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Hydrogen-filled RF Cavities for Muon Beams

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2008-0003

Fermilab Technical Contact: Vladimir Shiltsev

Summary Report

6 January 2020

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CRADA number: FRA-2008-0003

CRADA Title: Hydrogen-filled RF Cavities for Muon Beams

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

Abstract of CRADA work:

RF cavities pressurized with hydrogen gas may provide effective muon beam ionization cooling needed for muon colliders. Recent 805 MHz test cell studies reported below include the first use of SF 6 dopant to reduce the effects of the electrons that will be produced by the ionization cooling process in hydrogen or helium. Measurements of maximum gradient in the Paschen region are compared to a simulation model for a 0.01% SF 6 doping of hydrogen. The observed good agreement of the model with the measurements is a prerequisite to the investigation of other dopants.

Summary of Research Results:

The Fermilab MTA was used to extend measurements of maximum stable RF gradient in strong magnetic fields and in the presence of ionizing radiation. Beam-induced gas breakdown was studied by improving computer simulation models that include the use of electron-absorbing dopants, external magnetic fields, and variations of cavity geometry and materials. RF cavities were built or improved to verify the models using MTA RF, beam, and magnetic field.

Related Reports, Publications, and Presentations:

1. Technical Report 952646
2. Project Report "Hydrogen-filled RF Cavities for Muon Beam Cooling", Ankenbrandt, Dr. Charles, Muons, Inc. <https://www.osti.gov/servlets/purl/1104744>
3. Project Report "RF Breakdown Studies Using Pressurized Cavities", Johnson, Rolland, Muons Inc., <https://www.osti.gov/servlets/purl/1157043>

Subject Inventions listing:

None

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Technical Contact at Fermilab: Vladmir Shiltsev

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