

# AES/BNL Crab Cavity Development SBIR Phase I Proposal “Development of an 800 MHz Crab Cavity”

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# SBIR Program Format

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- Phased program
- Phases awarded independently
- Phase One
  - 8-9 Months
  - Limited Program
  - 500 Hours (13 Man Weeks)
  - Feasibility Study
  - Costing Study for Phase Two
- Phase Two
  - Based on successful Phase One
  - Phase Two is proposed via Phase One report.
  - Two year program \$750K max
  - Year two technically optional for DOE
  - Hardware and Test phase

# BNL AES Collaboration

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- BNL
  - Cavity Physics and RF Design.
- AES
  - Engineering, Analysis, and Manufacturing.

# Technical Objectives

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- The overall technical objective of our project over phase I and II is to design, fabricate, and test an 800 MHz prototype crab cavity.
- We will also generate a preliminary design for a cryomodule for this cavity.
- The Phase I objective is to perform the preliminary design of the crab cavity including; physics design, RF design, initial analysis, and the preliminary mechanical design.
- We will also perform the conceptual design of cryomodule which includes selection of the configuration and the initial layout.

# Principle Technical Issues

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- Physics/RF design of cavity.
  - Type of cavity to be used.
  - Detailed shape definition.
  - Optimization of squash ratio.
- Cavity layout in cryomodule.
  - Number and location of cavities.
- Definition of HOM loads to be utilized.
  - Layout and configuration.
- Definition of tuners and power couplers.
  - New tuner design may be required.

# Phase I Work Plan

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- Preliminary Design of Cavity
  - Physics Design
  - RF Design
  - Initial Analysis
  - Preliminary Mechanical Design
- Conceptual design of cryomodule
  - Select configuration
  - Initial layout
- This work will be divided among BNL and AES.

# Work Breakdown

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- BNL Tasks
  - Perform Physics Design of Initial Crab Cavity concept.
  - Perform RF Design in support of Physics Design to generate initial crab cavity shape.
  - Assist in initial definition and layout of cavity support equipment required for cryomodule such as couplers, HOM loads, tuners, etc.
- AES Tasks
  - Preliminary Design of Cavity
    - Perform initial mechanical design of Crab Cavity as defined by BNL Physics and RF Design.
      - Mechanical layout
      - Weld sequence
      - Fabrication Methodology
    - Perform initial analysis in support of mechanical design.
      - Temperature dependent thermal analysis.
      - Structural Analysis including thermal stress and vacuum loads.
    - One iteration of the interactive mechanical design and analysis process will be performed resulting in an indication of whether our approach is feasible and should be carried forward to Phase II.
  - Conceptual Design of Cryomodule.
    - Evaluate cryomodule requirements and select overall cryomodule configuration.
    - Perform initial layout of cryomodule internals including cavity, structure, shield package, couplers, tuners, HOM loads etc.

# Phase II

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- A successful completion of the phase I activities would result in a feasible preliminary design concept for an 800 MHz crab cavity along with an initial concept for a cryomodule to house and support it.



# Phase II Program Plan

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- Cavity Design and Fabrication
  - Complete mechanical design with supporting thermal/structural analysis.
  - Generate complete fabrication drawing package for the Crab Cavity.
  - Fabricate Prototype Crab Cavity
  - Perform HPR and BCP (EP?) on Prototype Crab Cavity at AES if our facilities can accommodate it. We anticipate that we will be able to accommodate an 800 MHz elliptical crab cavity.
  - Support Crab Cavity VTA testing at BNL
- Cryomodule Design
  - Finalize and begin to define the selected cryomodule configuration with fairly detailed models of the various support components, internal structure, plumbing, and shielding package.
  - Perform initial thermal and structural analysis to validate our preliminary design concept for the cryomodule.
  - Create a preliminary design and CAD model of the complete cryomodule including cavity, structure, shield package, couplers, tuners, HOM loads etc.
- Plan for phase II will be finalized in phase I

# Summary

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- Full program is about two and a half years.
- Primary objective is to fabricate and test a prototype Crab Cavity.
- Then define support components required.
- And complete preliminary design of a crymodule.
- Phase One will more clearly define the Phase Two Program.