Forging New, Non-Traditional Partnerships among Physicists, Teachers and Students
quarknet.i2u2.org

Marjorie Bardeen, Fermilab
Mark Adams, University of Illinois at Chicago (retired)
Mitchell Wayne, University of Notre Dame
Dan Karmgard, University of Notre Dame
Anna Goussiou, University of Washington

(mbardeen@fnal.gov)
Context
The Collaboration
Benefits
Others too
lends itself to non-traditional education (outreach) programs.

Large collaborations & facilities
Long development & run times

Central management with distributed work nationally & internationally

(more than 160 U.S. universities, institutes & labs)

M. Bardeen, ICHEP, August 2016
Next Generation Science Standards
Science and Engineering Practices
To make science education more closely resemble science

“The practices better explain and extend what is meant by ‘inquiry’ in science and the range of cognitive, social, and physical practices that it requires.”

M. Bardeen, ICHEP, August 2016
QuarkNet – in its 19th year

A long-term professional development program for physics teachers supported by the particle physics research community

50+ centers at universities & labs across the U.S.
82 physicists as volunteer mentors
563 active teachers & their students

+ international outreach

M. Bardeen, ICHEP, August 2016
What makes it non-traditional? It’s . . .

- About building lasting relationships.
- 18 years old.
- A partnership between physicists & teachers top to bottom.
- An open door for teachers into our research community.
- About teachers & student teams making meaningful contributions to HEP experiments.
- Bringing 21st century physics into classrooms.
Engagement with Scientific Investigations

- Research internships
- Research-based workshops
- Masterclasses
- Cosmic ray detectors
- Access to online datasets
- Data-based instructional materials
- Ongoing support
The QuarkNet Collaboration

Management Chart

Advisory Group

4 PIs

3 IT/Tech Staff

3 Staff Teachers

Outside Evaluators

Center 1

Center 2

Center 3

Typical Center

Center 48

Center 49

Center 50

2 Mentors

2 Lead Teachers

8-10 Associate Teachers

Helping Develop America’s Technological Workforce
Opportunities to:

• Share their passion for particle physics.
• “Recruit” the next generation of scientists . . . and new students for the department.
• Get help in their ongoing research from an interested and eager team.
• Use sophisticated cosmic ray experiments to inspire undergraduate and graduate students.
Opportunities to:

• Learn from the challenges and opportunities of teaching high school physics.
• Reach out to their communities.
• Participate in a credible, impactful outreach program that is highly regarded by our funding agencies.
Opportunities to Work:

- With physicists who are passionate about the work they do
- With real data . . . with all of the joys and frustrations that accompany that
- On "real-world" problems that don't necessarily have clear "back of the book" answers
- On building things! (e.g., detector components or classroom cosmic ray detectors)
Opportunities to:

- Study topics in 21st century physics.
- Learn science by doing science, not just reading about science.
- Have a sense of wonder about the universe.
- Challenge even the brightest students.
- Motivate students to potentially pursue physics or some STEM field.
Opportunities to:

• Learn science by doing science, not just reading about science.
• Go right to the experts; talk directly with physicists.
• Collaborate with students worldwide.
• Experience the environment of a scientific collaboration.
• Conduct their own scientific investigations.
QuarkNet – a strong program that benefits teachers, students & physicists

• Becoming members of a learning & research community
• Using inquiry-based teaching/learning strategies
• Using particle physics examples in introductory physics
• Doing HEP projects in class
• Using data-based instructional resources

Could you adapt our model in your country?

M. Bardeen, ICHEP, August 2016
Teilchenwelt, Germany (2010)
http://www.teilchenwelt.de

HISPARC, The Netherlands (2001)
http://www.hisparc.nl

---

Institute for Research in Schools, UK (2016)
http://www.researchinschools.org