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Muon Capture, Phase Rotation, and Cooling in Pressurized RF Cavities

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2006-0002

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Summary Report
April 2009

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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-2006-0002

CRADA Title: Muon Capture, Phase Rotation, and Cooling in Pressurized RF Cavities

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

Abstract of CRADA work:

Gas-filled rf cavities can provide high-gradient accelerating fields for muons and can be used for simultaneous acceleration and cooling of muons. In this paper we explore using these cavities in the front-end of the capture and cooling systems for neutrino factories and muon colliders. We consider using gas-filled rf cavities for the initial front-end cooling systems. We also consider using them for simultaneous phase-energy rotation and cooling in a front-end system. We also consider using lower-density rf cavities, where the gas density is primarily for rf breakdown suppression, with less cooling effect. Pressurized rf cavities enable higher gradient rf within magnetic fields than is possible with evacuated cavities, enabling more options in the front-end. The status of designs of the capture, phase rotation, and precooling systems of muon beams in pressurized cavities is described. Funded in part by SBIR grant DE-FG02-05ER86252.

Summary of Research Results:

These initial examples demonstrate that H2 gas-filled rf cavities can be inserted into the phase-energy rotation section and cooling sections and obtain muon capture and cooling as good or better than that in the optimized neutrino factory design study 2A scenario[1]. The present examples establish that a high-performance υ–factory front end can be developed using the gas-filled cavities for simultaneous high-gradient rf and energy-loss cooling. Variations on the technique can also be explored in preparing muon beams for a μ^+ -μ^- collider.

[1] "Cost-effective Design for a Neutrino Factory", with J. S. Berg, S. A. Bogasz, S. Caspi, J. Cobb, R. C. Fernow, J. C. Gallardo, S. Kahn, H. Kirk, R. Palmer,K. Paul, H. Witte, M. Zisman, Phys. Rev. STAB 9,011001(2006)

Related Reports, Publications, and Presentations:

FERMILAB-CONF-09-14-APC, April 2009, Neuffer, David et al, "Muon Capture, Phase Rotation, and Cooling in Pressurized RF Cavities"

Subject Inventions listing:

None

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