

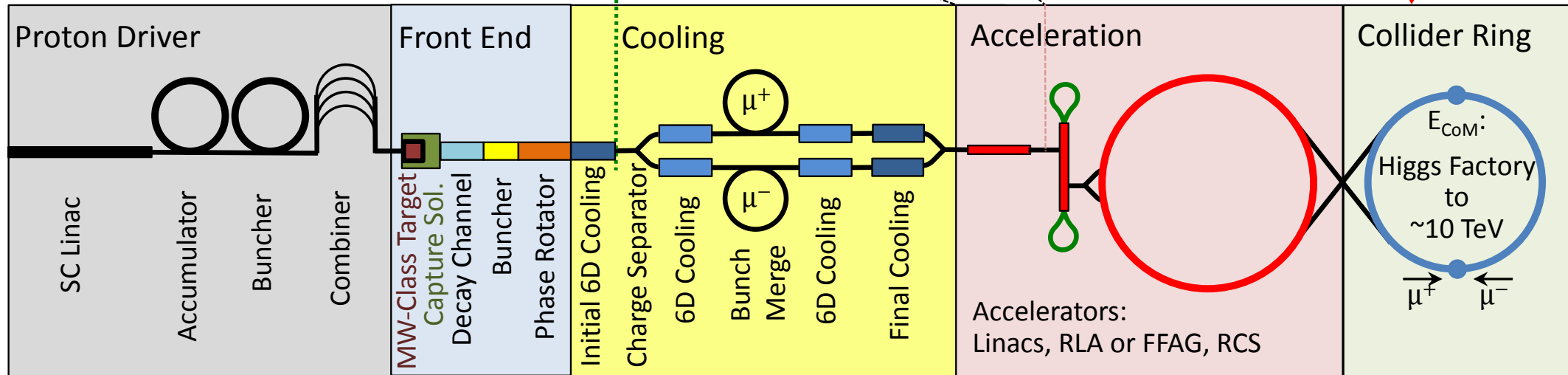
First thoughts on required RF testing infrastructure

Alexej Grudiev

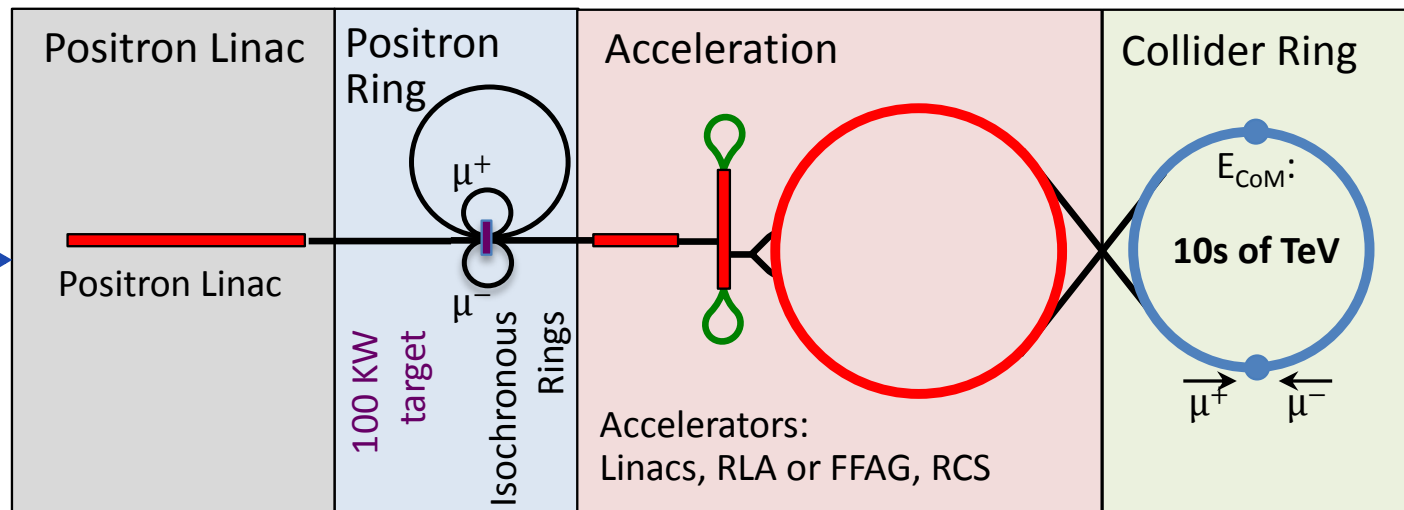
Muon Collider Workshop, CERN

October 10th, 2019

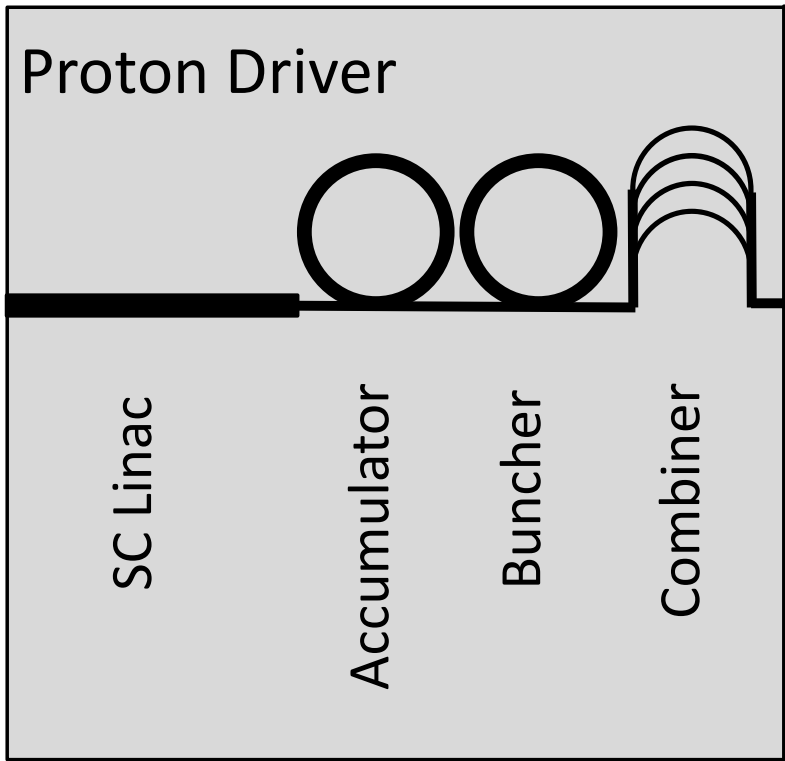
Muon Collider



Low EMittance Muon Accelerator (LEMMA):
 10^{11} 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.



What kind of dedicated RF test facilities are need for **feasibility** demonstration ?



RF RF RF

Required RF Test facility for feasibility demonstration

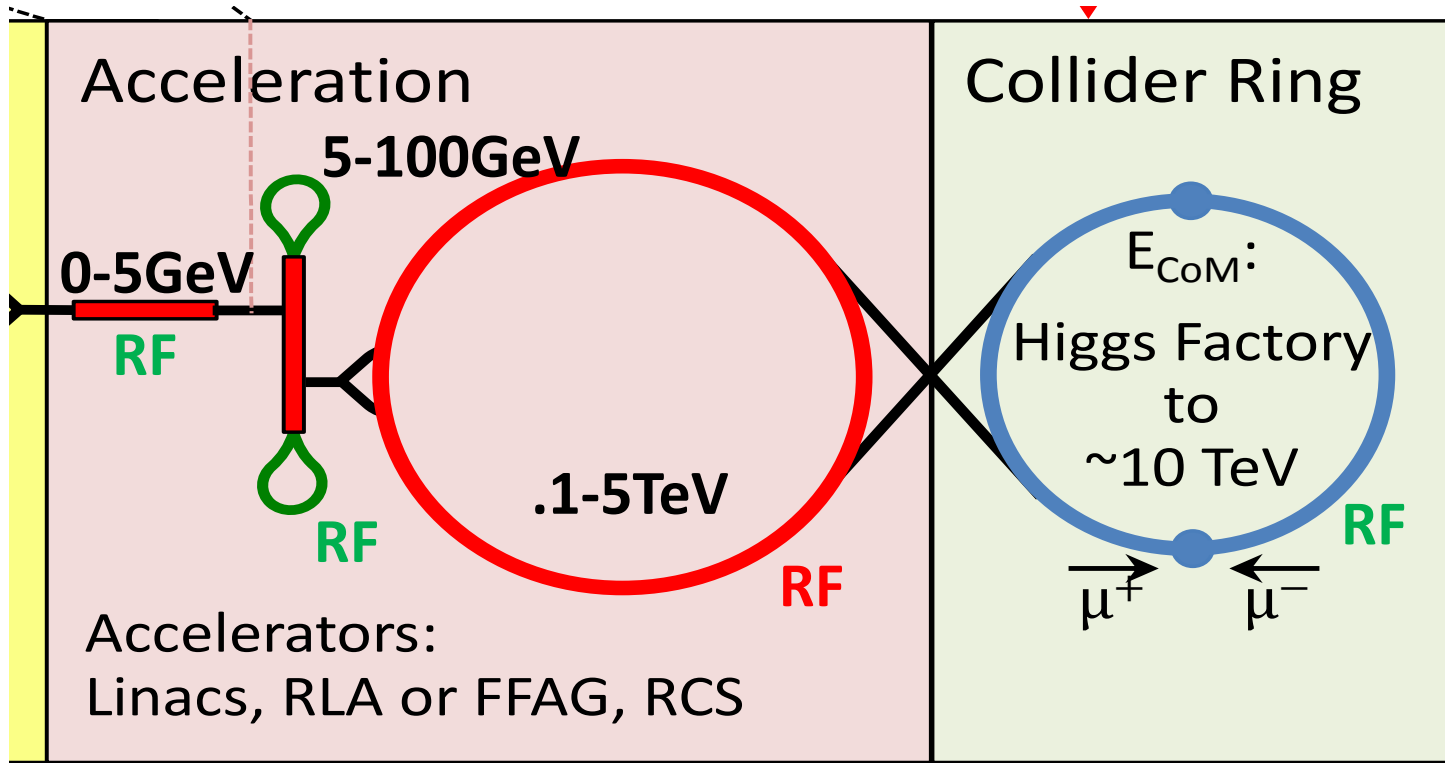
- NO

Challenges:

- Few MW beam power
-

 State of the art RF technology (SNS, ESS, ...)





Challenges:

- High Gradient
- Longitudinal Wakes

State of the art:

- SC 650MHz, L-band RF
(EuXFEL, CEBAF, ILC...)

RLA:

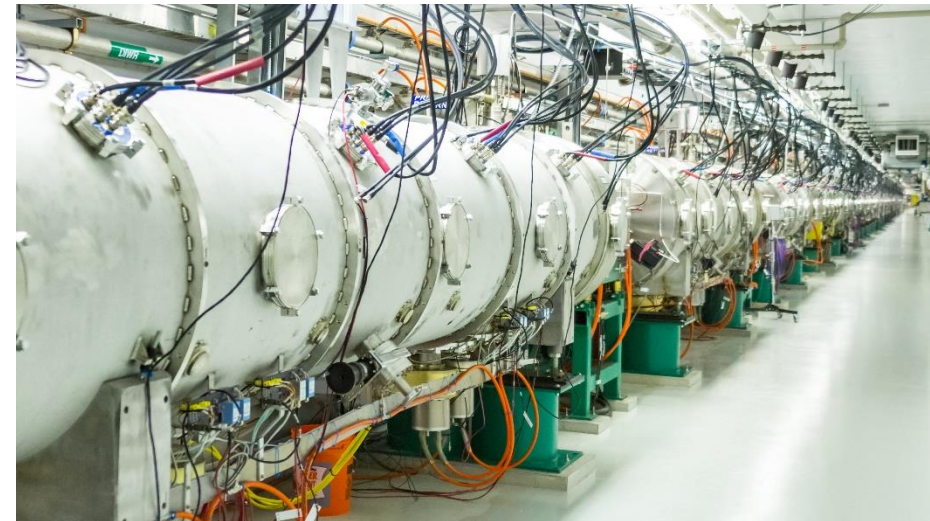
100GeV / 5 passes = 20 GeV per
linac

Ring(s):

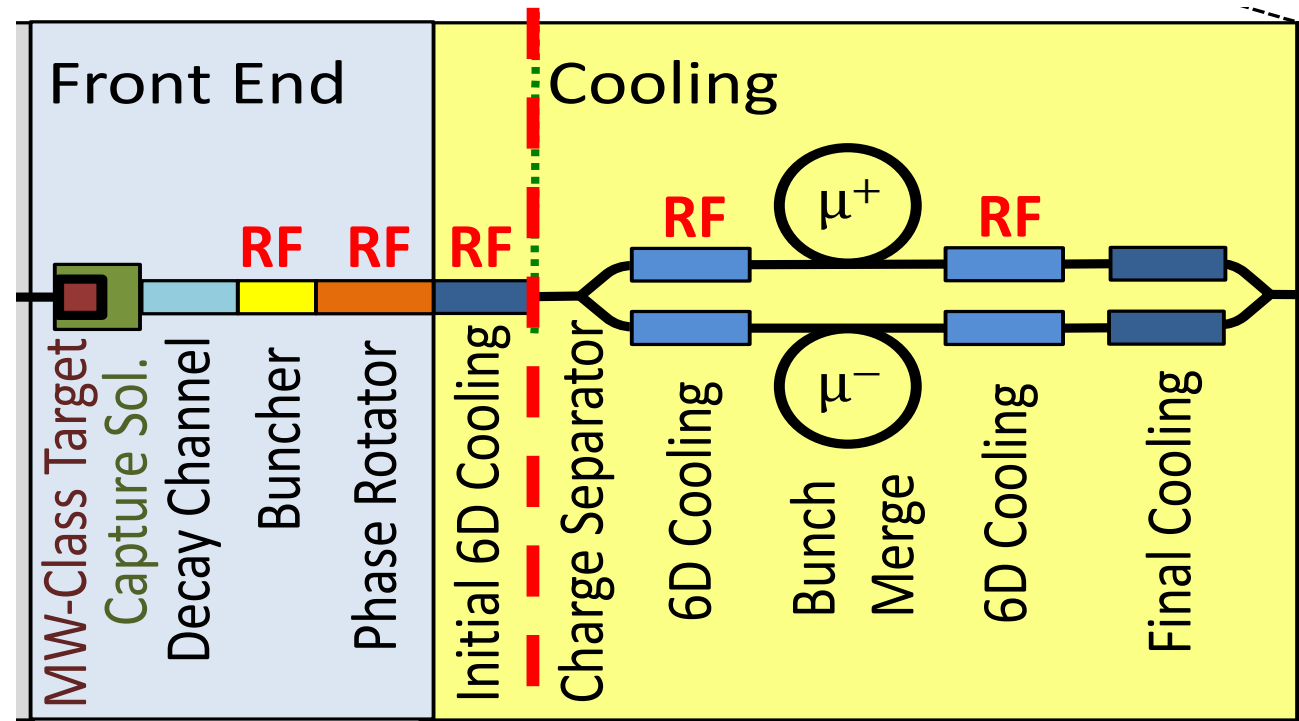
- **100 turns => 50 GV / turn**
- **1000 turns => 5 GV / turn**

**Required RF test
facility for
feasibility
demonstration**

- **NO**



So far it was always assumed that due to very high levels of magnetic field only normal conducting RF can be used. It is not true anymore for HTS superconductors. Can we use them? Should we use them?



Complex RF system:

- 318 cavities,
- 1700 MV,
- 1000 MW peak,
- 31 frequencies: 325-490 MHz
- Gradient: 0 – 25 MV/m

More cavities,
few GV,
few GW peak,

Challenges:

- High Gradient
- High magnetic field
- High radiation
- Technology far from been common

State of the art (not complete):

- MICE 200 MHz RF module prototype (IPAC2016, MOPMW034):

4T, 10 MV/m, 1ms@1Hz

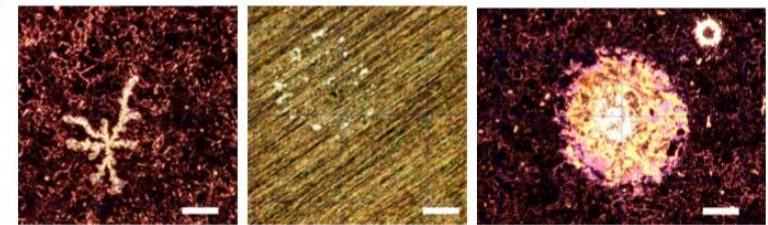
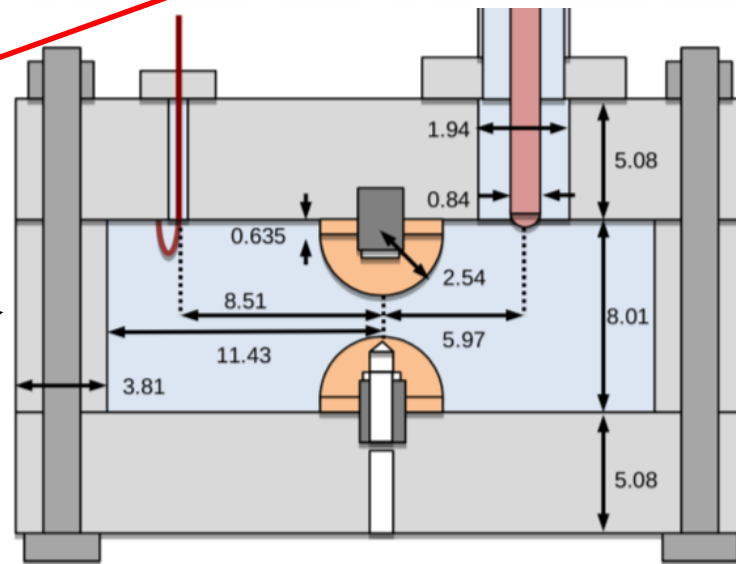
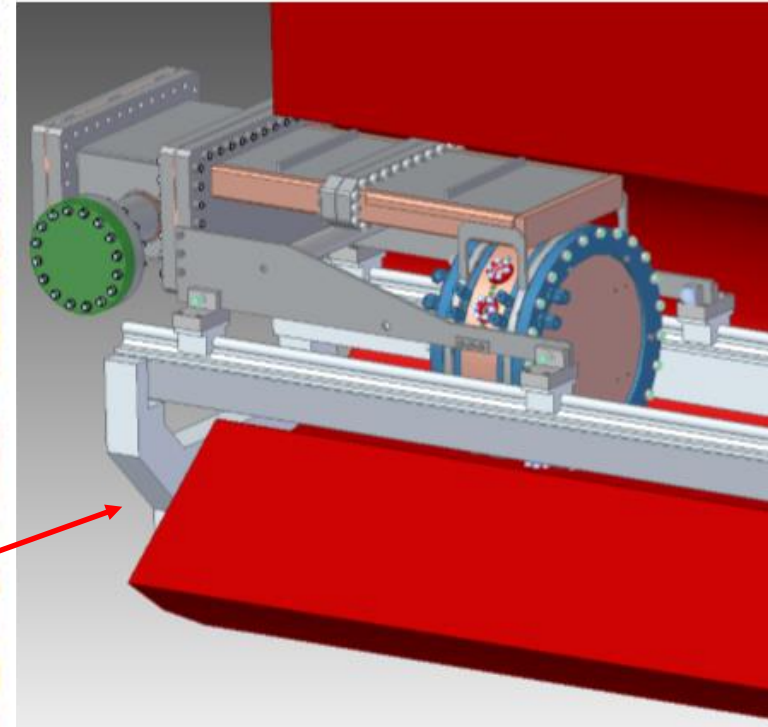
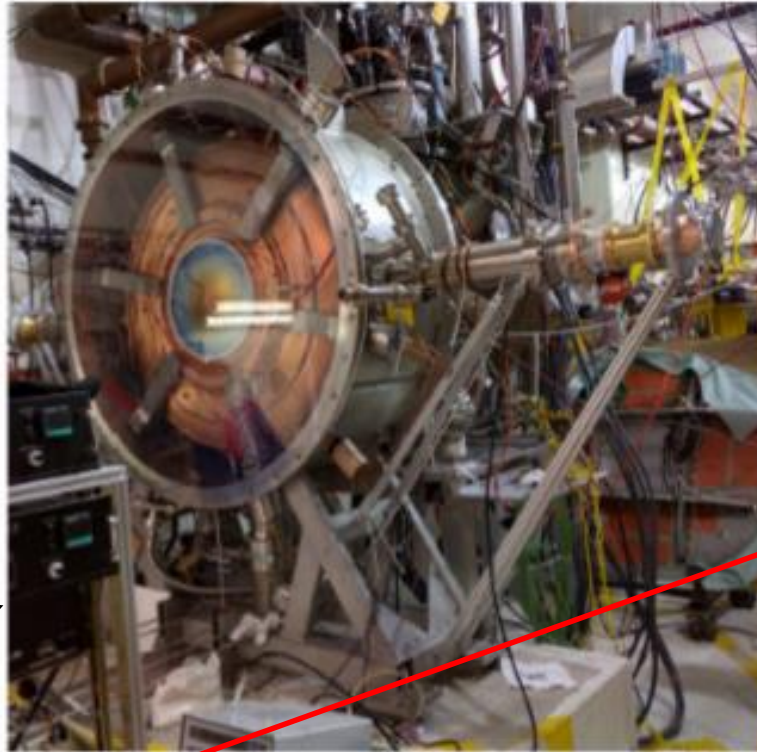
- 800 MHz **beryllium** cavity (FERMILAB-PUB-18-335-AD-APC):

3T, **50 MV/m**, 30us@10Hz

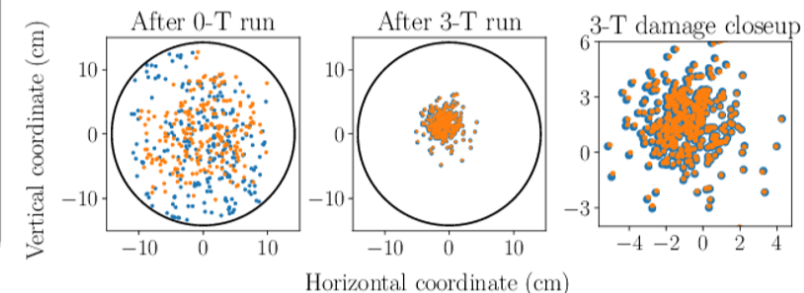
- **Gas** filled RF cavity

(2018 JINST 13 P01029):

Small gap, 200 MHz, >50 MV/m



(a) Cu, 0 T (b) Be, 0 T (c) Cu, 3 T



Required RF test facilities for feasibility demonstration

- Stage 1: Versatile high gradient RF test facility
 - Frequency: 200 - 800 MHz
 - Magnetic field: 0 - 5T, different field configurations
 - Different materials: Cu, Be, Al, ...
 - Different temperatures: Cryo NC, HTS SC, ...
 - Different gases and pressure: 0 – few Bars
 - Different designs
- Stage 2: Prototype(s) for cooling test facility
 - Parameters has to be defined based on the results of Stage 1 and the (re-)design
 - May include irradiation capability to check its impact on the performance
- Stage 3: Muon acceleration and cooling