5-year plan review: Components and Experiments

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Stated Goals

- Establish the viability of concepts and components used for the MC-DFSR and NF-RDR designs
- Establish the engineering parameters that can be assumed in the design studies
- Provide a good basis for cost estimates
- Also provide a basis for the post-DFSR R&D tests and experiments (not part of this proposal) that will be needed before a MC can be built.

MUTAC on Plan

- The five year plan should include:
  - Milestones (i.e. figure of merit for gradient/B-field, B-field for cooling channel magnets, B-field for downstream cooling solenoids, etc.) and target values for each milestone that when achieved define success,
  - Mechanism for down selecting among technology choices,
  - Decision on a baseline design to be developed for the muon collider feasibility study should be made as early as possible. The committee is concerned that the three years allowed may be inadequate to complete a defensible study.

MICE

The official MICE US deliverables are:

- Spectrometer solenoids (2), including engineering, fabrication, testing, and field-mapping
- Assembly of scintillating-fiber planes (15) for fiber-tracking spectrometers
- AFE-IIt readout boards, VLPCs, and VLDS interface modules for fiber-tracking readout
- Design, fabrication, and commissioning of VLPC cryostats (4) for fiber-tracking spectrometers
- Fiber-tracking readout system integration and commissioning
- Fabrication, installation, and commissioning of two Cherenkov counters
- RFCC modules (2), each comprising 4 rf cavities and 1 coupling coil
- Scintillating-fiber beam position/profile monitors (4 planes)
- Design and fabrication of LiH absorbers
- Beam line optimization
- Participation in MICE operations and analysis

MICE extensions in plan

Beyond this initial MICE program, there is the possibility of using the MICE apparatus to begin to explore some aspects of 6D cooling that are relevant to the design of MC cooling channels, and that can inform the MC-DFSR studies.

A simple test of the six-dimensional ionization-cooling concept can be made by inserting a wedge absorber (composed, e.g., of LiH) into a beam having suitable dispersion, and measuring the effect on the beam. This may be possible in MICE either by tuning the incoming beam so as to produce the desired dispersion or by selecting out of the distribution of incoming muons an ensemble that has dispersion matched to the configuration of the wedge absorber. This concept needs further study to evaluate both its feasibility and the degree to which it could constitute an incisive demonstration of six-dimensional cooling.

MUTAC on MICE

- Assess the performance of the 201 MHz RF in the magnetic field levels specified for MICE in order to verify that dark current levels are acceptable.
- Recognizing the vital contribution that a timely delivery of MICE step VI will make to both the neutrino factory IDS and a Design Feasibility Study (DFS) for a Muon Collider, this committee recommends that maximum pressure be exerted by the collaboration on UK funding bodies to make a timely decision to fund the entire program to the aspirational timescale.
- Provide an assessment of the timescales and costs of phase III MICE.

RF

- SCRF cleaning techniques
  - Test 201 in appropriate magnetic field
  - Build and test 805 “scale model” in magnetic field
  - Test 201 prototype for 6D channel
- Atomic Layer Deposition
  - Build 805 cavity for ALD coating, test in B field
  - ALD process 201 prototype and retest
  - Investigate durability

RF II

- Magnetic Insulation
  - Rotatable cavity
  - 805 cavity incorporating magnetic insulation
- High Pressure RF
  - Beam test of existing test cell
  - Build and test prototype 805 cavity
- Continue exploration of alternative materials and coatings using buttons in test cavity.

RF III

- Not explicitly in the plan
  - Beryllium test cavity?
  - Redo measurements compromised by 805 coupler damage?
- In the plan – but objectives vague
  - Superconducting RF

MUTAC: MTA

- Select and identify goals for the MTA with a short and well-defined list of target parameters to be reached, and corresponding milestones.
- Clearly define priorities: for example, prioritize tests of 201 MHz, 805 MHz, HPRF and E x B study with new rectangular cavity.
- Clearly define MTA's 5-year plan and required resources.

MUTAC: RF R&D

- Provide a resource loaded RF R&D schedule, highlighting prioritized activities and any potential for expediting the down-selection process.
- Define a minimum RF specification to expedite the RF down-selection.
- Modify the employed QA processes to change the 201 MHz Be windows to ensure more appropriate protection of the RF surfaces.

Magnets -HTS

- Goals
  - Establish R&D issues that must be addressed
  - Asses likelyhood that suitable HTS conductor will be available in appropriate timeframe
- Plan
  - Develop functional specs
  - Summarize status of conductor properties. Evaluate new conductors and insulations
  - Develop conceptual designs for magnets the meet specs
  - Build and test representative HTS and hybrid inserts
  - Develop a plan to build a 1m >30T post-plan

Magnets - HCC

- Issues
  - Matching sections
  - Functional and interface specs, interface with RF, heat load limits
- Plan
  - Develop functional specs
  - Conceptual design study, joint RF/magnet
  - Fabricate 4-coil models
  - Develop and test short section capable of housing RF

Magnets - Ring

- Issue: decay electrons
  - Thick absorbers?
  - Open midplane?
- Plan
  - Compare design options for ring/IP dipoles/quads
  - Provide consistent magnet parameters, incl. en. dep.
  - Technology tests in support of magnet design
  - Design main magnetic elements sufficiently for cost estimate
  - Provide cost estimates for further R&D and production

MUTAC: Magnets

- Develop a model for the magnet development program including crucial milestones and decision points.
- The committee would like to hear plans and progress on the modular HTS test facility at the next review.

Cooling Channel Sections

- Contingent on RF results, and end-to-end simulations based on established parameters.
- Path
  - Years 1-2: Successful 805 RF test
  - Year 3: Design test section
  - Years 4-5: Build and test section

MUTAC comment: N/A

Prep for 6D cooling experiment

- Execution is post-plan
  - No commitment until baseline is selected
- Open questions
  - Which cooling channel to test?
  - Early/Late 6D cooling?
  - What about high field 4D cooling?
- Preparations needed
  - Beam and detector technology to measure cooling
  - Integration of the cooling channel components for each potential experiment

MUTAC comment: N/A

“Missing” Effort

A-LIST NEEDS

	FY08	FY09	FY10	FY11	FY12	FY13
2.1 MICE		12	11	10	8	0
2.2 RF R&D		7.5	11.5	8	5.5	4.25
2.3 Magnet Studies		12.2	12.45	14.25	12.2	9.4
2.4 6D Cooling Sections & Tests		0	12.1	10.6	10.7	10.7
2.5 Other R&D		0	0	0	0	0

BNL+LBNL+FNAL

	FY08	FY09	FY10	FY11	FY12	FY13
2.1 MICE	6.75	8	8.5	7.5	4.5	1.25
2.2 RF R&D	9.8	7.5	6.5	7	7.25	7.25
2.3 Magnet Studies	2	5.2	7	7.5	8	9.9
2.4 6D Cooling Sections & Tests	3	0	3	4	7	7
2.5 Other R&D	1.7	1.5	1	1	0.5	0

A-LIST NEEDS - LAB CONTRIBUTIONS

	FY08	FY09	FY10	FY11	FY12	FY13
2.1 MICE		4	2.5	2.5	3.5	-1.25
2.2 RF R&D		0	5	1	-1.75	-3
2.3 Magnet Studies		7	5.45	6.75	4.2	-0.5
2.4 6D Cooling Sections & Tests		0	9.1	6.6	3.7	3.7
2.5 Other R&D		-1.5	-1	-1	-0.5	0