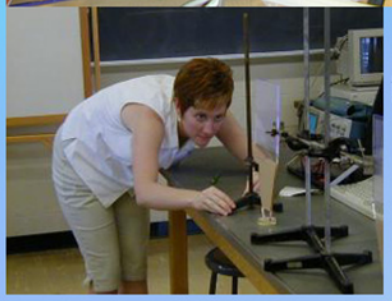
Helping Develop America's Technological Workforce

QuarkNet

The QuarkNet Collaboration





NSF | Office of Science U.S. Department of Energy

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Our Research Community

Physicists, teachers & their students collaborate on research projects and investigations.

- **Scientists as mentors**
- **Teachers as researchers & facilitators**
- **Students as researchers**

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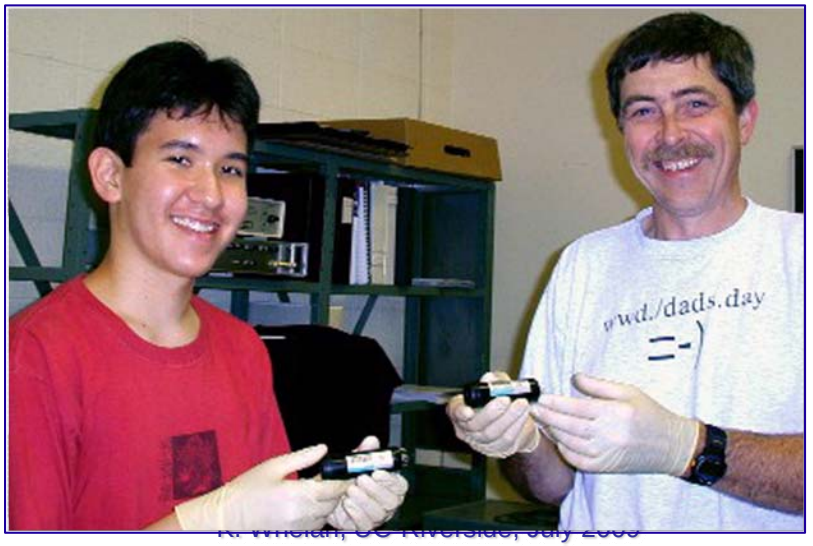
Impact

- Long-term relationship on teachers' professionalism

- Students' opportunities and abilities to engage in scientific investigations.



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Vision

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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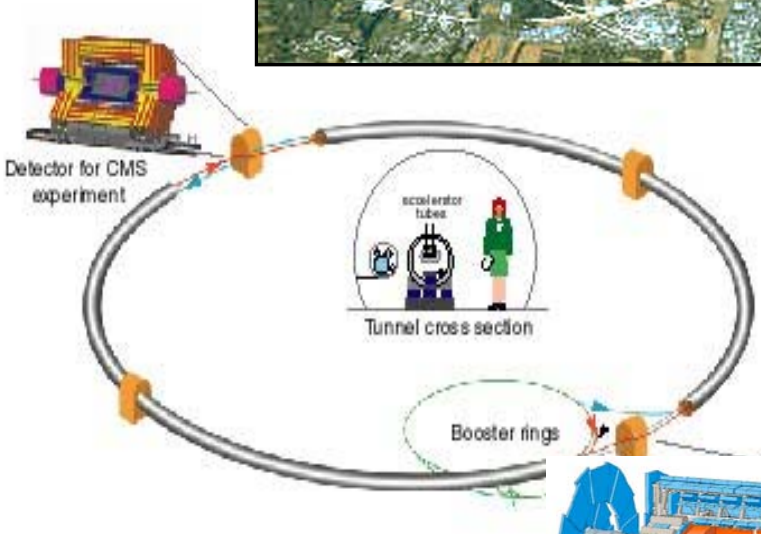
Why QuarkNet?

Our understanding of the universe is about to change as a new accelerator, the LHC, and its experiments, ATLAS, CMS, ALICE and LHCb turn on.

Join particle physicists to work on physics projects exploring the nature of matter, energy, space and time.



ATLAS & CMS

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QuarkNet . . .

- Supports learning by inquiry.
- Provides teachers and students with real research opportunities in particle physics.
- Encourages national and international collaboration among students, teachers and scientists.

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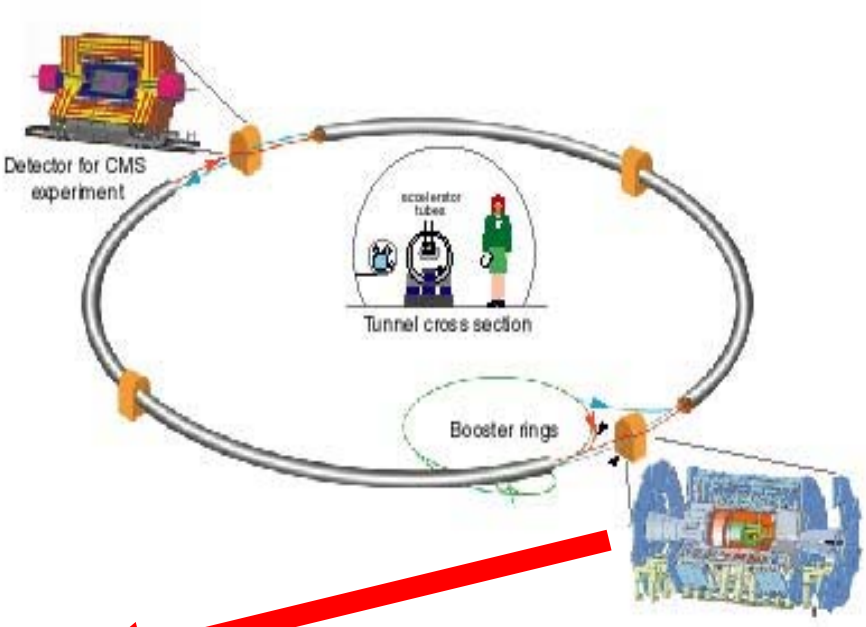
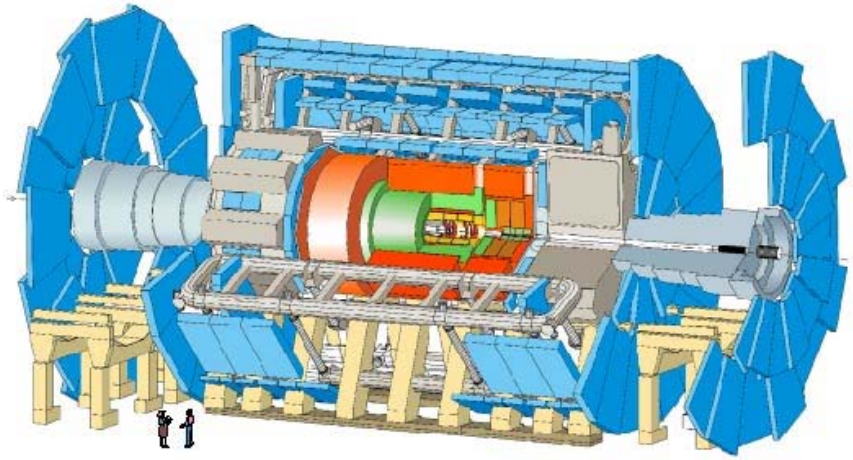
QuarkNet Origins



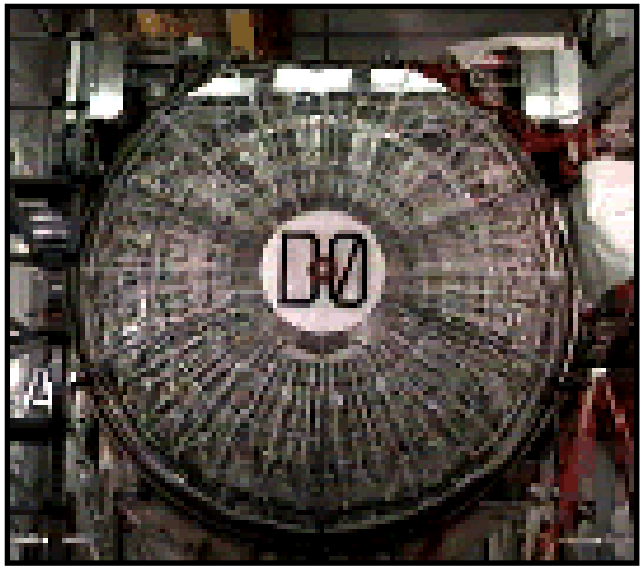


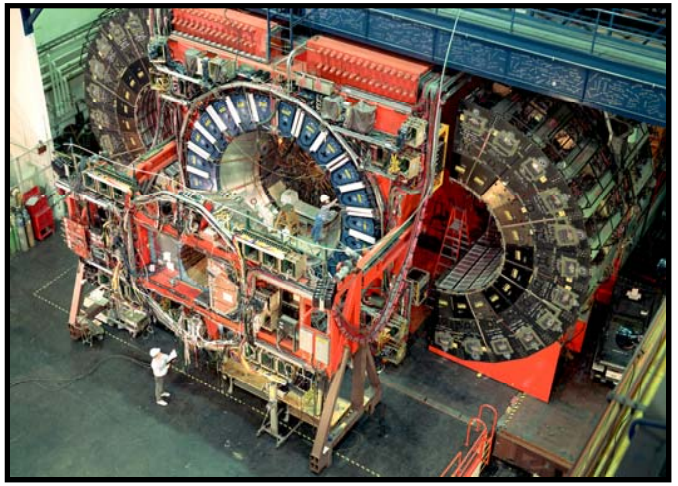
ATLAS and CMS at CERN

QuarkNet

QuarkNet Origins

CDF & DØ
at
Fermilab





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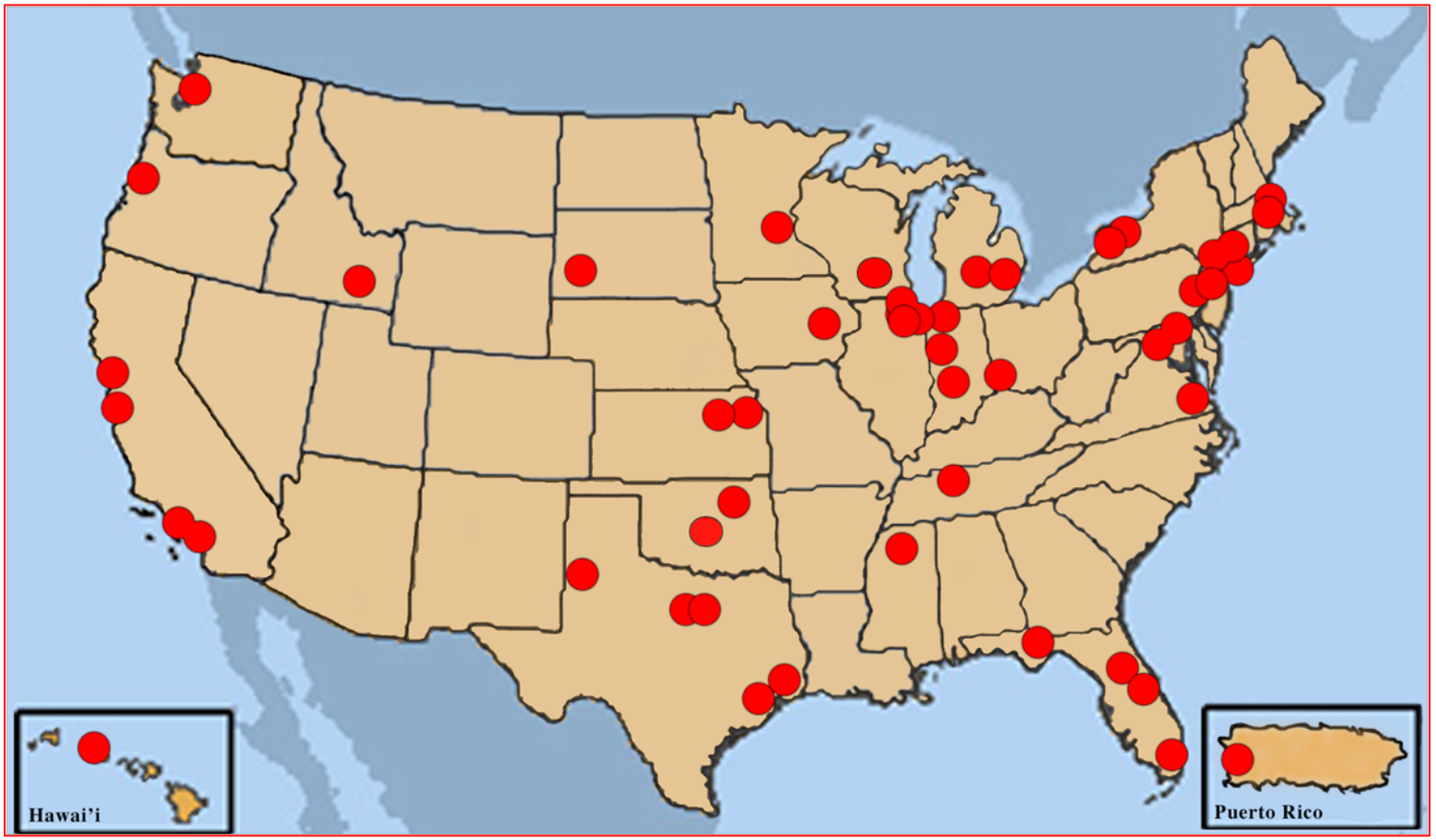
Current Active Centers



K. Whelan, UC-Riverside, July 2009

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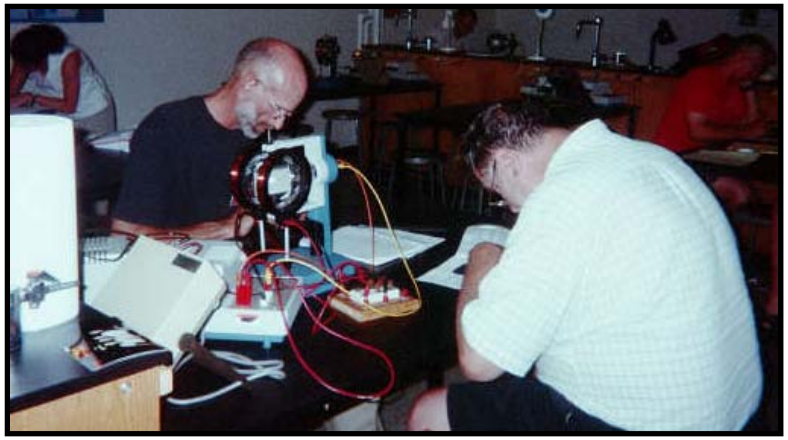
Current Status

- 53 Active centers
- 158 Mentors
- 615 Teachers
- 108 Summer students



K. Whelan, UC-Riverside, July 2009

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Year 1: Research Experience

For 2 lead teachers:

- **1-week Boot Camp at Fermilab**
- **7-week research with mentors at local university or lab**
  - **Plan Year 2 research workshop for up to 10 associate teachers.**
  - **Stipend, travel, mini-grant**
  - **Graduate credit available**

QuarkNet Year 2: Research Experience

For up to 12 teachers

- **3-week program based on research scenario**
- **Time may be split between summer & academic year.**
- **Stipend (2009- $100/day), mini-grant**

QuarkNet Year 3+: Learning Communities

- **Program**
  - **1-week follow-on program for all teachers (year 3+)**
    - **$100/day plus funds for materials, travel, etc**
  - **Optional programs**
    - **Student summer research teams (year 3+)**
    - **Particle Physics Boot Camp (all years)**
    - **Reunions (all years)**
    - **Cosmic Ray Studies (all years)**
    - **Other opportunities to be described later**

Teachers as Researchers

So..what can teachers do?

- **Construct and test detector components.**
- **Create data sets for students.**
- **Develop online experiments for students.**
- **Develop classroom detectors.**

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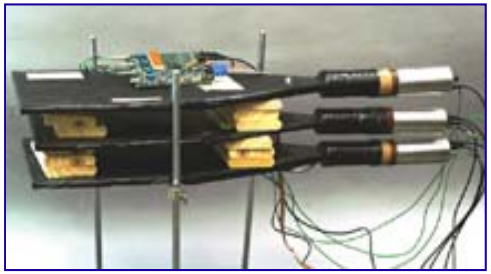
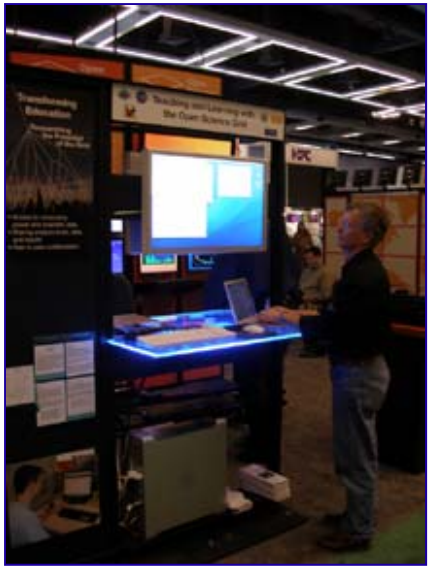
Cosmic Ray Detector



- Teachers' idea
- Several prototypes
- Collecting data led to e-Lab



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Reunions and Opportunities

- LBNL, SLAC/Stanford Reunion, 3/18/2005
- NSTA Reunion at SMU, 4/1/2005
- Fermilab Reunion, 10/7-9/2005
- CSAAPT at College Park, 11/05/2005
- AAPT Meetings
- Particle Data Group 50th 9/23/2006
- Fellows Program 2007- ongoing
- Fermilab Pajama Party for LHC Start-up 9/10/2008.

And…….

5 teachers sent to CERN in Geneva, Switzerland for a 3 week workshop (2007-2009)

Riverside, July 2009

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U.S. Masterclass

Student teams:

- **Discover the world of quarks and leptons with real data.**
- **Join a videoconference with students around the world.**

K. Whelan, UC-Riverside, July 2009

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Boot Camp at Fermilab

- **Research teams:**
  - **Explore data to learn about particle physics.**
  - **Use energy and momentum conservation.**
  - **Reconstruct Z decays from event data.**
  - **Present findings in culminating seminar.**
- **Talks and tours provide background info.**

SRCH EPCF

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Student Summer Research

- 11 centers with 4 student slots each (avg)

A taste of a succulent future

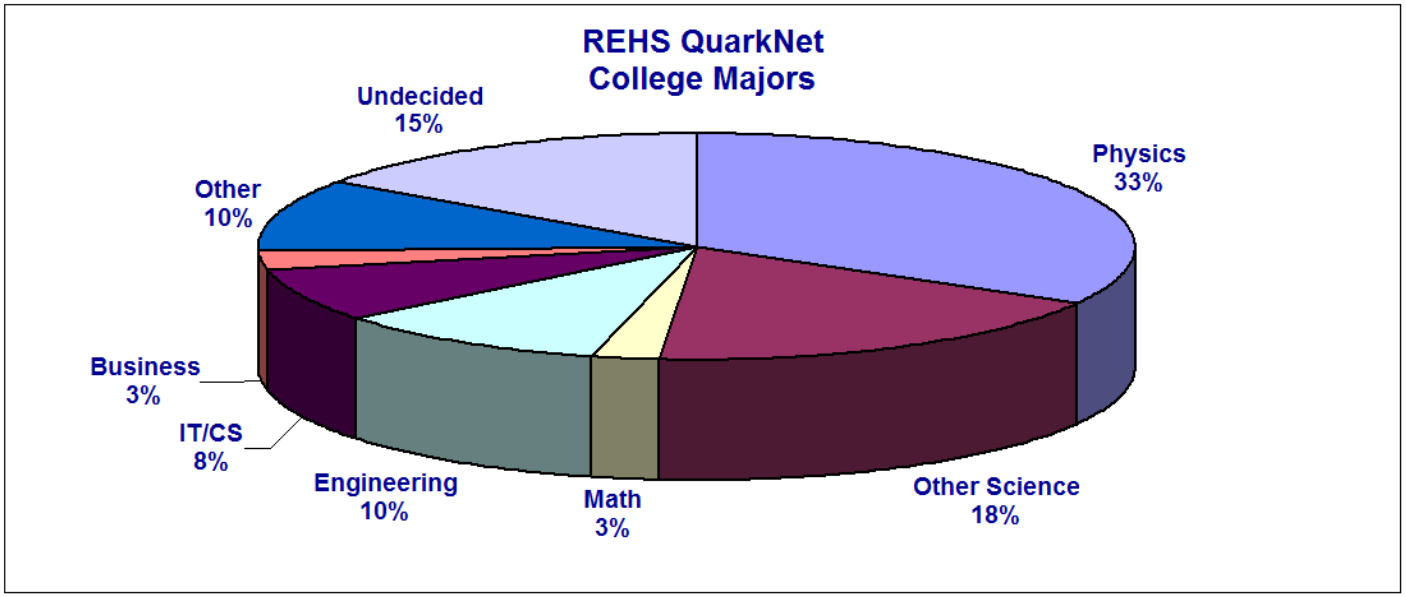
Astounded by the beauty & simplicity of the particles that define our existence

Continually challenged me

Too much fun

Invaluable Experience

Report on 39 Summer Students



I will be attending the University of Michigan this fall with an intended major of biochemistry and a minor in physics. I really enjoyed my summer and it was a big factor in not only my school choice but my decision to minor in physics. Amanda - 2005

Funding

- NSF ESIE grant
- NSF Experimental Particle Physics support
- DOE High-Energy Physics support
- ATLAS & CMS education support
- Research groups & dept.'s in-kind contributions

Helping Develop America's Technological Workforce

QuarkNet Team

PIs

- Marge Bardeen
- Michael Barnett
- Randy Ruchti

Dan Karmgard, Mitch Wayne

Staff Teachers

Bob Peterson, FNAL
Tom Jordan, Florida

Kris Whelan, LBNL

Ken Cecire, Notre Dame

Support Staff

Gayle Millman, LaMargo Gill, FNAL
Anne Zakas, Notre Dame

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What does the future hold? Where does the "Road" go now?

- Renewal of NSF Grant was approved last year
  - 5 year cycle
- Comments from the NSF/DOE review panel were overwhelmingly positive.
  - "QuarkNet is a model for other groups to use"
- New/Additional Directions for QuarkNet

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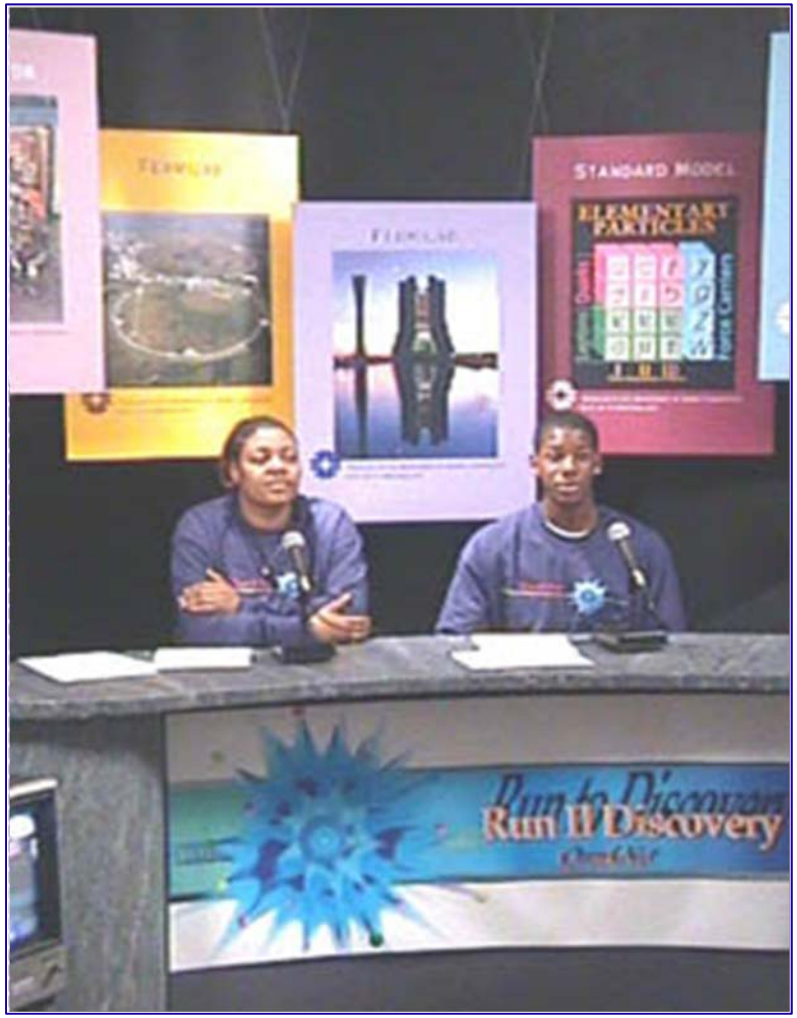
Summary



QuarkNet is:

- A successful program which started in 1999 and continues to grow.
- A long-term program based on the LHC timeline.
- A partnership between physicists and teachers.
- A program that contributes to providing highly qualified teachers in physics classes (NCLB).