



# It's Not Just a Good Idea...

Education and Outreach in Particle Physics

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# Science Drivers...

## Big Questions and Technical Challenges

- Big Questions...
  - Mass
  - The nature of spacetime
  - Symmetries
  - Dark Matter
  - Dark Energy
- Technical Challenges...
  - Accelerators
  - Detectors
  - Cyberinfrastructure
  - Analyses

Addressing: The Big Questions...

Meeting: The Technical Challenges...

- We must have
  - A thriving and vibrant scientific program.
- We need
  - A skilled scientific workforce and infrastructure.
  - An understanding and supportive public.
  - International collaboration and cooperation.

# The Scientific Program

## Some key elements

- The LHC:
  - Compelling physics potential and output.
  - Strong public awareness.
  - A strong and persistent education program.
- The ILC:
  - Compelling physics potential.
  - Credible cost and international partnership.
  - Strong public awareness.
  - A strong and persistent education program.
- Non-accelerator Physics/Neutrino Physics/Underground Science:
  - Compelling physics potential and output.
  - Credible cost.
  - Interagency partnership and international partnership essential
  - Strong public awareness.
  - A strong and persistent education program.

# Framing the importance of our science

## Public Relations and Education & Outreach

- Public Relations:
  - The Voice
  - The skill to convey a message
    - Targeted audiences
    - Directed and specific
    - Rapid timescales
    - Pivotal
  
- Education & Outreach:
  - The Eyes and Ears
  - The trained senses to see, hear and appreciate the message
    - Targeted audiences
    - Directed but broad in coverage
    - Evolutionary timescales
    - Transformative

# Timescales

## What are the implications

- A Graduate Student in 2020
  - Age 23 then
  - Age 9 now
    - An elementary schooler...
    - What career path will this young person choose?
- A Senior Physicist in 2006
  - Typical Age 50 now
  - Age 64 then
    - Retirement age looming...
    - What will be her/his legacy?

# Formal Education

## Opportunities

- We need to work within the education process at all levels.
  - Professional development for teachers and students
    - One-on-one mentoring.
    - Immersive research opportunities.
      - On experiments
      - In test beams
      - Analyzing data
      - Designing and building R&D equipment
    - Involvement in professional meetings
  - Classroom enrichment
    - Opportunities for in-class exposure to:
      - Real research
      - Meaningful experimentation
    - Alignment with Standards
      - Teachers essential to develop these elements
  - We need to collaborate with other scientists, computer scientists, and educational disciplines.
- Work with undergraduate degree granting institutions, community colleges, junior colleges
- Work/Study/Internships with the private sector and at National Labs
- Working with education schools that train teachers for primary and secondary education

# Informal Education

## Opportunities

- New exhibits to engage the public in forefront science
  - Accelerators, Particle Beams, Detectors
- Strengthening methods that provide a broader educational experience
  - Pre-visit or pre-lecture background or exposure.
  - Post-visit follow up activities and opportunities.



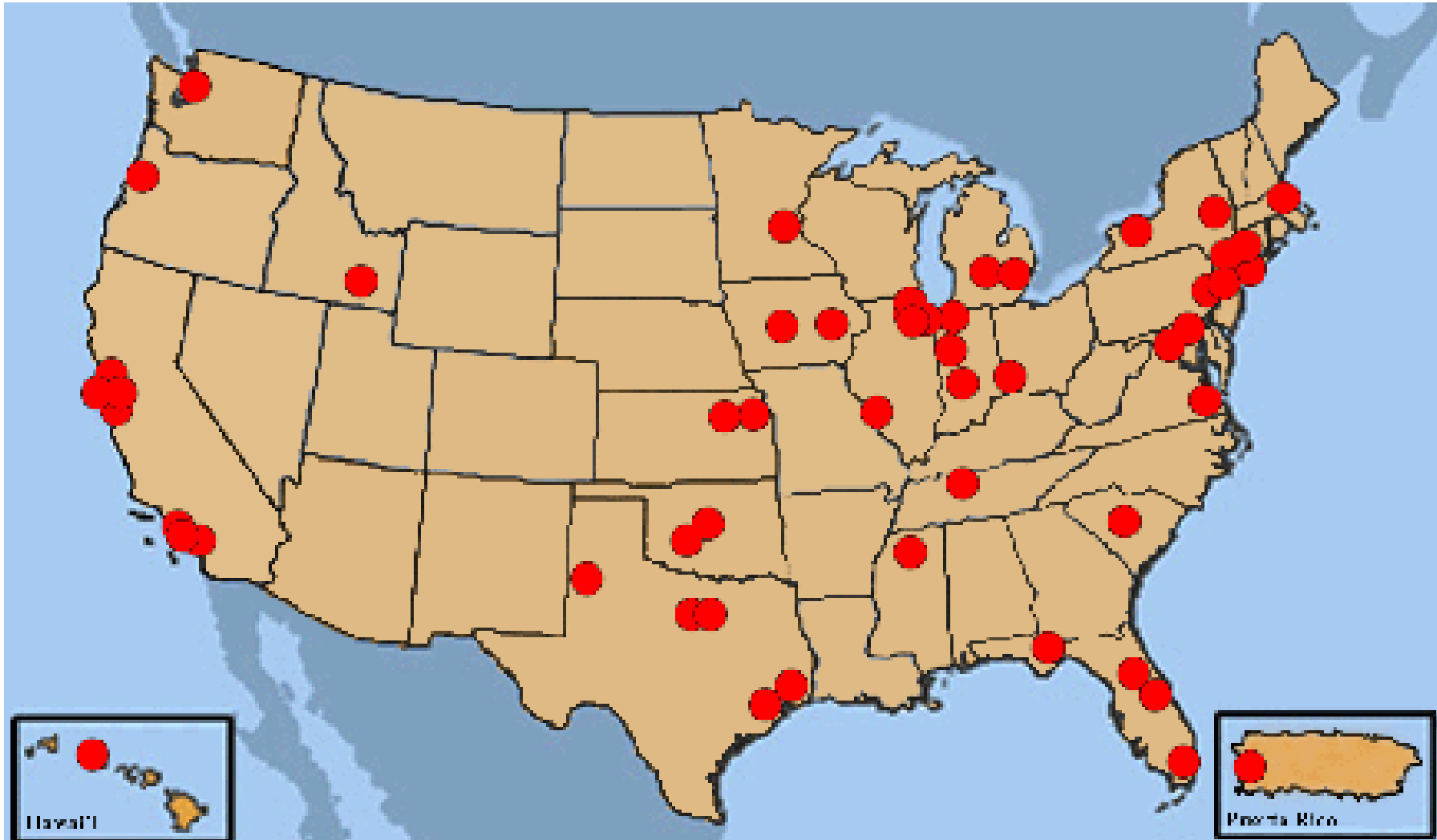
# The Reach of E&O Programs

Research and Educational Experiences for HS teachers and students

- Continental
  - NALTA (ALTA/WALTA/CROP/SCROD/CHICOS/QuarkNet)
  - National (25 States + Puerto Rico)
- National
  - QuarkNet (25 States and Puerto Rico)
- State
  - CROP (Nebraska)
- Regional
  - Mariachi (Long Island)
- County
  - CHEPREO (Miami, but including links to Brazil)
- Community
  - Your university or lab or school

# Example: QuarkNet

## Center Locations



# E&O International

## A new arena to develop

- A working group with representation from the regions
- The development of a plan for an international effort
- Current activity at ILC Workshops
  - Some effort is already underway:
    - At Bangalore – QuarkNet Cosmic Ray Grid Project
    - At this Meeting – Sessions and Cosmic Ray Program
    - At DPF Honolulu – Sessions and QuarkNet Program
- Have an E&O column or dedicated issue in the ILC Newslines, Interactions,...
- Engage senior scientists to help facilitate this effort

# Education and Outreach

## The impact of Senior Scientists and Researchers

- What will such individuals do to continue to make a difference?
  - Coordinated volunteerism
    - Working with the public
    - Helping with international efforts in E&O
  - Resource Persons
    - Working with elementary and secondary schools – in collaboration with professional teachers
    - Active guidance for non-traditional and underrepresented groups
    - Guiding immersive research experiences for younger students
      - including secondary students and undergraduates.

# At NSF

## Underlying Themes

- Empowering University-Based Investigators
- Adding Value
  - Partnerships
    - Building Interdisciplinary Collaboration
  - Broadening Participation
    - Single Investigators
    - Non-traditional/Underrepresented participants
    - RUI's (Research at Undergraduate Institutions)
  - Education and Outreach Activities

# NSF & DOE Some Collaborative Examples

## Intra-agency/Across Agencies

- **QuarkNet**
  - NSF MPS/EPP
  - NSF MPS/OMA
  - NSF EHR/ESIE
  - DOE/HEP
  - In Kind
- **CHEPREO**
  - NSF MPS/EPP
  - NSF OISE
  - NSF EHR/ESIE
  - NSF OCI
  - NSF MPS/OMA
  - In Kind
- **I2U2**
  - NSF MPS/EPP
  - NSF MPS/PHY
  - NSF MPS/OMA
  - NSF EHR/TPC
  - NSF EHR/ISE
  - NSF EHR/IMD
  - In kind
- **Lederman Science Center**
  - DOE/HEP
  - DOE/SCI
  - NSF(QuarkNet, I2U2)
  - State of Illinois
  - Private Foundations

# Education and Outreach

## Some discussion points

- International E&O planning
  - Including Regional planning
  - A working group
  - Value added to existing programs
- Engaging youth
- Engaging senior researchers and teachers
- Providing added value to ongoing programs
- Looking for new opportunities
  - Science and scientific collaboration
  - Geographic Reach
  - Nontraditional and underrepresented individuals and communities
- Informal education

# Education and Outreach

## In Particle Physics

- It's not just a good idea...
- It can be transformative
  - Professional Development for Teachers
  - Enrichment of the educational experience for young students
  - Reaching the public through new museum exhibits
  - Forging new international connections.
  - An invitation and welcome to our science.