Community Advisory Board | RadiaBeam Small Business Innovation and Research (SBIR) Project

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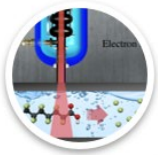
Background

IARC at Fermilab

IARC works with the technology from a “big science” application and matures it to a stage where industry can adopt the technology for use outside of Fermilab.

Whether it’s sterilization of medical devices, breaking down forever chemicals like PFAS, or even improving the lifetime of roadways, IARC is working to utilize technology developed by Fermilab to solve these problems.



Destruction of PFAS

Addressing one of the biggest contamination concerns in the world

Municipal water treatment

On-demand sterilization of water

Medical Device Sterilization

Creating alternatives for sterilization

Destruction of toxins in soil

Helping DOE/DOD manage legacy waste

Curing of pavement

Developing new and improved pavements

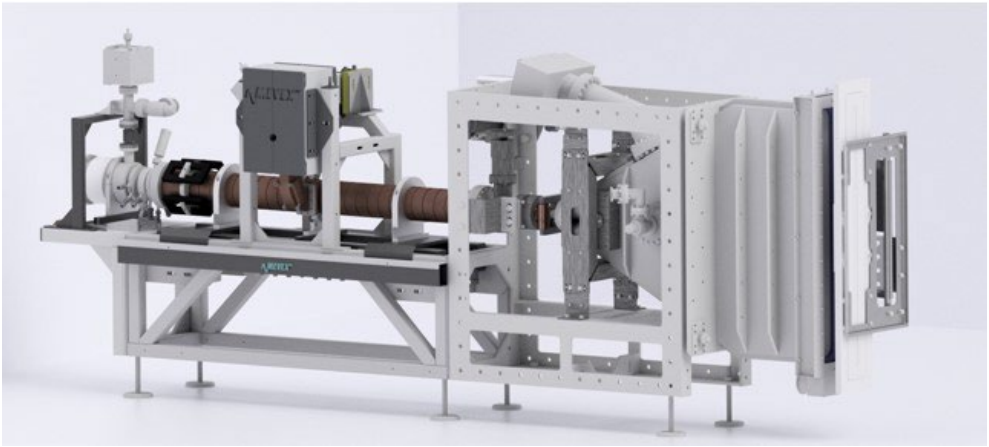
Accelerators for Industrial Applications

Conventional Accelerators are being used for a variety of applications by industry today

- Single use medical device sterilization
- Food phytosanitary treatment
- Gem coloration
- Polymer crosslinking
- Semiconductor doping
- Isotope generation
- and more…

Currently industrial accelerators are NOT SRF which are inefficient, resulting in higher operating expenses.

SRF is much more efficient which is driving the desire for industrial SRF machines

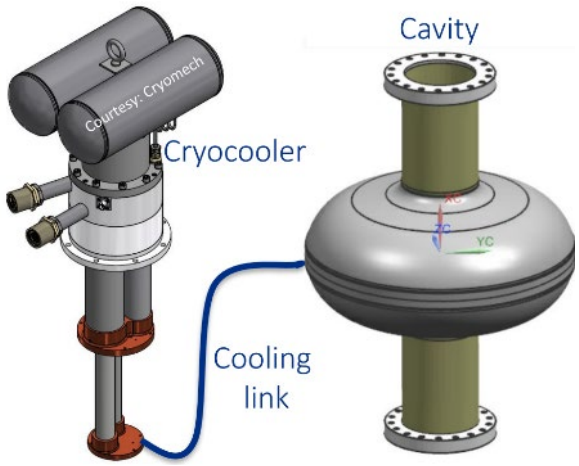


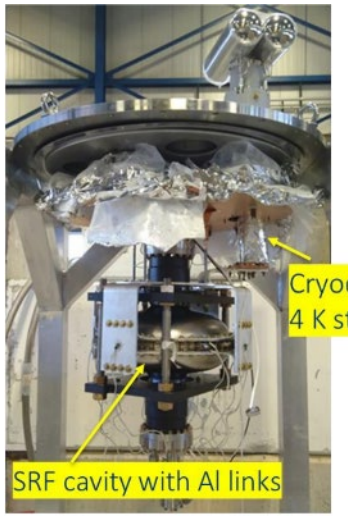
Challenges of Industrial SRF

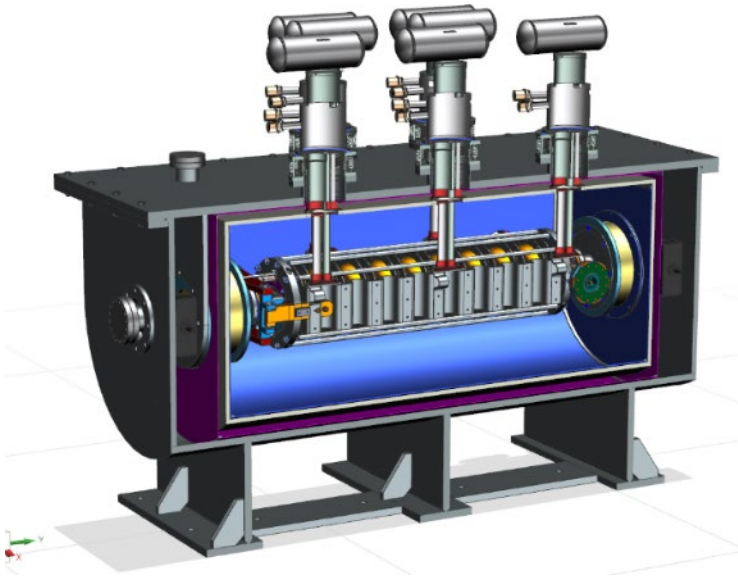
SRF machines typically use liquid cryogens, but this requires special infrastructure and personnel so it's not a realistic option for industry.

Conduction Cooled SRF enables industrial usage by offering a simpler cooling method compared to liquid cryogens

- IARC at Fermilab was the first to demonstrate conduction cooling of a SRF cavity







Small Business Innovation and Research (SBIR) Program

- Competitive program that encourages domestic small businesses to engage in R&D programs that support innovation in priority areas
  - Strong emphasis on commercialization after R&D complete

RadiaBeam Technologies

- RadiaBeam is a small business based out of Santa Monica, California
- Historically has worked on conventional accelerators but wants to break into SRF market

The Project

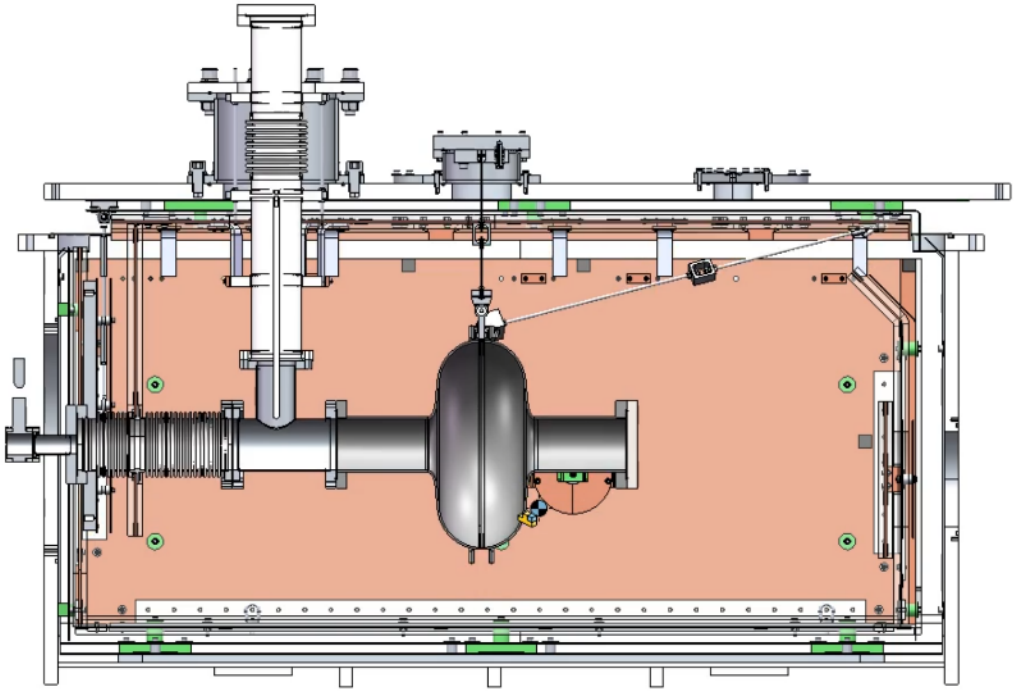
The SBIR Project – Conduction Cooled Cryomodule

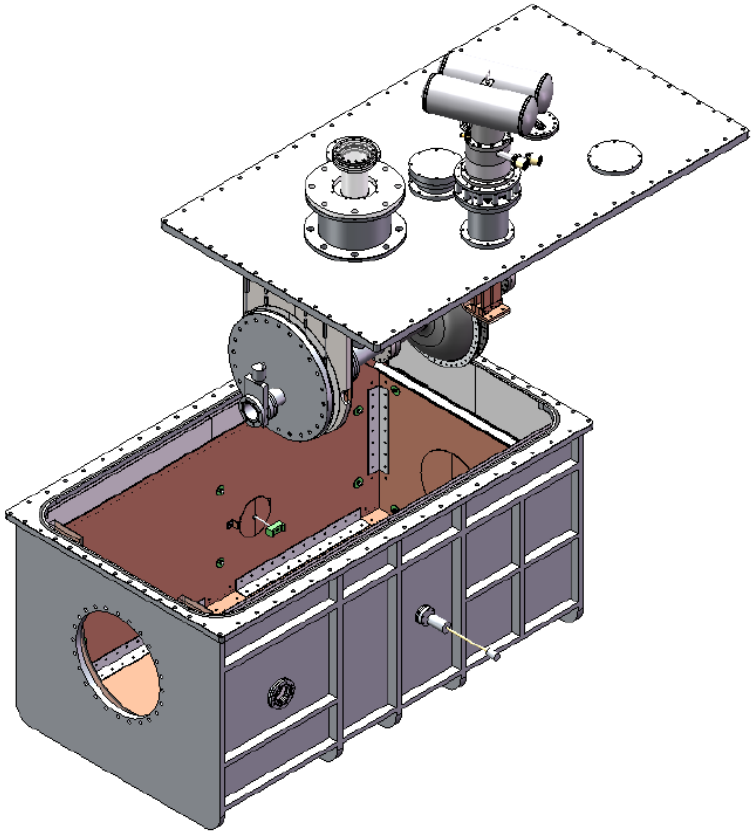
- RadiaBeam's Goal: Break into the SRF field by developing a conduction cooled cryomodule with the help of Fermilab
- Fermilab's Goal: Help RadiaBeam develop SRF capabilities via tech transfer of conduction cooled knowledge and expertise

- Scope: The design, assembly, and testing of a conduction cooled cryomodule suitable for commercial applications
  - RadiaBeam: Leads design, procures materials, and assists with building and testing
  - Fermilab: Provides design guidance, leads assembly and testing

Design

- Fermilab helped RadiaBeam with the design of the cryomodule
  - Cryostat
  - Magnetic shielding
  - Conduction cooling thermal link (link between cavity and cooling head)
  - Instrumentation



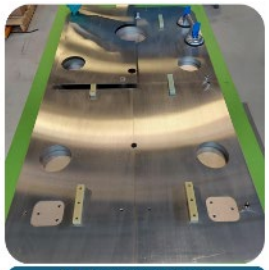


Assembly

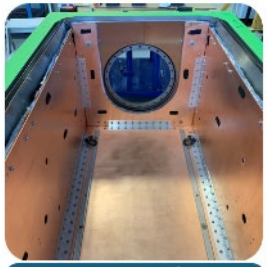
- Fermilab led the assembly effort while working closely with RadiaBeam
  - Regular meetings, RadiaBeam personnel visited FNAL multiple times during assembly and testing phases

Vessel shown before installing magnetic shielding.

Vessel after installing two layers of shielding.



Lid of vessel, showing two layers of magnetic shielding.



Thermal shield, assembled, wrapped in MLI, installed in vessel.

Thermal shield interior MLI installed.

Top plate shown, with cryocooler head and mock coupler.

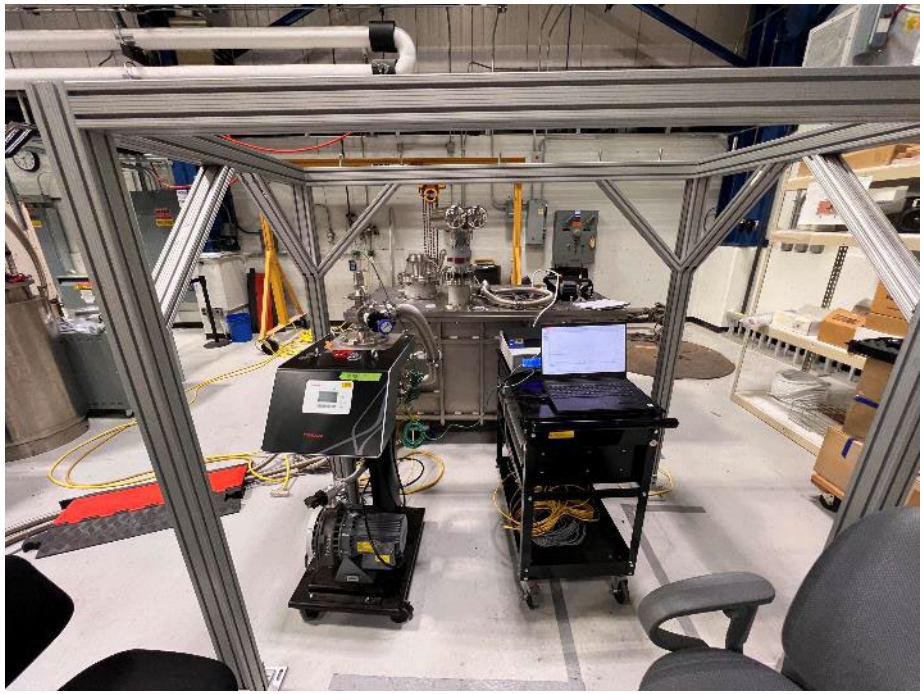
Cavity string with cryocooler link attached.

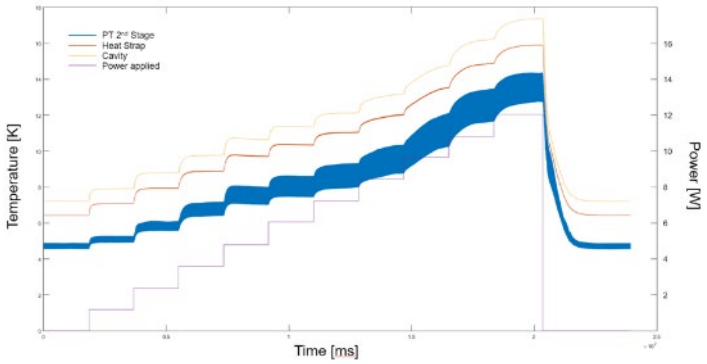
Cryocooler link shown connected to cooling rings on cavity

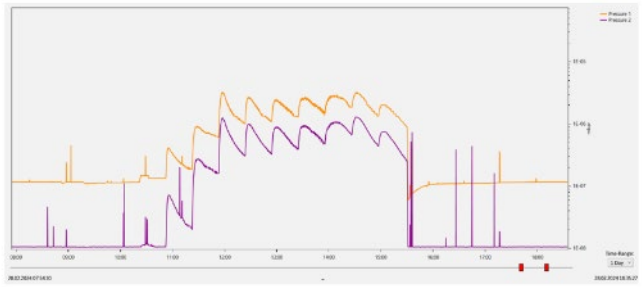
Fully assembled, ready to test.

Testing

- Cryomodule underwent vacuum testing as well as cold testing where the cryomodule was pumped down to ultra-high vacuum levels and cooled down to 4.2K (-452F)
  - Fermilab and RadiaBeam worked together with Fermilab personnel performing hands-on work and RadiaBeam working on data analysis remotely
  - Fermilab and RadiaBeam kept in close contact during testing to talk about testing status, troubleshoot, and discuss results







Final Notes

- By working on this project together, Fermilab successfully transferred conduction cooling technology to RadiaBeam who aims to break into the SRF field for industrial applications
- The IARC team assembled another conduction cooled cryomodule improving our familiarity/skillset with these systems
- Established strong connections and furthered working relationship with domestic small business accelerator company
- Fermilab and RadiaBeam will be presenting this work at Applied Superconductivity Conference in September