Education and Outreach in HEP

Randy Ruchti

University of Notre Dame

DPF2009

“Clarification”

- Education
  - Formal (in classroom or instructional setting…)
  - Informal (displays, museums, shows…)
- Outreach
  - Public events
  - Websites
  - Social networking (Web 2.0…)
  - Café scientifique…
- Broader impacts

Approach

How?

- Start with an idea(s)
- What are the needs and/or objectives
- Target audiences
- Approach
  - Team
  - Proposal and resources
- Implementation
- Evaluation
- Sustainability

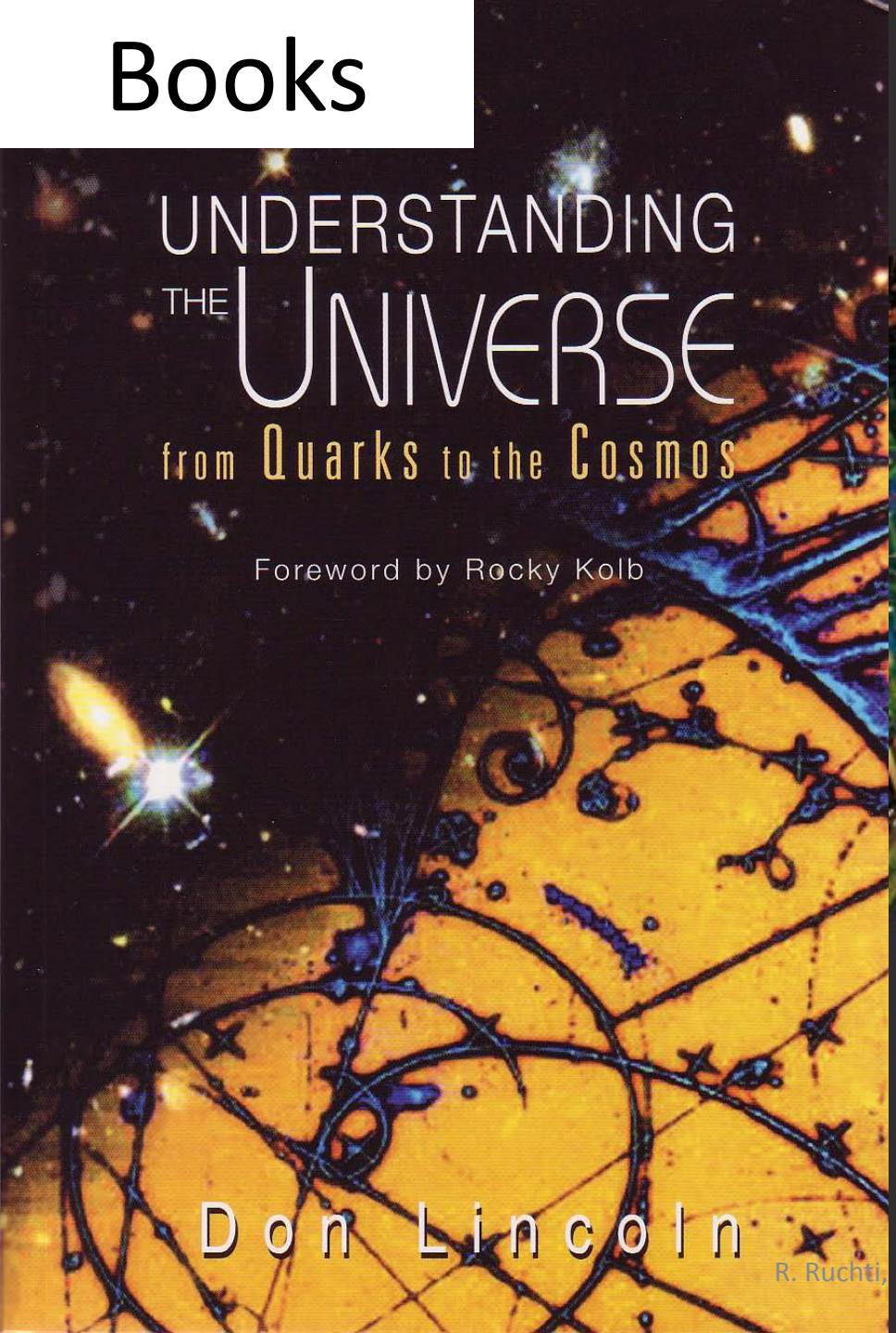
Where?

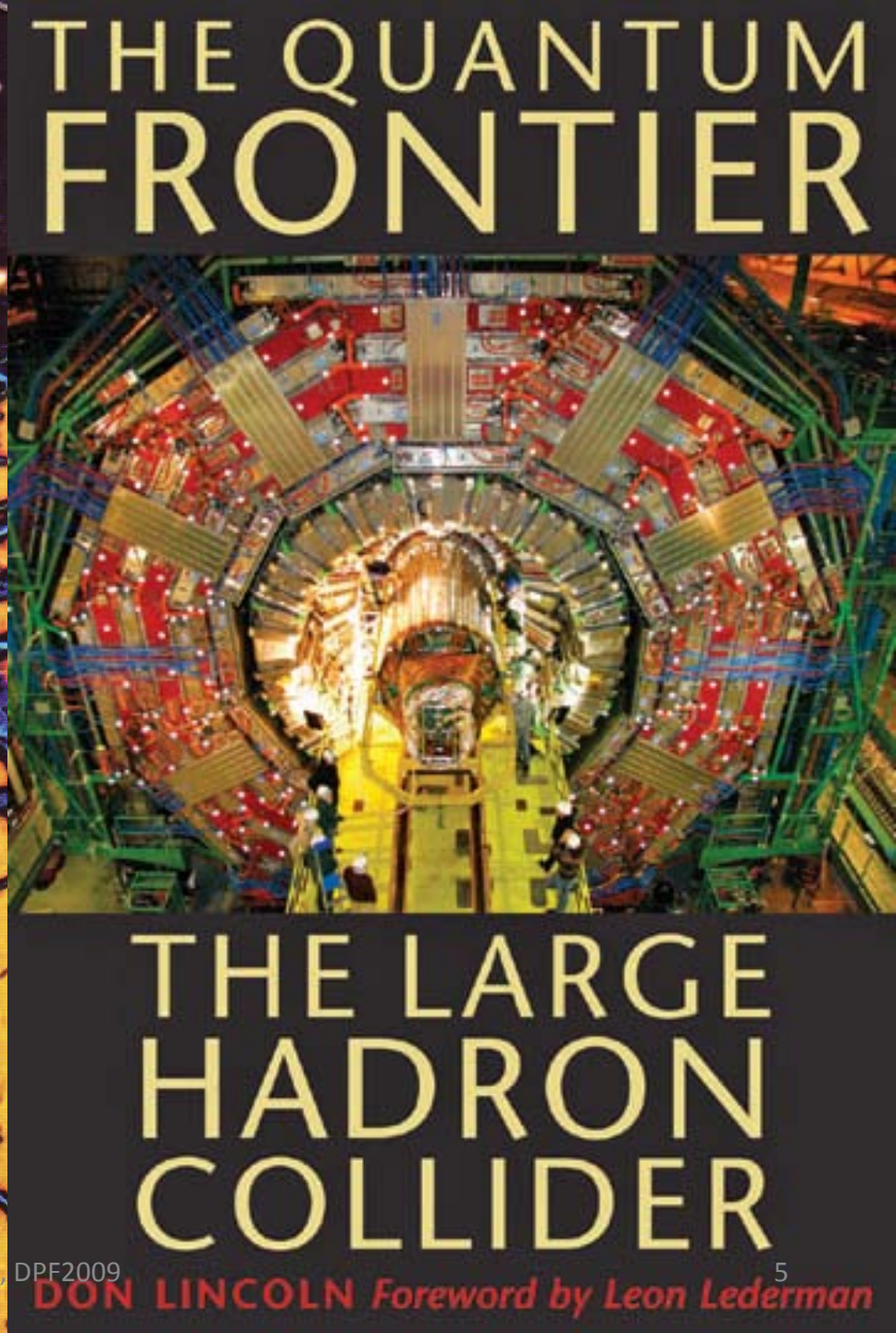
- Scale or scope of the activity
  - Personal
  - Local
  - Regional
  - State
  - National
  - International
  - …

Who does Education and Outreach ?

- You and your friends
- Interested groups
- Experimental Collaborations
- Universities
- Laboratories
- …

Books


UNDERSTANDING
THE UNIVERSE
from Quarks to the Cosmos
Foreword by Rocky Kolb
Don Lincoln


THE QUANTUM
FRONTIER
THE LARGE
HADRON
COLLIDER
DON LINCOLN Foreword by Leon Lederman

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.”

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'Daniell

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

CERN

Fermilab

U.S. DEPARTMENT OF ENERGY

National Science Foundation

Local - UIUC

Individual/Team Effort

A Golden Opportunity

Total lectures: 61

- **United States – 44**
- **Canada - 8**
- **France – 4**
- **Germany – 2**
- **Spain – 1**
- **Switzerland - 2**

Total reported attendance: 4,628

Total attendance >5,000 !!!

The Fermilab Communications Office

National press release
Served as press contacts
Worked with Sony Pictures
Images and videos for media
Links to other resources
"In the News" archivev

Local - 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

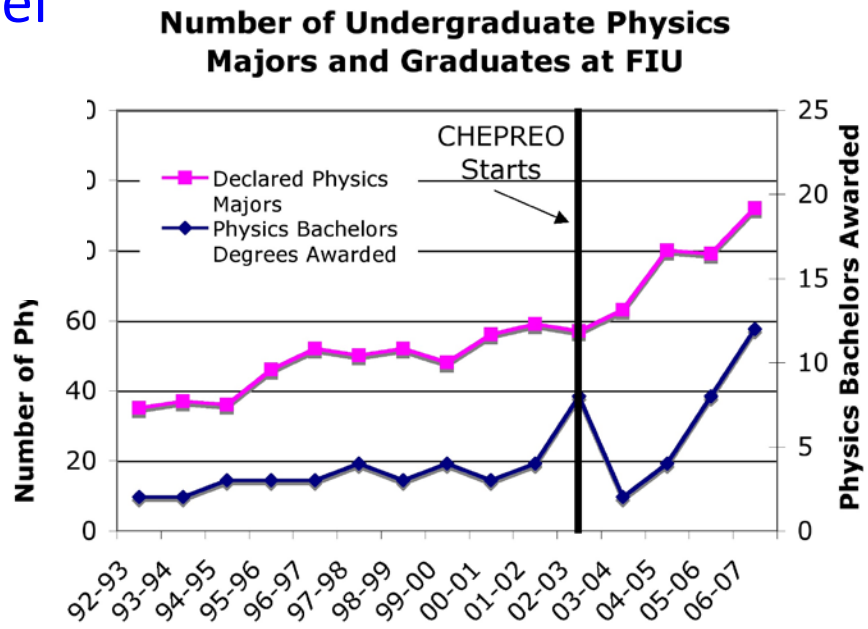
Opportunity to Enhance & Broaden Science Participation

- 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

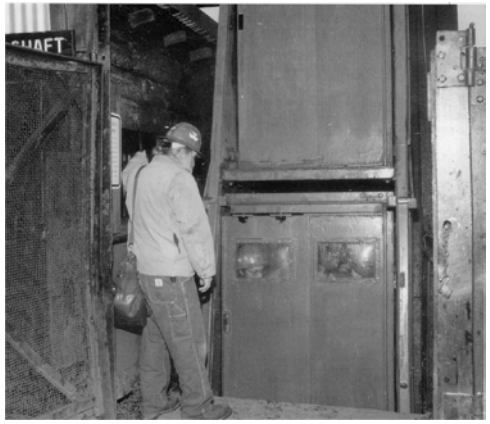
Redefining Model for Education Outreach

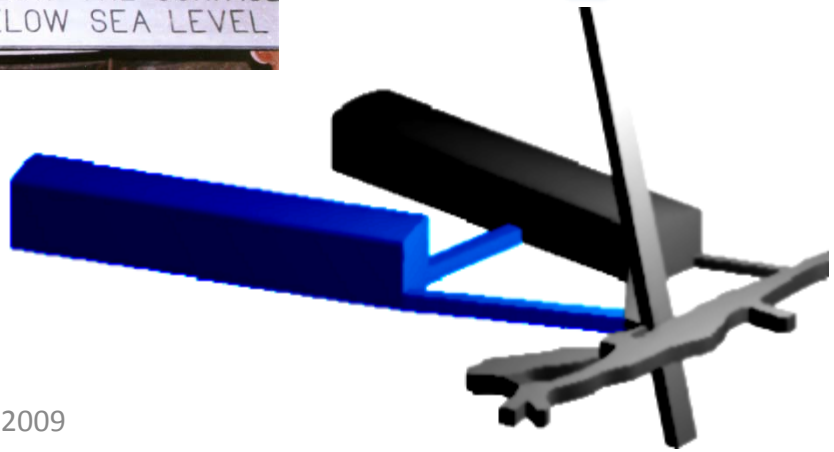
CHEPREO's Impact

- 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



Regional: Soudan Underground Mine State Park





Over 25 years of large neutrino and particle physics studies in Northeastern Minnesota

Soudan 1-35t
1981-89

Soudan 2-1Kt
1985-2001

MINOS-5.6Kt
1999-??

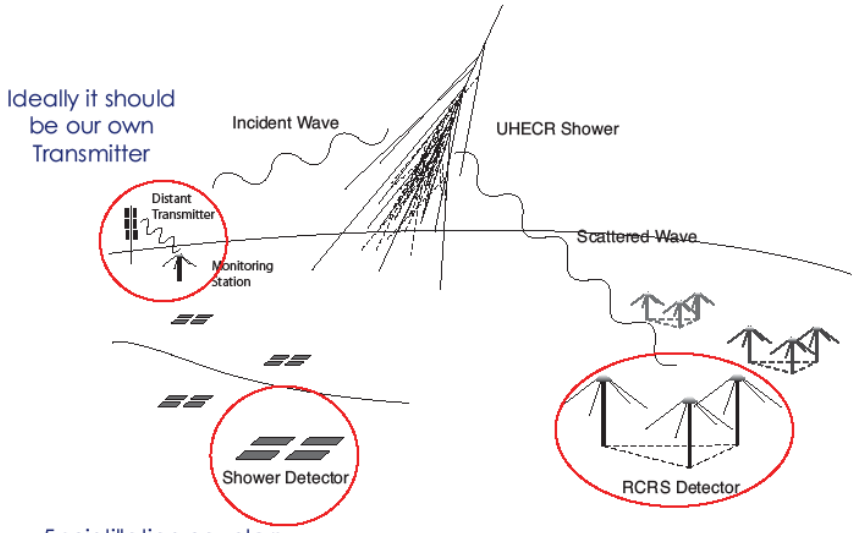
CDMS
2000-??

Soudan Program Growth

- Soudan 2 era
  - 1000 visitors/yr
- MINOS era, broad effort to engage community
  - Open House, offsite presentations
  - Now 4000 visitors/yr
  - Underground Tours
    - The BEST school tours are ones when the teacher has been proactive and uses some of our lesson plans off the website.
    - The single most asked question is WHY ARE WE DOING THIS! Is there any benefit to mankind.
- Now have NSF Funding for Soudan Outreach Program
  - Coordinator, RET Teacher tour guides, Student Interns

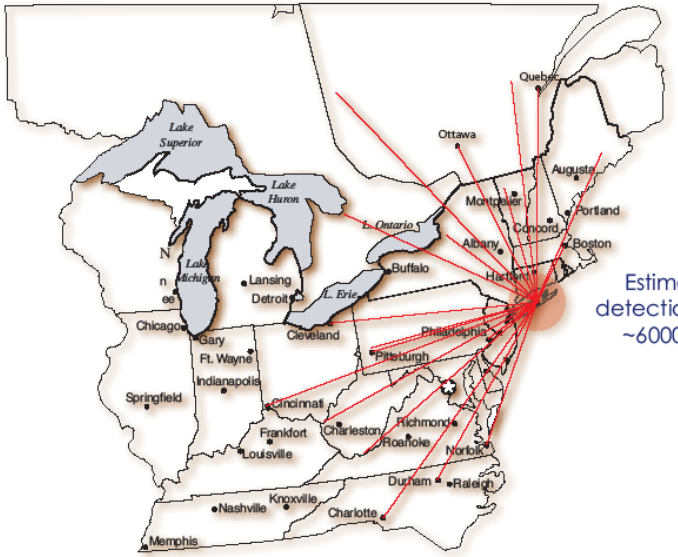
Regional - MARIACHI

Experimental Setup

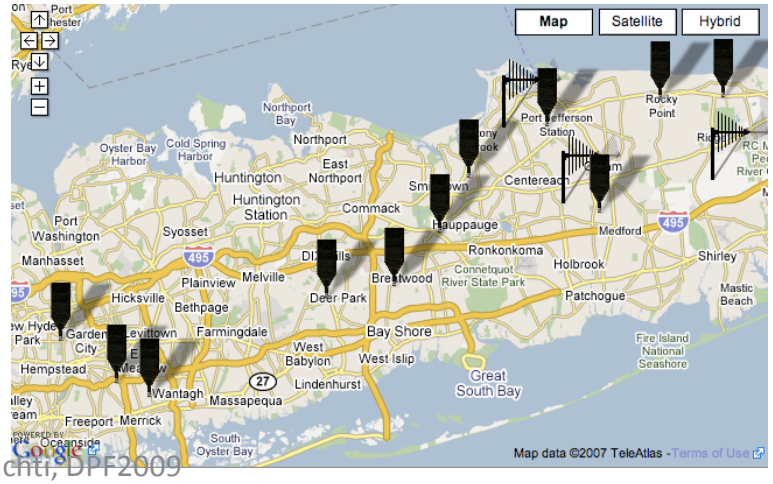


Stations are distant and **independently** operated.

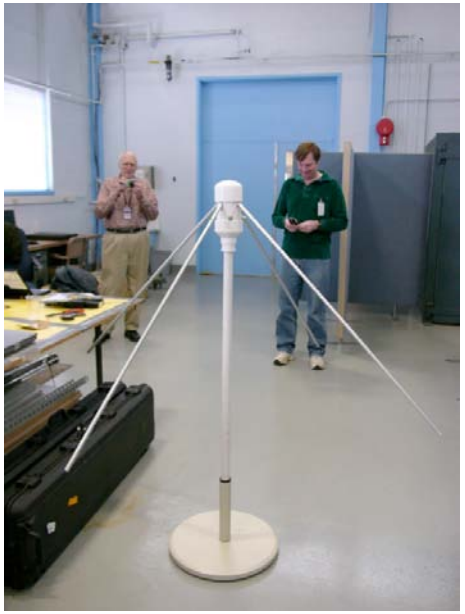
TV Broadcast Stations

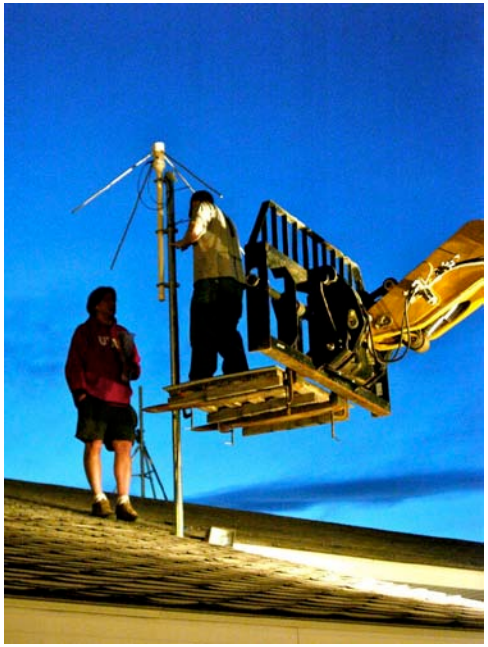


Estimated detection area ~6000 km²

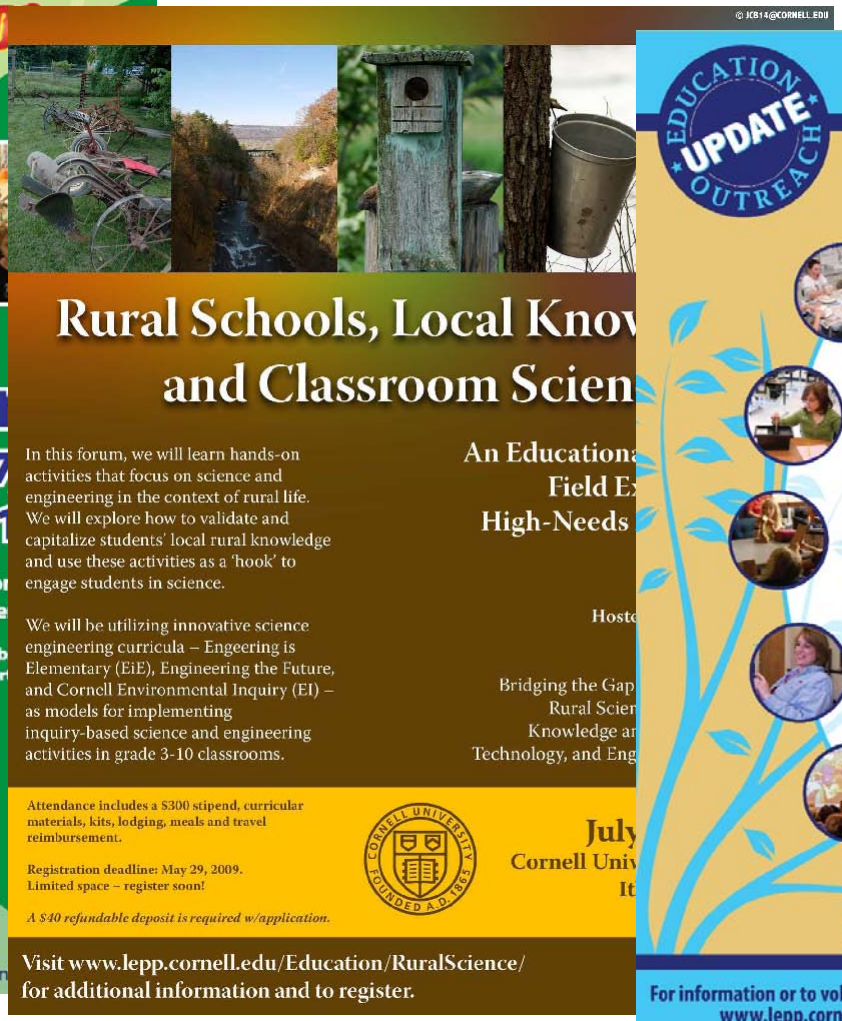


Mariachi in action





Regional - Cornell



State – LIGO/Livingston Science Education Center

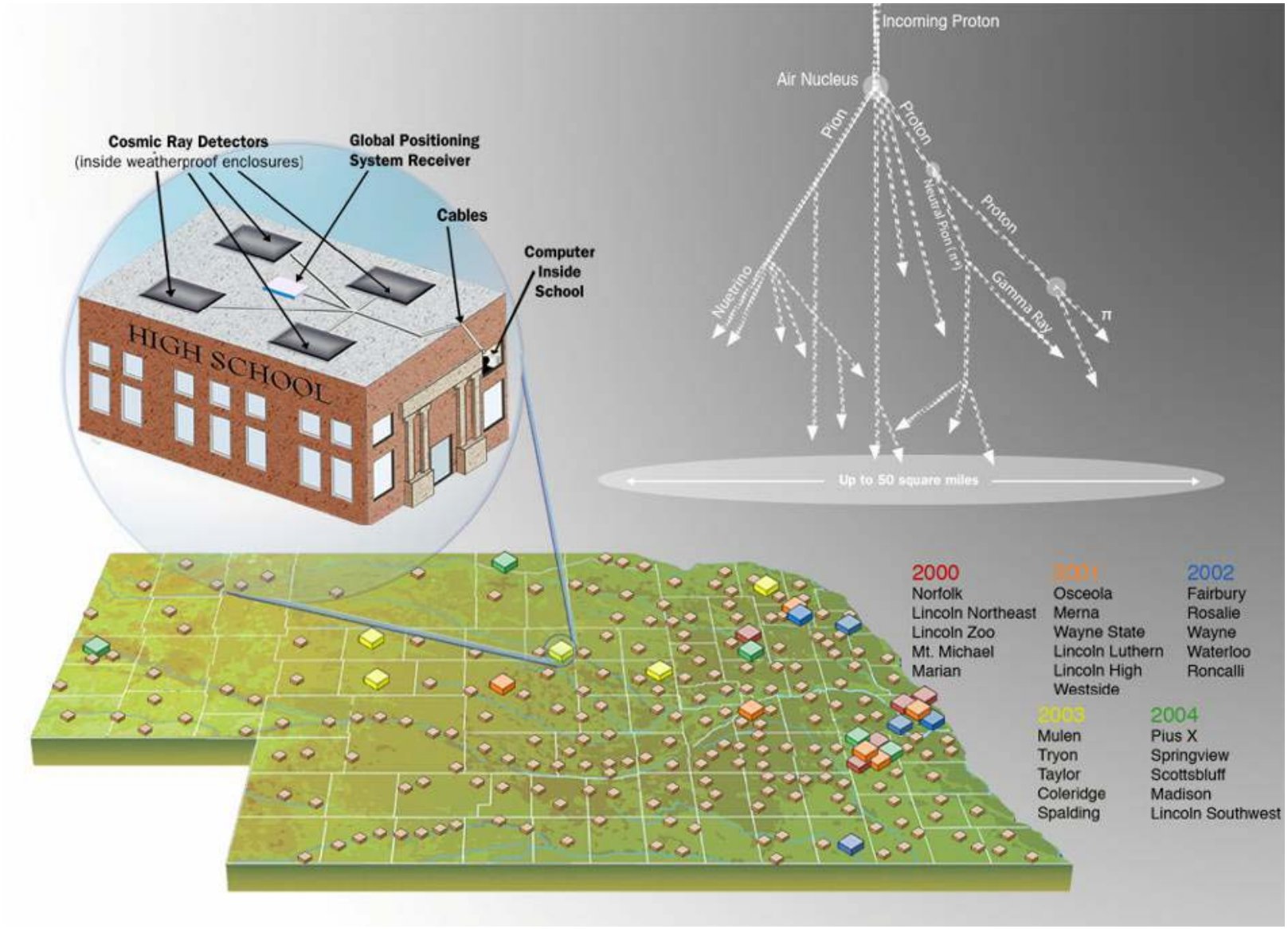
A collaborative

- 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

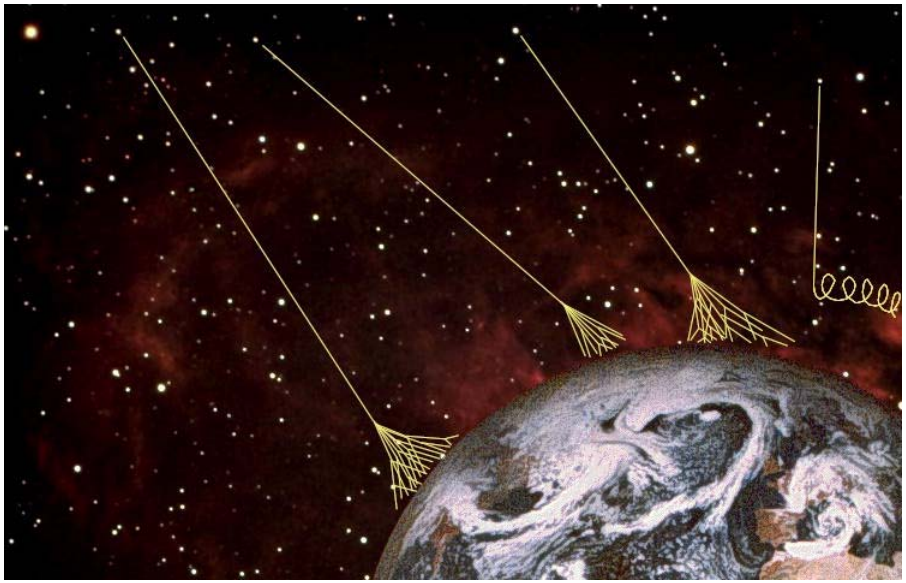
State – Cosmic Ray Observatory Project



Summer 2004 Workshop Activities
Detector assembly and testing

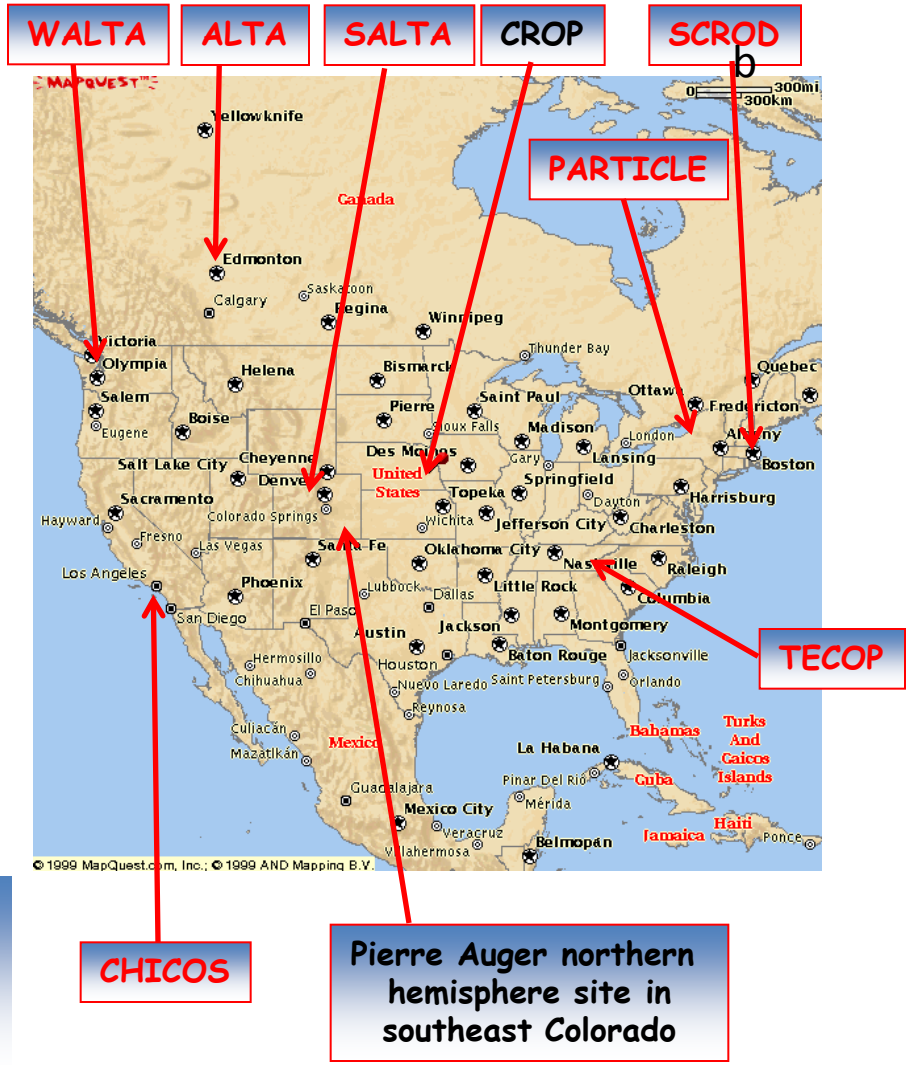
Excellent extensive air shower data taking run overnight

International/Global Air Shower Arrays

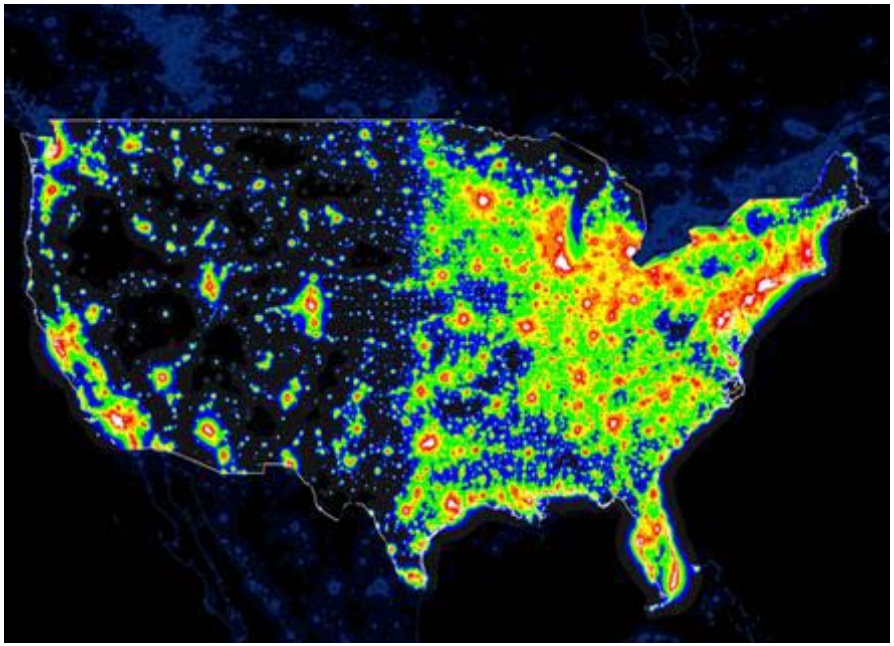


NALTA
The North American Large-Scale Time-Coincidence Array

http://csr.phys.ualberta.ca/nalta/
- **Includes links to individual project Web pages**



National - QuarkNet



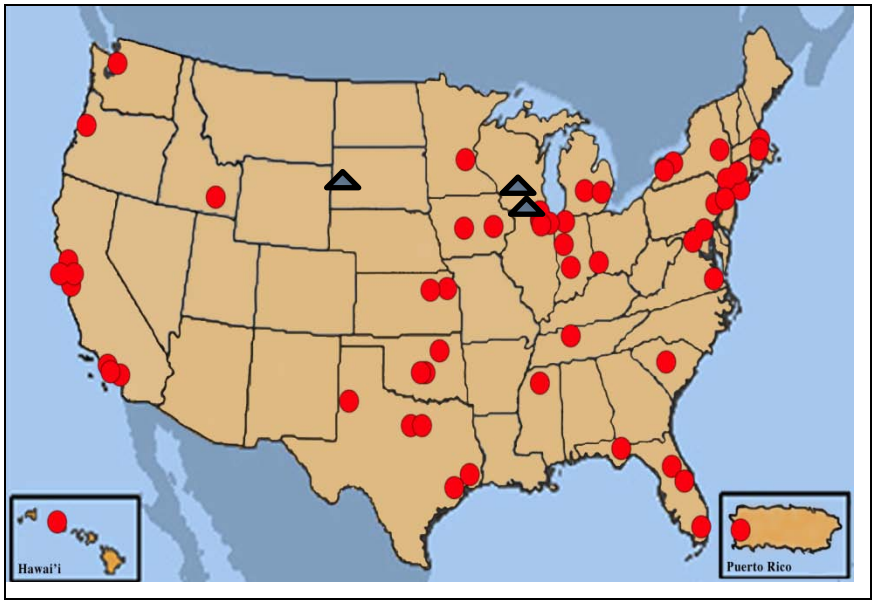
52 Centers in 25 states and Puerto Rico

500 HS Teachers
150 Particle Physicist mentors
100 HS Students annually

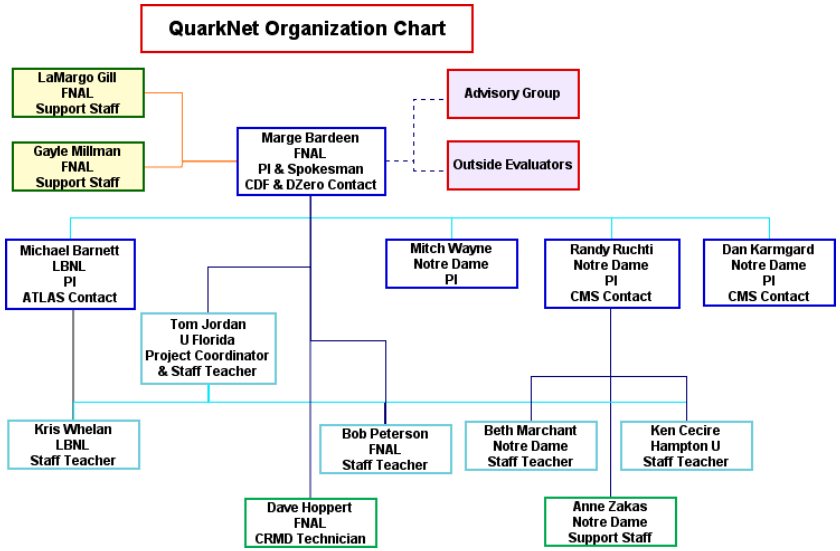
A professional development program for HS Teachers with immersive research experience for HS teachers and students.

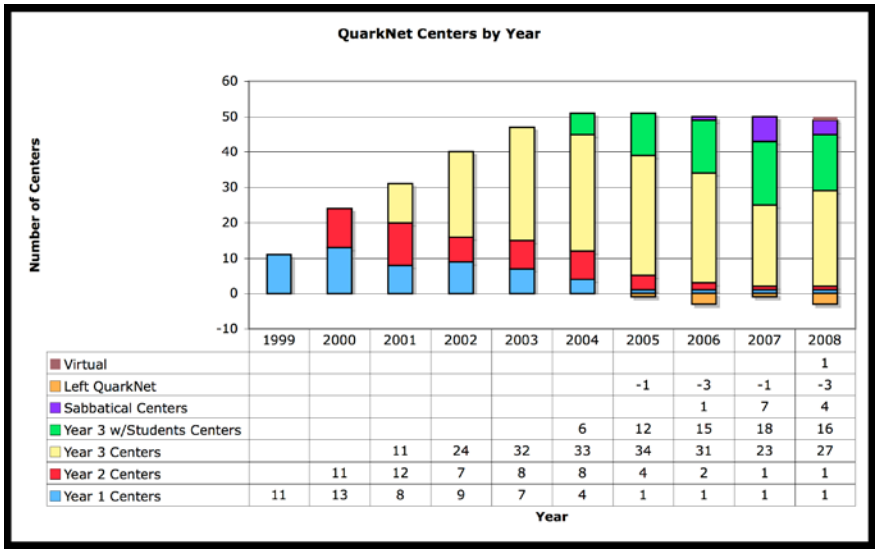
Now in its 12th year. Supported by NSF and DOE

http://quarknet.fnal.gov/



QuarkNet Organization Chart





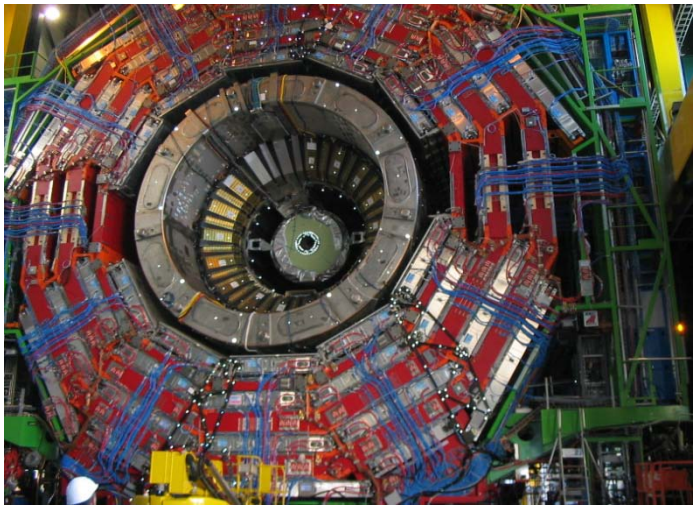
- National Activity
  - Fellows
  - Boot Camp
  - Virtual Center
  - e-Labs (Data & Analysis)
  - Masterclasses
- Center Activity
  - QuarkNet weeks
  - Teacher professional development
  - Student Research Experience

QuarkNet

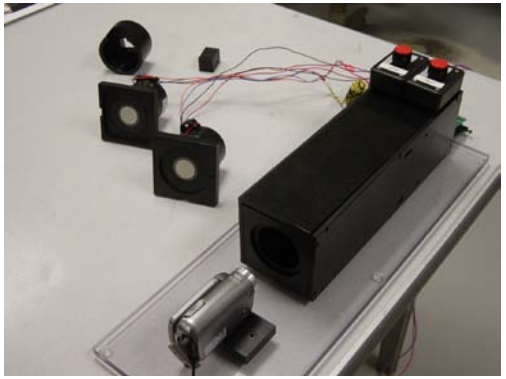
The QuarkNet Collaboration

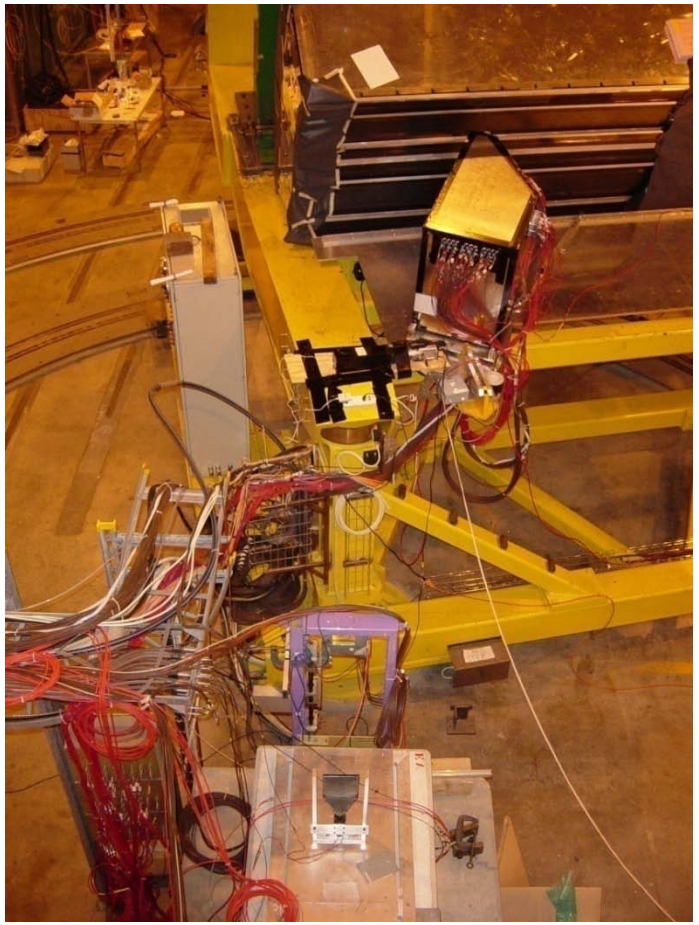
QuarkNet Student Research

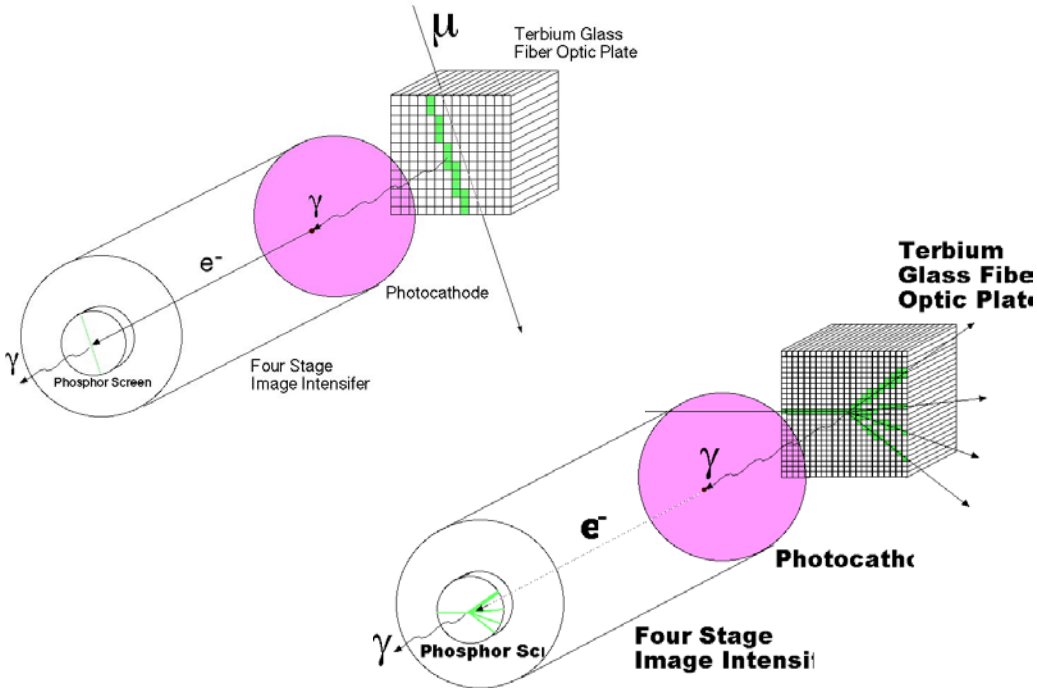
- Optical decoding for the HCAL Barrel, Outer Barrel and Endcap
- 550 Fiberoptic decoder units.



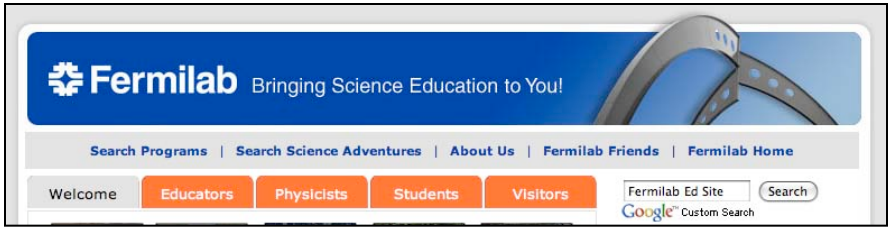
Informal Education - Compact Particle Detectors



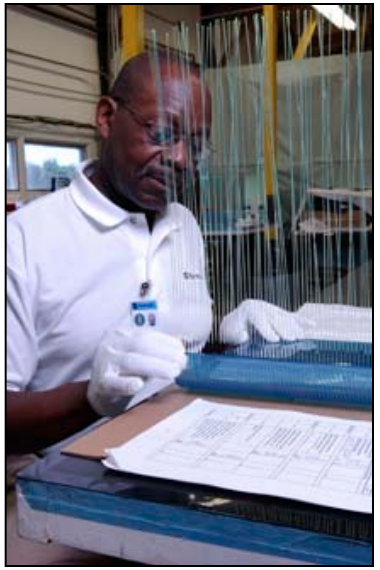




Fermilab Education Office - for Teachers



Website & Teacher Resource Center



Research Appointments

Workshops

In 2008, 30,000 students and 3,000 teachers benefited from the programs.

Fermilab Education Office - for Students

Physics Exhibits

Field Trips & Open Houses

Symposium on Nature of Science

Classroom Presentations

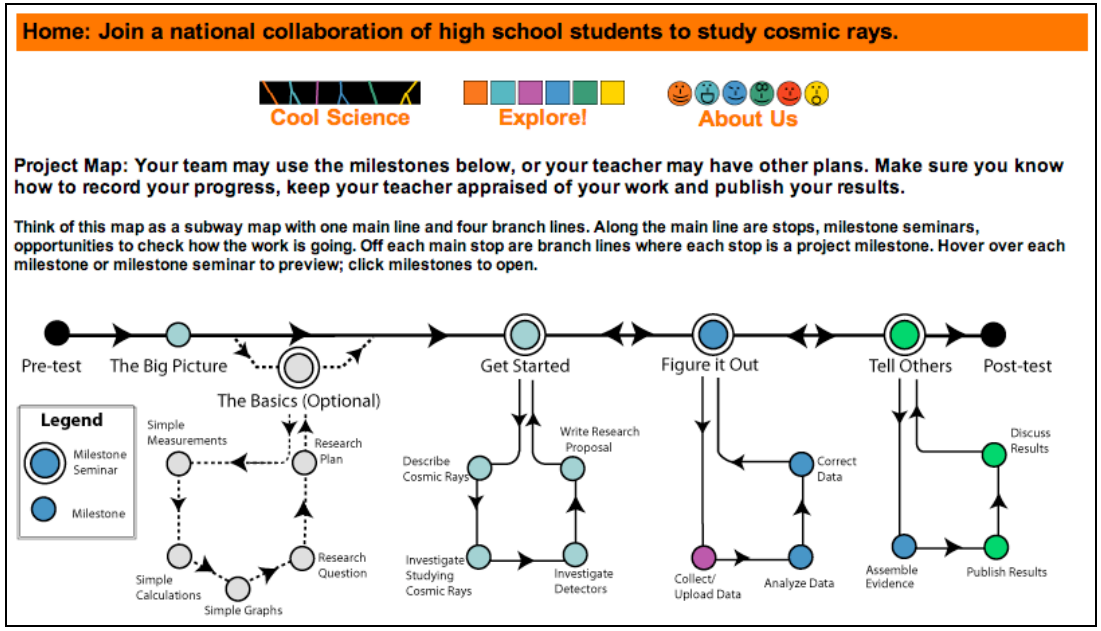
In 2008, 30,000 students and 3,000 teachers benefited from the programs.

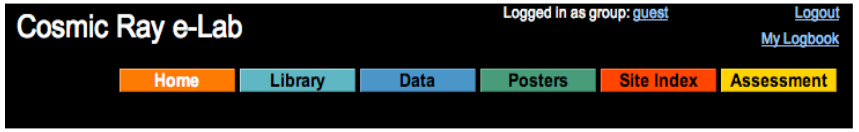
Interactions in Understanding the Universe - I2U2

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





Social Media

What are social media?

- User-generated content / Consumer-generated media
- Publicized through inexpensive, accessible tools that allow anyone to publish or access information
- Distinct from traditional or mass media, such as newspapers, television, radio

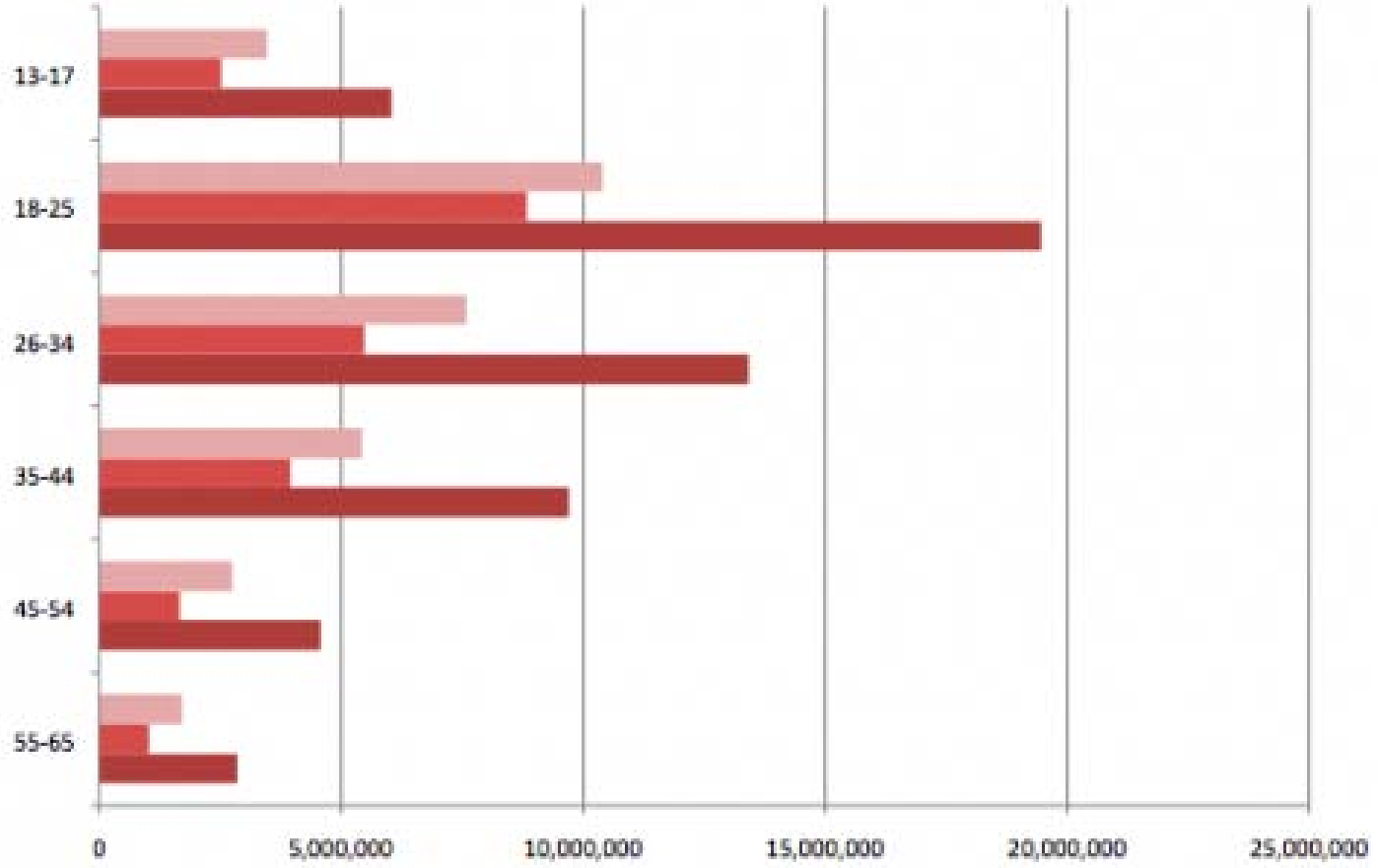
Top social media sites

1. Blogger (222 million)
2. Facebook (200 million)
3. MySpace (126 million)
4. Wordpress (114 million)
5. Windows Live Spaces (87 million)
6. Yahoo Geocities (69 million)
7. Flickr (64 million)
8. hi5 (58 million)
9. Orkut (46 million)
10. Six Apart (46 million)

Social Networking:

- Facebook leads all social networks with 87.3 million unique visitors in June 2009.
- More than 250 million active users
- More than 120 million users log on to Facebook at least once each day
- More than 1 billion pieces of content (web blinks, news stories, blog posts, notes, photos, etc.) shared each week

US Facebook Users By Age Group and Gender (3/25/09) (InsideFacebook.com)



	55-65	45-54	35-44	26-34	18-25	13-17
Female	1,721,880	2,743,620	5,420,240	7,591,020	10,405,980	3,470,120
Male	1,024,540	1,670,780	3,947,760	5,473,780	8,844,760	2,518,840
Total Users	2,848,860	4,582,160	9,700,980	13,422,920	19,461,380	6,048,660

Summary

- Particle physics is very actively engaged in Education and Outreach.
  - Across a variety of scales and approaches
  - Electronic media, for instruction, research analysis and social interaction are evolving.
  - But one-on-one mentoring is important too.
- We need to continue to do more.
  - Enlightened self interest
  - It's the right thing to do.

With thanks for contributions…

- H. Alvarez, M. Bardeen, M. Barnett, D. Barney, K. Grim, L. Hine, D. Karmgard, L. Kramer, D. Lincoln, W. Miller, K. Pitts, G. Snow, H. Takai, M. Tigner, M. Wayne, S. Wojcicki

- The Funding Agencies