Cost Estimate for the MICE Magnets with Cryostats with Extra Momentum Margin

	Coupling*	Focusing**	Detector^
Number of Magnets	2	3	2
Number of Coils per Magnet	1	2	5
Inner Cryostat Radius (m)	0.655	0.24	0.2
Outer Cryostat Radius (m)	0.93	0.668	0.4
Cryostat Length (m)	0.356	0.784	2.1
Coil Inner Radius (m)	0.69	0.255	0.25
Total Coil Length (m)	0.27	0.334	1.74
Average Coil Thickness (m)	0.1	0.09	0.05
Length of the Cold Mass (m)	0.31	0.734	2.02
Cold Mass Inner Radius (m)	0.69	0.255	0.23
Cold Mass Outer Radius (m)	0.83	0.39	0.31
Superconductor Mass per Magnet (kg)	773	320	850
Remainder of the Cold Mass per Magnet (kg)	246	259	379
Cryostat and Shield Cold Mass per Magnet (kg)	297	166	94
Total Magnet Mass per Magnet (kg)	1316	745	1323
Cost per Unit Mass of the Superconductor ($/kg)	80	95	95
Cost per Unit Mass of the Bobbin Assemblyr ($/kg)	40	40	40
Cost per Unit Mass of the Cryostat and Shield ($/kg)	40	40	40
Superconducting Material Cost per Magnet (k$)	62	30	81
Bobbin Subasseembly Cost per Magnet (k$)	10	10	15
Cryostat and Shield Subassembly Cost per Magnet (k$)	12	7	4
Other Material cost per Magnet (k$)	14	18	30
Absorber Installation Cost per Magnet (k$)	0	40	0
Vendor Engineering and Tooling Cost for All Magnets (k$)	200	250	200
Fabrication Cost per Magnet for Magnet #1	1119	633	1125
Fabrication Cost per Magnet for Magnet #2	783	443	787
Fabrication Cost for Magnet for Magnet #3	649	367	652
Vendor Cost for Magnet #1 (k$)	1416	989	1454
Vendor Cost for Magnet #2 (k$)	881	549	917
Vendor Cost for Magnet #3 (k$)	747	473	782
Vendor Cost for Coils in MICE (k$)	2297	2010	2371
Overhead on the Vendor Cost (k$)	43	40	44
LBNL Engineering Cost (k$)	220	440	330
TOTAL MAGNET COST (k$)	2560	2491	2745
Contingency 30 percent (k$)	768	747	824
TOTAL COST w contingency (k$)	**3328**	**3238**	**3569**

* The coupling coil cost includes the extra cost for the RF cavity vacuum vessel flange.

** The focusing coil cost includes the absorber vacuum vessel and the absorber into the coil assembly.

^ The detector includes the two coils needed to fit the muon beam into the detector solenoid.

MICE Magnet and Absorber Refrigerations Cost

Number of Refrigerator Cold Boxes	1
Number of Two-phase Helium Control Dewars	1
Volume of the Liquid Helium Control Dewar (liters)	500
Overall Main Transfer Line Length (meters)	12
Number of Side Transfer Lines	24
Number of Bayonet Joints	24
Overall Length of the Side Transfer Lines (meters)	36
Design Main Transfer Loss (W/m)	1
Design Side Transfer Line Loss (W/m)	0.5
Absorber Window Space Radius (mm)	220
Absorber Design Heat Load from Beam (W)	10
Absorber Heater Power (W)	30
Helium Inlet Temperature to the Absorber Exchanger (K)	14
Helium Outlet Temperature from Absorber (K)	18
Absorber Maximum Temperature (K)	19.5
Magnet Operating Temperature (K)	4.4
Design Force in the Longitudinal Direction (metric tons)	120
Coupling Magnet Current (A)	1000
Focusing Magnet Current (A)	250
Detector Magnet Current (A)	250
4.4 K Heat Load per Coupler Magnet (W)	1.62
4.4 K Heat Load per Focusing Magnet (W)	1.52
4.4 K Heat Load per Detector Magnet (W)	1.37
4.4 K Heat Load for Transfer Lines (W)	27.40
Total 4.4 K Refrigeration Load (W)	37.93
30 K Load per coupler Magnet (W)	10.1
30 K Heat Load per Focusing Magnet (W)	7.3
30 K heat Load per Detector Magnet (W)	6.9
Total Mass Flow of 18 K Gas to Cool Shields and Leads (g/s)	0.66
Total Design Heat Load per Absorber (W)	86.9
Equivalent Refrigeration at 4.4 K (W)	137.3
Size of the Refrigeratorat 4.4 K (W)	199.9
Refrigerator Cost (k$)	645
Transfer Line Cost (k$)	120
Control Dewar Pump and Heat Exchanger Cost (k$)	60
Cryogenic System Sub Total (k$)	825
Purchaing Overhead	34
LBNL Enginering (0.7 man yr)	154
Cryogenic System Cost w/o Contingency	1013
30% Contingency	304
TOTAL REFRIGERATION SYSTEM COST (k$)	**1317**
Total Installed Power for the Refrigeration System (kW)	200

Cost Estimate for the MICE Magnets with Cryostats w/o Extra Momentum Margin

	Coupling*	Focusing**	Detector^
Number of Magnets	2	3	2
Number of Coils per Magnet	1	2	5
Inner Cryostat Radius (m)	0.655	0.24	0.2
Outer Cryostat Radius (m)	0.93	0.668	0.4
Cryostat Length (m)	0.356	0.784	2.1
Coil Inner Radius (m)	0.69	0.255	0.25
Total Coil Length (m)	0.27	0.334	1.74
Average Coil Thickness (m)	0.09	0.07	0.04
Length of the Cold Mass (m)	0.31	0.734	2.02
Cold Mass Inner Radius (m)	0.69	0.255	0.23
Cold Mass Outer Radius (m)	0.816	0.36	0.29
Superconductor Mass per Magnet (kg)	683	241	668
Remainder of the Cold Mass per Magnet (kg)	221	196	261
Cryostat and Shield Cold Mass per Magnet (kg)	297	166	94
Total Magnet Mass per Magnet (kg)	1202	603	1022
Cost per Unit Mass of the Superconductor ($/kg)	80	95	95
Cost per Unit Mass of the Bobbin Assemblyr ($/kg)	40	40	40
Cost per Unit Mass of the Cryostat and Shield ($/kg)	40	40	40
Superconducting Material Cost per Magnet (k$)	55	23	63
Bobbin Subasseembly Cost per Magnet (k$)	9	8	10
Cryostat and Shield Subassembly Cost per Magnet (k$)	12	7	4
Other Material cost per Magnet (k$)	14	18	30
Absorber Installation Cost per Magnet (k$)	0	40	0
Vendor Engineering and Tooling Cost for All Magnets (k$)	200	250	200
Fabrication Cost per Magnet for Magnet #1	1022	513	869
Fabrication Cost per Magnet for Magnet #2	715	359	608
Fabrication Cost for Magnet for Magnet #3	592	297	504
Vendor Cost for Magnet #1 (k$)	1311	858	1177
Vendor Cost for Magnet #2 (k$)	804	454	716
Vendor Cost for Magnet #3 (k$)	682	393	612
Vendor Cost for Coils in MICE (k$)	2115	1705	1892
Overhead on the Vendor Cost (k$)	41	37	
LBNL Engineering Cost (k$)	200	400	300
TOTAL MAGNET COST (k$)	2357	2142	2192
Contingency 30 percent (k$)	707	643	658
TOTAL COST w contingency (k$)	**3063**	**2785**	**2850**

* The coupling coil cost includes the extra cost for the RF cavity vacuum vessel flange.

** The focusing coil cost includes the absorber vacuum vessel and the absorber into the coil assembly.

^ The detector includes the two coils needed to fit the muon beam into the detector solenoid.

MICE Magnet Power Supply and Cable Cost

Design Stored Energy of the Coupling Magnets (MJ)	5.5
Design Stored Energy of the focusing Magnets (MJ)	1.0
Design Stored Energy of a Detector and Matching Magnet (MJ)	3.5
Minimum Charge Time for the Magnets (s)	2400
Maximum Charging Voltage for the Coupling Magnets (V)	9.17
Maximum Charging Voltage for the Focusing Magnets (V)	10.00
Maximum Charging Voltage for the Detector Magnets (V)	23.33
Design IR Voltage for the Cables and Diodes (V)	2.50
Power Needed to Charge the Coupling Magnets (kW)	11.7
Power Needed to Charge the Focusing Magnets (kW)	3.1
Power Needed to Charge the Detector Magnets (kW)	6.5
Number of Coupling Main Main Power Supplies	1
Number of Focusing Magnet Main Power Supplies	1
Number of Detector Magnet Main Power Supplies	1
Number of Small Power Supplies for Tuning the System	8
Cost per Coupling Coil Power Supply including Controller (k$)	42.3
Cost per Focusing Coil Power Supply including Controller (k$)	36.3
Cost per Detector Coil Power Supply including Controller (k$)	37.6
Cost per Tuning Power Supply including Controller (k$)	10.0
Cable Cost per Focusing Magnet System (k$)	5.5
Cable Cost per Coupling Magnet System (k$)	10.7
Cable Cost per Detector Magnet System (k$)	14.8
Large Power Supply Cost (k$)	116
Tuning Power Supply Cost (k$)	80
Cable and Cable Tray Cost (k$)	31
Power Supply and Cable Cost Sub Total (k$)	227
Purchasing Overhead (k$)	11
LBNL Engineering Cost (k$)	50
Power System Cost w/o Contingency (k$)	289
30 % Contingency	87
TOTAL MAGNET POWER SYSTEM COST (k$)	**375**
Installed Power for the Magnet Power Supplies (kW)	62.3