Muon Cooling Test Facility at ESS

Photo 8 October 2020

CERN Muon Collider Workshop on Testing Opportunities 24-25 March 2021

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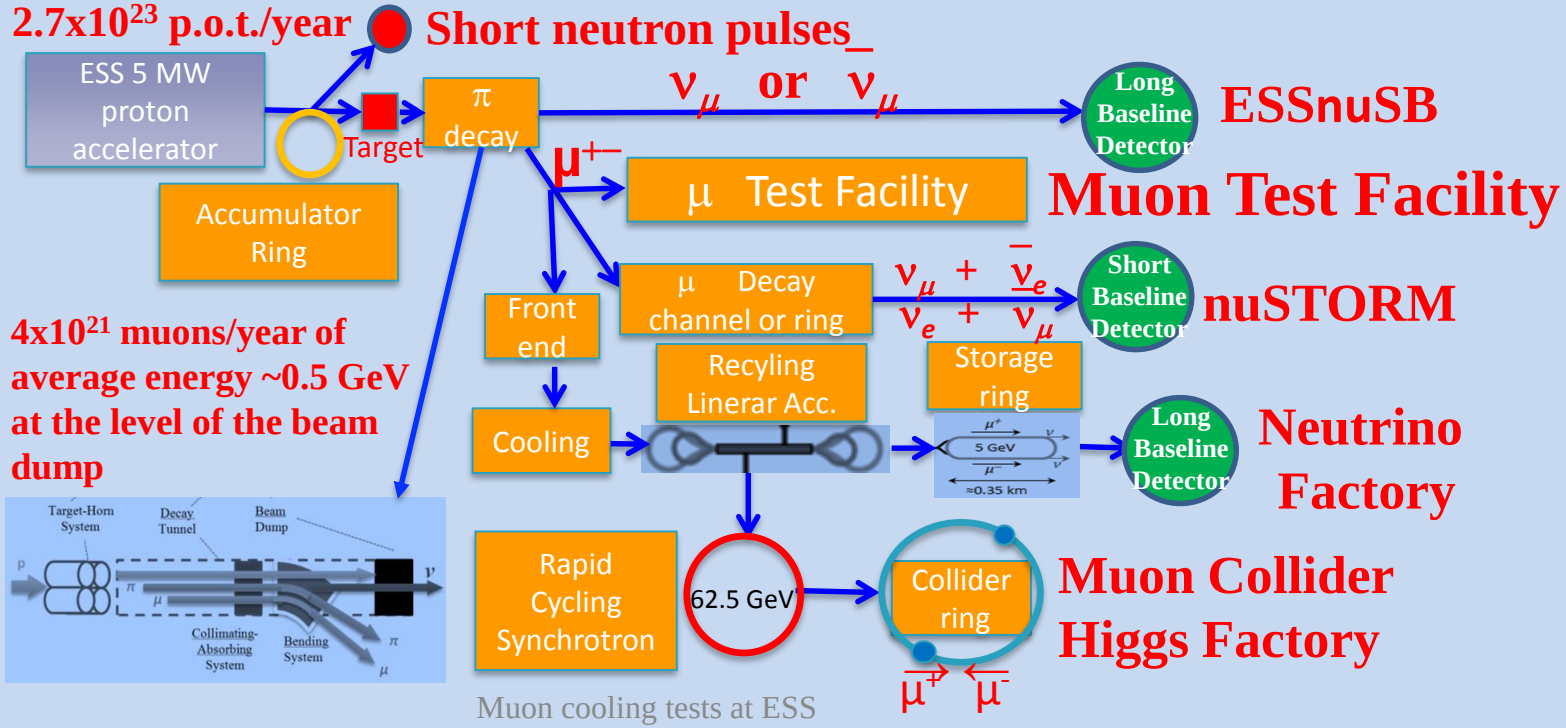
Prospects for Intensity Frontier Particle Physics with Compressed Pulses from the ESS Linac

High Intensity Frontier Initiative HIFI

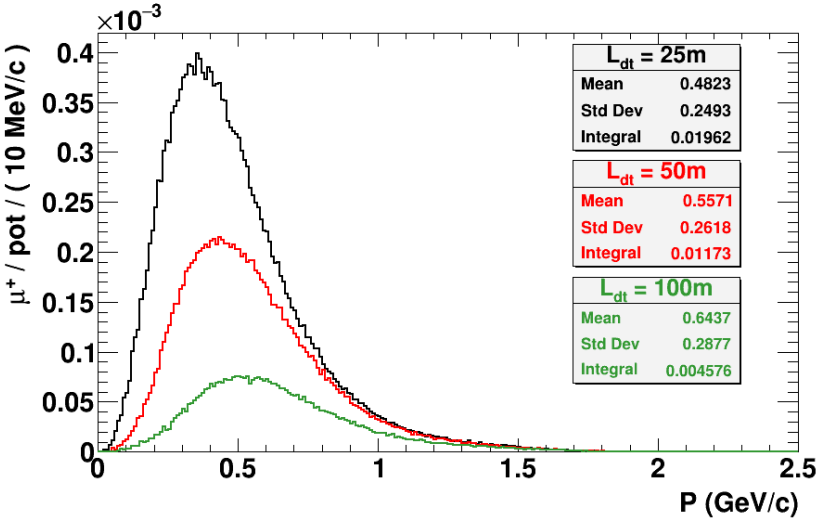
Open workshop at Uppsala University
2-3 March 2020

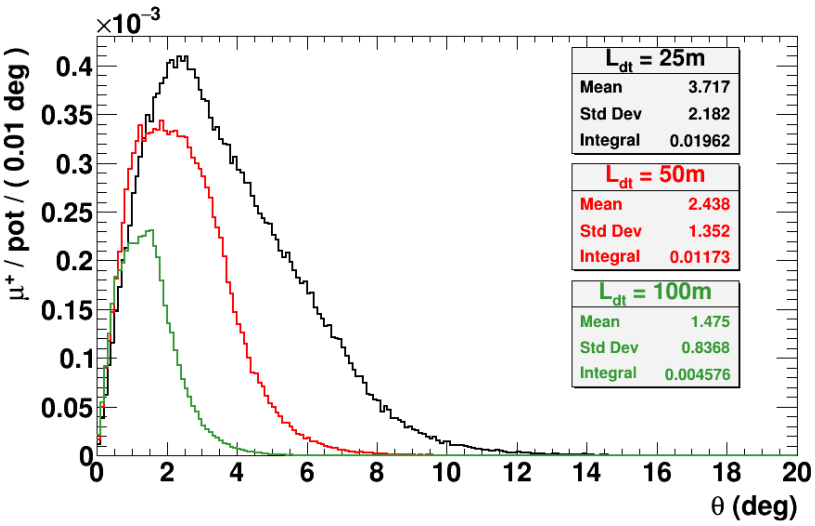
Program and registration at: https://indico.cern.ch/event/849674/



The participants in the HIFI Uppsala Workshop 2-3 March 2020

Muon momentum and angular distribution in a 4m x 4m aperture

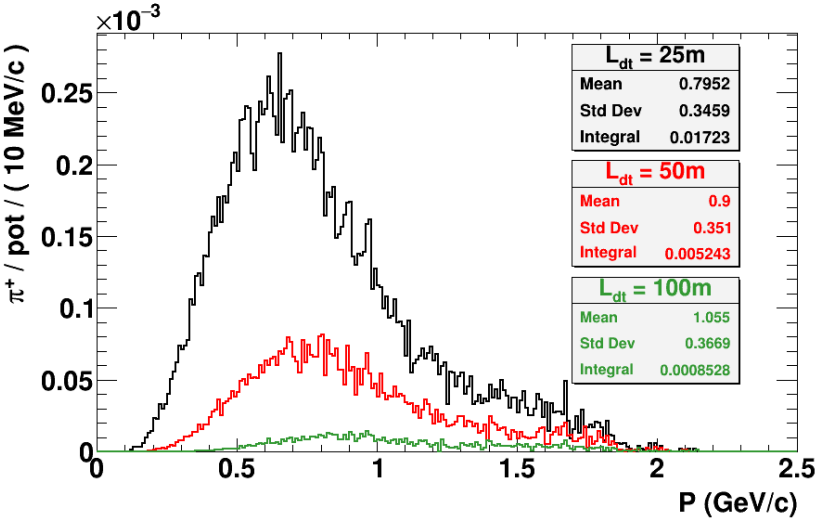


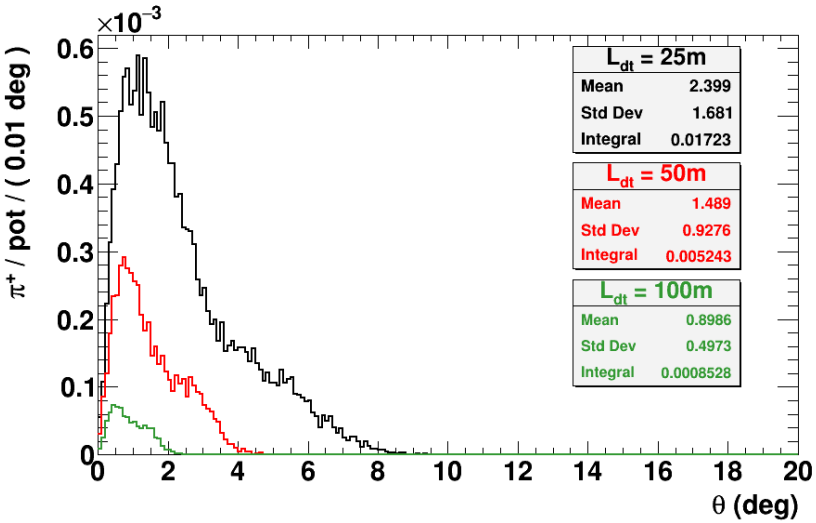


$L_{dt}\,(m)$	$N_\mu\ (\mu^+/pot)$	$N_\mu\ (\mu^+/s)$	$N_\mu\ (\mu^+/200d)$	$\langle P_\mu \rangle\,(GeV/c)$
25	0.02	2.5×10^{14}	4.3×10^{21}	0.48
50	0.01	1.2×10^{14}	2.1×10^{21}	0.56
100	4.5×10^{-3}	0.6×10^{14}	1.0×10^{21}	0.64

Prepared by Loris D'Alessi IPHC

Pion momentum and angular distribution in a 4m x 4m aperture



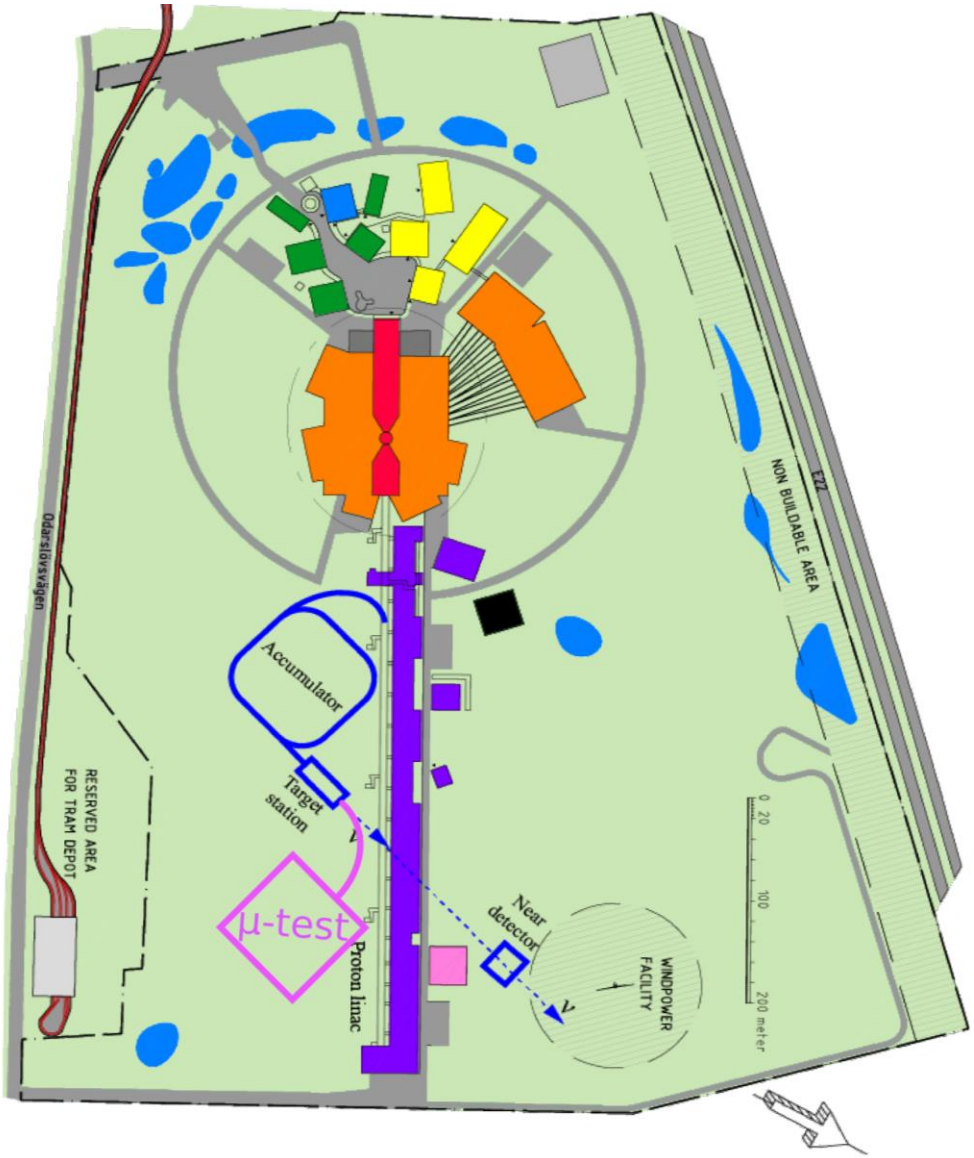


$L_{dt}\,(m)$	$N_\pi\ (\pi^+/pot)$	$N_\pi\ (\pi^+/s)$	$N_\pi\ (\pi^+/200d)$	$\langle P_\pi \rangle\,(GeV/c)$
25	0.017	2.1×10^{14}	3.7×10^{21}	0.79
50	5×10^{-3}	0.6×10^{14}	1.1×10^{21}	0.9
100	8.5×10^{-4}	0.1×10^{14}	0.2×10^{21}	1.06

Prepared by Loris D'Alessi IPHC

Conceptual sketch illustrating ideas for the Muon Test Facilty implementaion at the ESS site

Need to avoid passing the muons in a beam tunnel under the linac tunnel



EU funding opportunities from 2021

- **Destination 1.1 RI Concept Development**

for new infrastructure or for major upgrades of existing infrastructures.
How much? 3 MEUR per project *Dead-line*: 24 March 2022

- **Destination 4 Next generation of scientific instrumentation, tools and methods**

to enable new discoveries and keep Europe's RIs at the highest level of excellence
Requirement: providing R&D for at least 2 Research Infrastructures/Laboratories
How much? 10 MEUR per project *Dead line*: 24 March 2022

- **ERC Synergy Grants**

Who can apply? Between 2 and 4 renowned PIs.
Criterion: scientific excellence.
How much? 10-14 MEUR per project D*ead-line*: probably in late 2022

Outlook

- **ESSnuSB Design Study well advanced**
  - Conceptual Design Report (CDR) by end 2021,
  - Demonstrating feasibility of superior ESS neutrino Super Beam

- **High Intensity Frontier Initiative (HIFI):**
  - widening of the ESSnuSB Design Study scope
  -including first Muon Cooling Facility, later nuSTORM facility, Neutrino Factory and eventually of a Muon Collider Higgs Factory.

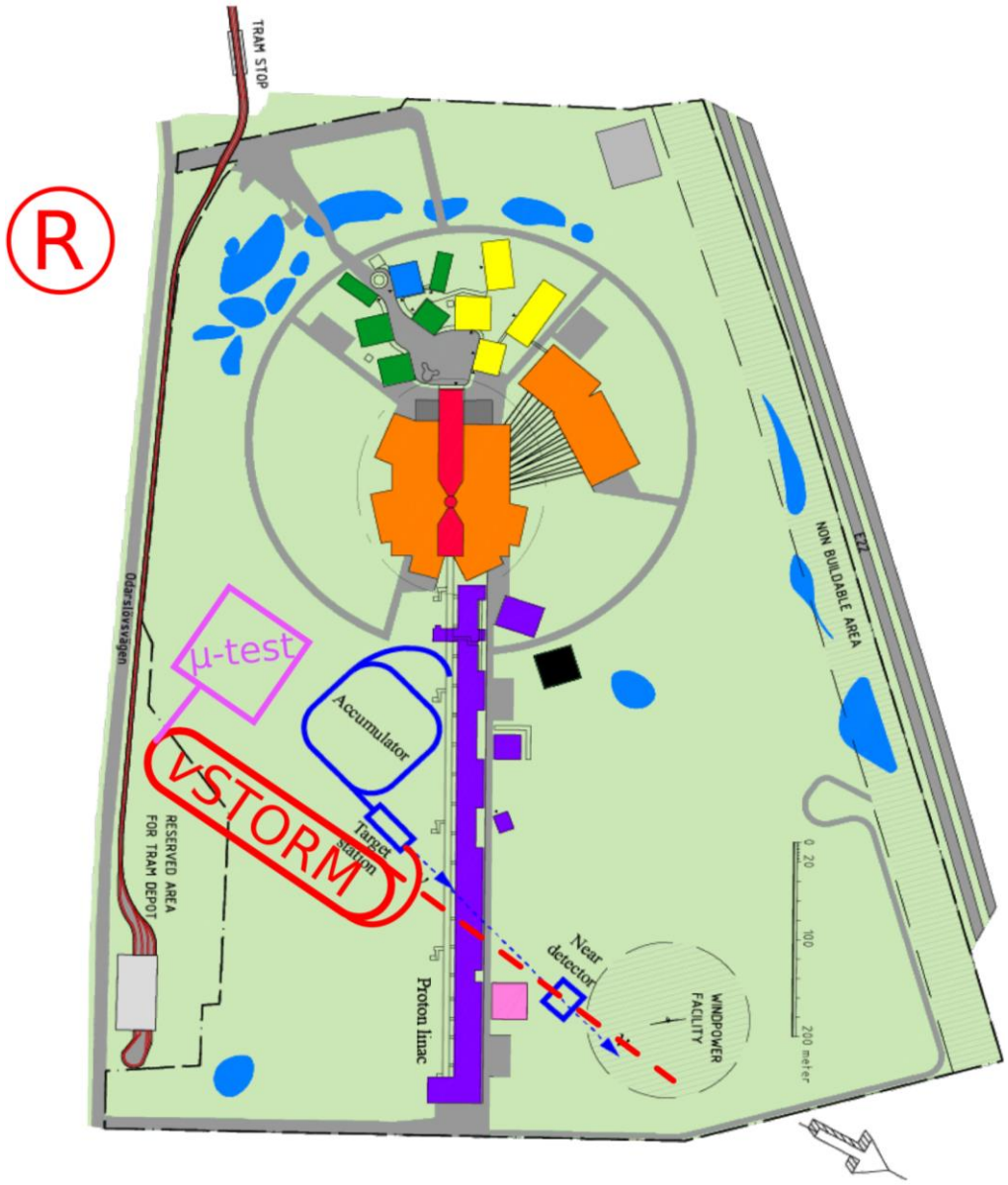
- **First: Initial Muon Cooling Program synergetic with CERNs Muon Collider program**
  - muon momentum range 0.2 - 1.2 GeV/c, mean 0.64 GeV/c
  - 10^{21} muons per year (depending on phase-space volume).

- **Applying for Horizon Europe support for a Destination 1 Design Study 2022-2025**
  – Goal: Technical Design Report (TDR) for ESSnuSB and Conceptual Design Report for the Muon Cooling Program and the other projects by 2025.

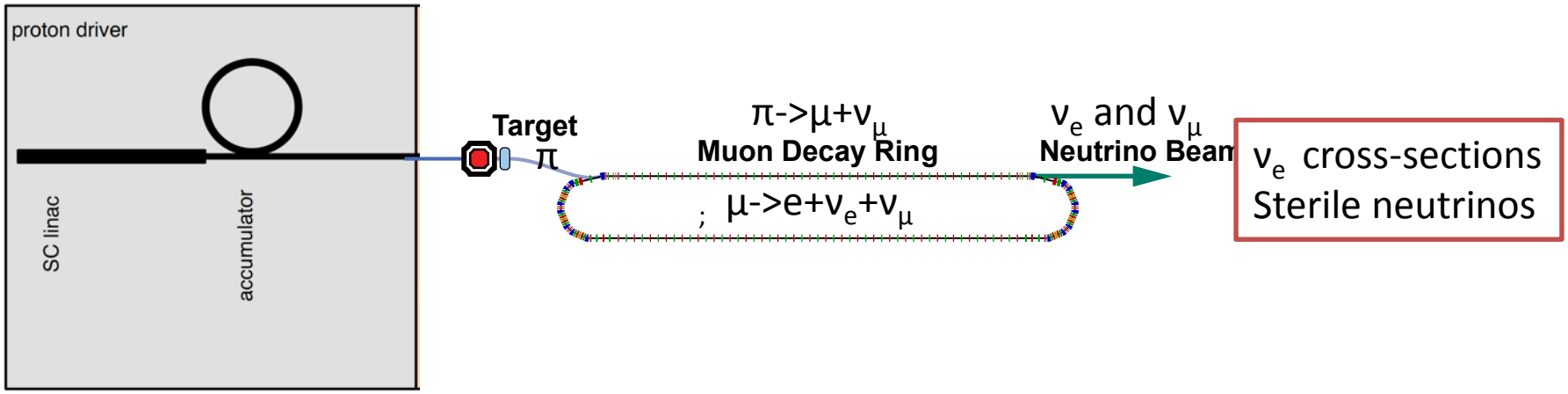
Backup slides

Conceptual sketch illustrating ideas for nuSTORM + Muon Test Facility layout at the ESS site

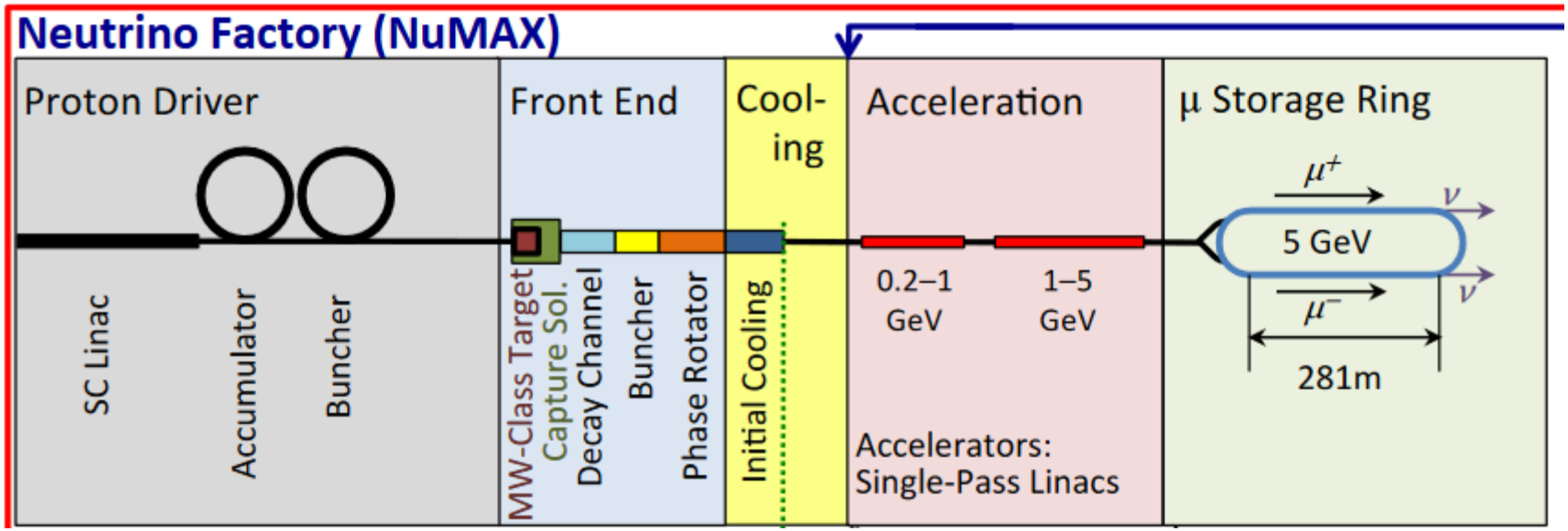
Need to avoid passing the muons in a beam tunnel under the linac tunnel

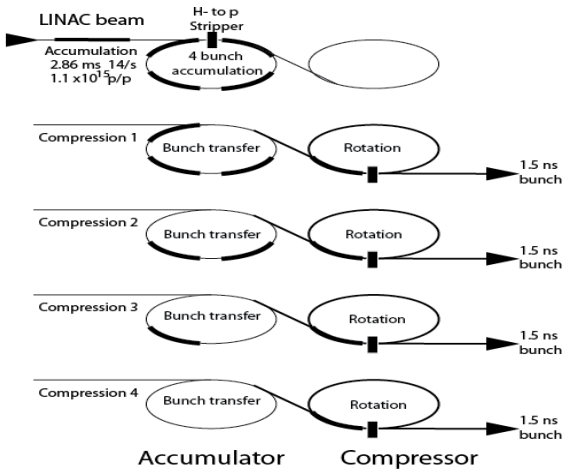


nuSTORM generic lay-out

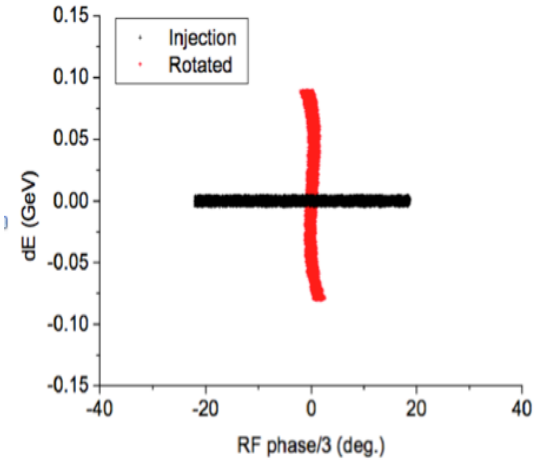


HIFI Neutrino Factory generic layout





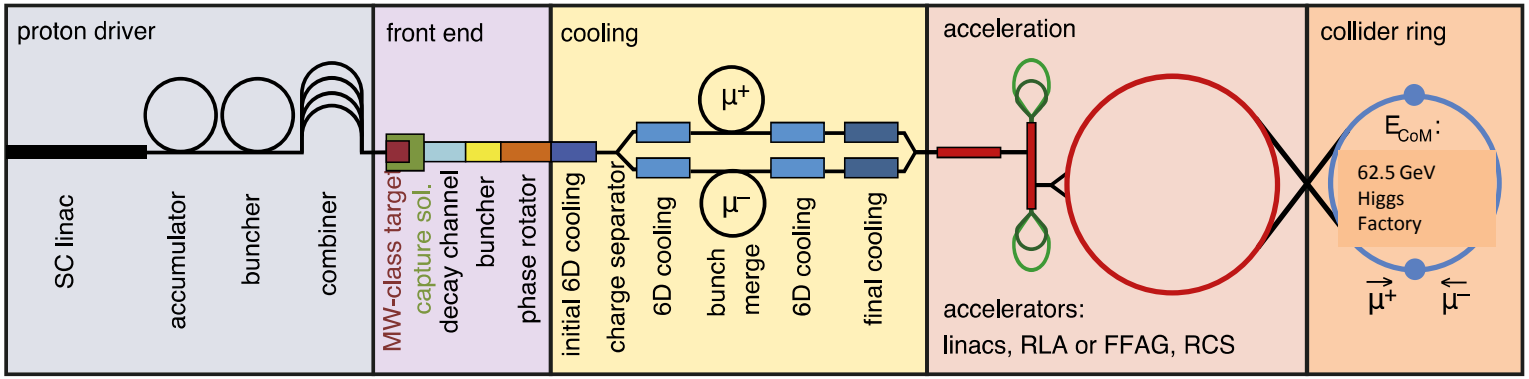
Accumulation and bunching

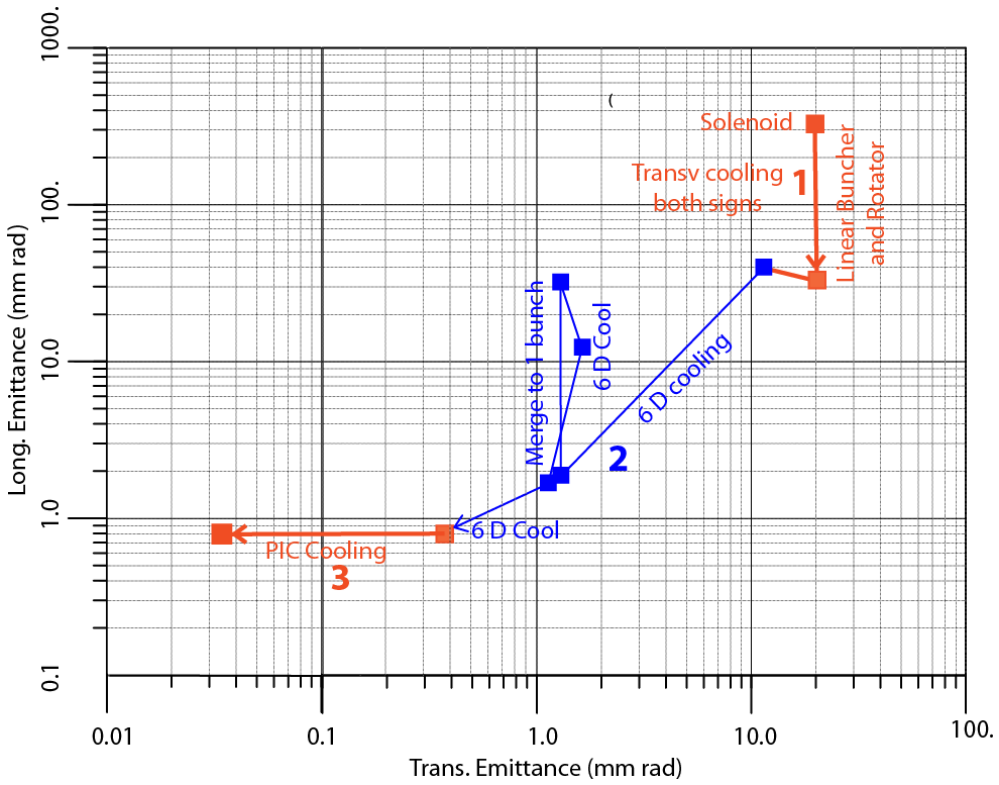


Phase rotation

Then cooling, acceleration and storage in a μ decy ring

Muon Collider Higgs Factory at ESS generic layout





Muon cooling in 3 steps:

1. Linear transverse cooling
2. 6D cooling
3. Parametric Resonance Cooling

Then acceleration to

62.5 GeV and collisions