# Project 9

- **Title:** Addressing impedance matching and noise generation in pulsed power plasma reactors-**EHT**
- **PI:** John Foster/Mark Kushner—The University of Michigan
- **Need and Relevance:** pulsed power related electrical noise and reflected power associated with transmission line delivery require optimization
- **Goals:** Understand origin and eliminate noise from pulsed power system/optimize deliver to load; reduce architecture cost
- **Approach:** apply basic shielding methods in conjunction with pulse power modulator architecture modification
- **Outcomes/Deliverables:** noise free system/test data
- **Project Duration, Budget:** 12 months / $50,000

# Need and Relevance

- The basis of many of the atmospheric pressure water treatment systems is the pulsed power modulator.
  - This technology enable the production of cold, 1 atm plasmas since the fast rise time circumvents the development of an arc discharge.
- While this technology is enabling for large scale water systems, there are two issues associated with its implementation that is problematic:
  - 1) impedance matching to load
  - 2) noise
- For any realistic system, the delivered power fraction to the load must be reasonably high and the associated noise must be manageable to the point that it does not interfere with other equipment operation.

# Goals

- The goal of this effort is to:
  - 1) optimize EHT power delivery to the plasma load to improve overall system efficiency
  - 2) to develop a transmission line methodology and shielding that prevents electromagnetic pulse effects from adversely affecting nearby equipment.
- Additionally, the goal is to model the pulse shape and understand its effect on delivered power to the load

# Approach

- The general approach is to utilize an EHT supplied power supply with two plasma water reactors and study the power delivered to the load.
  - We will analyze the waveform and also assess using plasma diagnostics the actual power delivered to the plasma.
    - Includes SPICE modeling of the transmission line
  - Plasma modeling tools will be used to assess the nature of power delivery to the plasma for the two reactor geometries to complement the experiments as well as enable optimization.
- We will utilize EMI best practice approaches to quantify and reduce noise associated with the reactor to acceptable levels.

# Outcomes/Deliverables

- The chief deliverables from this effort is test data.
  - We will show the sensitivity of delivered power for each reactor as a function of waveform
  - We will also correlate delivered power to decomposition efficiency of model compounds
- We will also document the results of the EMI reduction tests and recommend best practices for the EHT system.
- These results should be useful to the greater community that utilizes this power supply system regardless of the environmental application.

# Project Timeline and Duration

| Task / month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantify noise levels and absorbed power for each reactor | x | x | x | x | | | | | | | | |
| Model equivalent circuit and simulate efficiency based on absorbed dosed and radicals produced | | | | x | x | x | x | | | | | |
| Modify transmission lines to reduce noise and improve delivered dose | | | | | | | x | x | x | x | | |
| Completed system optimization; generate final report | | | | | | | | | x | x | x | x |

# Project Budget

| Item | Cost |
|---|---|
| Student stipend | $ 40,000 |
| Supplies | $ 0.00 |
| Purchased services | $ 0.00 |
| Equipment | $ 50,000 |
| Travel | $ 0.00 |
| **Project total*** | **$ 90,000** |

*C-PEAB leadership recommends not to exceed $40,000/year unless discussed with IAB