Post-Launch Assessment Review

I) Basic Information

Team Name: The Rocket Men

Motor Choice: Cesaroni K2045 Vmax

II) Payload Summary

Our payload was named Heliacal Sky, which means near to the sun in the sky. It was named this, since the goal of our experiment is to see if more solar energy is collected when the solar panel is closer to the sun. The purpose of the payload was to accurately measure a change in current generated by a solar panel, as the rocket descends from one mile above ground. The base of the payload consisted of a BT300 body tube, with wooden trusses spaced equidistantly around the outside of the BT300. A flexible solar panel was then glued to the wooden trusses. The wooden trusses were spaced out, to leave space for the wiring from the solar panel, to go through the BT300 tube, and into the inner sled of the payload. Around the solar panel, a Lucite cylinder was placed to protect the solar panel from the ejection charges and from landing. The Lucite cylinder formed a perfect fit within the rocket to provide for easy removal, while not fitting loosely as to shift during flight. Within the payload, wires ran from the solar panel into a circuit. A voltmeter and ammeter in the circuit provided a reading to an Arduino Uno with an SD card shield, which logged the data in half a second increments to a 4 GB SD card. Along with current and voltage, a pressure reading was taken, which provided a height reading as to at which height a reading was collected. All of the data taken by the Arduino was logged onto a comma-separated values file, which could be brought up in an Excel document and then graphed using Excel.

The scientific value of the payload was to determine if it would be worth investing in solar panels at higher elevations, even at such a low altitude. With only a mile of atmosphere, it was hard to see that difference. That is why we chose this experiment, to see if there was a difference at only a mile high. It has already been proven that there is a difference at higher altitudes, so we decided to investigate. Our hypothesis was that we would see a change in current. Due to short circuits, it was hard to interpret data. We would need to run another test, by having another flight, to verify that there is a change in current up about 4300 feet high compared to the ground.

III) Rocket Summary

The rocket was named The Phoenix, after many successful flights. The rocket measures 7.15 inches in length, and has a body tube diameter of 3.9 inches. Our body tube was made of Public Missile's Limited fiberglass-wrapped phenolic body tubing. The fins were made from G10 FR4 fiberglass and six fillets were placed on each fin. The bulk heads and centering rings were made from ½ inch plywood that was routed out on a CNC Router. The recovery system has multiple components within it. The electronics bay was the first. It made use of two PerfectFlite StratoLogger altimeters which controlled four total ejection charges. It also used two Aerocon Systems Type 2 key switches to turn on the StratoLogger altimeters that were within the electronics bay. The recovery system also consisted of 1 inch Tubular nylon shock cord that was hooked to a 15 inch Classical Elliptical drogue parachute. The last part of the recovery system, that safely deployed the rocket to the ground, consists of a 1 inch Tubular nylon shock cord that hooked to the 72 inch Iris Ultra main parachute. Besides the rocket and dual deployment system, another impressive feature of the rocket was the K2045 Vmax motor that had a burn time of 0.7 seconds. The motor caused the rocket to undergo 46 G's of acceleration as the rocket lifted off the pad, which is why the design of our rocket was so robust, to withstand these forces. The rocket's final mass was about 16.9 pounds, and reached an altitude of 3900 feet in Huntsville, Alabama.

IV) Project Plan Summary

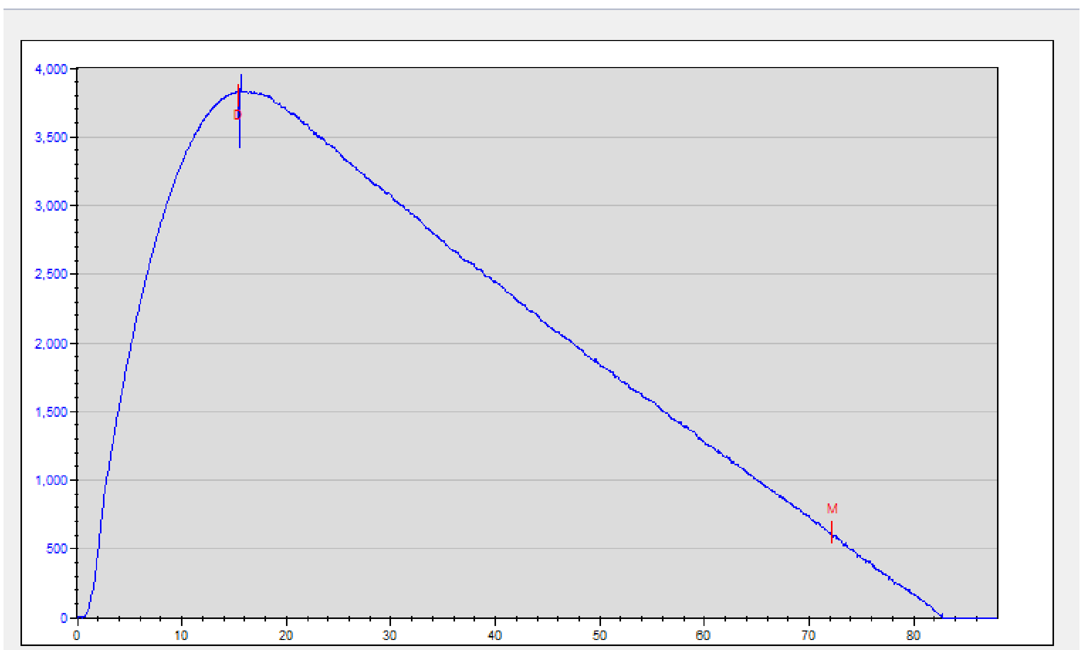
We were able to education many students in our district from a range of 5th-9th graders. Students from our team introduced the basic concepts of rocketry, along with the details of SLP. Presentations were given by team members, to these students, and feedbacks were great. Many students were interested in the progress of the project, and a few were even interested in participating in TARC, SLI, or USLI in the following years. We have consistently been involved in our high school, to spread awareness of our project. Students have been involved in pep rallies, and we plan to have our own banquet to thank all of the people who made our project possible.

Since we did not get enough kids to sign up for our Rocketry Workshop, we plan to keep the kits for a possible end of the year session with Physics students, a summer program, or using them at the beginning of next year with our new Team, to get more kids involved in rocketry. Depending on the availability of students, we will do our proposed Rocketry Workshop when we can get the best turn out. The goal of the workshop was to get students not only interested, but started in other programs such as TARC or possibly SLI.

Although we went over our initial budget, we invested in new wireless power tools that can be used for next year's project on launch days. These investments were necessary this year, and will continue to be useful if the team's proposal is accepted next year. As our project went on, we adjusted our budget for any extra expenses, and always had enough funding along the way due to fundraising. To ensure that we did not accumulate credit, or go over our adjusted budget, we kept track of all purchases and kept fundraising throughout the year in case any unexpected expenses.

V) Launch Day Flight Analysis

The rocket did not go as high in Huntsville, as is usually has in practice flights. In our practice flights our rocket usually reaches an altitude of 4300 feet, while in Huntsville our rocket reached 3900 feet. This was expected due to the different wind patterns that Huntsville has. This may also be the reason that our Main Parachute deployed shortly after apogee. We have only had this problem once before, and speculate that it may be due to the smaller amount of shear pins we used. If we were to launch that rocket again, we would make sure to use more of them to make sure the main parachute does not come out at apogee. We only used two on each side of the electronic bay, and would instead use a minimum of three shear pins per side. Although our main parachute deployed at apogee, the ejection charges for our main parachute did go off, and were heard by Team members. This is also why at the Main parachute mark; there was no change in the descent rate of the rocket. The rocket did land safely, and no damage was done to the outer airframe of the rocket since it was still flying in for landing at a safe velocity.



Our payload was tested before flight to ensure that it would work during flight. All data was then wiped from the 4 GB SD card to optimize the amount of space for data collection on the SD card. The sit time was tested to ensure that the payload would be able to record data for an extended amount of time. The payload collected a sufficient amount of data during flight. It sat safely within the rocket, until it deployed at apogee. Since the main parachute deployed at apogee, there is an excess of data, since the rocket was deploying for twice as much time. The payload logged for a little over 2 hours, leaving a massive amount of data to interpret. The weather was optimal for our experiment, and was sunny the entire time during descent. The pressure sensor must have overheated in our previous flight, causing it not to read, making data interpretation harder. On launch day, data did not log for long. A short circuit occurred, causing a stop in the data. Only a small amount of points were collected before the short circuit happened, so no data was taken during the fifth flight of The Phoenix.

VI) Project Overview

At the beginning of our project, no one on our team had experience with high-powered rockets. We had many questions, and it took a lot of time researching. Our team mentor also helped guide us through our project as well, giving us suggestions of what materials to use. One of the biggest research topics done was based on parts of the configuration of the rocket.

One thing that we learned during our test flights, was that a faster burning motor, is not as consistent as a slower burning motor, or one that is likely to yield the height that you see in simulation, despite how it may seem like a faster-burning motor would provide less time during ascent for the rocket to curve off of its path. Another thing that we learned is how to fold our Fruity Chute parachute. When we started our project, our main parachute was not coming out. So, we did some research to find the best way to fold our 6 inch diameter main parachute. Once we found a method for folding the parachute that worked, the parachute deployed in every flight, flawlessly.

We learned that when using key switches with metal part for the electronics bay works better. We learned this due to the fact that nonmetal parts were starting to melt due to the heat of the soldering iron. Also, a large lesson that we learned is to use stranded wire, instead of solid core. This was because the stranded wire is not as flexible, which made it hard to take out the components within the electronics bay to check the wiring and put new batteries in the electronics bay before each flight. This also caused problems within the electronics bay wiring, which had to be replaced with stranded wire. A suggestion that was mentioned to us after the construction of our rocket was to screw the electronics bay into the top half of the rocket rather than having the rocket separate on either end of the e-bay. This is because the ejection charge will help for the parachute out of the rocket if it is to come out of the nose cone. Since our rocket was already built, and constructed to separate on both ends of the electronics bay, we kept the rocket that way since test flights were not having any problems with the rocket separating at each programmed height.

The last thing that we learned from our flights is that our rocket could never be too robust. A fall from one mile high can ultimately destroy a rocket that you have worked long and hard on. This is why we decided to design our rocket with six fillets on the fins, as well as having your body tube wrapped in fiberglass. We knew our rocket would undergo extreme forces due to our rocket motor choice and calculated terminal velocity during descent, we designed a very robust structure to have your rocket as reusable as possible.

Overall the project was the highlight of the entire team's year. With our project, we attempted to build a successful rocket, payload, and overall project. We also tried to involve the students in our district to learn about rocketry. SLI was a rewarding experience with many challenges that needed to be overcome. Practical problem solving outside of the classroom was not only attempted, but successfully applied to our project. SLI was a very valuable experience that none of the Team members will ever forget. Every lesson will be carried on throughout the rest of our lives. This was one of the biggest projects that any of our team members have worked on. It taught us how to work with people, and develop real life work relations. The most important thing we learned wasn't as much about rocketry, as it was about each other. That lesson was that we must work as a team to succeed as a team.