Summary of MCenter Task Force Mini-review

Submitted by Rob Plunkett for the Task Force

Mini-review held 10/9/2009

Charge to the Task Force

This Task Force is being charged to conduct a review to consider options for the MCenter area, focusing on time and space constraints in the context of a possible upgrade of the Fermilab test beam facility and proposed MIPP upgrades.

In particular the reviewers should identify potential time and space conflicts and/or synergies between proposed modifications of MCenter and the installation and operation of MIPP-II. They should identify problems that may arise due to occasional test beam use during MIPP-II installation and operation.

MIPP-II results are potentially important for precision neutrino experiments, atmospheric shower and particle production simulations, and the development of hadronic calorimetry, especially for an ILC detector. The reviewers should comment on when MIPP-II results need to be available to be important to each of these efforts, and in what role MIPP-II data could be incorporated into such efforts.

It is expected that a summary of MIPP-1 data analysis, results, and plans for publication will be provided. The reviewers should comment on this and suggest ways to enhance this effort, if deemed necessary.

Similarly the reviewers should examine the capabilities and plans for the MTest and MCenter beams, and the most appropriate test beam uses of each.

Membership of the Task Force

Rob Plunkett (Chair - FNAL)

Sanjib Mishra (South Carolina)
Leslie Camilleri (Nevis)
Nikolai Mokhov (FNAL)
Marcel Demarteau (FNAL)
Debbie Harris (FNAL)
Gaston Gutierrez (FNAL)
Felix Sefkow (DESY)
Mark Messier (Indiana)
Paolo Privitera (Chicago/Kavli)

Note: Messier participated by telephone.
Demarteau participated in comment review.

Task Force Review Process

- Documentation placed in Docdb before date of mini-review.
- Mini-review held on 9 October, 2009
- Talks by stakeholders followed by discussion.
  - MIPP: R. Raja, M. Paley, H. Meyer
  - Testbeam: E. Ramberg 4
  - Technical: J. Kilmer 4
  - User community: S. Kopp (near-term neutrino), G. Mills (LBNE)
- Discussion and preliminary closeout.
- Circulation for comments and consensus.

Findings

- Current testbeam is well-used.
- Additional capacity is likely to be needed soon, driven by LHC upgrades, ILC and other major systems.
- Plans are provided to produce a test beam in MCenter.
- LBNE, other neutrino experiments, hadronic simulations, and cosmic ray communities need high-quality information on particle production.
- Although some MIPP results are nearing publication (2-3 months were cited), the general program of publications is severely limited by human resources.
- MIPP I data analysis is being carried out by 8 named people at an estimated 4 FTE level.
- There is a likelihood of new effort by new Indian collaborators.
- MIPP-II can provide excellent information 5 on particle production if it works to specification.
- MIPP-II upgrade plans involve a large number of detector subsystems. Several of the required electronic systems have been prototyped.
- Plans to rebuild the Jolly Green Giant spectrometer magnet are well advanced.
- Interferences between the proposed testbeam and plans for commissioning and running of MIPP are manageable.
- Floor load limits above M-Bottom, lack of crane coverage, space limitations, and possible intensity limitations will have an effect on which tests can be done in the MCenter area.

Comments

- MIPP II upgrade will take more than a year because of the many complex subsystems.
- MIPP II needs clear statements of dedicated collaboration interest.
- Consideration of approval of MIPP-II as soon after data is published as possible will increase the likelihood of strengthening the collaboration and of having real impact in the field.
- If the MIPP II upgrade can be expedited, its results could be used for design of new experiments such as LBNE, or if not, they can be used later in analysis.

Comments, continued

(*requested supplemental information in italics*)

- Given the current status of particle production models, existing data and demands from new planned experiments, the simulation community will benefit from high quality hadron production data to benchmark the codes.
  - This includes thin target inclusive spectra at low (2 to 15 GeV/c) and high (120 GeV/c) beam momenta, and, at lower priority, thick target single particle double-differential yields for a subset of the parameter space, *both with experimental errors not to exceed ~5%.*
  - Double-inclusive and exclusive distributions measured for a reduced parameter space *with error < 10-15%* will help with benchmarking for calorimetry applications.

- Of special interest for simulations are measurements with proton, π+, π-, and tagged neutron beams on H, d, C, Al, Cu and Pb thin targets for all secondaries (including fragments down to as low an energy as possible (~20 MeV kinetic).

Comments, continued
(requested additions in italics)

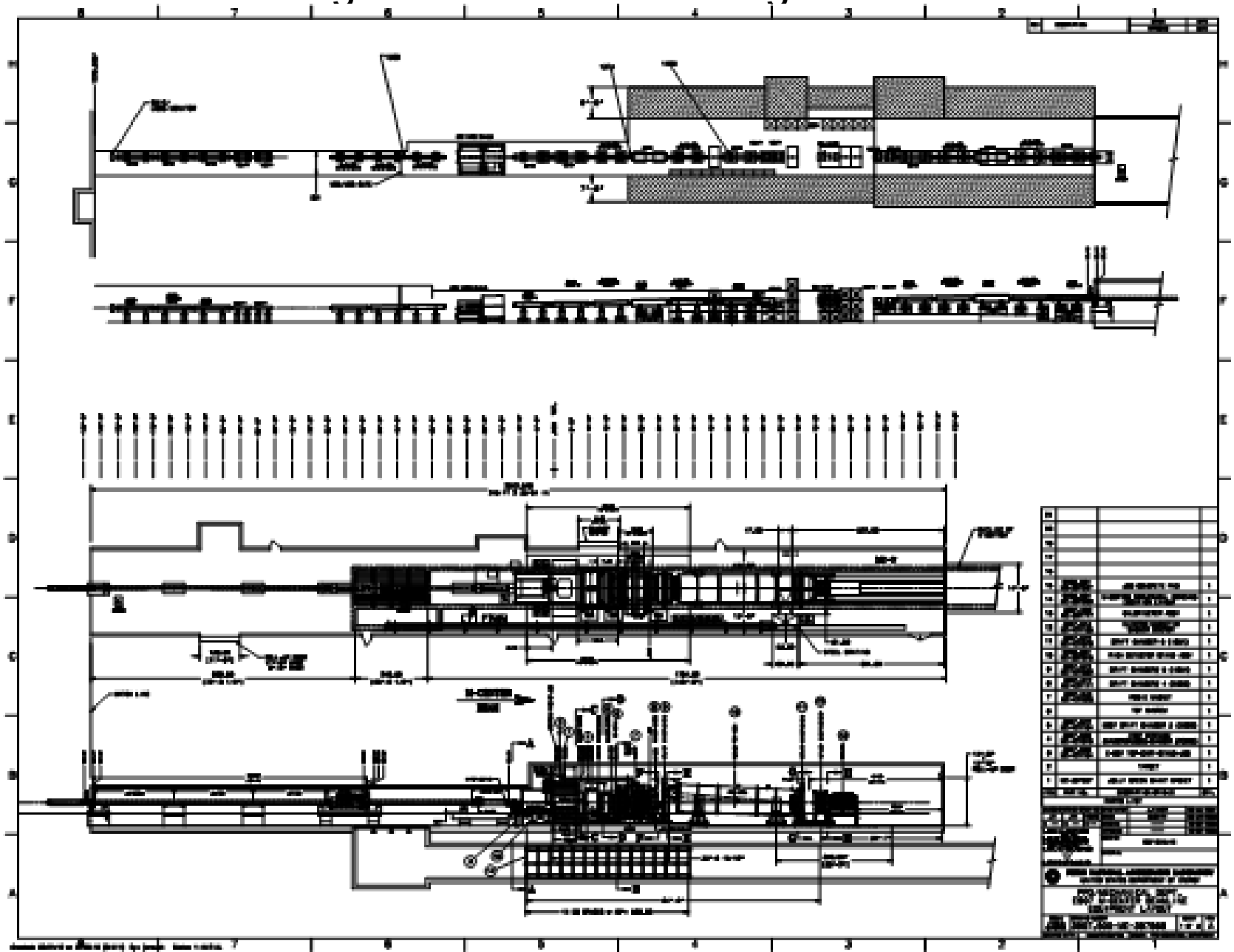
- Although the contribution to neutrino flux by kaon decays is small, it is much less well-known than that from pion decays, resulting in a significant contribution to the systematic uncertainty to those fluxes.
  - For 120 GeV primary protons, for example, kaon production is uncertain at the 15-20% level at best, and in some regions of phase space the uncertainty is much larger.
  - The uncertainty is even larger when neutrinos, especially ν_e and anti-ν_e, are produced in the decays of kaons produced either at the primary target or in subsequent interactions downstream of the primary target.
  - Particle production measurements of kaons off the NuMI target, as well as production measurements of K+ and K- on a set of thin targets,will go a long way to reduce these uncertainties.
  - *About a three-fold reduction of uncertainties in this area is needed.*

Possible physical constraints of the MCenter area.

(Requested Addition contributed by J. Kilmer)

- The maximum Floor loading anywhere in MC7 that is over M-Bottom is less than 400 lbs/ft^2. Higher loadings in that area will require shoring up the M-Bottom tunnel to support the weight.
- There is no crane in MC7. All materials handling is done by forklifts.
- With the new coils the Jolly Green Giant's maximum field is 7 Kg.
- There are no loading docks servicing the area. There are two rollup doors, one to the south and one on the north end.
- Low roof height limits the use of moveable gantry cranes, etc.

Elevation Drawing of MCenter showing floor reinforcements



Recommendations

- The laboratory should complete the Jolly Green Giant repair.
- A shielding assessment for MCenter should be completed without delay.
- The magnet power supplies should be upgraded to extend the momentum range of the MCenter beam to lower momentum.
- The proposed MCenter test beam plan should be encouraged.
  - The switch between uses of the beamline should be made simple and fast.
  - A study of potential users and needed instrumentation should be done.
- Additional resources should be assigned to minimize space and time conflicts in the MCenter area.
- Ways should be found to increase the analysis manpower on MIPP, including supporting efforts by universities to gain funding.

Appendix – Comments received during fact-checking phase

- Comments received were mostly additional input rather than factual concerns. Below, factual concerns are italicized. Others represent the statements of presenters.
- From J. Paley – presenter for MIPP
  - *4 FTE level (slide one, bullet 6) was originally "unspecified FTE level".*
  - MIPP II results may be too late for LBNE design, more useful in data analysis.
  - Air shower simulations may benefit from MIPP-II data.
- From R. Raja (paraphrase)
  - Thick target data referred to in Page 7, bullet 1, should include neutrino targets
  - Data should be made available with a generalized user interface which allows specification of target, beam, beam energy, and distribution. This would be similar to databases used in nuclear data.
  - Addition of a post-doc to MIPP would help speed up the analysis process.
- From S. Kopp
  - Numerical targets for performance of MIPP-II should be requested.