::IPRO 303 Final Report::

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Introduction

The intent of IPRO 303 was to propose ideas for an exhibit at Fermilab. Fermilab, located in Batavia, Illinois, is one of the world's leading institutions for experiments in particle physics and is being considered as a site for the International Linear Collider, a multi-billion dollar instrument for high-energy collisions. Visitors including politicians and business interests would view the exhibit while touring the facility so the project is intended to appeal to people as art more than a literal explanation of the science.

Background

Three things needed to be considered in order to develop our ideas—the history and general understanding of particle physics, the relation of science to art, and the exact space proposed for this project at Fermilab. Individual group members performed research on topics related to science and art; visits to the site and architectural drawings of the building showed us the space we had to work in. That space is an atrium roughly 150 feet high running through the entire building and visible not only to people entering but also to everyone working in the offices.

Working Methodology

Early on the team members organized three different working groups to pursue their different ideas of using this space. Below are the descriptions which include each team's goals and the research they drew ideas from.

1::Confluence

Confluence: **1** a coming or flowing together, meeting, or gathering at one point; **2** the flowing together of two or more streams; **3** the place of meeting of two streams; **4** the combined stream formed by conjunction

Confluence:: CONCEPT

The focus of discussions among the members of the Confluence team was dualistic and opposing phenomenon's occurring at the subatomic scale: positive and negative, matter and antimatter, presence and absence; and the resulting phenomenon of energy conversion.

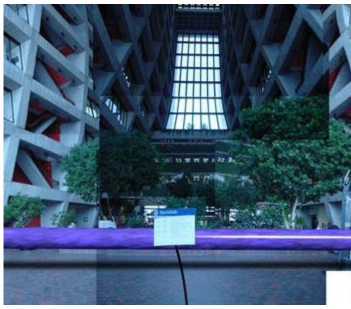
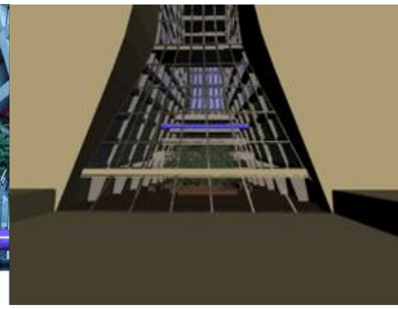
Confluence:: GOAL

The names we give to quarks are paired opposites: up and down, top and bottom, left and right. The nature of the forces and structures observed within the particle world seem to have a representative symmetry of opposites on a number of levels, and when these opposites interact, strange things happen. In order to visualize annihilation and transformation of this energy, we have created a proposal which will demonstrate how subatomic particles and their components interact with each other via a visual and artistic representation.

Confluence:: INSTALLATION

The installation consists of a sculptural object representing the collision. It is fluid filled transparent tube, containing a pearlescent additive to make visible the movement of the liquid within. Stirring devices at either end agitate the liquid, causing counter rotating currents to develop and intersect at the center of the tube. At this point the transformation begins. The energies from either end of the tube collide, resulting in the visualization of annihilation and creation of energy. The event which is represented in this installation is one of the driving forces behind the science we have come to know as particle physics. Physicists are ever researching how particles gain and lose energy as they travel throughout space, Confluence hopes to establish a visual metaphor for the basics of what physicists conclude.

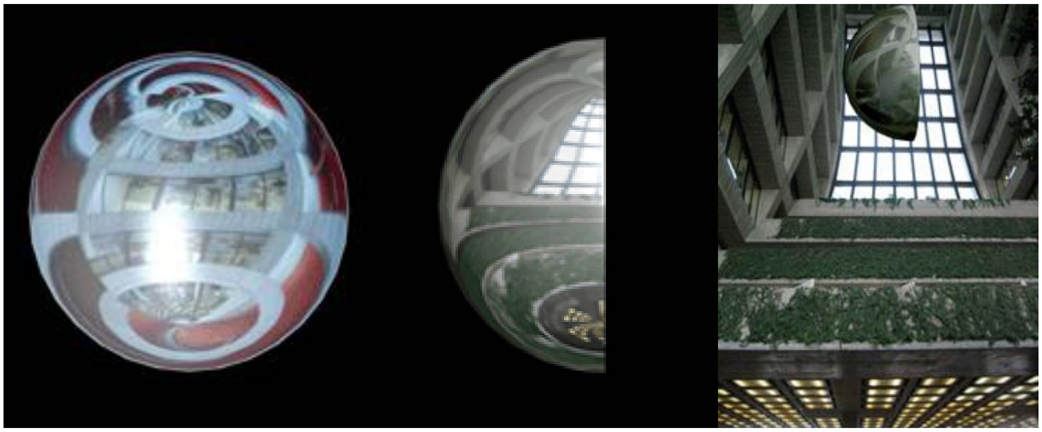
The sculpture itself could be displayed either vertically or horizontally within the atrium space, creating a dynamic model of the collision of the invisible particles within the self-created accelerator.


In a further iteration of this scheme, we see the tube reduced to a human scale. As one approaches the structure the user finds them self embarking into a motion filled environment. The tubes, stacked vertically in this idea, will create a tunnel of sorts with which the viewer can walk though. This iteration of Confluence projects the idea of how it takes many particles to begin an experiment, but in the end only a handful of them are left to be analyzed.



Another proposal from the Confluence team takes the original ideas into a different direction and visual experience. Focusing in on the particle, Confluence takes the form of spherical mirror. It is the sphere that we use to visualize and understand the atom and it’s all of its complex components. The sphere is reflective, present only in how it interacts with its surroundings, and is also bisected. The center of the sphere is hollow, which creates two types of reflections, concave and convex. In the relation to the study of physics, a metaphor for a positive and a negative is created. The concave side produces a holographic effect like a polished spoon, creating within it a virtual sphere. The view is at once visible and non-existent. The outward facing side of the sphere is convex, creating a sculptural view of the atrium and its surroundings. Within the atrium, it could be suspended on axis, allowing different views up and down the staircases and from the offices.



2::Visible Collision

Collision: **1** an act or instance of colliding; **2** an encounter between particles (as in atoms or molecules) resulting in exchange or transformation of energy

Visible collision:: CONCEPT

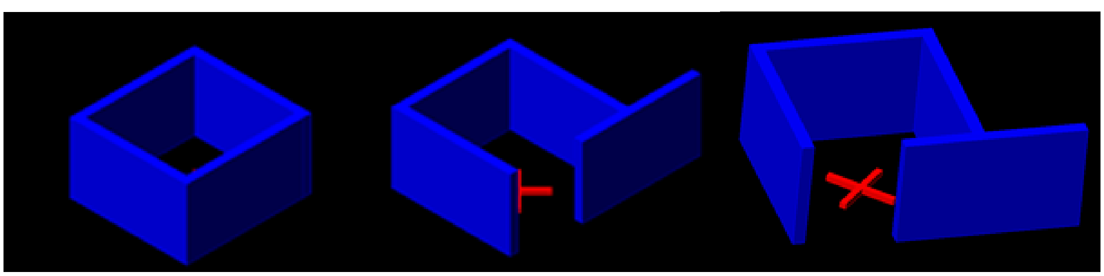
The idea behind Visible Collision is to abstractly represent subatomic collisions at the human scale. At the present time, physicists accelerate various subatomic particles to unprecedented speeds and propel them into various targets. Whether it is a stationary target or another particle, the reaction that occurs is quite violent given the relative size of the particle. To view these collisions, physicists rely on computer programs to graphically represent the experiment which they cannot see. Visible Collision breaks down the very idea of these particle collisions and blows them up into a more tangible and understandable element.

Visible collision:: GOAL

The goal of Visible Collision is to give the everyday user, primarily visitors to Fermi Lab, a brief look into the 'idea' of the science that occurs at the facility. As an outsider looking in, many visitors may not comprehend or be able to grasp at the idea of a particle collider, Visible Collision will model particle physics as an everyday occurrence.

Visible collision:: INSTALLATION

The Visible Collision begins with the collection of data from the very essence of Fermi Labs existence; the collision. In a controlled environment, items of various size, similarity and character will be dropped from a predetermined height.



As the items are dropped, high speed video capture from above, below and side will collect the data. Items of similarity can also be used to model the effects of how different sized particles create very different sized collision results from one to another. An example of this may be the sampling of various amounts of colored water or similar substance. The amount of energy and violence created in the collision of a five gallon jug of water to that of an eight ounce bottle is amazing. What these experiments achieve is a rather simple explanation of the nature of the science which occurs in the Tevatron itself. By using every day objects, at the scale of the human body, Visible Collision is able to model the amazing complexities and nuances of the very essence of Fermi Lab, analysis of the **collision**.

In a series of tests performed, we were able to model the effects of numerous objects and the results of their sizes, materiality, and shape. The ability to collect data in a much more controlled manner is a must. One idea for this is to create a controlled environment, such as a small room, where each experiment can be removed and the area cleaned each time. This will result in more streamline data and higher quality images, although there is something to be said about the montage of many experiments on each other. Below are some rough examples of the data which can be collected:



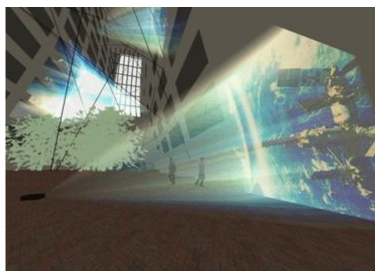


The items tested were:

- -2 liter Pop
- -Watermelon
- -1 Gallon of Fruit Punch
- -Scanner
- -15 inch Monitor
- -32 inch Television

The display of the data can be executed in numerous manners. One proposition is to incorporate the idea of video and still images into the presentation. An assembly such as a kiosk can be created in order to display the images and video of each collision. The kiosk will consist of three flat panel monitors hooked up to a computer to play the video files. The kiosk can either be a free standing, free from element, or can be a much more structured room with which the user enters and begins the experience. In order to draw the user toward the area, the kiosk shall be surrounded with images pulled from the video which will spark the curiosity of the passerby. As the user approaches, one of two options can be implemented for video play back. Three separate flat panel monitors can be used in order to simultaneously display the three views suggested above. A simple push button system can be implemented to select which experiment the user wishes to view. As the video plays, the viewer is encompassed with the motion and sound from all angles at once. The confusion and intensity will provoke the video to be played back numerous times. We feel that this interaction is crucial to the success of Visible Collision. The more a user can view the video collected, the better an understanding one will have of the complexities of high powered particle collisions.

The kiosk is a medium which also comes with great flexibility. While keeping the design of the kiosk simple and compact, it can be moved to and from numerous areas in the building. This introduces another aspect of how one can interact with the installation. The kiosk can show up in a hallway, on the second floor gallery space or even outside or in a bathroom. The flexibility of Visible Collision will help the installation to be recognized and experienced greater.


Other ideas which have been thought of are how the Visible Collision and Interstitum can be incorporated with each other. The kiosks can be installed at the points at which Interstitum converges or disperses. The points can be seen as a “collision” and offer great opportunities for further explanation of both installations.

Visible collision:: CONCLUSION

Visible Collision is seen as an exhibit which can be very flexible in its construction, which adds design flexibility, but is rigid in its message. The installation strives to answer the many questions that were brought to our minds as we began our investigation as to what Fermi Lab is. What is Fermi Lab? What is particle physics? What do physicists see? We hope that, by the simplified ideas expressed in the installation, Visible Collision can help to relate the answers to these questions and many more in a beautiful and intriguing manner.

3::Interstitium

Interstitium: **1** a space between things or parts, especially a space between things closely set; **2** to stand still in the middle of something; **3** the matrix or supporting tissue of an organ; **4** spaces within a tissue or organ—often composed of connective tissue.

Interstitium:: CONCEPT

A network of fibers filling the atrium in Wilson Hall.

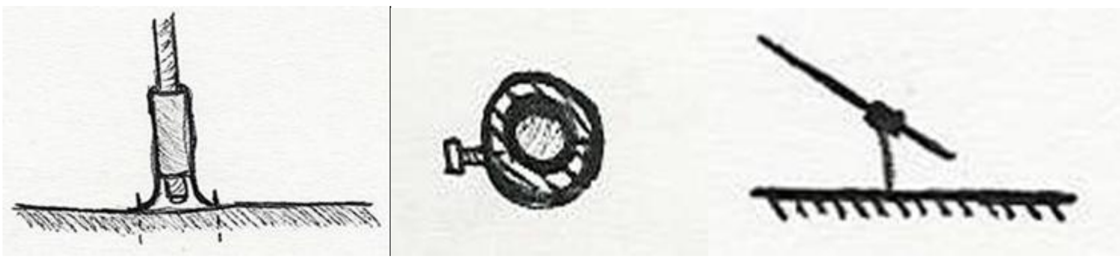
Interstitium:: GOAL

Interstitium's goal is to suggest the tangled interactions that particle physicists look at. An exhibit that fills the entire atrium captures the attention of first-time visitors but allows for views from all around. Even the people who enter Wilson Hall every day will find nuances and new angles to the project that keep it interesting.

Interstitium:: INSTALLATION

Interstitium proposes a criss-crossing web inside Wilson Hall's atrium. This might be a single fiber twenty miles in length, zig-zagging like shoelaces and demonstrating how a single object can appear to be many depending on the viewpoint. Or it could be very many single pieces tied between two points and intersecting each other to cause interactions—when one fiber is plucked the others vibrate in different ways. This requires someone to grab the cable and shake it—the design includes points on the ground and along the stairwells where people could reach out and touch the cables.

Both options rely on showing the vibrations connected pieces would transmit. At the scale of the atrium it would be very difficult to tune the fibers to produce audible pitches, but they can be made visible in many ways. Tying the cables to basins of water would create ripples with their own patterns of interference. Or pieces of metal and fabric could be attached to the cables to create wind-chime mobiles that react to the motion of the network. Strobe lights could break down the blur of motion in the cables into clear patterns and even project that up onto walls and screens so viewers below could see what was going on all the way at the top. Another possibility is wave-changing fiber, a fiber-optic like Lucite that absorbs ambient light and emits colored light from the ends, which would be mounted prominently for viewing. The emitted streaks of color could be projected on screens throughout the building to show the network's reaction to changing light within the space.



Interstitium:: CONCLUSION

An exhibit constructed to occupy all of the building's atrium will naturally draw people's attention to it. The sheer volume of such a construction is always impressive, while the concept behind it is relatively simple to construct it will lend itself to the building well. During a visit to the site, our team experimented with string and created a small network across the atrium utilizing some stairwell railings for supports, confirming the visual impact of the proposal, the result was amazing. Immediately, with only two strands of string installed, the project demanded the attention of passersby. Many tried to touch the string, while others just pondered what they had just encountered.

Further discussion regarding materials for the cable include the incorporation of black lights to amplify the colorful, fluorescent fiber which emits bright colors of light from its body and even more so at its ends in response to UV exposure. Therefore, we have also designed various possibilities for connectors and attachment hardware that leave the ends of the material exposed for viewing.

Finally, we would like to leave the installation open for personal interpretation of the observer. We realize that at some point the length of twenty miles will be lost in the tangles of the fiber, but we know that Interstitium represents so much more than that. It can represent a web of science and technology, of information, of unknown desired information, of collaborative scientific effort…the beauty of the project is that the concept is in the eye of the beholder. Thus, we end up coming full-circle to the various dynamics that our original intent encompasses.

Critical Barriers and Obstacles

The first obstacle to working was the lack of design restrictions which left us without specific direction for our ideas—we resolved this by splitting into teams each having a clear working concept. We had problems building a physical model of the space because the unusual curving structure of the building was tough to build accurately at a small scale and is naturally unstable. The first model broke under its own weight, so we reconsidered what we needed and developed a simpler, clearer one of superior strength. For all of us the project was challenging due to the overlap of science and art—the team included architect-majors who were comfortable with an artistic display, but no understanding of particle physics, physics/engineering majors who knew the science, but had no design experience, and a political science major who had never worked in either realm.

Conclusion

The above designs are the culmination of an entire semester of concepts and ideas melded into three defined, distinct proposals to be presented to Fermilab's Creative Design Team and Arts Director during finals week. These proposals embody our best efforts to accomplish our goal for designing an installation that will not only develop the atrium space inside of Wilson Hall at Fermilab for future use, but will also represent the dynamic work being done within the laboratories themselves. All of these ideas are visually potent and incorporate concepts of science behind them. We look forward to presenting our finished designs to the Fermilab staff. We hope that they will find our creations to be as dynamic as we do, and decide to follow through with their construction based on these proposals.