

Measurement and Control of Microphonics in High Loaded-Q Superconducting RF Cavities (THP66)

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- SRF cavities for the Rare Isotope Accelerator (RIA)
- Beam loading & rf requirements
- Prototype elliptical cryomodule
 - THP70
 - Collaboration with JLAB
- Microphonics measurements
- Adaptive feedforward cancellation of sinusoidal disturbances
 - TUP76



RIA SRF Cavities





- Design beam for RIA driver linac
 - -400 kW, 400 MeV/u ²³⁸U^{88,89,90+}
 - 0.37 mA

Туре	6-cell	6-cell	6-cell
β_{g}	0.47	0.61	0.81
V _a (MV)	5.12	8.17	13.46
P _{beam} (W)	1660	2640	2600*
Qbeam	9.1×10^7	9.1×10^7	$1.4 \mathrm{x} 10^8$
$P_{g}(W)$	3320	5280	5200
QL	3.0×10^7	3.0×10^7	$4.7 \text{x} 10^7$
Control bandwidth	25	25	16
$\Delta_{\text{allowed}}(\text{Hz})$	23	23	10

*Decreased from maximum value due to transit time factor

Prototype β=0.47 Cryomodule (THP70)





β=0.47 Tuner-Cavity-Power Coupler

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β =0.47 Module Assembly





β =0.47 Module Assembly





β =0.47 Module Assembly





β =0.47 Module Assembly (Feb 04)





805MHz 10kW Amplifier



• THALES TH382 aircooled vacuum tetrode w/ a TH18482 cavity





Cavity and microphonics circuit







External/room temperature tuner

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Tuner Bode diagram





Active damping

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• Adaptive feedforward cancellation of sinusoidal disturbances (TUP76)



6.5 Hz helium oscillation

57 Hz electric motor

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- Protype elliptical cryomodule has demonstrated requirements for RIA
- Continue testing thru 2005
 - LLRF controls and high power testing
 - Improved passive & active microphonics control
- Invitation to colleagues interested in high Q_L operation
 - Test LLRF & microphonic control techniques





β=0.47 Module Clean Room Assembly (Nov '03)





β =0.47 4-Cavity Module





$\beta = 0.47$ Module Cross-Section



β =0.47 Module End View





Cold Mass Transport from JLAB to MSU (Nov '03)





























β =0.47 Module Test Results (March 04)

- Static load ~10 W at 2 K
- Power coupler operating at full power
- External frequency tuner
 - 1 MHz range with resonance near center
 - Piezoelectric operational
- High field tests
 - Approaching design gradients (32.5 MV/m and 64.2 mT peak)

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- Limited by X-rays (100 mRem/hr) since no shielding
- Calorimetry for Q measurements underway
- Microphonics
 - Design $Q_L = 2x10^7$, bandwidth~40 Hz
 - Preliminary measurements show peak microphonic levels less than design bandwidth



β=0.47 R&D Program

e-beam welding and first test performed at JLab





NSCL SRF Facility Layout





NSCL SRF R&D Facility





NSCL SRF Chemistry Facility









BCP Pumping System

Temperature	<15 C
Heat Exchanger	5 kW
Filtration	4 microns
Speed	8 gpm

