

A Brief Introduction to the Muon Accelerator Concepts

Muon Collider – Preparatory Meeting, April 10-11, 2019

Mark Palmer

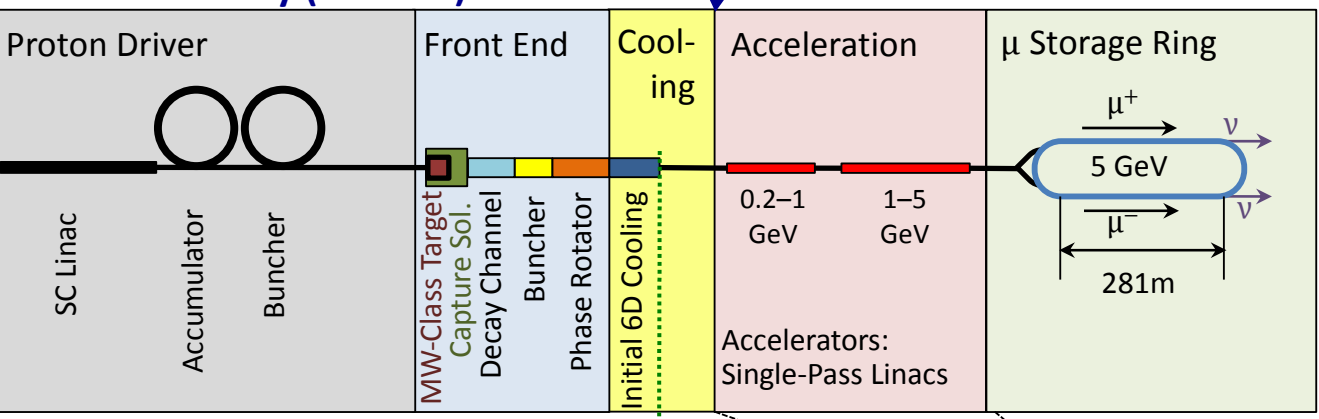
The logo for Brookhaven National Laboratory, featuring a stylized 'B' and 'N' in black, with the text 'BROOKHAVEN NATIONAL LABORATORY' below them.

BROOKHAVEN
NATIONAL LABORATORY

The logo for the U.S. Department of Energy, featuring a circular seal with a shield and the text 'U.S. DEPARTMENT OF ENERGY' to its right.

U.S. DEPARTMENT OF
ENERGY

Neutrino Factory (NuMAX)

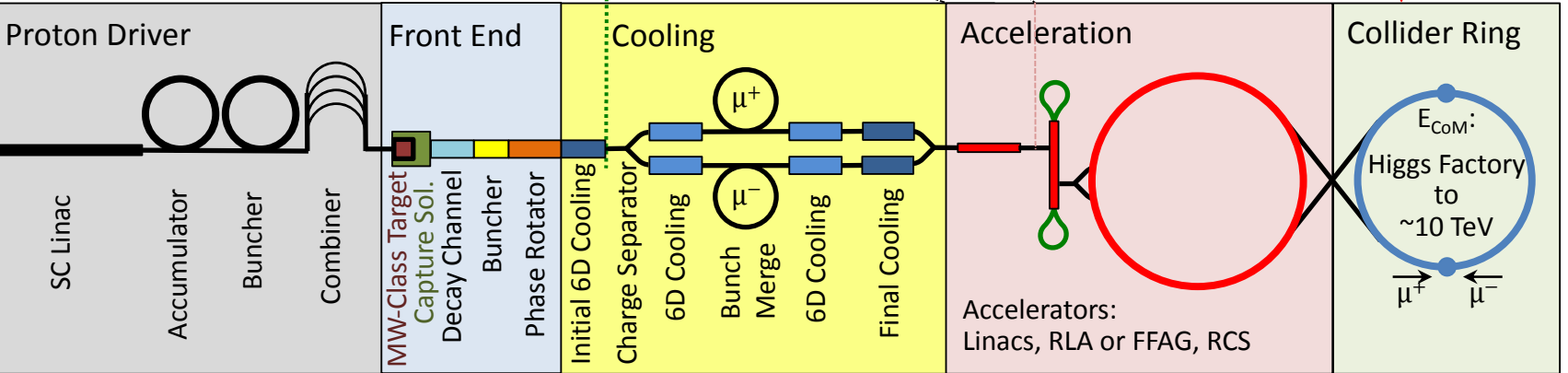


n Factory Goal:
 10^{21} μ^+ & μ^- per year
 within the accelerator acceptance

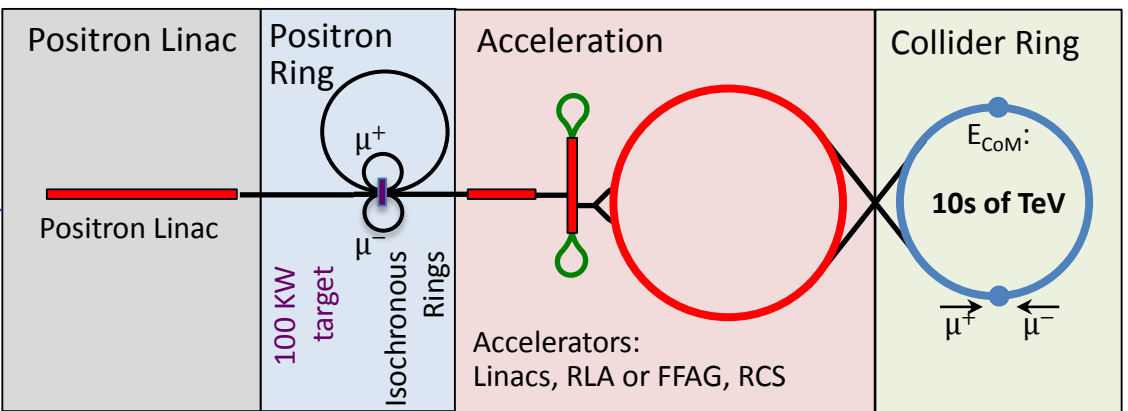
∞ Collider Goals:
 126 GeV ⇔
 ~14,000 Higgs/yr
 Multi-TeV ⇔
 Lumi > 10^{34} cm⁻²s⁻¹

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Muon Collider



Low EMittance Muon Accelerator (LEMMA):
 10^{11} μ pairs/sec from e^+e^- interactions. The small production emittance allows lower overall charge in the collider rings – hence, lower backgrounds in a collider detector and a higher potential CoM energy due to neutrino radiation.



Broad Applications:

- Neutrino Factories
- Colliders from ~100 GeV to 10s of TeV scale
- Secondary Beams

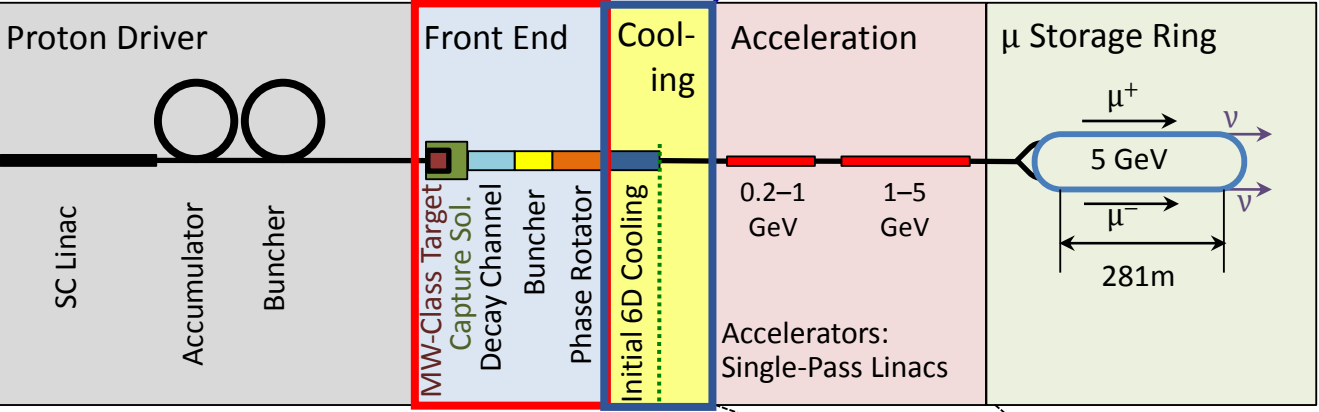
Potential Sources:

- Proton-driver with ionization cooling
- Positron-driver with low emittance

Muon Accelerator Design Status

- Full conceptual designs for NFs
- Collider effort (US) focused on key R&D elements as opposed to a full conceptual design
 - In 2012, justified by the facts that
 - Proposed parameters for some systems appeared extremely challenging
 - Some concepts could not be “easily” demonstrated
- R&D and design progress since 2012 arguably changes this picture

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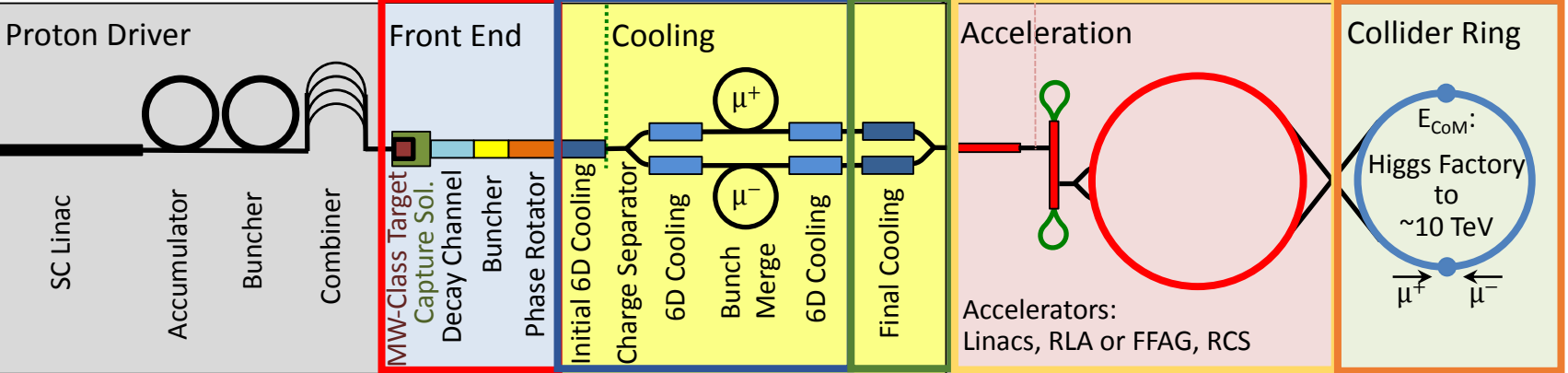


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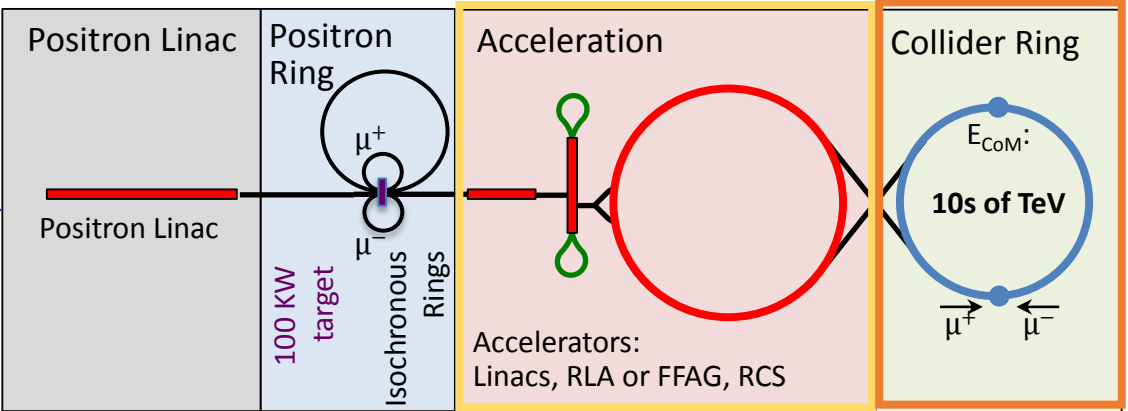
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Magnet Topics:

- Large-diameter, high-field capture solenoid
 - Very high radiation environment
 - Must support remote handling for target module
- Front End
 - Superconducting transport solenoids
- 6D Cooling Channel
 - RF in SC Solenoids
 - LTS-only in MAP baseline
 - Performance improvements with higher RF gradient
 - Can final-stage performance be improved with HTS?
- Final cooling very high field solenoids
 - $\sim 30\text{T}$ HTS with >25 mm bore
 - Field and aperture demonstrated at NHMFL
- Accelerators
 - Fast-ramping SC (or NC) magnets
 - SC Halbach Designs
- Collider
 - Large aperture with significant shielding
 - IR Strengths for high energies