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Development and Demonstration of Six-Dimensional Muon Beam Cooling (Same)

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2007-0004

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Summary Report

06 January 2020

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CRADA number: FRA-2007-0004

CRADA Title: Development and Demonstration of Six-Dimensional Muon Beam Cooling (Same)

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

Abstract of CRADA work:

Ionization cooling, a method for shrinking the size of a particle beam, is an essential technique for the use of muons in future particle accelerators. Muon colliders and neutrino factories, examples of such future accelerators, depend on the development of robust and affordable ionization cooling technologies. A 6D cooling experiment has been proposed, incorporating a novel configuration of helical and solenoidal magnets in a prototype cooling channel. This Helical Cooling Channel (HCC) experiment is being designed to provide an affordable and striking demonstration that 6D muon beam cooling is understood well enough to enable intense neutrino factories and high-luminosity muon colliders. Because of the large amount of expected beam cooling, helium instead of hydrogen can be used for the initial experiment, avoiding the safety complications of hydrogen. The main points of the experiment are described, and corresponding numerical simulations are reviewed.

Summary of Research Results:

Summary of accomplishments and project activities are as follows:

1. Helical Cooling Channel (HCC) magnet design progressed in considerable detail.
2. HCC four-coil test: The magnet reached 85 percent of short sample, the approximate level of design operation. It also reached a considerably higher current than the design current, albeit in a lower field. The field distributions agree well with predictions.
3. Several approaches to integrating the RF into the helical magnet were investigated.
4. Placement of the experiment in the MICE hall at Rutherford-Appleton Lab was explored.
5. Investigated the integration and matching of the MANX magnet with the MICE spectrometers and their magnets.
6. The MANX collaboration was formed, held a meeting, and submitted the MANX proposal to the Fermilab AAC.

7. Twelve conference posters and papers were prepared and presented, demonstrating progress and attracting new collaborators.

Related Reports, Publications, and Presentations:

1. Final Technical Report on STTR Project DE-FG02-06ER86282, "Development and Demonstration of 6-Dimensional Muon Beam Cooling", Muons Inc.
<https://www.osti.gov/servlets/purl/1015012>

Subject Inventions listing:

None

Report Date: 06 January 2020

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