

## **Main Deliverables**

### **Project Evaluation Report**

An assessment whether the muon collider is a promising option and addressing the following questions:

What is a realistic luminosity target?

What are the background conditions in the detector?

Can one consider implementing such a collider at CERN or other sites?

What are the cost drivers and what is the cost scale of such a collider?

What are the power drivers and what is the power consumption scale of the collider?

What are the key technical risks?

### **R&D plan**

A report describing an R&D path toward the collider

A conceptual design report for the muon cooling test facility

A description of other R&D efforts required

## **Sub-deliverables**

### **Neutrino Radiation Mitigation Concept**

Assess requirements for neutrino mitigation system

Assess technology issues of neutrino mitigation system

Conceptual design of key technical components for neutrino mitigation system

Prepare conceptual design of mitigation system

Develop a concept to mitigate the neutrino flux from the acceleration system

Verify the simulation tools

Develop the interaction region lattice considering MDI and neutrino flux mitigation

Develop an operation concept consistent with the neutrino flux mitigation

### **MDI Assessment**

Simulations of impact of background on physics studies

Development of concepts to mitigate background impact

Beam-beam simulation code

Develop the interaction region lattice considering MDI and neutrino flux mitigation

### **Collider Ring Concept**

Develop the interaction region lattice considering MDI and neutrino flux mitigation

Develop the arc lattice considering neutrino flux mitigation and muon decay induced losses

Develop an operation concept consistent with the neutrino flux mitigation

Assessment of collective effect-induced limitations on high-energy accelerator design

### **High-energy Acceleration Concept**

Develop a concept to compress the beam during the high-energy acceleration

Develop a lattice that allows to determine the pulsed synchrotron energy swing

Verify the transverse beam stability and resulting specifications

Assess the neutrino radiation from the accelerator complex

Assess the key issues of the initial high-energy acceleration linac systems

Concept of the high-energy acceleration linacs

### **FFA Assessment**

Assess potential benefits of FFA as an alternative

Key lattice design of FFA

Key magnet design for FFA

Assessment of collective effect-induced limitations on high-energy accelerator design

### **Muon Cooling Concept**

Final cooling optimisation

- Overall optimisation of cooling strategy
- Assessment of 6D cooling cell challenges
- Assessment of collective effect-induced limitations in muon cooling design
- Assessment of fundamental limit of proton beam density
- 6D cooling optimisation
- Engineering design of cooling cell
- Concept of muon bunch combination
- Initial cooling concept
- Explore alternatives

#### **Proton Target Assessment**

- Assessment of target parameters
- Solenoid performance specifications
- Mitigation concept for radiation in target solenoid
- Conceptual design of proton target

#### **Proton Complex Assessment**

- Assess proton complex parameters and challenges
- Determine fundamental limit of proton beam density
- Conceptual design of bunch combination complex
- Conceptual design of H- source

#### **Beam Dynamics Assessment**

- Assessment of collective effect-induced limitations on high-energy accelerator design
- Assessment of collective effect-induced limitations in muon cooling design
- Assessment of fundamental limit of proton beam density
- Determine fundamental limit of proton beam density
- Simulations of key collective effects
- Development of simulation tool for beam-matter interaction

#### **High-field Magnet Technology Assessment**

- Assess which high-field magnet performance specifications are realistic goals
- Conceptual design of final focus magnets
- Conceptual design of collider ring combined function magnets
- Conceptual design of collider ring arc dipoles
- Conceptual design of pulsed synchrotron magnets
- Conceptual design of FFA magnets
- Conceptual design of target solenoid
- Conceptual design of final cooling solenoids
- Conceptual design of 6D cooling solenoids

#### **Fast-ramping Magnet Technology Concept**

- Develop a concept of the fast-ramping magnets and their powering
- Perform tests of fast-ramping magnet materials to maximise the ramping speed and efficiency
- Explore HTS options for fast-ramping magnets
- Experimental verification of fast-ramping magnet system power efficiency

#### **Muon Cooling RF Technology Concept**

- Develop a concept of the high-energy acceleration cavities that mitigates single-bunch beam loading
- Develop a concept for the efficient powering of the high-energy RF
- Infrastructure for muon cooling cavity tests
- Collaborate for tests of high-gradient, low-frequency superconducting cavities

#### **High-energy RF Technology Concept**

- Develop cavity concepts to optimise the muon cooling RF for performance, power and cost
- Develop RF powering concepts to optimise the muon cooling RF for performance, power and cost

#### **Shielding concepts**

- Design the masking system for the detector
- Assess required shielding of the arcs
- Assess shielding needs for target solenoid
- Verify the simulation tools for neutrino radiation
- Assess potential losses in high-energy superconducting RF

#### **Civil engineering assessment**

- Assess site choice options considering neutrino radiation mitigation
- Assess site choice considering geological implications
- High-level cost scale determination
- Contribute to assessment of potential test facility sites
- Develop civil engineering concept for test facility

#### **Muon Cooling Cell Design**

- Assess technological issues of 6D cooling cell
- Integrated design of 6D cooling cell
- Conceptual design of technical systems for 6D cooling cell

#### **Test Facility**

- Scope of test facility
- Identify potential suitable site
- Conceptual design of key parts of test facility
- Conceptual design of key parts of test facility
- Technical design of test facility

#### **Other Technologies**

- Assess technology issues of neutrino mitigation system
- Conceptual design of technical components for neutrino mitigation system
- Assess technological issues of 6D cooling cell
- Conceptual design of technical systems for 6D cooling cell