Muon Collaboration

Neutrino Factory & Muon Collider R&D – US & International Perspective

Steve Geer

DOE Visit.

6 August 2003

INTRODUCTION

1. Neutrino oscillations are exciting, the physics case for a Neutrino Factory seems strong, and the case for NF R&D compelling.
2. The Muon Collaboration has made excellent progress on its hardware R&D program.
3. We have put together a strong International Collaboration for a Muon Ionization Cooling Experiment (MICE), have a good experiment design, and have submitted a proposal to the Rutherford Lab which has received Scientific Approval. Note that MUTAC has identified this experiment as "critical".
4. We are making good progress in developing design concepts that we hope will substantially reduce the cost of a neutrino factory. We believe we will be ready to initiate "Study III" in about 2 years.
5. The recent funding reduction has hit us very hard, and seems not consistent with the community support for neutrino factory R&D (HEPAP sub-panel recommendation, MUTAC & MCOG recommendations, neutrino community support …)

HEPAP Subpanel Recommendation

Accelerator R&D

"We give such high priority to accelerator R&D because it is absolutely critical to the future of our field. … As particle physics becomes increasingly international, it is imperative that the United States participates broadly in the global R&D program."

Neutrino Factory & Muon Collider R&D

"We support the decision to concentrate on intense neutrino sources, and recommend continued R&D near the present level of 8M$ per year. This level of support is well below what is required to make an aggressive attack on all of the technological problems on the path to a neutrino factory."

Support from the neutrino community

6 January, 2003

To: John O'Fallon

From: J. Conrad
W. Louis
D. Michael
M. Shaevitz
S. Wojcicki

Dear John,

We would like to encourage you to increase support for Neutrino Factory R&D in FY04.

Neutrino oscillation physics has entered a very exciting period. In the not-too-distant future we expect that results from MiniBooNE and MINOS will add to the excitement. No matter what the results are from these experiments it is already clear that more ambitious long-baseline experiments will be needed in the future. It also seems increasingly likely that we will ultimately need the full power of a Neutrino Factory to unambiguously determine all of the parameters that describe neutrino oscillations. This will be particularly true if the LMA solution to the solar neutrino problem is confirmed (which initial KamLAND results suggest is the case), or if MiniBooNE and/or MINOS make discoveries that indicate there is more going on than just three-flavor mixing.

The HEPAP subpanel recommended a funding level for Neutrino Factory R&D at the FY01 level of 8M$ per year. We understand that since that recommendation support for the all important R&D has been significantly reduced. We believe it is important to maintain an investment in the long-term future. Since the HEPAP subpanel presentations the R&D seems to have made good progress, and the physics case for an eventual Neutrino Factory has, if anything, grown stronger. We would therefore like to encourage a restoration of the support for Neutrino Factory R&D to the level that the subpanel recommended.

cc: Steve Geer
Bob Palmer

MUTAC Review – October 2001

Every year the Muon Collaborations R&D is reviewed by an external technical committee (MUTAC: H. Edwards (chair), M. Breidenbach, G. Dugan, M. Harrison, J. Hastings, Y.-K. Kim, J. Lykken, A. McInturff, R. Ruth, K. Yokoya), who report to a multi-laboratory directorate level oversight group (MCOG).

The MUTAC report was very positive. The MUTAC report received a strong letter of transmittal from our oversight group (MCOG = representatives from BNL, LBNL & FNAL Directorates):

> *" The impressive record of progress is epitomized by the summary judgment of the report, namely, that*
> *The committee finds the progress since last year excellent. "*

MUTAC Review – January 2003

The review this year was in January, and resulted once again in a very positive report. In their transmittal letter to the laboratory directors, MCOG say:

> *The successful record of progress is epitomized by the summary judgment in the report, namely that "Overall, MUTAC was impressed by the accomplishments since the last meeting, particularly given the strained financial situation. MUTAC can enthusiastically assure MCOG that the limited funding is being well and carefully utilized."*

> *MCOG has concluded that it is imperative that DOE seek to provide enhanced R&D funding for this work if it is to meet either the intent or the recommendations of the Long Range Plan laid out in the 2002 Gilman Report of HEPAP.*

MCOG Recommendations to the DOE
(Spring 2003)

1. In the area of experimental work, the highest priority should continue to be accorded to the 800 MHz and 200 MHz RF work, especially the testing of the 800 MHz cavity in a magnetic field. This work is critical to the advancement and eventual success of the MUCOOL and MICE projects. High power target R&D is important to a number of future high energy accelerator projects under consideration in the U.S. program and this work should be continued.

2. MCOG supports participation by the U.S. in the Muon Ionization Cooling Experiment (MICE) and urges DOE to support this valuable international activity.

3. The creative conceptual advances made by the Muon Collaboration are strengthening the notion that a muon-storage-ring-based neutrino factory is feasible and will offer opportunities for a future facility. As such, we recommend continued support for conceptual development activities in parallel with the strengthened experimental and engineering R&D activities described above.

Activities in Europe

European feasibility study in 1999:

Prospective study of muon storage rings at CERN

CERN 99-02

ECFA report in 2002 encouraged R&D program

EMCOG set up in Spring 2002

ECFA

ECFA/01/213
13 September 2001

ECFA EUROPEAN COMMITTEE FOR FUTURE ACCELERATORS

REPORT OF THE WORKING GROUP ON THE FUTURE OF ACCELERATOR-BASED PARTICLE PHYSICS IN EUROPE[1]

ECFA Recommendations

In the immediate future:

1) the allocation of all necessary resources to fully exploit the unique and pioneering LHC facility;

2) continued support for ongoing experiments, since they promise significant scientific results, provide an optimal physics return on previous investment, and are vital for the education of young physicists;

3) the realisation, in as timely a fashion as possible, of a world-wide collaboration to construct a high-luminosity e^+e^- linear collider with an energy range up to at least 400 GeV as the next accelerator project in particle physics; decisions concerning the chosen technology and the construction site for such a machine should be made soon;

4) an improved educational programme in the field of accelerator physics and increased support for accelerator R&D activity in European universities, national facilities and CERN.

For the long-term:

5) a co-ordinated collaborative R&D effort to determine the feasibility and practical design of a neutrino factory based on a high-intensity muon storage ring;

6) a co-ordinated world-wide R&D effort to assess the feasibility and estimate the cost of a 3-5 TeV e^+e^- linear collider (CLIC), a very large hadron collider (VLHC) and a muon collider; in particular, R&D for CLIC is well advanced and should be vigorously pursued.

The European Version of MCOG: EMCOG

European Muon Concertation and Oversight Group (EMCOG)

CERN:	Carlo Wyss (chair), Helmut Haseroth, John Ellis
CEA-DAPNIA:	Pascal Debu, François Pierre
IN2P3:	Stavros Katsanevas, Marcel Lieuvin
INFN:	Marco Napolitano (Napoli), Andrea Pisent (Legnaro)
GSI:	Oliver Boine-Frankenheim, Ingo Hofmann
PSI:	Ralph Eichler, Albin Wrülich
Geneva:	Alain Blondel (secretary)
RAL:	Ken Peach, Rob Edgecock
PPARC:	Ken Long

Meetings

18-19 April 2002
15 Octobre 2002
10 December 2002
6 February 2003
25 March 2003

"Cooling is on the critical path for a neutrino factory; there is a consensus that a cooling experiment is a necessity."

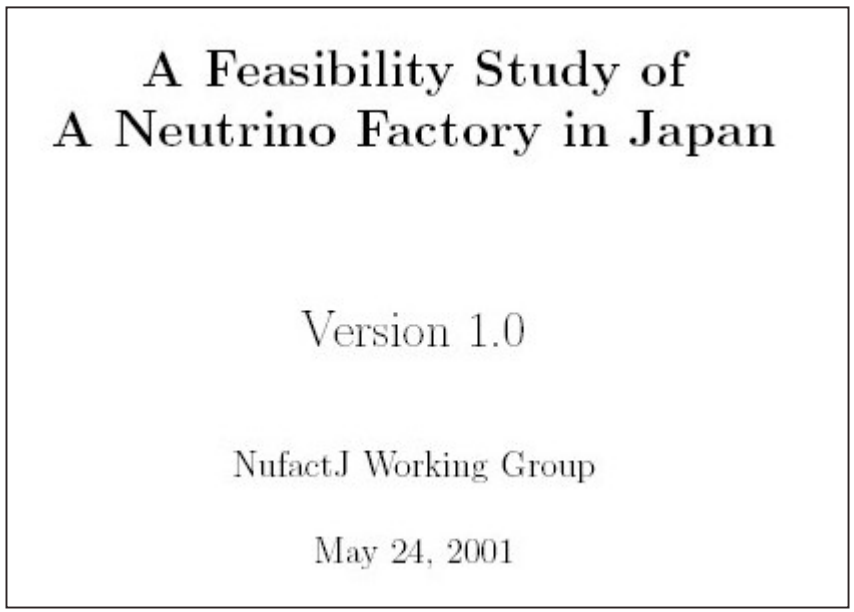
RAL Review of MICE

The Peer Review Committee's initial response to the MICE proposal 28 February 2003

The committee wishes to thank the proponents of MICE for their clear and enthusiastic presentations, and also for some useful clarifications of issues which were raised during the exchanges in the closed session. The committee appreciates the timeliness of MICE and its importance as a necessary step towards a serious proposal for the construction of a Neutrino Factory. The proponents and RAL are encouraged to proceed towards the difficult but essential step of achieving adequate funding and resources.

Activities in Japan

Neutrino Factory R&D group in Japan has also made a Feasibility study:


A Feasibility Study of
A Neutrino Factory in Japan

Version 1.0

NufactJ Working Group

May 24, 2001

In addition the Japanese are contributing to the US Muon Collaboration R&D program … the MUCOOL hardware development … & participating in MICE.

Summary

1. We believe the Muon Collaboration (MC) is making excellent use of the resources it has. The MC is a new way to conduct accelerator R&D with many University & Laboratory institutions, particle & accelerator physicists and engineers. We are succeeding.

2. The HEPAP sub-panel recommendation was for stronger support than we are now getting. Increased support is also recommended by MUTAC and MCOG, and encouraged by the neutrino community.

3. In Europe, EMCOG and the RAL advisory committee, together with our own MUTAC and MCOG, all concur that the Muon Ionization Cooling Experiment is important, and should be funded.

4. Lead time for R&D on big projects is very long. The technical ground work needed before a future neutrino factory decision can be made must be pursued vigorously now.