Expression of Interest for R&D towards A Neutrino Factory Based on a Storage Ring and a Muon Collider

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The Neutrino Factory and Muon Collider Collaboration

Edited by K.T. McDonald for the Collaboration

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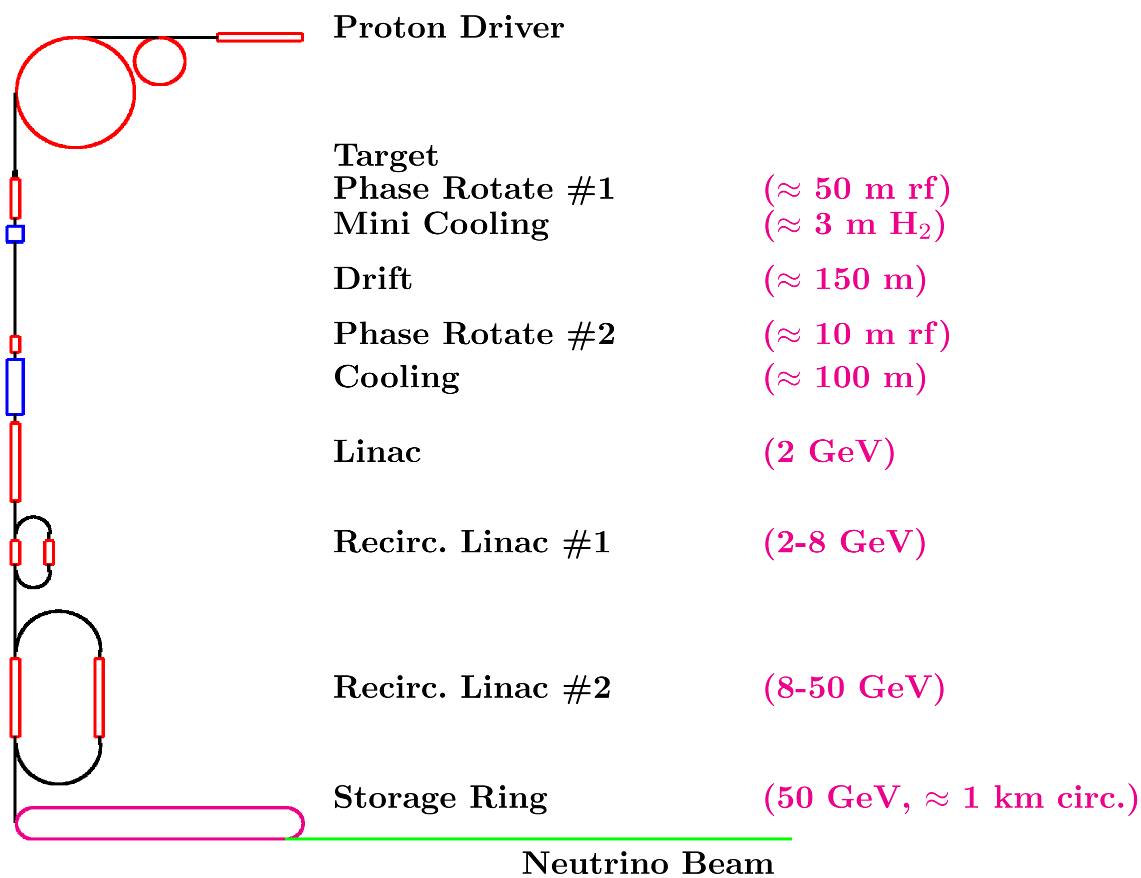

Collaboration Home Page: http://www.cap.bnl.gov/mumu/

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Executive Summary

Recent evidence from atmospheric, solar, and accelerator neutrinos suggests that neutrinos have mass, and mix among the flavors ν_e, ν_μ and ν_τ. Neutrino mass is evidence for physics beyond the Standard Model, and has cosmological implications.

Because neutrinos interact so weakly, unusual efforts are required to detect them. Although many of the recent, exciting results in neutrino physics have been obtained by non-accelerator techniques, the neutrino mass and mixing parameters appear to be such that a new generation of accelerator experiments with long baseline distance to the detectors can perform detailed measurements. For this, a new source of well-characterized neutrinos is needed.

We are exploring the feasibility of a neutrino factory based on a muon storage ring. In this, beams of ν_μ and $\overline{\nu}_e$ arise from the decay of μ^- particles (or alternatively, $\overline{\nu}_\mu$ and ν_e from μ^+). The muons come from the decay of low-energy pions produced by a megawatt proton beam incident on a nuclear target. The muons are captured into a magnetic channel, "cooled" by ionization in liquid hydrogen, accelerated to energy of order 50 GeV, and injected into a storage ring. A nonhorizontal ring can deliver neutrino beams to an on-site detector, as well as to two off-site detectors separated by global distances.

Such a neutrino factory is a challenging extension of present accelerator technology. It is also a natural path to a muon collider, in that both facilities share many common elements upstream of their storage rings. Prior to a formal design study, R&D must be performed in several keys areas, such detailed simulations and actual targetry and cooling experiments. This in an excellent opportunity to advance the field of accelerator physics both at national laboratories and at universities.

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