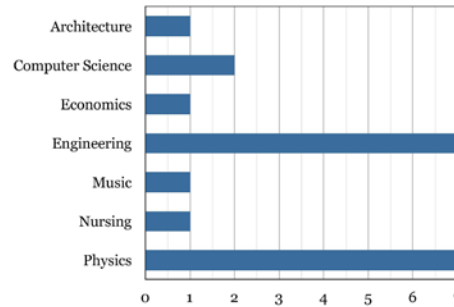
Number of students in CERN MasterClass events. The inset shows the number of students in in-school MasterClass events. The number of schools involved grew from 1 to 6 in the same period.



Number of teachers in QuarkNet summer workshops. From these teachers 6 constitute the core group who help organize and run workshops. After 2005, approximately 40% of teachers return every year.



Where are they going?



Surveyed research students majors. Declared or received degrees. Based on received responses (72%).

Peter Muhoro  
Hampton U.,  
APS - Minority  
Bridge Program  
Manager



Jessica Newman  
Stony Brook  
Sikorsky Aircraft

# CHEPREO

## Learning Community Embedded in Particle Physics Research

CHEPREO @ Florida International University

Center for High Energy Physics Research and Education Outreach

- CMS Physics / Grid Computing / Education Outreach
- FIU: Hispanic-Serving Institution located in Miami with 38k students

### Opportunity to Enhance & Broaden Science Participation

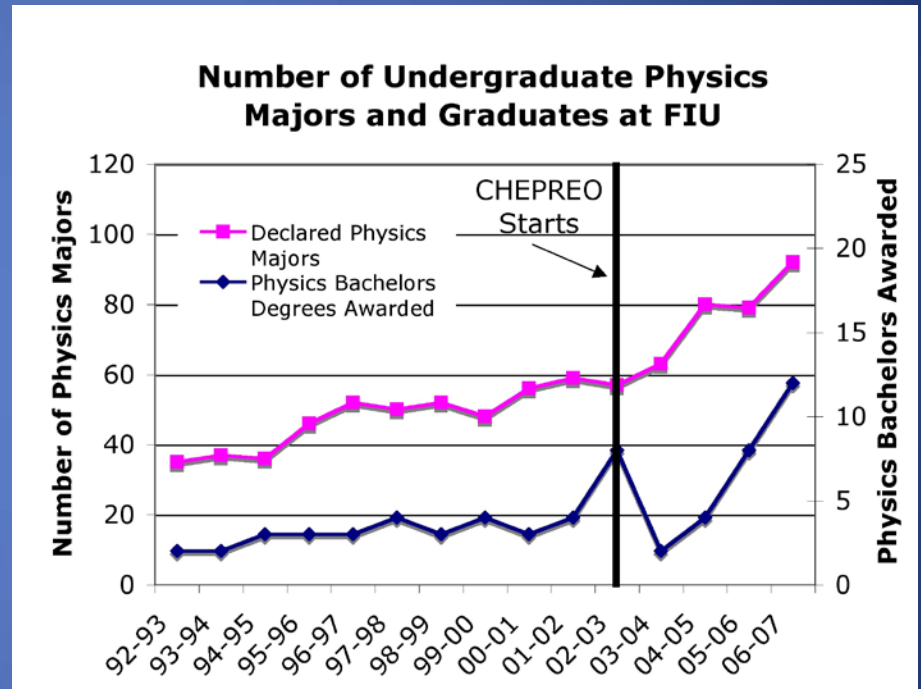
- Research and Learning Community
  - High School / University Stakeholders
  - Integrated Pipeline to Support Students
- Focus on Underrepresented Groups
- Target HS & Introductory Classes
  - Modeling Instruction: Studio-format
- Explicit Community Building
- Seed for Science & Math Reform



### Redefining Model for Education Outreach

# CHEPREO's Impact

- Modeling Instruction has Improved
  - Performance: FCI both at high school and college
- Change in Physics Majors: Community!
- Sparked Physics & Cross-College Reform
  - New Ed Degrees in Math / Chem / Earth Sci
- **New Education Outreach Model**





# CHEPREO's Impact (HEP)

## CHEPREO Fellows engage in HEP computing activities

- Establishment of local computing at FIU
  - Fellows are constructing our new CMS Tier3 Computing facility at FIU
  - Fellows are now helping us build a new CMS Center at FIU
    - To support group video conferencing, and CMS online shift taking
    - Outreach to large South Florida community, CMS information + QuarkNet CRiL display



*FIU Tier3' new 216 core Dell cluster*

*CMS Center at FIU*

## CHEPREO Fellow @ CERN

- Fellow sent to CERN in Summer 2009
  - Student participated in test beam activities helping FIU with its HCAL commitments



# QuarkNet

52 Centers in 25 states and Puerto Rico

500 HS Teachers

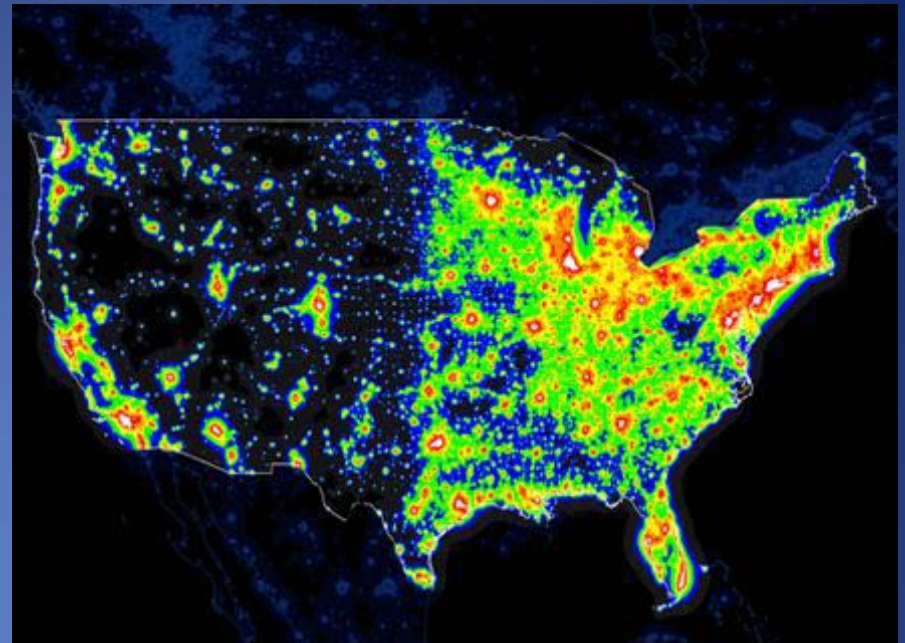
80 Particle Physicist mentors

100 HS Students annually

A professional development program for HS Teachers with immersive research experience for HS teachers and students.

Now in its 13<sup>th</sup> year. Supported by NSF and DOE

<http://quarknet.fnal.gov/>





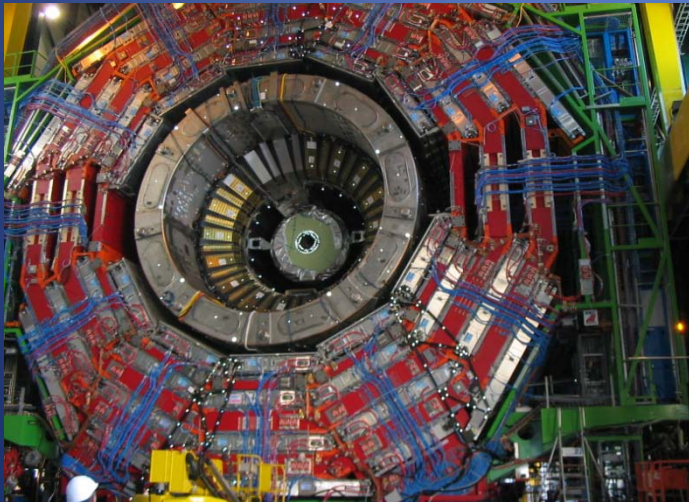
# QuarkNet

## The QuarkNet Collaboration

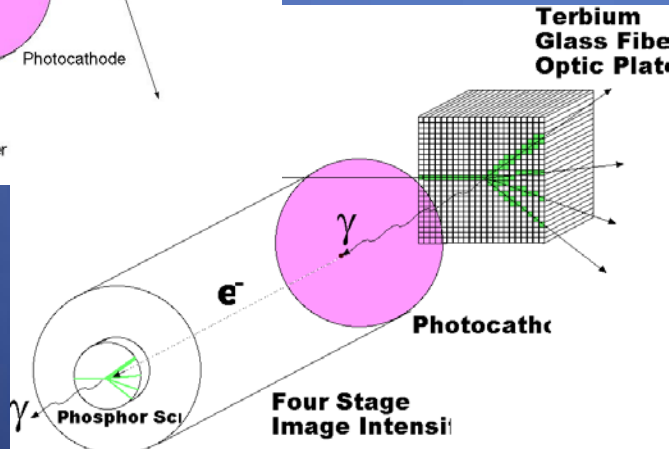
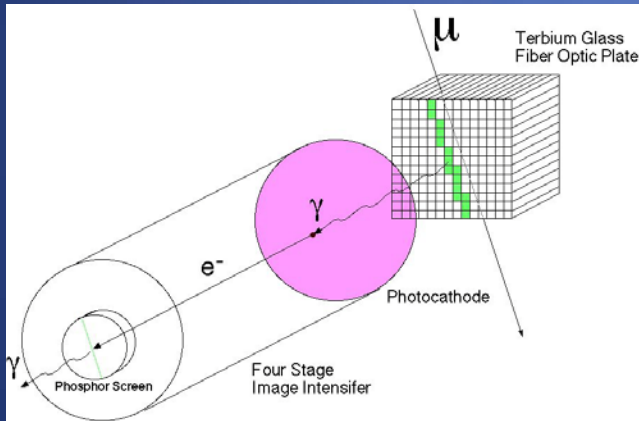
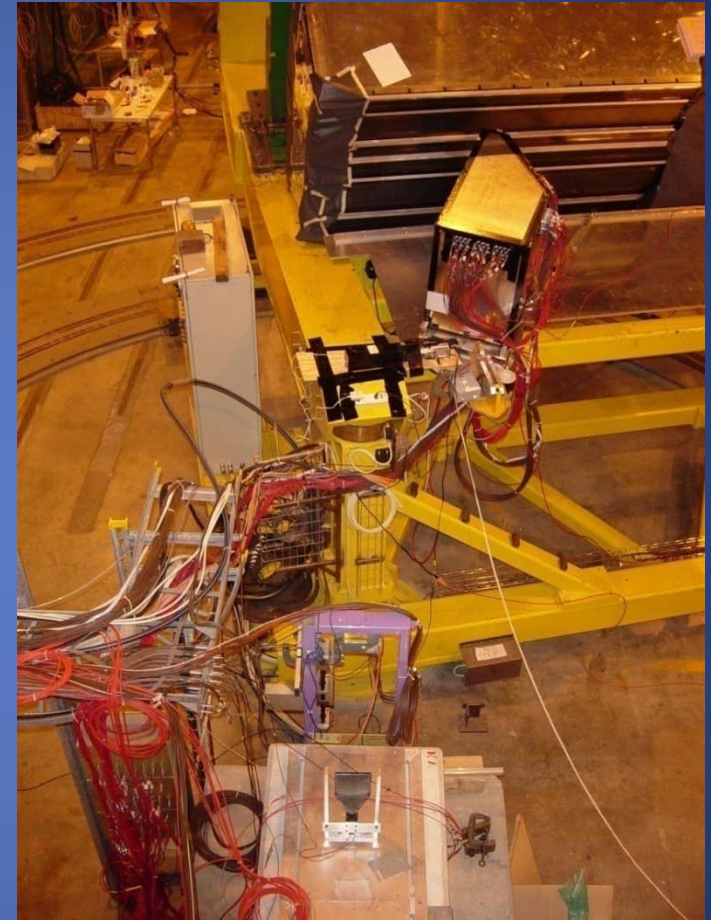
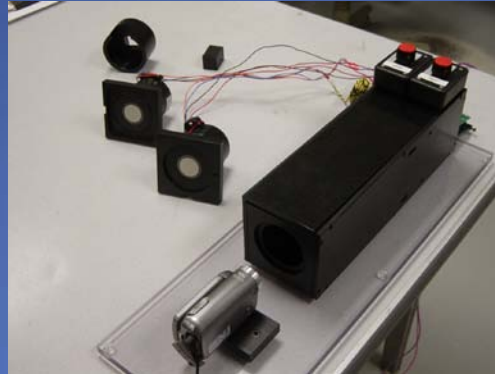


# QuarkNet Student Research

- Optical decoding for the CMS HCAL Barrel, Outer Barrel and Endcap
- 550 Fiber-optic decoder units.



# Informal Education - Compact Particle Detectors



# Interactions in Understanding the Universe - I2U2

High school students use e-Labs to conduct science investigations.

## About I2U2

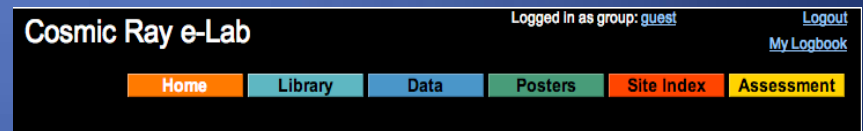
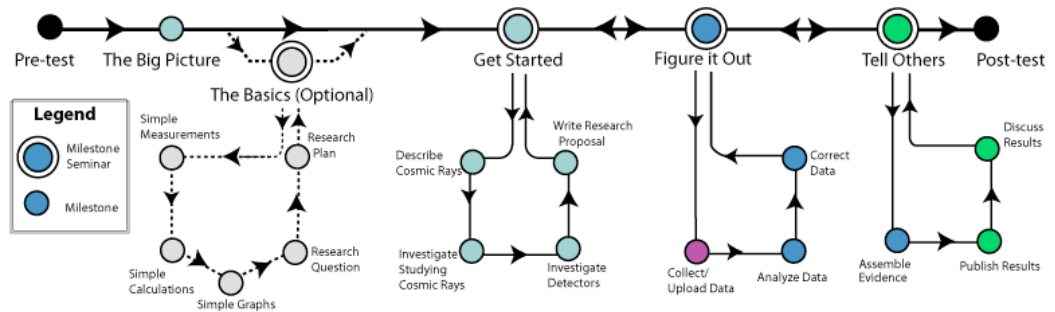
- Guided inquiry instructional model
- Developed with scientific collaborations
- Grid-based analysis tools
- 3-year grant testing student learning

Home: Join a national collaboration of high school students to study cosmic rays.



**Project Map:** Your team may use the milestones below, or your teacher may have other plans. Make sure you know how to record your progress, keep your teacher apprised of your work and publish your results.

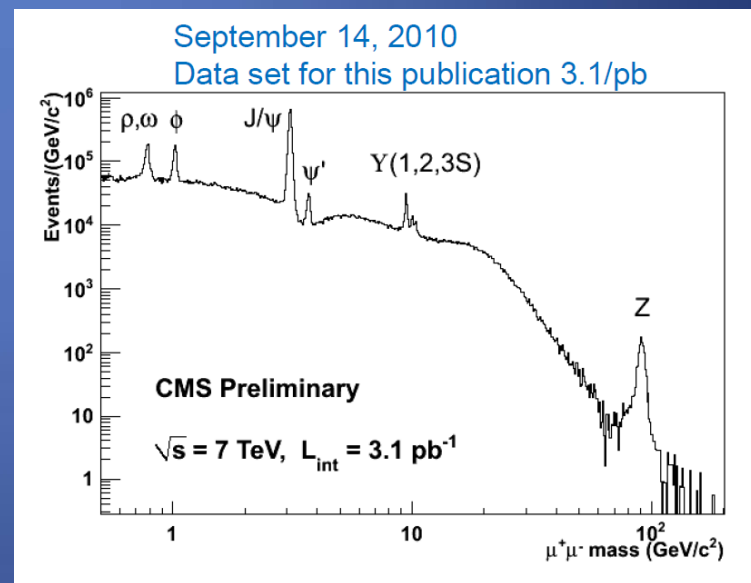
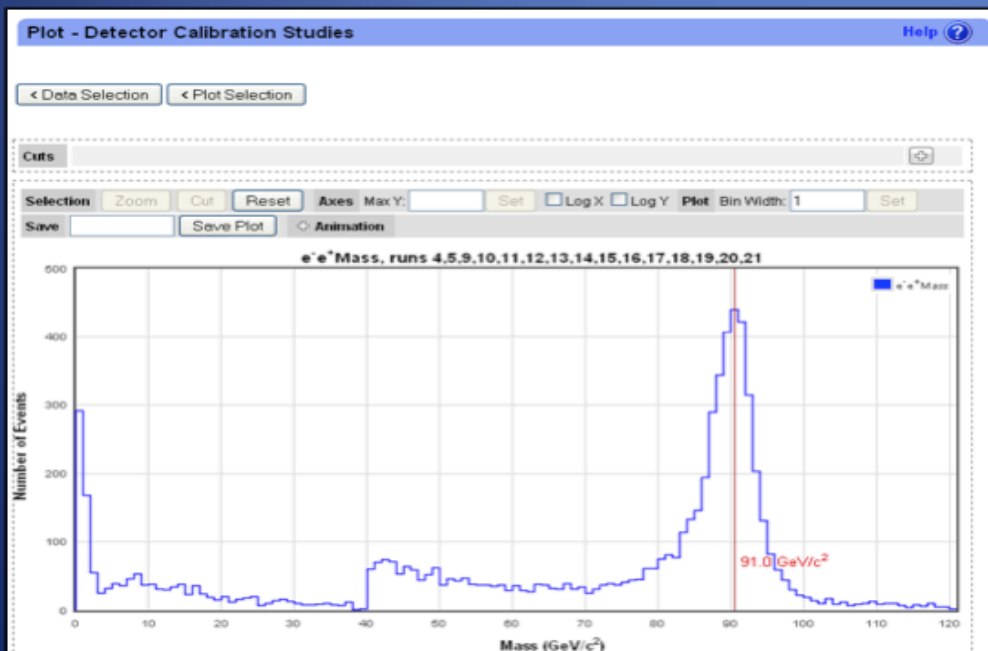
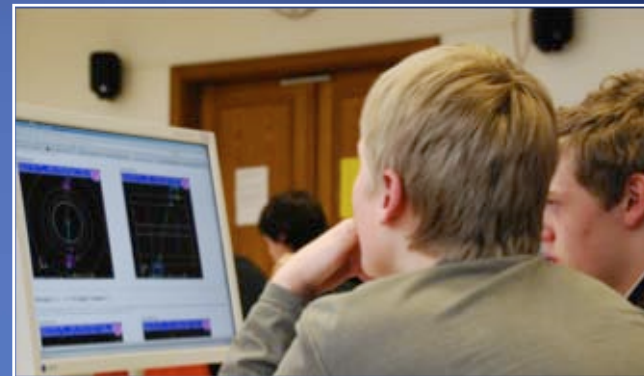
Think of this map as a subway map with one main line and four branch lines. Along the main line are stops, milestone seminars, opportunities to check how the work is going. Off each main stop are branch lines where each stop is a project milestone. Hover over each milestone or milestone seminar to preview; click milestones to open.





# QuarkNet and I2U2 activities bring the excitement of particle physics at the LHC to teachers and students

- ✓ Research for high school students
- ✓ Cosmic ray detectors and e-Lab
- ✓ International Masterclasses
- ✓ CMS e-Lab
- ✓ Other QuarkNet center activities







**Detector Model** ?

- Tracker
- ECAL Barrel
- ECAL Endcap
- ECAL Preshower
- HCAL Barrel
- HCAL Endcap
- HCAL Outer
- HCAL Forward
- Drift Tubes (muon)
- Cathode Strip Chambers (muon)
- Resistive Plate Chambers (muon)

**Tracking** ?

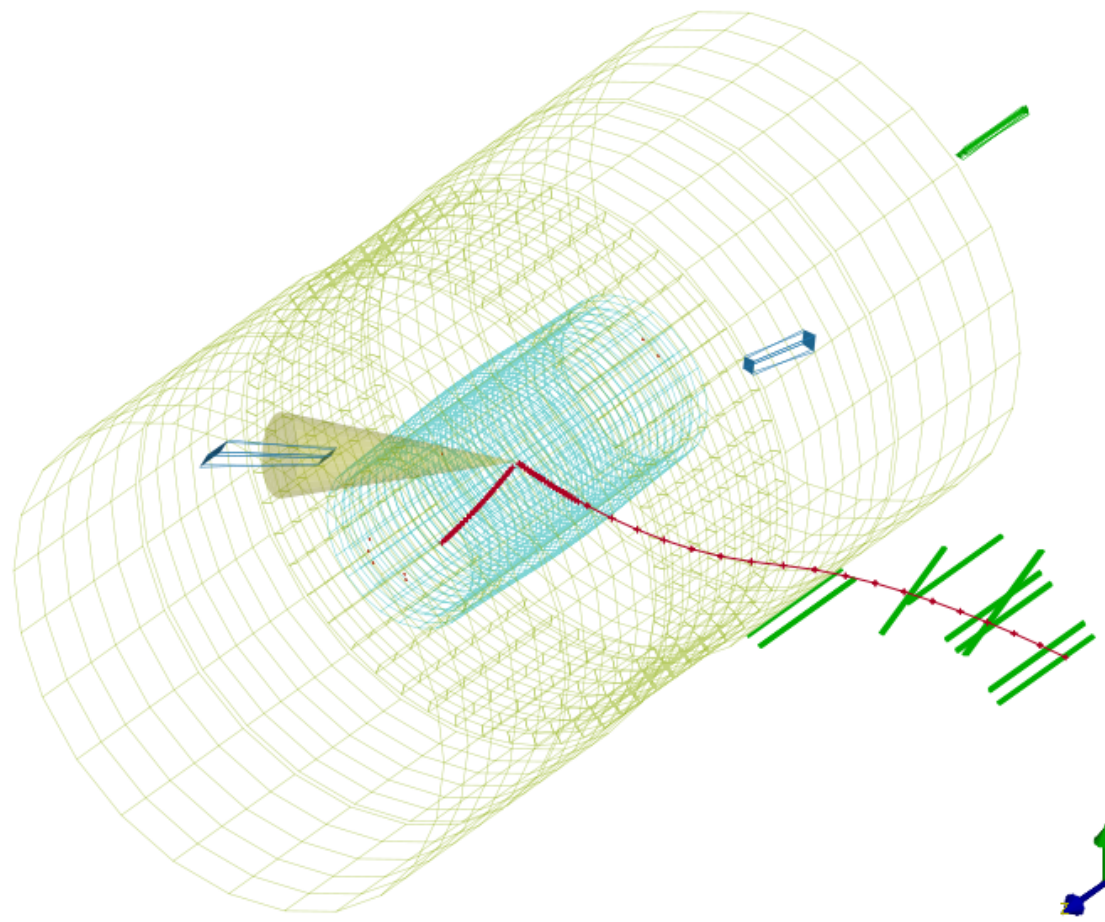
- Tracks (reco.)(132)
- Electron Tracks (GSF)(0)
- Clusters (Si Pixels)(726)
- Clusters (Si Strips)(5052)
- Rec. Hits (Tracking)(1825)

**ECAL** ?

- Barrel Rec. Hits(1024)  ▷
- Endcap Rec. Hits(958)  ▷
- Preshower Rec. Hits(936)  ▷

**HCAL** ?

- Barrel Rec. Hits(796)  ▷
- Endcap Rec. Hits(278)  ▷
- Forward Rec. Hits(310)  ▷
- Outer Rec. Hits(316)  ▷



# CMS event display for the Masterclass

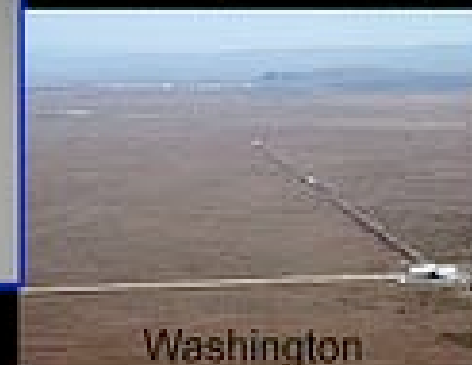
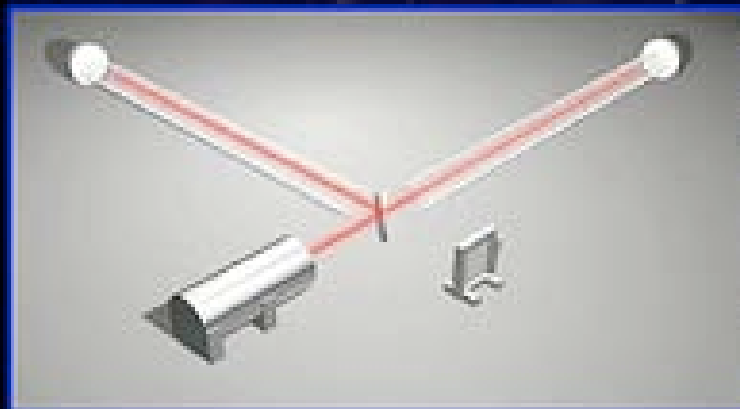
### LIGO: A New Way to Explore the Universe.

[Home](#)  
Project Map

[H L D P A](#)  
Explore!

[😊 😊 😊 😊 😊](#)  
About Us

- LIGO Big Picture
- LIGO Maps
- LIGO Sensors
- Related Data
- LIGO Glossary
- Bluestone
- Tutorial

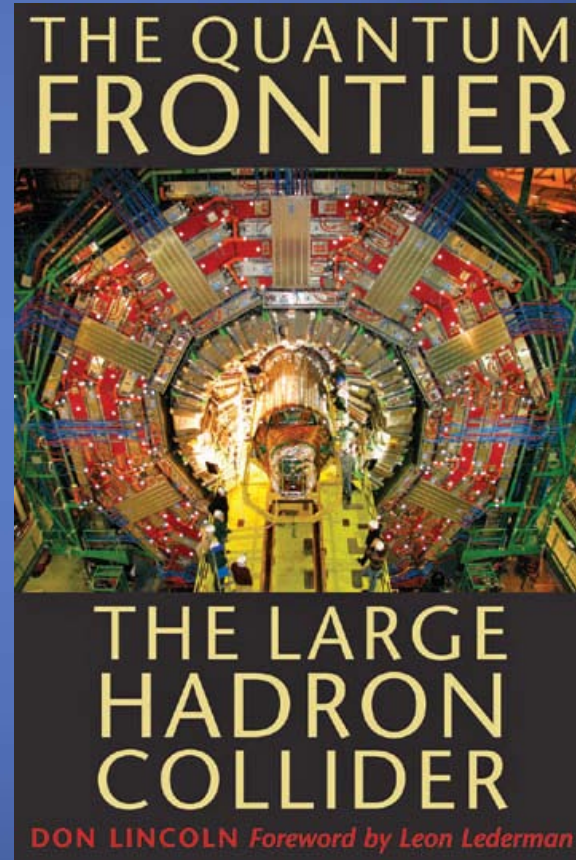
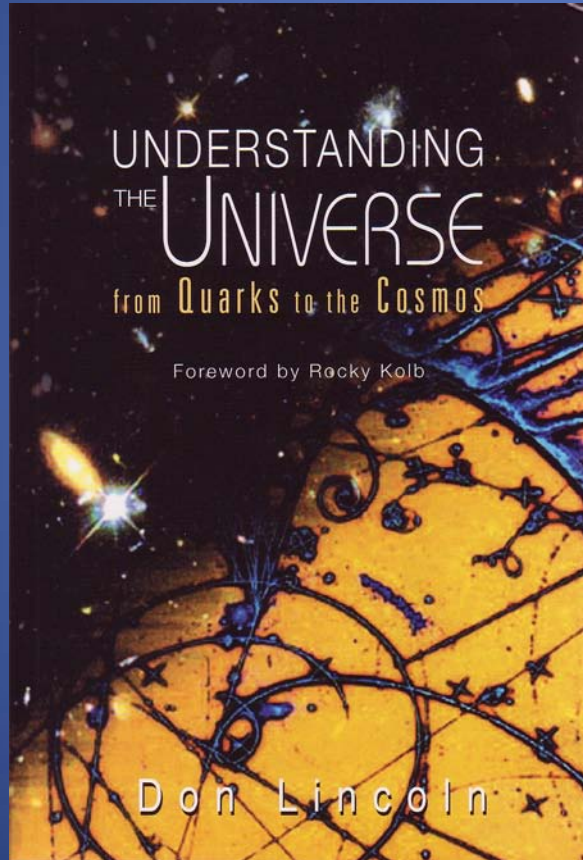


Eventually these gravitational waves will pass by the LIGO Observatories in Louisiana and Washington. Laser light, bouncing between mirrors in LIGO's detectors, will pick up tiny vibrations that are caused by the waves.

# Outreach Examples

- Printed Media
- Public Events
- Websites
- Social Networking

# Authoring books...



# Websites

The screenshot shows the ATLAS Experiment website homepage. At the top, the ATLAS logo is prominently displayed next to the CERN logo. A navigation menu includes links for Home, Info, Multimedia, Store, Blogs, Links, Tour of ATLAS, Contact, Collaboration Site, Press, and Student/Teachers. Below the menu, there are social media sharing options for Facebook (Like, Like us) and a section for 'ATLAS Blog: Realizing the an\_'. The main content area is divided into several sections: 'ATLAS HEAVY ION COLLISION EVENT' with sub-sections for 'IMAGES' and 'ANIMATION', a 'Live Events (when available)' section showing a circular detector diagram and a message that no live events are currently available, and a 'Latest News' section featuring a photo of Helio Takai with actor Alan Aida and his wife, and a link to 'Trillions of Reasons to Be Excited (NY Times)'. Below the main content, there are sections for 'About ATLAS' (describing the experiment's goals), 'ATLAS Run Status' (showing 'Proton Run' and 'Heavy Ion Run' with an 'ACTIVE' indicator), and 'Latest LHC Runs' (with 'Status' and 'Plans' buttons). A 'Features' section at the bottom offers video content: 'Episode 2', 'ATLAS Movie', 'Interviews and Film', and 'One Minute'. A 'Follow us on twitter' button is also present.

ATLAS EXPERIMENT

Home Info Multimedia Store Blogs Links Tour of ATLAS Contact Collaboration Site Press Student/Teachers

ATLAS Blog: Realizing the an\_ Like 45 Like us

ATLAS HEAVY ION COLLISION EVENT

IMAGES ANIMATION

EARLY HEAVY ION EVENT NOV. 2010. RAW NUMBER OF RECONSTRUCTED TRACKS WITH  $P_T > 1$  GeV IS 1115.

Live Events (when available)

No live events available, showing recently recorded events.

Event Displays | Event Animations

Latest News

Trillions of Reasons to Be Excited (NY Times)

ATLAS PopUp Book second edition now available.

Helio Takai with actor Alan Aida and his wife.

About ATLAS

Mapping the Secrets of the Universe

ATLAS is a particle physics experiment at the Large Hadron Collider at CERN. The ATLAS detector is searching for new discoveries in the head-on collisions of protons of extraordinarily high energy. ATLAS will learn about the basic forces that have shaped our Universe since the beginning of time and that will determine its fate. Among the possible unknowns are the origin of mass, extra dimensions of space, unification of fundamental forces, and evidence for dark matter candidates in the Universe.

- Potential Discoveries in ATLAS?

ATLAS Run Status

Proton Run Heavy Ion Run ACTIVE

Latest LHC Runs

Status Plans

ATLAS Blog Follow us on twitter

Features

Also available at YouTube

Episode 2 ATLAS Movie Interviews and Film One Minute

# ANGELS & DEMONS™

## Lecture Night

### THE SCIENCE REVEALED

#### The News-Gazette.com

#### UI physicists to discuss science in "Angels & Demons"

Thursday May 28, 2009

URBANA — Around the world, big screens show Tom Hanks trying to save the Vatican from antimatter that, if exposed, will destruct with enough force to vaporize a chunk of Rome.

Well, that's the fiction of "Angels & Demons" anyway.

Around the country, physicists like the University of Illinois' Kevin Pitts and Mark Neubauer — scientists who work with facilities that produce the real antimatter — will be hosting dozens of public talks about the real physics behind the movie magic.

"The movie touches on the kind of science that we do — which doesn't happen very often," Pitts said.

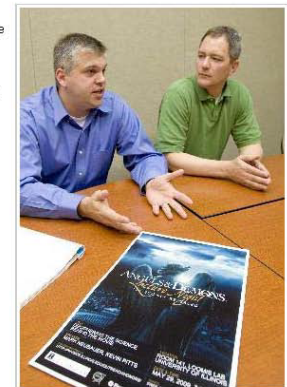
"We think that it's an opportunity to clarify," said Neubauer, who was at CERN, the Geneva lab that's an "Angels & Demons" plot point, when Tom Hanks visited for the movie.

Both will be clarifying on Friday, when they'll welcome anyone — kids included — to a free 7 p.m. lecture "Deciphering the Science Behind the Movie" in Loomis Lab on northeast corner of Goodwin Avenue and Green Street in Urbana on the UI campus.

"Antimatter is real, we really do produce it," Pitts said.

That happens at places like CERN or Fermilab in northern Illinois, where scientists do collide matter together at speeds a "tiny, tiny fraction lower than the speed of light," Neubauer said. "We focus energy to create different kinds of matter."

That collision creates "like a spray of lots of different kind of particles," he said.



Robert K. O'Daniel

Mark Neubauer, left, and Kevin Pitts talk about their lecture on the real science of antimatter, as featured in the new movie "Angels & Demons," at Loomis Lab on the University of Illinois campus.

ILLINOIS



Fermilab



# Electronic forms...Social Media



# Top social media sites

- Facebook.com 145M+ U.S. visitors per month
- YouTube.com 109M+ U.S. visitors per month
- Blogspot.com 58M+ U.S. visitors per month
- Blogger.com 52M+ U.S. visitors per month
- MySpace.com 46M+ U.S. visitors per month
- Wordpress.com 30M+ U.S. visitors per month
- Twitter.com 30M+ U.S. visitors per month



# Individual and Team effort

## The Large Hadron RAP

- “Twenty-seven kilometers of tunnel under ground  
Designed with mind to send protons around  
A circle that crosses through Switzerland and  
France  
Sixty nations contribute to scientific advance...”



## Katie McAlpine & Friends



- From the Geneva Gazette: “Katie has received notoriety of late as the creator and star of "The Large Hadron Rap," a rap video showcasing the science behind CERN's Large Hadron Collider. The video has been viewed more than 2 million times, and has been featured in major web, print and TV news outlets such as the New York Times, Discover, USA Today, MSNBC and Fox News.”

# Why Fermilab uses social media...

Facebook: Fan page

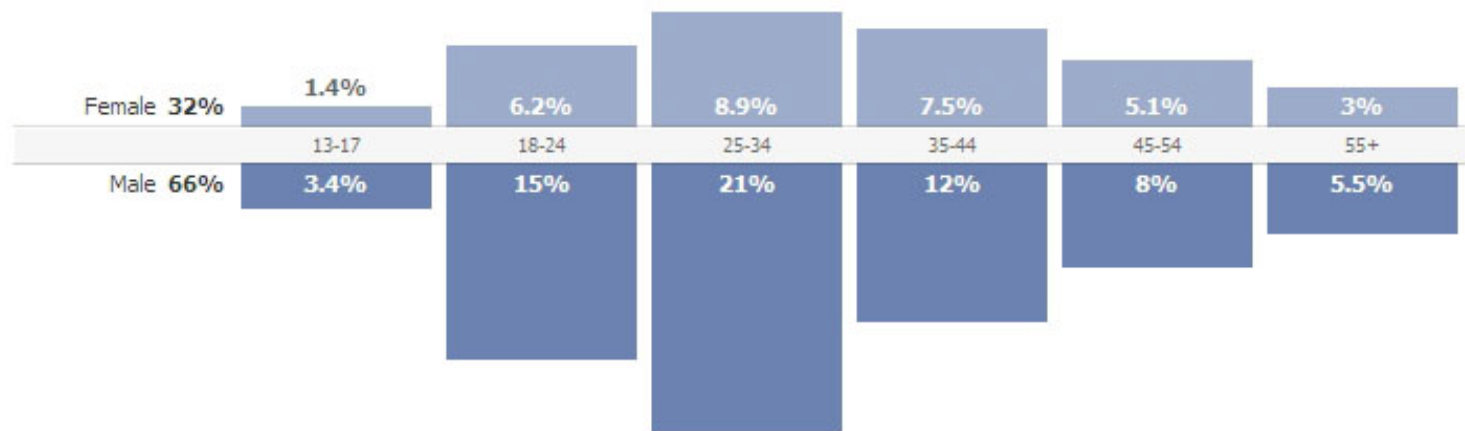


Blog: Quantum diaries



It meets people where they are.  
It's an inexpensive way to share content with a wider audience.  
It reaches people traditional media might miss.  
It allows us to interact.

## Gender and Age



### Countries

- 1,710** United States
- 82** Italy
- 64** India
- 57** Turkey
- 53** United Kingdom
- 47** France
- 43** Germany

[More](#)

### Language

- 1,944** English (US)
- 196** English (UK)
- 65** Italian
- 64** Spanish
- 46** Turkish
- 37** French (France)
- 29** German

### Cities

- 197** Elmhurst
- 186** Chicago
- 88** Romeoville
- 41** Batavia
- 39** Cicero
- 33** New Delhi
- 32** Mexico City

[More](#)

# Recently had most popular blog post ever about holometer experiment

Stats: symmetry breaking ([Dashboard](#))



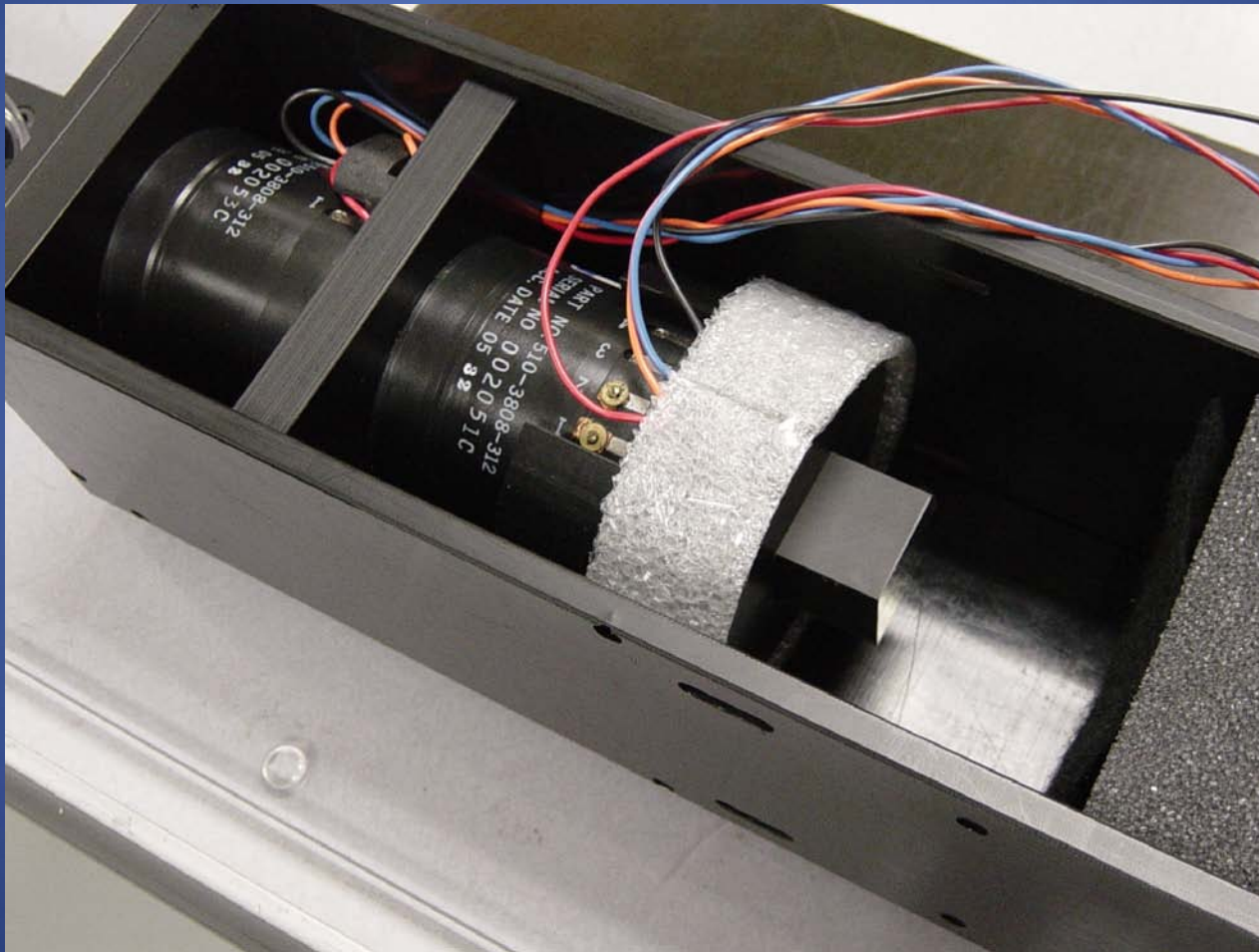
# Summary

- HEP makes a substantial effort in education, outreach and the workforce.
  - Provides value added to what we do.
- A number of programs have been created which are exemplars in these domains.
- It's about networking and sharing the great physics that we do.
  - The development of an extended research and education community.

# With thanks for contributions...

Heidi Alvarez, Marge Bardeen, Michael Barnett,  
Barry Baumbaugh, Ken Cecire, Kathryn Grim, Lora Hine,  
Judy Jackson, Tom Jordan, Dan Karmgard, Laird Kramer,  
Jean Krisch, Don Lincoln, Tom Loughran, Jeff Marchant,  
Mike McKenna, Bill Miller, Pat Mooney, Homer Neal,  
Peggy Norris, Bob Peterson, Kevin Pitts, Jorge Rodriguez,  
Bill Roggenthen, Ben Sayler, Greg Snow, Helio Takai,  
Maury Tigner, Mark Vigneault, Mitch Wayne, Kris Whelan,  
Stan Wojcicki, Anne Zakas

# “Seeing” particles in real time



# In a particle beam...

