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Low-Cost Two-Stage Magnetron with Power Control for Project X

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2011-0004

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Summary Report
6 January 2020

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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.

CRADA number: FRA-2011-0004

CRADA Title: Low-Cost Two-Stage Magnetron with Power Control for Project X

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

Abstract of CRADA work:

In a particular embodiment, a device is disclosed that includes means for providing a high-power continuous wave (CW) radio frequency (RF) source based on two injection-locked 2-stage CW magnetrons with outputs combined by a 3-dB hybrid combiner. The device also includes means for operating the high-power CW RF source based on the two injection- locked 2-stage CW magnetrons with outputs combined by the 3-dB hybrid combiner to drive superconducting cavities of a linac. In another particular embodiment, a method is disclosed that includes steps for providing a high- power continuous wave (CW) radio frequency (RF) source based on two injection-locked 2-stage CW magnetrons with outputs combined by a 3-dB hybrid combiner. The method also includes steps for operating the high-power CW RF source based on the two injection- locked 2-stage CW magnetrons with outputs combined by the 3-dB hybrid combiner to drive superconducting cavities of a linac.

Summary of Research Results:

The experiments with 2.45 GHz, 1 kW, CW tubes demonstrated capabilities of the magnetrons controlled by a phase-modulated injection-locking signal for dynamic phase control required for intensity-frontier superconducting accelerators. Vector methods of power control in magnetrons are equally fast but provide limited average efficiency at the control. The novel method of power control via wide-range control of the magnetron current provides highest efficiency at low noise and can minimizing the capital and operating costs for ADS-class projects.

Related Reports, Publications, and Presentations:

1. Technical Report 1358091 “Methods of Phase and Power Control in Magnetron Transmitters for Superconducting Accelerators”, Kazakevich, G., Johnson, R., et. al., Muons Inc., Fermilab. https://lss.fnal.gov/archive/2017/conf/fermilab-conf-17-100-ad-td.pdf

Subject Inventions listing:

US10374551B2 Subcritical-voltage magnetron RF power source

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