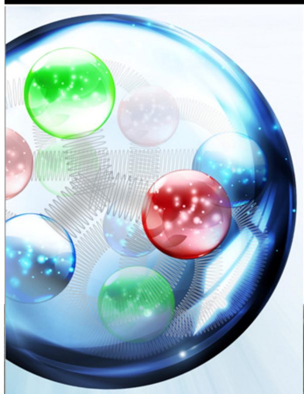
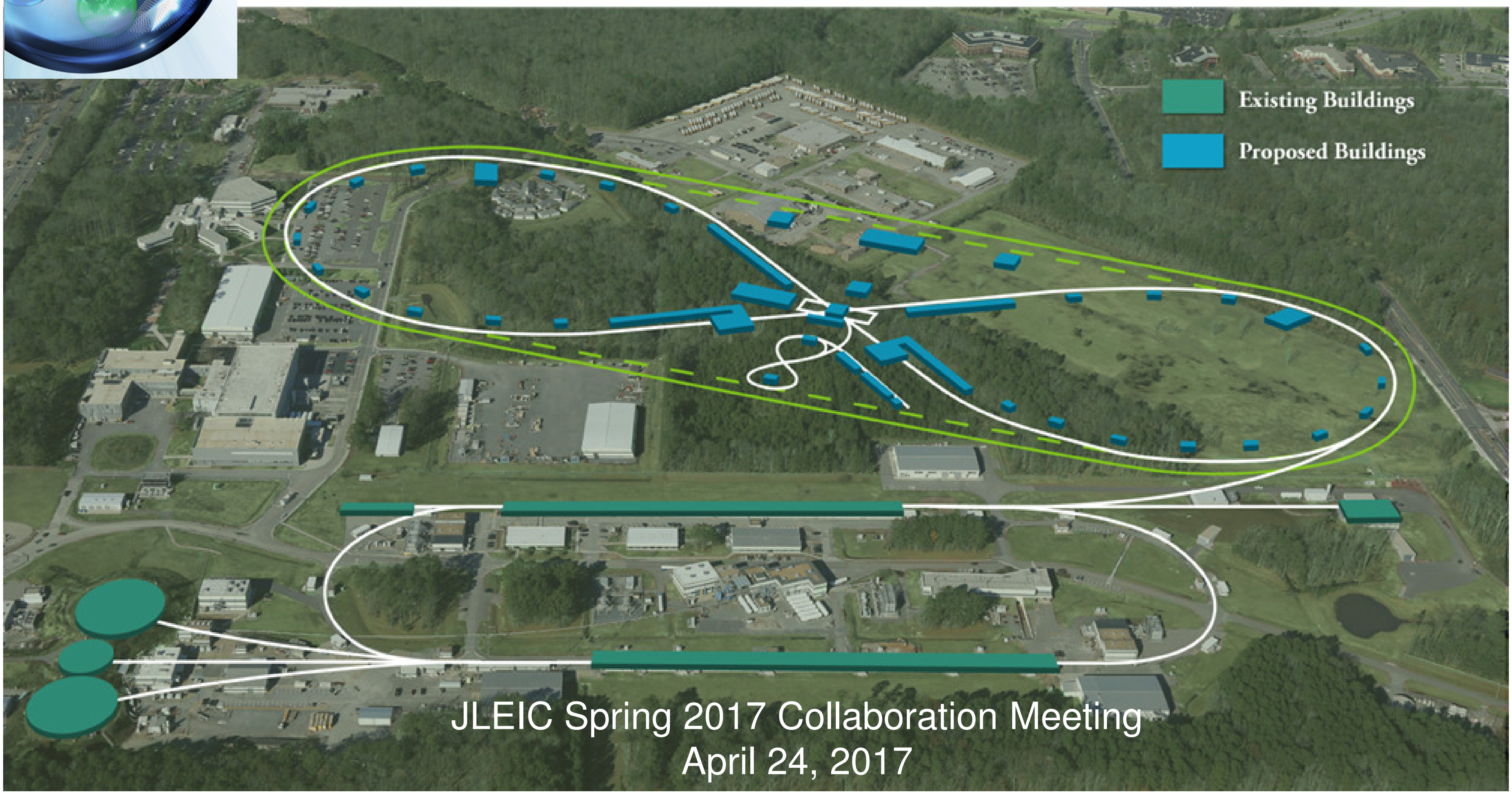


Engineering Status

Tim Michalski



JLEIC Spring 2017 Collaboration Meeting
April 24, 2017

Agenda

- Superconducting (SC) Magnet R&D
- Beamline Elements Affecting Impedance
- Beamline / Site Layout
- Next Steps

SC Magnet R&D

- 6 SC Magnet R&D Proposals
  - MAG1: Superferric 3T, Fast Ramping, Short Prototype
  - MAG2: Alternate SC 3T Fast Ramping Magnets
  - MAG3: Full Length Prototype with Cryostat
  - MAG4: IR, Compact, Large Aperture, High Radiation Magnets
  - MAG5: Cooler Solenoids
  - MAG6: Spin Rotator Solenoids

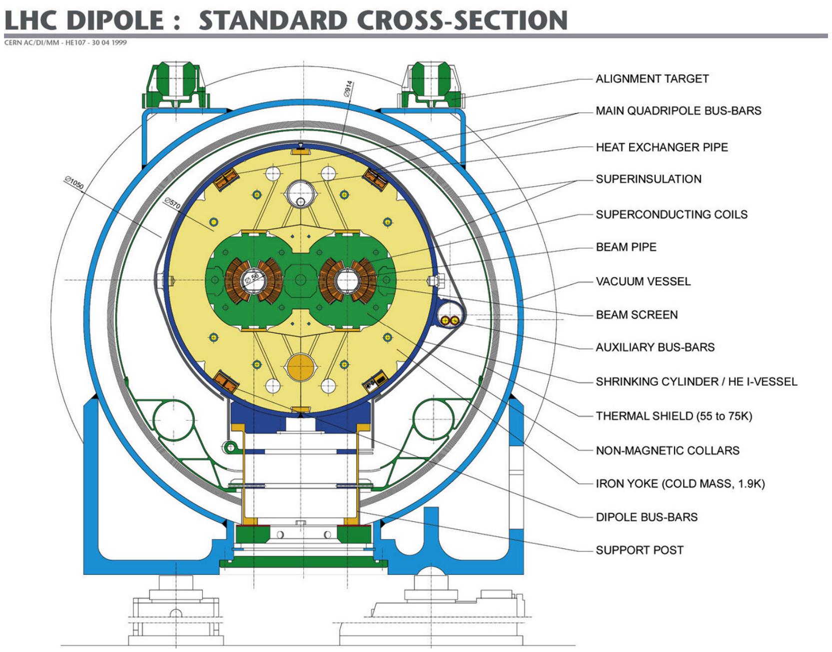
- More detail in the Magnet R&D presentation.

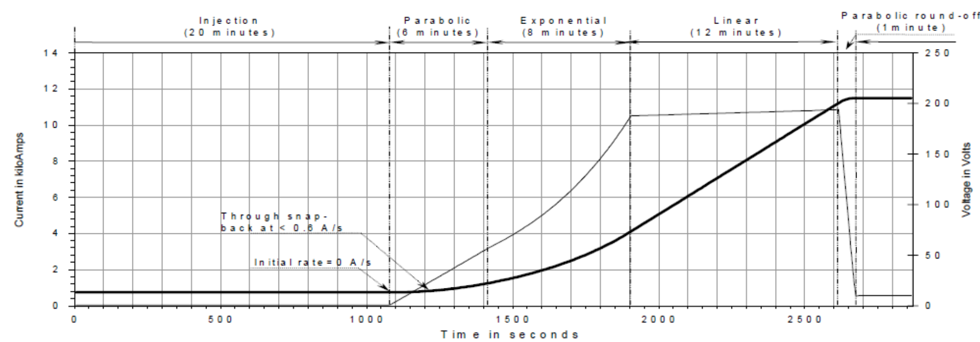
SC Magnet R&D

- 4 Activities SC Magnet
  - Documenting SC magnet design parameters
  - Developing list of supporting analyses required for the 1.2m, 3T, fast ramping CICC model dipole with TAMU
  - Developing a test plan and supporting diagnostics for testing 1.2m, 3T, fast ramping CICC model dipole
  - Developing a plan for IR Magnet Development

LHC Dipole Design – Adapting to JLEIC

- R&D Review Committee recommendation, “magnet design can follow LHC magnet design” for 6T JLEIC – required to support 200 GeV Ion Collider Ring
- Not a “drop in” solution
  - LHC is 8.4T @ 1.9K, JLEIC is 6T @ 4.5K
  - Aperture: LHC – 2 x 56mm, JLEIC – 10cm x 6cm
  - Ramp Rate: LHC is .008 T/sec, JLEIC is .05 T/sec





Beamline Impedance Elements

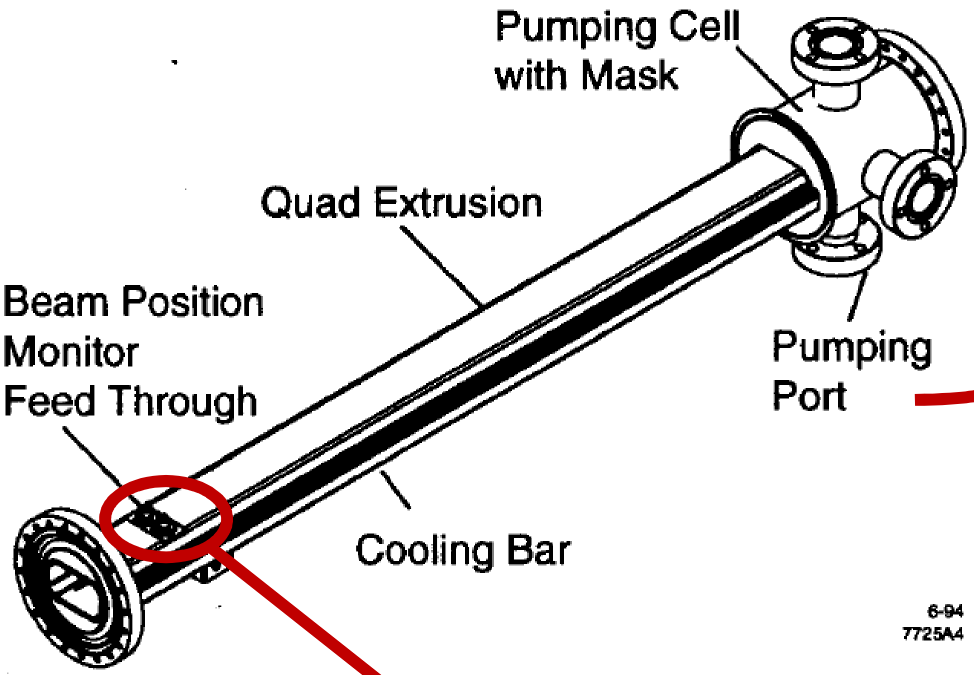
Beamline Impedance Elements

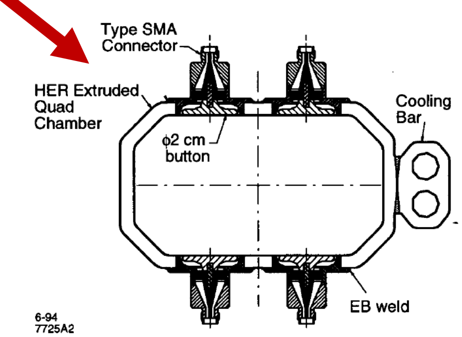
- Discontinuities in the beamline internal surface creates an impedance which leads to beam instabilities (R. Li presentation)

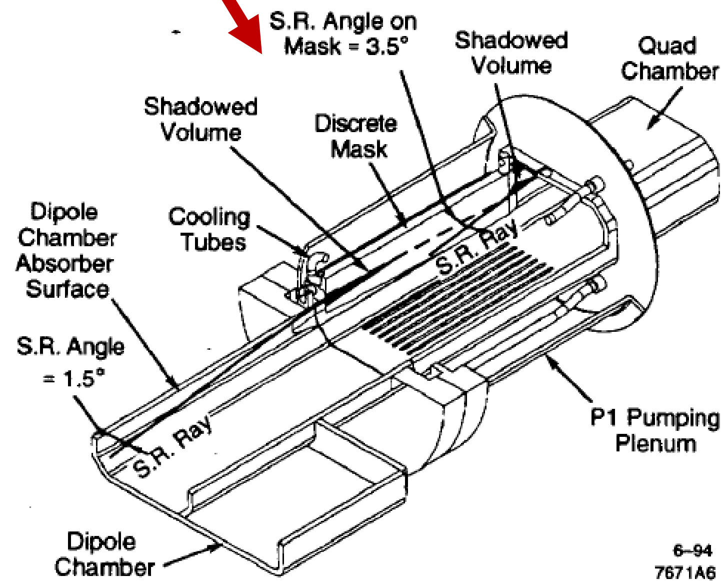
	Electron Collider Ring	Ion Collider Ring
Flanges (Pairs)	1215	234
BPMs	405	254
Vacuum ports	480	92
Bellows	480	559
Vacuum Valves	23	14
Tapers / Transitions	6	6
Slots in DIP screen	470k holes - holes are 3.2mm diameter	
Crab Cavities	4	12
RF/SRF Cavities	33	41
RF/SRF Bellows	2	34
RF/SRF Valves	70	24
Length of Vac Chamber	2,154 m	2,154 m
Vac Chamber Mat'l	Copper - arcs Stainless Steel - straights	Stainless Steel

Beamline Impedance Elements

- SLAC – PEP-II

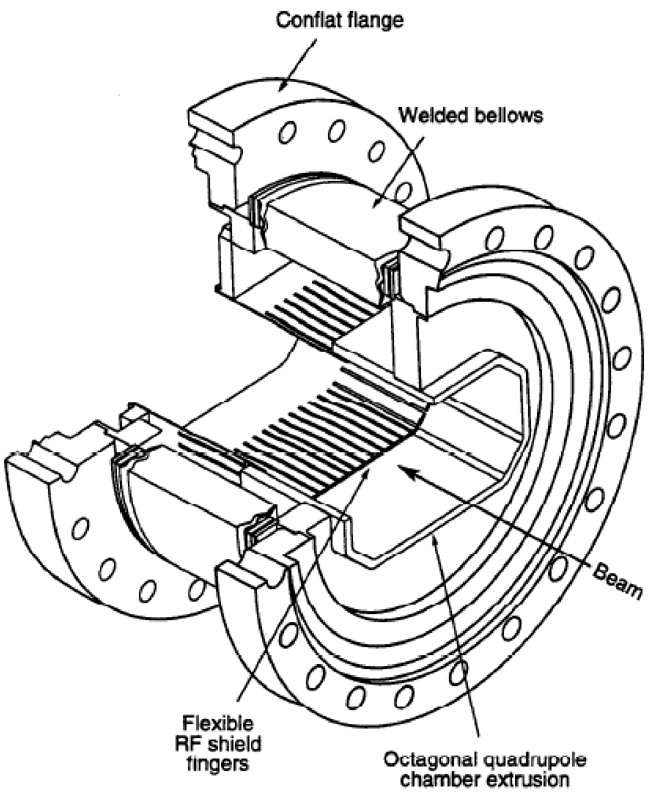


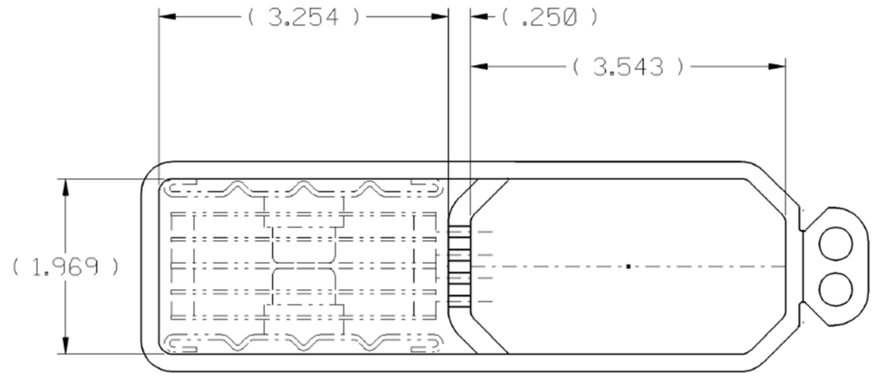


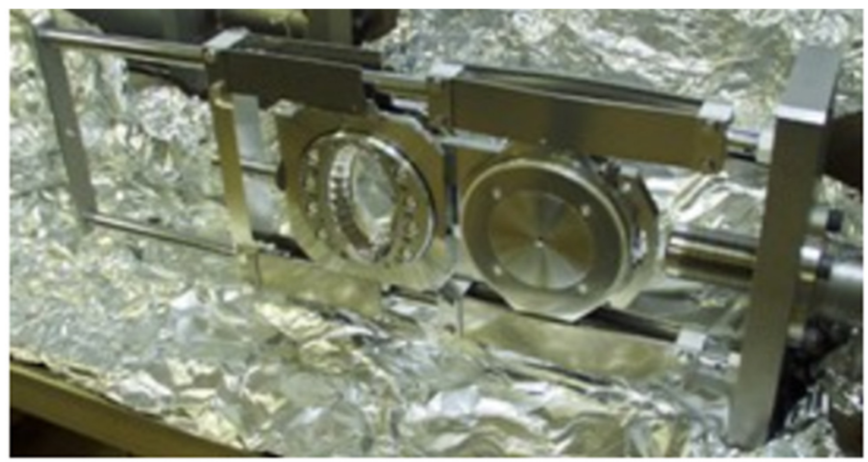


Beamline Impedance Elements

- SLAC – PEP-II







LER Vacuum Valve

Beamline Impedance Elements

Table 6. The main contribution to the inductive impedance of PEP-II

	L (nH)	k_l (V/pC)
Dipole screens	0.10	
BPM	11.	0.8
Arc bellow module	13.5	1.41
Collimators	18.9	0.24
Pump slots	0.8	
Flange/gap rings	0.47	0.03
Tapers oct/round	3.6	0.06
IR chamber	5.0	0.12
Feedback kickers	29.8	0.66
Injection port	0.17	0.004
Abort dump port	0.23	0.005
Total	83.3	3.4

Beamline / Site Layouts

Magnets, Kickers - Summary

Element	Type	Electron Complex	Ion Complex
Length of Beamline		2,439 m	2,629 m
Dipole Magnets	Normal-Conducting	270	12
	Superconducting	-	325
Quadrupole Magnets	Normal-Conducting	488	15
	Superconducting	7	292
Sextupole Magnets	Normal-Conducting	212	-
	Superconducting	-	156
Correctors Magnets	Normal-Conducting	405	-
	Superconducting	-	129
Solenoids Magnets	Superconducting	8	2
Kickers (RF)	Normal-Conducting	2	3

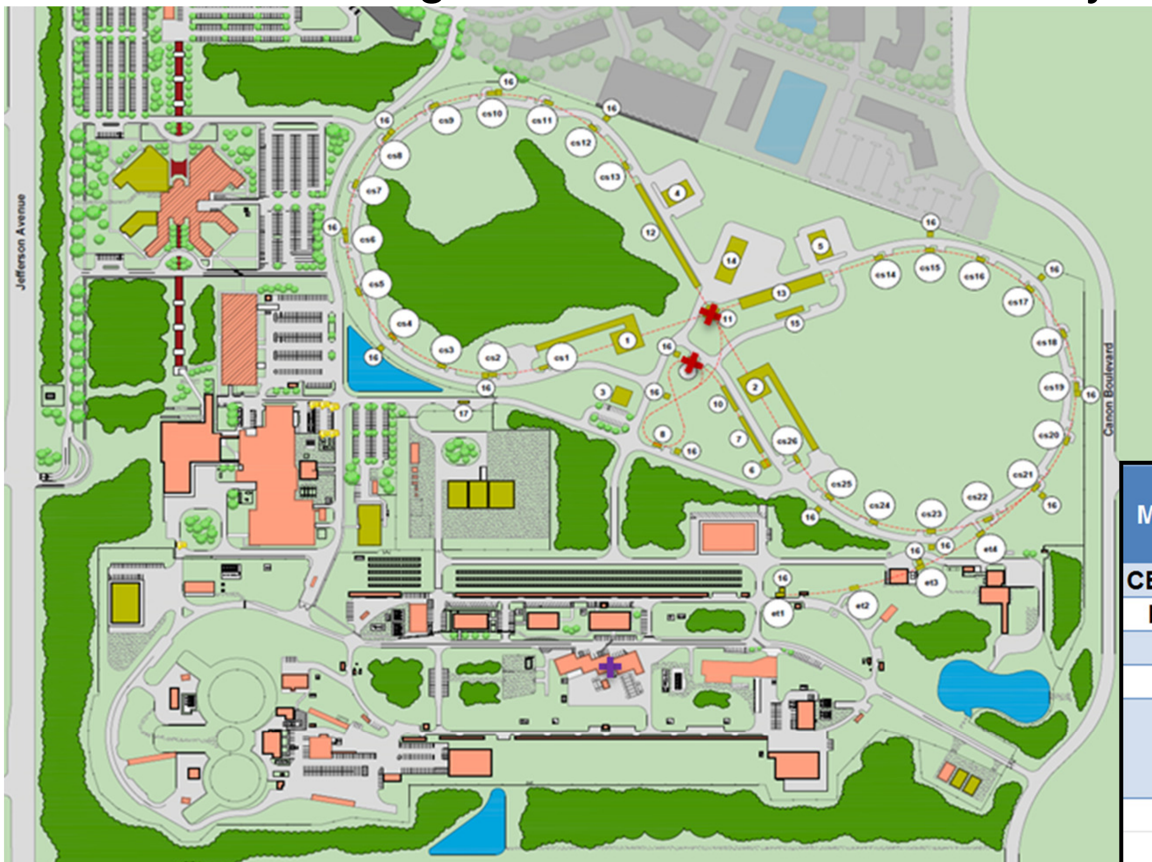
Accelerating and Bunching – Summary

		#	Cavities per unit	Fwd Pwr per cavity (kW)
Electron Collider Ring	Acceleration	33**	1	500**
	Crab Cavities	2	2	13
Booster	Acceleration	2	1	50
Ion Collider Ring	Bunch Ctrl (normal-cond)	7	1	100
	Acceleration	7	5	75
	Crab Cavities	2	6	13
Electron Cooling	DC Cooler (Booster)	1	4	500
	Bunched Beam (Ion Collider Ring) – Injector	1	2	50
	Bunched Beam (Ion Collider Ring) – ERL	1	6	50

** - PEP-II Cavities and HPAs

Site Layout

- Defining Global/Local Coordinate Systems for Machine Segments



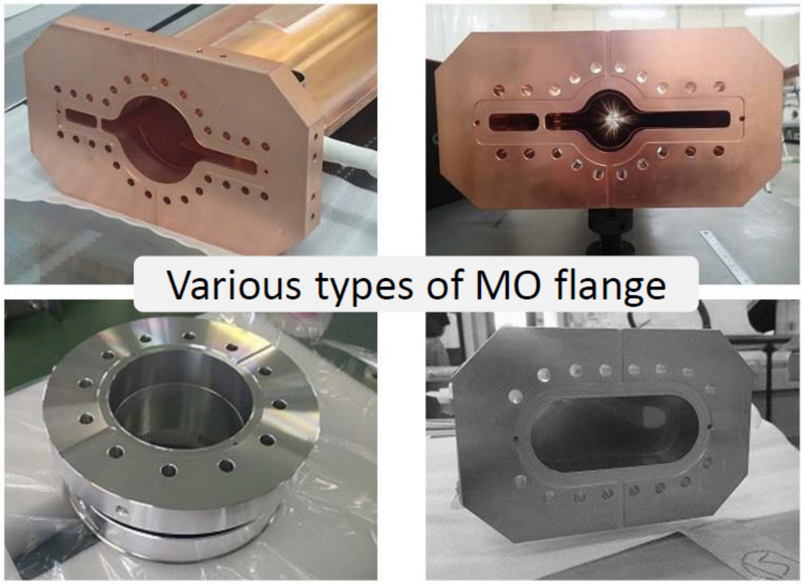
Machine Segment Name	Local Coordinate System Origin (m,m,m)	Global Coordinate System Origin (m,m,m)
CEBAF (Electron Injector)	0,0,0	0,0,0
Electron Collider Ring	0,0,0	393.75,?, 102.08
Ion Collider Ring	0,0,0	393.75,?, 102.08
Ion Booster Ring	0,0,0	339.58,?,80.42
Ion Injector/Linac		
START POINT	0,0,0	228.75,?,157.92
END POINT	81.67,?,(44.38)	310.42,?,113.54
Ion Linac / Xfer Line		
START POINT	0,0,0	310.42,?,113.54
END POINT	29.17,?,(33.13)	339.58,?,80.42
Electron Transfer Line		
START POINT	0,0,0	80.6,?,180.18
END POINT	219.79,?,457.29	219.79,?, 457.29
Ion Transfer Line		
START POINT	0,0,0	316.67,?,93.75
END POINT	77.08,?,8.33	393.75,?, 102.08

Next Steps

- Staff activities supporting SC Magnet R&D
  - 3T S-F Dipole Analysis, Build, Test
  - 6T Dipole Study and Concept Design
  - IR Magnets
  - Magnet Parameters Defined
- Impedance Analysis Support
  - Next level of detail on element definition, counts
- Site Design Support
  - Update tunnel cross sections
  - Support site vibration study
- Beamline Layouts – ensure fit of design elements

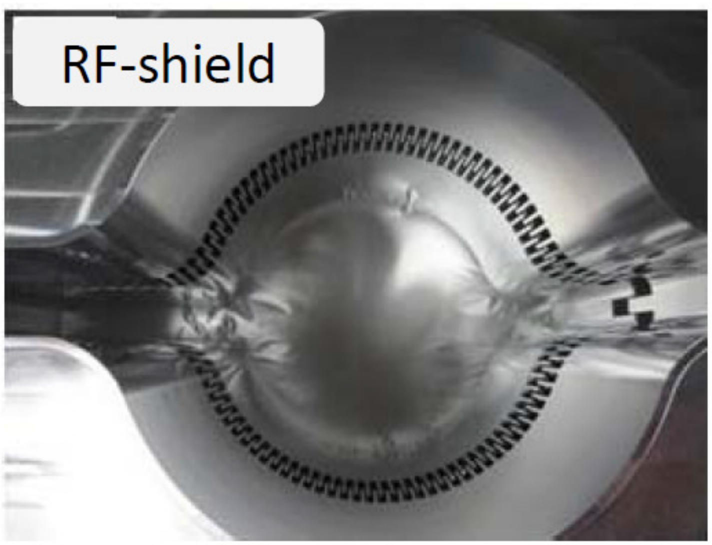
Backup Slides

SuperKEKB Low Impedance Elements



Various types of MO flange

Gate valve for antechamber



RF-shield

Aluminum alloy bellows chamber