I. Summary of PDR report

Team Summary

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  Kane'ohe Hawai'i 96744
- Dr. Joseph Ciotti (Principle Investigator)
  Dr. Jacob Hudson (Team Official)
  Helen Rapozo (IT Specialist)
  Premitivo Ames II
  Joleen Iwaniec
  Todd Esposito
  Patrick Lancaster
  Jasmine Maru

Launch Vehicle Summary

- The team rocket is to be 84 inches in length, with a 4" diameter
- The rocket is designed to accept an Aerotech K560W 75-mm motor
- The rocket is designed to have a dual deployment recovery system incorporating a 36" drogue deployed at apogee, and a 96" main to be deployed at 500' altitude.

Payload Summary

In order to continue its efforts at promulgating interests in science, technology, engineering, and mathematics, the Center for Aerospace Education (CAE) wanted to acquire a re-usable rocket to perform diagnostic testing for several of our education outreach projects: A Rocket Launch for International Student Satellites (ARLISS), testing for the National CanSat competition, various High School Science Fair experiments, and as the hands-on component for a course on Rocketry that is to be integrated into the University of Hawai'i curriculum. The rocket would be designed to carry a non-specific payload, of limited weight and size, to an altitude of 1 mile (5280'), and then return safely to its launchers. The targeted altitude can change with the incorporation of our aero-brake system and different engine selection. It will also have the ability to maintain the payload through entire flight or to eject its payload at apogee. These options depend on the needs of the outreach program that it is being used for. The payload carrier would have an on-board data acquisition system capable of determining where the payload compartment is, how fast it is going, how high above ground level it is, and what angle the payload section is above the horizon. In addition, the payload carrier electronics will also include the ability to perform a 'voice–over' to a ground PA system to inform all observers of the information being collected and the status of the rocket.

II. Changes made since Proposal

The WCC USLI rocket is designed with Education Outreach in mind. Several design constraints are considered with this thought paramount. Since projects are to be canvassed from interested high school students or participating colleges, the payloads are somewhat unspecific. It was thought that a payload weight limit of 1 kg would allow some latitude for the high school students, was twice the weight limit allowed by the National CanSat competition, and more than enough for the past electronic payload testing that has previously been performed for the ARLISS program. Along with this was the understanding that volume constraints must also be outlined; whereas we will be pushing the National CanSat competition, we did not want this to be the only option for interested students. A cylindrical volume, having a diameter of 3.75 inches, and length of 10 inches, was optimal for our purposes. If the payload weighs less than 1kg, to reach the desired altitude, extra mass can be added, a different motor can be selected, or the aero-brake system can be used. Any changes made will be thoroughly tested using our simulation software (RockSim) and our to scale prototype to ensure that all safety requirements are still maintained throughout the rocket's flight.

Determination of the motor that is going to be used in USLI was more problematic. It was thought that we should initially over-power the rocket to carry a heavy payload to a height greater than 1 mile. By suitably deploying aero-brakes, open throughout the flight, and extra mass, it was thought that we could attain the right height. It was this in mind, as well as some simple kinematics, that led us to our initial choice of the L1400 motor. After further consideration, coupled with the arrival of our flight simulation (RockSim) routine, we concluded that this was inherently un-safe. The flight simulation showed that the amount of mass that would have to be added to the rocket using an L1400 motor was too much to guarantee a safe recovery. Further flight simulations showed that we would get a better flight profile using a K560 motor, which implied a 75-mm diameter motor mount. The 75/2560 casing, required for a K560 motor, determined that the motor mount length was to be at least 11 inches. A 20-inch length was chosen for convenience, and offers some latitude in future choice of motor, should the need arise.

The overall length of the rocket was determined not so much by the payload, as by the dual deployment recovery that is planned. Rocket design started with the nose cone, standard ogive 1:4.25, yields a nose cone length of 17 inches. The choice of this type of nose cone was dictated by the fact that this shape is commercially available. This is where the data acquisition electronics, monitoring the rocket flight profile and status of the payload, will be located. The payload section of the rocket is 19 inches in length; 4 inches as the nose cone shoulder, 10 inches as the payload section, and 5 inches is half the coupler length. Below the payload section of the rocket is the avionics section, chosen to be 18 inches in length; 7 inches to accommodate 5 inches of coupler and stowage of the drogue chute, 6 inches for the avionics electronics, and 5 inches to accommodate the coupler. The avionics electronics will consist of 2 G-Wiz HCX flight controllers, and a Perfect Flight MAWDs as a redundant back-up system. The Booster section is 30 inches in length, of which the motor mount will take up the lower 20 inches. The upper 10 inches will accommodate 5 inches of coupler, and act as the main chute stowage area. It goes without saying that this section will hold the three fins, and the aero-brake assembly. This yields an overall length of 84 inches (7 feet).

We plan to use G-10 fiberglass as the main tube material, with two 10-inch couplers, three ¼-inch thick plywood bulkheads, two ½-inch thick Birch wood centering rings, and three fiberglass trapezoidal fins. We estimate the un-loaded weight of our rocket to be 13.9 lbs, and a pad weight of just under 20 lbs.

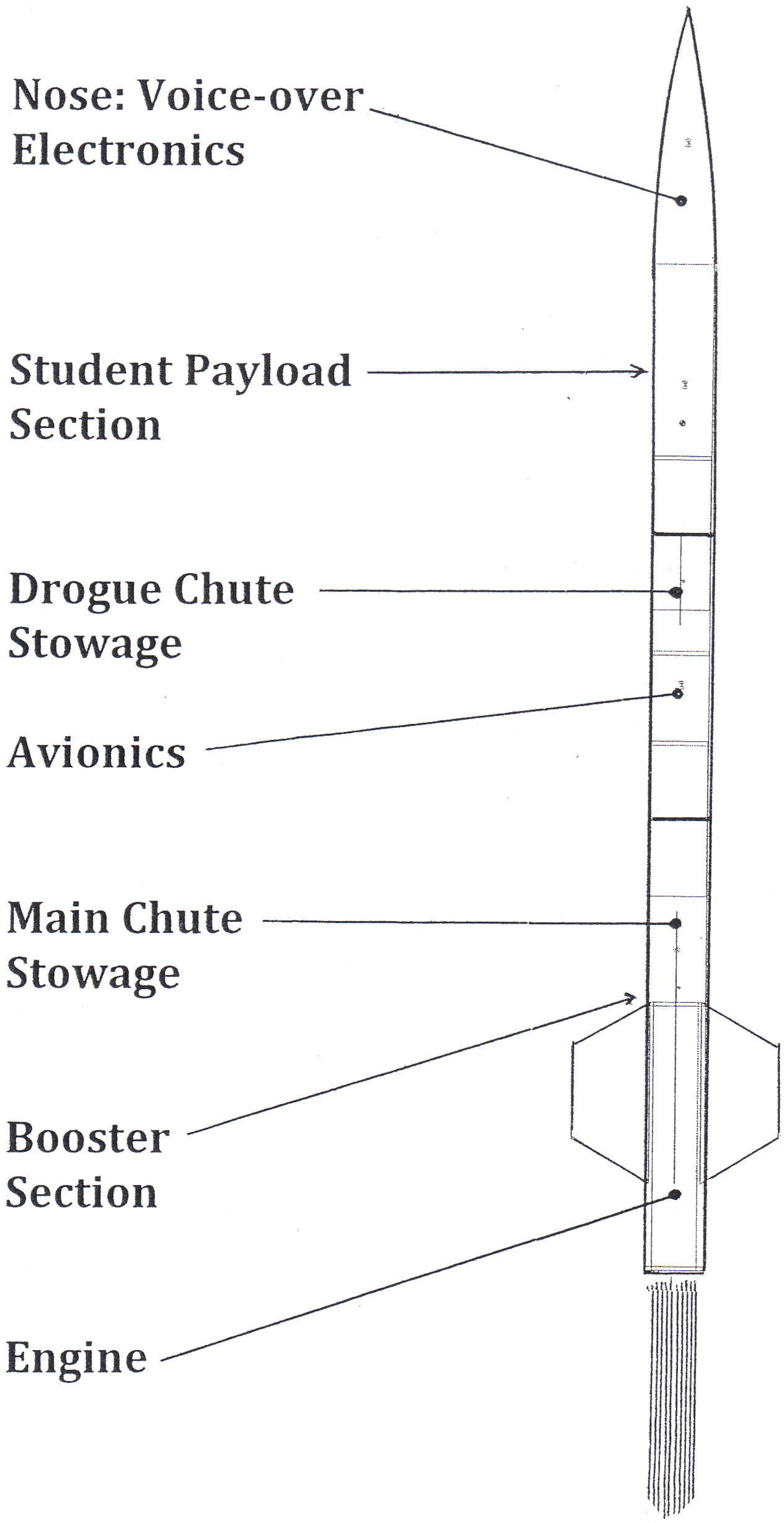
The flight profile that our rocket will follow is the standard dual deployment routine, and has been simulated (under various launch conditions) on RockSim. The flight will begin with the boost phase. The K560 motor will produce an average thrust of 120 lbs (giving us a thrust to weight ratio of 6), with a burn time of 4.95 seconds. The maximum estimated acceleration is ~8 g's (258 ft/s/s), with an estimated maximum speed of 500 mile/hr (735 ft/s). At motor burnout, the rocket then enters its coast phase. We expect the rocket to reach apogee ~25 seconds after launch. At apogee, a 36-inch drogue chute will be deployed, yielding an initial descent speed of ~ 60 ft/s. At an altitude of 500 ft, a 96-inch main chute will be deployed, slowing the rocket descent rate to less than 20 ft/s, which we believe to be a safe descent rate.

III. Vehicle Criteria

With outreach being the main focus of WCC's USLI rocket our vehicle must be able to successfully carry different payloads for various outreach projects. These payloads must stay within our dimensional and weight limitations to guarantee the safety of the rocket, payload, and observers. Also to ensure that it will be successfully recovered.

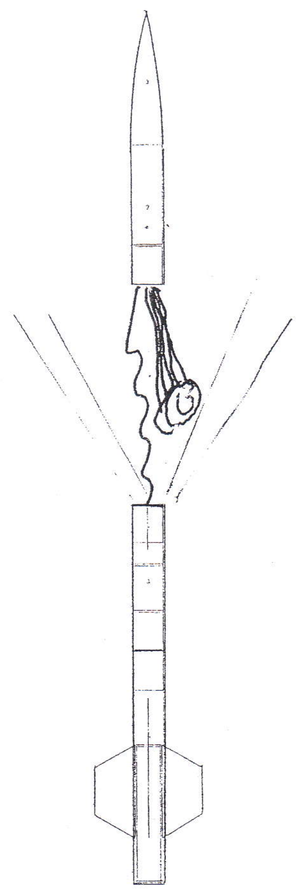
Flight Profile & RockSim Data:

Boost Phase

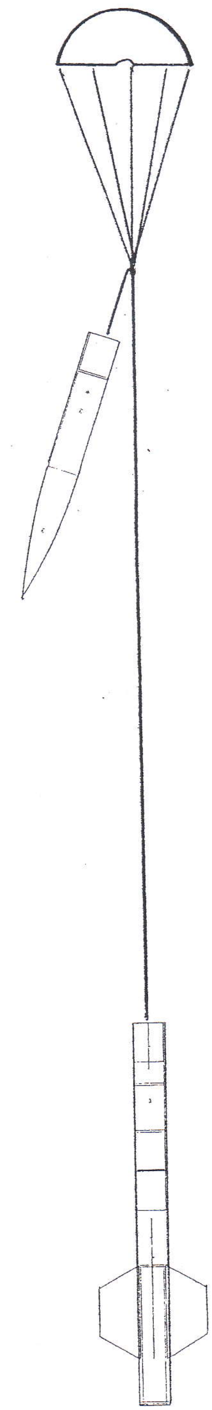


Nose: Voice-over Electronics
Student Payload Section
Drogue Chute Stowage
Avionics
Main Chute Stowage
Booster Section
Engine

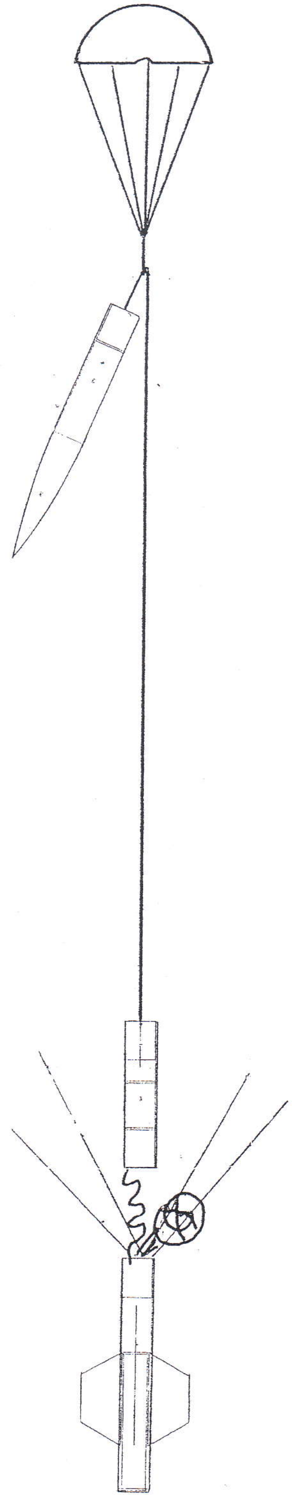
Apogee: Drogue Deployed

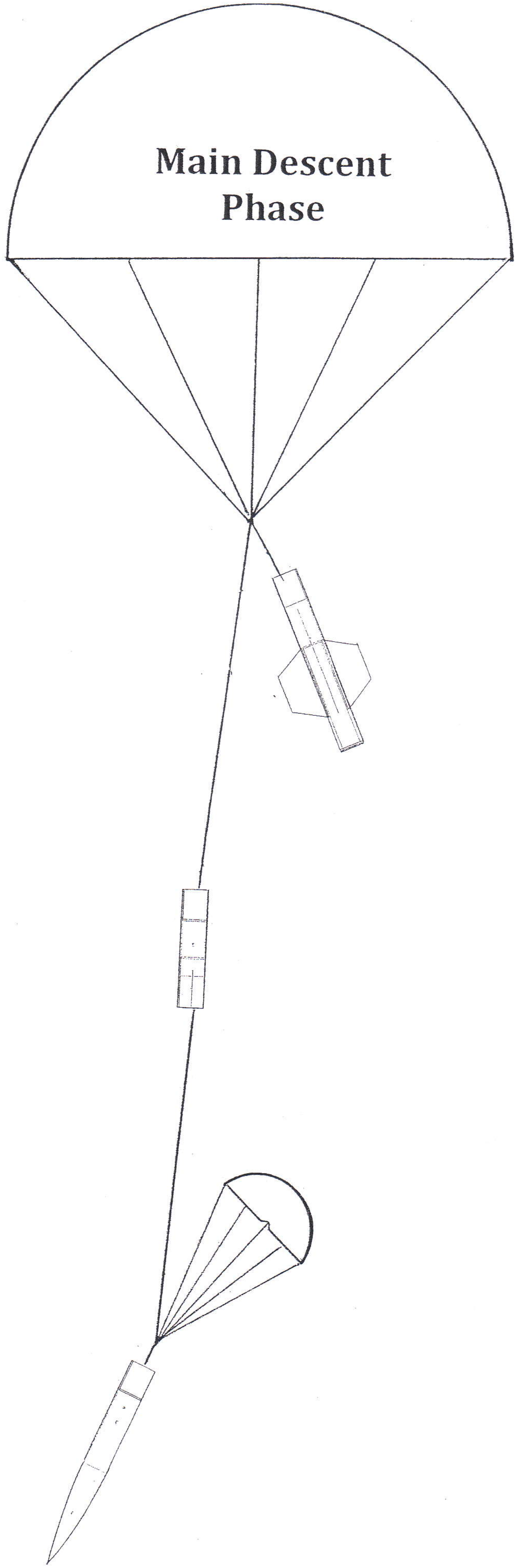


Drogue Descent Phase

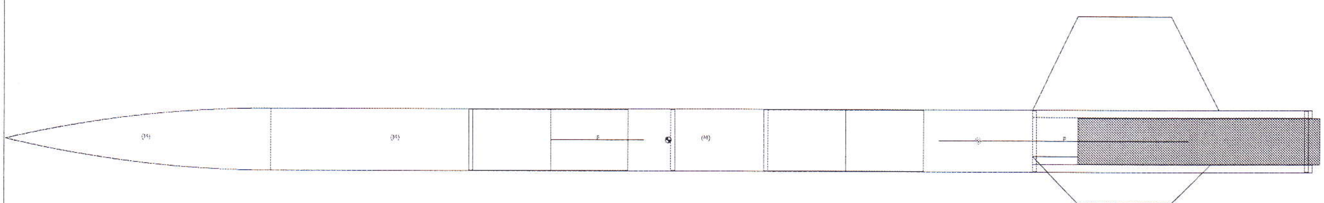


**500' Altitude:
Main Chute
Deployed**




Main Descent
Phase

leo hana rocket
Length: 84.0000 In. , Diameter: 4.0000 In. , Span diameter: 16.0000 In.
Mass 328.6602 Oz. , Selected stage mass 328.6602 Oz.
CG: 42.5836 In., CP: 62.5025 In., Margin: 4.98 Overstable
Engines: [K560W-None,]



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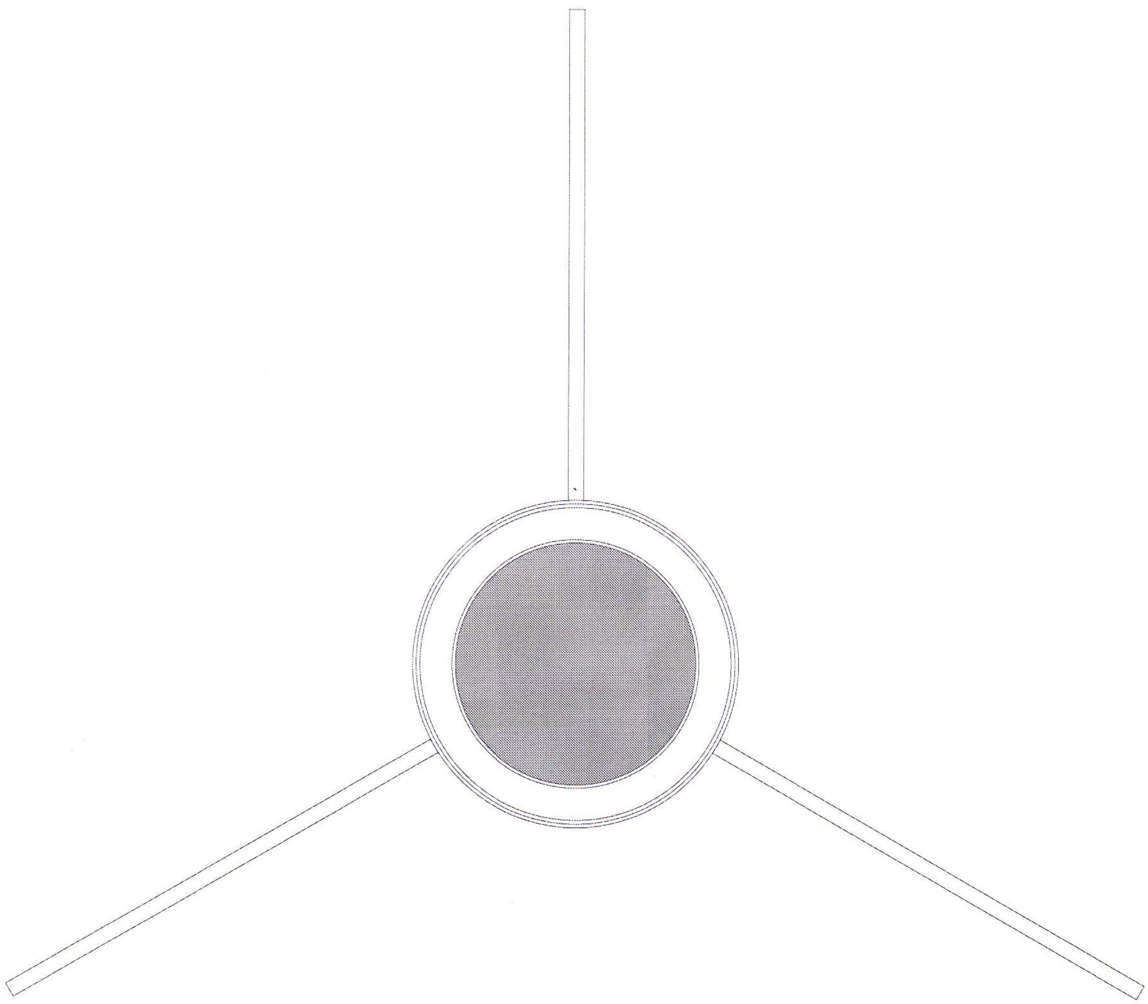


Sustainer parts

Nose cone LOC Precision - - , Material: Polystyrene PS

- Nose shape: Solid Ogive, Len: 17.0000 In., Dia: 4.0000 In. Body insert: OD: 0.0000 In., Len: 0.0000 In.
- CG: 11.6817 In. , Mass: 69.5017 Oz. Radius of gyration: 0.186895 (m) , 18.6895 (cm) Moment of inertia: 0.0688234 (kgm^2) , 688234 (gcm^2) , RockSim XN: 7.8976 In. , CNa: 2

Voice elec - Custom, Material: Custom

- CG: 0.0000 In. , Mass: 35.2740 Oz. Radius of gyration: 0 (m) , 0 (cm) Moment of inertia: 0 (kgm^2) , 0 (gcm^2)

Payload section - Custom, Material: G10 fiberglass

- OD: 4.0000 In. , ID: 3.9100 In. , Len: 18.0000 In.
- CG: 9.0000 In. , Mass: 11.0837 Oz. Radius of gyration: 0.136832 (m) , 13.6832 (cm) Moment of inertia: 0.00588312 (kgm^2) , 58831.2 (gcm^2) , RockSim XN: 0.0000 In. , CNa: 0

Tube coupler - Custom, Material: G10 fiberglass

- Tube couplerOD: 3.9100 In., Hole #1: : 97.0280 In. Len: 10.0000 In. Location: 13.0000 In. From the front of Payload section
- CG: 5.0000 In. , Mass: 6.0175 Oz. Radius of gyration: 0.0812158 (m) , 8.12158 (cm) Moment of inertia: 0.00112524 (kgm^2) , 11252.4 (gcm^2)

Bulkhead - Custom, Material: Aircraft plywood (Birch)

- BulkheadOD: 3.9100 In., Len: 0.2500 In. Location: 12.7500 In. From the front of Payload section
- CG: 0.1250 In. , Mass: 1.2580 Oz. Radius of gyration: 0.0249241 (m) , 2.49241 (cm) Moment of inertia: 2.21543e-05 (kgm^2) , 221.543 (gcm^2)

experimental payload - Custom, Material: Custom

- CG: 0.0000 In. , Mass: 38.8014 Oz. Radius of gyration: 0 (m) , 0 (cm) Moment of inertia: 0 (kgm^2) , 0 (gcm^2)

Avionics section - Custom, Material: G10 fiberglass

- OD: 4.0000 In. , ID: 3.9100 In. , Len: 19.0000 In.
- CG: 9.5000 In. , Mass: 11.6995 Oz. Radius of gyration: 0.143933 (m) , 14.3933 (cm) Moment of inertia: 0.00687123 (kgm^2) , 68712.3 (gcm^2) , RockSim XN: 0.0000 In. , CNa: 0

Tube coupler - Custom, Material: G10 fiberglass

- Tube couplerOD: 3.9100 In., Hole #1: : 97.0280 In. Len: 10.0000 In. Location: 14.0000 In. From the front of Avionics section
- CG: 5.0000 In. , Mass: 6.0175 Oz. Radius of gyration: 0.0812158 (m) , 8.12158 (cm) Moment of inertia: 0.00112524 (kgm^2) , 11252.4 (gcm^2)

Avionics aft Bulkhead - Custom, Material: Aircraft plywood (Birch)

- BulkheadOD: 3.9100 In., Len: 0.2500 In. Location: 13.7500 In. From the front of Avionics section
- CG: 0.1250 In. , Mass: 1.2580 Oz. Radius of gyration: 0.0249241 (m) , 2.49241 (cm) Moment of inertia: 2.21543e-05 (kgm^2) , 221.543 (gcm^2)

Avionics fwd Bulkhead - Custom, Material: Aircraft plywood (Birch)

- BulkheadOD: 3.9100 In., Len: 0.2500 In. Location: 7.7500 In. From the front of Avionics section
- CG: 0.1250 In. , Mass: 1.2580 Oz. Radius of gyration: 0.0249241 (m) , 2.49241 (cm) Moment of inertia: 2.21543e-05 (kgm^2) , 221.543 (gcm^2)

Drogue Giant Leap - - , Material: Rip stop nylon

- 1 parachute, Shape: 6 sided Dia: 36.0000 In., Spill hole: 0.0000 In.
- CG: 3.0000 In. , Mass: 1.2806 Oz. Radius of gyration: 0.0483245 (m) , 4.83245 (cm) Moment of inertia: 8.47814e-05 (kgm^2) , 847.814 (gcm^2)

Avionics - Custom, Material: Custom

- CG: 0.0000 In. , Mass: 17.6370 Oz. Radius of gyration: 0 (m) , 0 (cm) Moment of inertia: 0 (kgm^2) , 0 (gcm^2)

Booster - Custom, Material: G10 fiberglass

- OD: 4.0000 In. , ID: 3.9100 In. , Len: 30.0000 In.
- CG: 15.0000 In. , Mass: 18.4729 Oz. Radius of gyration: 0.22307 (m) , 22.307 (cm) Moment of inertia: 0.0260594 (kgm^2) , 260594 (gcm^2) , RockSim XN: 0.0000 In. , CNa: 0

Fin set - Custom, Material: G10 (PML 0.062")

- Planform: trapezoidal, Root chord: 12.0000 In., Tip chord: 6.0000 In., Semi-span: 6.0000 In., Sweep: 2.9118 In., Mid-Chord: 6.0006 In. Misc: Location: 12.0000 In. From the front of Booster Thickness: 0.1875 In. Profile: square
- CG: 5.9608 In. , Mass: 0.0055 Oz. Radius of gyration: 0.0818712 (m) , 8.18712 (cm) Moment of inertia: 1.04678e-06 (kgm^2) , 10.4678 (gcm^2) , RockSim XN: 69.6275 In. , CNa: 22.6392

Motor Mount Semroc - - , Material: Spiral/Glassine

- OD: 3.0315 In. , ID: 2.9528 In. , Len: 18.0000 In. Location: 12.0000 In. From the front of Booster
- CG: 9.0000 In. , Mass: 3.2674 Oz. Radius of gyration: 0.134842 (m) , 13.4842 (cm) Moment of inertia: 0.00168423 (kgm^2) , 16842.3 (gcm^2) , RockSim XN: 0.0000 In. , CNa: 0

Bulkhead cr(aft) - Custom, Material: Aircraft plywood (Birch)

- BulkheadOD: 3.9100 In., Hole #1: : 77.0000 In. Len: 0.2500 In. Location: 0.2500 In. From the base of Booster
- CG: 0.1250 In. , Mass: 0.5018 Oz. Radius of gyration: 0.0315057 (m) , 3.15057 (cm) Moment of inertia: 1.41202e-05 (kgm^2) , 141.202 (gcm^2)

Bulkhead cr(fwd) - Custom, Material: Aircraft plywood (Birch)

- BulkheadOD: 3.9100 In., Hole #1: : 77.0000 In. Len: 0.2500 In. Location: 17.7500 In. From the base of Booster
- CG: 0.1250 In. , Mass: 0.5018 Oz. Radius of gyration: 0.0315057 (m) , 3.15057 (cm) Moment of inertia: 1.41202e-05 (kgm^2) , 141.202 (gcm^2)

Main chute Giant Leap - - , Material: Rip stop nylon

- 1 parachute, Shape: 6 sided Dia: 96.0000 In., Spill hole: 0.0000 In.

leo hana rocket - Simulation results

Engine selection

[K560W-None]

Simulation control parameters

- Flight resolution: 800.000000 samples/second
- Descent resolution: 1.000000 samples/second
- Method: Explicit Euler
- End the simulation when the rocket reaches the ground.

Launch conditions

- Altitude: 0.00000 Ft.
- Relative humidity: 50.000 %
- Temperature: 59.000 Deg. F
- Pressure: 29.9139 In.

  Wind speed model: Light (3-7 MPH)
  - Low wind speed: 3.0000 MPH
  - High wind speed: 7.9000 MPH

  Wind turbulence: Fairly constant speed (0.01)
  - Frequency: 0.010000 rad/second
- Wind starts at altitude: 0.00000 Ft.
- Launch guide angle: 0.000 Deg.
- Latitude: 0.000 Degrees

Launch guide data:

- Launch guide length: 36.0000 In.
- Velocity at launch guide departure: 32.3588 ft/s
- The launch guide was cleared at : 0.243 Seconds
- User specified minimum velocity for stable flight: 43.9993 ft/s
- Minimum velocity for stable flight reached at: 64.2847 In.

Max data values:

- Maximum acceleration:Vertical (y): 256.259 Ft./s/sHorizontal (x): 3.118 Ft./s/sMagnitude: 257.627 Ft./s/s
- Maximum velocity:Vertical (y): 718.6425 ft/s, Horizontal (x): 11.5666 ft/s, Magnitude: 721.6199 ft/s
- Maximum range from launch site: 983.41198 Ft.
- Maximum altitude: 7296.72424 Ft.

Recovery system data

- P: Drogue Deployed at : 21.550 Seconds
- Velocity at deployment: 44.7121 ft/s
- Altitude at deployment: 7296.72420 Ft.
- Range at deployment: -983.41198 Ft.
- P: Main chute Deployed at : 133.785 Seconds
- Velocity at deployment: 59.4403 ft/s
- Altitude at deployment: 499.98650 Ft.
- Range at deployment: 153.76327 Ft.

Time data

- Time to burnout: 4.965 Sec.
- Time to apogee: 21.550 Sec.
- Optimal ejection delay: 16.585 Sec.

Landing data

- Successful landing
- Time to landing: 156.324 Sec.
- Range at landing: 412.82071
- Velocity at landing: Vertical: -21.9012 ft/s , Horizontal: 11.5666 ft/s , Magnitude: 24.7679 ft/s

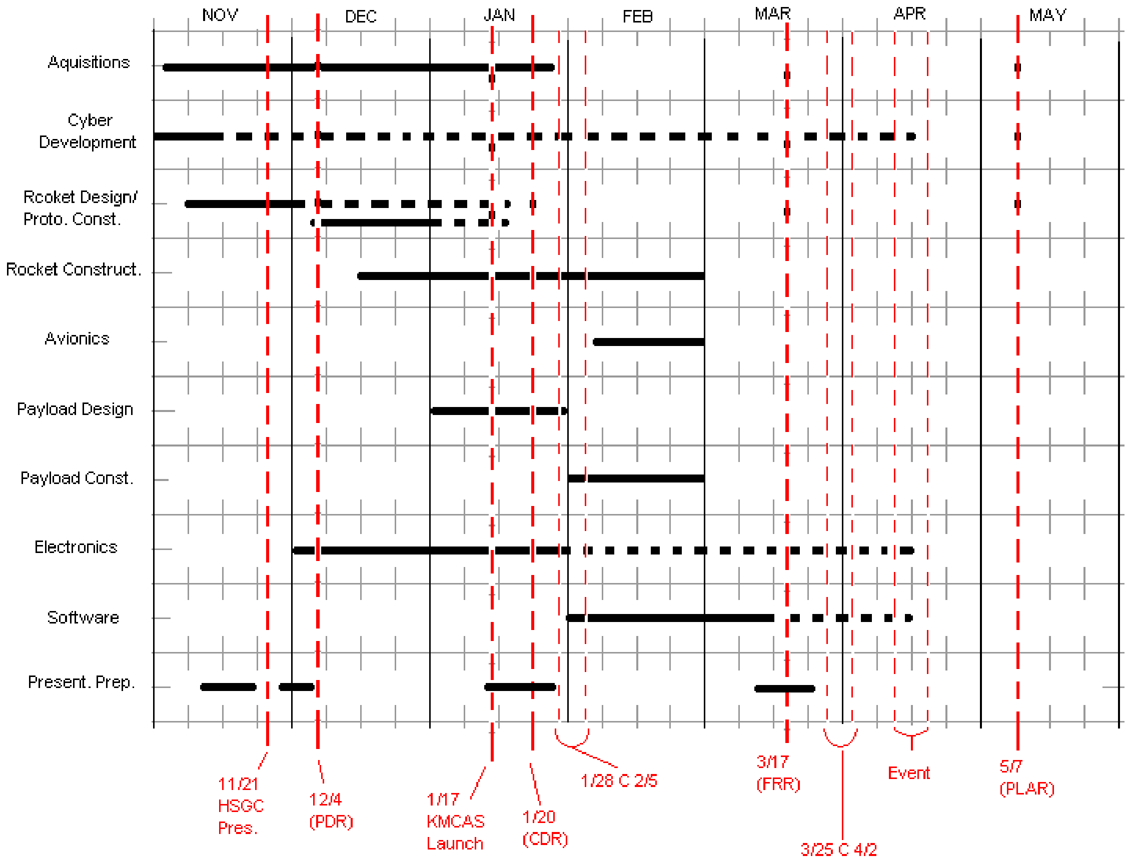
Competition settings

Competition conditions are not in use for this simulation.

IV. Activity Plan

The main objective of this program is to focus all efforts to reaching students island wide. An informative brochure will be sent to all public, private and charter schools as well as youth clubs such as YMCA of Hawaii, Girl Scouts, Boy Scouts, and Boys & Girls club of America. Also kids will partner with USLI team members in monthly launches that are open to the public at Windward Community College. The Kaneohe Marine Corps Air Station (KMCAS) has opened its gates for the USLI to launch larger scaled rockets. Beginning in 2010 K.I.T.S. will also be participating in theses launches with students from the Outreach program. We are excited in this endeavor and the opportunity to share the passion for rocketry!!

Gantt chart for USLI project



V. Safety Plan Mitigation Table

All construction will be in collaboration with our campus OSHA officer.

In addition to all the mitigation tactics listed below the team will always maintain good Environment		
Materials	**Risk**	**Mitigation**
Phenolic Powder- Black	Ingestion Hazards, Skin Irritation, Eye Irritation, Respiratory Irritation from Dust	Team members will work in well-ventilated areas and wear face masks at all times to prevent inhalation and ingestion of the dust from the Phenolic Black Powder. Gloves will be worn at all times to prevent skin irritation. Goggles will be worn at all times to prevent eye irritation.
Phenolic Resin	Toxic Fumes, Skin Irritation, Eye Irritation	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with clothing. Goggles will be worn at all times to prevent Eye Irritation
Copperhead igniter	Ingestion Hazards, Toxic Fumes, Skin Irritation, Eye Irritation, Inadvertent Ignition, Burns to skin	Team members will work in well-ventilated areas and wear face masks at all times to prevent inhalation and ingestion of hazardous chemicals. Gloves will be worn at all times to prevent skin irritation and burns to skin. Goggles will be worn at all times to prevent eye irritation. Igniters will be kept away from ignition sources such as flames, matches, and heat sources, and will be properly stored in Type 3 or Type 4 magazines to prevent inadvertent ignition.

First Fire Igniter	Ingestion Hazards, Toxic Fumes, Skin Irritation, Eye Irritation, Inadvertent Ignition, Burns to skin	Team members will work in well-ventilated areas and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of hazardous chemicals. Gloves will be worn at all times to prevent skin irritation and burns to skin. Goggles will be worn at all times to prevent eye irritation. Igniters will be kept away from ignition sources such as flames, matches, and heat sources, and will be properly stored in Type 3 or Type 4 magazines to prevent inadvertent ignition.
First Fire Jr. Igniter	Ingestion Hazards, Toxic Fumes, Skin Irritation, Eye Irritation, Inadvertent Ignition, Burns to skin	Team members will work in well-ventilated areas and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of hazardous chemicals. Gloves will be worn at all times to prevent skin irritation and burns to skin. Goggles will be worn at all times to prevent eye irritation. Igniters will be kept away from ignition sources such as flames, matches, and heat sources, and will be properly stored in Type 3 or Type 4 magazines to prevent inadvertent ignition.
Rocket Propellant	Skin Irritation, Inadvertent Ignition, Burns to skin	Gloves will be worn at all times to prevent skin irritation. Propellant will be kept away from ignition sources, such as flames, matches, igniters, heat sources, and will be properly stored in Type 3 or Type 4 magazines to prevent inadvertent ignition. After motor burn, the team will wait 15 minutes before disassembling the motor, while wearing insulated gloves to prevent burns to skin.

Epoxy Resin	Toxic Fumes, Skin Irritation, Eye Irritation	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with clothing. Goggles will be worn at all times to prevent Eye Irritation
5-Minute Epoxy Resin	Toxic Fumes, Skin Irritation, Eye Irritation	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with clothing. Goggles will be worn at all times to prevent Eye Irritation
Sinmast 4 Epoxy Mortar Mix - Normal Cure	Ingestion Hazards, Skin Irritation, Eye Irritation	Team Members will wear face masks at all times to prevent ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with clothing. Goggles will be worn at all times to prevent Eye Irritation
Compressed Carbon Fiber Sheets	Inhalation Hazards, Eye Irritation, Skin Irritation	Team Members will wear face masks at all times to prevent inhalation of the material. Goggles will be worn at all times to prevent Eye Irritation. Gloves will be worn at all times to prevent skin irritation
Fiber Glass Cloth	Inhalation Hazards, Eye Irritation, Skin Irritation	Team Members will wear face masks at all times to prevent inhalation of the material. Goggles will be worn at all times to prevent Eye Irritation. Gloves will be worn at all times to prevent skin irritation

Polystyrene	Ingestion Hazards	Team Members will wear face masks at all times to prevent Ingestion of Material
Polystyrene Foam	Ingestion Hazards, Skin Irritation, Eye Irritation	Team Members will wear face masks at all times to prevent Ingestion of Material. Goggles will be worn at all times to prevent eye irritation
Duct Tape	Skin Irritation, Eye Irritation	Team members will avoid prolonged exposure of duct tape to bare skin to prevent skin irritation. Team members will not place duct tape on their eyes to prevent eye irritation
Masking Tape	No Risks Stated	No Mitigation Required
Super Glue	Toxic Fumes, Ingestion Hazards, Eye Irritation, Skin Irritation	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with. Goggles will be worn at all times to prevent eye irritation.
Acetone	Toxic Fumes, Ingestion Hazards, Eye Irritation, Skin Irritation	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with. Goggles will be worn at all times to prevent eye irritation.

Mineral Spirits	Severe Eye Irritation, Skin irritation, Ingestion hazards	Team Members will wear face masks at all times to prevent Ingestion of the material. Gloves will be worn at all times to prevent skin irritation. Goggle will be worn at all times to prevent eye irritation
Denatured Alcohol	Toxic Fumes, Ingestion Hazards, Eye Irritation	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Goggles will be worn at all times to prevent eye irritation
Carbon Dioxide	Inhalation Hazards	Team members will work in a well-ventilated area to prevent inhalation hazards
Silicone Lube	Ingestion Hazards, Skin Irritation, Eye Irritation, Toxic Fumes	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with clothing. Goggles will be worn at all times to prevent eye irritation
White Lithium Grease	Ingestion Hazards, Skin Irritation, Eye Irritation, Toxic Fumes	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Gloves and chemical resistant aprons will be worn at all times to prevent Skin Irritation and contact with clothing. Goggles will be worn at all times to prevent eye irritation

Isopropyl Rubbing Alcohol	Toxic Fumes, Ingestion Hazards, Eye Irritation, Inadvertent Ignition, Burns to Skin	Team Members will work in a well-ventilated area and wear face masks at all times to prevent inhalation of toxic fumes and ingestion of the material. Goggles will be worn at all times to prevent contact with eyes leading to eye irritation. Material will be kept away from ignition sources, such as flames, matches, igniters, heat sources. Team members will wear gloves to protect from burns to skin in the event of an inadvertent ignition
Black Powder	Inhalation Hazards, Eye Irritation, Inadvertent Ignition, Burns to skin	Team Members will wear face masks at all times to prevent Inhalation of the Black Powder. The Black Powder will be kept away from ignition sources such as flames, matches, and heat source to prevent inadvertent ignition. Gloves will be worn to prevent burns to skin. Goggles will be worn at all times to protect eyes. Equipment used with or near the Black Powder will be nonstatic producing materials to prevent inadvertent ignition. Storage of BP will be in a type IV magazine.

Rocket Parts List

Part	Part No.	Description	Price	Quantity	
Body Tube	FTEX2	3.91" x 4.00" x 36"	$56.88	4	$227.52
Nose Cone	FNC	4.0 4:1 FT 3.91 17" Ogive	$55.00	2	$110.00
Coupler	CT-3.91"	10" Long Coupler	$13.61	4	$54.44
Fins	FR-4	Fiberglass sheet 0.187" Thick	$24.00	3	$72.00
Fin Can		Aluminum Fin Can 4" Airframe	$135.95	1	$135.95
Centering Ring	CR 3.9-3.0	Centering for Motor Tube	$4.20	3	$12.60
Bulk Plate	BP-3.9	Frame Tube 3.91" 1/2" Plywood	$2.10	5	$10.50
Motor Tube	FT-3.00	3.005" x 3.129" x 20"	$18.75	1	$18.75
http://www.hawkmountain.ws/					

Chute	36"	STANDARD LOW-POROSITY 1.1 RIPSTOP PARACHUTES	$35.00	1	$35.00
	96"	STANDARD LOW-POROSITY 1.1 RIPSTOP PARACHUTES	$65.00	1	$65.00
http://the-rocketman.com/chutes.html					
Altimeter	mini Alt/WD	Compact flight-logging altimeter with dual event deployment capability.	$99.95	1	$99.95
http://www.perfectflite.com/index.html					
Flight Computer	HCX-50	Flight Computer	$235.95	2	$471.90
	USB Interface	USB Interface	$35.00	1	$35.00
http://www.gwiz-partners.com/index.html					
		Parts Total:			$1,348.61

For the Payload Monitoring Electronics please refer to:

Angelfire project www.vernk.com

Milestone Review Flysheet

PDR, CDR, FRR

Institution Name	UH - Windward Campus
Milestone	

Rocket Properties	
Diameter	4.0 in
Length	84.0 in
Gross Liftoff Weight	20.0 lbs
Launch lug/button size	3/8 in button
Motor Retention	Not required for PDR

Motor Properties	
Manufacturer	Aerotech
Designation	K560W
Peak, Average Thrust	120 lbs
Mass (before,after burn)	9.1 kg, 6.31 kg
Total Impulse	2560 N-s

Stability Analysis	
CP, CG Location (from nose)	62.5 in
Stability Margin	8.74
Thrust-to-Weight Ratio	6
Rail size, Length	9 ft

Ascent Analysis	
Max Velocity	725 ft/s
Max Acceleration	258 ft/s/s
Peak Altitude	5280
Rail Exit Velocity	30 ft/s

Recovery System Properties	
Drogue Parachute	
Size	36 in
Configuration	octagonal
Altitude at Deployment	5280
Velocity at Deployment	0

Recovery System Properties	
Main Parachute	
Size	96 in
Configuration	circular
Altitude at Deployment	500 ft
Velocity at Deployment	60.0 ft/s
Velocity upon Landing	<20 ft/s

Recovery System Properties				
Electronics/Ejection				
Altimeter(s) Make, Model	G-Wiz HCX			
Redundancy Plan (altimeters, switches, batteries, etc.)	PerfectFlight MAWD			
Pad Stay Time (launch configuration)	Dual Deploy			
Rocket Locator (Make, Model)	GPS Flight			
Frequencies of Transmitting Electronics	Not required for PDR			
Black Powder Mass	Main	96 in	Drogue	36 in

Payload/Science	
Succinct Overview of Payload/Science Experiment	Payload Carrier for un-specified payloads, including electronics that monitor the GPS position of the payload, altitude, speed over ground, and status of the payload.A ground based reciever will then use a voice synthesizer and a PA
Identify Major Components	GPS-Flight with its tranciever, and possibly ARDAS.
Mass of Payload/Science	1.5 kg

Test Plan Schedule/Status	
Ejection Test(s)	January 17, 2009 Previous to full-scale test
Subscale Launches	On-going; December 19
Full-Scale Launches	January 17, 2009 at KMCAS