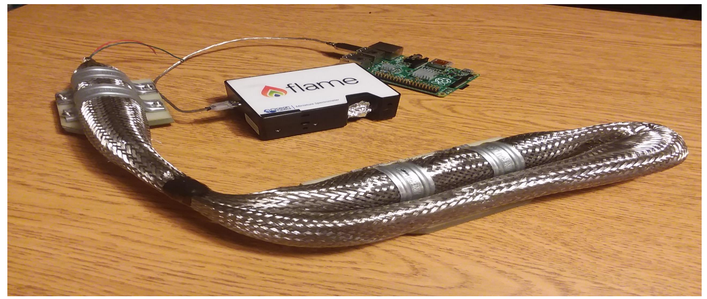
Dusty Plasma Lab: SPARK Circuit and Frequency Testing

By: Marcus Bailey

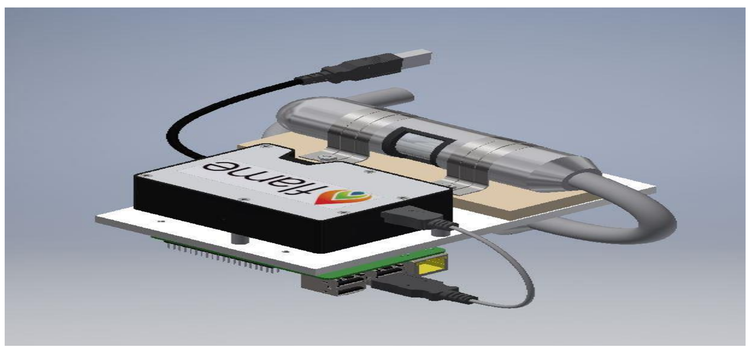
Overall Motivation

Constructing a payload that seeks out Sodium in the upper atmosphere to prove a hypothesis. If there are any detections of Sodium (Na) at apogee; up to 150km above Earth's atmosphere at high volumes, this will further prove that meteorites continue to add Sodium in Earth's ocean.

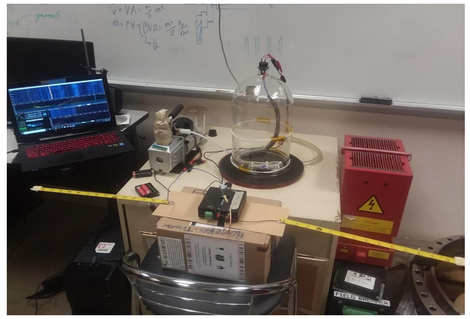


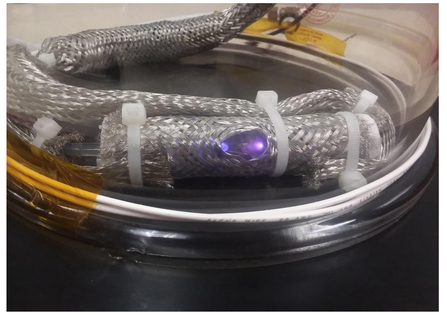
Goals

- Use the HDSDR software to make sure that we were not interfering with Penn State's frequency range before flight.
- Use Spitzer's Resistivity to find the resistance of the plasma.
- Characterize the circuit to match impedances from the wire and plasma to limit feedback and resonance noise.



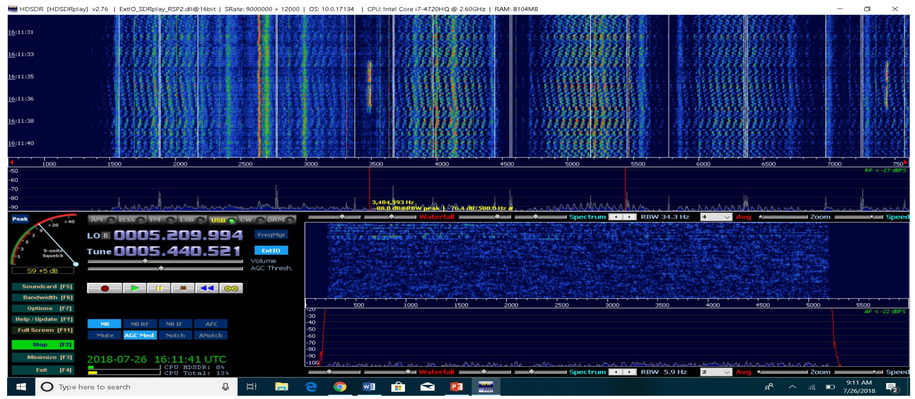
Setup





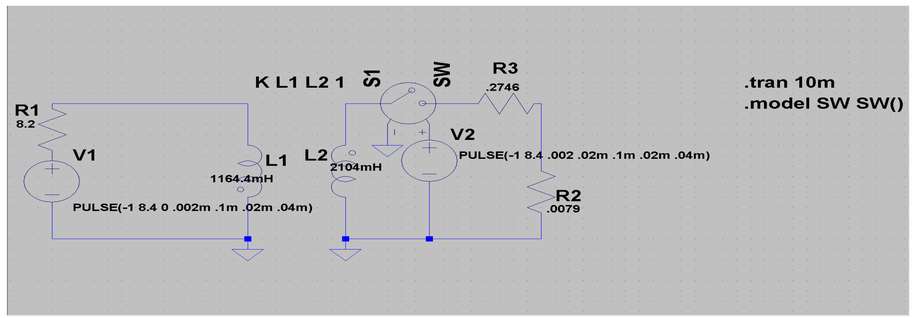
Spark Gap, HDSDR software, antenna, and vacuum

HDSDR Frequency Testing(Inside the Vacuum)



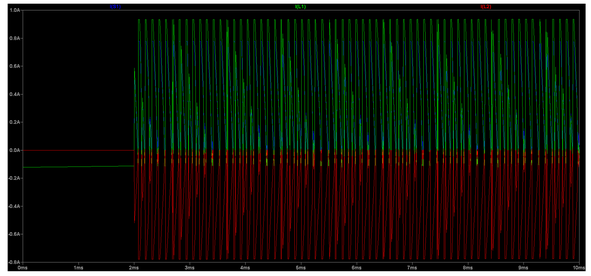
- Frequency range requirements were between 1Mhz and 7MHz

Circuit Modeling



- This was a numerical alternative to find missing values.
- The Current was estimated.

Small Math and Circuit Equation/ Results



Circuit Equation

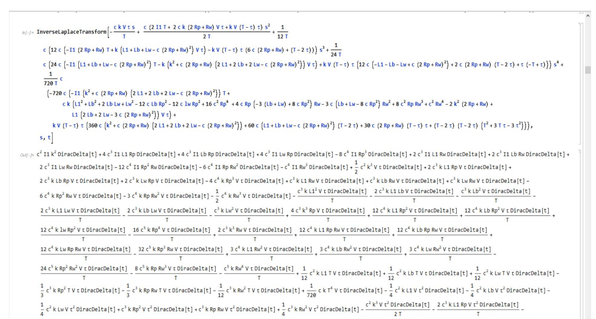
$$R_B I_1 + V_T + L_B \frac{dI_1}{dt} + L1 \frac{dI_1}{dt} + K \frac{dI_2}{dt} = 0$$

$$R_p I_2 + R_w I_2 + L_w \frac{dI_2}{dt} + \frac{\int I_2\, dt}{C_w} + K \frac{dI_1}{dt} = 0$$

$$R_p = \rho \frac{L}{A} \qquad \eta_\perp = 1.03 \times 10^{-2} Z \ln \Lambda T^{-3/2}\ \Omega\ \mathrm{cm}$$

$$R_p = .2746\ \Omega$$

Challenges/Goals



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