High Altitude Student Platform 2018

Stratospheric On-board Laminar-flow Acidic Reduction Inspection System (SOLARIS)

Science Report

College of The Canyons
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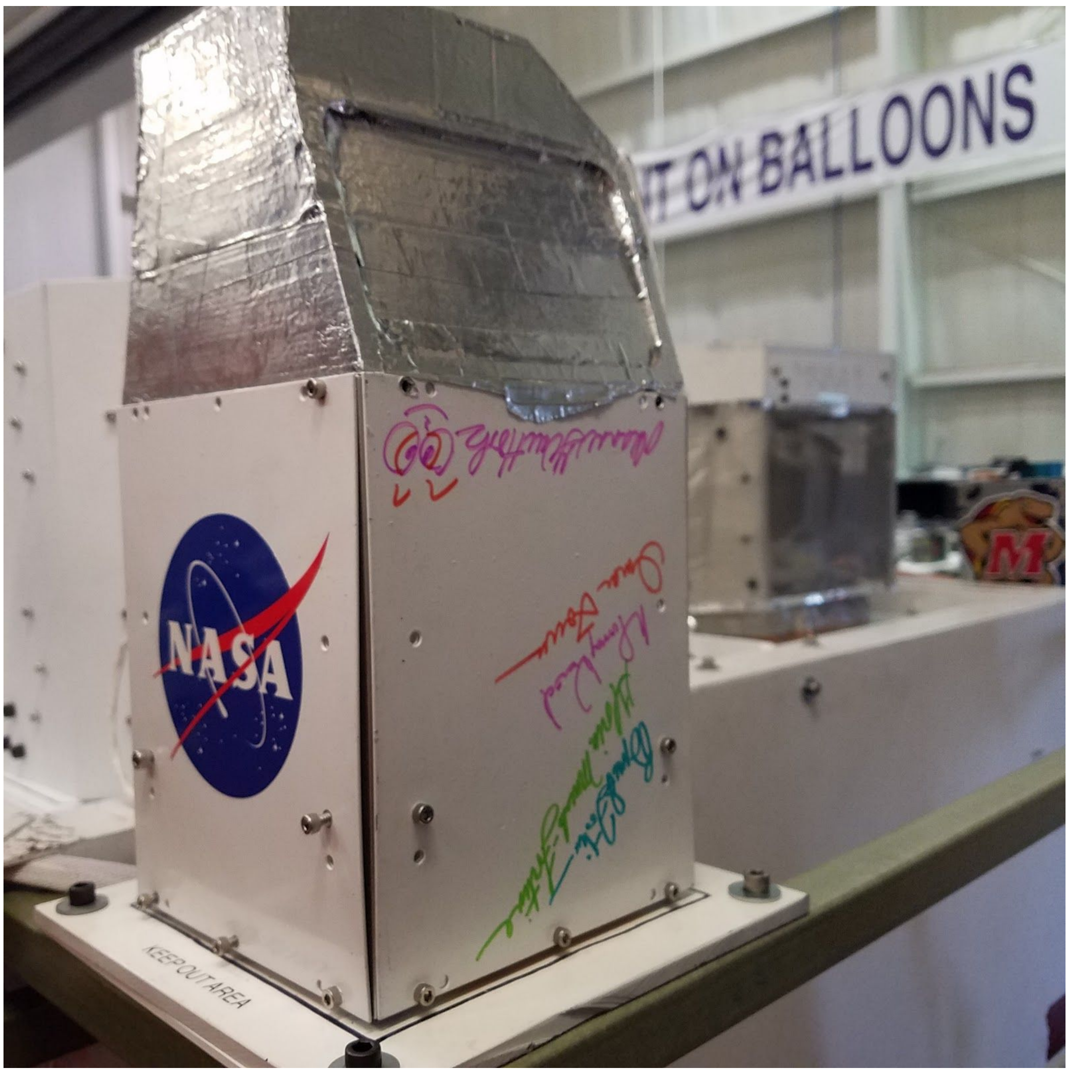


Table of Acronyms

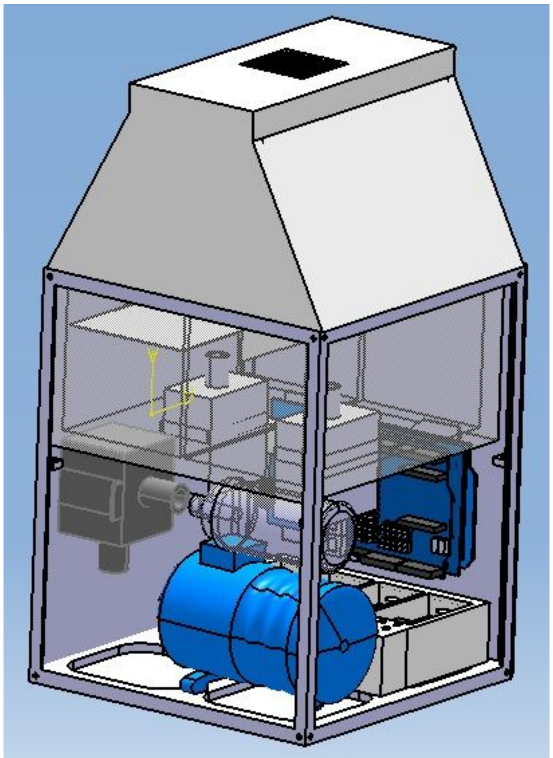
FCB	Flight Control Board
WRP	Weight Reduction Pockets
COC	College of the Canyons
TVT	Thermal Vacuum Testing
HASP	High Altitude Student Platform
LSU	Louisiana State University
FLOP	Flight Operations Plan
PSIP	Preliminary Specification and Integration Plan
SOLARIS	Stratospheric On-board Laminar-flow Acidic Reduction Inspection System

I. Abstract

Increased human activity has begun to alter the natural balance of our environment. Pollutants from transportation, manufacturing, and decomposition have been infiltrating the atmosphere with a haze of acids that find their way into the stratosphere. It is here that the gaseous acids react with sunlight and a redox reaction occurs that breaks down ozone. Over time this has created a thinner ozone layer and the byproducts of these reactions remain in the atmosphere, creating a barrier from which less and less heat can escape. New insights into geo-engineering are discovering what intervention, if any, can be performed to help reduce these pollutants in the stratosphere. Pulling inspiration from SCoPEx - an experiment from Harvard set to launch in 2020 - SOLARIS aims to explore alternate delivery systems and testing platforms that use common substances as a base to neutralize the harmful acids by introducing atmospheric samples to an aqueous solution via an isolated experiment chamber . The team's objective is to contribute to ongoing research in this emerging field by actively experimenting in stratospheric conditions in ways never before tested. The NASA HASP 2018 program has provided an opportunity to test a developing hypothesis while collecting valuable data that will aid in a better understanding of the stratospheric environment, the processes that contribute to the destruction of ozone, and perhaps a viable solution towards mitigating the effects of climate change.

II. Introduction

Concept



2018 marked the inaugural flight of College of the Canyons' SOLARIS payload with a plan to refly the experiment in 2019. The projected came to fruition by taking inspiration from similar proof-of-concept experiments slated to occur in the future, and from a combination of our team's ideas and ground experimentation which ultimately determined the payload's flight delivery system. Instead of bringing our solution to the atmosphere, we attempted to bring the atmosphere to our solution. Although this principle of operation evolved from the original concepts outlined in our proposal, various complications necessitated the switch to a more self-sustained and simpler system in order to accomplish the payload's scientific objectives. As a primary objective, SOLARIS validated the collection of stratospheric atmosphere using its collection system and measured acid concentrations present in stratospheric atmosphere treated with our basic solution.

Since SOLARIS' original spectrometer measurement device was too complicated for this year's integration, we were unable to obtain baseline readings from the stratospheric acid concentration; we did however receive results that measured the change in our solution's pH levels during flight and through post-flight analysis. Overall the main scientific objective was to validate the concept of acid neutralization in the stratosphere by means of a basic solution of our own creation. The applications for which will attempt to be scaled up in 2019 in order to investigate the efficacy of the solution and system for large scale stratospheric acid removal.

Principle of Operation

Because science of this type is an emerging field, SOLARIS had to envision new methods of operation that would safely and effectively bring acidic aerosol samples in contact with our agent. The payload serves as protection for a suite of onboard sensors and hardware that assured the isolation of the experiment and continuously collected both environmental and pH data to be used along with post-flight analysis to determine the validity of the initial proof of concept. The SOLARIS platform is unique in its compact delivery system and simplistic operation. During the balloon's accent the payload remains relatively inert, handling housekeeping and environmental data. At float altitude, all of the payload's systems go live; this is the result of a preprogrammed timed event.

A centrifugal fan provides the greatest air intake in the thin-atmosphere environment. The aerosol samples travel into the intake manifold in which a mechanical one-way valve serves as the primary entrance and exit point into the experiment chamber; relief valves were present to prevent high pressure conditions inside the chamber. At float altitude, the valve is opened and atmosphere is allowed to enter the chamber where a pump pulls it into our solution chamber. Upon interacting with the solution, redox reactions occur through titration, and the resulting pH fluctuations are measured by an analog sensor using its own control board. The payload runs an open cycle for approximately eight hours. Another timed event terminates the operation; the valve closes, the fan shuts down and the solution is once again protected from the environment outside the stratosphere, preserving the integrity of the samples.

III. Design and Fabrication

SOLARIS was developed using tried and true materials and processes developed over the course of the last two years participating in HASP, while also exploring the potential for new materials and manufacturing process that may greatly reduce costs and production times in the future. The team had the unique experience of completely designing, modeling and producing an entirely new concept from scratch in only a few months, often leading to innovative modifications being made during the manufacturing process in order to keep the project on schedule. The relatively short design phase along with the difficult aspects of our chemical objective made HASP 2018 one of the most challenging experiments College of the Canyons has ever performed.

Mechanical

SOLARIS embodied the concepts of its predecessors, using quarter inch aircraft grade aluminum as a base plate and sixteenth inch side panels. Its construction layered threaded holes that tap-head screws joined multiple sections of the payload together in one operation. This configuration produced the structural support necessary to withstand the landing forces as outlined in HASP's compliance manual, and also provided a lightweight but sturdy frame in which the experiment chamber and intake manifold were securely supported.

Contained within the payload's frame were three tiers. The base plate is where SOLARIS' flight computer and **FCB** were mounted while also providing the attachment points to the EDAC plate. The mid-deck plate served as a platform to house supporting sensors underneath the chamber and provided an alternative space for wiring. Lastly, the third tier was composed entirely of the experiment chamber; made from polycarbonate. It served as a watertight vessel that would safely contain our aqueous solution and isolate our experiment from the rest of the payload's systems and the outside environment. A host of manufacturing technologies were used in the production of our payload; an end mill, drill press, circular saw, sheet metal press, and bandsaw were used to perform the sizing of all three tiers, the drilling of holes, and adding weight reduction pockets to the polycarbonate.

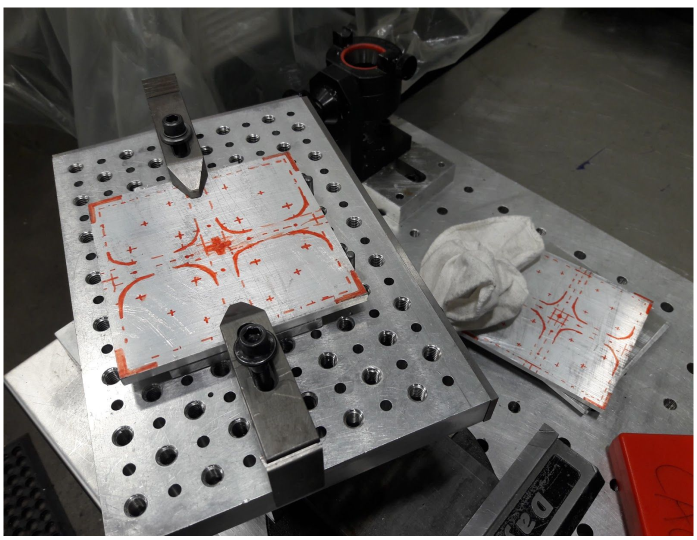


Figure 1a: Rough stock for base plate
for base plate

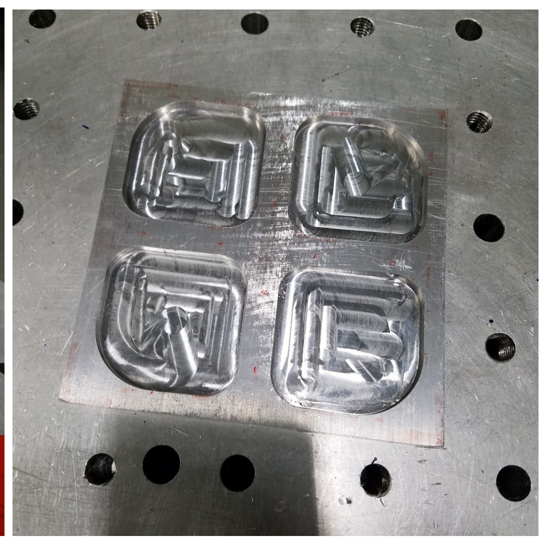
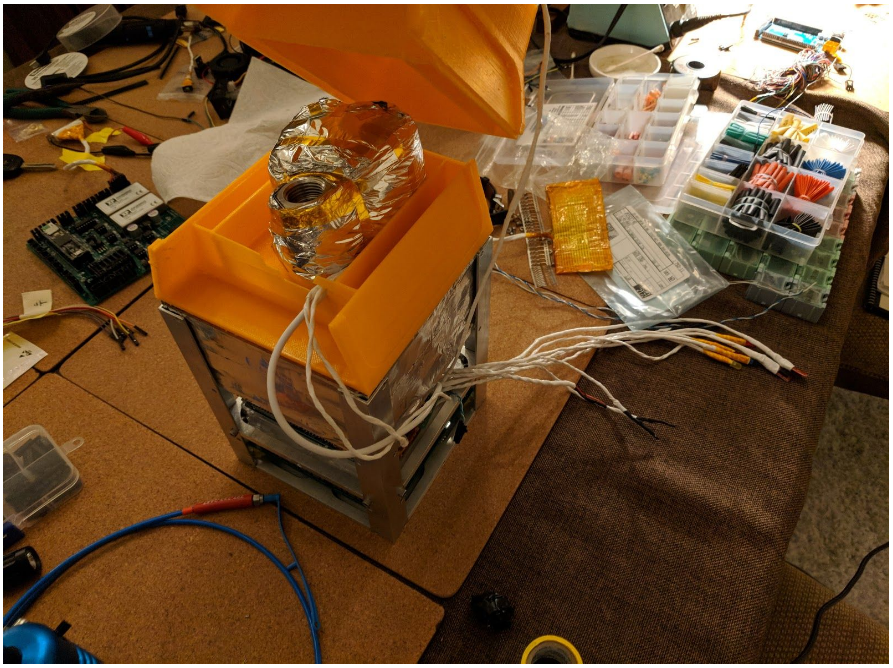


Figure1b: Weight reduction pockets

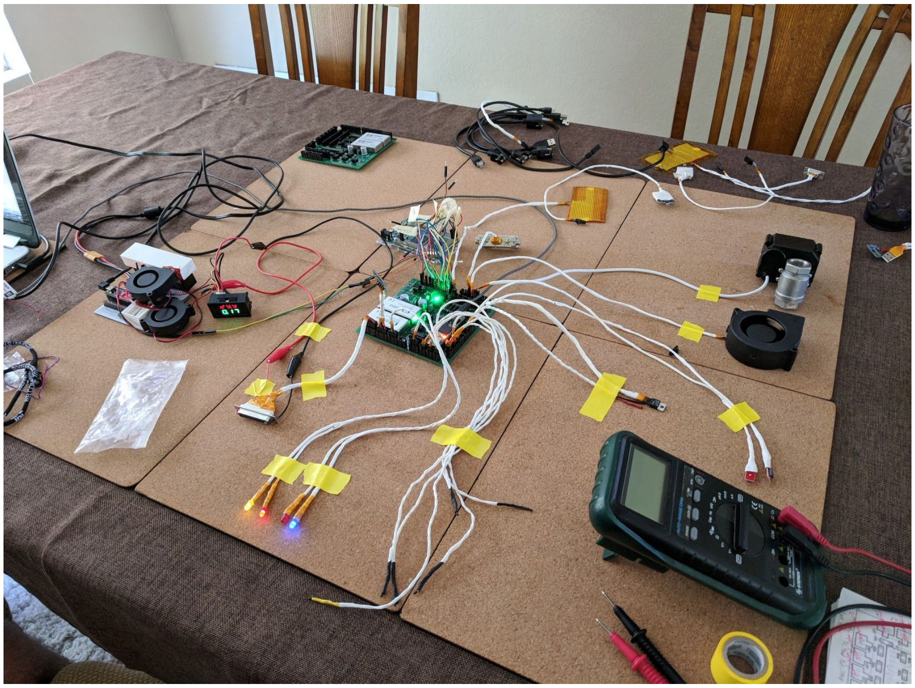
College of the Canyons is unique in that its students have access to both a traditional and CNC machine shop. The team enlisted the use of one of these CNC machines to add the deeper **WRP** to the quarter inch aluminum plates. One of our main concerns in utilizing a different delivery and detection method were the complications and time constraints in reengineering the payload to accommodate the new system. Despite changes being made to the internal operation of the payload, we were satisfied that SOLARIS took the form of preliminary CAD models and did not deviate much from the original mechanical concept. Overall, the design worked well for our applications, if only a bit cramped internally once the wiring harness took shape.

Intake Manifold



The intake assembly served as the architecture that connected the experiment chamber to the outside environment. The fan, valve, and outflow lines were housed within its construction, making it a critical component of the payload's structure. Like most of the payload's mechanical systems, the intake was developed using Catia's advanced workbenches; surface modeling was used to bifurcate the original solid modeling into two distinct pieces. This allowed for ease of assembly of the payload and maintenance to the valve. Due to its complex geometry and weight limitations, the college's MakerSpace rendered its 3D printing services to help produce the part. We used PET, a type of high strength plastic, to preserve SOLARIS' structural integrity while being able to withstand the maximum temperature of 160*C projected for thermal vacuum testing. This was the first year **COC** used 3D printing to produce a major component of our payload; given its success, future iterations may be applicable for our payload's intake systems.

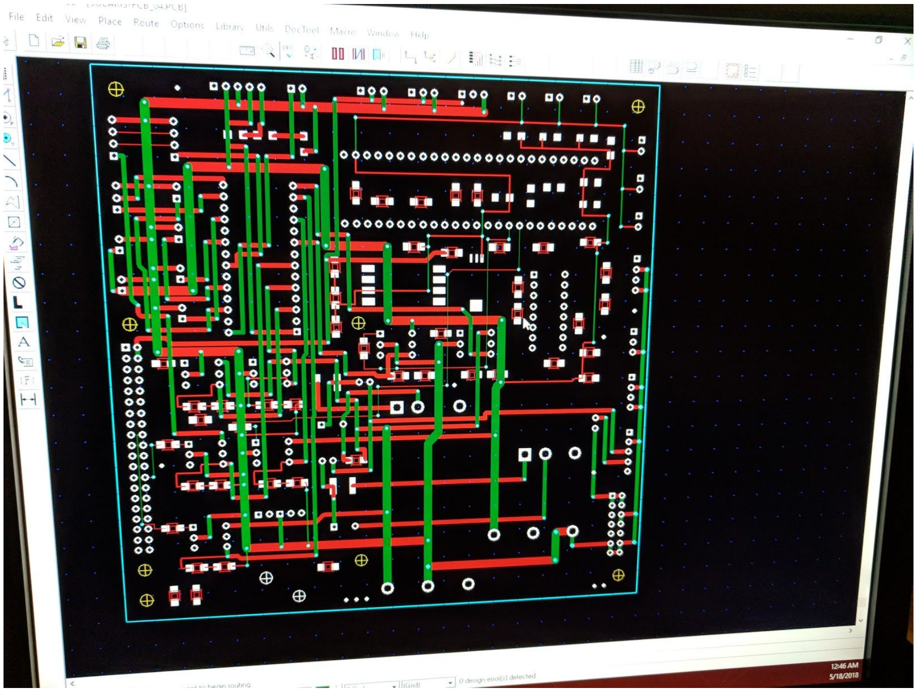
Electrical

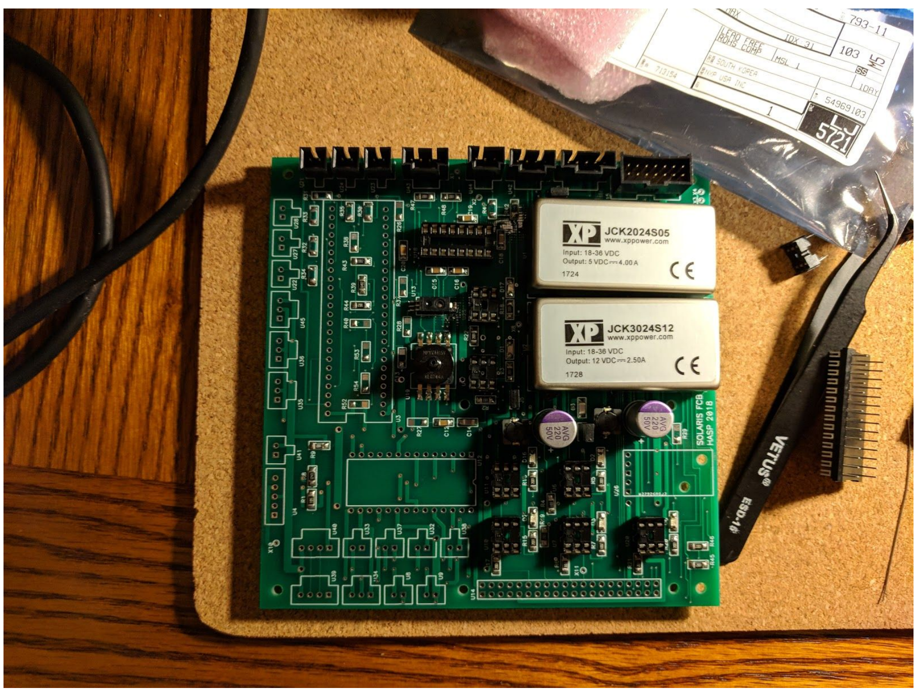


The electrical systems utilized for our payload consisted of an integrated design built directly into our PCB board. Regulators received and conditioned the power from HASP's side before relaying the specified voltages to the appropriate devices. This was intended to reduce the extra mass involved with a dedicated electrical system and to simplify the work required. Power was relayed from the regulators into our Arduino and Teensy computers which were used as relays to control power to the sensors and the intake fan. Two dedicated power lines were utilized for the pump assembly and intake valve due the power demands which would have risked overloading the flight computers.

Electrical systems performed nominally during testing and flight. Unlike the previous year, we did not experience any difficulties with electrical arcing or shorting in the pre integration vacuum tests at the College.

Flight Control Board





As in previous years, SOLARIS utilized a flight control board to efficiently route electrical components together with a custom printed design by our systems team leader. Unlike the prior year however, the board was printed as such to accomodate all hardware needed and removed the tiered design previously used, saving on mass and space. Additionally, the board's dimensions allowed for a greater number of I/O, analog, and power pin connections in order to bypass the need for dedicated arduino shields and breakout boards. The board performed well during testing and flight, however a bad trace on the RS232 chip configuration did prevent uplink commands from being utilized.

Sensors

Ph

Our analog pH sensor was the simplest, most cost effective solution to replacing the spectrometers to measure potential redox reactions. It was secured in place by a mounting port at the top of the solution bottle, allowing it to be fully submerged in the agent while taking readings directly above the mixing source. The probe functioned using a seperate control board and was read via the onboard teensy . The probe read the changing pH of the solution; 700 was considered a baseline reading while either higher or lower numbers correlated to a inversely proportional relationship with the acidity of the solution.

Current/Voltage

Current was monitored both through a returned value with an onboard current sensor, as well as the data returned through the HASP housekeeping data. Voltage however was only monitored through returned HASP data due to an inactive program in the payload’s coding. Originally it was intended for our onboard sensor to track both, but complexities in the wiring and coding made this difficult. Regardless, power draw remained nominal and within expected values through flight with the trend being towards higher draw during heating and measurement cycles.

Fan/Valve/Pump Signals

Interpretation of power signals running through the FCB allowed us to track the use of our fan, valve, and pump systems. The team decided not to utilize a complex sensor system for these devices and instead relied on the indirect observation of power draw.

The downlink was able to return these interpreted values of operation through the use of our code.. Closed or off values returned a 0 in the line, where open or on values returned a 1. This allowed us to very simply determine if the experiment was functioning properly and signaled the beginning and end of the autonomously run program.

Software

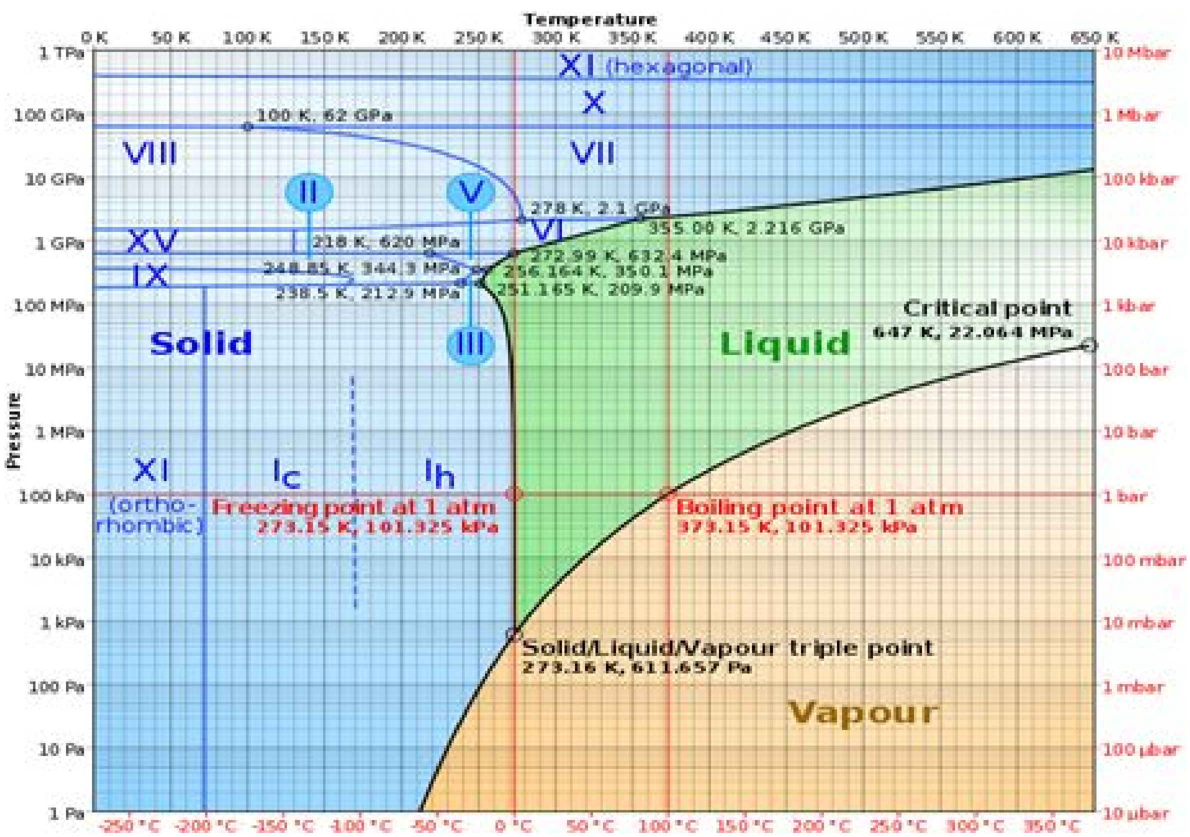
Software for this year’s payload was written with Arduino architecture to simplify programming and reduce the chances for errors that a more complex code could have produced. This additionally allowed us to tailor our flight computer selection to Arduino based components. To prevent the issues encountered during last year's integration, coding and testing began extremely early on in the program, allowing us to arrive at CSBF with a functional code. There was some difficulty interfacing with the HASP gondola systems, mainly due to an improperly wired RS232 converter and a switching of the serial data input. In order to integrate on time, the program was changed to run on an automatic timer sequence which negated the need for non functioning uplink commands.

The program and sequence initiated during the flight with only minor issues in the pH sensor values, which were easily corrected by cycling power. We believe this was a hardware issue with the probe itself however. This year's dataset was one of COC's most robust to date, spanning from first power on to termination. This allowed us to produce viable conclusions on the feasibility and effectiveness of our solution and system.

Chemical

The chemical team was directly responsible for calculating the theoretical potential of the payload's neutralization agent, analyzing all scientific data both digitally logged during flight and acquired during post-flight experimentation, producing an aqueous solution that would remain stable at a wide range of pressures and temperatures, and derive the chemical equations of different redox reactions occurring between stratospheric acids and the agent.

Solution



The use of base substances, like calcium carbonate and sodium bicarbonate, can reduce

the buildup of acids such as hydrochloric and sulfuric acid. These chemical substances are not hazardous or toxic and are a naturally occurring byproduct of limestone production. Specifically, the mission targets the reactions with Hydrochloric, Sulfuric, and Nitric acids:
Calcium carbonate + hydrochloric acid produce carbon dioxide gas + water + dissolved calcium.
$CaCO3 + 2HCl \rightarrow CO2 + H20 + Ca+ + 2Cl6$

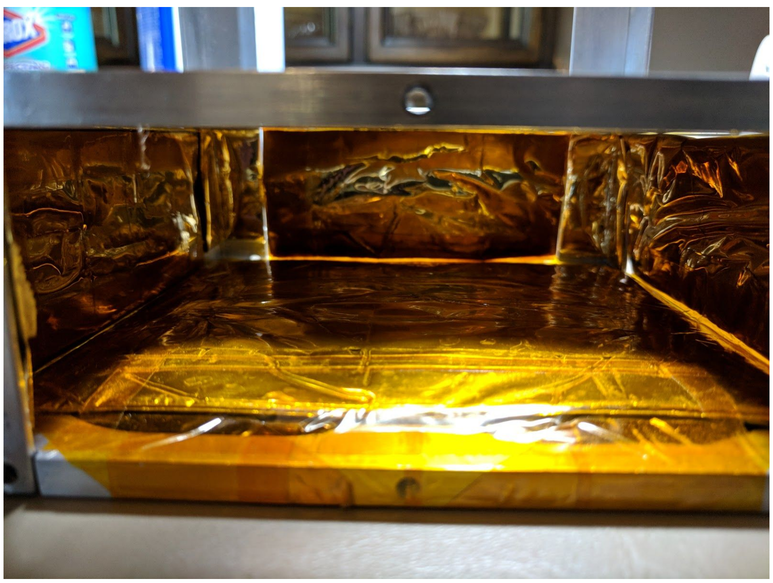
Calcium carbonate + sulfuric acid produce calcium sulfate + carbon dioxide gas + water
$CaCO3 + 2H2SO4 \rightarrow Ca(SO4) 2 + CO2 + H2O$

Calcium carbonate + Nitric Acid produce calcium nitrate + carbon dioxide + water
$CaCO3$ (s) + **$2HNO3$** (g) $\rightarrow$ **$Ca(NO3) 2$** (s) + **$CO2$** (g) + **$H2O$**(g)

The carbon dioxide from these reactions takes a gaseous form while allowing these acids to be converted into calcium sulfate, calcium nitrate, chlorine, and water. Just about any acid can produce these results, but dilute hydrochloric acid or vinegar are the two recommended acids for testing the effectiveness of calcium carbonate solutions. The result of these reactions will be the neutralization of acids present in the stratospheric layer of our atmosphere with the byproducts produced being more benign substances.

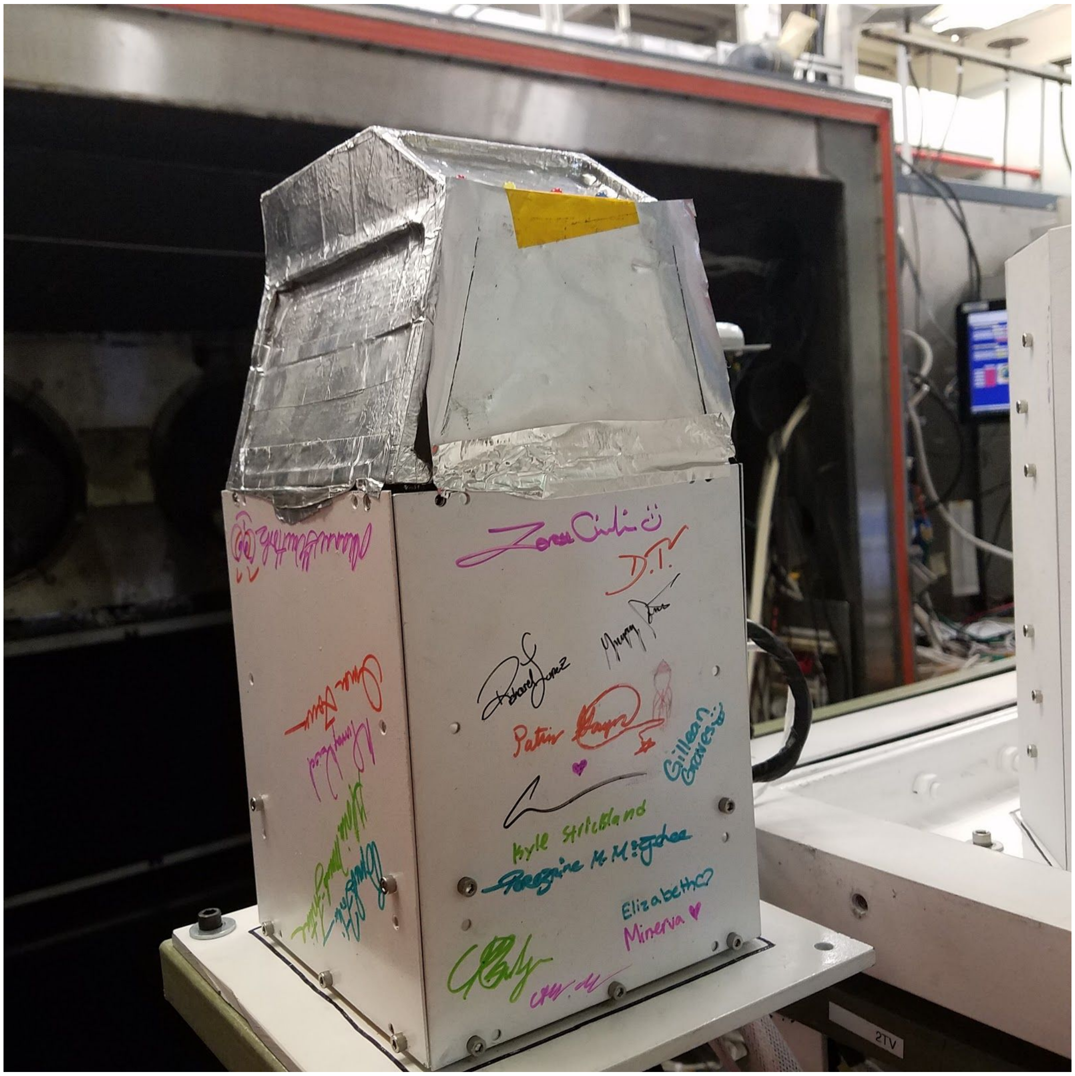
As atmospheric pressure lowers the boiling points of liquids and the conditions of the flight promote subzero temperatures, the solution agent used was a 50/25/25 mix. 50% of the solution contained a mixture comprised of filtered water taken from a 100 mL tank with 35.9 grams NaCl (salt) dissolved into it. This ensures a maximum soluble mixture of around 39.5% salt to water percentage. Salt water has a higher boiling point than regular untreated water and resists freezing more efficiently. 25% of the solution contained propylene glycol concentrate, which is often used as an food preservative agent. Propylene glycol is classified as nontoxic to humans as well as being relatively stable at a range of temperatures which will assist in keeping the solution stable. Lastly, 25% of the solution contained calcium carbonate concentrate to act as a neutralizing agent for acidic particles in air samples.

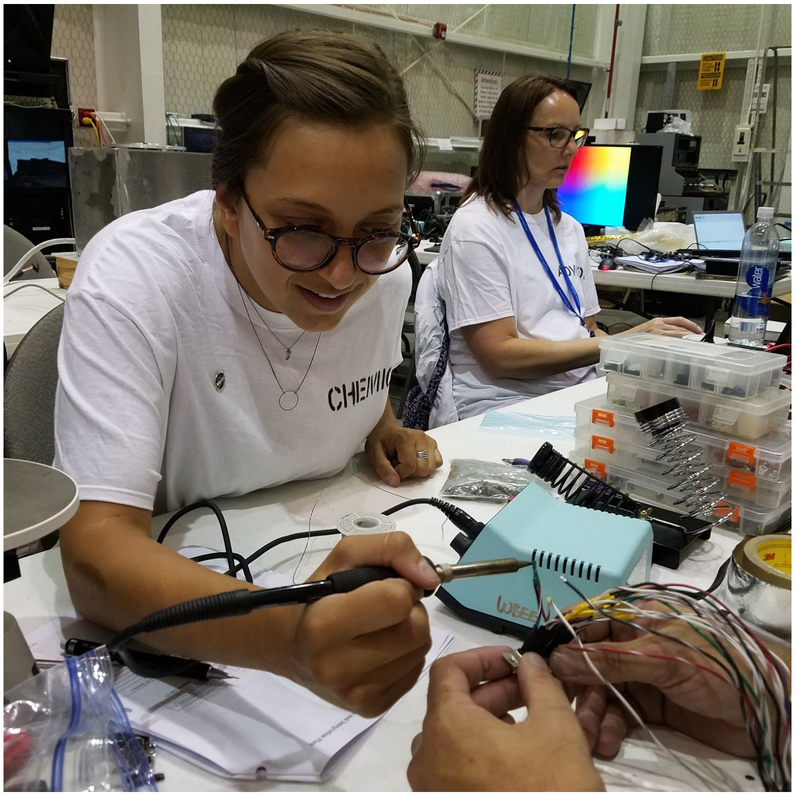
Thermal Protection



Along with using the proper materials to withstand environmental temperatures, our team also used a variety of simple passive and active methods to regulate the payload's internal temperature. On the passive side the payload used layers of mylar wrapped in reflective tape; specially designed channels cut into various pyload structural components allowed for additional mylar to be packed there to further insulate the interior. The exterior was given seven layers of white paint in order to reflect the rays of the sun. On the active side, flexible heaters were wrapped around critical flight hardware such as the valve and pump assembly. These heaters were programed into the code to keep the ambient temperature of these components around 65 degrees fahrenheit. Together, these measures prevented the freezing or overheating of our payload; from the onboard data, we can see that the internal temperature remained fairly constant throughout the flights duration.

IV. Integration

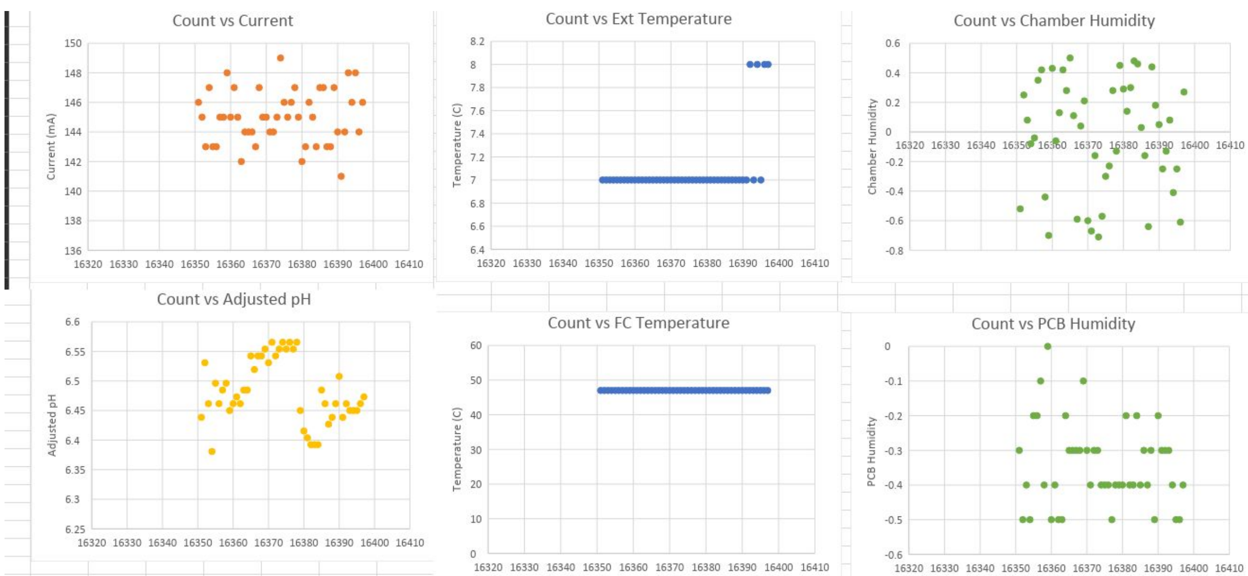




The team arrived at CSBF with a fully intact and functioning payload. We passed pre integration on our first day; that's a first for College of the Canyons. During pre integration however, it was determined that our serial communications was not operational. The team spent much of the first day on site trying to diagnose this problem and cleaned up the payload's wiring and structural components in preparation for our first **Thermal Vacuum Test.** Our first TVT highlighted potential issues with our experiment; our first downlink packet was not received until roughly an hour after it was sent through the HASP interface. This data showed that while SOLARIS functioned nominally during the cold cycles that it did encounter problems during the heating cycle. These issues corresponded to erroneous readings with our pH probe. Upon inspection of the payload it was discovered that our solution had either entirely evaporated or leaked, thus explaining the strange data.

The team spent the following day reinforcing the solution bottle and checking the pH probe for damage. We also mixed a new batch of our reaction agent to assure the proper mix ratios which were confirmed to be stable at the anticipated temperature range. Several hours were dedicated to addressing the payload's serial uplink command errors to no avail; it was decided that the team would modify our program to autonomously utilize a series of timed events compared against a twenty-four hour internal clock on the teensy to avoid reiterations of the code if a power cycle should occur. This year marks the first year College of the Canyons participated in two TVTs, thus the payload received double the ground testing as it normally received. This was ideal to ensure the functionality of our payload but also problematic in the sense that our equipment was run twice as long and risked complications and or failures.

Our second TVT was more optimal; the payload remained functioning through all cycles and more of our solution remained by the tests end. Our new autonomous code worked perfectly and required only minor modifications to the timed events and clock to make sure it would function successfully on New Mexico’s time and have enough of a delay for pre-launch power cycling. The data for SOLARIS’ probe was still strange though; while it showed some functionality, we determined it to have failed at some point during testing, probably during the first TVT. Despite this, the team was happy with the results and gave the payload the all clear to fly. When time for HASP personnel to clear SOLARIS for launch there was an issue in reading our downlink data. It was later determined to be a faulty EDAC cable on the HASP gondola; to much relief of the team, the payload functioned as planned and it was given the approval for flight.

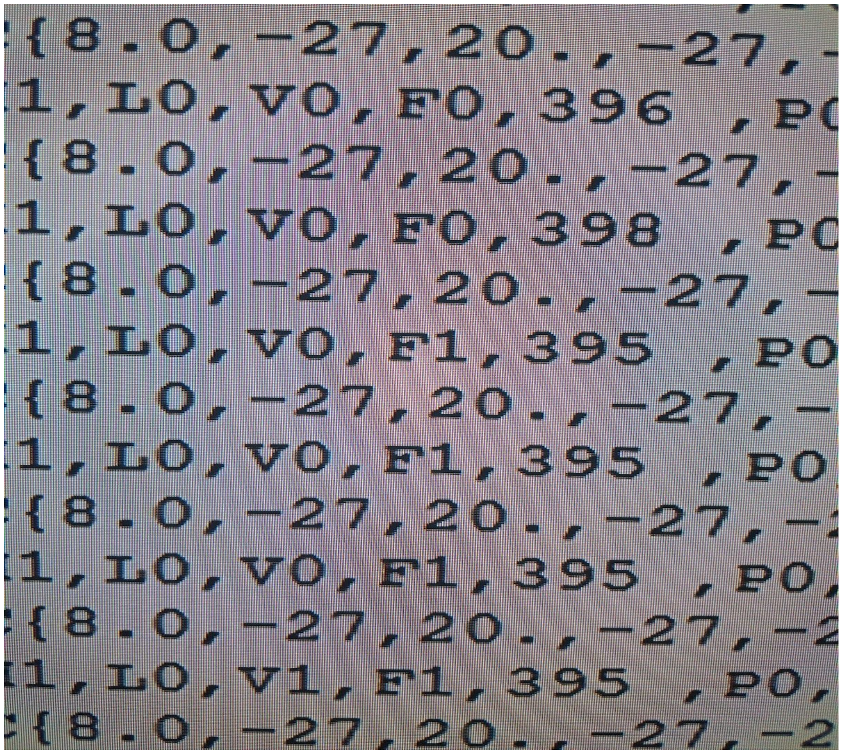


Data return and plotted from TVT testing

V. Ft. Sumner Reintegration and Pre-Launch Support

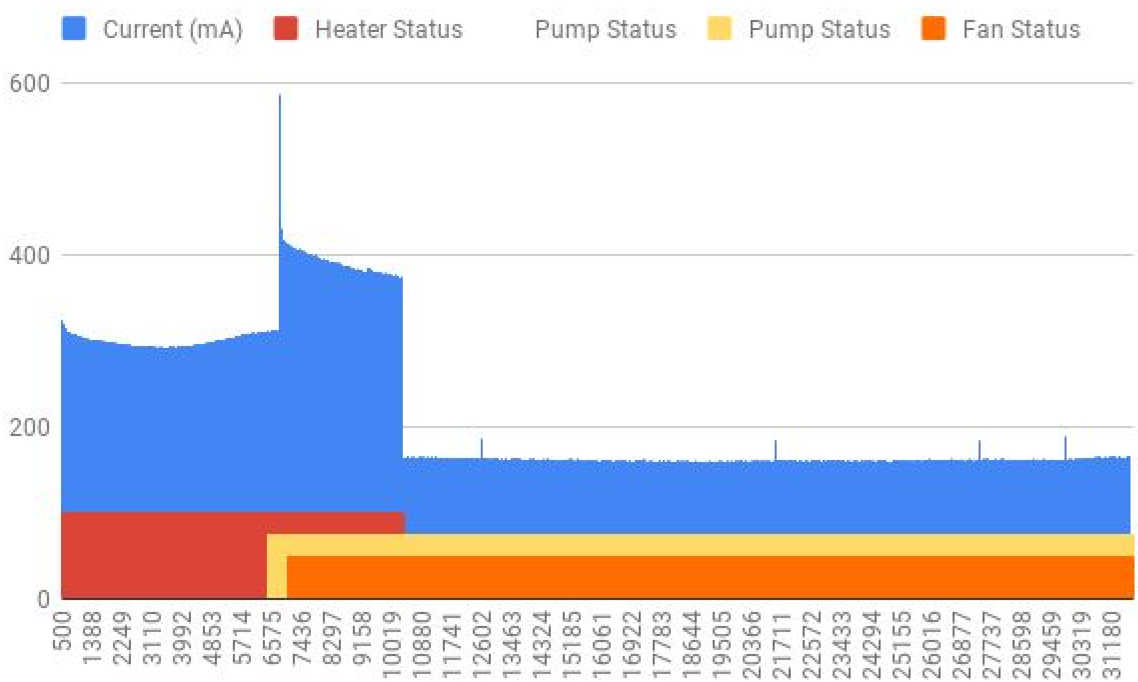
This was also the college's first year of attending the launch at Ft. Sumner. The payload required a mission critical pre-launch operation so attendance was mandatory. After a nineteen hour drive from California, both the project manager and chief engineer arrived at the hangar. We promptly unpacked our payload and filled the solution bottle with a fresh mix of our agent before sealing the payload shut and reintegrating it onto the balloon gondola. The following morning a pre-flight check was done and again the payload's pH sensor sent corrupted data. We affirmed at this time that either the probe or control board was not functional. We were granted fifteen minutes the following day before the hang test to assess the problem. We bought a spare unit and quickly switch it out through the payload's quick disconnect system. This returned nominal data and we declared SOLARIS fully operational. We enjoyed being on site for launch and provided a different dimension to our HASP experience. Unfortunately local thunderstorms scrubbed our launch attempt for a window longer than the duration of planned attendance. We returned home to await the next launch date.

VI. Flight

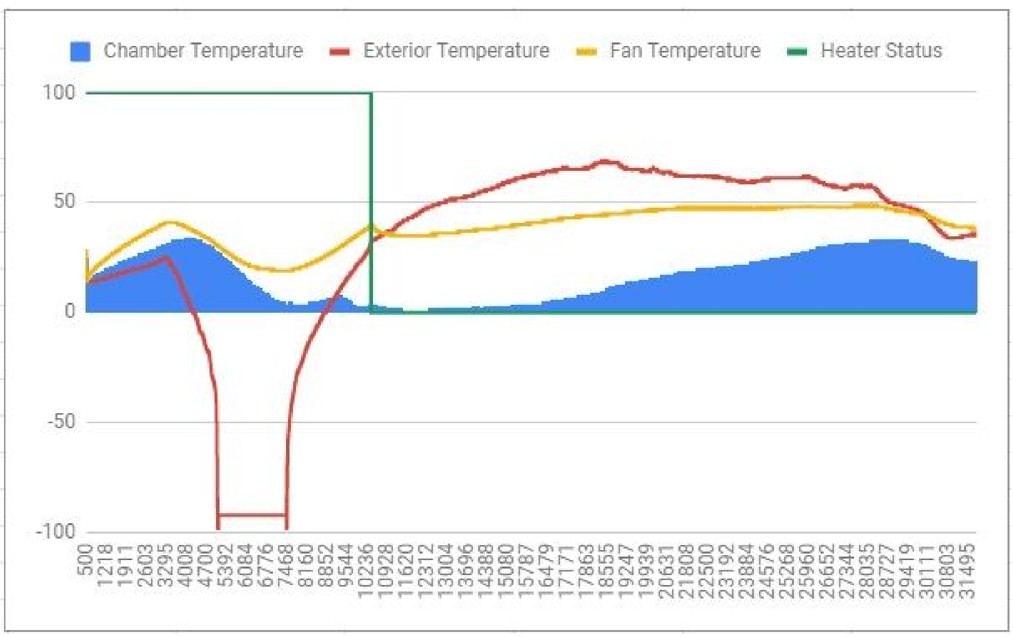


Downlink showing our autonomous payload program activating

SOLARIS performed its objective with relatively little complications. The payload's timed events executed as expected once the balloon had reached float altitude. Downlinked data confirmed all systems were on and operating successfully. Current draw only approached limit levels at one point during the flight according to the data returned, which could potentially have been an anomaly.



Current draw mapped over the duration of the flight.



Graph 1: Temperature vs Time Graph during flight transposed with heater status and operation

A small problem arose when thermistors that controlled the payload's active thermal control began to fail, forcing the heaters to remain off for the duration of the flight.

The use of an autonomous program left the team's interaction with the HASP spreadsheet to a minimum; for the first half of the flight nominal status updates were given and the team continued watching for any inconsistencies in the data. During the second half of the flight, the pH probe began to hold steady values; this was not an expected behavior. A power cycle was requested and the probe began returning steadily fluctuating data. At a later point in the flight the problem reappeared and another power cycle was requested; each time resetting the probe and returning it to normal functionality.

After a third error of this specification, the team decided to request hourly power cycles to assure consistent data was being collected. Unfortunately this plan was implemented with only a few hours remaining in the flight window. Systems terminated successfully as the payload began its descent with the balloon back to earth. From the photos taken at touchdown, the landing appeared rough, though SOLARIS despite being close to the weight threshold withstood the impact and was returned to College of the Canyons relatively unschathed. Upon opening the payload's internals it was discovered that there was still some remnants of the solution and these samples were quickly collected and preserved in order to conduct physical testing and verification.

VII. Post-Flight Analysis

The instruments objective was to neutralize stratospheric acids using a basic solution consisting of a sodium bicarbonate and propylene glycol solution. Due to pH sensor malfunction during flight (Data 1), pH data is taken from physical samples measured with litmus paper before and after flight(Data 2). Possible experimental error accounting for pH probe failure might be subzero temperature, insufficient current draw or physical damage to probe prior/during flight. Initial pH was measured at 10 prior to flight, confirming the basicity of our proposed neutralization agent.

A pH drop should be expected if the agent successfully neutralizes acid. Reaction: (excluding spectator ions, where A = Cl, HSO_4, NO_3) $NaHCO_3$(aq) + HA (g) -> NaA(s) + H_2O(l) + CO_2(g). Final pH of the solution, taken upon recovery, measures at 9.5, indicating that neutralization during flight did occur. The amount of acid neutralized was calculated from pH data and found to be 6.5×10^{-12} moles (Equation 4). The concentration of acids in the stratosphere are in the nanomolar range, confirming our result to be within an acceptable range.

Equation 1: $pH_i = 10;\ [H]_i^+ = 1\times10^{-10}\,\frac{MOLES}{L}$

Equation 2: $pH_f = 9.5;\ [H]f^+ = 3.16\times10^{-10}\,\frac{MOLES}{L}$

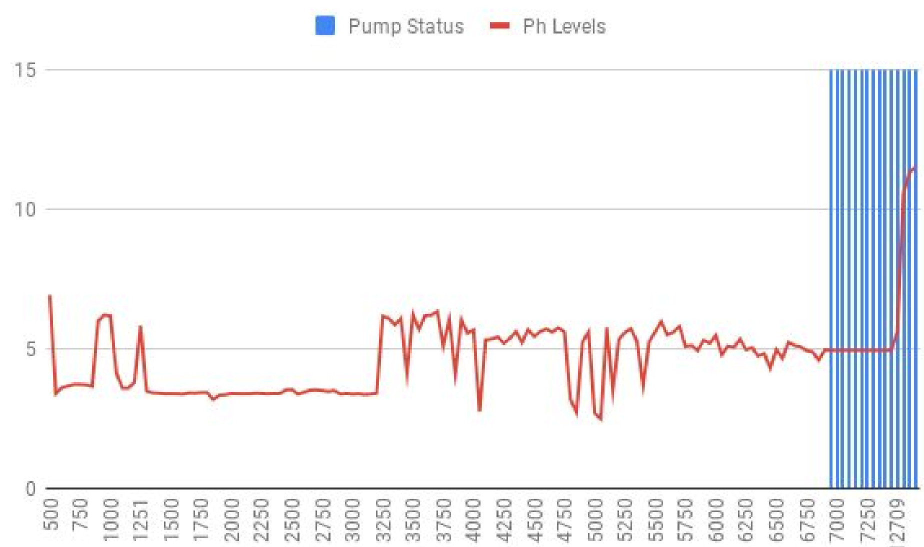
Equation 3: $[H]f - [H]\,i = 2.16\times10^{-10}\,\frac{MOLES}{L}$

Equation 4: $2.16\times\frac{10^{-10}mols}{L}\times\frac{1\,L}{1000\,mL}\times 30mL = 6.48\times10^{-12}mols\ acid\ neutralized$

VIII. Results

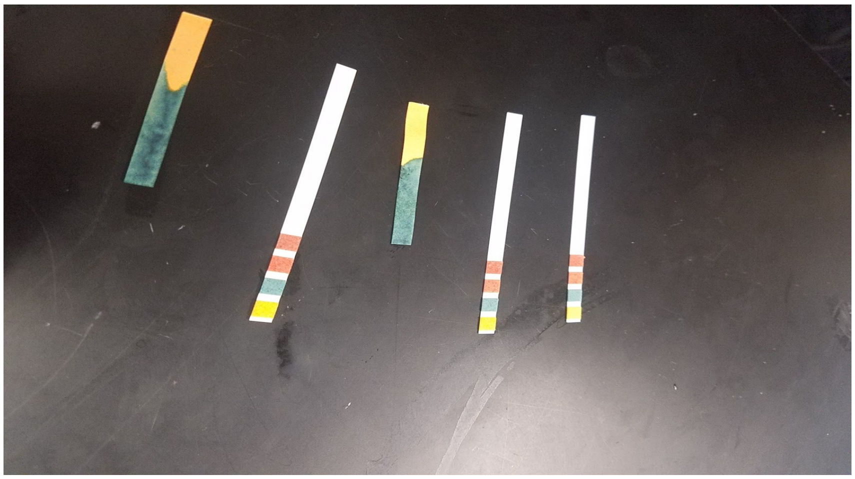
In Flight Data

Data returned from the PH probe in flight, while problematic due to freezes in the program, did yield results that showed as the pump assembly was activated, a corresponding drop in PH was measured. We do not believe this to be due to error when compared to the physical sample collection.



Graph of PH over time in compared to the pump assembly status.

Physical Sample Comparison



Physical samples of the flown solution and container were analyzed at our labs on campus. Multi-range pH paper was used on both a stable, unflown solution and the samples taken from flight. The test was run three times for redundancy and the average was taken to be used in the final calculations. The physical readout on the pH strips showed a change in the solution's pH between the control and scientific samples. The numbers acquired were used to determine approximately how much acid was neutralized during flight. The team was excited to learn that SOLARIS succeeded in neutralizing some stratospheric acid.

VX. Conclusion

College of the Canyons' has now flown with HASP for the third time; team SOLARIS worked roughly 2200 hours designing and building a new payload from scratch for the first time in two years. Although the experience was challenging, it was also rewarding. This next section will include a discussion of what went wrong, the plans for SOLARIS, and what the HASP experience has provided the students here.

Failures and Analysis

Although our flight this year was largely considered a success, there were several areas and aspects of the payload that either did not perform as planned or failed to perform.

RS232 Converter

The payload arrived in Texas for integration with a major PCB tracer issue which prevented the team from being able to send uplink commands to the payload, a critical issue at the beginning due to our need to command several pieces of hardware. During development and up until integration, our team was utilizing a direct access to the flight computers via an offshoot connector rather than attempting access through the EDAC serial connector and thus our RS232 chip, preventing us from catching this issue at an earlier stage of development. The issue was not discovered until near the cut off for the second round of thermal vacuum testing and integration certification. In response, our team developed a timer system inside of the program which was utilized instead to trigger our commands in a specific order, bypassing the need for uplink commands entirely.

Although we were initially disappointed in the lack of uplink commands, we ultimately found that this method proved to be much easier on the CoC and HASP teams due to not requiring external input. It also required unique troubleshooting experimentation which helped our team to develop additional skills that can be transferred to next year's payload. The program initiated the events without fault and proved to be a viable method of operating a payload.

PH Probe

The PH probe that was used during flight consisted of a standard off-shelf system that proved to be more susceptible to environmental changes than planned. During our first thermal vac test, the probe and controller failed during heating and failed to return data unless power was cycled. It was also found that the first probe had cracked due to the nature of the hardware which utilized an aqueous solution and glass probe head to take measurements. We believe that the extreme environmental changes caused the damage and prevented proper operations. During flight, a similar data return issue occured around 3/4ths the way through flight, required several power cycles to have values returned.

Although the probe ultimately survived, we would like to find a more robust model for next year's experiment and to build an enclosure that would better shelter this sensitive hardware. Additionally, we will be designing the liquid enclosure and payload to allow the PH probe to be installed from the top, rather than from the side, as we had difficult times preventing leaks and broken seals in the current configuration.

Spectrometer

Initially, our payload was designed to be more complex by utilizing a visual and uv spectrum spectrometer to determine the effectiveness of our solution at the atomic levels. The programming involved however proved to be much more complex and much less user friendly than originally stated by the company. Although we were able to redesign our payload to perform a very similar experiment (which ultimately will be included on next year's payload as a secondary method of confirming data), the team would prefer to approach this system for next year as a primary scientific instrument. Several options are being pursued, including the collaboration with similar experiments from other projects and a larger focus towards development of the software involved.

Aerosol delivery system

In addition to the spectrometer, the proposed aerosol delivery system was replaced with a static pump assembly that relied on titration mainly due to the complexity and certification requirements for a pressurized container. We instead decided to use this flight as a way to develop and test the feasibility of our proposed liquid solution. Air was filtered through a pump in a process called titration to dissolve and neutralize acids present in stratospheric atmosphere. The solution remained liquid in an unsealed, but partially protect state that allows us to theorize that the development of an aerosol delivery system is viable and will be included on next year's payload.

Serial line inversion

A small issue was found in our serial port wiring in where we had switched the inputs, disabling our ability to downlink. A sincere thank you is owed to the HASP team, especially Anthony, who helped us to solve this issue by placing an inline inverter, which allowed us to downlink.

Future Experiments and Implications

Given the successful execution of two of our objectives, the team agrees that this year's payload was successful. The amount of acid neutralized is in the acceptable range of what we were expecting given the low concentration of roughly (insert estimate figure here) acid particles within the region of stratosphere where float occured. The team learned a great deal about coding and operating off timed events and greatly simplifying the manufacturing and assembly process. Data was well received and within the parameters of the baud rate while still providing detailed information of the flight; an excel spreadsheet contains roughly 33,000 lines of data logged from the flight. The largest challenge for future iterations of the project is finding a reliable, effective, and simplistic way to measure fluctuations in such miniscule quantity of acids in our stratospheric samples remotely. The functionality of our spectrometer system will become the primary objective for any future attempts of SOLARIS; we still feel this is the most effective way at detecting results and logging data.

There is also a debate of expanding the volume of the experiment chamber to allow for a larger sample to be collected which may diversify and consolidate more opportunity for reactions to occur. The team is also redesigning the delivery method so its implications are readily available to serve the team in experimentation. Since our testbed platform yielded favorable results, the needs are met for the justification to continue further experimentation; a larger, more sensor oriented and technologically advanced payload is currently being developed to continue SOLARIS' mission objectives. Larger payload volume, more sensitive instrumentation, and a larger variety of sensors and delivery methods are being integrated to create a payload that can utilize multiple methods of both exposing samples to our agent and detect the reactions that occur.

Scientifically, there may be opportunity to present our findings and experiment at an astronomy and science convention in 2019 in an effort to contribute to the community responsible for the future advancements in this field of study. We're excited at the possibilities ahead of us and are looking forward to working with HASP again to take our experiment to the next level and continue collecting more robust data that may be useful in potentially mitigating some of the effects of climate change.

X. Team and Student Impact

Name	Gender	Ethnicit y	Race	Role	Occupation	Previous HASP Participant?	Graduated?
Patrick Gagnon	Male	Non Hispanic	Caucasian /African American	Project Manager	Aerospace Engineering Student	Yes	No
Hunter Napier	Male	Non Hispanic	Caucasian	Chief Engineer	Aerospace Engineering student	No	No
Teresa Ciardi	Female	Non Hispanic	Caucasian	Logistics Advisor	Physical Science Professor	Yes	N/A
Krys Ciardi	Female	Non Hispanic	Caucasian	Mechanical Team	High School Student	No	Yes
Gregory Poteat	Male	Non Hispanic	Caucasian	Manufacturin g Advisor	CNC Manufacturing Professor	Yes	N/A
Peregrine Mcgehee	Male	Non Hispanic	Caucasian	Software/Ele ctrical Advisor	Astronomy Professor	No	N/A
Patricia Foley	Female	Non Hispanic	Caucasian	Chemical Advisor	Chemistry Professor	No	N/A
Gillean Graves	Female	Non Hispanic	Caucasian	Chemical Lead	Chemical Engineering Student	No	Yes - UC Berkeley
Richard Lopez	Male	Hispanic	Hispanic	Electrical Lead	Electrical Engineering Student	No	No
Kyle Strickland	Male	Non Hispanic	Caucasian	Software Lead	Electrical Engineering Student	Yes	Yes - CSUN
Minerva Cardova	Female	Hispanic	Hispanic	Mechanical Lead	Mechanical Engineering Student	No	No
Daniel Tikhomirov	Male	Non Hispanic	Caucasian	Systems Lead	Electrical Engineering Student	Yes	Yes - UC Irvine
Arthur Berberyan	Male	Non Hispanic	Caucasian	Chemical Team	Astrophysics Student	No	No

				member			
Phillip Bonell	Male	Non Hispanic	Caucasian	Chemical Team member	Chemistry Student	No	No
Savannah Niedrick	Female	Non Hispanic	Caucasian	Chemical Team member	Student	No	No
Elizabeth Provencio	Female	Non Hispanic	Caucasian	Chemical Team member	Highschool Student	No	No
Charla Provencio	Female	Non Hispanic	Caucasian	Mechanical Team member	UCLA Student	No	Yes
Matthew Merritt	Male	Non Hispanic	African American	Software Team member	Highschool Student	No	No
Raul Venegas	Male	Hispanic	Hispanic	Electrical Team member	Electrical Engineering Student	No	No
Lorenzo Gingco	Male	Hispanic	Hispanic	Electrical Team member	Electrical Engineering Student	No	No

SOLARIS had the added benefit of impacting a large group of students both on the college and highschool level. A team of roughly thirty students composed the largest HASP team **COC** has ever had. The team prided itself on being a safe, inclusive learning environment for many, who, had their first experience designing and fabricating a space faring payload. A suite of outreach events kept HASP and SOLARIs in the public eye, further spreading the impact of the project into the community.

To date, students that have participated with HASP were more likely to receive internships in their field of interest; Six of our team members from this year have obtained internships with such institutions as Armstrong Flight Research Center, Jet Propulsion Laboratory, Stennis Space Center, and L'Space Academy's Lucy program. For most, HASP was the first real opportunity students had to do something practical with their academic experience; SOLARIS and its stories of success continue to inspire the minds of those interested in pursuing STEM careers of their own and excite them at the possibility of participating with us again next year as we attempt our fourth year with HASP.

Internships

Participation in HASP has been beneficial and in some cases crucial to these students who have acquired internships due in part to their experience gained working on these projects.

Name	Year(s) Participated	Internships/Opportunities
Patrick Gagnon	2016 - 2017 - 2018	2018: NCAS - National Community College Aerospace Scholars at Stennis Space Center 2019: Armstrong Flight Research Center Intern - Mechanical Engineering Intern on the FOSS team
Hunter Napier	2018	2018: L'Space Academy - Lucy Pipeline Internship for the Deep Space Network
Mindy Sailors	2016	2018 - Schweitzer Engineering Labs
Arthur Berberyan	2017	2018: L'Space Academy - Lucy Pipeline Internship for the Deep Space Network 2018: : NCAS - National Community College Aerospace Scholars
Kyle Strickland	2017 - 2018	2018: Jet Propulsion Laboratory SIRI Fall internship - Mar rover prototyping
Daniel Tikimirov	2016 - 2017 - 2018	2017/2018: Jet Propulsion Laboratory 2018: Caltech Internship

In The News

The SOLARIS Team was featured in the local news quite a few times over the duration of HASP 2018. College of the Canyons uses this press to get the community involved in the projects and promote the opportunities HASP offers to those who participate. Below are the articles and events the team were featured in this year.

GREAT NEWS FROM THE ASTRONOMY PHYSICS CLUB!

Two teams of students have been working on proposals and designs for two different NASA student payloads (science experiments) and both teams have been accepted to participate!

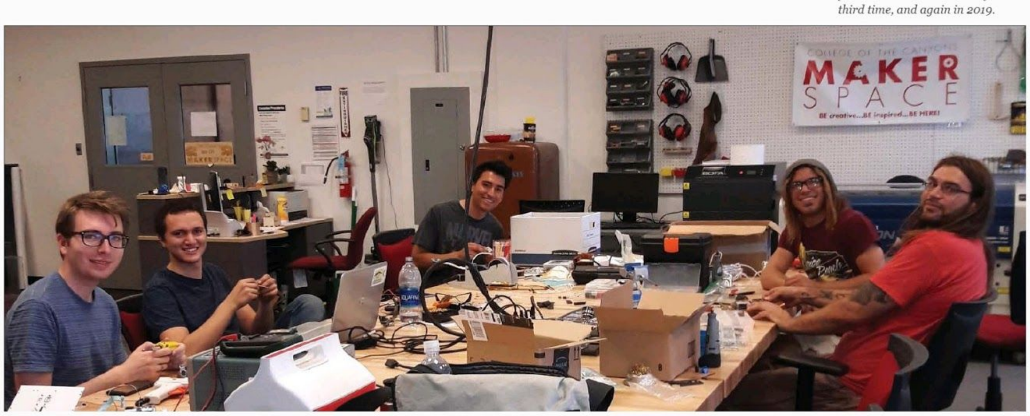
- One of the projects will be manifested on **NASAs RockSatX** rocket which is set to launch in June 2018. This team successfully competed against universities across the nation and passed three design reviews of the payload.
- The second project was accepted for the **NASA High Altitude Student Platform (HASP).** This team also competed against universities from across the nation. No other community college has ever flown on HASP **three times** and COC has been **selected three years in a row**! NASA HASP will launch in August/September 2018.
- We are incredibly proud of our students and of their amazing advisor Professor Teresa Ciardi.

03/27/18 Foundation Board Meeting - Chancellor's Report 4

COC club preps to launch

College readies one of 12 entries in annual NASA balloon program

The Signal 21 Aug 2018 By Brennon Dixson Signal Staff Writer



The club builds parts at the Center for Applied and Competitive Technologies and programs the flight computer in the on-campus MakerSpace.

In the 12-year history of NASA's High Altitude Student Platform program, only five community colleges have sent payloads into outer space, and College of the Canyons — the first community college selected — will participate in next month's launch for a third time, and again in 2019.

"There are no other community colleges doing this," said Teresa Ciardi, the COC Astronomy and Physics Club's adviser. "When we started in 2016, we were the only community college selected."

Universities from around the world compete for one of 12 spots on the HASP platform, which is a collaborative venture of the NASA Balloon Program Office and the Louisiana Space Consortium. The space balloon operates at anywhere between 100,000 and 120,00 feet for up to 24 hours, and provides a launch platform for 12 student research experiments.

"It is anticipated that the payloads carried by HASP will be designed

And built by students and will be used to flight-test compact satellites or prototypes and to fly other small experiments," according to NASA's website. "The major goals of the HASP program are to foster student excitement in an aerospace career path and to help address workforce development issues in this area."

The balloon that's sent to space is multiple stories tall and at least 10

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Photo Courtesy of NASA

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COC Students To Participate In NASA High-Altitude Launch

Posted by: Brianne Ingram in College of the Canyons, Santa Clarita Latest News August 31, 2018 - 12:35 pm 0
114 Views

Two College of the Canyons students are set to launch a project nicknamed 'Frosty' into the stratosphere on a scientific balloon during the NASA's High-Altitude Student Platform (HASP) Friday.

Home » Santa Clarita News » Education » College of the Canyons » College Of The Canyons Students Are Working Alongside NASA To Launch Projects Into Space

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College Of The Canyons Students Are Working Alongside NASA To Launch Projects Into Space

Posted by: Devon Miller in College of the Canyons, Santa Clarita Latest News January 24, 2018 - 4:45 pm 0
370 Views

A team of College of the Canyons students have begun to work on two individual projects — with the help of two NASA affiliated programs — that have the potential to be launched into Earth's upper atmosphere.

SCV Students Gain Knowledge, Advice at National Manufacturing Day

PRESS RELEASE | TUESDAY, OCT 17, 2017

The Advanced Technology Presentation about “Careers in the Making…Design, Engineering, Fabrication and More…” in celebration of National Manufacturing Day was a huge success.

The evening was both inspirational and informative. Panel speakers from local companies offered advice on how to pursue high wage, high demand careers across a wide variety of advanced technology industries. The panel also featured a student representative from the High Altitude Student Payload (HASP) who helped the audience realize the potential for hands-on, advanced learning opportunities right here in Santa Clarita at College of the Canyons. Our keynote speaker offered encouragement that even the toughest obstacles can be overcome with drive, passion and hard work.

Click Here to Get Our 'SCV This Morning' Newsletter

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Teresa Ciardi - COC - NASA program - July 17, 2018 - KHTS - Santa Clarita

Events

In addition to the media response that the payload and project received, the College and our team attended many events to promote our work and encourage the community to participate and gain understanding.
Listed below are just a few of the outreach events we participated in over the last year.

- Green STEM summit
- VIA cyber security conference
- College of the Canyons' Star Party
- College of the Canyons' Chancellor's Circle Dinner
- College of the Canyons' Manufacturing Day
- iLead science and innovation expo
- Makerspace planning committee tour
- The Local Group Astronomy Day