

NOvA Near Detector Considerations – Record of Decision

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This note/Record of Decision is now final.

Introduction

The introduction of a Near Detector for the NOvA Detector has a non-trivial impact on the underground infrastructure mainly, but not only, because it will demand some underground excavation. As a result, a special PMG heard presentations from Mark Messier and John Cooper on the physics need, and the construction options. Steve Geer, Chris Laughton and Stephen Pordes served as special consultants to the PMG. All three consultants provided written comments. As a result, Mark Messier gave the NOvA view in an e-mail. This note records my conclusions, driven primarily, but not only, by the commentaries from the consultants.

Near Detector Physics Case

It is imperative that the background to the appearance of electron like events, signaling the presence of electron neutrinos, in the far detector, be well estimated. The proposed method is to use a Near Detector.

A Near Detector is well nigh imperative for the success of the experiment. It is convincing that the ability to align the Near Detector in the off-axis direction is necessary. The fiducial mass is established by considering the statistical impact of the Near Detector measurements and leads, through event containment arguments to the total size of the Near Detector.

An outstanding issue, which the collaboration will need to work on more is the establishment of the actual electron-neutrino signal in the presence of very large backgrounds from the muon-neutrino flux in the Near Detector. As a result of oscillations, this flux is not present in the Far Detector. This concern does not negate the conclusion reached here.

Construction Options

NOvA presented several alternative excavations. Their preference was for the option which minimized the span of the resulting cavern. This was also the cheapest option.

Chris Laughton discussed some alternatives, for example, he considered the possibility that, if the span chosen for the enlarged tunnel becomes large, a side tunnel and modest cavern might not cost much more. He also provided material which suggests

that excavations in quite close proximity to sensitive HEP installations can be successfully concluded.

Broader Considerations

We have seen that the MINOS Near Hall and the NuMI tunnel is a valuable component of the Fermilab infrastructure, which has facilitated the mounting of the Peanut test, the COUPP Test Experiment, and will enable the expansion of the latter and the mounting of the MINERvA Experiment. It is highly desirable that the possibility to exploit this infrastructure be retained. In particular we judge that it be wise to ensure, perhaps with some effort, the ability to use half of the cross sectional area and half of the base width of the NuMI tunnel to ensure passage of largish components of apparatus from the shaft to the MINOS Near Hall.

It appears to be possible to ensure that the detector and associated oil containment can be moved to one side of the tunnel to allow the desired clearance. Therefore the minimal excavation scheme would appear to respect these access considerations.

NOvA Position

Mark Messier, the NOvA co-spokesperson writes:

Dear Mont,

I would like to thank our reviewers for taking the time to think about the needs of the NOvA near detector and their careful thoughts and comments. I think we all agree that the near detector is a crucial component of the NOvA experiment and that the investment to allow it to be properly oriented with respect to the beam axis is prudent. We will continue to work to refine the estimates of the systematic uncertainties and investigate ways to further reduce those uncertainties, however we believe that the detector we presented, 6 blocks of PVC and scintillator plus a muon iron ranger, will allow us to reach the experiment's goal sensitivity.

We presented several excavation schemes. Of these the simplest, least expensive, excavation is our preferred solution. In this solution, we would be able to move the detector modules allowing 50% passage through the tunnel given approximately 2-3 weeks notice. This is the solution we are planning to pursue.

Cheers,
Mark

Conclusions

Given the above considerations we accept the NOvA proposal and the project preparation and planning should proceed along those lines. However, in addition:

- The collaboration should continue to seek understanding of what are the actual systematic uncertainties to be expected taking into account all aspects of their approach.
- The design of the containment for the Near Detector should be done in such a way that the requirement for passage with modest effort is retained through to the conclusion. If this aspect is put in jeopardy the situation should be reconsidered at a PMG.
- The excavation details should be developed with due consideration to the need to minimize impact on the surrounding infrastructure and operations and the second-tunnel-cavern should be used as a counter point alternative.

Acknowledgements

We appreciate the presentations from Mark Messier and from John Cooper and would like to thank our consultants, Steve Geer, Chris Laughton and Stephen Pordes for their effort on this issue.