Planning the Lederman Science Center Exhibition

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Fermilab

EPPOG June 2009

Outline

Lederman Science Center Exhibits ('91)

- Context
- Development/Planning
- Content - Big Ideas & Topics
- Exhibits

Site-wide Visitor Program ('03)

Context

Audience: Target middle school kids on field trip.

Goals:
- Find out how Fermilab does physics . . . from a kid's point of view.
- Explore how physicists understand nature at the smallest scale.
- Discover for themselves.

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Goals:
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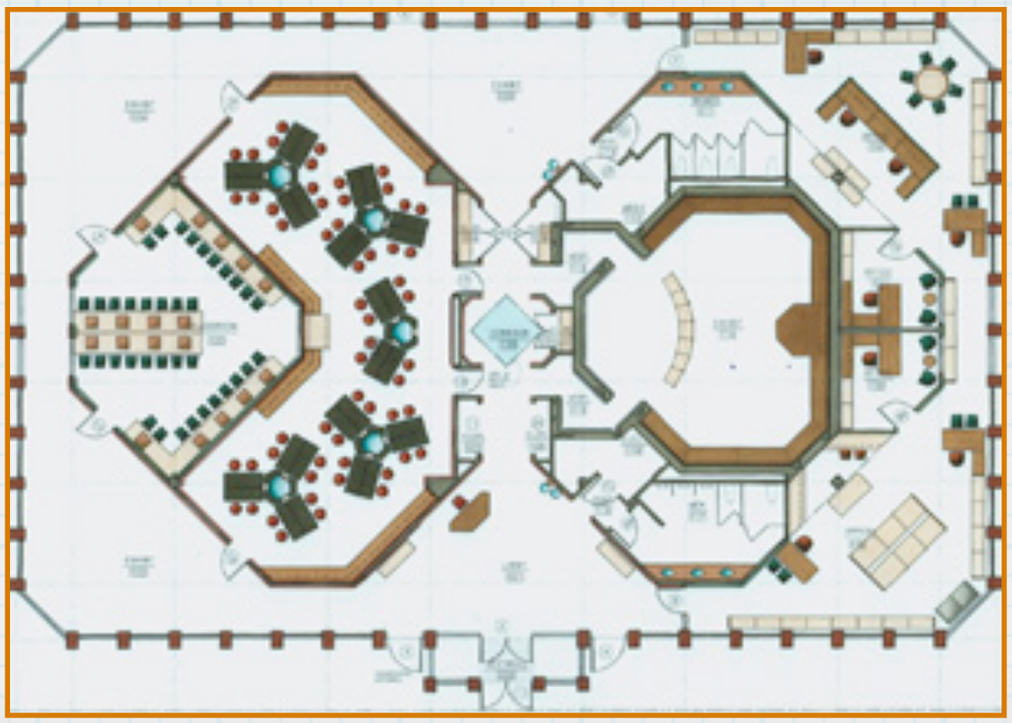
Space: 235 Sq M

Budget: $100-$150K



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Context

Field Trip Assumptions

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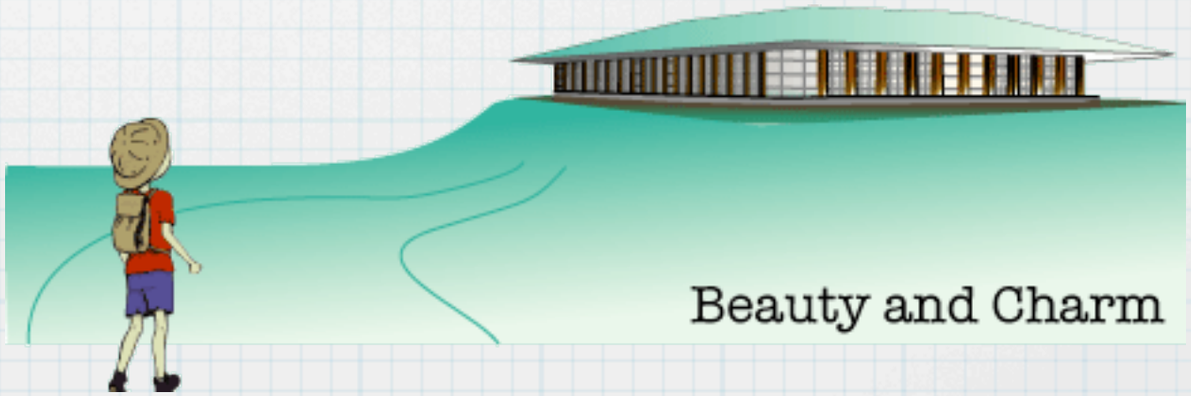
Context

Field Trip Assumptions

Students would:

- Have studied about Fermilab before the visit.
- Have a total of 2 hours at the Lab.
- Work in research groups at the Center.
- Have a "logbook" to record results.
- Not have time to do all of the exhibits.



Context

Field Trip Assumptions

Teachers would:

- Attend a workshop.
- Teach a study unit.
- Follow up back at school.

Docents would guide student exploration.

Development/Planning

Wilson Hall, LINAC Tour

Meet a Scientist

Field Trip Experience

METHODS: Colliding Particles Reveal Nature's Secrets - Patterns Are the Clue

To study particles much too small to see, Fermilab physicists look for patterns in their data when particles collide.

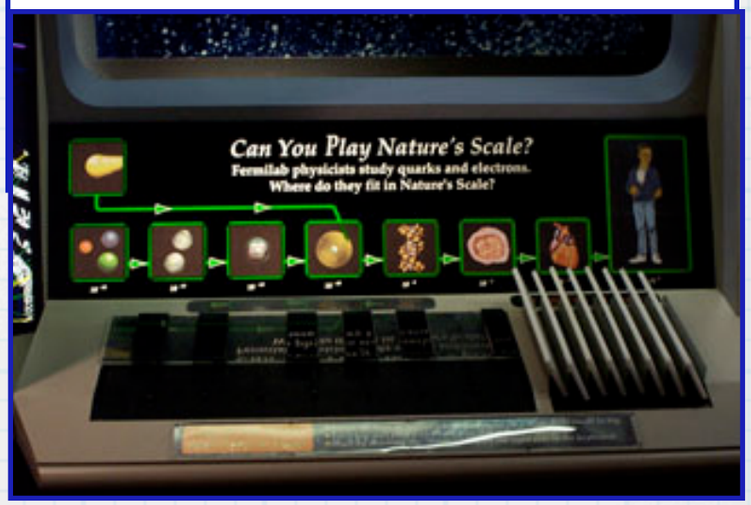
Shoot Particle Pinball - 10 Points

- Use the levers to empty the bins and pick a hidden target.
- Fill a tray with ball bearings by holding it down in the loading slot and pressing the knob to its left as necessary.
- Place the tray in the launcher and lift the red knob to collide the ball bearings against the target. (The ball bearings act like particle probes.) Do it again . . . and again . . . .
- Study the "scatter pattern" the ball bearings make.
- Look at the diagrams on the wall or on the triangular display on the exhibit.

The targets hidden under the tabletop make the balls scatter in patterns similar to those shown in the diagrams.

Match the targets and the diagrams:

Target #1 Diagram _____



Exhibits - Logbooks

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Development/Planning

Amateurs

Working group of physicists and teachers

10 main ideas from each person

Merged into 12 main ideas

Story

Exhibit matrix

Development/Planning

Amateurs

Working group of physicists and teachers

10 main ideas from each person

Merged into 12 main ideas

Story

Exhibit matrix

Experts

Thematic matrix

Themes to rooms

Exhibit designer & builders

Exhibits

Signage

Content - Big Ideas & Topics

12 things we want people to get out of a visit to the Center

1. Fermilab can be understood by everyone.
2. The meaning of basic quantities such as size, mass, force, acceleration, energy, etc.
3. There is a structure in nature with beautiful patterns and symmetries.
4. Quarks and leptons are the most basic constituents of matter . . . with the four forces . . . we create a new periodic table.
5. Space, interatomic and intergalatic space is remarkably empty.

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Content - Big Ideas & Topics

12 things we want people to get out of a visit to the Center

6. There are connections between studies of the very small and the very large.
7. Signatures, how we see events & spectra.
8. HEP research is basic science.
9. Scientists can study something even if they cannot see it.
10. Accelerators, tools like microscopes, provide a beam of high-energy particle to experimenters.
11. Detectors determine the presences of particles involved in collisions or events.
12. Fermilab is big science funded by the Feds and enjoys strong state and local support.

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The Story

Ideas - What We Study

There is an amazing beauty and symmetry in nature.

Methods - How We Work

Scientists work by posing important, new questions, developing theories . . .

Tools - What We Use to Do Our Work

The instruments that particle physicists use for their studies include . . .

Connections - The Biggest and Smallest Things in the Universe

When scientists study these particles and the forces that bind them together . . .

ed.fnal.gov/lsc_exhibits/story.html

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Exhibit Matrix

Ideas - Theory What do we think?	Method - Experiment How do we work?	Tools - Technology How does the machine work?
ACCELERATORS		I Interactive Video Tour A I Linac Rocket A I TV Set & Maget R I Large Ring Analogy A ? Light / energy levels A I Bouncing Ball A
DETECTORS	O Familiar tracks R I Paint - track turn table A I Shadow Wall A O Historic Detectors R	? Liquid Crystal R O Spark Chamber R_f I Bubble Chamber R_f I Geiger Counter R I Fiber Optics Scint. R I Scintillator Glass R
COLLISIONS SCATTERING	I Event Selection Frogs A I Particle Probe A I Scattering Targets A I Wave Tank A I Slinky A I Air Table A	I CDF Live Display R I Film Aanalysis Table R_f O Real targets R
INNER SPACE O Powers of 10 A I Views of Penny R O Smoke & Dust R I Rutherford Pinball R I Brownian Motion A I Spectra Sculpture R	I Projection Micro R O Video Electron Micro R	
OUTER SPACE O Cosmology Timeline A I Spectra R I Light Table R I Balloon Universe A I Living Star A	I Tele. Triangulation R	I Telescope R

I = interactive O = non-interactive A = analogy R = real item R_f = real Fermilab item

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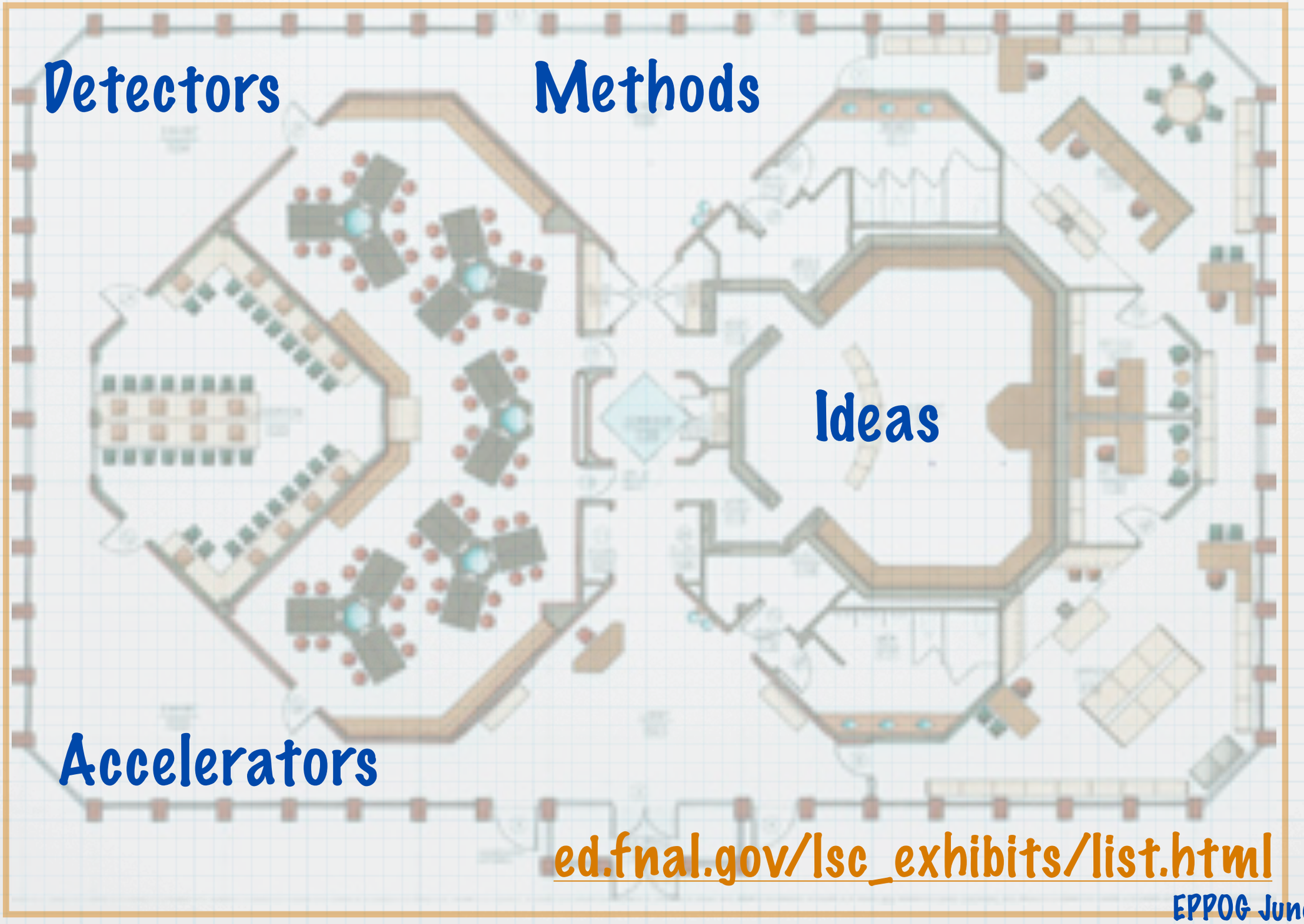
Lederman Science Center



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Logbook

TOOLS: Accelerators give particles OOMPH!

Fermilab scientists use accelerators to give particles as much energy as possible. But what is acceleration?

Beat the Spiral Accelerator - 10 Points

Can you keep up with the ball as it goes down the track?

- Find the ball in the bottom of the exhibit. Have one person start it rolling down the top of the ramp while the other races it.

Describe the race.

- Mark off a straight track the same length as the spiral track.

Most Fermilab accelerators are circular. Why is this an advantage?

- Design and conduct an experiment to demonstrate that this exhibit is an accelerator. You may want to use the timer. Write up your experiment. Include a chart or graph to show your results.

What did you learn? Make a few notes.

ed.fnal.gov/lsc_exhibits/list.html

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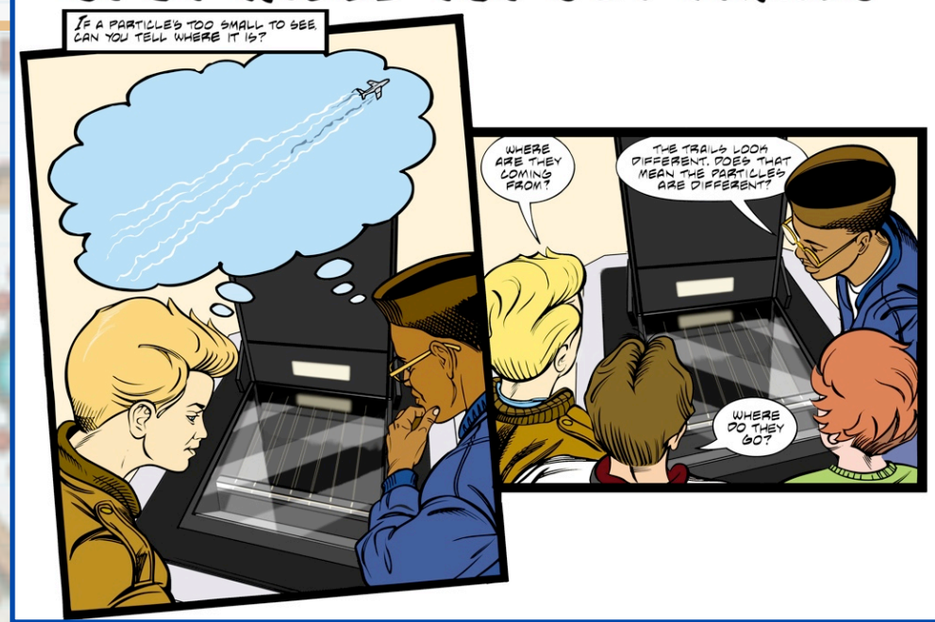
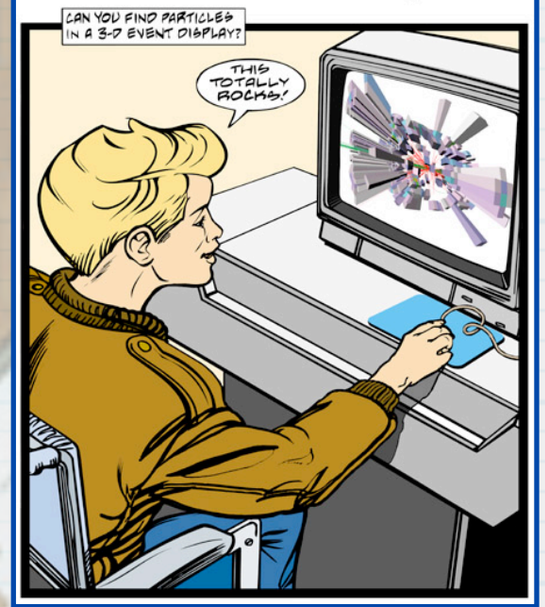
Exhibits

Signage

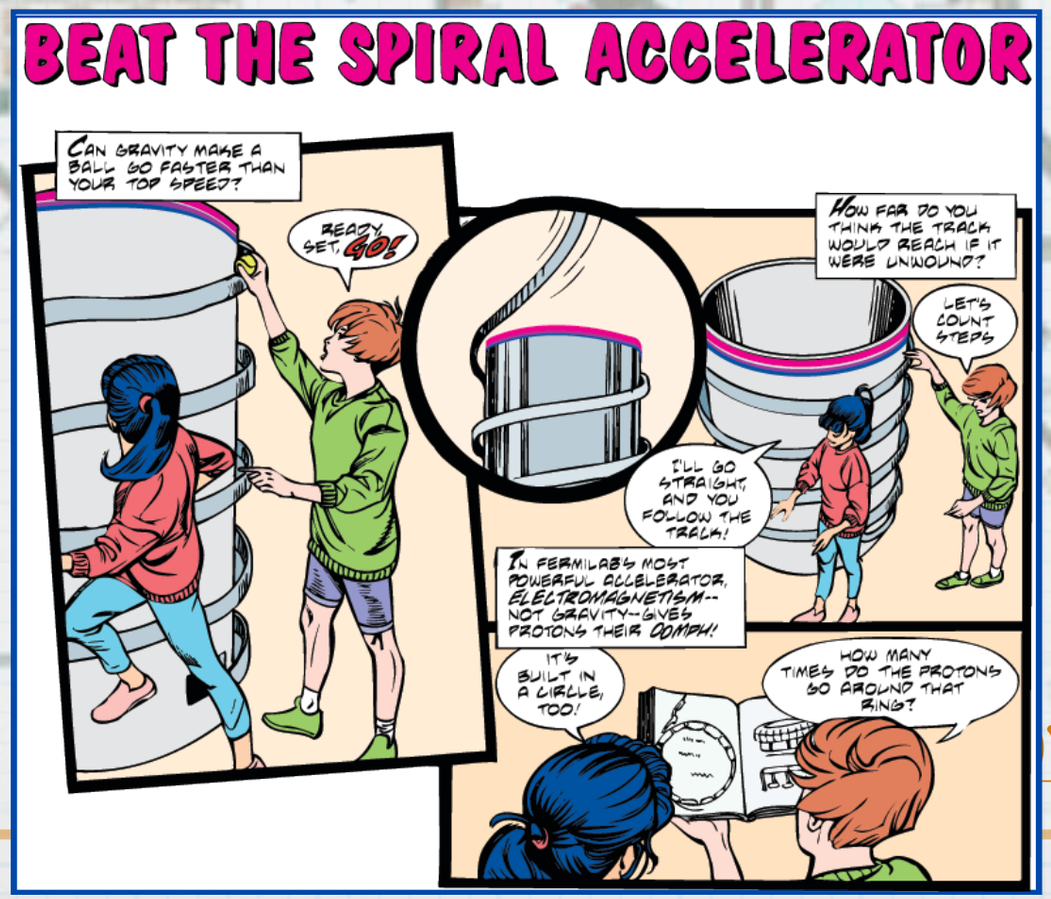
SPOT TABLE-TOP JET-TRAILS



JOIN THE DETECTOR DETAIL



BEAT THE SPIRAL ACCELERATOR



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Favorite Exhibits

Ideas

1. Accelerating Science
2. Powers of Ten: Inner Space and Outer Space
3. Can You See a Million?
4. Can You Play Nature's Scale?
4. Can You Imagine Making Heavy Steel Balls by Colliding Two Ping-Pong Balls?
6. What Is a Particle Family?
7. Do Rules Matter?
8. Can You Make Particles with Nature's Building Blocks?
9. What Are the Basic Forces Between Particles?
10. What's Dynamic about this Duo of Forces?
11. What is Symmetry?
12. What's the Same in a Mirror World?
13. What Happens When Symmetry Breaks?
14. Can You Make Primordial Soup?
15. Fermilab at Work

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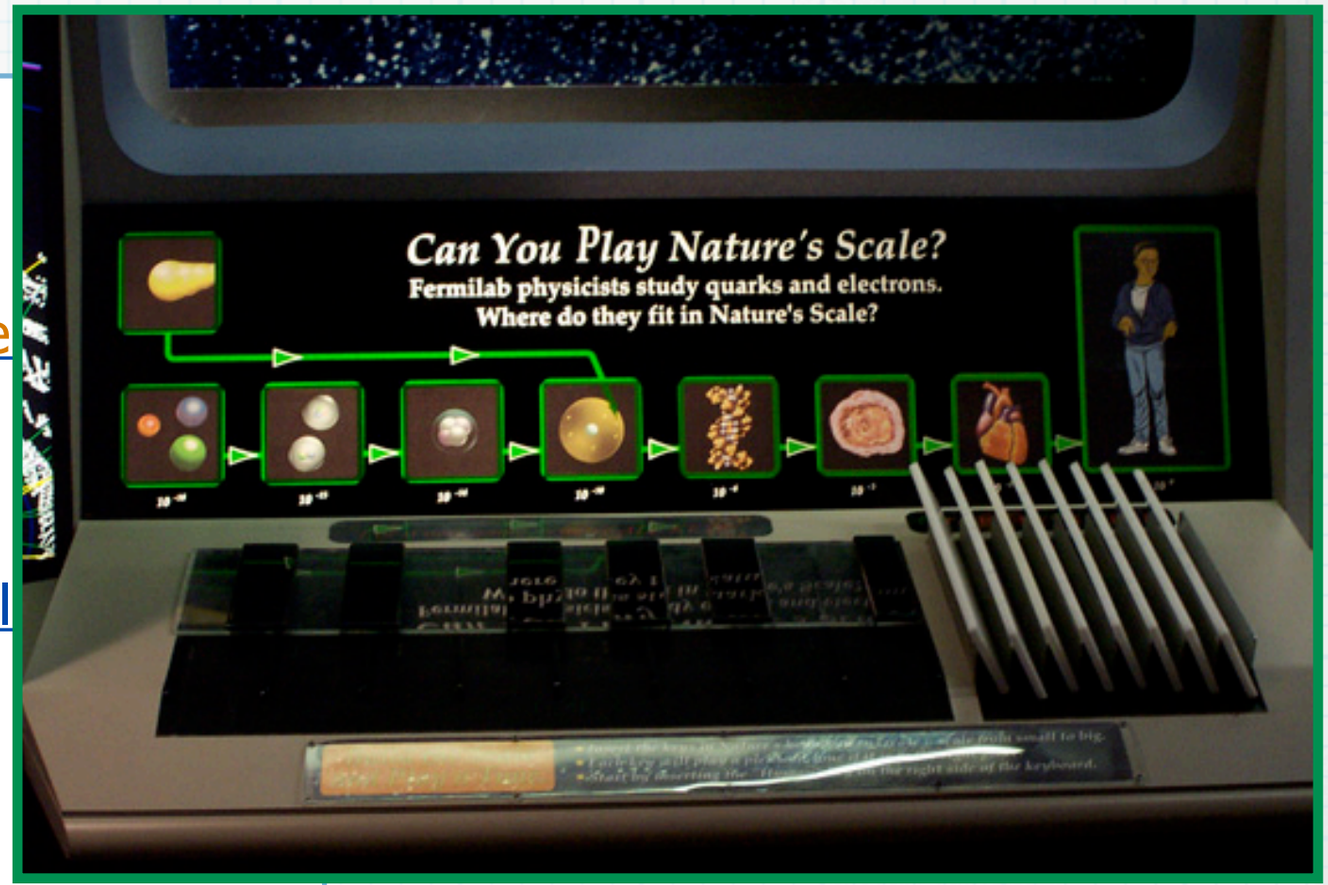

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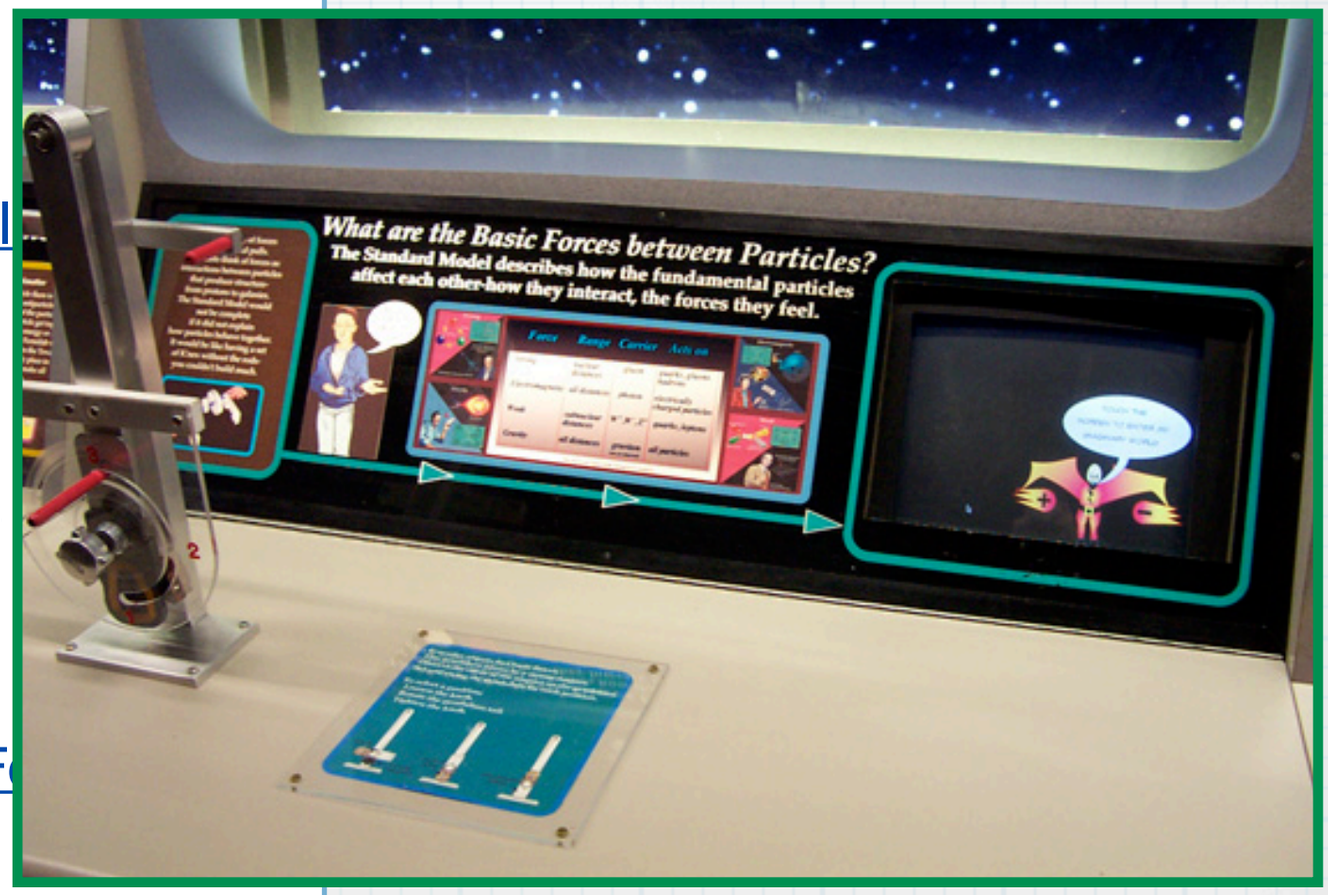

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Favorite Exhibits

Methods

16. Follow the Bubbly Tracks
17. Read Particle Graffiti
18. Play Particle Pool
19. Aim the Shape Shooter
20. Shoot Particle Pinball
21. Find Top's Grandchildren
22. Build a Neutrino Chart

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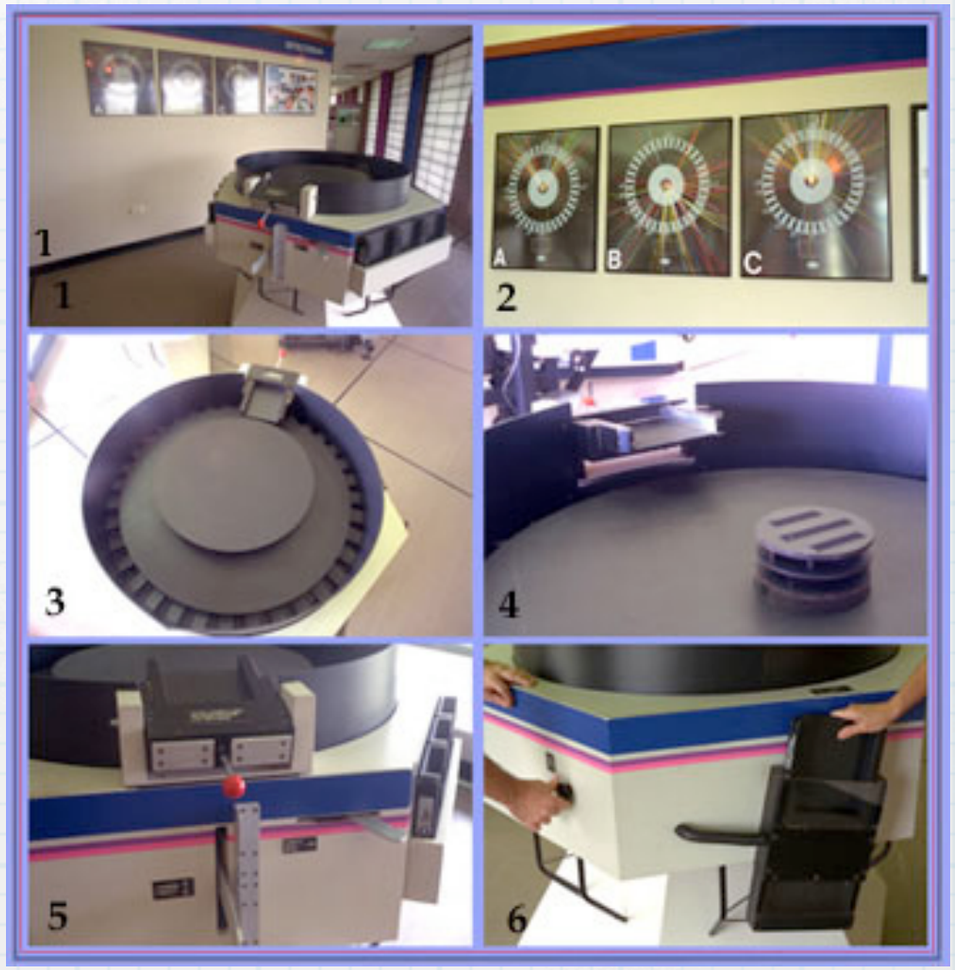

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Favorite Exhibits

Accelerators

23. Race for Energy
24. Check Your Timing with the Linac
25. Beat the Spiral Accelerator
26. Boost the Energy in the Ring
27. Probe with Pinheads
28. Bend the Beam
29. Find Out More about Accelerators

Detectors

30. Detect Invisible Bullets
31. Spot Tabletop Jet Trails
32. Watch for Messengers from Space
33. Catch Cosmic Rays
34. Chart Cosmic Rays
35. Freeze a Moment in Time
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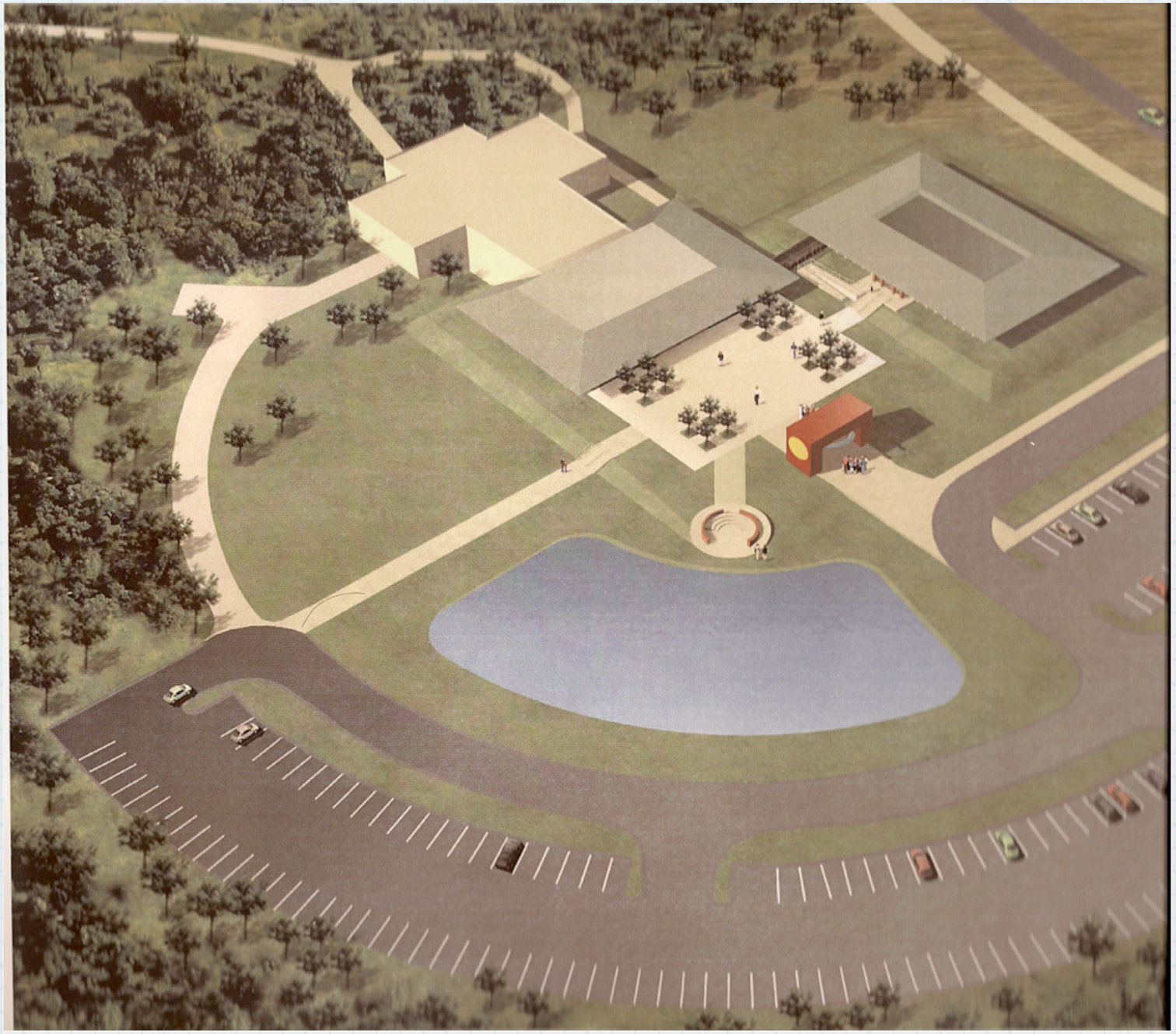
A Unique Visitor Experience

A proposal for a site-wide program



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Proposal Planning

1. Information gathering
2. Stakeholders meetings
3. Vision workshop
4. Action plan
5. Planning for experimental area exhibits

Fermilab
&
Aldrich Pears Associates
Holabird & Root

www.fnal.gov/pub/exhibitrfi/prep/

A Unique Visitor Experience

A proposal for a site-wide program

Key Features

1. Build a new visitor center.
2. Link the center to the Lederman Science Center.
3. Zone the site.
4. Improve visitor services at the science facilities.
5. Provide public access to secure parts by guided tour.

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A proposal for a site-wide program

Audiences

VIPs
Scientists
School Groups
General Public

Messages

Discovery
Welcome
Technology
Physics without Borders
Real People
Safe, Green

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Site Tour Programs

1. Basic Tour

   General public & school groups

2. Deep Science Discovery

   Science enthusiasts, scientists & VIPs

3. Bison and Bosons

   Community & casual visitors

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