

New Muon Facility at FNAL



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New Program

- A single facility that does the major CLFV muon channels *and* a broader muon program
 - Requires PIP-II and grows with Booster Upgrade
 - Adapt next-generation ideas to reach $\mathcal{O}(10^{-19})$ on Au for muon-to-electron conversion
 - x100 improvement for $\mu \rightarrow e\gamma$ and $\mu \rightarrow 3e$
 - PSI techniques already at 1MW or new ideas
 - Potential Muon Campus & Storage Ring Experiments, May 2021, <https://indico.fnal.gov/event/48469>

Papers on these Upgrades

- A lot of thought has already gone into these ideas:
 - HiMB: <https://arxiv.org/pdf/2111.05788.pdf>
 - MEG Upgrades: <https://arxiv.org/pdf/1811.12324.pdf>
 - PRISM/PRIME: https://indico.fnal.gov/event/46669/contributions/203149/attachments/138299/173056/201210_PRISM_sato.pdf
 - Snowmass 2013 on Muon-Electron Conversion: <https://arxiv.org/pdf/1307.1168.pdf>

Beam Ingredients

- Need
 - a compressor ring to rebunch PIP-II beam (Prebys)
 - no special new technology here
 - a ~ 1 MW target inside a superconducting solenoid (Lynch)
 - overlap with muon collider
 - the FFA ring to store the muons and extract them to the experiments (Pasternak)
 - based on PRISM design at J-PARC

1 MW target in a Solenoid

- We know how to build 1 MW targets (neutrino program)
 - We have thought about horn beams (NuSTORM)
- But 1MW in a superconducting solenoid presents unique challenges
- SNS plans such a target station
 - Liquid Hg targets (MERIT)?
 - *needed for muon collider*
 - this program could be a test bed/existence proof

Intermediate Plans

- Talking with DM people about compressor ring that serves both
- Discussing using FFA for both signs at once; then could run decay experiments and conversion experiments in same calendar period. Plenty of protons...
 - 10^{10} useful muons/sec can be obtained; Renga et al (10.3390/universe5010027) show MEG technique limited there by accidentals even with converting the photon
- Maybe can only get 100-200 kW to start. Still groundbreaking since high-Z achievable

Plan

- We have written a Snowmass LOI
 - <https://www.dropbox.com/s/36b3gzfnkukcqqg/clfvLOI.pdf?dl=0>
- Will turn this into a white paper
- Goal is to have P5 say that this facility should be part of the US program and R&D for design should be funded