International MUON Collider Collaboration

CERN

Test Facility (Discussion)

Roberto Losito
CERN-ATS-DO

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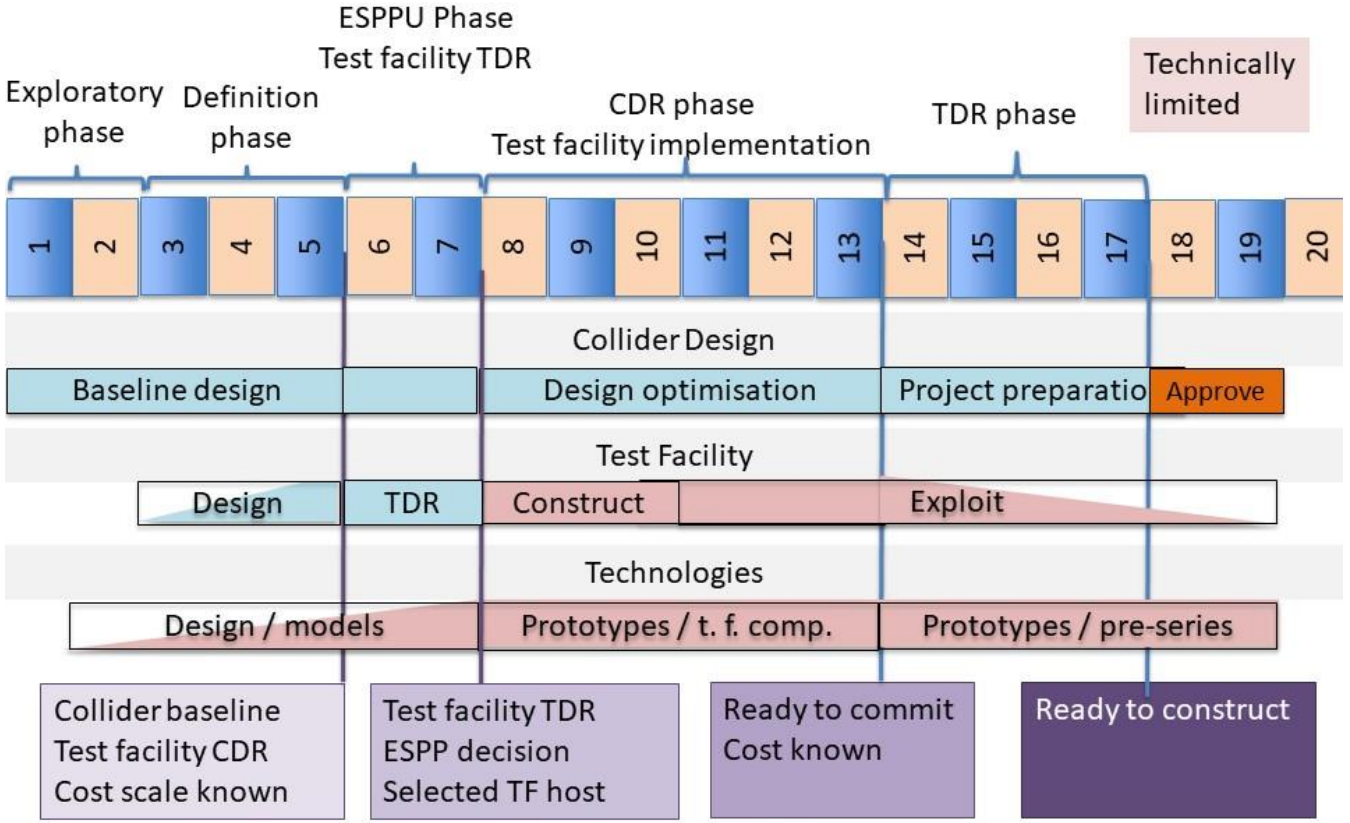
Scope and Potential Long-Term Timeline



Motivation

- While we have to provide “only” a feasibility study for the Collider, we should start soon a CDR phase for the Demonstrator.
- EU design study could provide the resources to write a CDR in the period 2023-2025 and be ready for a TDR in 2026.
- At some point (end of 2022) we will have to freeze the layout and start detailed studies

Motivation
(thanks Vladimir!)

1. a beam test facility, presumably at CERN, should demonstrate **items of critical importance for the MC luminosity**, namely, the ***6D cooling*** and ***integrated engineering of the cooling cells*** (also, some collider targetry and RF elements can be tested, too);

2. in addition, accelerator technology demonstrations require no-beam test stands to have a better idea of the cost range and technical challenges– HF-magnets, main acceleration RF, rapid-cycling magnets and efficient power storage, SC magnets on movers for the “travelling wave” collider technique, etc

Discussion topics: cooling

1) what are the most promising options for the cooling channel to be tested
    1) Low emittance rectilinear (transverse emittance< few 100 micrometers) (first priority)
        1) Strong solenoid, variable aperture (shielding?)
        2) Proton Beam power as high as possible
        3) Longitudinal emittance O(1mm) : 10 MeV, 100psec time spread
    2) High emittance (HFOFO) (second option)
        1) 325 MHz, 1 ns bunch
        2) Transverse emittance 10 mm,
    3) Final cooling (concept not mature yet, better to complete studies)
        1) Transverse emittance 100 micrometers
        2) 10 nsec
    4) Cooling ring
        1) High risk, cheaper if we find a way to do it.
    5) PIC cooling
        1) At the moment the concept is not yet demonstrated on paper.
2) Is it reasonable to test only one concept, or should we test more than one? Is this possible/financially affordable? What is the best ratio risk/benefit for the community?
3) What are the main beam characteristics at the entrance of the cooling channel ?

Discussion topics: Targetry

1) what are the most promising options for 1.5 MW and what has to be tested
    1) Graphite
    2) Others…

2) What are the most promising options for 4 MW and what has to be tested
    1) Fluidised Tungsten
    2) Liquid Lead
    3) Other liquid metals?

3) What is the best option for the test facility
    1) Can we go for a “conventional” graphite target or do we need to demonstrate anything of the above?

4) How can we test in the facility (or offline) the integration with the Solenoid and following magnets
    1) Reduce internal shielding of the solenoid to test quench limits ?
    2) Do we want the maximum beam power (100 kW) ? Highest instantaneous power, not necessarily high average power

Discussion topics: Available beams

1) What beams can we get at CERN and what upgrades are necessary to come close to the requirements
    1) 7 nsec, 10^13 ppp available at the PS (20 GeV)
        1) Need an accumulator or chopper
2) What beams can we get at ESS
    1) Microsecond pulse out of the accumulator ring (8.9 10^14 ppp) for the 5 MW option. 2.5 GeV
3) Can we get beams anywhere else (PSI? RAL? FNAL?)
    1) RAL has no beams with suitable characteristics, but can invite component testing
    2) FNAL: MuonE planned until 2030. Test beams eventually possible. Difficult to imagine a dedicated facility (in g-2 cavern?) before 2030.
    3) Bob Zwaska: *The g-2 target station is available for limited running while Mu2e operates. We intend to develop it as a test station. It's parameters will be modest, probably 1e13 protons, but with a small spot size.*

RF & Magnets

- RF & Magnets for muon production and cooling require significant R&D.
- Should we discuss tradeoffs between performances and availability in the timescale of the demonstrator?