2003-180-N0 -- TESTING OF A MODEL 345 MHZ FAST TUNER FOR THE RIA DRIVER LINAC

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Purpose: RF phase control of superconducting (SC) accelerating structures can be difficult and expensive, particularly for cw operation at modest beam currents, as is the case for the RIA driver linac. Several methods of phase control have been developed for other applications, such as the PIN-diode based reactive tuner used for some SC cavities below 150 MHz, and piezoelectric mechanical tuners used in pulsed operation on some elliptical-cell cavities at frequencies of 805 MHz and above. The aim of this project is to evaluate various methods for suitability for tuning the 345 MHz superconducting cavities required for the RIA driver, and as part of this process, develop efficient, cost-effective tuner hardware to compensate the effects of microphonic-induced variations in cavity frequency.

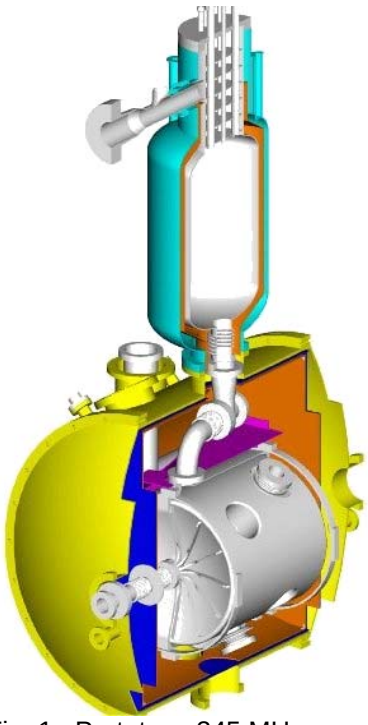

Fig. 1. Prototype 345 MHz double-spoke cavity assembled in a horizontal test cryostat.

Approach: A recently completed test model 345 MHz double-spoke cavity has been mounted in a horizontal cryostat connected the ATLAS helium refrigeration system. This cavity can be operated cw for long periods at gradients as high as 8 MV/m and provides an excellent test bed for (a) determining the nature and extent of microphonics and (b) evaluating tuning devices. Our overall approach is to examine microphonics in this cavity, analytically and/or numerically design and evaluate various options for fast tuners, and fabricate and test fast tuners as appropriate. The goals are to evaluate potential methods and devices, to develop as necessary to establish feasibility, and to enable system design choice for the RIA driver.

Technical Progress and Results: Created and acquired electronic rf systems to enable accurate measurent of microphonic phase/frequency noise in 345 MHz superconducting cavities.

Characterized microphonics in the test model 345 MHz double-spoke cavity as a function of several parameters, including rf heat load.

Demonstrated a method of fast-tuning, using over-coupling to an rf power amplifier, and demonstrated phase control of the 345 MHz double-spoke cavity for an extended period of time while operating at 4.3 K at an accelerating gradient of 7 MV/m.

With Stefan Simrock (DESY) and Jean Delayen (JLAB), we have designed and acquired elements for a piezo-electric mechanical fast-tuner.

We have worked with Energen, Inc. by specifying the design of a magnetostrictive fast-tuner for test and evaluation on our test model 345 MHz double-spoke cavity.

In the future, we hope to complete, cold-test, and evaluate a piezo-electric fast-tuner and complete, cold-test, and evaluate a magnetostrictive fast-tuner.

Specific Accomplishments:

Michael Kelly, Sergey Sharamentov, Kenneth Shepard, Jean Delayen, “Microphonics Measurements in SRF Cavities for RIA,” in Proc. 2003 IEEE Particle Accelerator Conference, Portland, Oregon (May 12-16, 2003).

M.P. Kelly, K.W. Shepard, J.D. Fuerst, M. Kedzie, “Microphonics Measurements in RIA Cavities,” in Proc. 11th Workshop on RF Superconductivity, Lubeck, Germany (September 8-12, 2003).