Cooperative Agreement NCC8-124

Between NASA/MSFC and UAH

Final Report

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Introduction

From its start in December 1996, the Cooperative Agreement NCC8-124 allowed that some tasks could be performed primarily by UAH, some primarily by MSFC and some in a joint manner. The detailed distribution of effort has evolved in a pragmatic fashion, with each organization focusing on those tasks that seemed most urgent and for which appropriate capabilities existed. The final, all-up experiments were envisioned as a very careful measurement process carried out jointly using components developed at both UAH and MSFC.

The total project began with an air of optimism that the necessary apparatus for the adopted objectives could be quickly and easily assembled. Not surprisingly, technological difficulties were encountered by all parties and it has proven impossible to complete the challenging experiments in the term of this cooperative agreement.

The UAH accomplishments toward the ultimate experiments are reported here in a taskwise manner.

Task 1, Superconducting Disk

Produced the first United States 12" superconductivity disk of 1-2-3 superconducting material

The steps completed include powder preparation, procurement of a unique twelve-inch die for cold pressure, disk pressing, disk heat-treating, and disk characterization. Each step posed problems that had to be overcome. During the forming of the disk, a press time and rate procedure was completed after approximately twenty attempts. In addition, discussion in the literature about the Podkletnov experiment stated a 2-1-1 disk was used. Dr. Li fabricated a 2-1-1 disk, but she discovered it was inferior to the 1-2-3 disk and does not recommend its use.

Two usable 1-2-3, 12" superconductivity disks were produced. To our knowledge, this is the first time disks of this size and quality have been produced in the United States. Use of the MSFC press capabilities was essential to this success and is gratefully acknowledged. Development of the technology to make large superconducting disks reproducibly is in itself a useful accomplishment, as they can have multiple applications.

For this project the superconducting disks are the heart of the experiments to be performed. There is little doubt that the supporting apparatus for disk levitation, cooling, rotation, etc., can be assembled with due diligence. Successful disk fabrication was initially not so clear. The hardest remaining task is assembly of a convincing suite of instrumentation capable of measuring small changes in a gravity field.

In summary, by mastering disk fabrication, UAH accomplished the key task expected of it.

Task 2, Cryogenic Dewar

This project task was primarily a MSFC responsibility.

Task 3, Superconductor Test Laboratory

The UAH laboratory to support this project was defined by Dr. Li. She prepared equipment lists with specifications for use in her lab. The equipment was procured and set up. Three operational furnaces of various temperature ranges were included in the lab. These are required for heat treatment of the disks.

To characterize the disks, Dr. Li conducted a superconductivity materials study. She developed instrumentation for all the superconductivity measurements. Included was measurement of high temperature transition superconductivity materials. The nominal time for a comparable effort is measured in years, but, in this case, it was completed in the first year of the agreement.

Task 4, Levitation Magnet

For development tests with disks smaller than 12", an array of permanent magnets assembled by MSFC was used in productive joint experiments.

UAH hoped eventually to acquire another array of permanent magnets suitable to levitate the 12" disks. This redundancy will allow development tests to progress in parallel at UAH and MSFC. At the end of 1997, limited levitation magnet facilities presented a bottleneck to progress.

The electromagnets ultimately needed are envisioned as a MSFC lead task.

Task 5, Rotation Mechanism

This project task has been primarily a MSFC responsibility.

Task 6, Gravity Effect Mechanism

UAH has given thought to this task, which will ultimately be crucial. The Consortium for Materials Development in Space has access to accelerometers that may be of value. Also, under separate MSFC funding, another UAH element tested a potential optical gravitometer without magnetic effect.

Task 7, Superconductor Tests

This final task embraced the expected experiments using levitated, rotating disks, perhaps with radio frequency illumination and a variety of gravity measurement instruments.

Final Status

After the first year of effort under this cooperative agreement, limited activity continued at UAH for some months with a no-cost extension. It as much as not continuation funding was received, and MSFC discontinued efforts on its tasks of the cooperative scope, the envisioned final experiments and measurements could not be completed.

UAH is satisfied that the primary role expected of it, namely 12" disk fabrication, was accomplished successfully. It is unfortunate that these fine superconducting specimens were never used in the desired experiments.