

IPRO 303 - Designing a State-of-the-Art Exhibit for the Atrium at Fermilab

1. Revised Objectives

The science at Fermi National Accelerator Laboratory (FNAL or Fermilab) involves studying nature at the smallest scale (elementary particle physics). Science at the smallest scales impacts science at the largest scales (cosmology and astrophysics). The team's goal is to design an atrium exhibit that conveys the scales of our research, the importance of basic research, the importance of science education, and the intersections of art and science for both a scientific and non-scientific audience. The exhibit would be open to the Fermilab staff and the general public.

The original goals of designing and prototyping an exhibit for the Fermilab atrium have not changed. However, they can now be described in more detail. The IPRO 303 team will develop both written and oral proposals for at least one exhibit installation. These proposals will be prototyped with both scalar and digital models and presented on IPRO day and at Fermilab.

2. Results to Date

The project began with research to give some context for exhibit development. The following topics were researched and presented to the group:

- Fermilab's namesake, Enrico Fermi
- The relationship between large and small science
- D-Zero
- Electron orbitals and micro-structure
- Linear Collider: scale and spatial requirements
- Mapping Fermilab
- Particle physics history
- Essence of color
- Science Metaphors in Art
- Science Metaphors in Architecture
- Scientific Visualization

After researching, the IPRO team entered the brainstorming phase. The team discussed, modeled, and critiqued many design ideas. Out of this development process, sub teams were formed and the following ideas developed:

2.1 Material Investigations

The focus of this research has revolved around a material investigation of the site and the act of molecular collisions. The site is full of chalkboards that record the collisions in equations and theories that are incomprehensible to the lay viewer. The task is to translate these chalkboards to the visitors of

Fermi lab. Whether the translation takes place through the media of video projected on the blackboards, the blackboards recording physical impact or the collided objects taking on the materiality of the chalkboards remains to be seen. The final task seems to be to create an environment where the visitor uses all their senses to become aware of the momentous acts occurring underneath their feet.



Figure 1 – Material Investigations

2.2 Models

As a visual and experimental tool, the IPRO team has decided to construct a $1/10" = 1'-0"$ model of Wilson Hall. The model will help the IPRO Group to visualize the space and scale of the atrium at Wilson Hall, which in turn will help us to make more focused design decisions. Alternatively, the model will also help us to present our installation ideas on IPRO Day and also to the board or directors at Fermi Lab. With a scalar element to our presentation, we will be able to convey our ideas to the board with out having to construct the installation at a large scale.

In addition to a physical model, the team has researched and created a digital model of the exterior and interior spaces of Wilson Hall. In this format, we as a group are able to create a much more detailed environment which in turn lends itself to many more opportunities of presentation and definition for the project as a whole. The ability of creating a virtual walk-through and complete adjustability of the installation will further strengthen our project. As we proceed, both of these unique tools will help the group finalize our research and final project. As tools for display, both the physical and digital models will help with graphic representation of our semesters work for IPRO Day and also in presentation to the board of directors at Fermi Lab.

2.3 Extended Physics Research

The first research presentation was a study of the history of particle physics. This focused mainly on the early stages of this field, but also stressed the changes it has undergone in the last one hundred years. Specifically changes in the size, power, and design of particle accelerators and detector

equipment. Further research was done on the effects of scaling up the collisions that occur in Fermilab's accelerators to a macroscopic scale. Also, string vibrations were studied as they related to the design of a possible installation.

2.4 Detector

This group has explored ideas that derived from the research of the technologies, geometries, and abstractions of the next international linear collider. The first designed concept was based on the essential notion of collision (the event that happens inside a collider) and more importantly, what it means to DETECT motion, sound, and collisions. What does it mean to detect something at a scale that is visible – analogous of the detections of matter at a larger scale? The first model represents the abstraction of collision via the creation of tubes hanging in the atrium at Fermilab, with the hope that these tubes, in some way that has yet to be explored, would collide within each other, creating often chaotic movements, or controlled motion and sound within the atrium.

This design idea also encompassed the notion of distance. What does it mean to visualize 20 miles - the approximate length of the next linear collider? The sum of the length of all the tubes would actually equal 20 miles – the distance roughly of Chicago's length and the visible distance from the Sears Tower on a clear day. The group then explored the notion of filling the atrium with 20 miles of string with the idea that a single length of string could start to create a network of lines reflecting/bouncing/detecting points within the surfaces of the atrium. With the choice of materials, these lines could start to incorporate sound (guitar strings), motion, and lights.

The group has created various models to depict design ideas and has met on a somewhat regular basis to discuss the project. Some research has been devoted to investigating materials via means of length and tension. This group will now further explore the idea of treating the atrium as a space that detects something, presenting results, then tracing the paths to find the source of an event.

2.5 Collisions

The collision group has focused on the idea of making invisible particle collisions visible to everyone through the medium of everyday objects. There is something captivating in the violence of a collision that is a central piece of the science done at Fermilab. The group has discussed presenting collisions in the following ways:

2.5.1 Video

Video provides an interesting medium for presenting collisions because the viewer gets to see and hear the impact. The group has thought about many methods for displaying the video at Fermilab. One idea is a kiosk or booth that the user can walk up to and see collisions. Larger display areas with multiple screens showing different views of the collision could also be constructed. For example, one screen above the user could show the view from the impact zone (it would like the object was dropping on you) while another screen on the floor could show the view from above (now it seems like you are dropping the object).

Another idea involves integrating display areas with the chalkboard idea from section 2.1. These two ideas could play very well together and can be situated into the terrain of the Fermilab atrium or developed in areas like the entrance, main-level gallery, or second floor gallery.

The group has also investigated different modes of user interaction with video displays. Users could press buttons that have pictures of collisions to play. Video could also be started by a number of sensors including touch (on the floor), infrared, heat, and camera tracking. Different modes of user interaction allow for different experiences with the piece.

Two prototype video shoots have taken place so far to investigate the feasibility of an exhibit within this medium. A proposal for this idea would include more professional photography and quality video editing.



Figure 2 – Screenshots of video collisions

2.5.2 Vortex Tube Model

The proposed installation is a massive tube, containing an iridescent fluid. At the ends of the tube, the liquid is stirred in opposite directions. The fluid inside shows all the vortices and currents generated as the two opposing spins come together to annihilate in the center of the tube. Lights may be placed inside the tube to highlight the activity inside. It is designed to act as a metaphor to the collisions that take place between

matter and antimatter in the Tevatron at Fermilab, as well as the proposed International Linear Collider. Furthermore, the uncertainty and chaos exhibited by the swirling liquid is not only aesthetically pleasing, but also symbolic of the uncertainty exhibited on the quantum scale of nature. Below, a three-dimensional render of one of the many possible tube configurations inside the atrium at Fermilab is shown.



Figure 3 – Vortex Tube Model

3. Revised Task/Event Schedule

The IPRO team will make a second site visit on March 25, 2005 to meet with physicists, building engineers, and architects to discuss our project. Following these meetings, the team will decide which proposals will be developed for presentation.

Each of the proposals that are going to be presented will have oral and written pieces ready for the week of April 11th.

Prototyping in both physical and digital models will be completed by the week of April 25th for presentation on IPRO day and at Fermilab.

4. Updated Assignments

The midterm is another key transition in this project development. The team will shift from individual and small group brainstorming to more focused development of a small set of design ideas that will be presented. Each proposal group will be working on their written and oral presentations, as well as prototyping their idea. The proposal groups will be finalized during the week of March 28th.

5. Barriers and Obstacles

This project is challenging by its very nature. The group wants to propose a state-of-the-art installation that is inspired by the science that takes place at Fermilab. There is a lot of research, critique, and discussion that has to go into a design of this magnitude. However, with some good interdisciplinary teamwork, there does not seem to be anything that would stop the I PRO 303 team from developing quality design proposals for the Fermilab atrium.