2003-188-N0 -- DEVELOPMENT OF A MODEL 3-SPOKE SUPERCONDUCTING RESONATOR FOR RIA

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Funding Profile:

FY 2001	$0K
FY 2002	$0K
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Purpose: The RIA baseline driver linac design employs 805 MHz, elliptical-cell cavities, operating at 2K, in the high-energy section. This work is to develop an alternative, 345 MHz three-spoke-loaded cavities, operating at 4.2K, which have the potential to provide increased performance while at the same time reducing both capital and operating costs. The particular task undertaken is to design, fabricate, test, and evaluate test versions of niobium 345 MHz three-spoke-loaded superconducting cavities suitable for the entire high-energy section of the RIA driver linac.

Approach: Development is proceeding in several steps:

1. Numerically simulate electromagnetic and mechanical properties to evaluate design concepts for two types of triple-spoke cavity.

2. Construct niobium test models to each of the two cavity types required. Use the tooling, forming, welding, and other techniques developed for the two-spoke RIA cavity as far as possible and develop further techniques as required.

[A] [B]

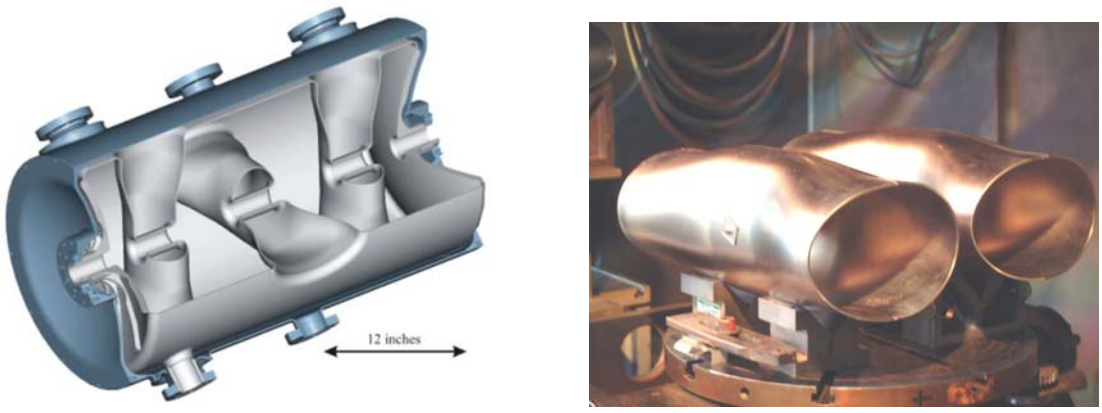

Fig.1: [A] Sectioned view of a 345 MHz triple-spoke cavity showing the niobium cavity housed within a stainless steel helium vessel; [B] Two elliptically-sectioned niobium spokes as set up for seam-welding the spoke-halves together.

3. Chemically process critical cavity surfaces and assemble for cold tests using low-particulate clean techniques as developed for the two-spoke cavity.

4. Perform cold tests to determine and establish the appropriate operating parameters for this class of cavity.

Technical Progress and Results: To date, we have

1. Developed, evaluated, and finalized designs for two cavity types.

2. Procured the high-purity (RRR>250) niobium required for fabrication.

3. Formed most of the dies and tooling required for fabrication.

4. Formed and welded major sub-assemblies of the test model cavities.

In the future, we will

1. Complete fabrication of both cavity test models.

2. Extend the test cryostat (developed for the two-spoke cavity) to accommodate the larger triple-spoke cavities.

3. Chemically process the cavities and perform cold tests as required to characterize performance.

Specific Accomplishments: Completed detailed Pro-E and Autocad drawing files for fabrication of two types of three-spoke loaded, 345 MHz cavities for particle velocities v/c = 0.5 and 0.62, as required for the high-energy section of the RIA driver linac.

Nine of the eleven dies required for forming niobium elements of the two cavity types have been fabricated and proved out. These dies are suitable for production of cavities for the RIA driver.

<u>Publications</u>

K.W. Shepard, P.N. Ostroumov, and J.R. Delayen "High-Energy Ion Linacs Based on Superconducting Spoke Cavities," *Phys. Rev. ST – AB,* **6**:080101 (2003).

Kenneth Shepard, "Status of Low and Intermediate Velocity Superconducting Accelerating Structures," in Proc. 2003 IEEE Particle Accelerator Conference, Portland, Oregon (May 12-16, 2003).