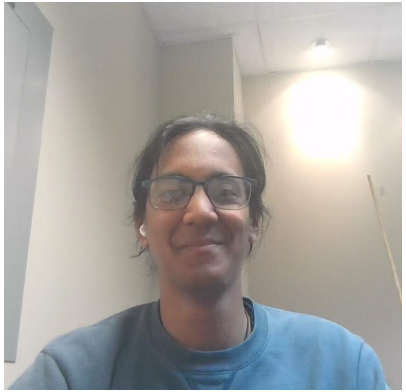
Plant Doctor: Batteryless Backscatter Radio Sensors for Plants and Agriculture

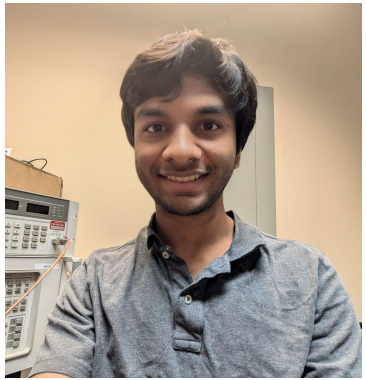
Meet the Team

Tyler Dalpe

Taha Touil



Ryan Sukhai



Rishabh Ramaswamy

Faculty: Aggelos Bletsas and Richard Howard

Project Description

- Plant wellbeing correlated to temperature
- Measuring leaf surface temperature (.001 ℃ difference)

Project Description - Continued

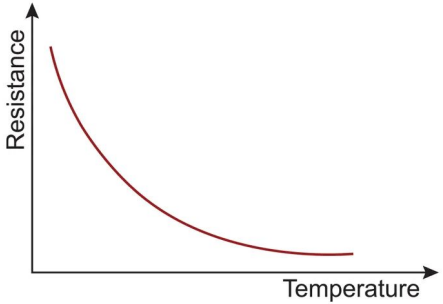
- Stressing plants with light & water
- Backscatter radio → communicate this data **wireless and batteryless**

How do we measure changes in leaf temperature?

Temperature Apparatus - Thermistors

- Temperature-sensitive resistor
- Used to track temperature changes
- Negative Temperature Coefficient (NTC) thermistor

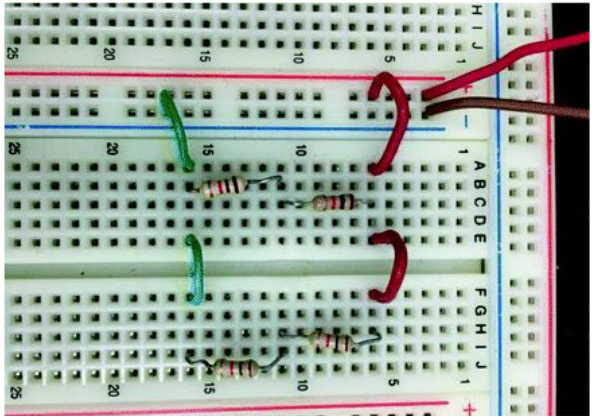
Thermistor on leaf



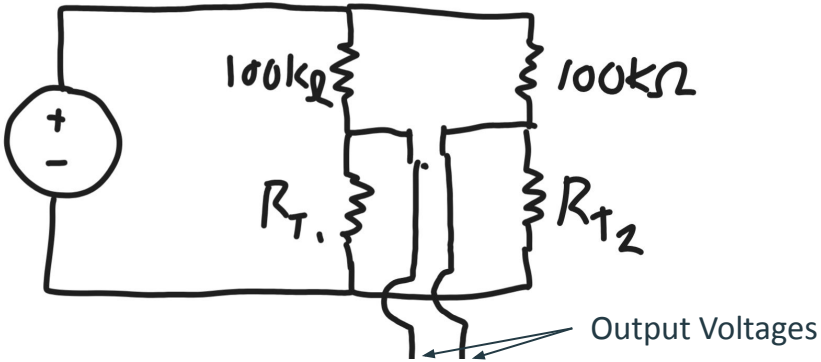
Temperature vs Resistance graph for NTC thermistors

Temperature Apparatus - Wheatstone Bridge

- Detects small resistance changes from thermistors
- Pairs of thermistors
  - One plant, one paper
  - Voltage difference = small
- Sensitive, precise



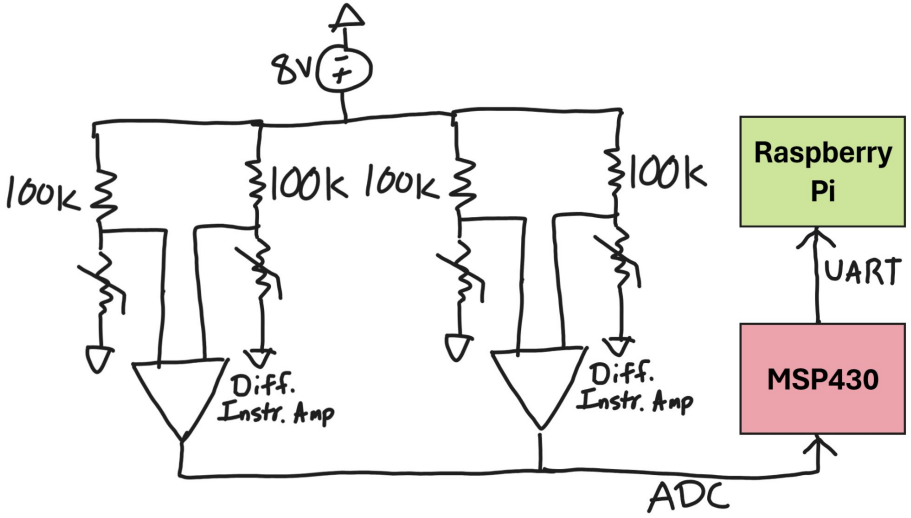
Wheat. Bridge recreated on Breadboard



Wheat. Bridge Circuit Diagram

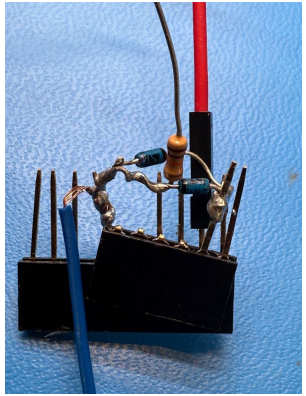
Temperature Apparatus - Full System Diagram

- Two pairs of thermistors
- Difference amplified
- ADC conversion
- UART transmission

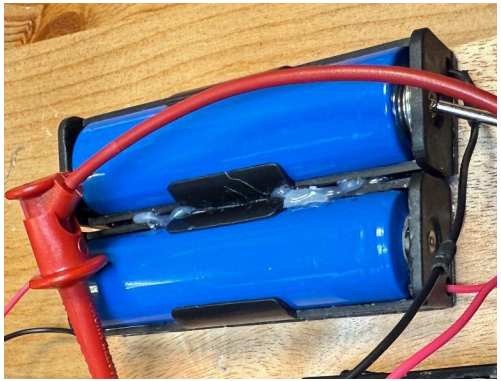


Soldering - Wheatstone Bridge

- Battery Holder error; soldered wires to new holder
- Fixed ground and broken thermistor
- Soldered second thermistor setup

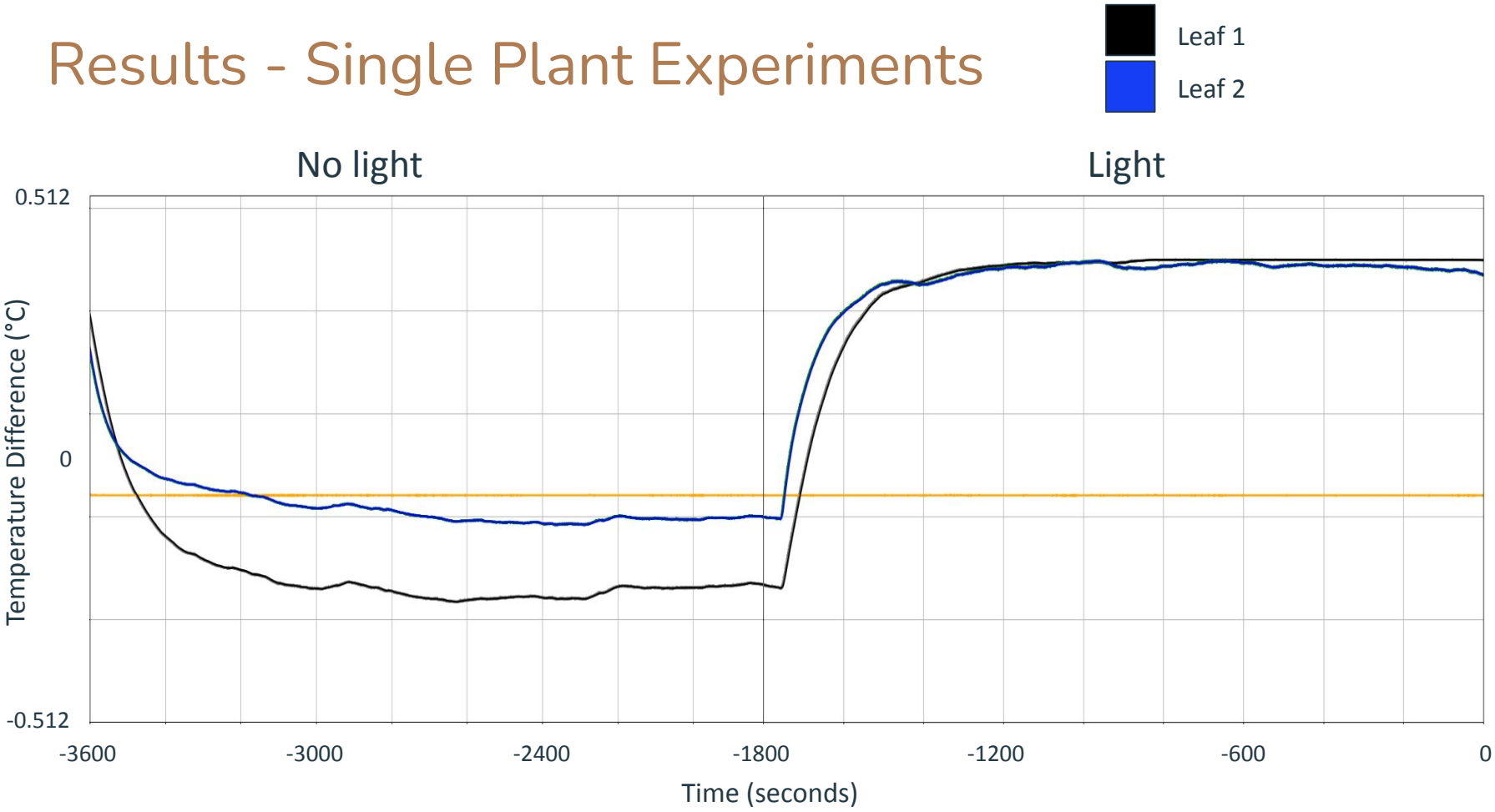


Schottky Diode

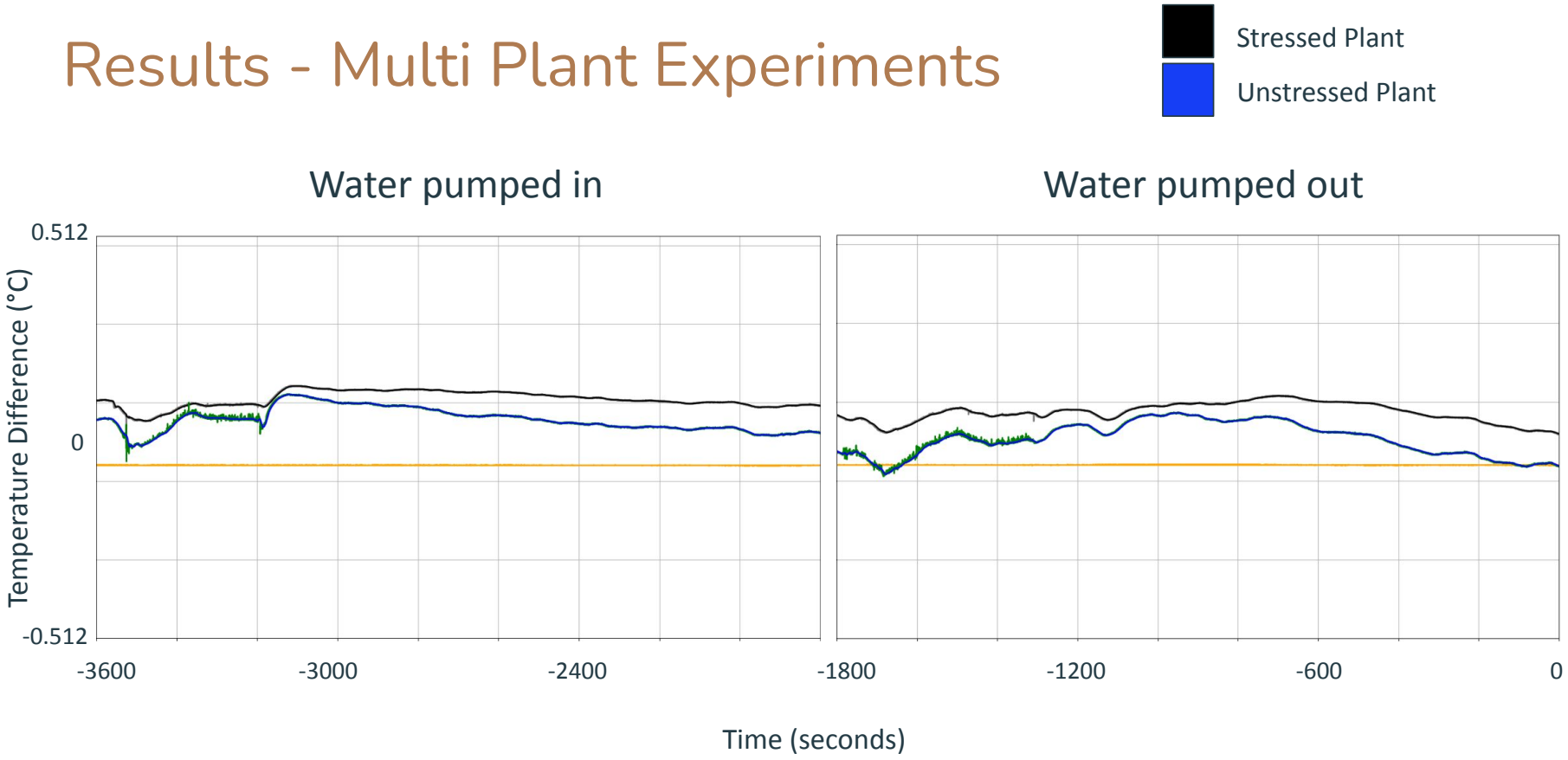


Battery Holder

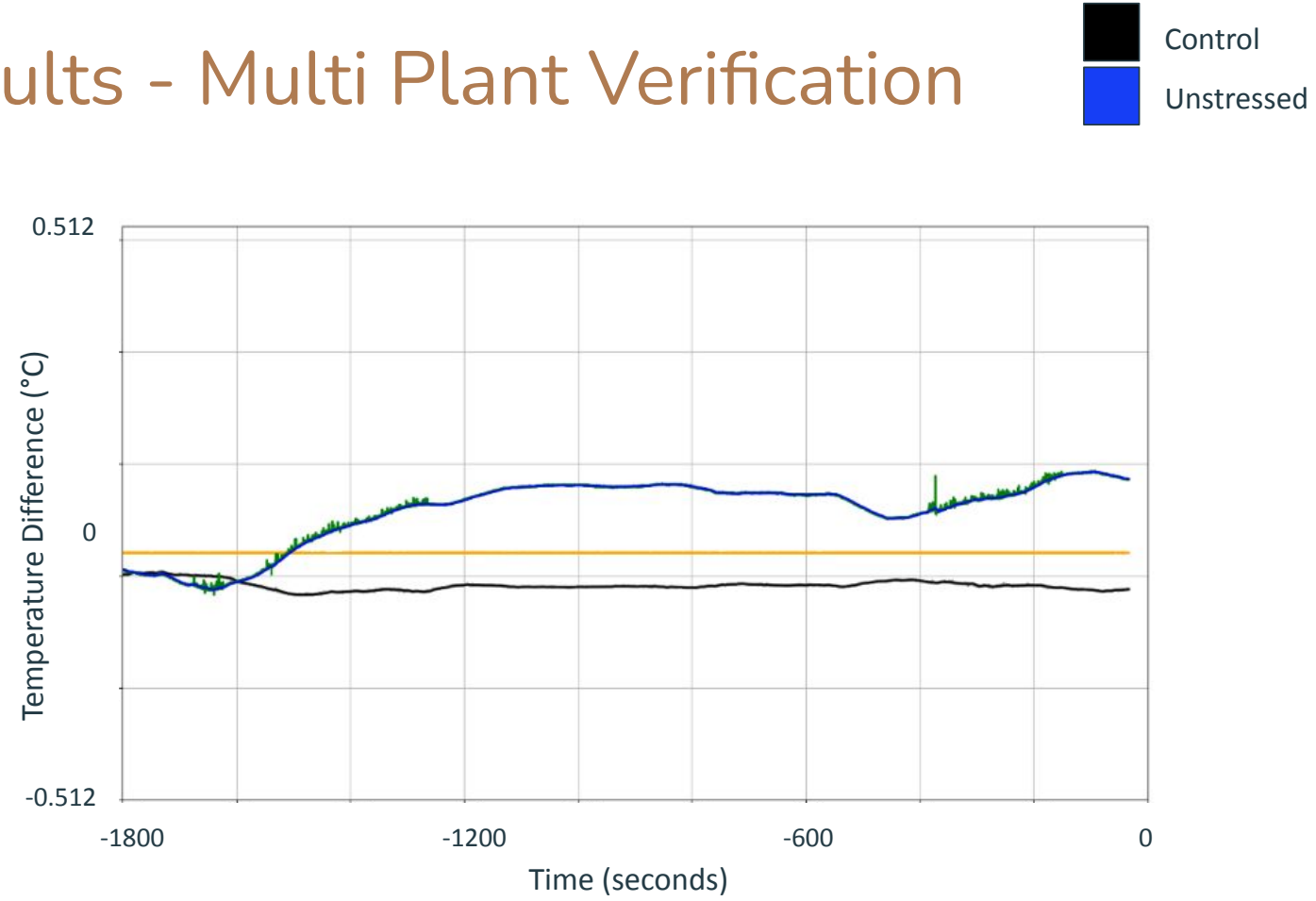
Results - Single Plant Experiments



Results - Multi Plant Experiments



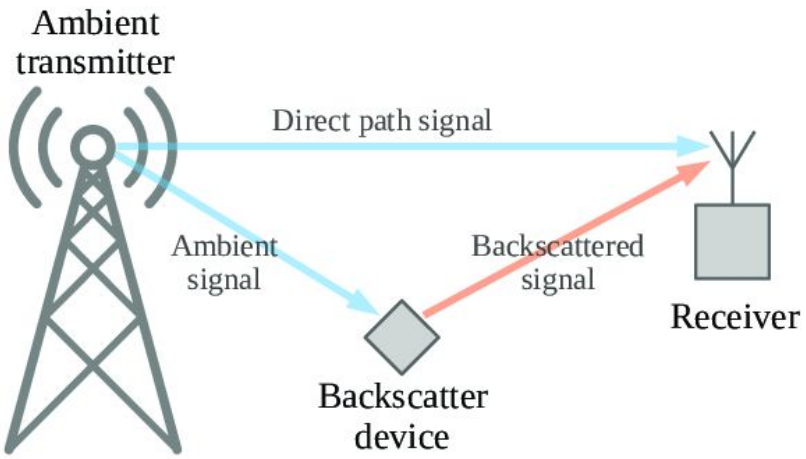
Results - Multi Plant Verification



But how do we communicate this data?

Backscatter

- Low cost, batteryless communication
- Radio Wave + Tag controlled by square wave using MSP430



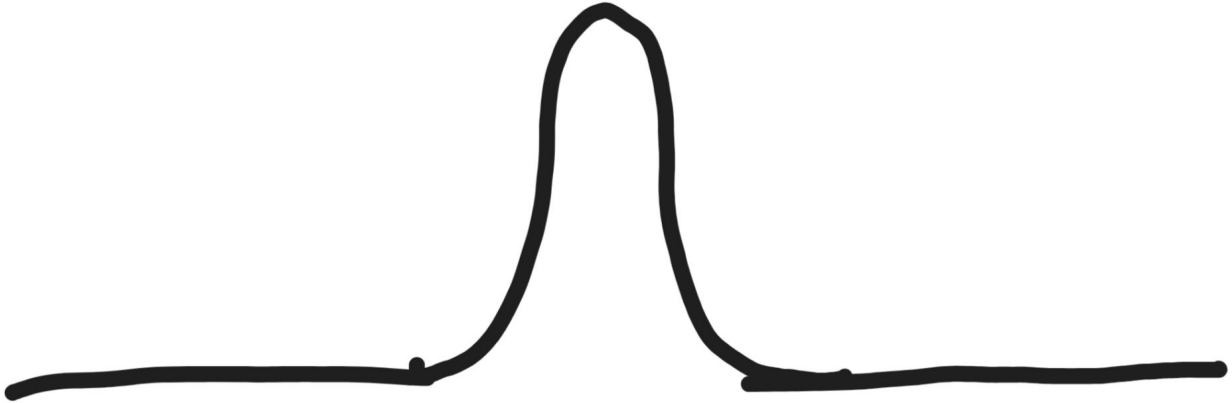
Backscatter

- No Radio Frequency Signal

Backscatter

0

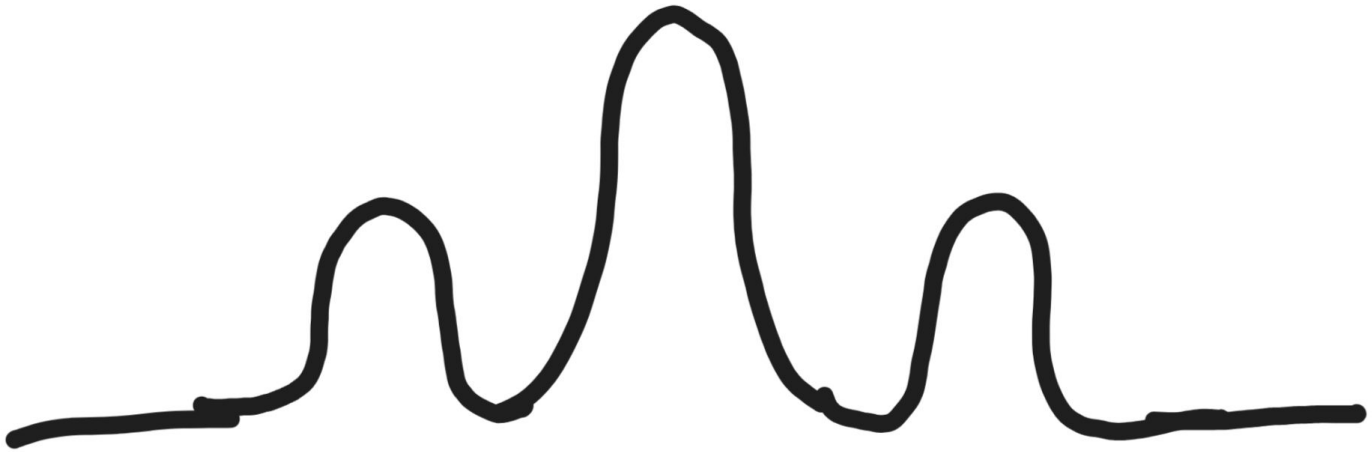
- Radio Frequency Signal, no Backscatter



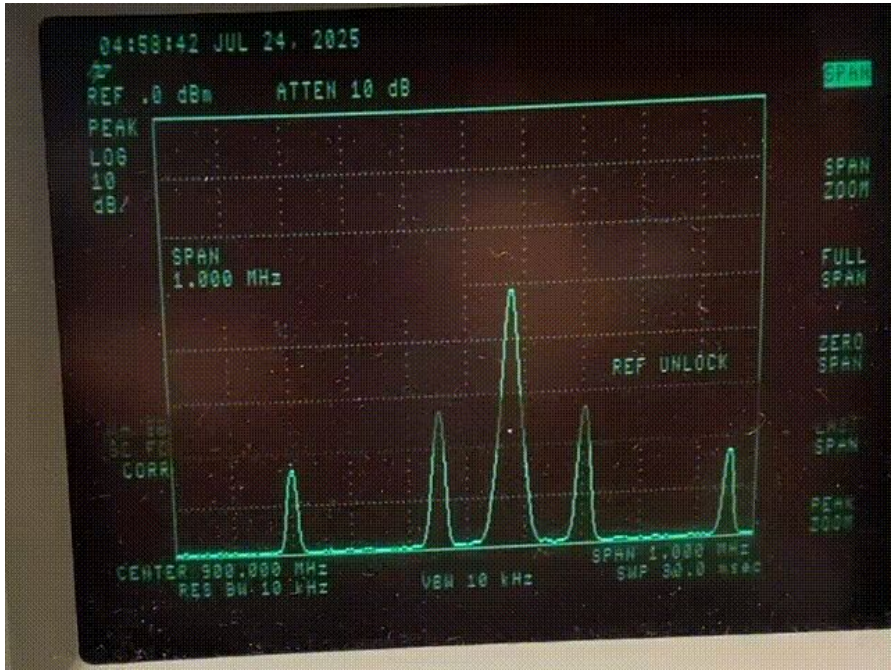
Backscatter

1

- Radio Frequency Signal w/Backscatter



Backscatter - Demo



Future Work

- Finish + integrate backscatter technology
- Refine plant setup
- Run additional experiments

Thank You