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Phase and Frequency Locked Magnetrons for SRF Sources

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2011-0003

Fermilab Technical Contact: Vladmir Shiltsev

Summary Report
6 January 2020

Fermi National Accelerator Laboratory / Kirk and Pine Street / P.O. Box 500 / Batavia, IL 60510 / 630.840.3000 / www.fnal.gov / fermilab@fnal.gov
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NOTICE

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

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CRADA Title: Phase and Frequency Locked Magnetrons for SRF Sources

Parties to the Agreement: Muons, Inc. and Fermi Research Alliance, LLC

Abstract of CRADA work:

Magnetrons are low-cost highly-efficient microwave sources, but they have several limitations, primarily centered about the phase and frequency stability of their output. When the stability requirements are low, such as for medical accelerators or kitchen ovens, magnetrons are the very efficient power source of choice. But for high energy accelerators, because of the need for frequency and phase stability - proton accelerators need 1-2 degrees source phase stability, and electron accelerators need .1-.2 degrees of phase stability - they have rarely been used. We describe a novel variable frequency cavity technique which will be utilized to phase and frequency lock magnetrons.

Summary of Research Results:

The work done on this project indicates that the technique to use ferrite-tuned anodes to accomplish phase and frequency locked magnetrons awaits better ferrites with better biasing characteristics and lower losses. The ferrite material is not sufficient to prevent losses that lower the operating Q of the magnetron and at the same time provide sufficient tuning capability. The magnetic field required for this ferrite is also greater than can be achieved with the biasing circuit designed here. This required biasing field was greater than anticipated by the computer modeling, perhaps due to the nonuniformity of the ferrite material. In addition, this raises the issue about whether or not there is sufficient shielding to prevent the ferrite biasing field from impacting the magnetron operating field. These issues need further tests and refinement as the type of ferrite is further investigated.

Related Reports, Publications, and Presentations:

1. Technical Report 1156696

2. Final Project Report "Phase and Frequency Locked Magnetrons for SRF Sources", Neubauer, Michael., Muons, Inc. https://www.osti.gov/servlets/purl/1156596

Subject Inventions listing:

None

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Technical Contact at Fermilab: Vladmir Shiltsev

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