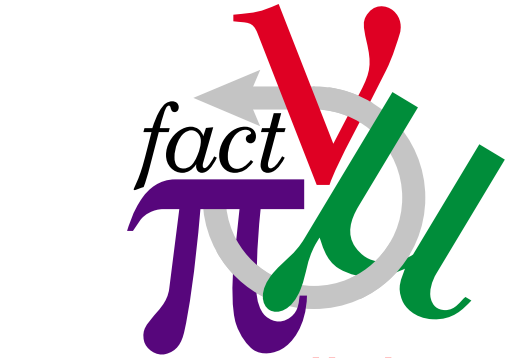
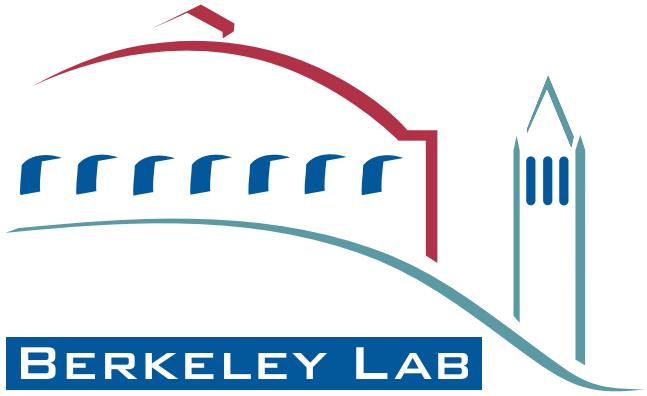




Comments on Feasibility Study II RF Parameters

John Corlett, Derun Li, Bob Rimmer

Accelerator and Fusion Research Division
LBNL

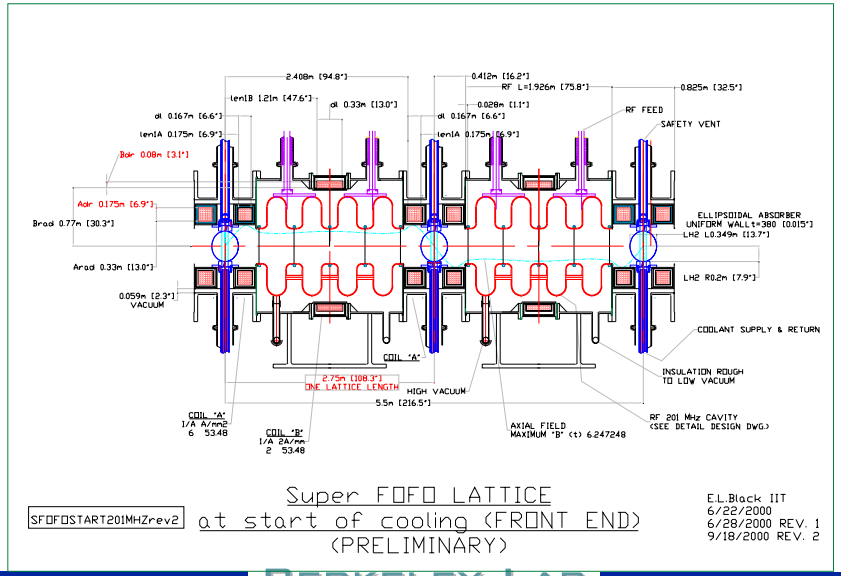
Muon Collaboration

Normal conducting RF systems - Feasibility study II parameters

J. Corlett
09/21/00

Feasibilty Study II Design A normal conducting RF parameters

	Frequency	Cell length	# cells per RF section	Gradient	Windows at ends of RF structures		Windows between cells		# sections	Total # RF cells	Shunt impedance	RF input power per cell	Total RF power per cell type	Windows at ends of RF structures		Windows between cells	
					Thickness	Radius	Thickness	Radius						RF power	Temp.	RF power	Temp.
	GHz	cm		MV/m	µm	cm	µm	cm			MΩ/m	MW	MW	W	°C	W	°C
Buncher section																	
	402.5	18.6	1	6.4	100	20			2	2	30.1	0.2	0.4	17	34		
	402.5	18.6	1	6	100	20	?	?	4	4	30.1	0.17	0.68	15	30	?	?
	201.25	37.3	4	6.4	125	21	250	25	1	4	23.4	0.5	2	16	26	32	26
	201.25	37.3	4	6	125	21	250	25	2	8	23.4	0.43	3.44	14	22	28	22
	201.25	37.3	4	8	125	21	250	25	2	8	23.4	0.77	6.16	25	40	50	40
Cooling section																	
[1,1; 1,2; 1,3]	201.25	46.6	4	16.29	125	21	250	25	6	24	22.6	3.5	84	118	189	448	359
[2,1]	201.25	55.9	2	17.6	75	18	125	21	14	28	20.3	4.4	123.2	85	227	304	487
[2,2]	201.25	55.9	2	17.6	75	18	75	18	10	20	20.3	4.4	88	85	227	170	453
[2,3a]	201.25	55.9	2	17.6	75	15	75	18	16	32	20.3	4.4	140.8	43	115	170	453
[2,3b]	201.25	55.9	2	17.6	50	15	50	15	16	32	20.3	4.4	140.8	43	172	85	340



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Normal conducting RF systems - Feasibility study II parameters

- Optimize cell lengths for maximum efficiency given lattice constraints
  - Maximum multi-cell pillbox shunt impedance at 105° per cell
    - 23.5 $M\Omega m^{-1}$
  - Maximum single-cell pillbox shunt impedance at 160° per cell
    - 20 $M\Omega m^{-1}$

	Frequency	Cell length	# cells per RF section	Gradient	Windows at ends of RF structures		Windows between cells		# sections	Total # RF cells	Shunt impedance	RF input power per cell type	Total RF power per cell type	Windows at ends of RF structures		Windows between cells	
					Thickness	Radius	Thickness	Radius						RF power	Temp.	RF power	Temp.
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Buncher section																	
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[2,3a]	201.25	55.9	2	17.6	75	15	75	18	16	32	20.3	4.4	140.8	43	115	170	453
[2,3b]	201.25	55.9	2	17.6	50	15	50	15	16	32	20.3	4.4	140.8	43	172	85	340

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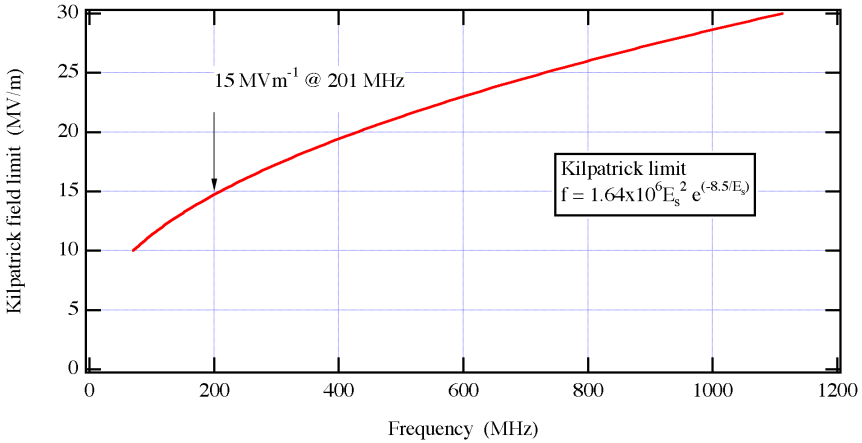
Normal conducting RF systems - Feasibility study II parameters

- Gradient is high
  - Up to 17.6 MVm^{-1}
    - Peak surface fields in pillbox ≈ accelerating field
      - ≈ Kilpatrick level



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Normal conducting RF systems - Feasibility study II parameters

- Power requirement large
  - up to 155 MW total
    - 13 MW buncher
    - 85 - 140 MW cooling
  - Large facilities required for power systems
    - Housing klystrons and modulators
      - *Develop high-peak-power tubes*

	Frequency	Cell length	# cells per RF section	Gradient	Windows at ends of RF structures		Windows between cells		# sections	Total # RF cells	Shunt impedance	RF input power per cell	Total RF power per cell type	Windows at ends of RF structures		Windows between cells	
					Thickness	Radius	Thickness	Radius						RF power	Temp.	RF power	Temp.
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[2,3b]	201.25	55.9	2	17.6	50	15	50	15	16	32	20.3	4.4	140.8	43	172	85	340

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Normal conducting RF systems - Feasibility study II parameters

- **Simple Be windows will distort at the required cavity parameters**
  - **Up to 450 W dissipated in one window**
    - **19cm, 125 μm foils may dissipate up to 20 W without distortion**
      - **Total up to 566 W dissipated in cooling section windows**
  - **Large diameter foils**
    - **Expensive ($15k - $17k per 19 cm radius foil)**
    - **Availability of large diameter foils is a concern (may need to join smaller foils)**
  - **Thin foils**
    - **Develop sandwich structures with cooling gas flowing between Be foils**

	Frequency	Cell length	# cells per RF section	Gradient	Windows at ends of RF structures		Windows between cells		# sections	Total # RF cells	Shunt impedance	RF input power per cell	Total RF power per cell type	Windows at ends of RF structures		Windows between cells	
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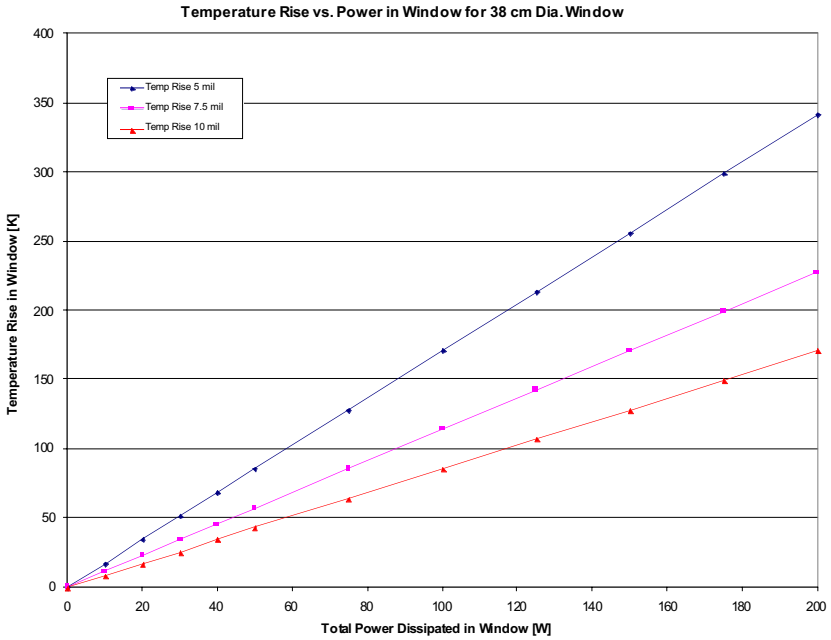
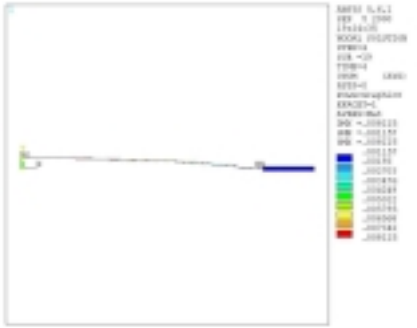
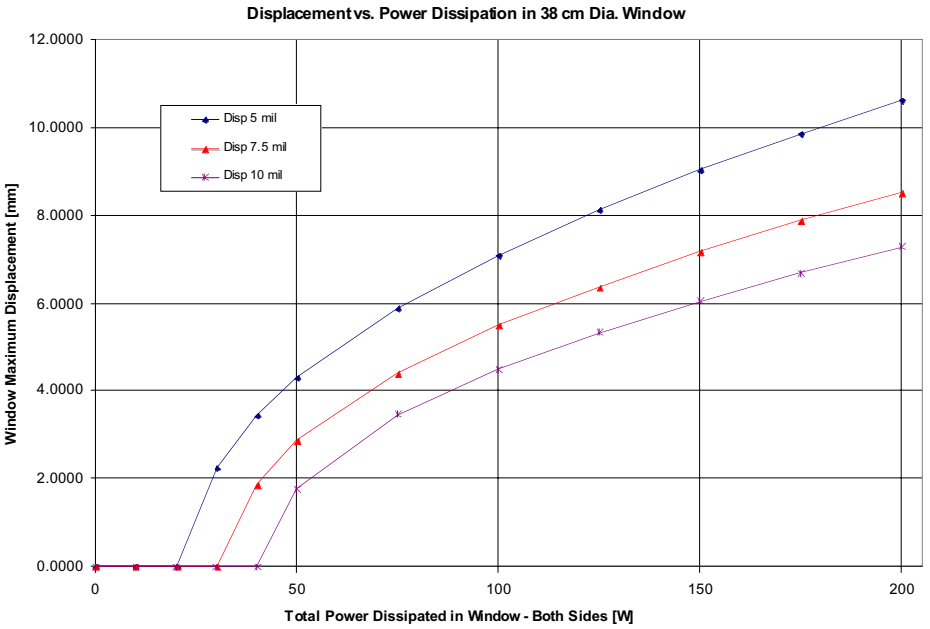
ANSYS model of 19 cm radius Be foil windows in 15 MVm^{-1} pillbox







19 cm radius, 125 µm thick foil may dissipate up to ~ 20 W before distorting

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Normal conducting RF systems - Feasibility study II parameters

- **Simple Be windows will distort at the required cavity parameters**
  - **Develop thin-walled crossed-tube designs?**
    - **Difficult to fabricate in Be**
    - **Large surface fields and currents**
    - **Cool with gas flow through tubes**
    - **Resistant to deformation**
      - **4x4 grid of 4 cm diameter Al tubes**
        - » **5x scattering of 125 μm Be foil**
        - » **Introduces few MeV momentum deviation**
      - **Investigate other grid arrangements and materials**

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Normal conducting RF systems - Feasibility study II parameters

- **Simple Be windows will distort at the required cavity parameters**
  - **Develop open-cell structures?**
    - **Peak surface fields are large**
      - **Peak surface fields in open-cell structures ≈ *N* Kilpatrick**
    - **RF power requirements increased**
      - **May be feasible option in some cases**

	Frequency	Cell length	# cells per RF section	Gradient	Windows at ends of RF structures		Windows between cells		# sections	Total # RF cells	Shunt impedance	RF input power per cell	Total RF power per cell type	Windows at ends of RF structures		Windows between cells	
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