In this sample lab report, annotation will in the comments. The lab report itself will be in black. A version of this report without annotation is also available so you can see what a typical report would look like.

The first page in any lab report is the **cover page**. This page has two major purposes. First, it gives the report a professional look. Second, it identifies who should get the grade, and in the event that the report is dropped, who should receive the report for grading and comment.

For a regular lab you'll be writing an individual report. However, you should also make note of who you did the lab with.

Note that lab reports are always **double spaced**, allowing the person reviewing your work to have room to write comments.

Beverly Crusher Sec. A2 Lab 1701 11/2/2376

Lab 1701: Faster-than-light Travel

EG1003 Section A2

Beverly Crusher

Lab Partner: William Riker

Date of Experiment: October 26, 2376

Date due: November 2, 2376

## Abstract

The objective of this lab was to build a model faster-than-light spacecraft and fly it down Jay Street to the East River. The model successfully flew the entire course, showing that faster-than-light travel was possible even in an urban environment. However, safety considerations proved to be more important than anticipated.

**Commented [EG1]:** The **Abstract** gives an overall, high-level view of the lab report. It is the portion of a lab report that a reader can scan and get a good idea of what the rest of the report should contain.

**It must contain:**
- The objective of the lab
- The results of the lab
- The significance of the results

**Commented [EG2]:** - States the objective of the lab

**Commented [EG3]:** -Explaining the results of the lab

**Commented [EG4]:** -Explaining the significance of the results

## Introduction

While traveling faster than the speed of light has been the dream of mankind for centuries, only recently has the technology become available to allow this to actually be implemented. Through the power of PolyThinking™ Poly Professor, Zefram Cochrane, discovered the Space Warp, allowing travel at speeds faster than the speed of light. Initially, very large spacecraft were required to contain the huge power plants necessary to generate the energy to achieve faster-than-light travel. However, as the technology developed, the size of the power plants needed to achieve speeds faster than light diminished, so much so that it can be achieved in model spacecraft. The object of this lab was to show that it is possible to achieve faster-than-light travel using such a model.

**Commented [EG5]:** The **Introduction** gives the background information necessary for the reader to understand the report.

**It should contain:**
- Relevant formulas, scientific theories, etc.

It is one of the longest sections of the report and you may paraphrase the manual. However, the work **must** be in your own words. Outside sources are allowed but **must** be cited.

**Commented [EG6]:** Demonstrates the problem being solved as requested in the "Your Assignment" section of the lab manual.

The model works on exactly the same principles as large starships, using a combination of matter and antimatter to generate large amounts of energy that accelerate the model to very high speeds. As the vehicle approaches the speed of light, it is possible to enter a space warp where, by taking advantage of the warping of space/time continuum it is possible to travel a distance much faster than it would be traveled by actually traversing such a distance. In effect, by warping the space/time medium, we can take a shortcut through space. This large

**Commented [EG7]:** Describes how faster-than-light travel is possible as requested in the "Your Assignment" section of the lab manual.

**Commented [EG8]:** Describes some applications of faster-than-light travel as requested in the "Your Assignment" section of the lab manual.

amount of energy can be obtained by harnessing a matter/antimatter reaction. In this type of reaction, matter is totally annihilated by antimatter. Einstein's Theory of Relativity states that: $E=mc^2$. E is the amount of energy released, m is the mass of the matter destroyed in kilograms, and c is the speed of light in meters per second. Using MKS (meter/kilogram/second) measurements, the speed of light is $3\times10^8$ meters/second. Using traditional Newtonian physics, the kinetic energy of an object is: $E=½mv^2$. E is the energy in Joules, m is the mass of the object in kilograms, and v is the velocity of the object in meters/second. Since antimatter does not have mass in our universe, the overall mass of the model is twice that of the matter fuel. Combining these equations, the velocity of the rocket can be found: $mc^2==½m^*v^2$. In this case $m^*=2m$. Simplifying the equation yield the following: $c^2=v^2$. Therefore, the rocket will travel at the speed of light using Newtonian equations. However, once the space warp phenomenon is considered, the speed of the rocket will exceed the speed of light.

**Commented [EG9]:** Describes how the matter/antimatter product occurs per the "Your Assignment" section in the manual.

## Procedure

**Commented [EG10]:** The **Procedure** section consists of two parts.

The first paragraph is where you describe the materials used and it **must be in sentences. Lists and bullet points are *not* acceptable.** Additionally, you should only list materials you have used.

The second paragraph is where you will describe the steps you took to complete the report. It **should not** be a copy-and-paste of the manual, it **must be in your own words.**

A model rocket requiring some assembly, a tube of "Super Glue," a cartridge of matter, and a tank of antimatter that was poured into the model just prior to launch were all used. In addition, the EG1003 course supplied equipment used by all the teams: the launch stand, the barrier, and two atomic clocks to verify that the rocket exceeded the speed of light.

First, the rocket kit was obtained from a TA. The kit was inspected to ensure that all the needed parts were present. The four control surfaces (fins) were attached to the fuselage of the model using the Super Glue. The fins were arranged at exactly 90 degrees from each other with a 45 degree tilt from the horizontal. Once the kit was assembled the red power switch of the model was pressed, activating the model. The time was noted to verify that there was enough battery

time when the rocket was launched. The yellow button was pressed, starting the Level 1 Diagnostic for the positronic control system. This ensured that the model would follow the proper flight path.

The model was taken out to Jay Street, and a matter cartridge was obtained. This cartridge was snapped into the model. The Antimatter Containment Vessel was then used to pour antimatter into the tank in the model. The stopper was put into the hole in the tank. The rocket was ready for launch. The model was mounted on the launch stand while one of the team members went to the barrier. When everything was in place, the rocket was launched. When the rocket arrived, and the flash from the launch strobe light was recorded, the atomic clocks were read to verify that the rocket had arrived before the light from the strobe light. The effects of the impact were also noted.

## Data/Observations

**Commented [EG11]:** The **Data and Observations** section is where you discuss what you saw and how you measured it. In this section, you should not explain what you did with that information.

There should **not** be any data calculations being completed in this section.

Any and all tables and photos taken should be included in this section.

Assembling the model was easy, although care was required with the Super Glue to avoid having various body parts being stuck together accidentally. The rocket activated as soon as the red button was pressed, and after the yellow button was pressed to run the Level 1 Diagnostic the green light came on, indicating that the rocket was ready for flight. The time was noted, and it showed that there was plenty of time left to complete the lab.

The model was moved to Jay Street, and the matter cartridge was snapped into the model with no problem. However, it was extremely difficult to pour the antimatter from the Antimatter Containment Vessel into the rocket. Some of the antimatter missed the hold and spilled onto the pavement, temporarily creating a hole in the sidewalk. The F Train tracks and some surprised

people standing on the platform were observed before the hole closed again after several seconds.

The model was attached to the launch stand and a team member took a shuttle bus to the destination, where there was a large wooden barrier. There was a big stack of barriers nearby since each barrier was destroyed with each rocket flight. After it was verified that everything was ready, the rocket was launched and the strobe light on the launch stand flashed.

As the rocket left the launch stand there was a white flash of light followed by a trail of light down Jay Street that went from white to red, and then disappeared. There was also an extremely loud boom, much like a sonic boom, but much louder. Several windows in the Marriott Hotel cracked from the noise. According to the atomic clocks at the barrier, the rocket arrived before the flash of light from the strobe light, but the difference in time was too small to measure accurately.

At the destination, a trail of blue light was observed that terminated at the barrier. This was the most probable path of the rocket, leaving a fuel stream as it arrived. When the rocket hit the barrier, the barrier was vaporized. What was left of the rocket after the impact with the barrier left a red trail of glowing metal until it hit the surface of the East River. A huge geyser of water was seen at the impact point of the molten metal.

## Discussion/Conclusions

Based on the observations, it is clear that a rocket was constructed that exceeded the speed of light, achieving the objective of the lab. The rocket arrived at the barrier before the flash

**Commented [EG12]:** In the **Discussion/Conclusions** section, you will show any and all calculations completed on the data as well as discussing the conclusions you have drawn.

You should always show:
- Calculations
- Overall results of the lab
- Come to conclusions about how things went
- Discuss how you could improve (even if you think it went perfectly)
- Avoid generalities like "this lab was a success"

of the strobe light, as measured by the atomic clocks. Several things could have been done to improve the lab.

First, apparently Poly neglected to tell the authorities about this lab. After the first rocket was launched, the neighbors called 911 to report explosions, UFOs, and streaks of light. By the time NYPD arrived, all the rockets had been fired. The result was that all the students, the TAs, and Professor Doucette (the faculty member present at the time) were all detained at the 84th Precinct. The NYPD Marine Division was called to comb the East River looking for rubble, and the Federal Environmental Protection Agency (EPA) was called to investigate possible contamination of the East River. Since the rockets vaporized, no pollution in the river was found. This lead to lengthy negotiations, at the 84th Precinct, over the nature of the lab, and the lack of foresight to inform the authorities about it. After exhaustive examination of local ordinances, it was eventually determined that Poly was in violation of the law because it did not have a valid parade permit for this activity. Professor Doucette paid the appropriate fines with his credit card, and everyone was released. He also promised that Professor Georgi, as Course Director, would serve any necessary jail time for the violation.

Second, complaints from the neighbors could be reduced by putting some sort of silencer on the rocket exhaust. Given the energy levels involved, this might be feasible.

Third, it would be helpful if the lab made it clearer that spilling antimatter on the ground would result in many frightened people on the subway. A different containment vessel should be considered.

To improve the design of the lab, the experiment should be conducting in desert lands of the west to prevent any possible accidents. Also designs should be thought of in helping the

**Commented [EG13]:** Answer the questions posed in the "Your Assignment" section of the manual of 'Does the model work?'

**Commented [EG14]:** Describes what happened when the model was tested (why it did or did not work) per the "Your Assignment" section questions.

rocket to stop without a barrier or the possibility of vaporization. The rocket should be designed for multiple uses and include safety features.