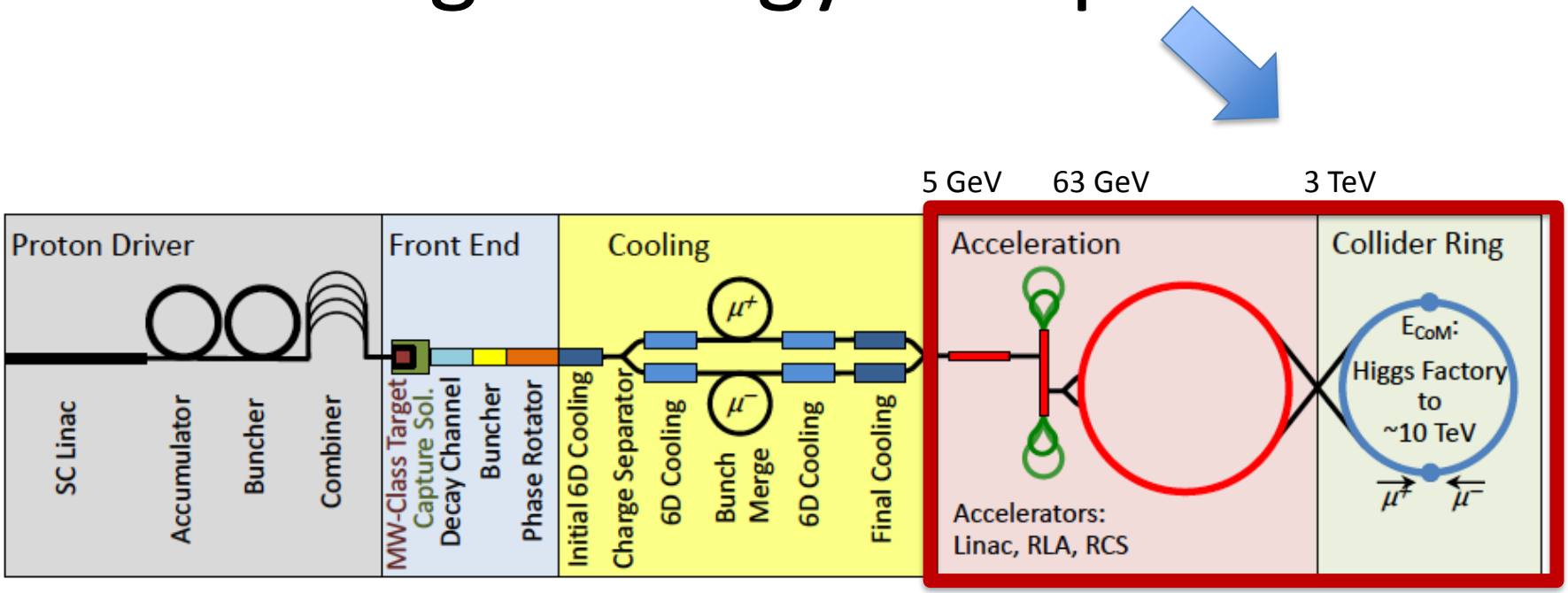
High-Energy Complex



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Muon acceleration

Muon collider

HEP Workpackages Description

GOAL:

Develop a **credible design concept Muon Collider** with **cost estimate**, **upgrade path**, and demonstration facility requirements by **December 2025** based on reasonable assumptions on technology development. Costing and final documentation will require at least roughly 12 months although updates can be accommodated through Fall 2025.

Requires **complete beamline description** with l**attices** with critical technologies identified and ideally have **start-2-end tracking** of **full system to demonstrate luminosity performance** (subsystem tracking may be sufficient). Identify outstanding challenges with possible mitigation approaches.

PREMISES:

Providing a **self-consistent, realistic parameter table** is given as starting point and the **beam dynamics tools** are **developed** and we will have an iterative and collaborative process in the collective effects part with the **Beam Dynamics** and in the IR design issues with the **Machine Design Int**erface

Proposed Workpackage Tasks

WP1: Muon acceleration Design Study

T1.1: Overall design parameters
T1.1.1 Baseline layout and parameters
T1.1.2 Performance optimization
T1.1.3 Simulations tools development (**Beam Dynamics collaboration)**
T1.1.4 Start to end simulations of HEC complex (individual systems)
T1.1.5 Feasibility footprint, cost estimate including powering

T1.2: Linac and Recirculating LA design
T1.2.1 Lattice optics design and single particle dynamics
T1.2.2 Collective effects (wakefields, space charge...) (**Beam Dynamics collaboration)**
T1.2.3 Alignment, positioning, errors and tolerance studies
T1.2.4 Injection concepts
T1.2.5 Study of muon decay effects on SRF cavities **(input for SRF team)**

T1.3: Rapid Cycling System (RCS) design
T1.3.1 Lattice optics design and single particle dynamics, including RF
T1.3.2 Collective effects (wakefields) (**Beam Dynamics collaboration)**
T1.3.3 Alignment, positioning, errors and tolerance studies
T1.3.4 Radiation mitigation in the arcs
T1.3.5 Injection and extraction concepts

T1.4: Alternative to RCS: FFA
T1.4.1 Lattice optics design and single particle dynamics, including RF
T1.4.2 Collective effects (**Beam Dynamics collaboration)**
T1.4.3 Alignment, positioning, errors and tolerance studies
T1.4.4 Injection and extraction concepts (including transfer lines in coordination with proton system and muon collider respectively)
T1.4.5 Synergy with other FFA projects

T1.5: Technical systems requirements and concepts
T1.5.1 Short cycling magnets (including HTS)
T1.5.2 Efficient, reproducible and stable power supplies (stored energy management)
T1.5.3 SC magnets requirements and conceptual design, including cryostats
T1.5.4 High gradient and High-Q SRF cavities
T1.5.5 Cryogenics for SC magnets and RF
T1.5.6 Beam diagnostics
T1.5.7 Vacuum system

Proposed Workpackage Tasks

WP2: Muon Collider Design Study

T2.1: Overall design parameters

T2.1.1 Baseline layout and parameters
T2.1.2 Physics requirements and performance optimization ***(MDI collaboration***)
T2.1.3 Simulations tools development
T2.1.4 Start to end simulations of HEC complex (individual systems)
T2.1.5 Feasibility footprint, cost including powering

T2.2: Machine design

T2.2.1 Lattice design and single particle dynamics, including IR ***(MDI collaboration***)
T2.2.2 Collective effects (impedance budget, beam-beam ,…)
T2.2.3 Injection and extraction/dumps/abort concepts and designs (including transfer lines in coordination with muon accelerators design)
T2.2.4 IR/FFS design, BIB (Beam Induced Background) and shielding ***(MDI collaboration)***
T2.2.5 Alignment, positioning, errors and tolerance studies
T2.2.6 Machine protection concepts
T2.2.7 Neutrino hazard

T2.3: Technical systems requirements and conceptual design

T2.3.1 Collider arc magnets: combined function magnets or other alternative magnets (open mid-plane dipoles...)
T2.3.2 Shielding, absorbers and dumps devices
T2.3.3 Global alignment techniques and girder studies, survey
T2.3.4 Machine protection system and shielding
T2.3.5 Power converter requirements and conceptual design
T2.3.6 RF system and integration
T2.3.7 Cryogenics for RF and magnets
T2.3.8 Beam diagnostics
T2.3.9 Vacuum systems

Proposed Workpackage Tasks

WP3: Technology R&D

T3.1 Short cycling magnet program
T3.2 Efficient, reproducible and stable power supplies and stored energy management
T3.3 High-gradient and high-Q SRF program
T3.4 Collider arc magnets: combined function magnets and alternative magnets
T3.5 Simulation tools development
T3.6 Beam screens (impedance and vacuum)
T3.7 Global alignment techniques and girder studies

Proposed Workpackage Timeline

The process for the Timelime and Resources/FTE first estimation and identification of the possible labs interested is on going.../