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# Forging New, Non-Traditional Partnerships among Physicists, Teachers and Students

[quarknet.i2u2.org](http://quarknet.i2u2.org)

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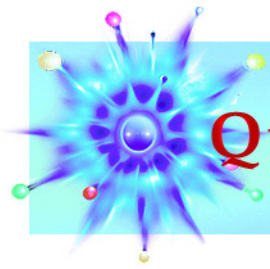


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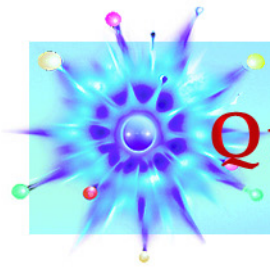


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**Context**  
**The Collaboration**  
**Benefits**  
**Others too**





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# Nature of HEP Research

**. . . 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)**

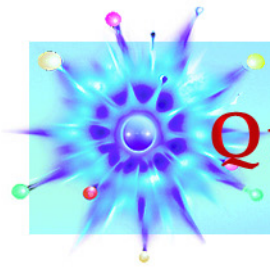


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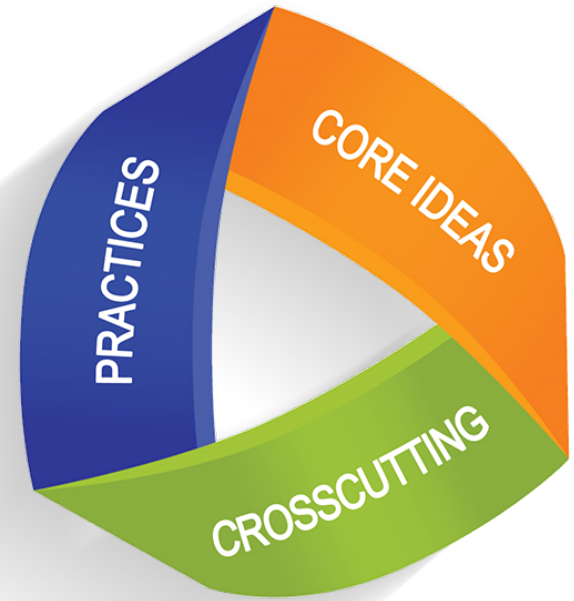
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# National Education Efforts

## 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.”

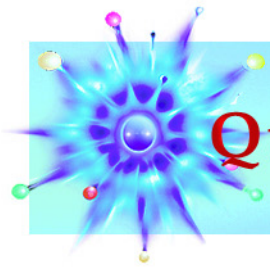


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# The QuarkNet Collaboration

## QuarkNet – in its 19<sup>th</sup> 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**

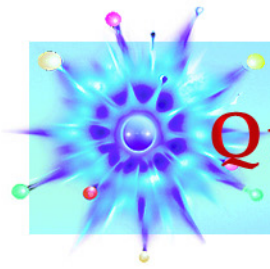


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# The QuarkNet Collaboration

## 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 21<sup>st</sup> century physics into classrooms.



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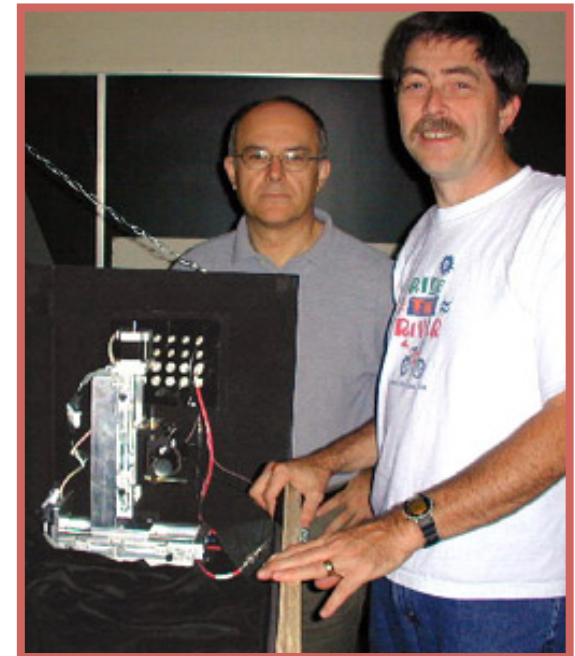
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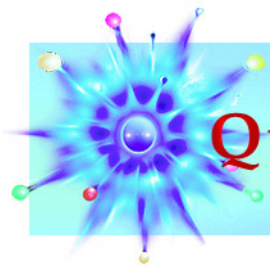


# QuarkNet Program

## Engagement with Scientific Investigations

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

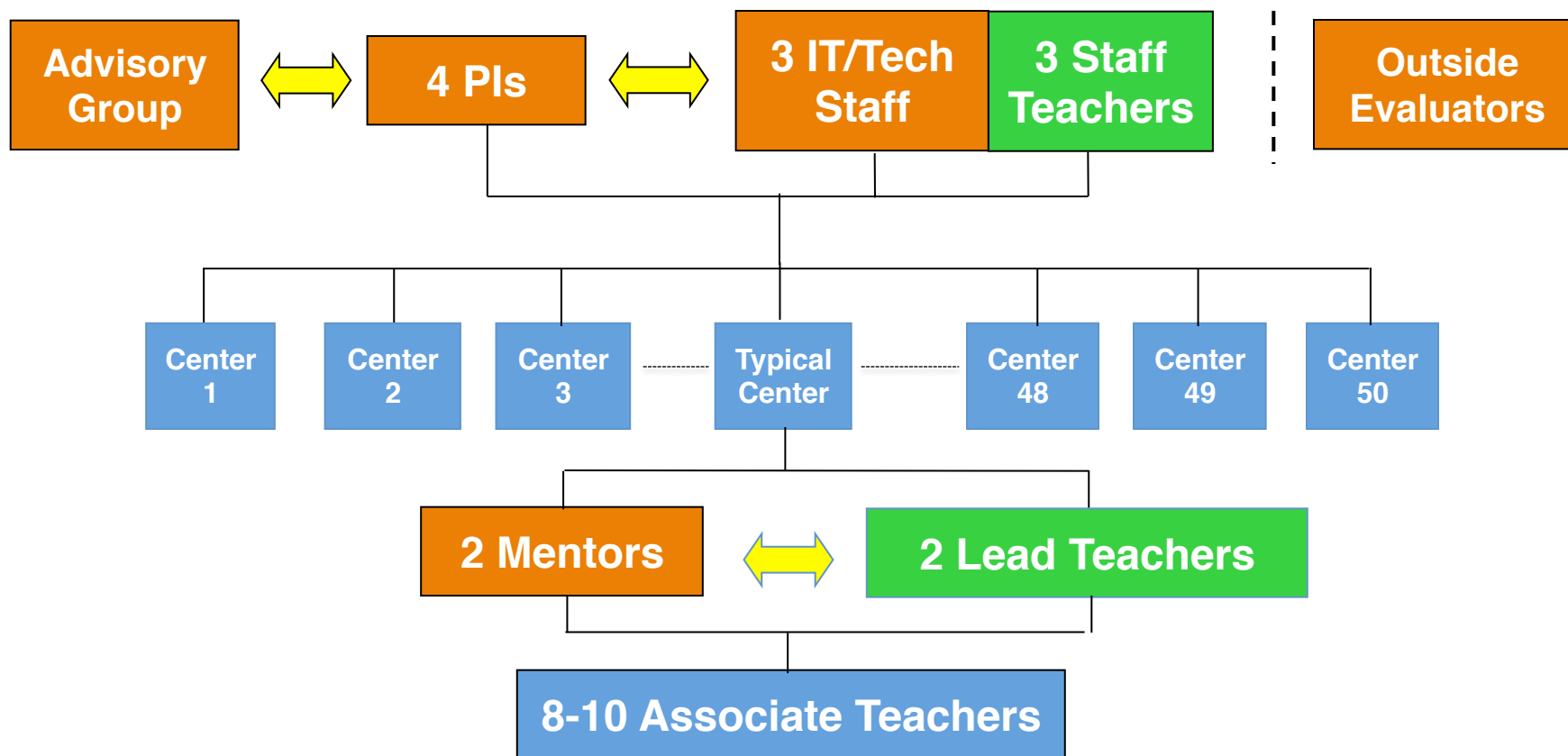




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# The QuarkNet Collaboration

## Management Chart



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# What Physicists Get

## 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.

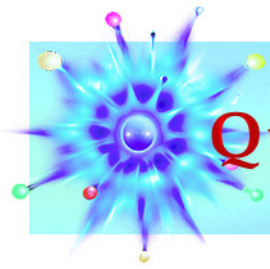


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# What Physicists Get

## 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.**

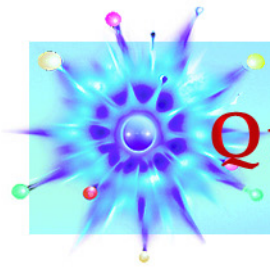


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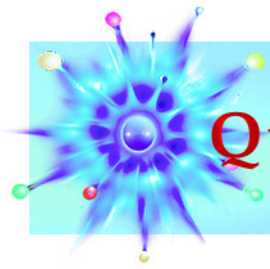
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## Opportunities to Work:

- **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)**





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# What Teachers Get

## 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.**

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- **Challenge even the brightest students.**
- **Motivate students to potentially pursue physics or some STEM field.**

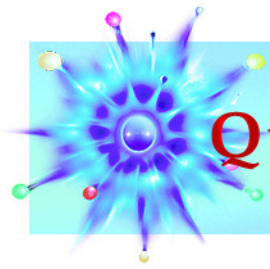


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# What Their Students Get

## 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.**

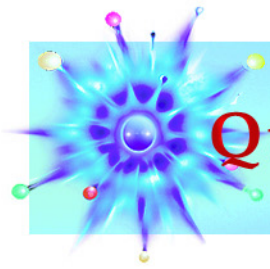


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# The QuarkNet Collaboration

**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?**



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# We Are Not Alone

## Teilchenwelt, Germany (2010)

<http://www.teilchenwelt.de>

## HISPARC, The Netherlands (2001)

<http://www.hisparc.nl>

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## Institute for Research in Schools, UK (2016)

<http://www.researchinschools.org>

