Research Activities on High Temperature Superconducting Devices for Naval Applications at FSU-CAPS

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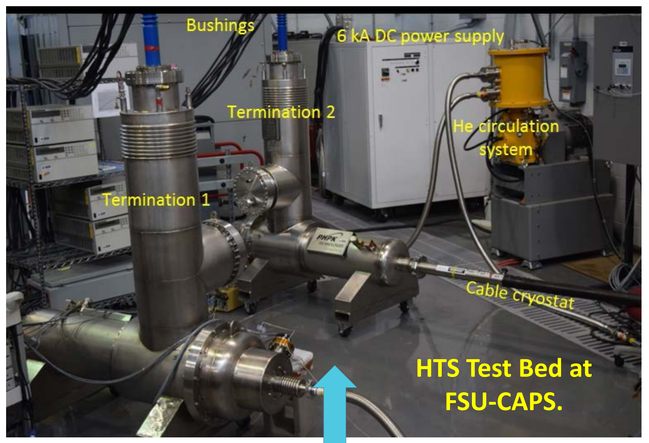
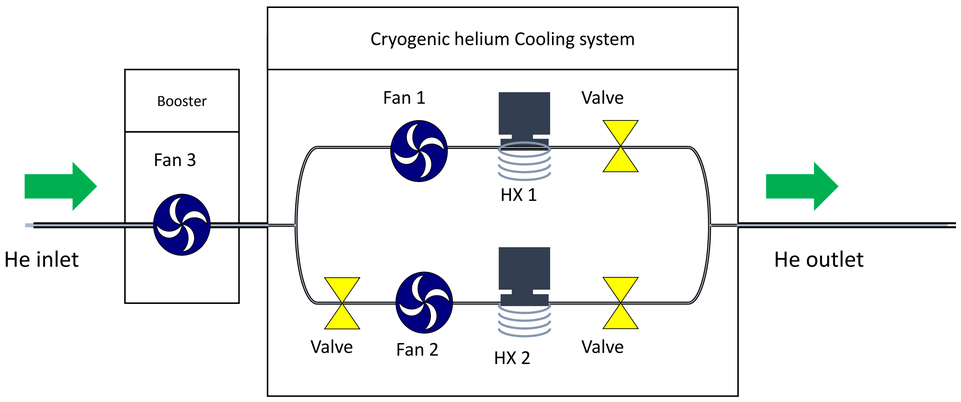
Objective: To achieve high power density superconducting (HTS) power infrastructure on future Navy ships through collaborative basic & applied research and supporting the industry in development, device design, fabrication, and testing. Addressing the challenges in cooling HTS devices with gaseous helium by developing helium gas cryogenics technology is also a focus of FSU-CAPS' research .

Recent Highlights

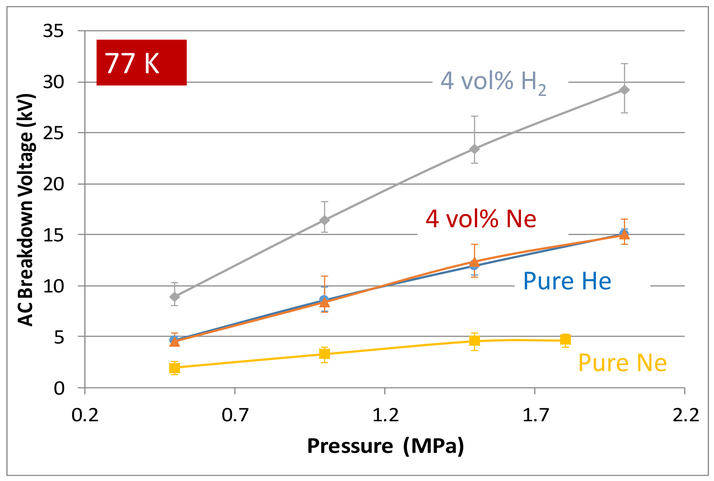
1. Successfully demonstrated a 30-m HTS DC cable - 6 kA and 3.5 kV at 65 K (suitable for ~10 kA at 50 K). The cable system was designed, fabricated, and tested by CAPS in collaboration with Southwire/Ultera.
2. Successfully demonstrated a 30-m HTS 3-phase AC cable - 3 kA at 70 K (suitable for ~4.8 kA at 60 K). Only one phase of the cable was tested. The cable was designed and fabricated by Composite Technology Development (CTD) with support from FSU-CAPS.
3. Discovered that a small (safe) volume % of hydrogen added to helium gas has significantly higher dielectric strength compared to pure helium. Important finding that will allow higher voltage HTS devices.
4. Collaborating with Naval Research Laboratory and American Superconducting Corporation in developing low AC loss HTS conductor architectures. Low AC loss HTS conductor will make allow for high power density superconducting HTS generators and other AC applications of HTS.
5. Actively supporting HTS industry and small businesses in the development of HTS components and devices in the design and demonstration. FSU-CAPS has established the infrastructure and expertise in HTS, cryogenic dielectrics, and cryogenic helium circulation systems necessary for the development of HTS.

1. American Superconductor Corporation
   High Capacity, Robust, Quick Disconnect Power Cable Connector
2. Super Power
   AC loss measurements on the bonded HTS conductor for FCL Transformer & Testing of a HTS coil module
3. Energy to Power Solutions
   Smart current lead for HTS devices & Hybrid HTS cable
4. Advanced Conductor Technology
   Compact HTS cable & Hybrid HTS cable
5. Composite Technology Development
   HTS AC cable design and testing
6. Advanced Magnet Lab
   Advanced AC loss measurements for HTS generator

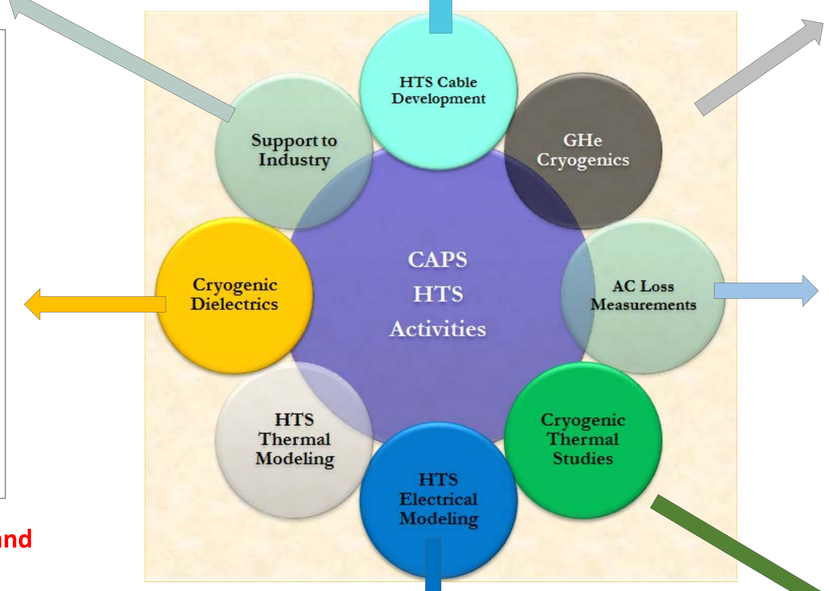


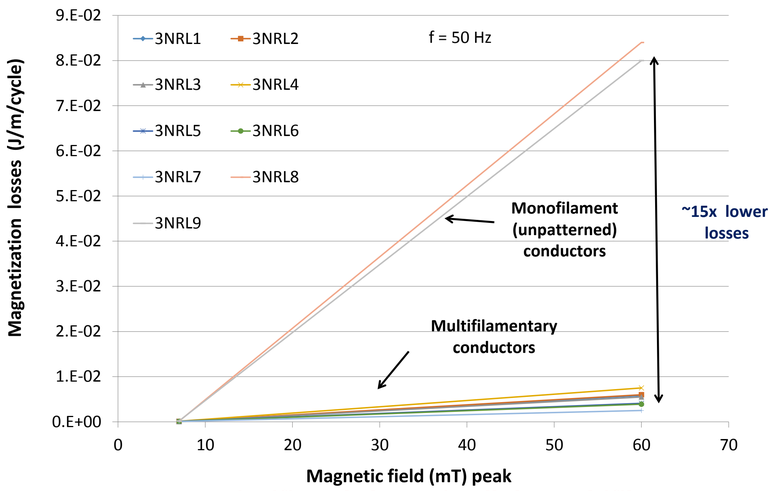


A schematic of a helium circulation system with multiple circulators in series and parallel configuration.

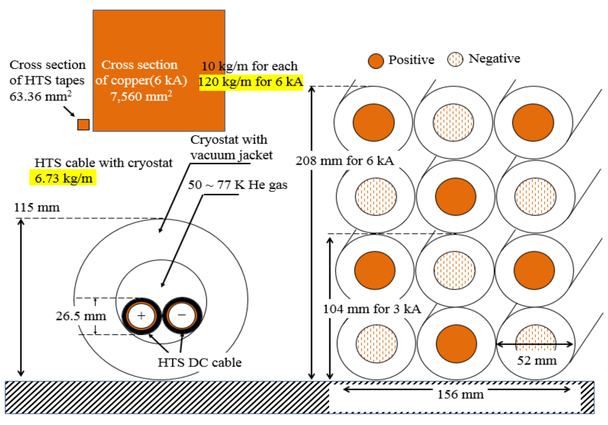


Breakdown voltage as a function of pressure for pure GHe and the mixtures

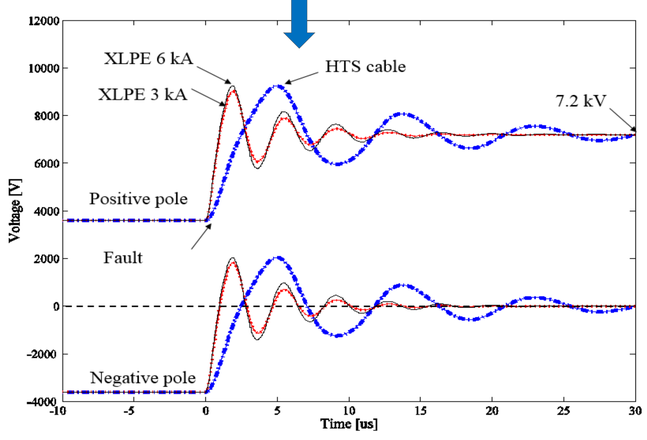




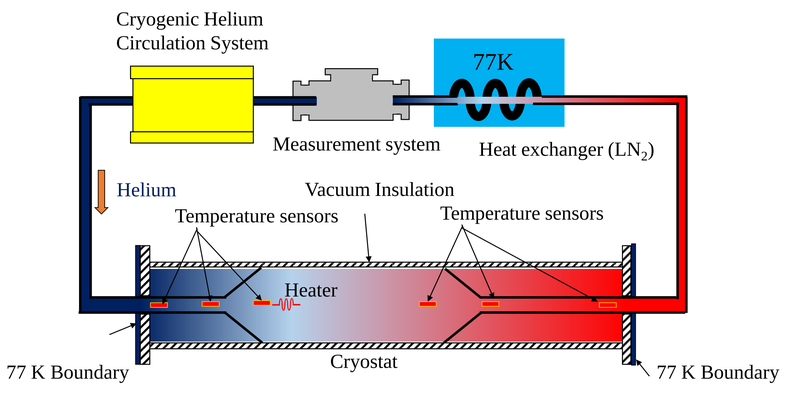
Losses are significantly lower in all the multifilamentary samples compared to the monofilament samples



Comparison of HTS and XLPE cables



Transient over voltage waveform of HTS (blue dashed) and XLPE cables



Measurements of heat capacity of the gas mixtures

Currently funded projects: N00014-14-1-0211; N00014-14-1-0346; N00014-14-1-0198