Design and Fabrication of The RHIC Electron-Cooling Experiment High Beta Cavity and Cryomodule

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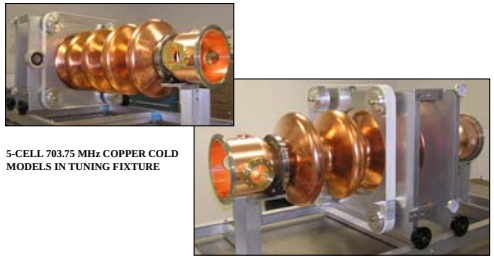
ThP26

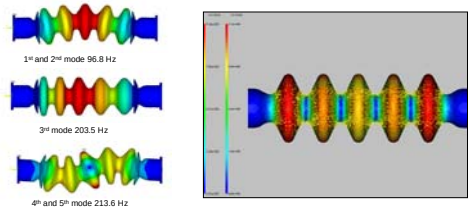
Abstract
Advanced Energy Systems is currently under contract to BNL to design and fabricate a five cell superconducting 703.75 MHz cavity and cryomodule for the RHIC e-Cooler SRF Energy Recovery Linac (ERL) program. The superconducting cavity fabrication is complete while fabrication of cryomodule components has begun. The cryomodule component design facilitates a build-in-place integration approach of the cavity string with the other major components of the cryomodule, helping to minimize assembly tooling requirements. This paper will review the design, analysis and fabrication of the e-Cooler cavity and cryomodule.

Schedule
- Cavity Fabrication – Complete
- Cavity Cleaning and Testing – Fall 2005
- Cavity String Assembly – Winter 2006
- Cryomodule Integration – Spring 2006



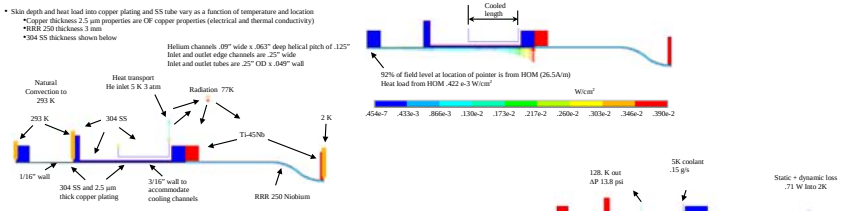
5-CELL 703.75 MHz COPPER COLD MODELS IN TUNING FIXTURE

Cavity Design & Analysis
The 5 cell cavity shape developed by BNL includes transitions to large diameter beam pipes allowing HOMs to propagate out of the cavity to external ferrite loads. AES fabricated two cold models and delivered them to BNL for RF design verification.

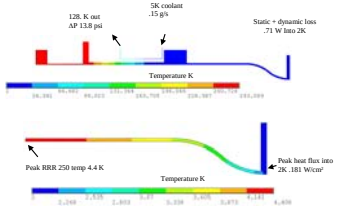


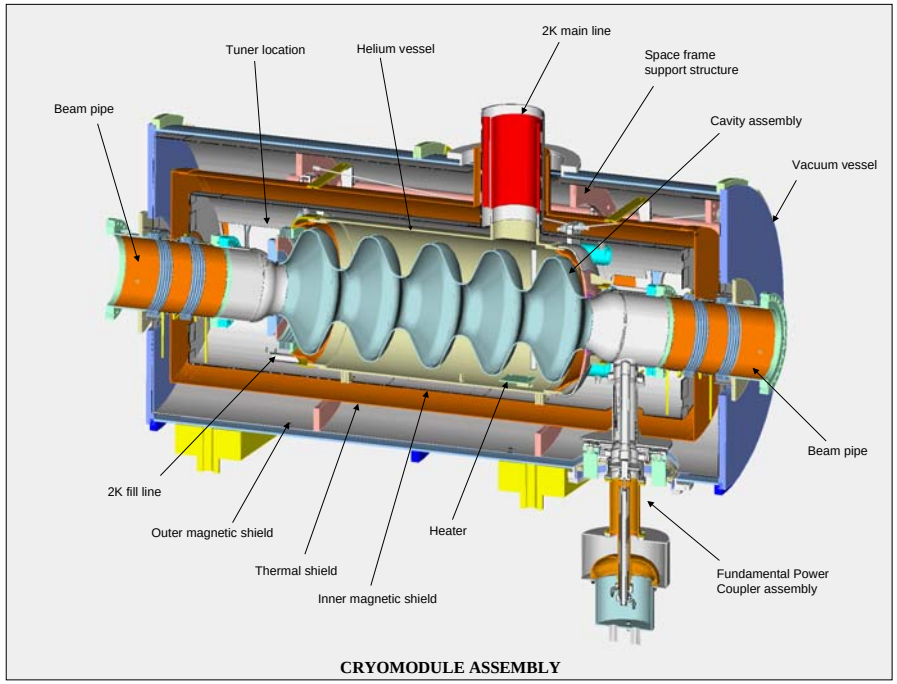
MECHANICAL AND ELECTROMAGNETIC ANALYSIS

Cavity Design & Analysis
Finite element models were used to evaluate the thermal, structural, and RF behavior of the cavities under thermal load, pressure load, and loads from the cavity tuner.



Beam Pipe Design & Analysis
Finite element models were used to evaluate the thermal behavior of the beam pipes due to fundamental and HOM RF Loads

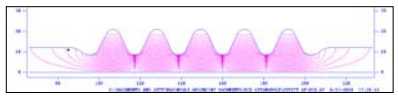




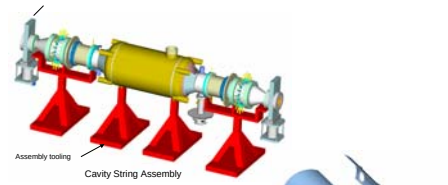
CRYOMODULE ASSEMBLY

Cavity Frequency	**703.781 MHz**
Energy Gain (E_0TL)	**15 MV**
E_0 (Iris to Iris, L = 1.065m)	**20.356 MV/m**
Max Design E Field at Iris, E_{peak}	**27.861 MV/m**
Max Design H Field at Wall, H_{peak}	**64870.6 A/m or 6.487 mT**
Avg Design H Field over Walls, H_{avg}	**61887.2 A/m or 6.189 mT**
Design Stored Energy	**126.931 Joules**
Residual Resistivity used in SUPERFISH	**10 nOhms**
Q_0 at 2K	**1.51×10^{10}**

RF Parameters as calculated by SUPERFISH



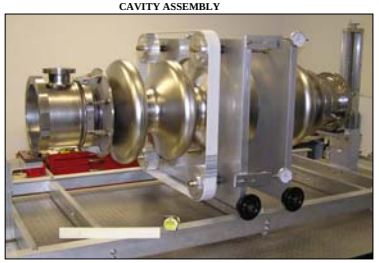
RF Field Profile as calculated by SUPERFISH



Cryomodule Buildup
The cryomodule design allows a build-in-place integration of the magnetic shielding, thermal shielding support structure and vacuum vessel to the cavity string assembly. This approach was adopted in an effort to minimize tooling requirements for the one of a kind cryomodule.

CAVITY PRE-WELD ASSEMBLY

CAVITY ASSEMBLY



CAVITY ASSEMBLY IN TUNING FIXTURE

Advanced Energy Systems, Inc.

BROOKHAVEN NATIONAL LABORATORY

Jefferson Lab