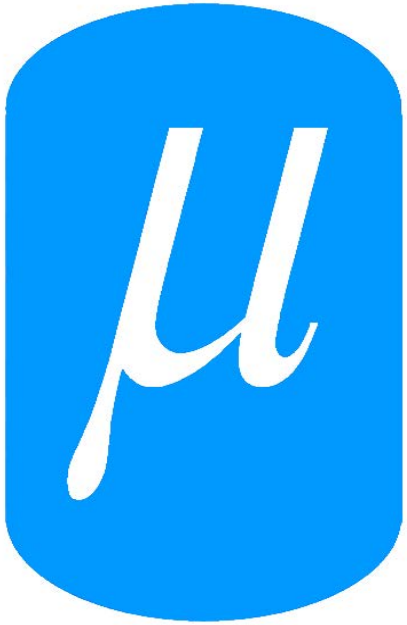
Superconducting Radio Frequency Technology at Muons, Inc.



Muons, Inc.
Innovation in Research

Program Goals

We provide solutions for the design and engineering of superconducting RF (SRF) cavities with focus on operational improvements and reliability.

Due to our close relationship with leading SRF research institutes and industrial manufacturing partners in the US, we are able to turn engineering designs into reality.

The following slide show presents a brief summary of our SRF programs.

Superconducting Particle Accelerator Forum of America

SPAFOA

Muons, Inc. is a gold member of the
Superconducting **P**article **A**ccelerator **F**orum of **A**merica

Superconducting Particle Accelerator Forum of America

"The not-for-profit SPAFOA is an industrial forum that promotes the participation of U.S. industry in major federally funded particle accelerator projects and develops the expertise within industry to apply this technology to the commercial marketplace. The forum provides a vehicle to integrate the resources of the U.S. industrial base into the research, development, manufacturing, construction and operation of major programs based on superconducting radio frequency (SCRF) accelerator technology". (http://spafoa.org)

Fabrication Know-How

Our staff has extensive know-how to design and build SRF cavities based on years of experience gathered at national accelerator laboratories such as Jefferson Laboratory, which owns industrial-standard SRF manufacturing, post-production and testing infrastructure.

450 ton press

male deep-drawing die

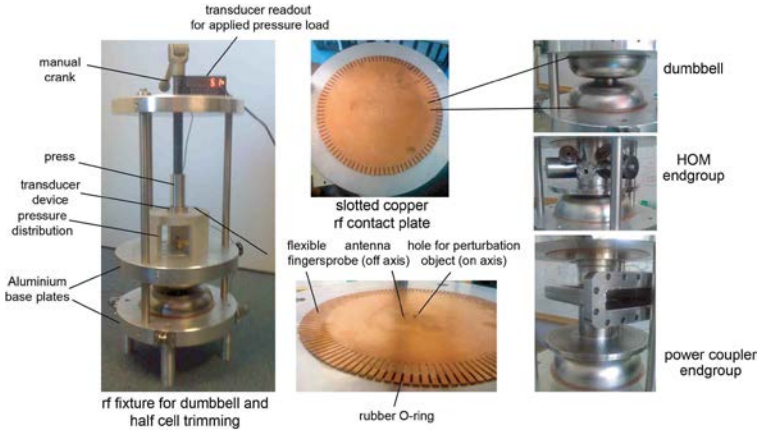
pressed half cells

vacuum electron-beam-welder

closed chemistry cabinet for BCP and HPR

electropolishing cabinet

vacuum furnace for heat treatment



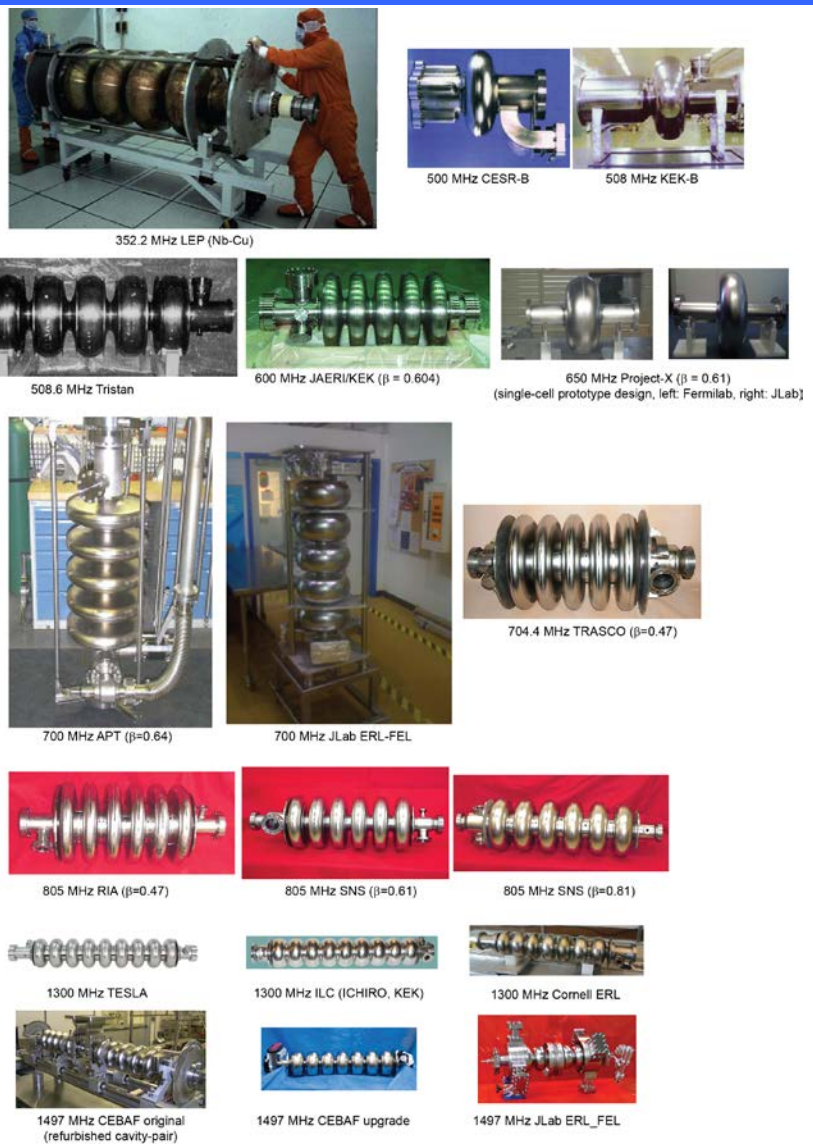
Jefferson Lab

SRF Cavities

Today's elaborate surface post-processing techniques allow SRF cavities to achieve accelerating fields well beyond 20 MV/m in multi-cell elliptical cavities with unloaded quality factors of *O*(1e10) (depending on operating frequency and temperature).

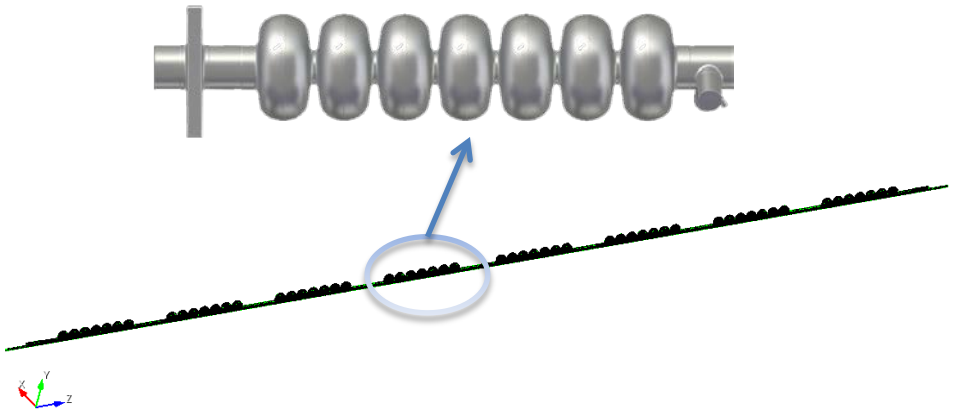
Operational limitations of SRF cavities/components come from effects such as field emission and multipacting.

Using our extensive suite of tools and expertise we are able to study these limiting phenomena and provide solutions for their mitigation.



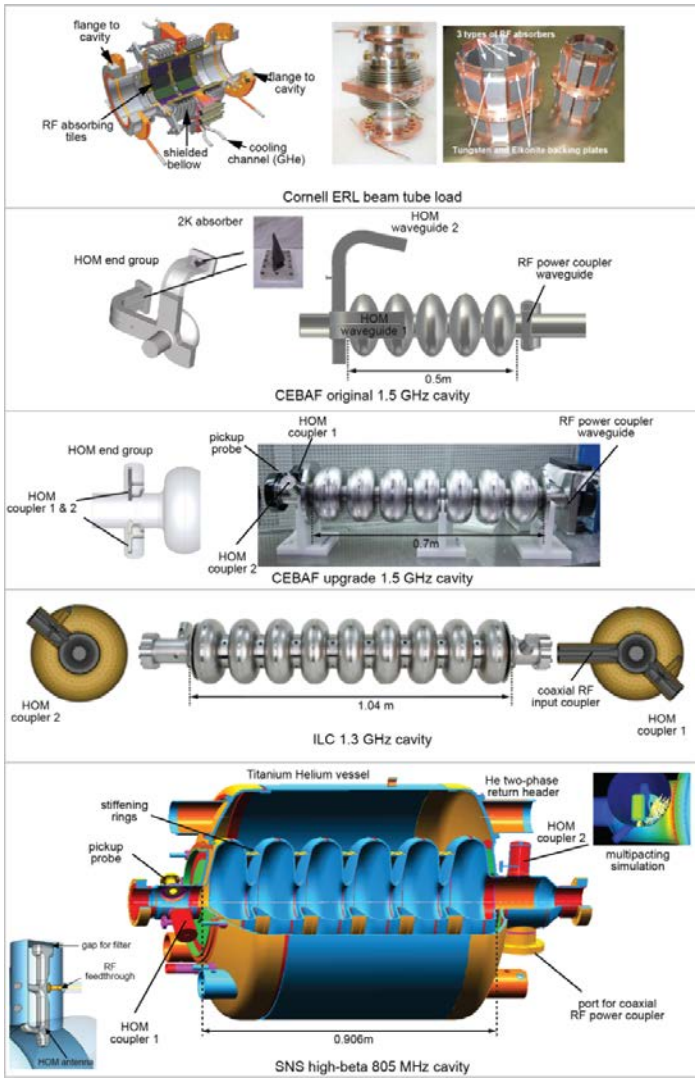
SRF R&D Program

Our R&D program services the demanding needs of national labs. Examples of our work include designing and optimizing SRF cavities/components such as higher order mode couplers/dampers, RF couplers and windows.



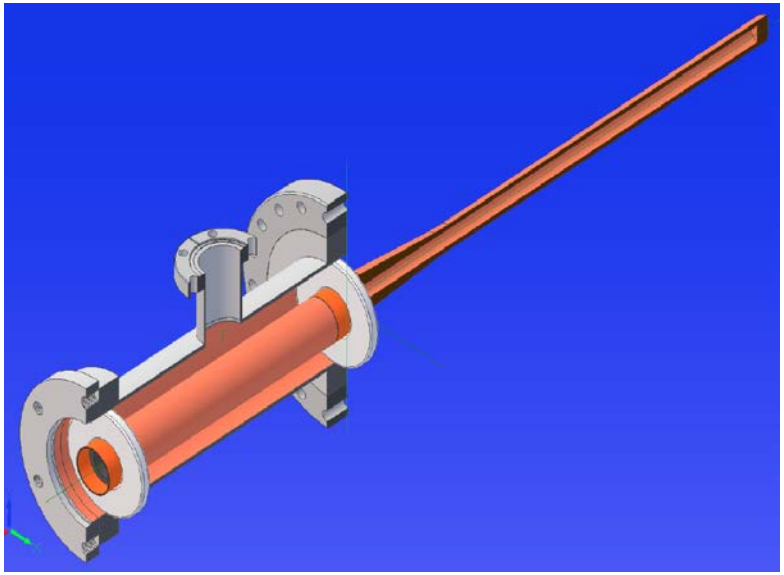
Top: RF supercomputing has been used to investigate Fowler-Nordheim field-emitted electron trajectories in SRF cavities combined to a string representing a realistic cryomodule assembly.

Right: Typical accelerating SRF cavities and components we are able to design and optimize.



RF Coaxial Window Coupler for SRF Cavities

Muons, Inc. is currently designing a dual window RF coaxial coupler at 400 MHz for Jefferson National Laboratory. The unique concept uses the size, spacing, and dielectric constant of the windows to properly maximize the power conversion to the beam. The design employs Muons' proprietary compression RF windows. Thermal and stress analyses are performed using ANSYS.

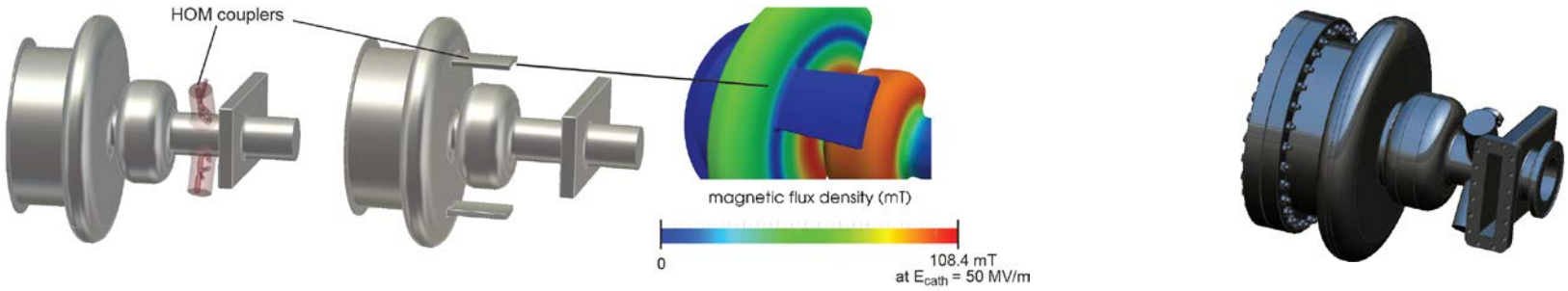


Compression window

Novel SRF Technologies

By replying to the US Department of Energy's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program, we provide SRF technology solutions for the demanding needs of research laboratories, much of this work also addresses improvements for industrial and medical accelerator applications.

Example: the figures below show a novel SRF photoinjector gun cavity optimized to yield a high brightness electron beam required for high brilliance light sources such as Free Electron Lasers or compact Inverse Compton Scattering sources.



Left: Design of an SRF photoinjector gun cavity with two options for Higher Order Mode damping, i.e. coaxial HOM-couplers or on-cell waveguide dampers. Right: Engineering design established under an SBIR Phase I program.

High Power SRF Accelerators to Address the Global Energy Demand

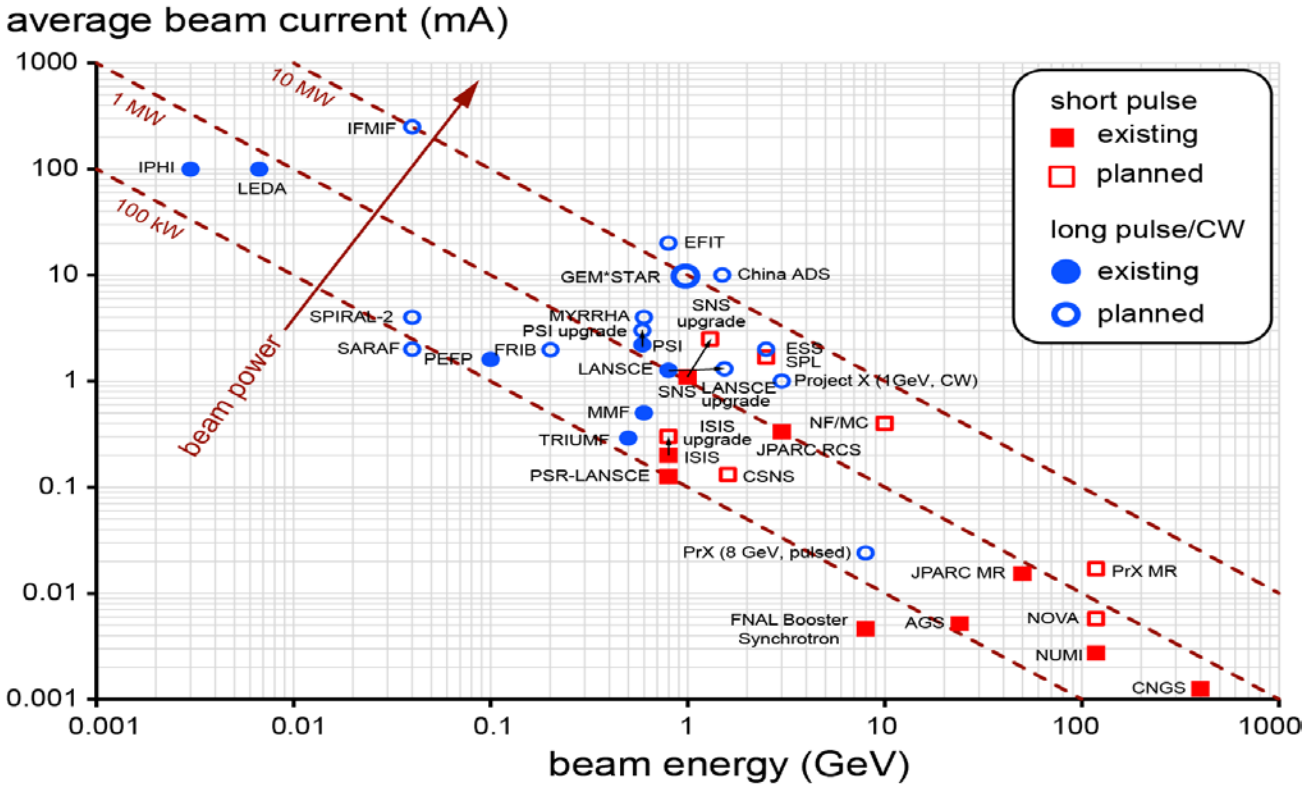
Muons, Inc. is committed to providing technical solutions for high power SRF accelerators. Furthermore, we have strong interest in leveraging our technical solutions to address the growing global energy demands.

High power SRF accelerators are the enabling technology for Accelerator Driven Subcritical Reactor (ADSR) systems.

These accelerator+reactor systems are conceived to fulfill the increasing global energy demand with inherently safe, sustainable, and green nuclear energy. The ADS concept allows supplementing fission neutrons by neutrons produced in spallation targets when bombarded with protons delivered from an accelerator.

The spallation process is most efficient at beam energies around 1 GeV and requires a beam power of a few to a few ten MW depending on the scale of the reactor. This power level can be achieved with average beam currents of a few to a few tens mA, which is most efficiently done using SRF technology.

High Power SRF Accelerator Landscape



Existing and proposed high power accelerators mostly rely on SRF technology rather than normal conducting or cyclotron technology to allow reaching higher beam energies and currents more efficiently. ADS systems (e.g. MYRRHA) and spallation neutron sources (e.g. European Spallation Source) using proton SRF linacs are already under construction in Europe and will provide a larger beam power than existing facilities (i.e. SNS, PSI , LANCSE).