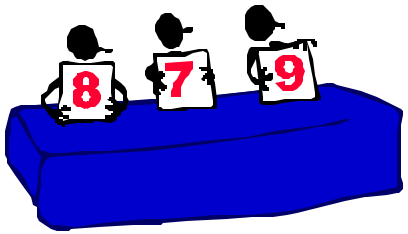
Joint NSF/DOE QuarkNet Review

December 13-14, 2001 at NSF Headquarters



Review Panel

Julie Callahan	**University of Utah**
Elliott Cheu	**University of Arizona**
Sarah Eno	**University of Maryland**
Lucy Fortson	**University of Chicago and Adler Planetarium**
Ken Heller (*Chair*)	**University of Minnesota**
Michael Kenney	**ASM International**
James Madsen	**University of Wisconsin, River Falls**
Mats Selen	**University of Illinois**
Fred Stein	**American Physical Society**
Joseph Stewart	**Formerly of the N S F**

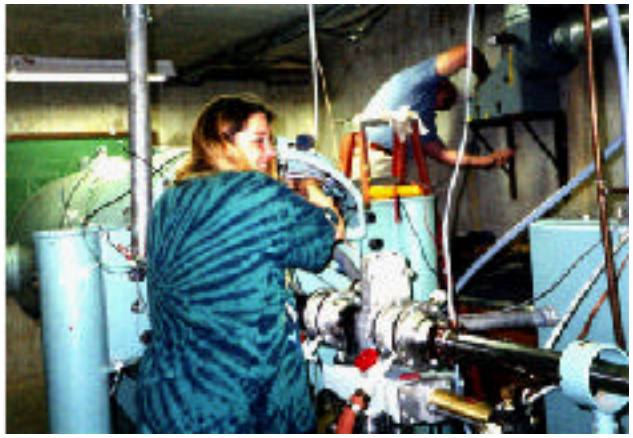
Charge

1. **Evaluate the progress to date and the level of meeting the goals set forth in the original proposal. Are the laboratory and separate site programs aligned with "Best Practices"? What is the level of the high school teachers' satisfaction with the project? How have the high school teachers and their students benefited from this project? What components need to be modified or refocused?**

Progress to date: Great
Best Practices: Yes
Teacher Satisfaction: High
Benefits: Teachers are respected and knowledgeable professionals.
Modifications: Another staff member for contingency useful. Increase participation of well-prepared but underrepresented and underserved groups including rural and inner city teachers.

National Involvement After 2.5 Years
140 mentors, 61 lead & 181 associate teachers at 32 centers

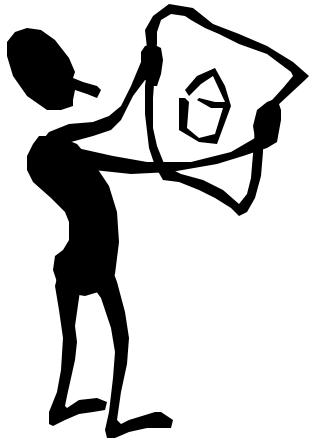
High school students engaged in:
143 research
536 at least 1 wk of particle physics classroom activities
700 classes with physicists visits to universities & labs



2. Evaluate the future plans and goals of the project. Can the project successfully expand to the proposed size?

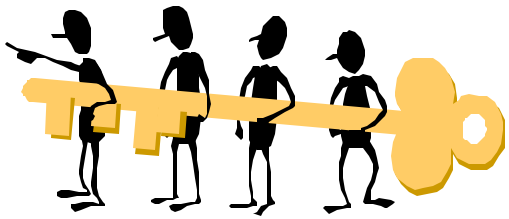
Future plans and goals: **Incremental modifications as more is learned is a good plan. Goals (excellent) remain the same. Possible adding of high school students in next renewal.**

Successfully expand: **No problem seen**



3. Evaluate the management of the project and comment on whether it is adequately integrating the needs of the teachers with participation of the mentor physicists and support by the project staff teachers.

Excellent management. Process going as planned including changes.



4. Comment on the proposed project funding profile over the life of the project. Are these funding estimates feasible and reasonable for DOE-HEP and the NSF team of MPS, ESIE, and Experimental Particle Physics Division?

Project funding profile is reasonable.

QuarkNet Project Costs ($k)

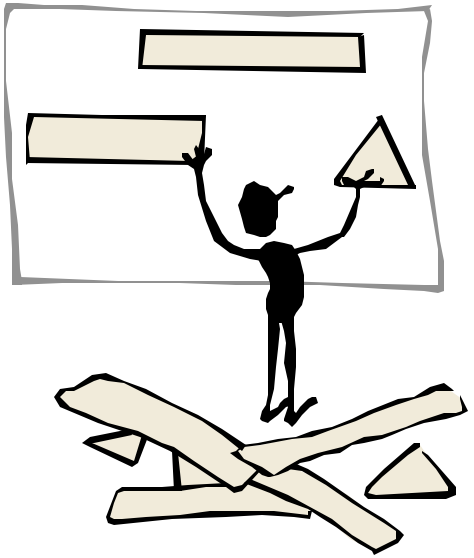
	FY99	FY00	FY01	FY02	FY03
Staff[1]	380.3	446.8	606.8	687.8	715.4
Center I[2] (#centers)	256.3 (13)	232.6 (12)	197.2 (12)	185.0 (12)	246.7 (12)
Center II[3] (#centers)	--	165.6 (12)	179.4 (12)	138.0 (12)	131.1 (9.5)
Center III[4] (#centers)	--	--	39.6 (11)	112.6 (24)	204.7 (36)
Center IV[5] (#centers)	--	--	--	--	--
Misc[6]	83.6	44.2	36.7	89.9	149.0
TOTAL	**720.3**	**889.2**	**1,059.8**	**1,211.4**	**1.447.0**

I - First stage, 2 lead teachers
II - Second stage, 2 lead teachers + 10 assoc. teachers.
III - Third stage, steady state.
IV - High school students added

FY04	FY05	FY06	FY07	FY08
737.3	764.8	793.1	834.2	853.4
--	--	--	--	--
172.6 (12)	--	--	--	--
247.7 (36)	247.7 (36)	165.1 (24)	82.5 (12)	--
237.7 (12)	475.4 (24)	713.0 (36)	950.8 (48)	1,188.4 (60)
131.0	131.0	131.0	131.0	131.0
1,527.4	**1,620.0**	**1,803.4**	**1,998.5**	**2,173.0**

Outline

- **What**
- **Why**
- **Who**
- **How**
- **Recommendations**



QuarkNet Purpose

Create a lasting community of researchers that includes high school teachers and students as well as physicists by

- **Engaging teachers, and subsequently their students, in scientific investigations**

- **Confronting particle physicists with current issues in science education**

Why

- **Mission of DOE**
- **Mission of NSF**
- **National Standards**
- **National Security**
- **Support of Basic Research**

Mission of DOE & NSF

Department of Energy Organization Act of 1977:

> **"The Department's involvement in mathematics, science, and engineering education should be consistent with its main mission and should be coordinated with all Federal efforts in mathematics, science, and engineering education, especially with the Department of Education and the National Science Foundation (which have the primary Federal responsibility for mathematics, science, and engineering education)."**

“The Office of Science has a long-standing and critical role in ensuring the flow of young scientists, engineers and technicians into the U.S. workforce.”

A Diverse Research Portfolio for the Nation’s Future, U.S. Department of Energy, Office of Science, TEID 3605, http://www.science.doe.gov, February, 2002.

“The U.S. has achieved its leadership position through the generous support of the American people. We renew and reaffirm our commitment to return full value for the considerable investment made by our fellow citizens. This commitment includes, but is not limited to, sharing our intellectual insights through education and outreach, providing highly trained scientific and technical manpower to help drive the economy, and developing new technologies that foster the health, wealth and security of our nation and of society at large.”

DOE/NSF High Energy Physics Advisory Panel (HEPAP) Subpanel on Long Range Planning for U. S. High Energy Physics report, http://doe-hep.hep.net/lrp_panel/, January, 2002.

U.S. Commission on National Security in the Twenty-First Century

"The nation is on the verge of a downward spiral in which current shortages will beget even more acute future shortages of high-quality professionals and competent teachers. The word "crisis" is much overused, but it is entirely appropriate here. If the United States does not stop and reverse negative educational trends—the general teacher shortage, and the downward spiral in science and math education and performance—it will be unable to maintain its position of global leadership over the next quarter century."

"Resolving these cumulative problems will require a multi-faceted set of solutions. ...Therefore, a set of additional actions must be taken to restore the professional status of educators and to entice those with science and math backgrounds into teaching. Only by addressing the systemic need to increase the number of science and math teachers will we ensure the supply of qualified science and technology professionals throughout our economy and in our national security institutions, both governmental and military."

National Science Standards K-12

- **Actively participate in scientific investigations (Science as Inquiry)**
- **Collect evidence, use models and develop explanations based on their work (Unifying Concepts and Processes)**
- **Study the structure and properties of matter and interactions of energy and matter (Physical Sciences)**

Teachers need to experience scientific practice in the context of doing science (real research)

Telling doesn't work
One-shot experiences not effective

U.S. Commission on National Security in the Twenty-First Century

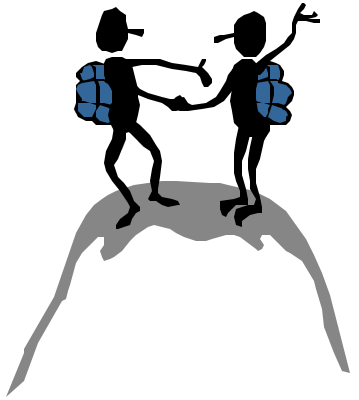
"Professional development that involves a substantial number of contact hours over a long period has a stronger impact on teaching practice than professional development of limited duration. Today, however, more than half of all science teachers in the United States report receiving no more than two days of professional development per year."

Road Map for National Security: Imperative for Change, The Phase III Report of the U.S. Commission on National Security/21st Century, The United States Commission on National Security/21st Century, http://www.nssg.gov/Reports/reports.htm , February, 2001.

Combine Strengths of NSF with Strengths of DOE

NSF

- Experience supporting K-12 Education
- Experience supporting University - K-12 Partnerships
- Experience supporting Fundamental Research in HEP



DOE

- Experience supporting Graduate/PostDoc Education
- Experience supporting Sustained Efforts
- Experience supporting National Collaborations through Central Laboratories
- Experience supporting Fundamental Research in HEP

Project Principal Investigators

O.Keith Baker
Hampton University

Marjorie G.Bardeen
Spokesperson
Fermilab

R.Michael Barnett
Lawrence Berkeley National Lab

Randal C.Ruchti
University of Notre Dame

Project Staff

Thomas Jordan, *Coordinator*
Fermilab (formerly at Illinois Mathematics and Science Academy,Illinois)

Beth Beiersdorf, University of Notre Dame (formerly at LaSalle High School, Indiana)

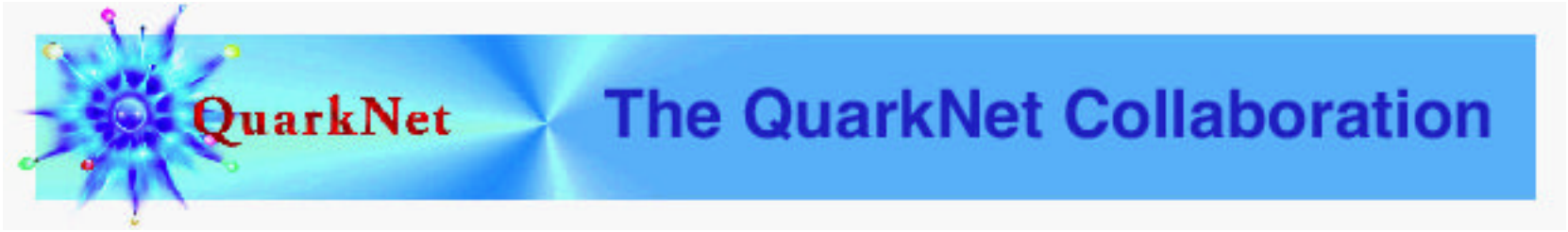
Kenneth Cecire, Hampton University (Warwick High School, Virignia)

Andria Erzberger, Lawrence Berkeley National Lab (Palo Alto High School, California)

Patrick Mooney, University of Notre Dame (Trinity School, Indiana)

How

Build the effort like a large HEP collaboration



QuarkNet will create 60 centers nationwide (45 now existing).

Each center has at least:
- **2 physicist mentors.**
- **2 lead teachers.**
- **10 associate teachers.**

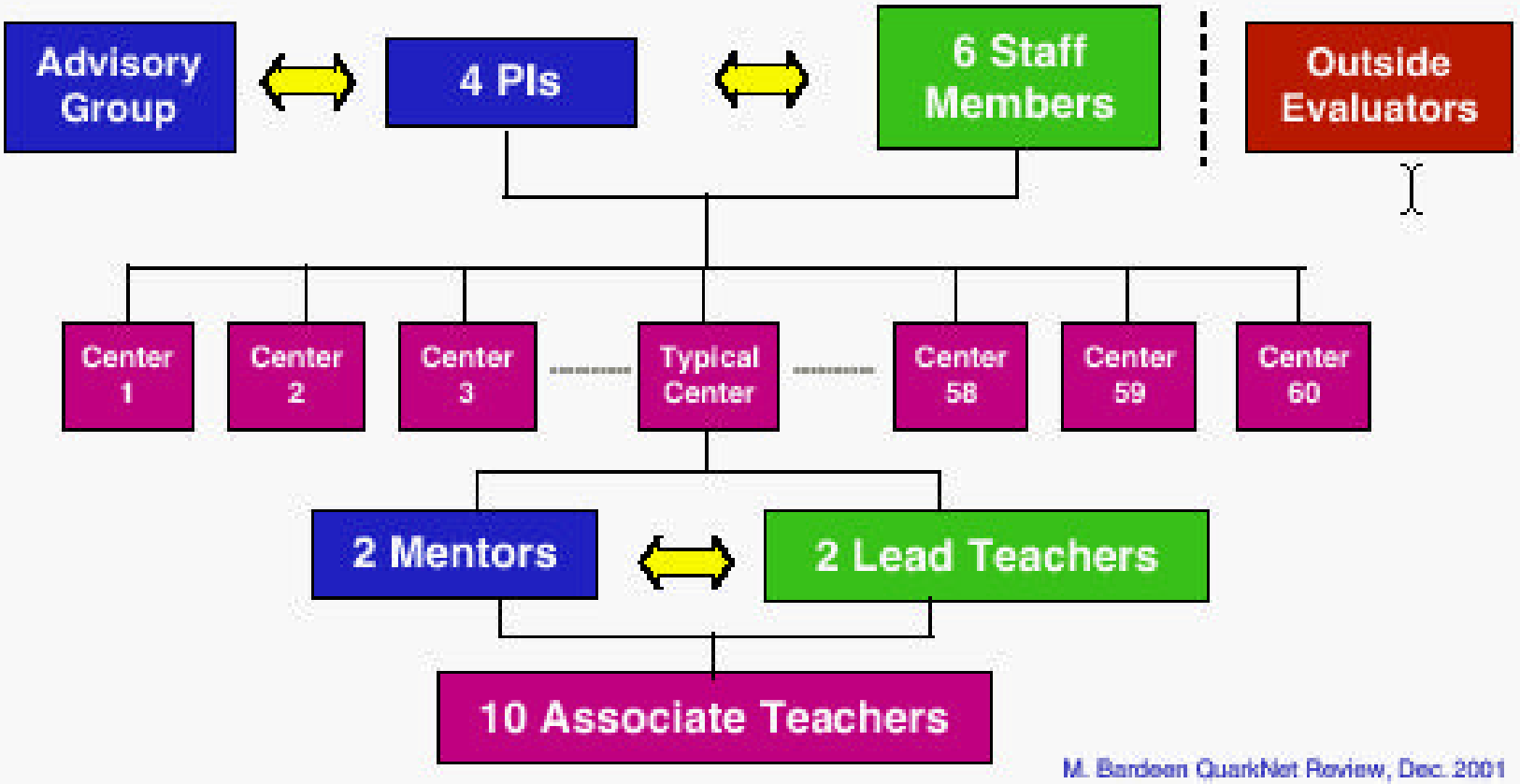
Project Management at Fermilab

HEP Management Structure

- **Central Resources, Oversite, & Technical Assistance**
- **Distributed Activity with Local Control**
- **Collective Decisions for Project Directions**
- **Leverage Local Resources especially facilities and effort.**

The QuarkNet Collaboration

Management Chart

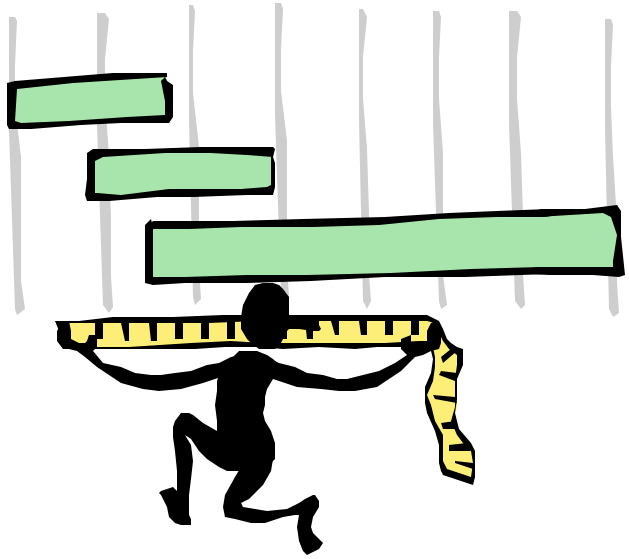


Support for Teachers

- **Stipends**
- **Year 1 — 1--week lead teacher orientation workshop**
- **7-week research appointment**
- **travel &subsistence for work away from home**
- **Year 2 — 3--week research-based institute for lead & associate teachers**
- **Following Years — 1-week follow-on program**
- **Academic Year Follow-on**
- **Stipend for 3.5 days (Year 1 only)**
- **Small reimbursement for instructional materials and/or attendance at professional meetings**

Program Evaluation Instruments

- Anecdotal information
- Best practice templates
- Classroom observation protocol
- Interviews
- Journals
- Portfolios including student work
- Pre-post-tests
- Site visits
- Surveys



QuarkNet Goals

- **Provide valuable research experiences to teachers enabling them to teach basic physics concepts in a context that students find exciting & rewarding.**

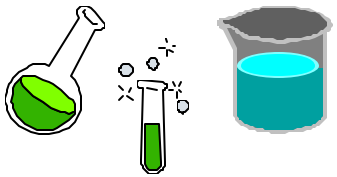
- **Develop links between high school classrooms & experiments that explore the scientific frontier.**

- **Attract students to careers in science &technology.**

- **Help develop scientific literacy.**

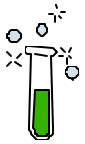
Only one (important) part of the mix needed to improve education

Quarknet (or programs like it) are necessary but not sufficient



Outcomes

Improve students ’:



- **Abilities to understand and appreciate the nature of measurement.**

- **Abilities to engage in scientific investigations.**

- **Knowledge of basic physics concepts.**

- **Attitudes toward & interest in studying science.**

- ***Knowledge of what physicists actually do.***

- ***Respect for teachers through teachers ’ ro les in real research.***

Outcomes

Increase teachers ':

- Knowledge of the scientific process.
- Knowledge of particle physics & how areas of the general physics curriculum such as forces, kinematics, conservation of momentum & energy, & relativity relate to particle physics.
- Abilities to solve science-related problems.
- Use of inquiry methods to develop in students the mental operations, habits of mind & attitudes that characterize the process of scientific inquiry.
- Classroom use of instructional resources that support student explorations of science.
- Contributions to the quality of practice of colleagues & the work of the larger science education community.

Conclusion

- **QuarkNet is an excellent project. The unanimous recommendation is that it be continued and expanded to its original planned scope.**
- **The project is well on its way to accomplishing the goals of the original proposal.**
- **The management and staff of QuarkNet were seen to have done an excellent job of modifying and refocusing the project as needed.**
- **If the project is functioning smoothly at the end of its original plan, the funding agencies should consider expanding the original proposal to allow participation by high school students.**

- **The funding profile is reasonable and should be well within the capability of DOE-HEP and NSF to fund.**
- **Funding should cover at least the level of its original plan and its future expanded plan if possible.**

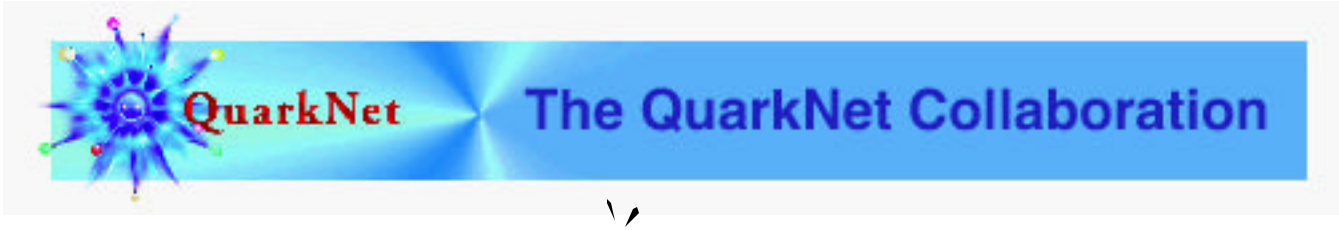
The Committee does not make these recommendations lightly, realizing that funding for the project could be a drain on both the modest scientific manpower and budget of the physics research program.

The Committee recommends that both agencies allocate funds to QuarkNet from sources other than the universities research program, whose recent funding has not kept pace with the costs of inflation.

•QuarkNet is seen by the Committee to be a project that strongly supports both education and scientific research.

•It should not be the only outreach project for high energy physics supported by NSF and DOE, but should be viewed as a successful example.

•The Committee urges that QuarkNet be supported at, or slightly above, the level proposed and that the funding agencies also support other types of outreach projects that can use QuarkNet as an inspiration if not a model.



Apple shift 3