Helping Develop America's Technological Workforce

QuarkNet

- A bit of history
- Current Program Structure
- Program Activities
  - National Program
  - Local Centers
- Summary

Mitch Wayne

University of Notre Dame

QuarkNet

Our Vision

To create a lasting community of researchers that includes high school teachers and students as well as physicists

"Doing science."

School science reflects the practice of science.

Science is what students DO, not what is done to them

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The QuarkNet Collaboration

NSF

Office of Science
U.S. DEPARTMENT OF ENERGY

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Administrative Structure

NSF Meeting on Broader Impacts – circa '97

Project Creators:
Baker, Bardeen, Barnett, Ruchti

Advisory Board

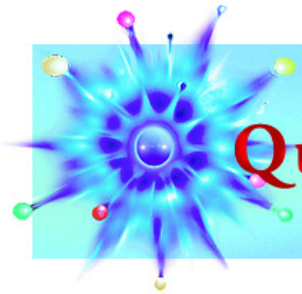
Project Offices
Fermilab and Notre Dame
PI: Bardeen

Project Evaluation

Project Staff
Teachers

Project
Administrative and
Technical Staff

1 | 2 | 3 | 4 | >>> | 48 | 49 | ~50 | **Virtual Center**



Personnel

QuarkNet Project Staff

- **Principal Investigators:**
- M. Bardeen, Fermilab
- M. Barnett, LBNL
- D. Karmgard, Notre Dame
- R. Ruchti, Notre Dame
- M. Wayne, Notre Dame

- **Administrative Staff:**
- L. Gill, Fermilab
- G. Millman, Fermilab
- M. Zakas, Notre Dame

- **Staff Teachers:**
- K. Cecire, Hampton (now Notre Dame)
- T. Jordan, Florida
- B. Marchant, Notre Dame (emerita)
- R. Peterson, Fermilab
- K. Whelan, LBNL

- **Technical Support:**
- D. Hoppert + Docents, Fermilab
- J. Marchant, Notre Dame
- M. Vigneault, Notre Dame

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Program Growth

Active Center Participation by Year

Project Year	# Center I	# Center II	# Center III	# Center III + students	Total # centers
1999	11				11
2000	13	11			24
2001	8	13	11		32
2002	7	8	24		39
2003	9	7	32		48
2004	4	9	33	6	52
2005		4	36	12	52
2006	1	2	28	13	51
2007	1	1	23	16	52
2008	1	1	27	16	45 (+1)
2009	2	1	23	23	49 (+1)

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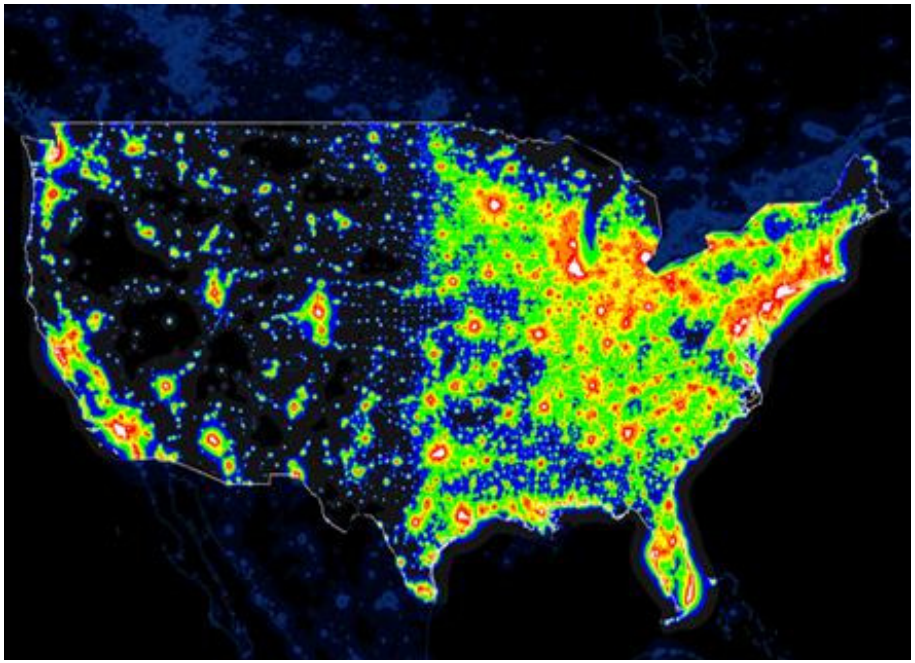
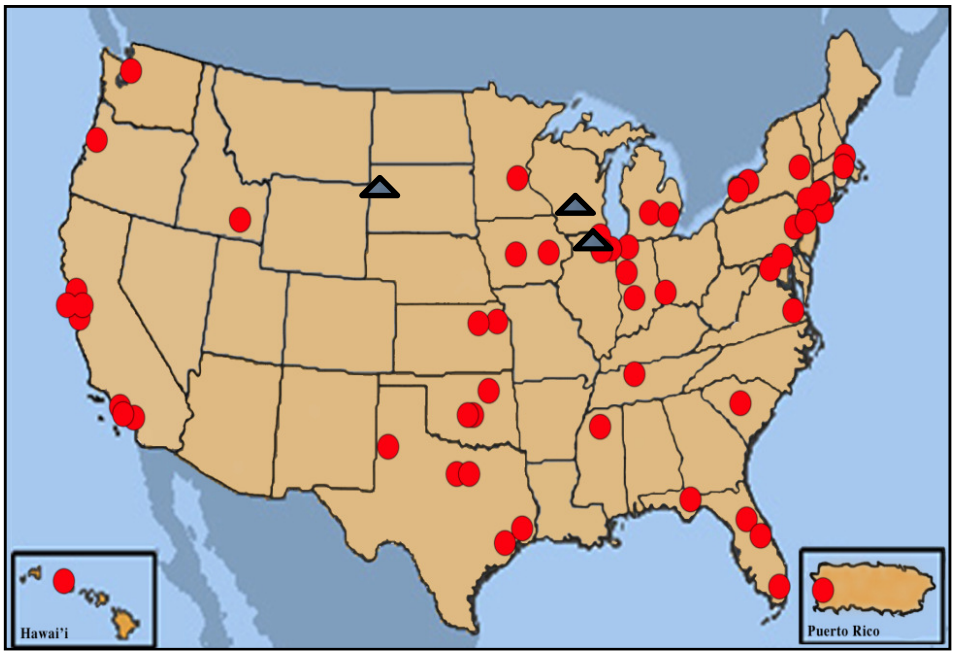
Geographical Distribution of Centers

QuarkNet Center Locations





Program Planning and Evolution

FY 98 – FY02:
Program Establishment
Initial Center Formation

Inquiry – based instruction

FY02 – FY07:
Program Growth
Maximum Size of 50 Centers

Student Researchers Introduced

e-labs and i-labs/I2U2 Concept

FY07 – present:
Enrichment

Teacher – Learning Fellows

I2U2 Launched

LHC Fellows

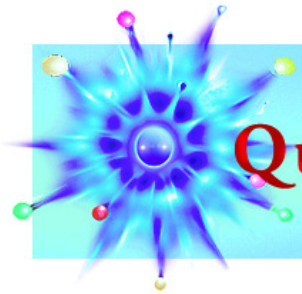
e-Labs

Master Classes

Virtual Center

LHC Awareness

Participation in and access to LHC (and other experiments) and data



Project Activities

- National level
  - Fellows
  - Boot Camp
  - Virtual Center
  - e-Labs
  - Masterclass
- Local level
  - QuarkNet weeks
  - Teacher professional development
  - Student Research Experience

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Teacher Fellows

The fellows are a force multiplier for staff efforts.

- 5 existing groups
  - LHC
  - vLHC
  - Teaching and Learning
  - e-Labs
  - Leadership

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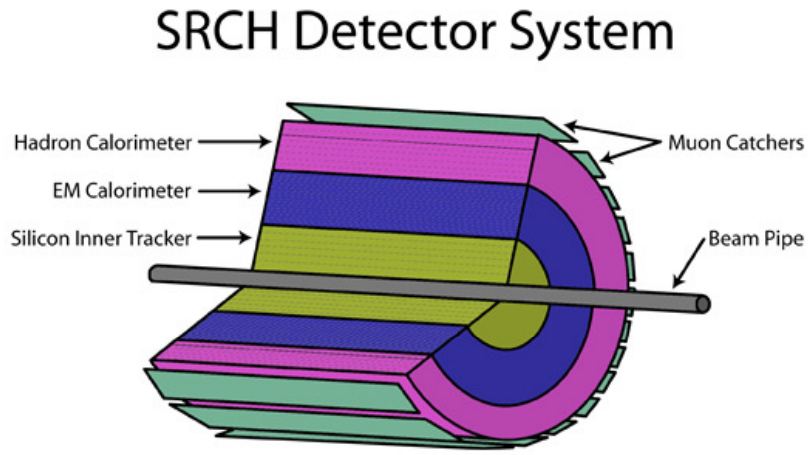
Annual Boot Camp

Provide more teachers the opportunity to:

- Connect entry-level physics to particle physics.
- Experience guided learning from the "other side of the desk."



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Virtual Center

- Supports teachers that have been "orphaned" due to:
  - Their own relocation.
  - Their center disbanding.
- Teachers were already QuarkNet participants.
  - Set up Web 2.0 site for interaction and sharing
  - Hold monthly EVO meetings.
  - Explored the e-Lab with e-Lab fellows.
  - Contact with international colleagues

  - Holding a face-to-face meeting at ND this week

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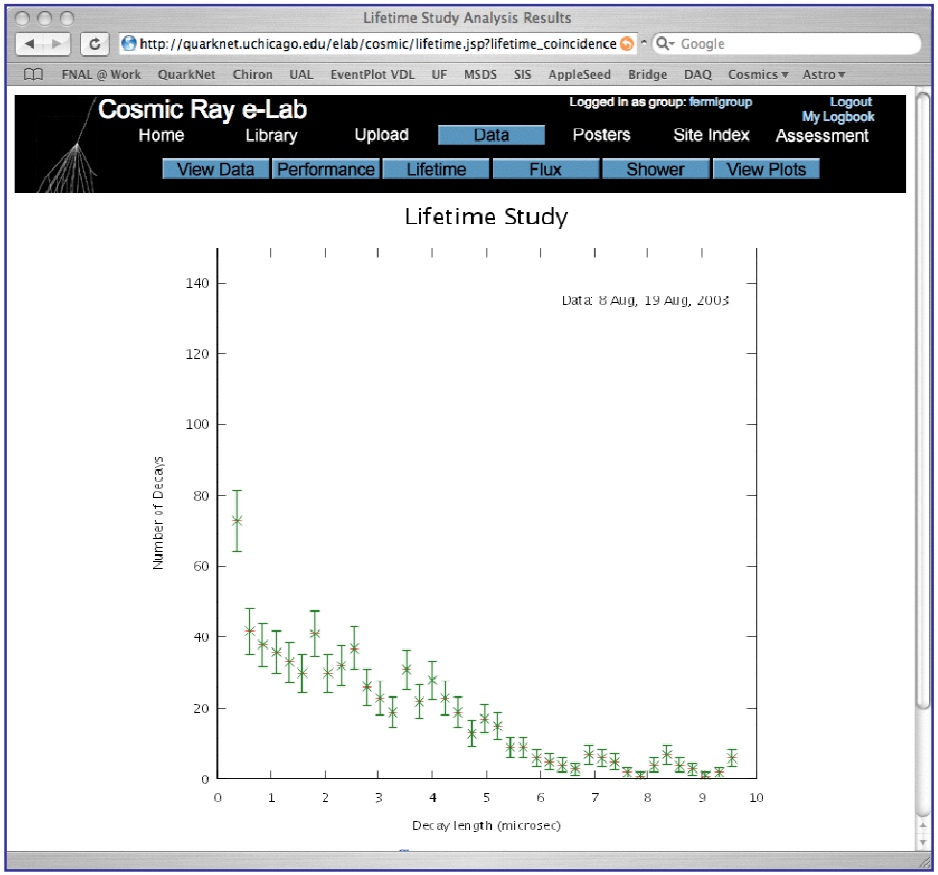
e-Labs

- Supports access to:
  - Raw or MC data
  - Analysis routines
  - Data product storage
  - "Publication" of results



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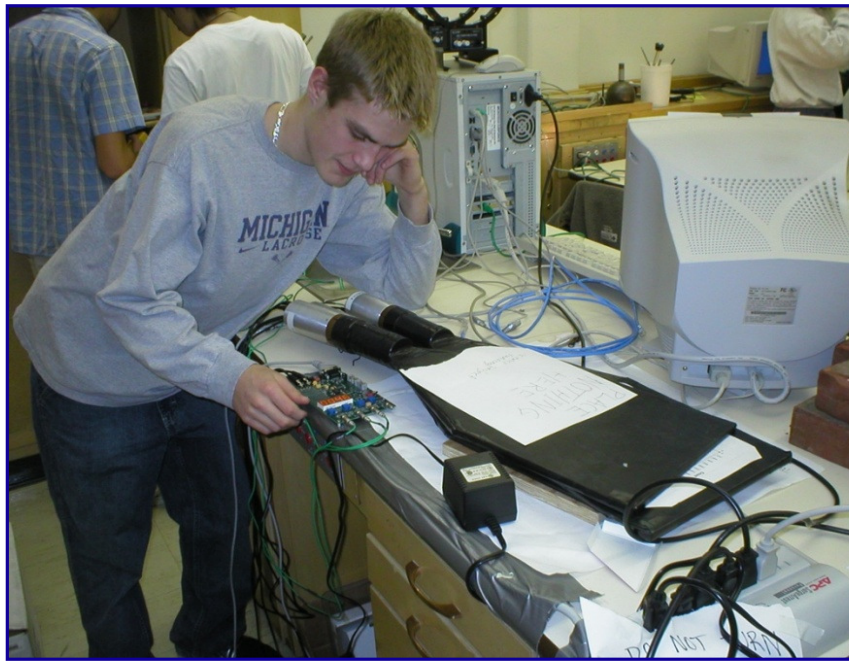
Cosmic Ray Muon Detectors



- 350 in the field
- Requests for 48 more in 2009
- Significant interest outside QuarkNet
- Students & teachers collaborate on simple experiments:
  - Shielding
  - Rates
  - Showers

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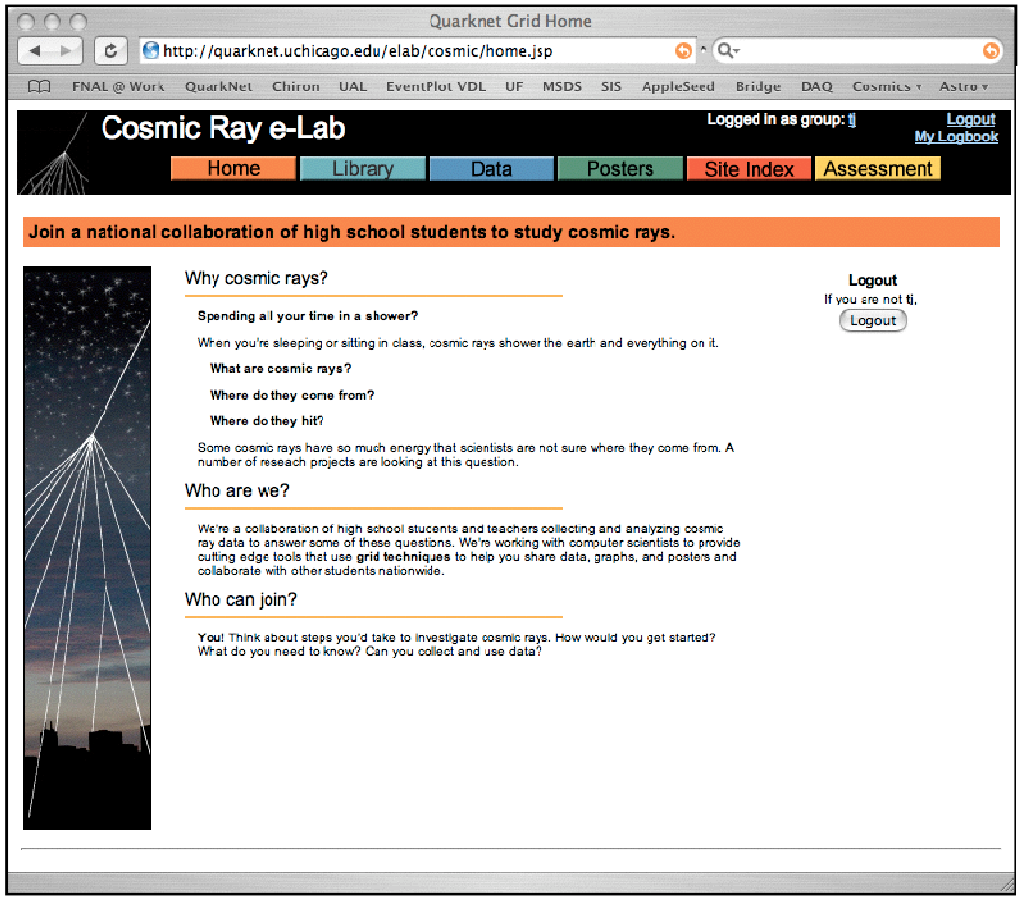
The Cosmic Ray e-Lab



- ~ 600 teacher accounts
- > 1,000 student accounts
- ~20,000 raw data files
- Thousands of analyses run this year
- Hundreds of posters created by students

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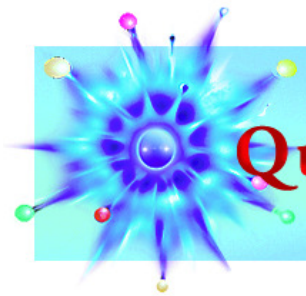
U.S. Masterclass

EPPOG runs this for European high school students. Students analyze LEP data to study Z-decays and LHC Monte Carlo data

- QuarkNet teachers modified this to be more involved in what the students do and learn.
  - 21 centers participated in 2009
  - ~350 students in total
  - QuarkNet mentors tutored students.



Local Center Activities

QuarkNet Centers …

- Construct equipment to take into the classroom
  - Cloud chambers
  - Cosmic ray detectors
  - Radio telescopes
  - Balloon borne measurements …
- Design experiments using the equipment
- Host talks on latest developments in the experiments (ATLAS, CMS, etc.) and in physics
- Promote sharing of curriculum among teachers
- Arrange for tours of Fermilab, university labs, etc.
- Guest lecturers for classrooms

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High School Summer Students

Students Doing Summer Research

- 23 Centers in 2009
- Students are plugged directly into experiments in HEP, including:
  - D0 Fiber Tracker
  - CMS HCAL
  - MINERvA
  - ILC R&D …

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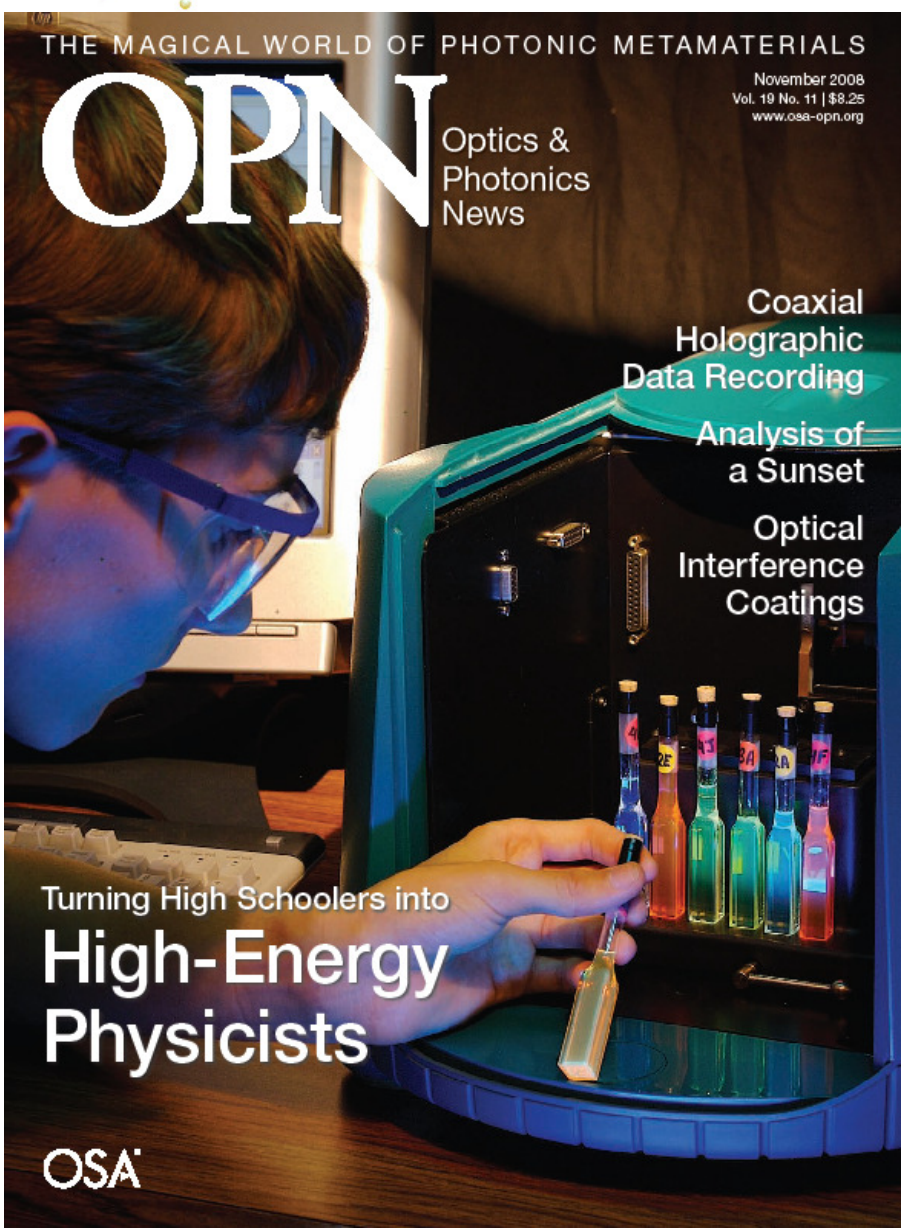
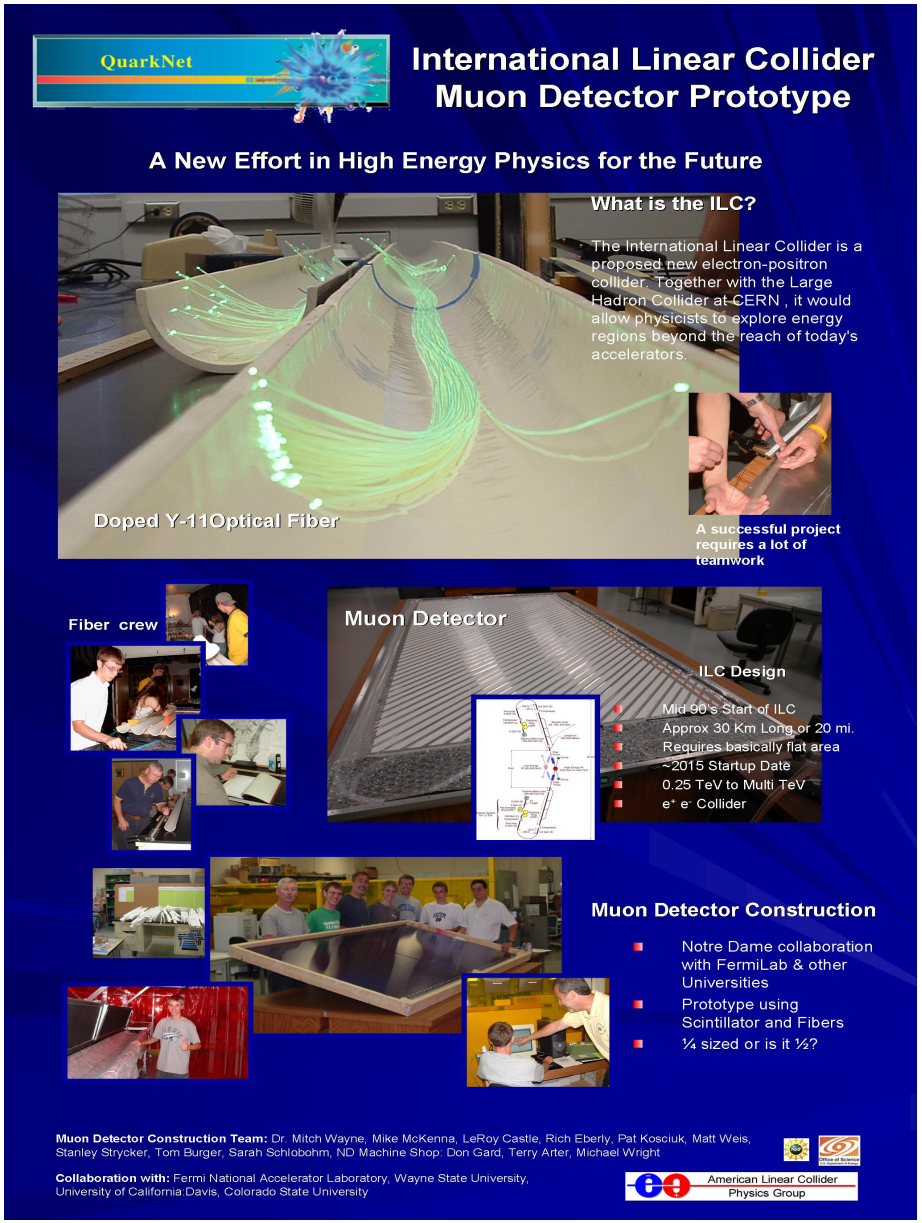
ND Center Activities





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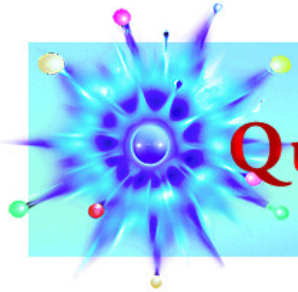
Local Program - Stories



Summary

- A model of inquiry-based learning
- A large community
  - ~ 50 Centers in 25 states + Puerto Rico (+ virtual center)
  - Serving 570 high schools
- A large impact on teachers
  - A community of teachers
  - University/lab faculty as mentors
- A large impact on students (about 400,000 since 1998)
- Analysis of real data from forefront experiments
- Use of Grid tools and networking
- Persistence – a twelve-year history and going strong
  - A staff of four high school teachers to make it work
- Looking forward to start of LHC, ATLAS and CMS