# Surface Muons for Project X

*Conceptual Discussion*

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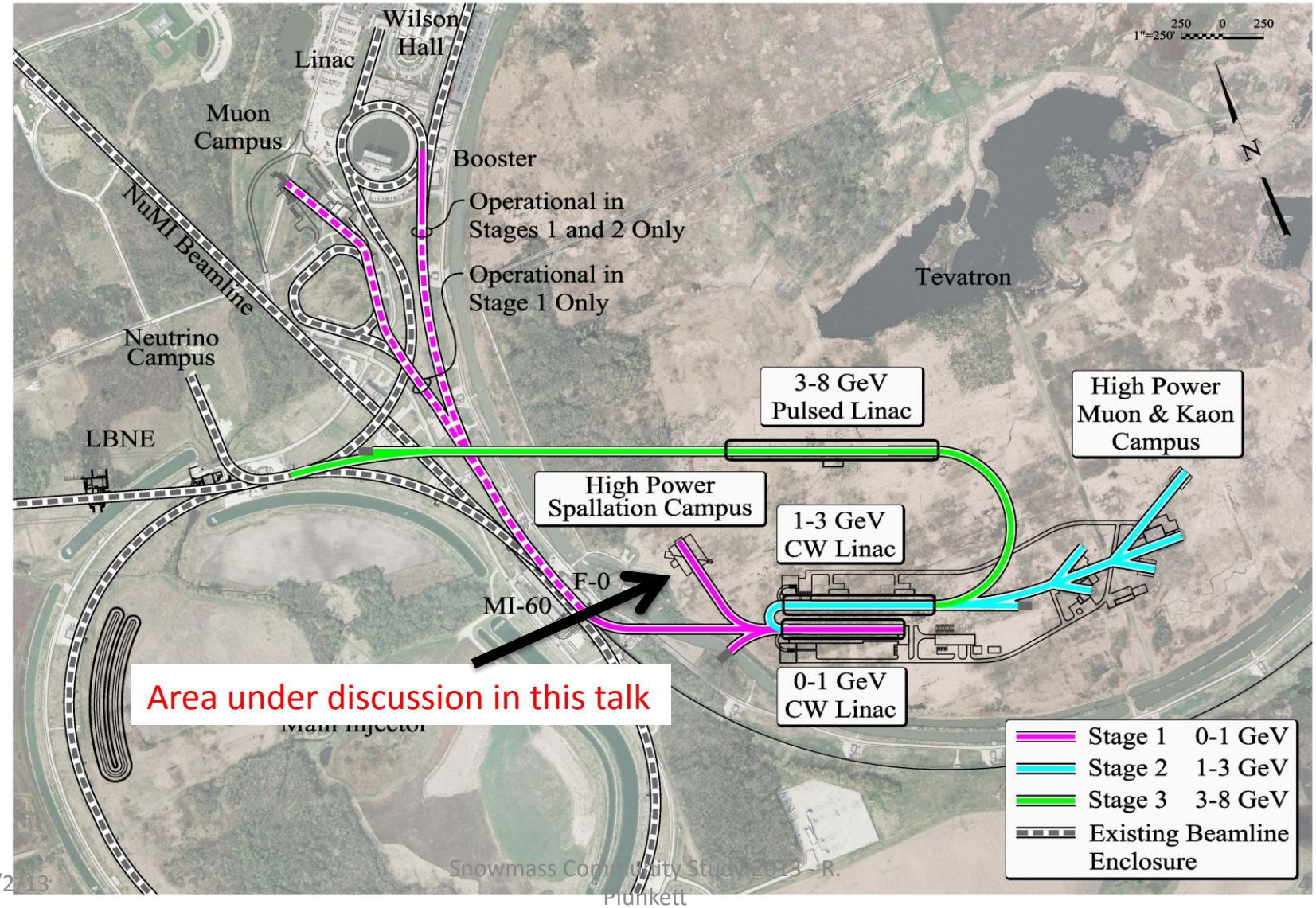
# Surface Muons and Project X

- Project X is a flexible, staged, linac for the next generation of Intensity Frontier Experiments
- Large pricetag – also has a lot of 1 GeV beam which is not used for Mu2e or neutrino programs.
- Surface, and other, muon applications clearly need to be investigated.
- We began our investigations focusing on applications – but always with fundamental physics in our minds as well.

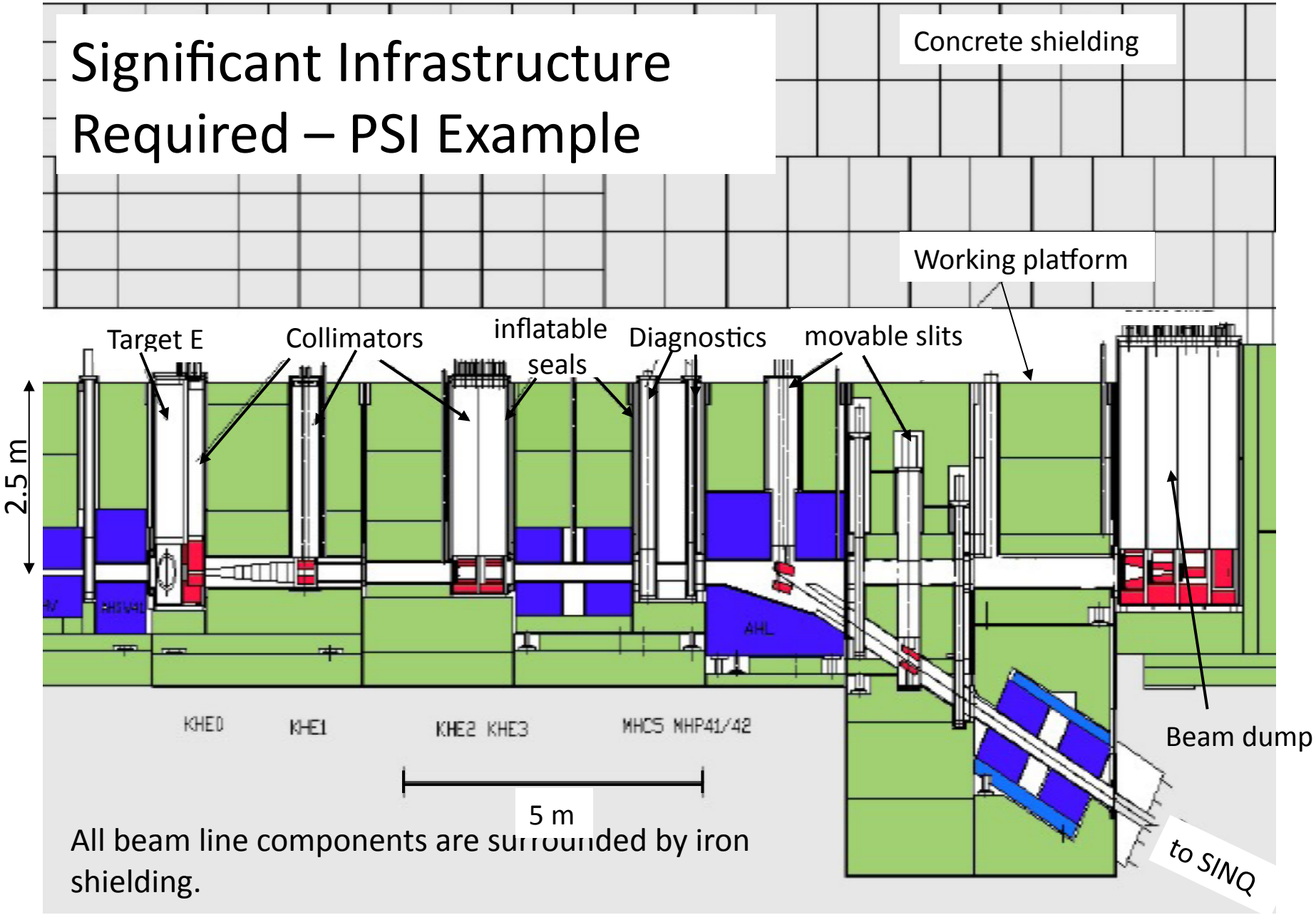
# Disclaimers

- I am a neutrino physicist. Before that I was a collider physicist.
- Very new to muon beam physics.
- The studies so far are very rough.
  - Aimed at providing resource materials for this meeting.
  - No time yet for real design or simulations.
  - Aimed at building collaboration with material scientists.
- Relying heavily on communications with experts.
- In the current case – this means you!

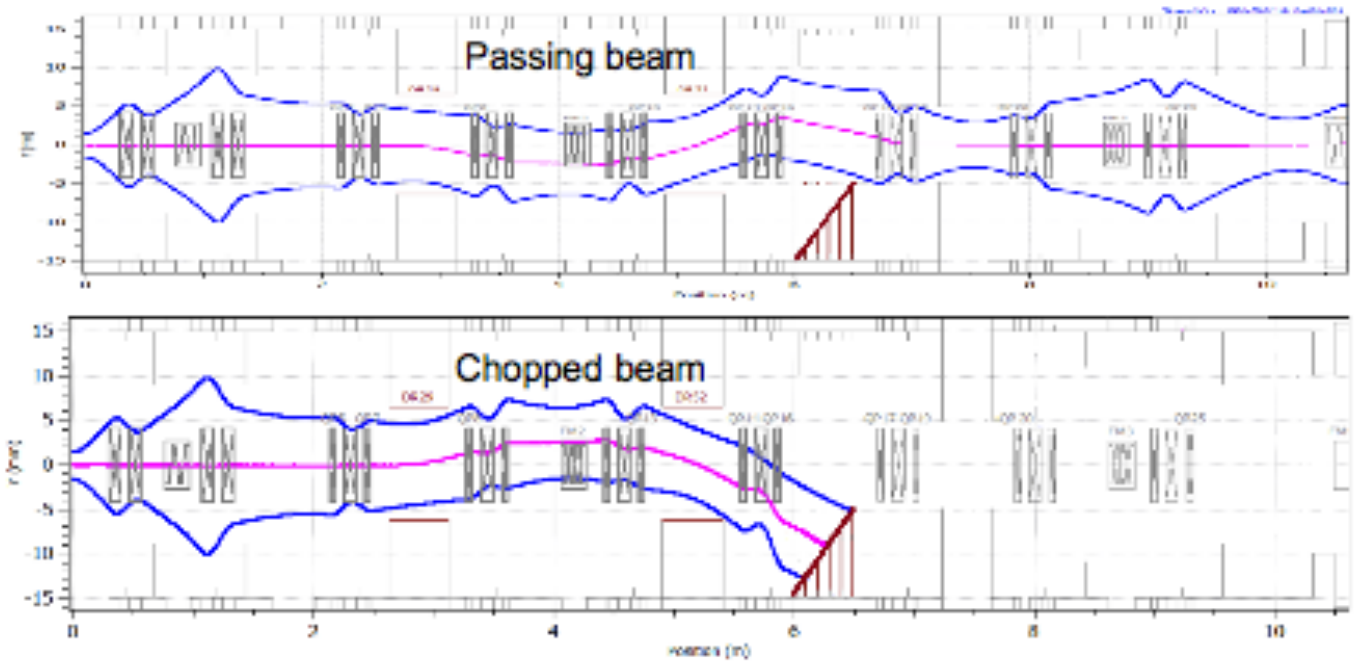
# Project X Site Layout



# Beam line from Target E to beam dump (side view)

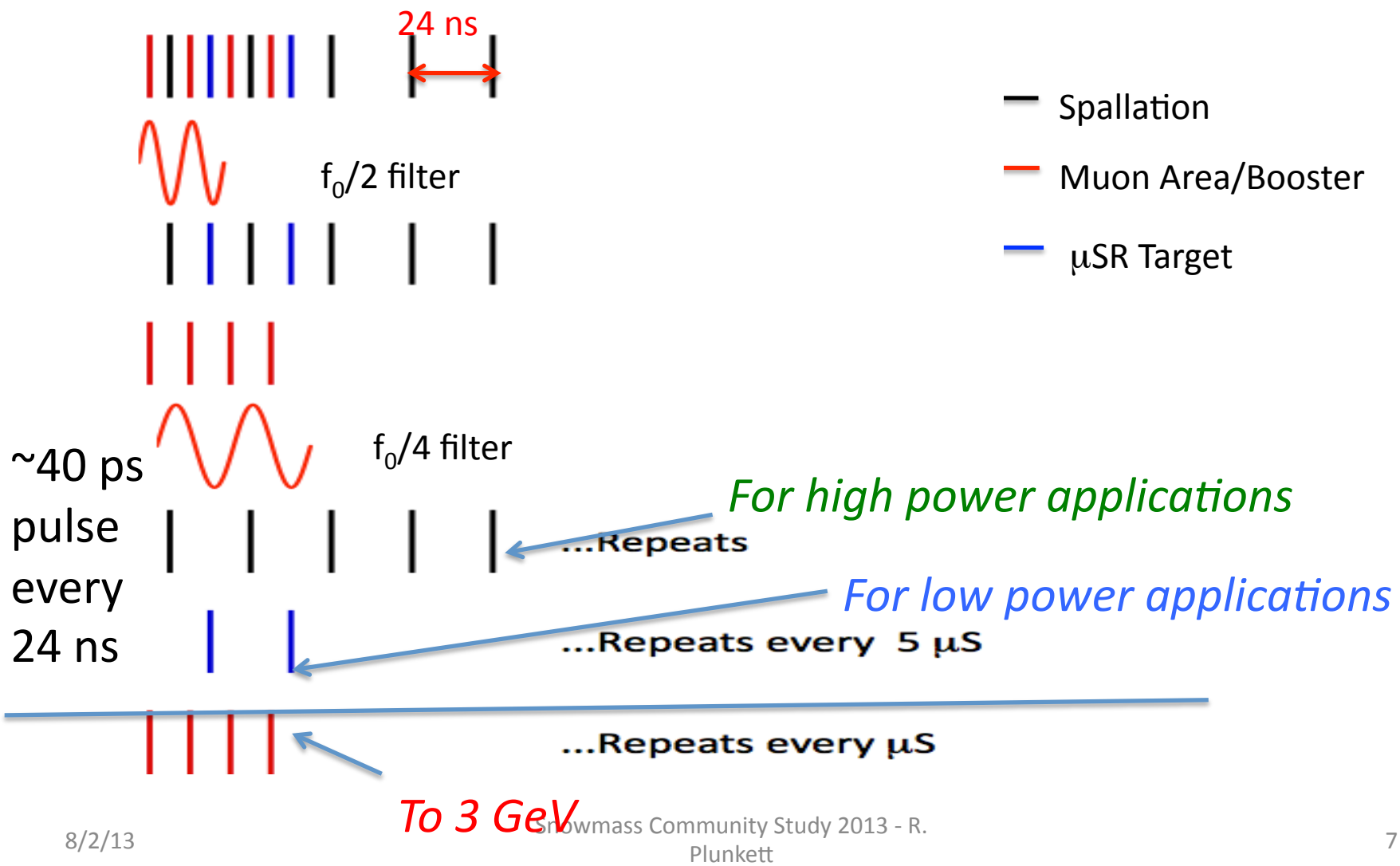


# 160 MHz Chopper in Project X Front End Beam Transport (2.1 MeV)

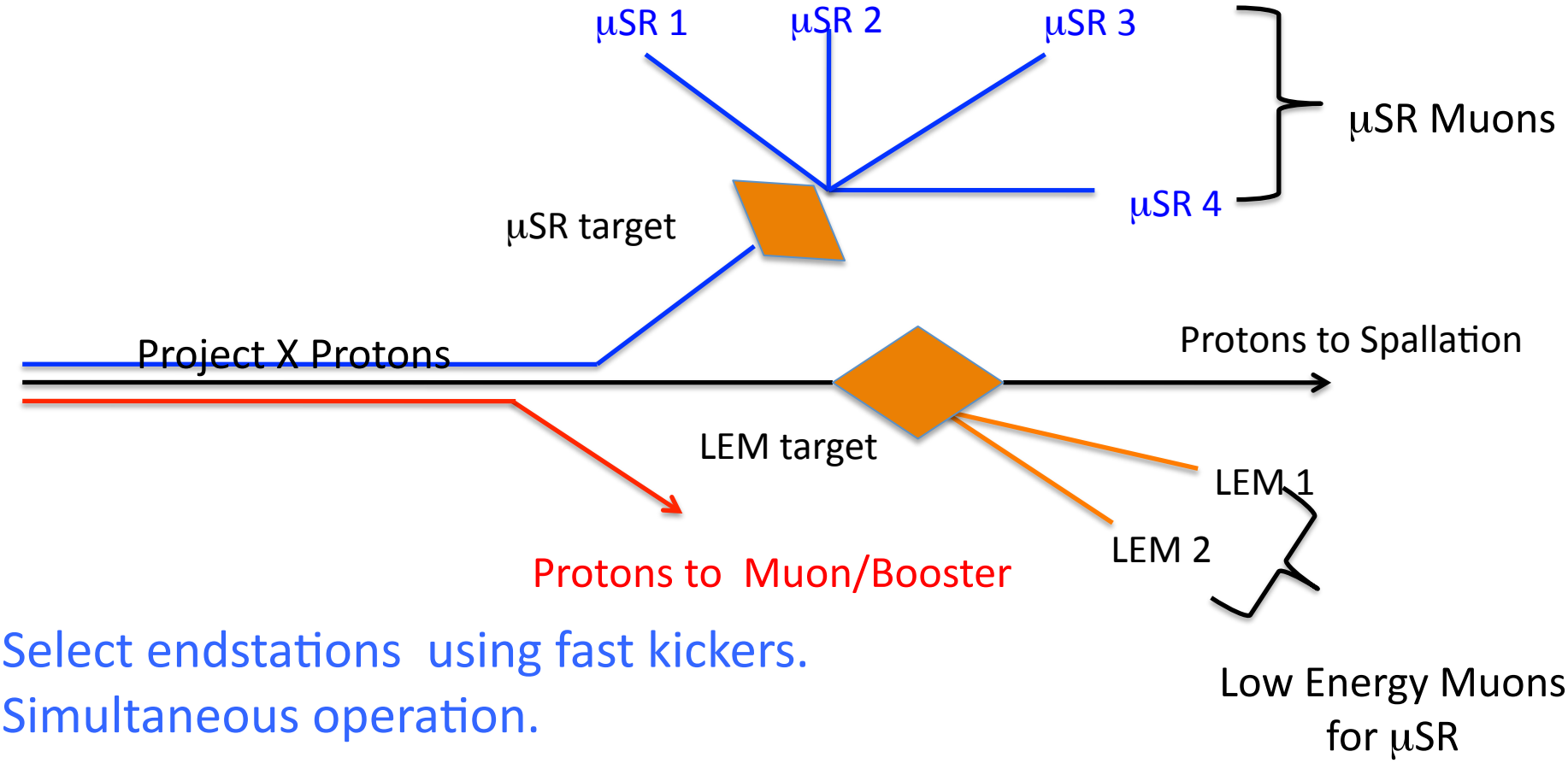



Allows the bunch structure programmability which is the signature feature of Project X

# Example of RF Filtering

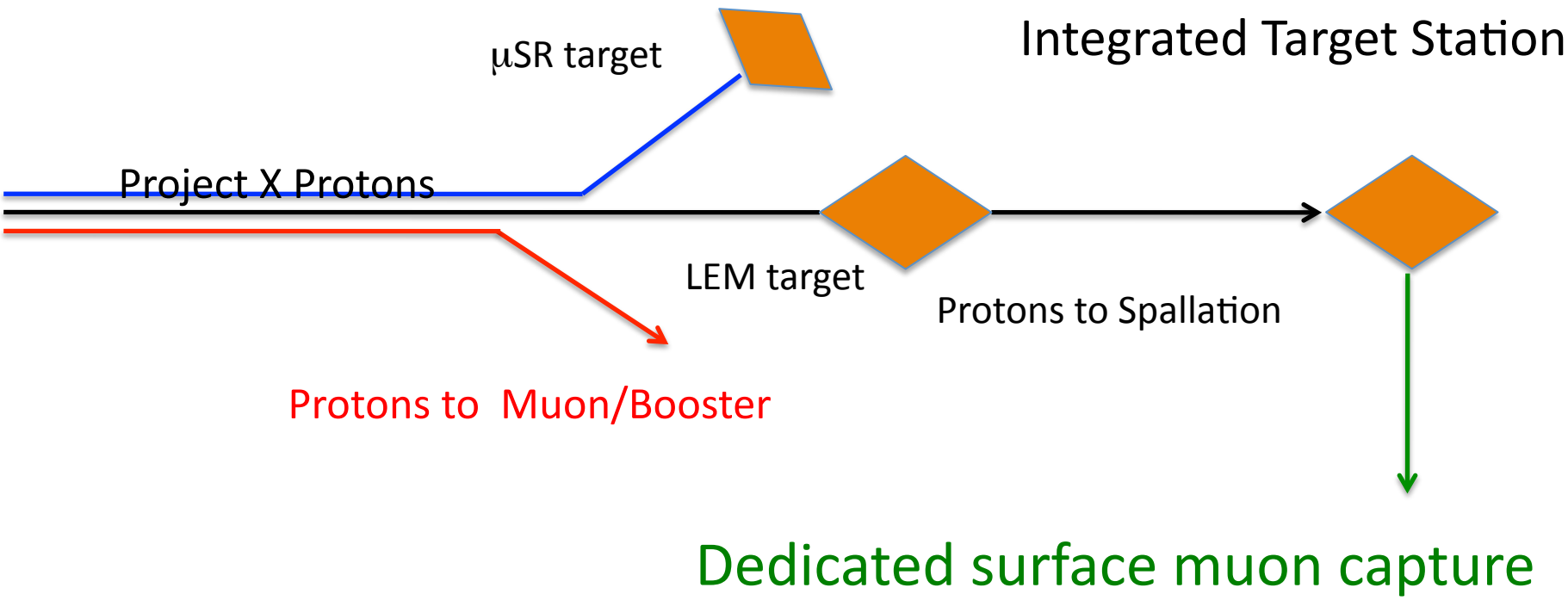


# Possible Beamline Layout



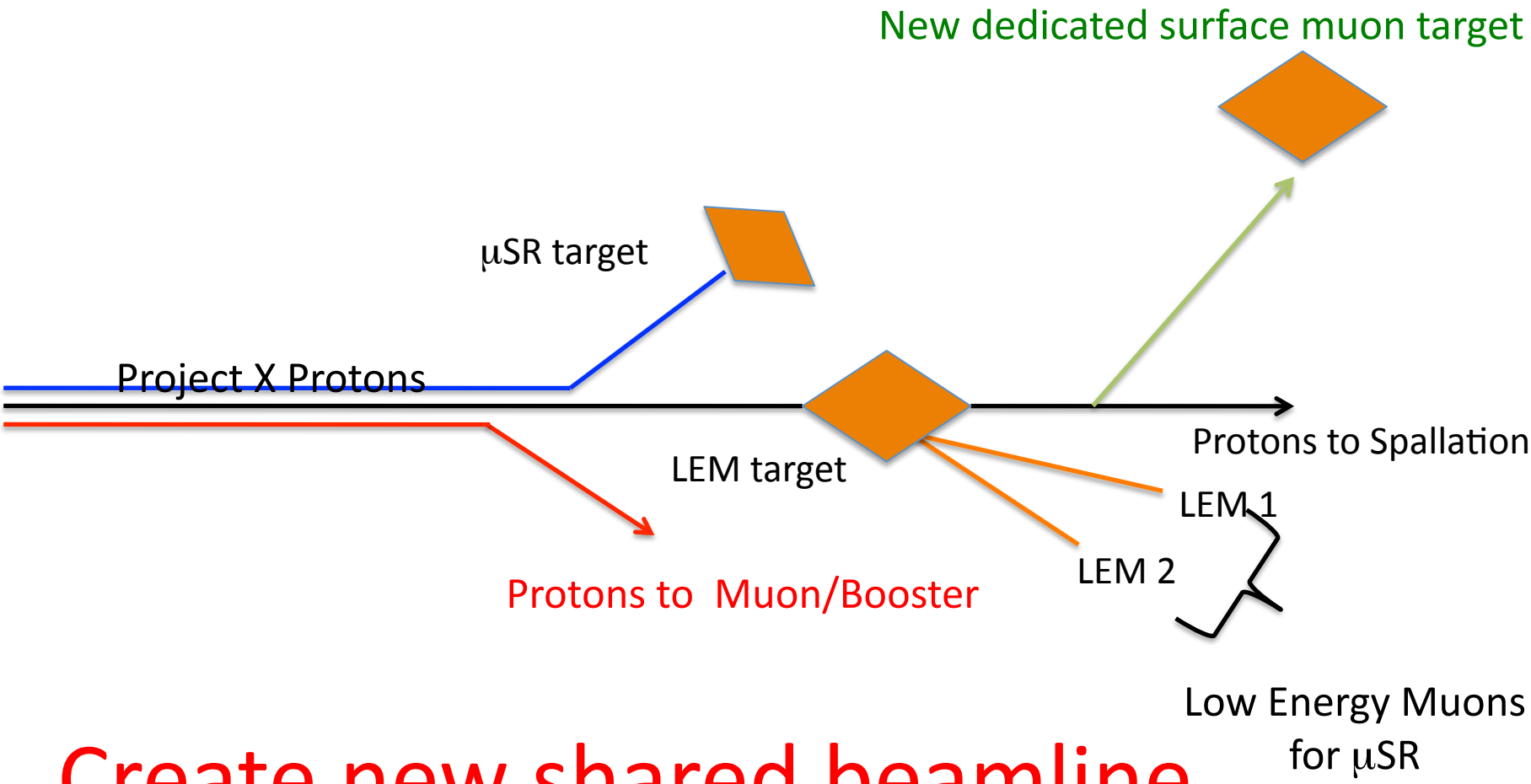

Select endstations using fast kickers.
Simultaneous operation.

# Modifications for more surface muons, I




## Modify Integrated Target Station

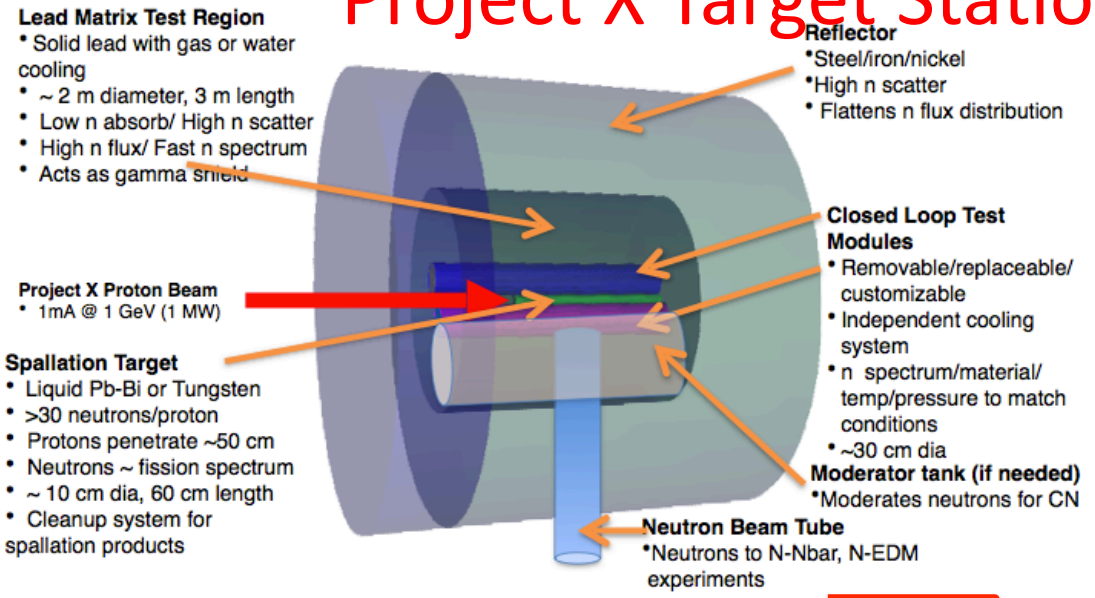
# Modifications for more surface muons, II



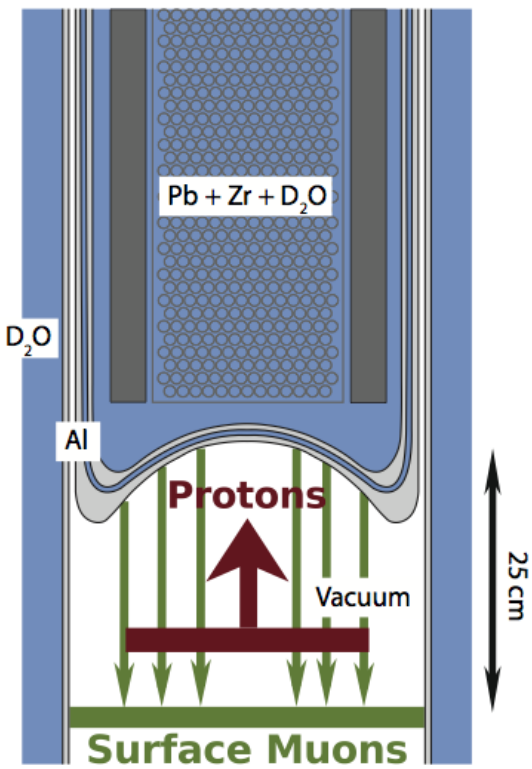

Create new shared beamline

# The Challenge

## Project X Target Station




## PSI Plan




Compatible Concepts?

Or should a new target station be considered?

# Rate Estimate

- In μSR study for Project X, we estimated, for each PX bunch/20 μs:
  - $1.3 \times 10^6$ surface muons/sec
- For this study, the relevant beam is basically CW
  - Correct by factor 20 μS * 40 bunch/μs = 800
  - Additional factor of 10 for total absorption in target. (Surface "skim" targets typically use 10%).
- Estimate $1.0 \times 10^{10}$ muons/s
- Comparable to PSI.
- Still need to further examine how much affected by 1 GeV proton energy.

# Pushing the Envelope

- Current at 1 or 3 GeV is limited by the total RF power installed.
- People are interested in a muon storage ring beam for LBNE – NuMAXX
- This might generate the need for some more current at 3 GeV, stage II. Maybe 30% more.
- It is not (I think) outlandish to consider a stage II request for additional 1 GeV RF in the same spirit.
- However – no guarantees – that is for sure.

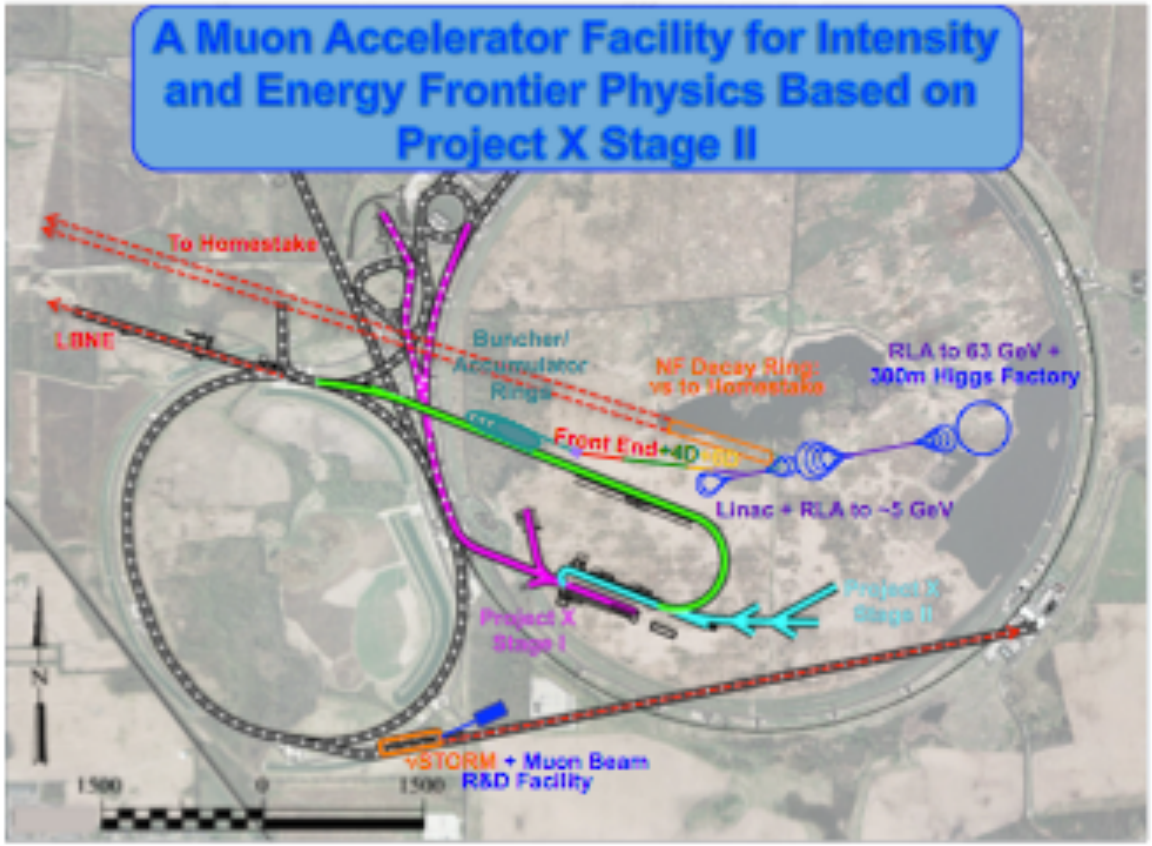



**Figure II-10:** Footprint of neutrino-factory and muon-collider facilities, including an initial muon collider Higgs factory, on the Fermilab site.

# Conclusions

- Project X has a high current beam, which can be used for “slow” muon physics.
- There are design and operational constraints.
- There is a reasonable timing structure.
- This dialog should remain open as we proceed further with the physics options.
- Thank you for inviting me!