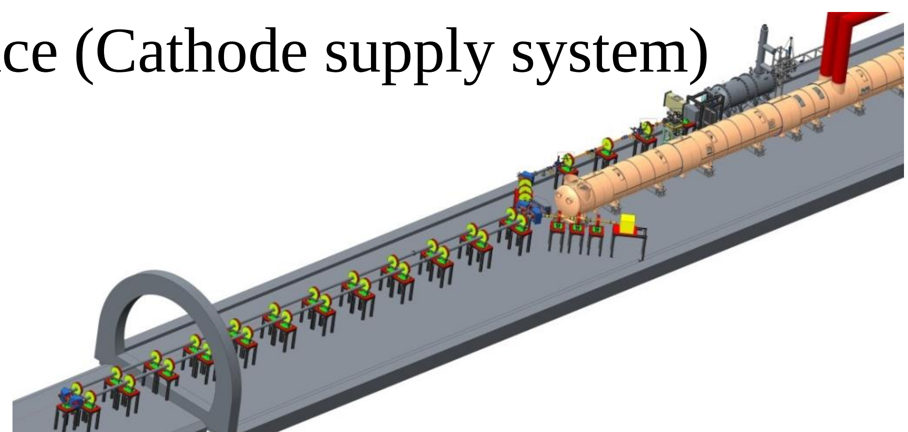
WBS 3.0 SCRF eGun and AccCavity, Mechanical Engineering Support for preliminary design, cost estimate, and DOE review.

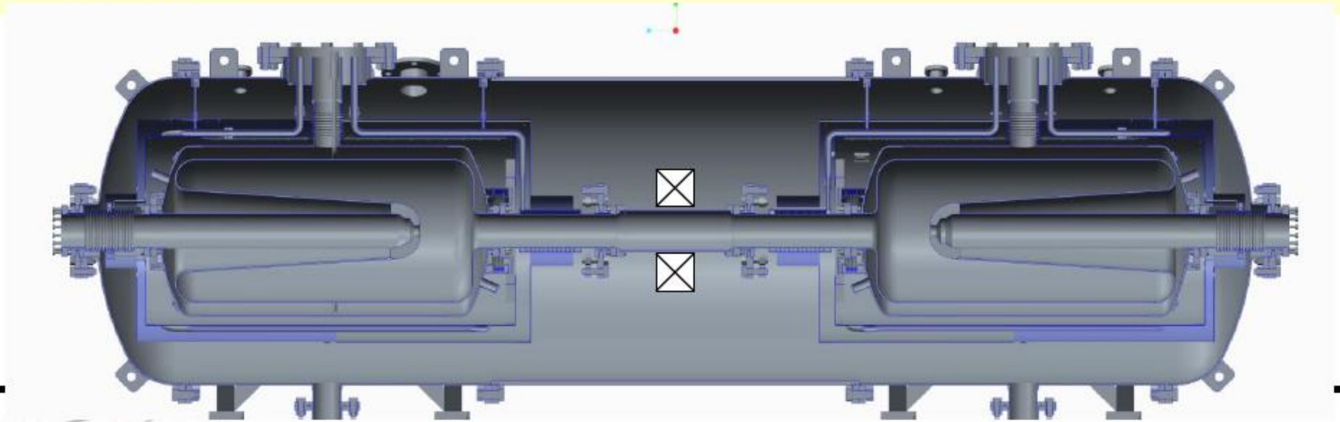
- Cavity Power Couplers + RF Transmission Line from 1002D
- Vacuum Cryostat Assembly (Procurement – ASME code vessel)
- Cryostat Vacuum Systems (Pumping and Monitoring)
- Cavity and Solenoid Magnet Support Frame
- (Shipping fixture Argonne to BNL)
- Magnetic Shield Assembly(s)
- Cryostat internal (or close external) 2.0K Helium Supply System
- Cryostat 50K Heat Shield Assembly
- Cathode insert fixture/cavity interface (Cathode supply system)
- Laser port interface
- Cavity tuner system(s) interface



Low Energy RHIC electron *Cooling*

LEReC SRF accelerator

- The electron accelerator (a short linac) will consist of a two-cavity superconducting RF (SRF) cryomodule producing beam with energy up to 5 MeV and normal conducting cavity for energy spread correction.
- The cryomodule will house:
  - A photoemission SRF gun of a quarter wave resonator (QWR) type, operating at 84.5 MHz;
  - A 84.5 MHz QWR SRF booster cavity;
  - There will be a superconducting solenoid (with magnetic field up to 1 kG) between two SRF cavities.
- 507 MHz normal conducting cavity will correct energy spread due to RF curvature of the SRF cavities.



designed in collaboration with ANL

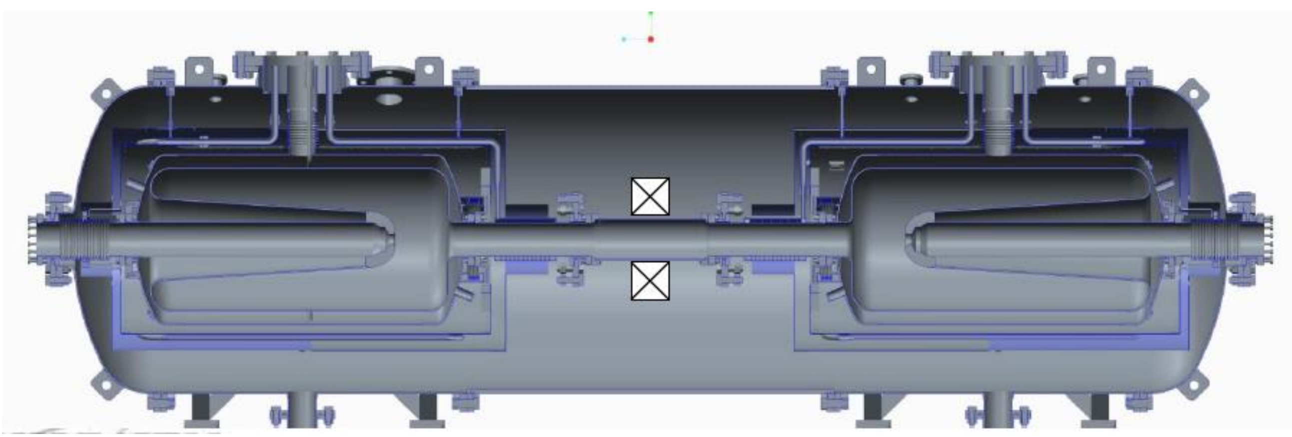
A. Fedotov et al., NA PAC13, Pasadena, CA, 2013

SCRF Cavity Issues

Decision to operate cavities at 2K instead of 4.5K.

- ANL provides 2 SCRF cavities with helium vessels and SC solenoid.
- TBD will they be provided as a completed string? Or in sections?
- BNL provides: Cryostat, Internal support frame, magnetic shielding, cryogenic supply and 2K heat exchanger, cryogenic heat shield, FPC (purchased window assembly + cryostat interface).
- Mechanical Engineering support team: G. McIntyre, J.C. Brutus, Y.R. Than, T. Tallerico, C. Pai

Decision on RF Amplifier Designs (A. Zaltsmen and S. Belomestmykh)



3	1	1	**SCRF eGun and AccCavity**	**Belomestnykh**	eGun and AccCavity	Belomestnykh	System Management
3	2	1	**SCRF eGun and AccCavity**	**Belomestnykh**	eGun and AccCavity	ANL	Cavity string assembly with He Vessel
3	2	2	**SCRF eGun and AccCavity**	**Belomestnykh**	Cavity End Tuner System	ANL	Cavity Tuning Mechanical Drive Assembly
3	2	3	**SCRF eGun and AccCavity**	**Belomestnykh**	Cavity End Tuner System	**ANL/DeSanto, Brutus**	Tuner Drive System
3	2	4	**SCRF eGun and AccCavity**	**Belomestnykh**	Cavity End Tuner System	**DeSanto**	Motor Drive Control
3	3	1	**SCRF eGun and AccCavity**	**Belomestnykh**	Fundamental Power Coupler	Belomestnykh	Cavity Power Couplers
3	3	2	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Brutus, Pai	Cavity, Solenoid, Cryostat assembly
3	3	3	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Brutus	Cavity Vacuum Cryostat
3	3	4	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Brutus	Cavity string assembly support frame
3	3	5	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Brutus	Magnetic Shield Assemblies
3	3	6	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Than	Cryostat 2.0 or 4.5K Helium Supply System
3	3	7	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Brutus	Cryostat 50K Heat Shield Assembly
3	3	8	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Mapes	Beamline internal vacuum components
3	3	9	**SCRF eGun and AccCavity**	**McIntyre**	eGun and AccCavity	Mapes	Insulating vacuum components
3	4	1	**SCRF eGun and AccCavity**	**Belomestnykh**	RF Power Supply	Zaltsman	RF Power Supply
3	4	2	**SCRF eGun and AccCavity**	**Belomestnykh**	LLRF	Zaltsman	LLRF
3	4	3	**SCRF eGun and AccCavity**	**Belomestnykh**	Coax Line	Zaltsman	Coax
3	5	1	**SCRF eGun and AccCavity**	**Belomestnykh**	Cathode	Skaritka	Cathodes
3	5	2	**SCRF eGun and AccCavity**	**Belomestnykh**	Cathode Support/Insertion	Brutus, Skaritka	Cathode Installation and Swap Assembly
3	6	1	**SCRF eGun and AccCavity**	**Belomestnykh**	Laser	Sheehy	Laser
3	6	2	**SCRF eGun and AccCavity**	**Belomestnykh**	Laser	Sheehy	Laser Transport Hardware
3	6	3	**SCRF eGun and AccCavity**	**Belomestnykh**	Laser	Sheehy	RF/Controls Interface
3	7	1	**SCRF eGun and AccCavity**	**Gassner**	Internal BPM Assembly	Mapes	BPM w/cryostat feedthroughs
3	8	1	**SCRF eGun and AccCavity**	**McIntyre**	Cavity Installation	Brutus, Pai	Including Support Stand
3	8	2	**SCRF eGun and AccCavity**	**McIntyre**	Cavity Installation	Folz	Tunnel Clean Room and Scaffold

4	1		**SC Solenoid Magnet**	**Belomestnykh**	SC Solenoid Magnet	Belomestnykh	System Management
4	2		**SC Solenoid Magnet**	**Belomestnykh**	Magnet Fabrication	ANL	BNL III 5 Cell Cavity
4	3		**SC Solenoid Magnet**	**Belomestnykh**	Magnet Support Frame	CAD ME TBD	BNL III 5 Cell Cavity
4	4		**SC Solenoid Magnet**	**Belomestnykh**	Magnet Leads and Feedthrough	CAD ME TBD	BNL III 5 Cell Cavity
11	1	1	**Cryogenic Systems**	**Than**	Cryogenic Systems	Than	System Management
11	2	1	**Cryogenic Systems**	**Than**	2.5/4.5K Cryogenic Supply & Return	TBD	RHIC LHe Supply/Transfer Line
11	2	2	**Cryogenic Systems**	**Than**	4.5K Cryogenic Supply & Return	TBD	Helium Heat Exchanger
11	2	3	**Cryogenic Systems**	**Than**	2.5/4.5K Cryogenic Supply & Return	TBD	Cryogenic valves and fittings, etc.
11	2	4	**Cryogenic Systems**	**Than**	2.5/4.5K Cryogenic Supply & Return	TBD	RHIC gHe Warm Return Xfer line
11	2	5	**Cryogenic Systems**	**Than**	2.5/4.5K Cryogenic Supply & Return	TBD	Warm return valves and fittings
11	2	6	**Cryogenic Systems**	**Than**	2.5K Cryogenic Supply & Return	TBD	He Vacuum system interface
11	2	7	**Cryogenic Systems**	**Than**	2.5K Cryogenic Supply & Return	TBD	System Installation
11	3	1	**Cryogenic Systems**	**Tallerico**	Cryogenic Instrumentation and Control	Tallerico	Electronics Controlers
11	3	2	**Cryogenic Systems**	**Tallerico**	Cryogenic Instrumentation and Control	Tallerico	PLC & Computing Hardware
11	3	3	**Cryogenic Systems**	**Tallerico**	Cryogenic Instrumentation and Control	Tallerico	Temp & Pressure Sensors
11	3	4	**Cryogenic Systems**	**Tallerico**	Cryogenic Instrumentation and Control	Tallerico	Software development
11	3	5	**Cryogenic Systems**	**Tallerico**	Cryogenic Instrumentation and Control	Tallerico	System Installation

1. Interface with Argonne on the engineering design of the niobium cavities and the surrounding helium vessels. This includes review of engineering calculations and stress analysis of the cavity designs that will be needed for the BNL safety reviews. Based on our previous experience CAD engineers will be the primary source for these calculations and will have to present them to the BNL committees. How will the parts be shipped ANL to BNL?

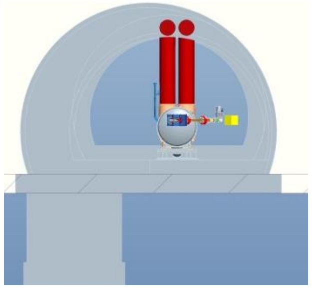
2. Interface with the BNL cryogenics group on the design of the helium vessels and the helium supply system, the heat shield, and the heat exchanger design incorporated into the cavity's' cryostat (Cryogenics WBS?). This includes review of engineering calculations and stress analysis of the internal cryogenic piping and heat exchanger that will be needed for the BNL safety reviews.

3. Cryogenic supply and return systems in the tunnel (Cryogenics WBS).
4. Cryogenic instrumentation in the gun/linac cryostat (Cryogenics WBS ?)
5. The cavity assemblies and solenoid will be installed into an ASME coded vacuum vessel. BNL is responsible for the procurement of the vacuum vessel and integration with the Argonne components, the cathode insertion fixture, the FPC's, etc.
6. The support frame for all of the internal components must also be designed and procured by BNL. The magnetic shields for both RF cavities are also BNL's responsibility.

7. The cathode support frame provided by Transfer Engineering is not robust and they do not have the cleanroom capability for clean assembly. A more robust support frame insertion track will be designed and fabricated in house by CAD and then assembled in the tunnel cleanroom.
8. Tunnel cleanroom, cryogenic scaffold, cryostat stand, and cryogenic piping support design, integration, procurement, and installation.
9. Design oversight of the solenoid magnet design, procurement, and installation (by Argonne). This will include oversight of the internal magnet mounting and alignment and the cold to warm lead design with thermal analysis.

10. Insulating vacuum system – pumping and instrumentation.
11. Internal cavity (beamline) vacuum system. Cathode insertion system “airlock”. Vacuum level and vacuum pumping while the cavity is “warm”.
12. Internal beamline BPM.

1:00 Tunnel



24m to larger tunnel

Estimate and Review Schedule

October 21: ***Freeze design parameters: 14 M or 20 M, (final white paper).***

01:00 Side, 2K cryogenics, passive magnetic shielding, 20 M

November 4: Provide conventional facilities estimated needs: AC power, water and air-conditioning, floor and rack space, heavy equipment, beamline components, cables and cable tray, . . .

November 18: round 1 - Cost estimate spreadsheets, milestone schedules, system operating/design parameters.

December 6: round 2 - Cost estimate spreadsheets, milestone schedules, system risk list and risk mitigation.

December 20: Project Execution Plan first draft (w/Risk List).

Janary 3: Project Execution Plan distributed internally for review.

January 7: DOE Presentation Dry Run

January 13: Project Execution Plan sent to DOE.

January 27 (Monday): DOE Review 2 ½ days.

Systems Engineers

SRF – **S. Belomestnykh** (RD

SCRF Cavity – Argonne NL /(BNL interface **-** AD) **G. McIntyre**

Cathode Insertion Fixture – **C. Brutus** (AD)

Power Coupler – **C. Brutus/**Sergey (AD)

Laser Port – **C. Brutus/**B. Sheehy (AD)

Cavity Tuners - DeSanto

RF Systems PS and LLRF – **A. Zaltsman** (AD)

Cryogenics – **R. Than**, T. Tallerico, P. Orfin, J. Haung (AD)

Cryostat BPM – **M. Minty, D. Gassner**, T. Miller

Drive Laser & Photocathode Development – **B. Sheehy** (CeC, RD)

Conventional Facilities Cleanrooms and Scaffold? – **J. Tuozzolo**

Internal and Insulating Vacuum Systems – **M. Mapes** (AD)