MUCOL WP8

Funded by the European Union under
Grant Agreement n. 101094300

SCOPE

- **The first objective** of this workpackage is **to select** the technologies that are more suitable for a construction of a cooling cell that will demonstrate the feasibility of the concept including:
  - ***Superconducting solenoids***, to limit the transverse blow-up of the beam.
  - ***RadioFrequency Cavities***, that will accelerate the beam providing back longitudinal momentum
  - ***absorbers*** that will decrease the emittance in both the longitudinal and transvers plane
- **The second objective** is **to design** each component of the cooling cell and integrate them in a single assembly to demonstrate that there is no showstopper for such systems.

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Interactions

- WP8 is strongly interlinked with
  - WP4 – Muon Production and Cooling
  - WP6 – RadioFrequency
  - WP7 – Magnets

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Solenoids

- A couple of meetings already took place, we agreed on reasonable parameters for a solenoid that could be built immediately:
  - Free bore 500÷600 mm:
    - Considered as a safe parameter to design our first SC solenoid, allowing at the same time a good freedom to select the RF frequency within a reasonable range (hopefully down to 700 MHz)
  - Configuration with two solenoids in order to have maximum flexibility in defining the magnetic field profile on the RF cavities (uniform or variable)
    - The two solenoids configuration will allow to test also the forces among solenoids pairs, fringing fields decoupling (if required) and maximum input loads that will be useful to validate the whole magnetic system of the cell.
    - The two solenoid may allow RF feeders coming form the gap between solenoid, if required

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RadioFrequency

- The first critical choice is the frequency of the cavity to be designed:
  - Has to fit in a cylinder of 500÷600 mm, including all ancillaries (couplers, cooling, supports etc…)
  - Compatible with RF test stand being discussed in WP6
  - Compatible with one of the existing RF sources available in the various Institutes
  - Previous studies (CLIC, LC) investigated scaling with frequency of breakdown characteristics and found they are constant, no effect from frequency.

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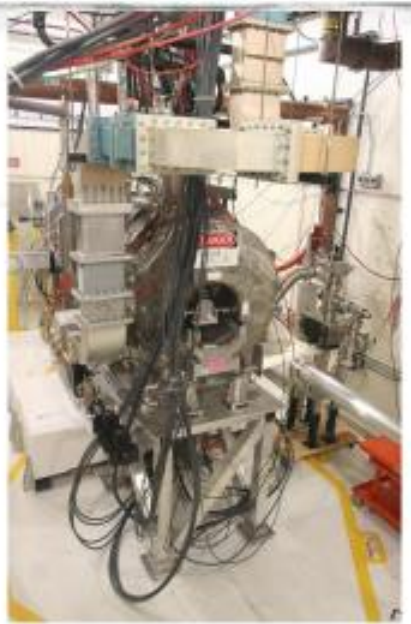

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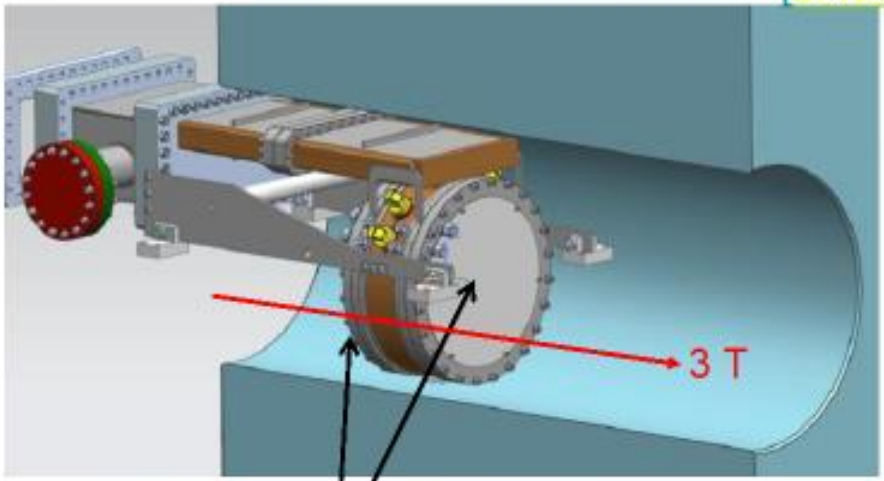

removable plates (Cu, Al, Be)

PHYSICAL REVIEW ACCELERATORS AND BEAMS **23,** 072001 (2020)

Operation of normal-conducting rf cavities in multi-Tesla magnetic fields for muon ionization cooling: A feasibility demonstration

D. Bowring, A. Bross, P. Lane, M. Leonova, A. Moretti, D. Neuffer, R. Pasquinelli, D. Peterson, M. Popovic, D. Stratakis, and K. Yonehara
Fermi National Accelerator Laboratory, Batavia, Illinois 60510, USA

Material	B-field (T)	SOG (MV/m)	BDP ($\times 10^{-5}$)
Cu	0	24.4 ± 0.7	1.8 ± 0.4
Cu	3	12.9 ± 0.4	0.8 ± 0.2
Be	0	41.1 ± 2.1	1.1 ± 0.3
Be	3	$> 49.8 \pm 2.5$	0.2 ± 0.07
Be/Cu	0	43.9 ± 0.5	1.18 ± 1.18
Be/Cu	3	10.1 ± 0.1	0.48 ± 0.14

- A Beryllium based cavity sustained a high gradient in the presence of multi-tesla B-fields!

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805 MHz

440 mm bore diameter

custom designed power coupler

10 Hz rep rate

32 microsec pulse

Absorbers

- For the first implementation, it seems wise to consider a solid absorber.
- Material will depend on the kind of test that we can envisage (Muon or Proton beam?)
- HiRadMat test could be envisaged (for candidate materials). Only proton beams can be obtained
- However also fluid based absorbers will be studied in WP4 and therefore we will extend the study to provide a full integration of most promising candidates if possible.

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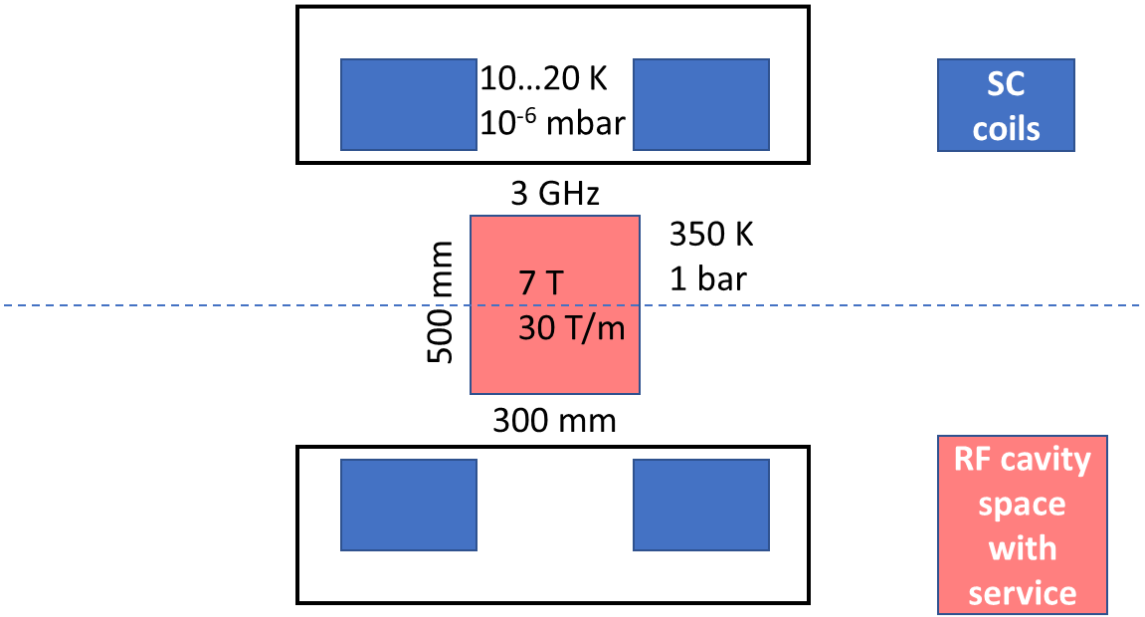
Layout of the cell

Schematic of the RFMF test facility



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Next Steps

- RF studies (WP6) need to confirm what frequency we can choose:
  - 3 GHz
  - 1.3 GHz
  - ~700 MHz (if feasible, will need a creative development to match it to power couplers within a 600 mm bore)
- HTS cable to be used needs to be discussed soon (WP7) to be ready for the design of the solenoid
- Will have to define the test programme for such a cell in order to select the best type of absorber
- What can we learn by a beam test with protons?

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Conclusions

- Work has started and first choices are tentatively made
- Need confirmation from WP6, WP7 about what is feasible.
- WP8 meetings will continue every first Monday of every month
- Egroup: MuCol-WP8-members@cern.ch

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Thank you
for your attention