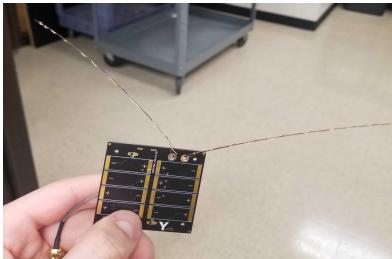
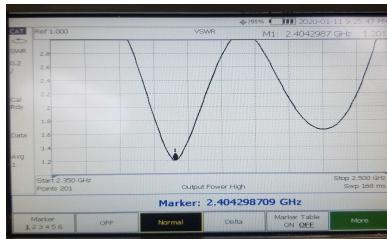


# Team 4: Communications

Week 2, Spacecraft Design Lab 2019-2020



Prototyping and testing the dipole antenna



S-Band antenna is looking good

## Updated Key Milestones (past + present)

- S-Band SWR tested, confirmed, good to go
- Planning to Explore Durand Radio Station
- Continued work on dipole mounting plan
- attach radios to a radio-test motherboard
- nail down U.FL cable lengths
- continued work with software

## Interfaces

- Structures
  - Mounting location & structure for dipole on the +Y PCB
- FSW
  - Get Radio sending packets from motherboard

## Requirements

- Need access to the room with the support equipment for Durand's antennas
- Need a motherboard to add radios to

## Weekly Results

- Gantt Chart
- Began testing the dipole and varying the length and angle of the antenna

## Next Week

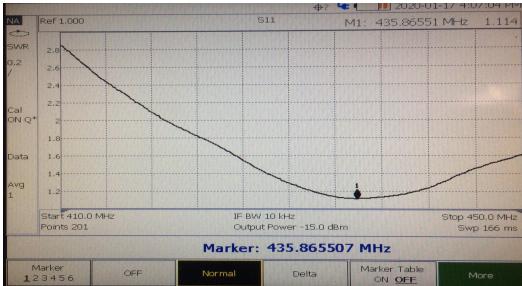
- Assess the capabilities of Durand's antennas
- Determine an optimal antenna length & angle
- Begin licensing paperwork
- HAM Technician license test on Saturday

# Communications

Week 3, Spacecraft Design Lab 2019-2020



Went on the roof to look at the antennas



Tuned UHF antenna VSWR

## Updated Key Milestones (past + present)

- S-Band antenna verified
- Began ground station setup
- UHF antenna roughly tuned (proof of concept)
- Started Hacking code for SX1272

## Interfaces

- Working with Structures to properly mount the dipole to the +Y PCB
- Work with FSW to format beacon and health packets

## Requirements

- 

## Weekly Results

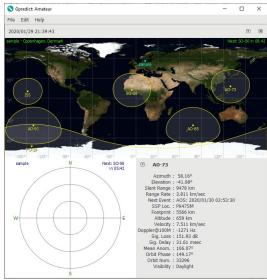
- Went on roof to see antennas
- Organized & inventoried the ground station room
- Tuned UHF antenna orientation (may need further)

## Next Week

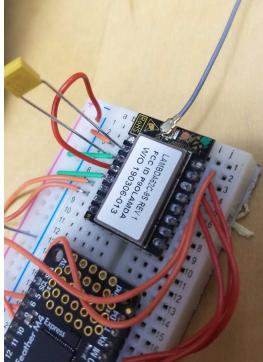
- Test rooftop antennas (rotors & cables)
- Fine-tune antenna length / angle
- Begin developing beacon and health packets
- Get SX1262 working

# Communications

Week 4, Spacecraft Design Lab 2019-2020



Started playing with Gpredict



Better Silicon?

## Updated Key Milestones (past + present)

- S-Band antenna verified
- Began ground station setup
- UHF antenna roughly tuned (proof of concept)
- Started hacking code for SX1272
- Got SX1262 transmitting for test purposes
- Radios have arrived?

## Interfaces

- Working with Structures to properly mount the dipole to the +Y PCB
- Work with FSW to format beacon and health packets

## Requirements

- Camera for rooftop to view antennas live during rotator testing

## Weekly Results

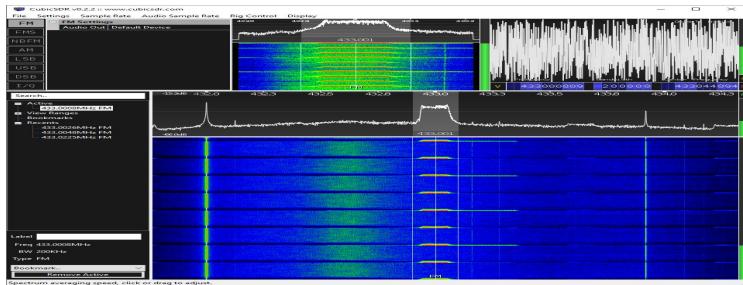
- Read through ham shack documentation & tried to verify rooftop antennas connection
- Started playing with Gpredict
- Determined mode for beacon (FSK)

## Next Week

- Develop beacon / health packets
- Continue to verify durand antennas

# Communications

Week 5, Spacecraft Design Lab 2019-2020



Waterfall from Satellite Radio to SDR

## Interfaces

- Working with Structures to properly mount the dipole to the +Y PCB
- Work with FSW to format beacon and health packets
- Work with structures to get a test article

## Requirements

- Camera for rooftop to view antennas live during rotator testing
- Handheld Yagi for range tests

## Updated Key Milestones (past + present)

- S-Band antenna verified
- Began ground station setup
- UHF antenna roughly tuned (proof of concept)
- Started hacking code for SX1272
- Pycubedmini boards exchanged radio packets

## Weekly Results

- Beacon packet data drafted
- Two pycubedmini boards exchanged radio packets
- Pycubedmini board talked to SDR & confirmed on waterfall

## Next Week

- Range testing of radio with nitinol antenna across the room
- Prepare for ridge test from the dish (make satellite mount, Yagi, short range testing)
- Set up camera on Durand roof to monitor rotators

# Communications

Week 5, Spacecraft Design Lab 2019-2020



Across-the-Room Test Set Up

## Interfaces

- Working with Structures to properly mount the dipole to the +Y PCB
- Work with FSW to format beacon and health packets
- Work with structures to get a test article

## Requirements

- S/C Mockup for ridge testing

## Updated Key Milestones (past + present)

- S-Band antenna verified
- Began ground station setup
- UHF antenna roughly tuned (proof of concept)
- Started hacking code for SX1272
- Pycubedmini boards exchanged radio packets

## Weekly Results

- Two pycubedmini boards exchanged radio packets in formalized across-the-room test
- Initial comparison between antenna with copper wrapped around base of nitinol vs wrapped end to end

## Next Week

- Continue range testing of radio: add baseline test (not using our antennas) and test using straight copper along the nitinol

# Communications

Week 6, Spacecraft Design Lab 2019-2020



Tx at ridge testing



Rx at ridge testing

## Updated Key Milestones (past + present)

- S-Band antenna verified 12-19
- Began ground station setup 1-20
- UHF antenna roughly tuned (proof of concept) 1-20
- Started hacking code for SX1272 1-20
- Pycubedmini boards exchanged radio packets 2-03
- First ridge test! 2-17

## Interfaces

### Structures

- Properly mount the dipole to the +Y PCB
- Test different copper wire wraps on dipole
- Get a test article for future ridge tests

### FSW

- Work with FSW to format beacon and health packets

## Requirements

- Wifi router for roof camera

## Weekly Results

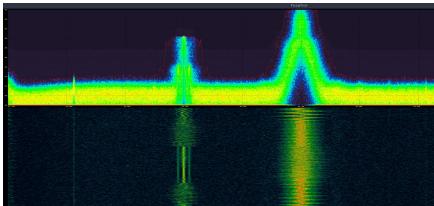
- Tuned dipole – copper wrapping along Nitinol does not affect performance
- Successfully performed first ridge test!

## Next Week

- Determine more sets of LoRa parameters to test
- Perform another round of ridge tests
- Set up camera on Durand roof & start working with the ground station again

# Communications

Week 7, Spacecraft Design Lab 2019-2020



fosphor waterfall



2nd ridge test locations

## Updated Key Milestones (past + present)

- |  |       |
|--|-------|
| • S-Band antenna verified                      | 12-19 |
| • Began ground station setup                   | 1-20  |
| • UHF antenna roughly tuned (proof of concept) | 1-20  |
| • Started hacking code for SX1272              | 1-20  |
| • Pycubedmini boards exchanged radio packets   | 2-03  |
| • First ridge test                             | 2-17  |
| • Decoded LoRa packets (RTLSDR to text file)   | 2-20  |

## Interfaces

### Structures

- Properly mount the dipole to the +Y PCB
- Test different copper wire wraps on dipole
- Get a test article for future ridge tests

### FSW

- Work with FSW to format beacon and health packets

## Requirements

- Internet hub for roof camera

## Weekly Results

- Performed ridge test for doppler shift
- Got GNU Radio Decode working
- Made progress on Durand radio room
- Worked on packet code more. (async)

## Next Week

- Perform another round of ridge tests
- Buy / set up new ground station computer with GNU radio software
- Get LimeSDR decoding working
- Get LoRa Packets forwarding over UDP to some kind of decoding software

# Communications

Week 9, Spacecraft Design Lab 2019-2020



Safety barriers block antenna rotation



LNA

## Interfaces

### Structures

- Properly mount the dipole to the +Y PCB
- Test different copper wire wraps on dipole
- Get a test article for future ridge tests

### FSW

- Work with FSW to format beacon and health packets

## Requirements

- Better camera for roof (?)

## Updated Key Milestones (past + present)

- |  |       |
|--|-------|
| • S-Band antenna verified                      | 12-19 |
| • Began ground station setup                   | 1-20  |
| • UHF antenna roughly tuned (proof of concept) | 1-20  |
| • Started hacking code for SX1272              | 1-20  |
| • Pycubedmini boards exchanged radio packets   | 2-03  |
| • First ridge test                             | 2-17  |
| • Decoded LoRa packets (RTLSDR to text file)   | 2-20  |

- |  |      |
|--|------|
| • Received signals through Durand antennas | 3-01 |
|--|------|

## Weekly Results

- |   |      |
|---|------|
| • Received signals using SDR with Durand antennas | 3-01 |
|---|------|
- Using SDR
- Received signals using SDR with Durand antennas
  - Further explored antenna rotator (can now rotate with computer)
  - Tried to get the LNA to work, seemed to make the antenna perform worse
  - Cleaned out servers from HAM shack

## Next Week

- Ridge test from Dish -> Durand without LNA
- Install new ground station computer

# Communications

Week 10, Spacecraft Design Lab 2019-2020



New LNA Installed



New Ground Station Setup

## Updated Key Milestones (past + present)

- S-Band antenna verified 12-19
- Began ground station setup 1-20
- UHF antenna roughly tuned (proof of concept) 1-20
- Pycubedmini boards exchanged radio packets 2-03
- First ridge test 2-17
- Decoded LoRa packets (RTLSDR to text file) 2-20
- Received signals through Durand antennas 3-01

## Interfaces

### Structures

- Properly mount the dipole to the +Y PCB
- Test different copper wire wraps on dipole
- Get a test article for future ridge tests

### FSW

- Work with FSW to format beacon and health packets

## Requirements

- 

## Using SDR

- ### Weekly Results
- Make satellite "contact" via ground station 3-07
  - Met with Sawson for more info about how the ground station used to work
  - Successfully tracked and contacted a satellite on uplink 435MHz, downlink 145MHz
  - Confirmed LNA was broken and installed new LNA
  - First ground station ridge test appears to confirm the new LNA is working
  - 2m Yagi no longer hits the guard rails

## Next Week

- Work with Sawson to put safety on LNA during TX
- Track more satellites with using new LNA