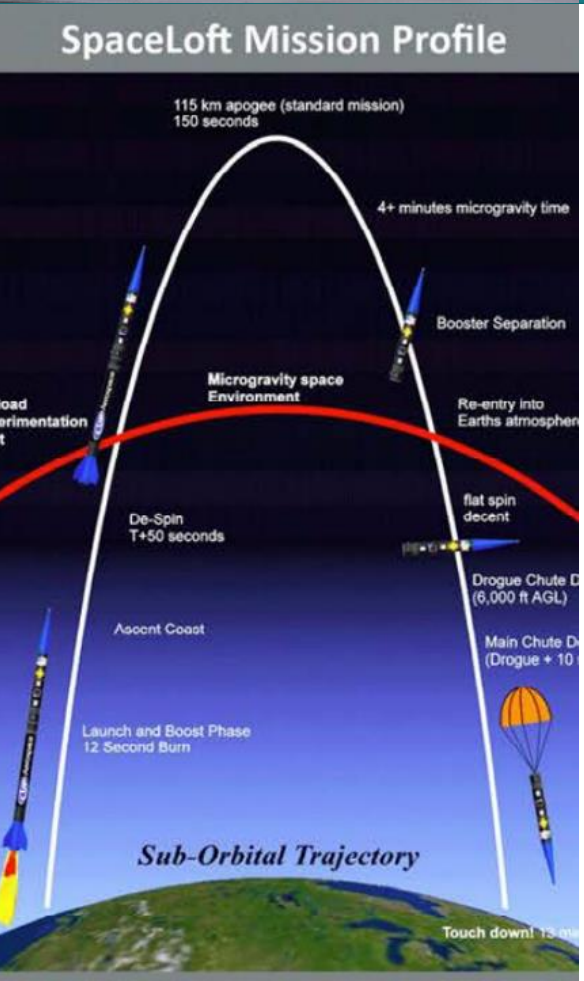
# SOAR

Sub-orbital Amateur Radio

# Introduction

Sub-orbital rocket launches provide opportunities for space environment payload testing and experimentation at a fraction of the complexity and cost of typical Low Earth Orbit missions.  The Sub-orbital Amateur Radio (SOAR) project's goals are to perform engineering and science experiments utilizing Amateur Radio, as well as increasing the Technology Readiness Level of Amateur Radio space flight systems.

This project is sponsored by the Open Research Institute.


# Typical Mission: UP Aerospace SpaceLoft

Sub-orbital launches using vehicles such as UP Aerospace's SpaceLoft follow the mission profile shown at the left. Launch and boost phase lasts 12.5 seconds during which the payloads will experience axial loads up to 16 g and radial loads up to 18.5 g. The vehicle will coast for 42.5 seconds and then reduce its spin rate to a few degrees per second. At this point, the vehicle enters the microgravity space environment for just over 4 minutes, reaching an apogee of over 100 km. The vehicle re-enters the atmosphere, deploys drogue and main chutes, and touches down at approximately 13 minutes after launch.

Top image photo credit: NASA
Bottom image credit: UP Aerospace Payload Users Guide

# SOAR

## ASCENT

- Payload will experience both axial (direction of travel) and radial (due to vehicle spin stabilization) high acceleration loading
- Frequencies will be altered via doppler shift as well as component drift due to acceleration and temperature changes
- More difficult to track with directional ground station antennas due to the velocity of launch
- Shortest portion of the mission

## SPACE

- Least dynamic environment of the mission
- Vehicle orientation may block antenna radiation (vehicle is slowly rotating)
- Best opportunity for longer range 3$^{rd}$ party reception

## RE-ENTRY

- Very dynamic vehicle motions prior to drogue and main chute deployments
- Highest temperatures of the mission
- Additional opportunities for 3$^{rd}$ party reception

# SOAR

## VEHICLE PAYLOAD

- A low-cost radio transceiver (Semtech SX1276) will be evaluated for use in space applications
- Modulation via LoRa, FSK, GFSK, MSK, OOK and FM voice modes are possible
- Test pattern data will be transmitted from the payload using different modes cycled in a predictable pattern

## GROUND STATION

- A Software Defined Radio Receiver (e.g. AirSpy R2) will be used to record the radio spectrum required to demodulate the various transmitted modes (+/- doppler and some margin for drift)
- A single station with an azimuth/elevation tracking antenna, or multiple stations with fixed antennas covering the flight trajectory will be used (TBD)

# ***SOAR*** Timeline

**September 2022**
- Payload hardware design complete
- Prototype payload ready for lab use

**October 2022**
- Testing of prototype payload
- Ground station options evaluation
- Ground station software prototype
- Initial pass of firmware complete

**November 2022**
- Payload hardware re-spin if required
- Finalize payload firmware
- Finalize Ground station hardware and software

**January 2023**
- Payload hardware delivered to UP Aerospace

**March 2023**
- Launch

# References


## Open Research Institute

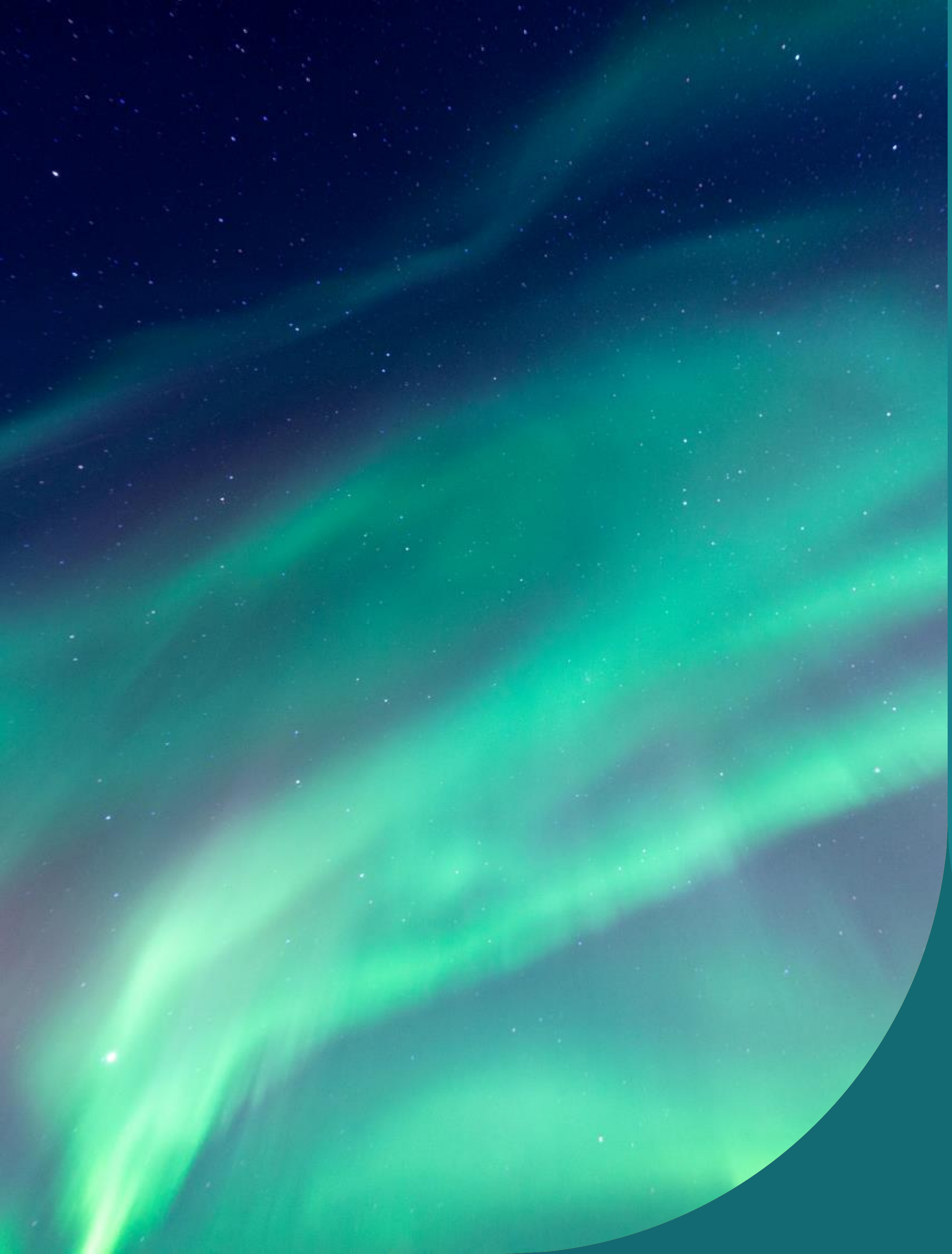
https://www.openresearch.institute/

## UP Aerospace Inc.

https://www.upaerospace.com/

## Semtech SX1276

https://www.semtech.com/products/wireless-rf/lora-core/sx1276

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