17963 - Advancement of University of Houston Undergraduate Student Instrumentation

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Program Background

At the University of Houston, our student-led research program Undergraduate Student Instrumentation Program (USIP) focuses on a variety of high atmospheric experiments. The sixth iteration of this program (USIP VI) concludes with an expedition to the state of Alaska in March 2025, conducting experiments developed by the student teams.

The program's objectives are twofold: to explore possible revisions or continuation of existing projects, and to research new ideas that may be further developed into experiments.

Experiment Methodology

Below are the primary methods used across experiments to ensure the best chance of success in the collection of desired variable data.
Excluding hardware and software design that is experiment specific.

System Standardization:
- Power distribution and component selection are chosen per expected environmental parameters on the ground or in flight.

Payload Structure:
- Balloon-based experiments are flown in a protected payload stack configuration using one balloon.
- Ground-based experiments are housed in a custom container configured to survive local climate conditions for multiple days at a time.

Environmental Testing:
- During the testing phase of each experiment, it undergoes a battery of environmental tests to ensure survivability and integrity of data collected.

Experiment Telemetry:
- GPS tracking is used for physical collection of the payload post flight with primary to tertiary trackers attached.
- Sensor data is recorded locally for retrieval and streamed using long range transmission equipment to a ground based receiver.

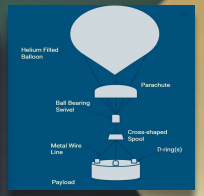
Experiments for March 2025

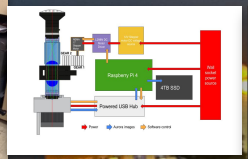
Current list of experiments being designed and tested in preparation for the programs expedition to Fairbanks, Alaska during the month of March 2025

Microplastics & Extremophiles

- To measure the concentration of microplastics suspended in the stratosphere and identify what microbial life is present

- Samples will be collected on filters flown at high altitude and analyzed via Raman microscopy and DNA sequencing





All Sky Imager

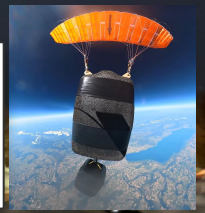
- To observe Na, OH,-OH, O2, and NO elements in the ionosphere using strong line indications from remote sensing

- This will be a redesign of a previous iteration to increase quality and duration of data collection sessions

Guided Parachute Recovery

- Develop a steerable parachute to autonomously guide a descending payload to a selected landing location to ensure rapid recovery its data

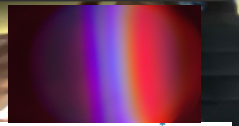
- This will be a redesign of experiments conducted by citizen scientist, adapted for payload stacks of variable weight up to 12 lbs

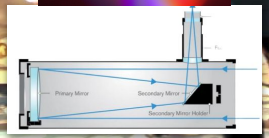


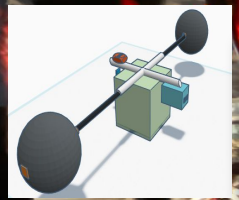
Arorual Spectroscopy

- Take images of the aurora borealis using a spectrophotometer and analyze the spectra to verify properties of atmospheric molecules

- This will be a continuation of the experiment with a larger image collection time frame with improved recording







Atmospheric Conductivity

- Enlarge global atmospheric conductivity data

- Explore possible causes of short-term conductivity variations

- Encourage others to collect global atmospheric conductivity

USIP VI's Research Goals

- Microplastics & Extremophiles:
Measure the concentration of microorganisms present in the stratosphere during a balloon flight.
- All Sky Imager:
Automated remote imaging and transmission with a further step of live image processing w/neural network for large sensor capture timing.
- Arorual Spectroscopy:
Engineer a way to make a payload out of the designated instruments and keep it as light as possible (<12lbs) while retaining essential components.
- Guided Parachute Recovery:
Create a cost effective open source experiment kit for schools to conduct more effective research.
- Atmospheric Conductivity:
Create a guide/kit for others to record their own conductivity data.