

**U. S. DEPARTMENT OF ENERGY
FIELD WORK PROPOSAL**

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| 1. WORK PROPOSAL NO.: <p align="center">2422.2</p> | 2. REVISION NO.: | 3. DATE PREPARED: <p align="center">03-15-07</p> | 3a. CONTRACTOR NO.: <p align="center">52120</p> |
| 4. WORK PROPOSAL TITLE: Muon Accelerators | | | |
| 5. BUDGET & REPORTING CODE: KA-15-02-03 | 6. WORK PROPOSAL TERM: Begin: End: | 7. IS THIS WORK PACKAGE INCLUDED IN THE INST. PLAN? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | 7a. PRINCIPAL INVESTIGATORS: Norem, J. |
| 8. HEADQUARTERS/OPERATIONS OFC PROGRAM MANAGER: Staffin, R. No. 301-903-3624 | 11. HEADQUARTERS ORGANIZATION: High Energy Physics | | 14. DOE ORG. CODE: SC |
| 9. DOE FIELD ORGANIZATION WORK PROPOSAL REVIEWER: | 12. DOE FIELD ORGANIZATION: Chicago | | 15. DOE ORG. CODE: CH |
| 10. CONTRACTOR WORK PROPOSAL MANAGER: Weerts, H.J. No. 630-252-8831 | 13. CONTRACTOR NAME: UChicago Argonne, LLC | | 16. CODE: 12 |
| 17. IS THIS PROPOSAL TO DO WORK THAT INCLUDES A SECURITY INTEREST? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | |
| 18. WORK PROPOSAL DESCRIPTION (Approach, anticipated benefit in 200 words or less): <p style="margin-left: 40px;">This task covers work related to the design of a neutrino factory, and an experiment that will demonstrate muon cooling. The work is primarily focused on the accelerator physics and technology associated with muon cooling, in particular high gradient rf cavities. Recent accomplishments include: 1) a description of backgrounds in the proof-of-principle Muon Ionization Cooling Experiment (MICE) approved at Rutherford-Appleton Laboratory, and 2) isolation of the dominant mechanisms that cause breakdown in rf cavities, which are applicable to all high voltage breakdown. This effort is specifically directed at demonstrating that muon cooling can work and that neutrino sources and muon colliders are practical options. In the process, we are discovering some of the most basic principles limiting the fields that can be generated in rf cavities.</p> | | | |
| 19. CONTRACTOR WORK PROPOSAL MANAGER: <p align="center"><i>H. Weerts</i></p> | | 20. OPERATIONS OFFICE REVIEW OFFICIAL: | |
| <p align="center">03-15-07</p> | <p align="center">03-15-07</p> | <p align="center">03-15-07</p> | <p align="center">03-15-07</p> |
| <p align="center">SIGNATURE</p> | <p align="center">DATE</p> | <p align="center">SIGNATURE</p> | <p align="center">DATE</p> |
| 21. DETAIL ATTACHMENTS: (See specific attachments.) | | | |
| <input type="checkbox"/> a. Facility requirements | <input checked="" type="checkbox"/> e. Approach | <input type="checkbox"/> i. NEPA requirements | <input type="checkbox"/> m. ES&H considerations |
| <input type="checkbox"/> b. Publications | <input checked="" type="checkbox"/> f. Technical progress | <input checked="" type="checkbox"/> j. Milestones | <input type="checkbox"/> n. Human/Animal Subjects |
| <input checked="" type="checkbox"/> c. Purpose (mandatory) | <input checked="" type="checkbox"/> g. Future accomplishments | <input type="checkbox"/> k. Deliverables | <input type="checkbox"/> o. Security requirements |
| <input type="checkbox"/> d. Background | <input checked="" type="checkbox"/> h. Relationships to other projects | <input type="checkbox"/> l. Performance Measures/Expectations | <input checked="" type="checkbox"/> p. Other (specify) |

**WORK PROPOSAL REQUIREMENTS FOR OPERATING/EQUIPMENT
OBLIGATIONS AND COST**

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|---|--|-----------------------------|--------|--------------|---------|-------------------------|------------------------|-----------------------------|----------------------|
| CONTRACTOR NAME UChicago Argonne, LLC | | WORK PROPOSAL NO. 2422.2 | | REVISION NO. | | CONTRACTOR NO. 52120 | | DATE PREPARED 01/30/2007 | |
| 21. STAFFING (in staff years) | | PRIOR YEARS | FY2007 | FY2008 | FY2009 | | FY2010 | FY2011 | TOTAL TO COMPLETE |
| | | | | ESTIMATE | REQUEST | AUTHORIZED | | | |
| a. Scientific | | | 0.8 | 2.0 | 2.0 | | 0.0 | 0.0 | |
| b. Other Direct | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | |
| c. Technical Services* | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | |
| d. Total Direct | | | 0.8 | 2.0 | 2.0 | | 0.0 | 0.0 | |
| 23. OBLIGATIONS AND COSTS (in thousands) | | | | | | | | | |
| a. Total Obligations | | | 200 | 562 | 568 | | 0 | 0 | |
| b. Total Costs | | | 202 | 543 | 566 | | 0 | 0 | |
| 24. EQUIPMENT (in thousands) | | | | | | | | | |
| a. Equipment Obligations | | | 0 | 0 | 0 | | 0 | 0 | |
| b. Equipment Costs | | | 0 | 0 | 0 | | 0 | 0 | |
| 25. MILESTONE SCHEDULE (Tasks) | | FY2009 DOLLARS | | | | PROPOSED SCHEDULE | AUTHORIZED SCHEDULE | | |
| | | PROPOSED | | AUTHORIZED | | | | | |
| | | | | | | | | | |
| 26. REPORTING REQUIREMENTS | | | | | | | | | |

* Technical services staffing includes ANL support divisions' scientific effort.

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| CONTRACTOR NAME UChicago Argonne, LLC | CONTRACTOR CODE CH | CONTRACTOR NUMBER 52120 | |
| WORK PACKAGE NUMBER | WORK PROPOSAL NUMBER 2422.2 | DATE PREPARED 03-15-07 | REVISION NUMBER |

21. DETAIL ATTACHMENTS: (See specific attachments.)

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|--|---|---|---|
| <input type="checkbox"/> a. Facility requirements | <input type="checkbox"/> e. Approach | <input type="checkbox"/> i. NEPA requirements | <input type="checkbox"/> m. ES&H considerations |
| <input type="checkbox"/> b. Publications | <input type="checkbox"/> f. Technical progress | <input type="checkbox"/> j. Milestones | <input type="checkbox"/> n. Human/Animal Subjects |
| <input checked="" type="checkbox"/> c. Purpose (mandatory) | <input type="checkbox"/> g. Future accomplishments | <input type="checkbox"/> k. Deliverables | <input type="checkbox"/> o. Security requirements |
| <input type="checkbox"/> d. Background | <input type="checkbox"/> h. Relationships to other projects | <input type="checkbox"/> l. Performance Measures/Expectations | <input type="checkbox"/> p. Other (specify) |

Neutrino Factory / Muon Collider - RF Studies

The long-term goal of the neutrino source / muon collider design effort is to determine if high intensity muon beams for neutrino sources and muon colliders are a realistic option for the High Energy Physics community. Argonne effort is centered on understanding and improving rf structure performance, with the long term goal of muon cooling, and the short term goal of insuring that the Muon Ionization Cooling Experiment (MICE) at Rutherford/Appleton Laboratory in England, will work. We have also been looking at SCRF and high frequency rf limits. Results of this work include:

- Improved understanding of how high gradient limits are affected by magnetic fields, pressures and cavity geometry. This work includes very limited exploitation of the Atom Probe Tomography facilities at Northwestern.
- A model of rf gradient limits in warm copper cavities. This model shows how gradient limits depend on a number of different parameters, and permits interpolation and extrapolation to other systems, DC operation and some superconducting rf failure modes.
- Initiation of a program to develop "failure-proof" nano-fabricated superconducting rf composites, being done by ANL/MSD (M. Pellin). Since SCRF systems fail in a few, fairly well understood ways, it is possible to design and manufacture materials that cannot fail in these ways. This should increase the reliability of all SCRF systems. This program could lead to real breakthroughs and should have very high priority.

a) FY 2006-2007 Accomplishments:

The Mucool test area is now functioning and we have taken data that helps understand high pressure, high magnetic field and geometry effects in the high gradient limits we need to optimize for MICE. We also have developed a model for understanding all high gradient limits for accelerators and have started a program to develop SCRF materials which cannot fail in known ways.

b) FY 2008/9/10 Plans:

We will continue development of rf cavities for MICE, modeling of breakdown triggers and experimental tests in the Fermilab MTA. Understanding the failure modes of rf structures is an important aspect of developing "failure-proof" nano-fabricated composites for superconducting (muon accelerators) and normal (muon cooling) applications.