Cosmic Ray Research in the Rochester Area

Susen Clark
PARTICLE lead teacher
Bioscience & Health Careers H.S. at Franklin
Professor Kevin McFarland, University of Rochester
PARTICLE PROGRAM

Physicists And Rochester Teachers Inventing Classroom Experiments

• Started as a QUARKNET center
• Has involved more than 25 teachers over a 5 year period
• Involves teachers from areas west of Rochester to east of Syracuse.
• Invite 6 new teachers/summer for a 3-week program
• Past participants return for a 1 week institute
The Goals of PARTICLE:

• Help local teachers learn more about high energy physics
• Provide teachers with equipment for lab work during their Modern Physics unit
• Get students to do research in high school
• Expose students to work of research scientists
PARTICLE Teacher Summer Institutes

• Program:
  – ⅜ Lecture and Discussion
    • Taxonomy and big picture of particle physics
      – Including experimental methods, lab tours, etc.
    • Other modern physics: relativity, quantum mechanics
  – ½ Lab work
    • Construct cosmic ray telescopes
    • Prototype student labs
  – ⅛ Discussion of Pedagogy, Classroom Applications
Particle Program

• During the school year:
  – Professor Kevin McFarland (U of R) or the PARTICLE graduate student visits schools during the year to talk to students about various topics including the classroom research of students
Particle Program

• During the school year:
  – Teachers have access to a shared equipment pool
    • Cloud chamber
    • Laminated lead for absorption study
    • E/m apparatus
    • Speed of light apparatus
    • Photoelectric effect apparatus
PARTICLE Day

• Culminating Experience
  ❖ Held in mid-May
  ❖ Students present their research
    ➢ Powerpoint or poster format
  ❖ University professors give a few lectures
  ❖ Students tour labs including the Laser Energetics Lab
Student Work at Franklin

- Inner city high school
- Physics is a semester course for juniors
- First time completing an authentic research project
- Students work in groups of 3 or 4 to investigate a topic of their choice.
Attacking the Research Project

- Students complete individual research to investigate cosmic rays.
- Find topics of interest.
- Sign up for lab time.
- Gather data.
- Analyze the data (excel).
- Prepare presentations.
Work at Pittsford Mendon

- Joe Willie’s students at Pittsford Mendon
  http://pittsfordschools.org/webpages/jwillie/
- Data collected around time of solar flare.
Mendon Research 2003

- Single 3-week data run.
- Three class projects:
  - Muon rate vs. pressure
  - Muon rate vs. time of day
  - Muon rate vs. geomag. Activity
  - (Using NOAA internet data)

Muon Rate vs. Time of Day

\[ y = -0.0561x + 9.0124 \]
\[ R^2 = 0.327 \]

Pressure Corrected Muon Rate (Hz)

Barometric Pressure (kilopascals)

Pressure Corrected Muon Rate (Hz)

K index analysis

\[ y = -0.0205x + 3.3911 \]
\[ R^2 = 0.9759 \]

K Index

4/28 - 5/17 Mendon Muon Run
Work by other students . . .

- Muon Lifetime
  - Students’ value - 2.16 µs
- Material absorption/shielding
  - Lead
  - Water
- Location, location, location
  - Rooftop vs. basement
  - NY vs. SLAC
  - (Airplane, Space Shuttle)
- Variation of muon rate with:
  - Pressure
  - Temperature
  - Direction
  - Solar Activity
- The list is expanding . . .

Greece Arcadia student measures cosmic rays beneath swimming pool
Where do we go from here?

• Jesse Chvojka, PARTICLE graduate student, has received a grant to work with several high schools on count rate vs. elevation by collecting data from plane rides.
• Students across the greater Rochester area are completing research that will be presented at PARTICLE day in May.
• Recruiting new teachers for the summer of 2004.
Web Sites

- [http://pas.rochester.edu/particle](http://pas.rochester.edu/particle)
- [http://pittsfordschools.org/webpages/jwillie](http://pittsfordschools.org/webpages/jwillie)
PARTICLE

• PARTICLE is supported by:
  – National Science Foundation
  – Research Corporation
  – Quarknet
  – Department of Energy