High-Energy Complex

Muon acceleration

5 GeV 63 GeV 3 TeV

Muon collider

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2nd Community Meeting 12-16 July 2021
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 lattices 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 Interface.
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

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# 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 Timeline and Resources/FTE first estimation and identification of the possible labs interested is on going.../