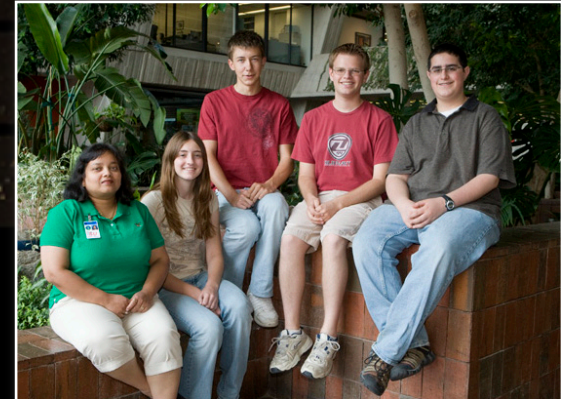


Authentic Data for Young People Activities from QuarkNet and SDSS Masterclasses – Investigations – Research

Marge Bardeen – QuarkNet - mbardeen@fnal.gov

QuarkNet

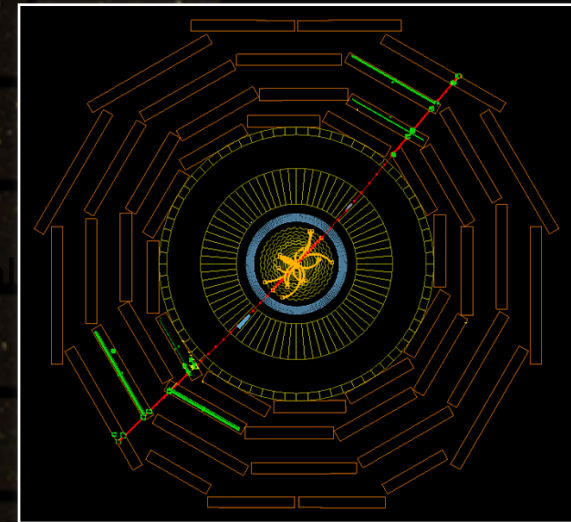
- a particle physics education *collaboration* embedded in the research community at 53 universities and labs across the country with
- a *national infrastructure* that facilitates participation of individual physicists
- a *long-term professional development* program for high school physics teachers and
- a *workforce development* program for their students



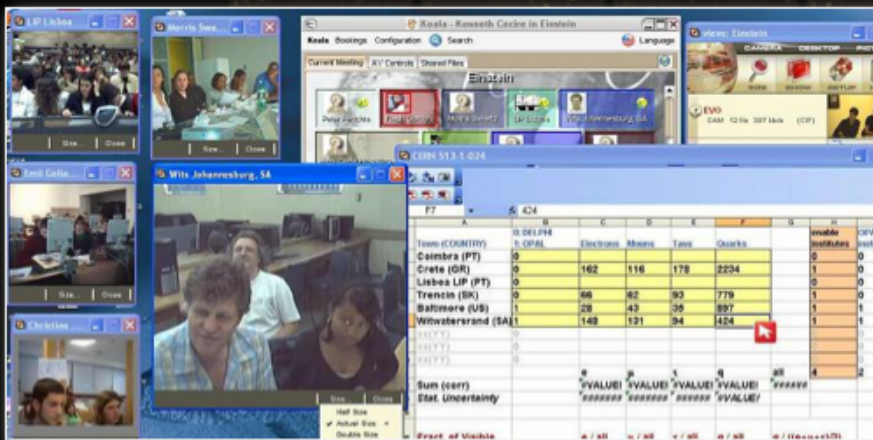
Hands-on Analysis with Your Data and You



Data Measurement Exercise



Masterclasses



Videoconference



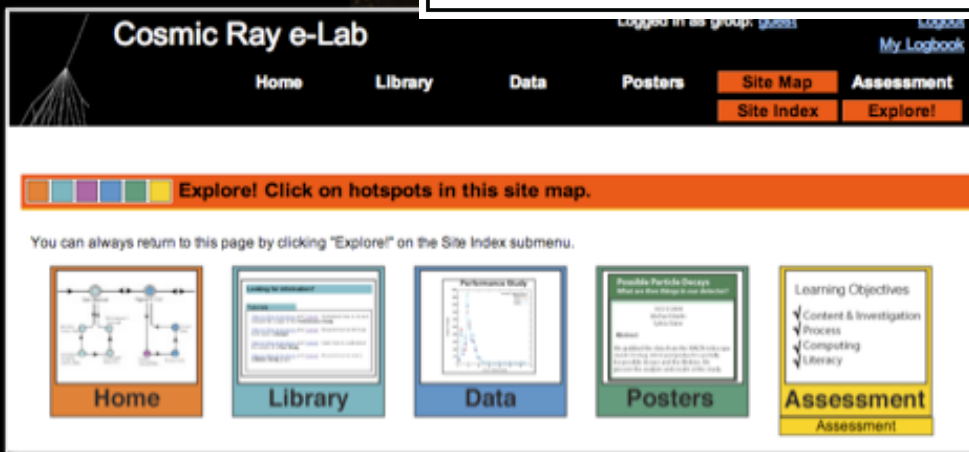
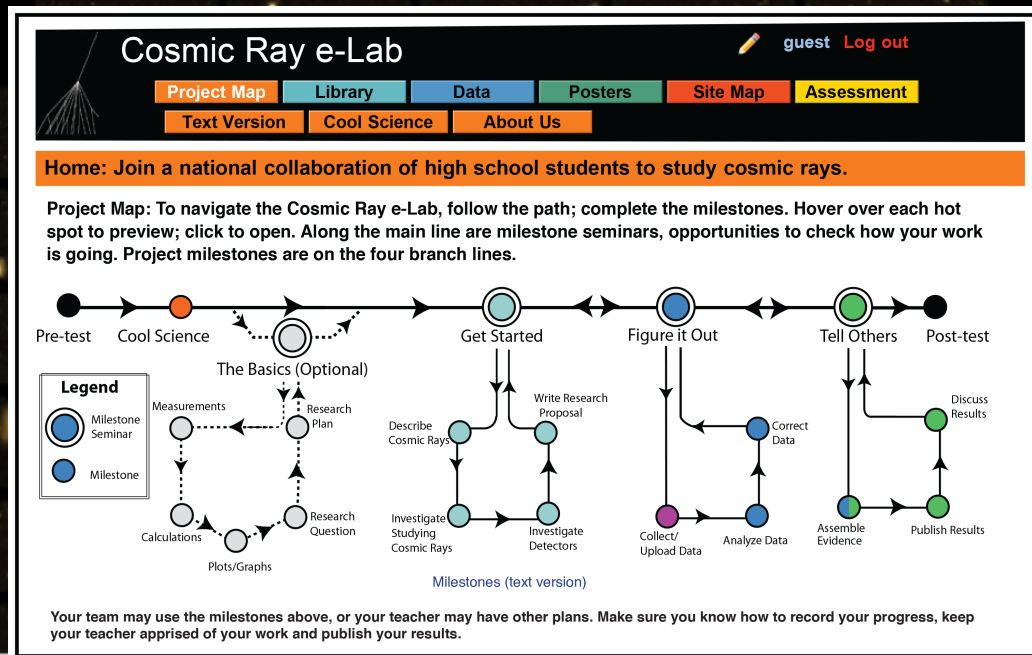
Facility Tour

Tips for Effective Masterclasses

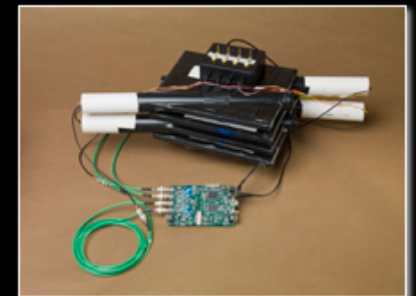
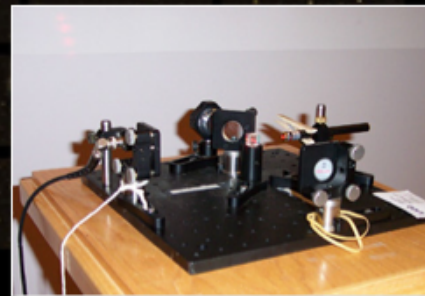
Get Real – Engage – Tell Your Stories

- 👁 Share useful examples; show relationships to everyday life.
- 👁 Bring students into your environment.
 - 👁 Tour; visit research areas.
- 👁 Give presentations; answer questions at students' level.
 - 👁 Focused, short, engaging
 - 👁 Talk about your experiences.
- 👁 Some preparation required school helps.

Student Guided Investigations

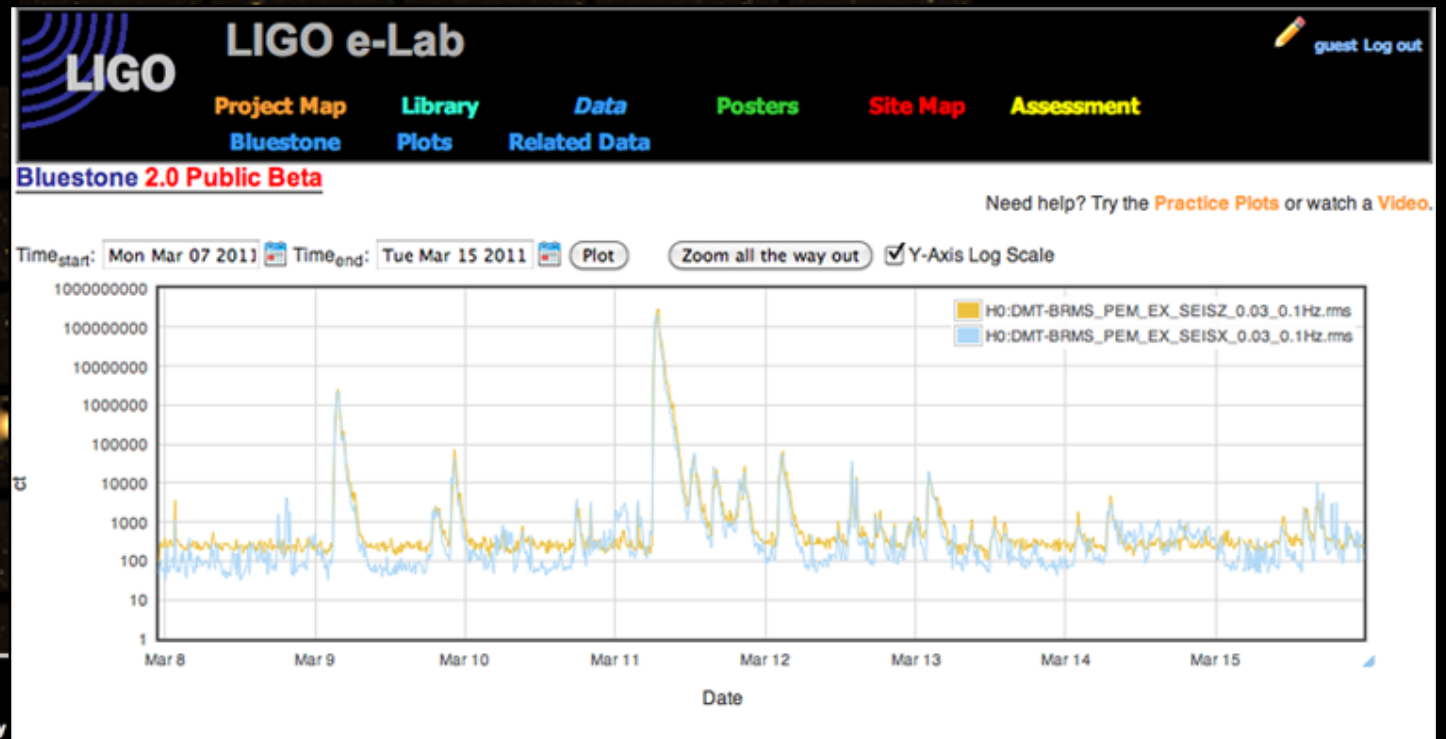


Online e-Labs from I2U2



M. Bardeen, DES-LSST Workshop, March 2014

Online Investigations with e-Labs



[Site Index](#) [Explore!](#)

Explore! Click on hotspots in this site map.

You can always return to this page by clicking "Explore!" on the Site Index submenu.

Home

Library

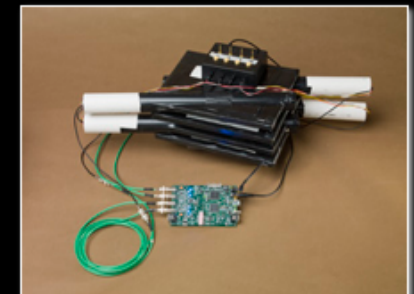
Data

Posters

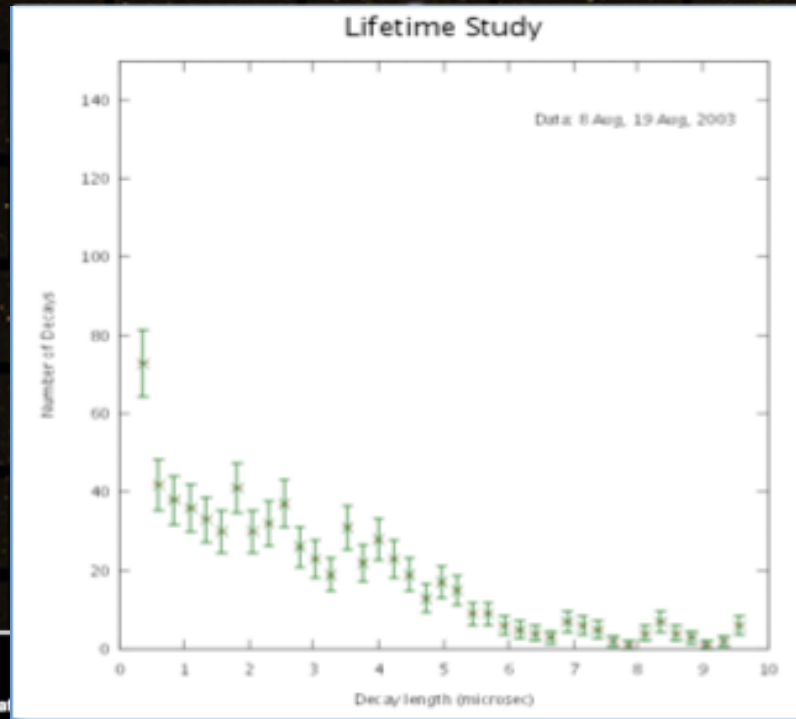
Assessment

Learning Objectives

- ✓ Content & Investigation
- ✓ Process
- ✓ Computing
- ✓ Literacy



Online Investigations with e-Labs



Cosmic Ray e-Lab

Home Library Data

Site Index Explore!

Explore! Click on hotspots in this site map.

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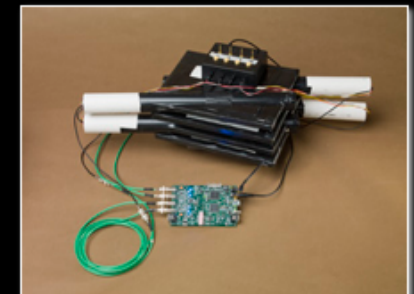
Data

Posters

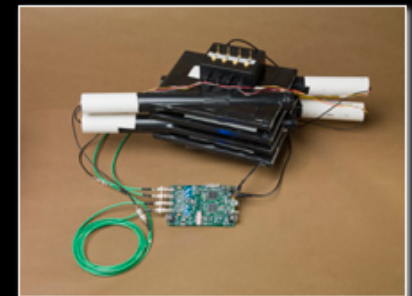
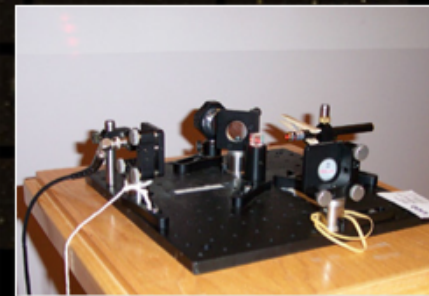
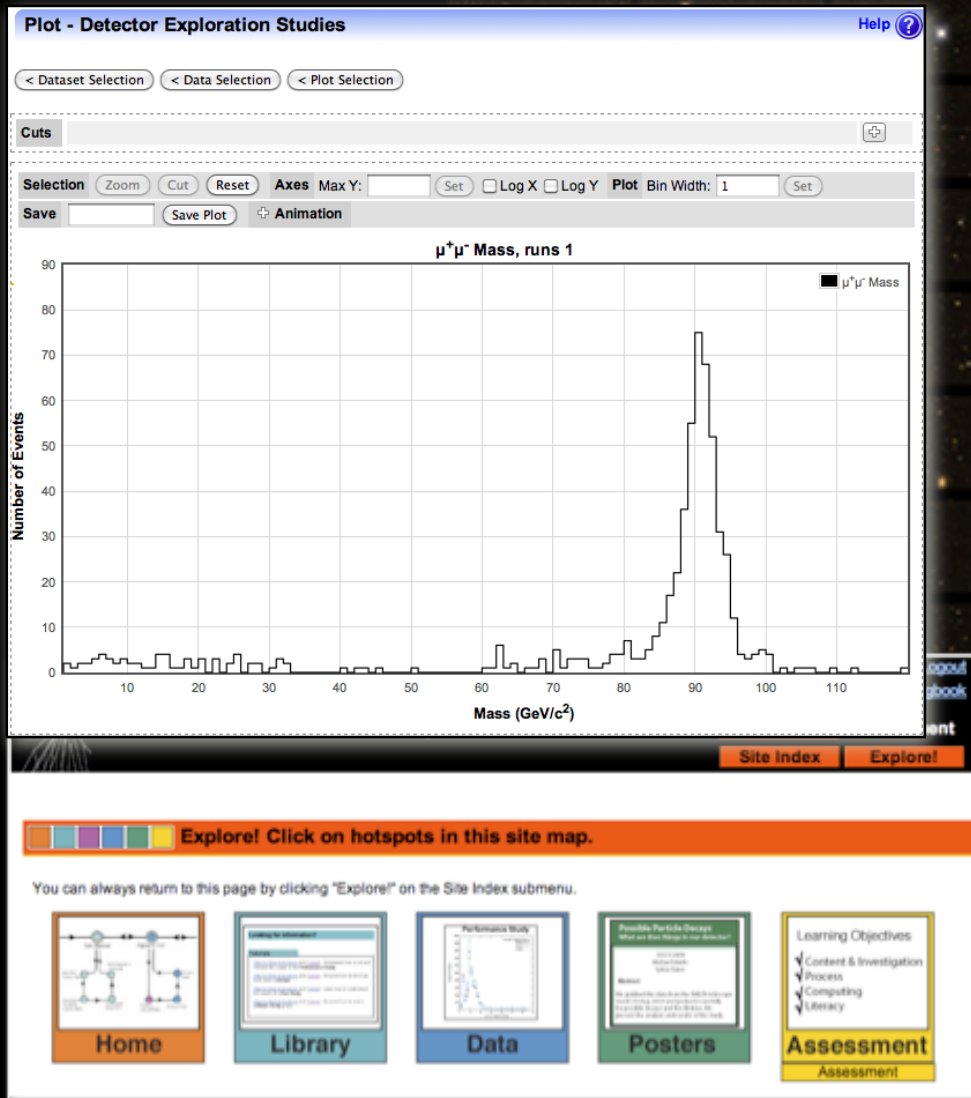
Assessment

Learning Objectives

- ✓ Content & Investigation
- ✓ Process
- ✓ Computing
- ✓ Literacy



Online Investigations with e-Labs



Explore an Event

/jpsi/jpsi-jan25_R000140124_T00000020.lg:Events/Run_140124/Event_910214790

The interface displays a list of event components on the left, including HCAL Forward, Drift Tubes (muon), Cathode Strip Chambers (muon), Resistive Plate Chambers (muon), Tracking, ECAL, HCAL, Muon, Particle Flow, and Physics Objects. Each component has a checkbox and a status icon. The main area shows a 3D visualization of particle tracks in a detector, with a coordinate system (x, y, z) in the bottom right. An 'Energy Range Selector' dialog box is open, showing a histogram and the following energy range for Barrel Rec. Hits:

Energy Range	Low cut	High cut
Barrel Rec. Hits	0.08 GeV (3%)	2.23 GeV (100%)

Controls:

- rotate
- Ctrl + → pan x / y
- Shift + → pan z

iSpy Online – Tom McCauley

Tips for Effective e-Lab Workshops

Get Real - Engage – Time to Reflect

A two- to three-day teacher workshop is essential for effective classroom implementation.

- Let them experience the e-Lab as their students will.
- Correlate data to the real detectors.
- Provide engaging presentations.
 - Background material
- Answer questions at their level of understanding.
- Provide time for teachers to talk about teaching strategies.

Research Experiences

QuarkNet Research Team

4 students

1 teacher

6 weeks

Engaged in all aspects of research



Tips for Effective Research Programs

Students become part of your research team:

- They experience all aspects of the scientific process.
 - Troubleshooting
 - Calibrating equipment
 - Use of journals or logbooks
 - Why data are analyzed in a particular way
 - Importance of communicating ideas & results
 -
- They report findings.
 - Presentations
 - Posters
 - Abstracts & papers
- They work at least four weeks.

What Students Gain

A broader frame of reference for science:

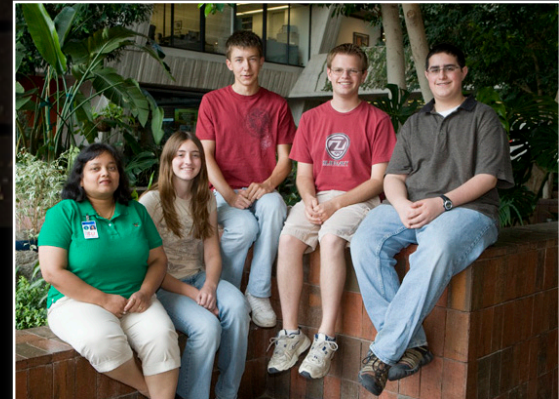
How scientists make discoveries

How they talk about their work



How We Know: Data from QuarkNet

Pre- Post-Tests
Teacher & Student Surveys
Scientific Poster Review
Concept Maps





Particle Physics Outreach to Secondary Education

Marjorie G. Bardeen, K. Erik Johansson and M. Jean Young

Annual Review of Nuclear and Particle Science
2011.61:149-70
(nucl.annualreviews.org)

Activities from SDSS

SkyServer

An interface to cataloged SDSS data

Simple to get started; direct access

Download catalog data in comma-separated-variable format.

Originally conceived for students

Became the portal to SDSS data for everyone.

Various activities for classrooms promote "authentic research" and "authentic data."

Over 495 million web hits

Over 74 million SQL queries

through December 31, 2008 (i.e., the end of the SDSS-II)

Activities from SDSS

Galaxy Zoo and Other Web Tools

Citizen scientists classify galaxy images morphologically, extending what can be done by machine.

More than a million participants

An example of what is possible in terms of public engagement in science, e.g., spawning Zooniverse - <https://www.zooniverse.org/>

Developed by a team of collaborators from the United Kingdom and the United States.

SDSS data used in Google Sky and WorldWide Telescope

Activities from SDSS

Other SDSS Outreach

Planetariums, science museums and centers

Educator workshops and professional development

Direct outreach to K-12 students

Research projects for undergraduate students

Except for the SkyServer, SDSS outreach was driven by interested individuals at the collaborating institutions. It was monitored but not directed by the project.

EPO Discussion Session

This workshop is exploring scientific synergies
between the two surveys.

We will explore synergistic EPO strategies too.

Thursday
Racetrack, 7th Floor Crossover

“The U.S. particle physics community recognizes the critical importance of
consistent and coherent communication, education and outreach .”

CSS final report